School of Biological Engineering & Sciences

Shobhit University, Gangoh

(Established by UP Shobhit University Act No. 3, 2012)

School of Biological Engineering & Sciences

Ordinances, Regulations & Syllabus

For

Master of Science in Microbiology (M.Sc.) Two Year Programme
Semester Pattern
(w.e.f. session 2017-18)

Revised and approved in the year 2020(13th meeting Board of Studies)

(Scheme & syllabus from 2020-2024)

PEOs: Program Educational Objectives POs: Program Outcomes PSOs: Program Specific Outcomes

Name of the Department: Department of Microbiology

Name of the Program: M.Sc. Microbiology

Duration of the degree: 2 Years

M. Sc. (Microbiology) course combines the concepts of biology and chemistry to understand living things and their relationship with the ecosystem. The course covers the study of microorganisms and their effect on human life. M.Sc. in Microbiology is an advanced course that helps students understand the microbes such as virus, bacteria, fungi, algae etc. at a deeper level. Students also learn the role of theses microorganism in waste management and the production of fermented foods. Throughout M.Sc. Microbiology course, students study the detailed microbiology topics and interdisciplinary subjects.

M.Sc. Microbiology has a significant role in pharmaceuticals, agriculture, brewery and manufacturing of commercial products. The practical, research-based project and laboratory work throughout the M.Sc. Microbiology helps candidates excel at the workplace with required skills and knowledge.

Program Educational Objectives (PEOs)

PEO 1: The objective of the Master's Program in Microbiology is to equip the students to gain bimolecular knowledge and analytical skills at an advanced level.

PEO 2: The program emphasizes to apply knowledge acquired about prokaryotic and eukaryotic cellular processes, interaction of microorganisms among themselves, with physical and chemical agents and higher order organisms in environment and biological systems to various conditions.

PEO 3: The laboratory training in addition to theory is included so that the students will acquire the skills to qualify for a broad range of positions in research, industry, consultancy, education and public administration, or for further education in a doctoral program.

PEO 4: Students will be able to address broad range of fields including biopolymer chemistry, marine biochemistry, environmental biotechnology, food science, microbiology, microbial genetics, molecular biology and systems biology.

Program Specific Outcomes (PSOs)

PSO 1: Acquires and demonstrates competency in laboratory safety. Develops routine and specialized microbiological laboratory skills applicable to research, hospitals and industries.

PSO 2: Applies statistical and bioinformatics tools for interpretation of biological data and gains expertise in Computational Biology.

PSO 3: Acquires knowledge of structural and enzymatic properties of microbes and fermentation engineering, to develop human / environment friendly products or processes.

PSO 4: Gets familiarized with principles and techniques of various basic and analytical instruments used in laboratories.

PSO 5: Recognizes the importance of IPR and Patenting. Gain Entrepreneurial skills to initiate Startup.

PSO 6: Gets trained in bimolecular mechanisms involved in life processes, health and diseases.

PSO 7: Gains proficiency in related disciplines such as Molecular Biology, Pharmaceutical Sciences, Nano biotechnology and Immunology.

PSO 8: Explores the life forms at cellular, molecular and nano levels. Understands amazing properties of microbial world and appreciates the beauty of microbial life forms.

PSO 9: Assesses the role of microbes in improving soil quality and agricultural output through sustainable microbiological applications.

PSO 10: Work as Health care professionals in the fields of laboratory management, hospital and community services, in development & preparation of Study material for visually challenged.

Program Outcomes Objectives (POOs)

The Masters in Microbiology Program will address the increasing need for skilled scientific manpower with an understanding of research ethics involving microorganisms to contribute to application, advancement and impartment of knowledge in the field of microbiology and molecular biology globally. The laboratory training will empower them to prepare for careers in broad range fields. The M.Sc. Microbiology student will have:

POO 1: State of art knowledge about various methodological and analytic approaches that are used within thespecialization.

POO 2: Knowledge of the leading edge in a chosen specialized area of Microbiology, based on own research experience from a master's project and international literature.

POO 3: Can compete in national level competitive exams such as NET-JRF or GATE or International exams such as GRE-TOEFEL and can pursue career in higher studies.

POO 4: In-depth knowledge in the structure of a repertoire of microorganisms, metabolism in the cell, knowledge of the concepts of molecular genetics and biosynthesis of proteins, enzymology, physiology, microbial pathogenicity, environmental and agricultural microbiology, genetic engineering, bioengineering and a good theoretical and practical insight into methods used to obtain this knowledge.

POO 5: Demonstrate practical skills in the use of tools, technologies and methods common to microbiology, and apply the scientific method and hypothesis testing in the design and execution of experiments.

POO 6: Develop ability to independently carry out a complete scientific work process, including the understanding of theoretical background, hypothesis generation, collection and analysis of data, and interpretation and presentation of results.

POO 7: Has high competence and multidisciplinary project experience within selected topics related to microbiology and ability to contribute in a multidisciplinary team.

POO 8: Is capable to evaluate methods and results within the field of specialization critically.

POO 9: Is able to evaluate and apply relevant theory, methods and analytic approaches within the specialized field of microbiology, including statistical methods.

POO 10: Can assess and predict the technological, ethical and social effects of their own work /disciplines and of microbiology.

POO 11: Acknowledges health, safety and environment (HSE) issues in handling chemicals and biological materials; understands the environmental impacts associated with the activity; performs risk assessments and is familiar with safety instructions in his/her subject area.

POO 12: Can communicate scientific results to the general public and experts by writing well-structured reports and contributions for scientific publications and posters, and by oral presentations.

Course Components of Academic Programme

M.Sc. (Microbiology)

Minimum Duration : 4 Semesters (2 Years)

Maximum Duration : 6 Semesters (3 Years)

Total Number of Credits : 93 Credits

Course Components		Credits
1.	**Compulsory Course**	
I.	Foundation Course (FC)	00
II.	Core Course (CC)	61
2.	**Elective Course**	
I.	Departmental Electives (DE)	06
II.	Interdepartmental Electives (IE)	00
3.	**Discipline-Centric Ability Enhancement Course**	
I.	Seminar (SM)	03
II.	Project (PJ)/ Dissertation (DS)	16
III.	Skill (SK) and Ability Enhancement Course (AEC)	04
IV.	Comprehensive (CM)	00
4.	**General Course**	
I.	Human Values, Health Care and Professional Ethics (HP)	00
II.	Healthy Living and Fitness (HF)	00
III.	Disaster Management (DM)	00
IV.	General Proficiency (GP)	03
5.	**Audit Course**	

Requirement of Awards of Degree: - Total Credits: - 93; CGPA>=4.5 and any other conditions as per regulation and ordinances.

Summary Sheet

M.Sc. (Microbiology)

Semester	Credit				Total
	CC	DCAEC (AEC/SK/SM/PJ)	DE	GC	
I	25	3	0	1	29
II	21	3	0	1	25
III	15	1	6	1	23
IV	00	16	0	0	17
Total	**61**	**23**	**6**	**3**	**93**

Core Courses: CC
Discipline-Centric Ability Enhancement Course: DCAEC
Ability Enhancement Course: AEC
Skill Course: SEC
Departmental Electives: DE
General Course: GC

M.Sc. (Microbiology)
PROGRAMME STRUCTURE (2020-21)

FIRST SEMESTER

Course Code	Course Title	Category	(L)	(T)	(P)	Credits
Core Courses						
MMB-101/ **MMB-101a/ MMB-101b/ MMB-101c**	Cell & Developmental Biology/Human Pathology/Cytology/Toxicology & Forensic Science	CC	3	0	0	3
MMB-102/ **MMB-102a/ MMB-102b/ MMB-102c**	Biochemistry & Enzymology/Elements of Biochemistry/Concept in Medicinal Chemistry & Drug Development/Biophysics	CC	3	0	0	3
MMB-103	Bacteriology	CC	3	0	0	3
MMB-104	Virology	CC	3	0	0	3
MMB-105	Computer Applications & Biostatistics	CC	3	0	0	3
Discipline-Centric Ability Enhancement Course						
AEC-101/ **AEC101a/ AEC101b/ AEC-101**c	Professional communication/Public Speaking-I/Effective Writing Skills-I/English Grammar-I	AEC	2	0	0	2
SM-101/ **SM-101 a**	Seminar & Research Orientation/Research Ethics-I	SM	0	0	1	1
General Course						
GP-101/ **GP-101a/ GP-101b/ GP-101c**	General Proficiency/Entrepreneurship development & Business communication-I/Human Values & Moral Ethics-I/Life Management-I	GP	0	0	1	1
LABS						
MMB-151	Cell & Developmental Biology Lab	CC	0	0	2	2
MMB-152	Biochemistry & Enzymology Lab	CC	0	0	2	2
MMB-153	Bacteriology Lab	CC	0	0	2	2
MMB-154	Virology Lab	CC	0	0	2	2
MMB-155	Computer Applications & Biostatistics Lab	CC	0	0	2	2
	TOTAL					**24**

SECOND SEMESTER

Course Code	Course Title	Category	(L)	(T)	(P)	Credits
Core Courses						
MMB-201	Immunology & Immuno-technology	CC	3	0	0	3
MMB-202	Molecular Biology & Recombinant DNA Technology	CC	3	0	0	3
MMB-203	Mycology & Phycology	CC	3	0	0	3
MMB-204	IPR, Biosafety & Bioethics	CC	3	0	0	3
MMB-205	Bioinstrumentation Techniques	CC	3	0	0	3
Discipline-Centric Ability Enhancement Course						
AEC-201/ **AEC-201a/ AEC-201 b/ AEC-201 c**	Career Skills/Public Speaking-II/Effective Writing Skills-II/English Grammar-II	SK	2	0	0	2

SM-201/ **SM-201 a**	Seminar & Research Orientation/Research Ethics-II	SM	0	0	1	1
General Course						
GP-201/ **GP-201a/ GP-201b/ GP-201c/ GP-201d**	General Proficiency/Entreprenuership development & Bussiness communication-II/Human Values & Moral Ethics-II/Life Management-II/Personality Development-II	GP	0	0	1	1
LABS						
MMB-251	Immunology & Immunotechnology Lab	CC	0	0	2	2
MMB-252	Molecular Biology & Recombinant DNA Technology Lab	CC	0	0	2	2
MMB-253	Mycology & Phycology Lab	CC	0	0	2	2
	TOTAL					**29**

THIRD SEMESTER

Course Code	Course Title	Category	(L)	(T)	(P)	Credits
Core Courses						
MMB-301	Microbial Genetics	CC	3	0	0	3
MMB-302	Medical Microbiology	CC	3	0	0	3
MMB-303	Bioinformatics	CC	3	0	0	3
Departmental Electives (DE) (Select any one of the following from Elective-I and Elective-II)						
Elective-I						
MMB-304 a	Environmental Microbiology	DE	3	0	0	3
MMB-304 b/ MMB-304 c/ MMB-304 d	Industrial Microbiology/Watershed and Wastland Managemant/Biochemical Engineering	DE	3	0	0	3
Elective-II						
MMB-305 a	Agriculture Microbiology	DE	3	0	0	3
MMB-305 b/ **MMB-305 c/ MMB-305 d**	Food Microbiology/Agricultural Journalism/Poultry Production & Management	DE	3	0	0	3
Discipline-Centric Ability Enhancement Course						
SM-301	Seminar & Research Orientation/Research Methodology	SM	0	0	1	1
General Course						
GP-301/ **GP-301a/ GP-301b/ GP-301c/ GP-301d**	General Proficiency/Entrepreneurship development & Business communication-III/Human Values & Moral Ethics-III/Life Management-III/Personality Development-III	GP	0	0	1	1
LABS						
MMB-351	Microbial Genetics Lab	CC	0	0	2	2
MMB-352	Medical Microbiology Lab	CC	0	0	2	2
MMB-353	Bioinformatics Lab	CC	0	0	2	2
	TOTAL					**23**

FOURTH SEMESTER

Course Code	Course Title	Category	(L)	(T)	(P)	Credits
Discipline-Centric Ability Enhancement Course						
MMB-401	Project/Dissertation	PJ	0	0	16	16
	TOTAL					**16**

Dissertation

Note: Students must submit their dissertation report immediately on return from summer vacation in

June /July and the same would be evaluated for 16 credit units, which would be included in the Fourth Semester marks.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

Cell and Developmental Biology

Course Code: MMB-101 **Credit Units: 03**

Pre-requisite: Basic information of Cell Biology

Course Outcome:

- Students will acquire knowledge about basics of cell biology.
- Students will learn about how various functions of organelles and their working.
- Students will gain an insight into microscopic structures and chemical components of various regions of cells.
- Students will attain a comprehensive knowledge of functioning of cell and synchronization of activities of various organelles.
- Students will be able to learn about various signaling mechanism involved in a cell which ultimately leads to a visible physiological response.
- Students will be able to understand the architectural components involved in making cellsrigid and how cells are connected to each other.
- Students will learn about molecular events involved in cell cycle.
- Students will apply the information gained in understanding the issues and conditions encountered if things go wrong with cell cycle and how our understanding of cell signaling generate drug targets.

Details of the Course:-

UNIT1

Introduction to prokaryotes, eukaryotes & cell theory
Introduction to microscopy
Plasma Membrane: structure – organization, lipid bilayer, proteins &glycoconjugates, liposomes, functions – ionic transport, types of transport (symport, antiport, active & passive), channel proteins.
Intracellular compartmentalization: structure, organization and functions of nucleus, mitochondria, lysosome, golgi bodychloroplast, peroxisome, endoplasmic reticulum (rough and smooth)

UNIT2

Vesicular traffic in the secretary and endocytic pathway: transport from endoplasmic reticulum through the golgi network to lysosome, endocytosis, exocytosis, molecular mechanisms of vesicular transport and the maintenance of compartments diversity.
Cell signaling: general mechanistic principles
Types of signaling, GPCR, RTK with examples, Calcium Signaling, Mechanism of Chemotaxis, signal transduction and vision Significance of vesicular trafficking and cell signaling

UNIT3

Cell motility and shape: structure and functions, microfilaments microtubules and intermediate filament.

Integrating cell into tissue: cell-cell adhesion and communication, cell matrix adhesion, extra cellular matrix: collagen & non-collagen components. Cell cycle, molecular events and regulation.
Cell division: general strategy and regulation, molecular mechanism of mitosis and meiosis.
Regulation of cell cycle
Role of cyclins / cdks in the initiation of replication.

UNIT4

Cancer-Biology: Types of cancer, onset of cancer, proto- oncogenes and tumor suppresser genes, oncogenic mutations affecting cell proliferation, cell cycle and genome stability.
Programmed cell death &unprogrammed cell death.
Expression patterns of proteins & enzymes during cellproliferation
Molecular signaling of cancer Aetiology of Cancer

UNIT5

Introduction to Developmental Biology, History and Basic Concepts, Basics of model systems: Vertebrate Model Systems,Invertebrate and Plant Model Systems, basic patterning and development plan of model Plan, initial division pattern, evolution and development biology

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Molecular Biology of cell, 4th ed. Alberts, Bruce (et.*al) (2002)* Garland Science Publishing, New York.	2002
2.	Cell Biology- Smith and Wood by Chapman and Hall. Cell Biology: Organelle structure and function, Sadava, D E. (2004) Panima pub., New Delhi. Cell and Molecular Biology, 8th ed. Robertis, Edp De and Robertis Emf De (2002) Lippincott Williams and Wilkins Pvt. Ltd., (International Student Edition) Philadelphia.	2004, 2002

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I **Human Pathology**

Course Code: MMB-101a **Credit Units: 03**

Pre-requisite: Basic understanding of diseases and their pathogenesis

Course Outcome:

Students will be able to learn and understand the concepts of how human system works in altered and diseased stage under the influence of various internal and external stimuli.

Details of the Course:-

Unit I: Introduction:

History of pathology, basic definitions and familiarization with the common terms used in pathology, techniques used in pathology.

Cellular Adaptations, Cell Injury and Cell Death:

Causes and mechanisms of cell injury: reversible and irreversible injury, Cellular responses: Hyperplasia, Hypertrophy, Atrophy, Metaplasia, Necrosis, Apoptosis, subcellular and intracellular response, (with suitable examples of diseases), Cellular ageing.

Unit II: Role of Inflammation in diseases (with suitable examples):

General features of acute and chronic inflammation: Vascular changes, cellular events, termination of acute inflammatory response. Cells and molecular mediators of inflammation, morphological effects and outcome of acute inflammation. Systemic effects of chronic inflammation, granulomatous inflammation.

Unit III: Tissue Renewal And Repair, Healing And Fibrosis:

Mechanism of tissue regeneration, role of ECM, repair by healing, scar formation and fibrosis, cutaneous wound healing, tissue remodelling in liver (mechanism of fibrosis and cirrhosis).

Unit IV: Hemodynamic Pathology:

Edema, hyperaemia, congestion, haemorrhage, haemostasis and thrombosis, Embolism, Infarction and shock and hypertension.

Nutritional diseases: Protein energy malnutrition, deficiency diseases of vitamins and minerals, nutritional excess and imbalances. Role and effect of metals (Zinc Iron and Calcium) and their deficiency diseases.

Unit V: Cell proliferation: Cancer:

Definitions, nomenclature, characteristics of benign and malignant neoplasms, grading and staging of cancer, biology of tumor growth, mechanism of tumor invasion and metastasis, carcinogens and cancer, concept of oncogenes, tumor suppressor genes, DNA repair genes and cancer stem cells.

Pathophysiology diseases:

- **Aetiology and Pathophysiology of:** Diabetes, Arteriosclerosis, Myocardial infarction, restrictive and obstructive respiratory diseases (COPD), Parkinson, Schizophrenia, Silicosis

- **Infectious Diseases:** Pathogenesis of diseases and overview of modes of infections, prevention and control with suitable examples like Typhoid, Dengue

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Robbins and Cotran Pathologic Basis of Disease, 8th edition (2009), Vinay Kumar, Abul K. Abbas, Jon C. Aster, Nelson Fausto; Saunders Publishers, ISBN-13: 978-1416031215.	2009
2.	Medical Laboratory Technology Methods and Interpretations Volume 1 and 2, 6th edition (2009), Ramnik Sood; Jaypee Brothers Medical Publishers, ISBN-13: 978-8184484496.	2009
	Reference Books	
1.	General and Systematic Pathology, 2nd edition (1996), J., Ed. Underwood and J. C. E. Underwood; Churchill Livingstone, ISBN-13: 978-0443052828.	1996
2.	Robbins Basic Pathology, 9th edition (2012), Kumar, Abbas, Fausto and Mitchell; Saunders Publication, ISBN-13: 978-1437717815.	2012

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I **Cytology**

Course Code: MMB-101b **Credit Units: 03**

Pre-requisite: Basic information of Cell Biology

Course Outcome:

- Basic chemical composition of living matter.
- Structural characteristics of prokaryotic and eukaryotic cells.
- Taxonomy and characteristics of the major kingdoms.
- Mechanics of membrane transport.
- Basic concepts of bioenergetics, photosynthesis, and cellular respiration.
- Mechanics of cellular reproduction.
- Mendelian genetics and genetic change.
- Nucleic acids and basic concepts of protein synthesis and gene regulation.

Details of the

Course:-UNIT I:

Cell:

Introduction and classification of organisms by cell structure, cytosol, Compartmentalization of eukaryotic cells, cell fractionation Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model

UNIT II: Cell Membrane and Permeability:

Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport. Sex-limited and sex-influenced inheritance, Transposons. Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments

UNIT III: Endoplasmic reticulum:

Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion. Lysosomes: Vacuoles and micro bodies: Structure and functions Ribosomes: Structures and function including role in protein Synthesis .

UNIT IV: Mitochondria:

Structure and function, Genomes, biogenesis. Chloroplasts: Structure and function, genomes, biogenesis. Nucleus: Structure and function, chromosomes and their structure. Extracellular Matrix: Composition, molecules that mediate cell adhesion

UNIT V: Membrane receptors:

For extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction. Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Molecular Biology of cell, 4th ed. Alberts, Bruce (et.*al) (2002)* Garland Science Publishing, New York.	2002
2.	Cell Biology- Smith and Wood by Chapman and Hall. Cell Biology: Organelle structure and function, Sadava, D E. (2004) Panima pub., New Delhi. Cell and Molecular Biology, 8th ed. Robertis, Edp De and Robertis Emf De (2002) Lippincott Williams and Wilkins Pvt. Ltd., (International Student Edition) Philadelphia.	2004, 2002

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I **Toxicology and Forensic Science**

Course Code: MMB-101c **Credit Units: 03**

Pre-requisite: Basic information of molecular biology and medical laboratory techniques

Course Outcome:

- Students will become familiar with how forensic scientists work.
- Students will be able to learn the tools and techniques used in forensic science and how they reach the conclusions they present in court.
- Students will be familiarized with the creative, problem solving and inquiry based approach to investigate the crime scene.
- Students will be able to explain the characteristics of a fingerprint collect, process, and analyze fingerprint evidence and explain DNA analysis.

Details of the Course:-

Unit I: Crime Scene Investigation:

Introduction and principles of forensic science, Forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science, causes of crime, role of modus operandi in criminal investigation.

Unit II: Types of injuries and death:

Classification of injuries and their medico-legal aspects, method of assessing various types of deaths.

Forensic chemistry and Ballistics:

Classification of fire arms and explosives, introduction to internal, external and terminal ballistics. Chemical evidence for explosives.

Unit III: Forensic Graphology:

General and individual characteristics of handwriting, examination and comparison of handwritings and analysis of ink various samples.

Unit IV: Forensic Toxicology and Fingerprint analysis:

Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification. Principle of DNA fingerprinting, application of DNA profiling in forensic medicine.

Unit V: Cyber Forensic Investigation:

Investigation Tools, eDiscovery, Evidence Preservation, Search and Seizure of Computers,Introduction to Cyber Security.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Forensic Science – An introduction to Scientific and Investigative Techniques, 3rd edition (2009), James SH, Nordby JJ and Bell S; CRC Press, ISBN-13: 978-1420064933.	2009
2.	Forensic Handwriting Identification: Fundamentals, Concepts and Principals 1st edition (2000) Ronald N. Morris, Academic press ISBN-13: 978-0125076401	2000
	Reference Books	
1.	Principles of Forensic Medicine and Toxicology, 1st edition (2011) Rajesh Bardale; Jaypee Brothers Medical Pub, ISBN-13: 978-9350254936.	2011
2.	Fundamentals of Forensic Science, 2nd edition (2010), Houck, M.M. and Siegel, JA; Academic Press, ISBN-13: 978-0123749895.	2010

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

Biochemistry & Enzymology

Course Code: MMB-102 **Credit Units: 03**

Pre-requisite: Background information of biochemistry.

Course Outcome:

- Students will be able to define biomolecules and buffers.
- Students will understand the structure and functions of biomolecules.
- Students will be able to classify and explain the role of various biomolecules in human body.
- Students will be able to analyze the causes of diseases on biochemical basis.
- Students will be able to understand various biochemical process and cell metabolism.
- Students will be able to classify enzymes and will understand kinetic properties.
- Students will be able to understand K_m and V_{max} for enzymatic equations.
- Students will be able to understand the application of enzymes in daily life.

Details of the Course:-

Unit : I Introduction:

Importance of water, pH and buffer, cell structure and organelles, structure of biomolecules: structure of amino acids and proteins (primary, secondary, tertiary and quaternary structure, reverse turn), Ramachandran plot, peptide synthesis, protein sequencing, protein
folding kinetics and cooperativity.

Unit : II Lipids:

Types, structure and function, oxidation of fatty acids- mitochondrial and peroxisomal oxidation, oxidation of unsaturated and odd chain fatty acids, ketone bodies, lipoproteins, rancidity, acid value, saponification value, iodine number, acetyl number, R.M. number. Biosynthesis of fatty acids, phospholipids and glycosphingolipids- synthesis.

Unit : III Metabolic pathways and their regulation :

Glycolysis/glycogenolysis, citric acid cycle, pentose phosphate pathway, oxidative phosphorylation, amino acid metabolism, basic nucleic acid structure, biosynthesis of purines and pyrimidines, glyoxalate cycle,
CAM, and metabolomics.

Unit : IV Enzymes:

Classification of enzymes; quantification of enzyme activity and specific activity. Effect of pH and temperature on enzyme activity, estimation of Michaelis-Menten parameters, kinetics of inhibition. Mechanism of enzyme catalysis with reference to chymotrypsin, lysozyme, metalloenzyme and the role of metals in catalysis with reference tocarboxypeptidases.
Allosteric enzymes: kinetics and examples. Techniques of enzymeimmobilisation-matrix entrapment, ionic and cross linking, column
packing.

Unit : V Enzyme Purification and Applications of Enzymes:

Extraction of commercially important enzymes from natural sources; commercial applications of enzymes in food, pharmaceutical and other industries; enzymes for diagnostic applications. Industrial production of enzymes.Applications of enzymes in analysis; design of enzyme electrodes and case studies on their application as biosensors in industry,healthcare and environment.

Suggested Books:

S. No.	Author/s/Book/Title/Publisher	Year
1.	Blanch, H.W., Clark, D.S. Biochemical Engineering Marcel Dekker	1997
	Bailey J.E. &Ollis, D.F., Biochemical Engineering Fundamentals (2nd Ed.) McGraw Hill	1986
2	Wiseman, Alan, Hand book of Enzyme Biotechnology (3rd Ed.), Ellis Harwood	1995
3	A. Lehninger, revised by Nelson and Cox, Principles of Biochemistry	2002
4	Van Holde and Ahern by Mathews, Biochemistry,. (3rd Ed.)	2002
5	White, Handler and R.B.Smith, Biochemistry (7th Ed.)	1983
6	L.Stryer Biochemistry (3rd Ed.)Freeman	1998
7	Voet and Voet Biochemistry	2001

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I **Elements of Biochemistry**

Course Code: MMB-102a **Credit Units: 03**

Pre-requisite: Basic understanding of biomolecules and concepts of general chemistry

Course Outcome:

- Students will be able to define biomolecules and buffers.
- Students will understand the structure and functions of biomolecules.
- Students will be able to classify and explain the role of various biomolecules in human body.
- Students will be able to analyze the causes of diseases on biochemical basis.
- Students will be able to understand various biochemical process and cell metabolism.

Details of the Course:-

Unit I:

A historical prospective, Amino acids & Proteins**:** Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.

Unit II:

Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines,. Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA.

Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein‟s and their biological functions.

Unit III:

Lipids: Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol.

Unit IV:

Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites, enzyme specificity: types & theories, Biocatalysts from extreme thermophilic and hyperthermophilic archaea and bacteria.

Role of: NAD^+, $NADP^+$, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxal phosphate,lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions

Unit V:

Carbohydrates Metabolism: Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. ß-oxidation of fatty acids.

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1	Biochemistry, Lubert Stryer, 8th Edition, WH Freeman, 2015	2015
2	Harper‟s illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M.Botham, PESEr J. Kennelly, Victor W. Rodwell, P. Anthony Weil. 30th Edition, McGrawHill, 2015.	2015
3	Biochemistry by Mary K.Campbell & Shawn O.Farrell, 9th Edition, Cenage Learning, 2018.	2018
4	Biochemistry, Donald Voet and Judith Voet, 4th Edition, Publisher: John Wiley andSons,	2010
	Reference Books	
1	The Organic Chemistry of Enzyme-catalyzed Reactions Richard B. Silverman Academic Press	2002
2	Practical Enzymology Hans Bisswanger Wiley–VCH 2012.	2012
3	Fundamentals of Enzyme Kinetics Athel Cornish-Bowden Portland Press 4th edition, 2012.	2012
4	Fundamentals of Enzymology Nicholas Price and Lewis Steven Oxford University Press 3rd edition 2009.	2009

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Semester I Concept in Medicinal Chemistry & Drug Development

Course Code: MMB-102b **Credit Units: 03**

Pre-requisite: Basic information of chemistry and drug development

Course Outcome:

After the successful completion of this course

- Students will be able to explain the relationship between structure and biological activity of various drug molecules.
- Students will be able to understand the most of various classes of drug molecules.

Details of the Course:-

Unit I: General Introduction and Drug target classification

Definition and scope of drug design.

Proteins as drug targets: Receptors – receptor role, ion channels, membrane bound enzyme activation, agonist and antagonists, concept of inverseagonist, desensitization and sensitization of receptors, affinity, efficacy and potency. Enzymes – Enzyme inhibitors (competitive,non-competitive, suicide inhibitors), medicinal use of enzyme inhibitors. Nucleic acids as drug targets: Classes of drugs that interact with DNA:DNA intercalators and DNA alkylators.

Unit II: Physicochemical principles of drug action

Partition coefficient, drug dissolution, acid base properties, surface activity, bioavailablity, stereochemical aspects of drug action.

Unit III: Drug receptor interactions

Kinetic analysis of ligand receptor interactions using scatchard plot, double reciprocal plot, Hill plot, forces involved, relationship between dose and effect (graded and quantal response).

Unit IV: Principles of drug design

Introduction to SAR, strategies in the search for new lead compounds, analogue synthesis versus rational drug design, concept of prodrugs.

Unit V: Drug discovery and pharmainformatics

Drug discovery pipeline, drug target identification and validation for microbial pathogen, selection of gene unique to the pathogen, screening for its presence in other microbes and human host, Drug Databases, PubChem, Calculating drug-like properties, introduction to rational drug design methods, optimization of lead compounds, protein3D structure and bindings it analysis, similarity based virtual screening using online tools.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books/Reference Books	
1.	Introduction to Medicinal Chemistry, 4th edition (2009), Graham l. Patrick, Oxford University Press. ISBN-13: 978-0199234479.	2009
2.	The Organic Chemistry of Drug Design and DrugAction,2nd edition(2004),Richard B. Silvermann, Elsevier, Academic Press. ISBN-13: 978-0126437324.	2004

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Semester I **Biophysics**

Course Code: MMB-102c **Credit Units: 03**

Pre-requisite: Basic knowledge of physics, and biotechnology

Course Outcome:

After completion of the course the students should be able

- To Learn understanding and appreciation of biophysics as an interdisciplinary research field;
- To Understand the link between the structure and functions of biological system from molecular to system level;
- To get insight on how experimental methods and theoretical approaches from physics can give answers related to the structure and functions of biological systems;
- To understand the diffusion processes and their role in the transport phenomena across the biological membrane;
- To understand the relationship of the membrane transport mechanisms and the electrical activity of the cell.

Details of the Course:-

UNIT-I:

Introduction to biophysics, basic physics, mechanical properties of matter, newton‟s law, applications of newton‟s law of motion in one dimension, motion, force and energy in more than one dimension, momentum, rotational motion. Ideal fluids, viscous fluids. Waves and resonance. Molecules and matters. Phases, force between molecules, thermodynamics, pressure, surface tension, stress and strain. Gravity, laws of gravity. Applications of these in living system.

UNIT-II:

Intensity of sound, superposition of sound, echoes and diffraction of sound, Doppler‟s effect and applications in life sciences. The human ear-physiology and function. Frequency response. Echo-location, The Doppler‟s effect, ultrasound, angiodynography.

UNIT-III:

Light rays, lenses and mirrors, reflection and refraction, prisms, colours. Wave nature of light, polarization and their applications in life. The human eye-physiology and functions. Lens. Defects and loss of visual acuity, Principle of microscopy, different microscopy. Quantum optics and Image analysis.

UNIT-IV:

Magnetic forces and field, electromagnetic induction, electromagnetic waves, applications in living world, magnets and medicines. Nuclear Magnetic Resonance, Electric charges, attractive and repulsive forces, Coulomb‟s law, Electric field and potential, Electric fields and sense organs, EMF and current, Ohm‟s law, resistance and capacitance. Membrane potential, conductance and capacitance. Cellular and electricity and electrophysiology. Biological motors.

UNIT-V:

The atomic nucleus and the radiation spectrum, sources of radiation, interaction of radiations with matter, Biological effects of radiation. Radiobiological consequences of nuclear fission. Radiation detectors, autoradiography, introduction to PET and SPECT.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	The Physics of Life Sciences by Jay Newman, Springer.	2008
2.	Introductory Biophysics: Perspectives on the Living State by James Claycomb and JQP Tran, Jones & Bartlett.	2017
	References	
1.	Biophysics Demystified by Daniel Goldfrab, TMH. McGraw-Hill Education; 1st edition.	2010
2.	Applied Biophysics by Tom Waigh, John Wiley.	2007
3.	Text Book of Biophysics by RN Roy, New Central Book Agency.	2001
4.	Essentials of Biophysics by P Narayanan, Anshan Publishing.	2010

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Bacteriology

Course Code: MMB-103 **Credit Units: 03**

Pre-requisite: Basic information of biology and microbiology.

Course Outcome:

Students will have knowledge of structure function and application of microorganism. On studying the subject students will be skilled to handle microorganisms in laboratory.

Details of the Course:-

Unit I: History of Microbiology:

Discovery of Microorganisms spontaneous generation: vs.biogenesis, Germ theory of disease. Scope of microbiology. Methods & basis of microbial classification.Modern trends of bacterial taxonomy.

Unit II:Morphology and ultrastructure of bacteria.

Cell wall of archaebacteria, Gram, negative and Gram-positive bacteria.Cell wall (Peptidoglycan) synthesis. Capsules- composition and function. Cell membranes-structure, composition and properties. Structure and function of bacterial cell organelles.

Unit III:Cultivation of bacteria :

Culture media,Microbial preservation techniques.
Synchronous and diauxic growth, Batch and continuous cultures.Nutritional types, Growth curve. Measurement of growth, Sterilization: physical and chemical methods.

Unit IV:Photosynthesis:

Photosynthetic microorganisms, photosynthetic pigments,Electron transport chain in photosynthetic bacteria.Carbon dioxide fixation pathways.

Unit V:Carbohydrate metabolism:

Glycolysis, Pentose phosphate pathway, EDpathway, Kreb‟s cycle and glyoxalate pathway. Bacterial aerobic respiration, components of electron transport chain,ATP synthesis: substrate level and oxidative phosphorylation and un-couplers, inhibitors of oxidative phosphorylation.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Pelczar Jr., M.J., Chan, E.C.S. and Krieg, Noel R., Microbiology, McGraw Hill (2003) 5th ed.	2003
2.	Stanier, R.Y., Ingraham, J.L. and Wheelis, M.L., General Microbiology, MacMillan (2007) 5thed.	2007
	References	
1.	Microbiology 10th Edition. Prescott, L.M.; Harley, J.P. and Klein, D.A. (2003) McGraw Hill, USA.	2016
2.	Foundations in Microbiology 10th edition, Kathleen Park Talaro and Barry Chess.	2017
3.	Microbiology- An Introduction. Tortora, G.J., Funke, B.R., and Case, C.L., , Pearson Education (2015)12th ed.	2015

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

Virology

Course Code: MMB-104 **Credit Units: 03**

Pre-requisite: Basic knowledge of Viruses

Course Outcome:

Students will be able to differentiate the nature of viruses, laboratory diagnosis of viruses using different techniques and classification of viruses.

Details of the Course:-

Unit I:

General Virology: Brief outline on discovery of viruses. Nomenclature and classification of plant, animal and bacterial viruses. Distinctive properties of viruses; morphology & ultrastructure of virus. Virus related agents (viroids, prions).

Unit II:

General Methods of Diagnosis and Serology: Cultivation of viruses in embryonated eggs, experimental animals, and cell cultures. Primary & secondary cell cultures. Monolayer cell cultures; cell strains, cell lines and transgenic systems. Serological methods – haemagglutination & HAI; complement fixation; immunofluorescence methods, ELISA and radioimmunoassays.
Assay of viruses – physical and chemical methods (protein, nucleic acid, radioactivity tracers, electron microscopy). Infective assay (plaque method, end point method).

Unit III:

Bacterial Viruses: Bacteriophage: structural organization and life cycle. Bacteriophage typing - application in bacterial genetics.Brief details on M13, Mu, T3, T4 and Lambda P1.

Unit IV:

Plant Viruses: Effects of viruses on histology, physiology and cytology of plants. Common viral diseases of plants; paddy, cotton, tomato and sugarcane. Common plant viruses: TMV, Cauliflower Mosaic Virus and Potato Virus X. transmission of plant viruses through vectors and without vectors. Control measures - virus-free planting material; vector control.

Unit V:

Animal Viruses: Epidemiology, lifecycle, pathogenicity, diagnosis,prevention and treatment of RNA Viruses Picorna, Ortho myxo, Paramyxo, Toga, Rhabdo, Rota, HIV - Oncogenic viruses. DNA viruses; Pox, Herpes, Adeno, SV 40, Hepatitis virus. Interferons, and antiviral drugs.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Conrat HF, Kimball PC and Levy JA. (1992). Virology. IIIrd edition. Prentice Hall, Englewood Cliff, New Jersey.	1992
2.	Dimmock NJ, Primrose SB. (2007) Introduction to Modern Virology VIth edition. Blackwell Scientific Publications, Oxford	2007
	Reference Books	
1.	Flint, S.J., Enquist, L.W., Krung, R. Racaniello, VR. And Skalka, A.M. (2015). Principles of Virology, Molecular Biology, pathogenesis and control, ASM Press, Washinton D.C.	2015
2.	Maloy SR, Cronan Jr. JE, Freifelder D. (1998). Microbial genetics. Jones and Bartlett publishers.	1998

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

Computer Applications & Biostatistics

Course Code: MMB-105 **Credit Units: 03**

Pre-requisite: Basic information of Computer Applications and Biostatistics

Course Outcome:

A student who successfully fulfills the course requirements will be able to

- define and appropriately use information technology terms;
- identify computer hardware components and describe their function;
- describe the essential elements of the computer's architecture and discuss how this architecture functions;
- describe the characteristics and representations of data, and interpret and compare data in different representations;
- identify and describe telecommunication components;
- describe the characteristics of operating systems and compare different operating systems;
- use a hypertext markup language to produce basic Web documents;
- discuss the general trends in technologies including examples of leading edge developments;
- Compare the roles of different sectors of the information technology.

Details of the course:

Unit 1: Introducing Computer System

Evolution Of Computers, Generations of Computer, Characteristics Of Computers, Functions Of Computers Advantages, Disadvantages Of Computers, Computer Applications,The parts of a Computer system, Types Of Computers. Storing Data: Types of storage devices, Memory Hierarchy. Essential computer hardware, software.

Unit 1I: Computer Input Devices:

Keyboard, Mouse, Webcam, Joystick and Output devices: Monitor, Printer, Plotters.
Data representation Using Operating System Operating system basics- The purpose of operating system, Type of operating system, providing a user interfaces. Networks and the Internet
Networking basics – The uses of a network, Common types of networks. Network topologies. What is the Internet? Internet‟s major services, Understanding the world wide web.

Unit II1: Algorithms and Flowcharts :

Algorithms, Flowcharts, Divide and computer strategy, Writing algorithms and drawing flowcharts for simple exercises – Swapping contents of 2 variables, Largest of given three numbers, Solving a given quadratic equation, Factorial Of a given integer Constants, Variable and Data types
Characters set, C tokens, Keywords and identifiers, Constants, Variables, Data types, Declaration of variables.

Unit 1V: Operators and Expressions:

Decision making and branching Decision making with if statement, simple if statement, the if…else statement, nesting of if…else statements. The else…if ladder, the switch statement, the: operator, the go to

statement.Decision making and looping The while statement, the do statement, The for statement, jumps in loops.

Unit V: Introduction of Bio statistics

Introductory Statistics, Measure of central tendency: Mean, Mode, Median. Measure of Dispersion: Standard Deviation, Variance, Moments, Skewness and Kurtosis.
Statistical methods
Sampling parameters Difference between sample and Population parametric and nonparametric statistics, Chi-square test.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books/ Reference Books	
1.	Norton, Peter, "Introduction to Computers", McGraw-Hill.	2005
2.	Rajaraman, V., "Fundamentals of Computers",PHI.	2005
3.	PK SINHA "Computer Fundamentals", BPB	Fourth edition
4.	Yashwant Kanetker, "Let us C",BPB.	2004
5.	A. Edmondson and D, Druce: Advanced Biology Statistics, Oxford University Press	1996
6.	W. Danial Biostatistics: A foundation for Analysis in Health Sciences, John Wiley and Sons inc	2004
7.	Rajaraman, V., "Computer Programming in C",PHI.	2005

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

Professional Communication

Course Code: AEC-101 **Credit Units: 02**

Pre-requisite: Basic information of English Language

Course Outcome:

- Exhibit competent writing that is reasonably proficient in correct grammar and sentencestructure skills.
- Construct the vocabulary of the students to assist them acquire plethora of knowledge offoreign as well as indigenous languages.
- Maximize the capability of students pertaining to discussion initiation, carrying on and conclusion.
- Help demonstrate proficiency in written communication using appropriate style, structureand voice.
- Provide knowledge in the area of research.
- Utilize the already learnt grammar skills towards accurate usage of language.

Details of the Course:-

UNIT I:

Functional GrammarTenses
Parts of speech

a) Usage of parts of speech
b) Spotting errorsVoice

UNIT II:

Articles Reported Speech

UNIT III:

Basic Vocabulary BuildingPrefixes ,suffixes Homonyms
Idioms & ProverbsPhrasal verbs One word
substitutionRole plays

UNIT IV:

Group Discussions Interview SkillsWritten communication
Paragraphing paraphrasing summarizing,Email writing,

UNIT V: Proof readingScientific paper Writing Difference in scientific reports ,
Research articles, review articles , book chapters, Reading a scientific

publication. literature review, writing research paper, review book chapter .Research work Presentation (oral /poster)

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Spoken English For India by R.K. Bansal and J.B. Harrison	1983
2.	A practical English Grammar By Thompson and Martinet – Oxford University Press	1986
3.	English is Easy By Chetananand Singh	2009
4.	A source book for English Learners By M.L. Tickoo- Orient Longman	2013
5	Professional Communication by Rajhans Gupta –Pragati Prakashan	2003
6.	Professional Communication By R.P. Singh –Oxford	2001

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

Public Speaking

Course Code: AEC-101a **Credit Units: 02**

Pre-requisite: Basic information of English Language

Course Outcome:

- Exhibit competent writing that is reasonably proficient in correct grammar and sentencestructure skills.
- Construct the vocabulary of the students to assist them acquire plethora of knowledge offoreign as well as indigenous languages.
- Maximize the capability of students pertaining to discussion initiation, carrying on and conclusion.
- Help demonstrate proficiency in written communication using appropriate style, structureand voice.
- Provide knowledge in the area of research.
- Utilize the already learnt grammar skills towards accurate usage of language.

Details of the Course:-

UNIT I:

Functional GrammarTenses
Parts of speech

c) Usage of parts of speech
d) Spotting errorsVoice

UNIT II:

Articles Reported Speech

UNIT III:

Basic Vocabulary BuildingPrefixes ,suffixes Homonyms
Idioms & ProverbsPhrasal verbs One word
substitutionRole plays

UNIT IV:

Group Discussions Interview SkillsWritten communication
Paragraphing paraphrasing summarizing,Email writing,

UNIT V: Proof readingScientific paper Writing Difference in scientific reports , Research articles, review articles , book chapters, Reading a scientific publication. literature review, writing research paper, review book chapter .Research work Presentation (oral /poster)

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Spoken English For India by R.K. Bansal and J.B. Harrison	1983
2.	A practical English Grammar By Thompson and Martinet – Oxford University Press	1986
3.	English is Easy By Chetananand Singh	2009
4.	A source book for English Learners By M.L. Tickoo- Orient Longman	2013
5	Professional Communication by Rajhans Gupta –Pragati Prakashan	2003
6.	Professional Communication By R.P. Singh –Oxford	2001

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

Effective writing skills I

Course Code: AEC-101b **Credit Units: 02**

Pre-requisite: Basic information of English Language writing.

Course Outcome:

- Exhibit competent writing that is reasonably proficient in correct grammar and sentencestructure skills.
- Construct the vocabulary of the students to assist them acquire plethora of knowledge offoreign as well as indigenous languages.
- Maximize the capability of students pertaining to discussion initiation, carrying on and conclusion.
- Help demonstrate proficiency in written communication using appropriate style, structureand voice.
- Provide knowledge in the area of research.
- Utilize the already learnt grammar skills towards accurate usage of language.

Details of the Course:-

UNIT I:

Functional GrammarTenses
Parts of speech

e) Usage of parts of speech
f) Spotting errorsVoice

UNIT II: Articles Reported Speech

UNIT III: Basic Vocabulary BuildingPrefixes ,suffixes
Homonyms Idioms & ProverbsPhrasal verbs One word substitution
Role plays

UNIT IV: Group Discussions Interview SkillsWritten communication
Paragraphing paraphrasing summarizing,Email writing,

UNIT V: Proof readingScientific paper Writing Difference in scientific reports , Research articles, review articles , book chapters, Reading a scientific publication. literature review, writing research paper, review book chapter .Research work Presentation (oral /poster)

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Spoken English For India by R.K. Bansal and J.B. Harrison	1983
2.	A practical English Grammar By Thompson and Martinet – Oxford University Press	1986
3.	English is Easy By Chetananand Singh	2009
4.	A source book for English Learners By M.L. Tickoo- Orient Longman	2013
5	Professional Communication by Rajhans Gupta –Pragati Prakashan	2003
6.	Professional Communication By R.P. Singh –Oxford	2001

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

English Grammer I

Course Code: AEC-101c **Credit Units: 02**

Pre-requisite: Basic information of English Language

Course Outcome:

- Exhibit competent writing that is reasonably proficient in correct grammar and sentencestructure skills.
- Construct the vocabulary of the students to assist them acquire plethora of knowledge offoreign as well as indigenous languages.
- Maximize the capability of students pertaining to discussion initiation, carrying on and conclusion.
- Help demonstrate proficiency in written communication using appropriate style, structureand voice.
- Provide knowledge in the area of research.
- Utilize the already learnt grammar skills towards accurate usage of language.

Details of the Course:-

UNIT I: Functional GrammarTenses
Parts of speech,Usage of parts of speech,Spotting errorsVoice

UNIT II: Articles Reported Speech

UNIT III: Basic Vocabulary BuildingPrefixes ,suffixes
Homonyms,Idioms & ProverbsPhrasal verbs One word substitution
Role plays

UNIT IV: Group Discussions Interview SkillsWritten communication
Paragraphing paraphrasing summarizing,Email writing,

UNIT V: Proof readingScientific paper Writing Difference in scientific reports , Research articles, review articles , book chapters, Reading a scientific publication. literature review, writing research paper, review book chapter .Research work Presentation (oral /poster)

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Spoken English For India by R.K. Bansal and J.B. Harrison	1983
2.	A practical English Grammar By Thompson and Martinet – Oxford University Press	1986
3.	English is Easy By Chetananand Singh	2009
4.	A source book for English Learners By M.L. Tickoo- Orient Longman	2013
5	Professional Communication by Rajhans Gupta –Pragati Prakashan	2003
6.	Professional Communication By R.P. Singh –Oxford	2001

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

Seminar & Research Orientation

Course Code: SM-101 **Credit Units: 02**

Course Outcomes:

- Describe the measurable skills, abilities, knowledge or values.
- Students should be able to demonstrate as a result of a completing a course.
- They are student-centered rather than teacher-centered.
- They describe what the students will do, not what the instructor will teach.

Detail of the course

Research methods: Lectures, seminars, and practical exercises that cover themes like what constitutes scientific knowledge
Research problems: How to identify and work through research problems
Primary and secondary sources: How to become familiar with sources and critique them, and how to research secondary sources
Research databases: How to use research database tools
Research proposals: How to prepare preliminary interdisciplinary research proposals

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

Research Methodology

Course Code: SM-101a **Credit Units: 02**

Course Outcomes:

- Students who complete this course will be able to understand and comprehend the basics in research methodology
- And applying them in research/ project work.
- This course will help them to select an appropriate research design.

Detail of the course:

Unit I : Foundations of Research:

Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance.

Unit II : Research Design:

Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches.

Unit III : Measurement:

Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size.

Unit IV : Data Analysis:

Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association. Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

9. Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline.

Unit V: Use of tools / techniques for Research:

methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism

Suggested Books :

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari 4. Select references from the Internet

SEMESTER I

General Proficiency

Course Code: GP-101 **Credit Units: 02**

Pre-requisite: Basic information of English Language

Course Outcome:

- Effective communication: The ability to exchange ideas and information in a way that builds trust and respect
- Critical and analytical thinking: The ability to explore issues and ideas before forming a conclusion
- Integrative thinking: The ability to synthesize knowledge across different domains and perspectives
- Preparing students to be engaged citizens: Preparing students to participate in political culture and thrive in a rapidly evolving world

Details of the Course:-

General language proficiency is the ability to read, write, listen, and speak in real-life situations. To test this, a test is usually developed for each skill with questions that are designed to imitate real life.
A syllabus is a guide to a course that includes course policies, rules, regulations, required texts, and a schedule of assignments and seminar.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

Enterprenuership Development and Business Communication I

Course Code: GP-101a **Credit Units: 02**

Pre-requisite: Basic information of Enterprenuership Development

Course Outcome:

- To familiarize the students, and make them understand with key concepts and processes in entrepreneurship and business communication.
- To provide context to the processes in the form of differences between small and large firms, and the economic environment.
- To introduce key debates around entrepreneurship and small businesses.
- To impart knowledge on different extension methods and approaches used for transfer of agricultural technology.
- To impart skills required for entrepreneurship development among the students for self-employment.

Details of the Course:-

Unit-I

Concept ofEntrepreneur, Entrepreneurship Development, Characteristics of entrepreneurs;

SWOT Analysis & achievement motivation, Government policy, and programs & institutions for entrepreneurship development.

Unit-II

Impact of economic reforms on Agribusiness/Agri-enterprises, Entrepreneurial Development Process.

Unit-III

Business Leadership Skills; developing organizational skills (controlling, supervising, problem-solving, monitoring & evaluation**).**

Unit-IV

Developing Managerial skills, Business Leadership Skills (Communication, direction, and motivation skills), Problem-solving skills

Unit-V

Supply chain management & Total quality management, Project Planning Formulation & report preparation; Financing of enterprise, Opportunities for agri-entrepreneurship & rural enterprise.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

Human Values and Moral Ethics I

Course Code: GP-101b **Credit Units: 02**

Course Outcome:

- Understanding life's purpose: Students become aware of their life's mission, vision, and goals.
- Developing virtues: Students learn to cultivate virtues and avoid vices.
- Understanding ethical personalities: Students learn to understand the metaphors of ethical personalities from various domains.
- Developing a positive outlook: Students develop a personality that allows them to view life in a positive way.
- Building strong relationships:

Unit I : Morals, values, and ethics:

This unit may cover topics such as integrity, work ethic, service learning, civic virtue, respect for others, living peacefully, caring, sharing, honesty, courage, valuing time, cooperation, commitment, empathy, self-confidence, character, and spirituality

Unit II : Engineering ethics:

This unit may cover topics such as the senses of engineering ethics, moral issues, types of inquiry, moral dilemmas, moral autonomy, models of professional roles, engineering as experimentation, research ethics, codes of ethics, industrial standards, and a balanced outlook on law

Unit III : Engineering ethics:

This unit may cover topics such as the senses of engineering ethics, moral issues, types of inquiry, moral dilemmas, moral autonomy, models of professional roles, engineering as experimentation, research ethics, codes of ethics, industrial standards, and a balanced outlook on law

Unit IV :Peer pressure, alcoholism, and drug abuse:

This unit may cover topics such as ethical values, causes, impact, laws, prevention, and the ill effects of smoking

Unit V : Global issues:

This unit may cover global issues
Indian and global case studies: This unit may cover Indian and global case studies

SEMESTER I

Life Management I

Course Code: GP-101c **Credit Units: 02**

- Goal setting: How to set SMART goals that are specific, measurable, achievable, realistic, and have a time frame.
- Prioritization: How to prioritize tasks and effectively manage time.
- Stress management: How to manage stress and improve work-life balance.
- Organization: How to organize work and use organization tools.
- Delegation: How to delegate tasks and assignments.

SEMESTER I

Cell & Developmental Biology Lab

Course Code: MMB-151 **Credit Units: 02**

Pre-requisite: Basic information of Cell Biology

Course Outcome:

- Students will acquire knowledge about basics of cell biology.
- Students will learn about how various functions of organelles and their working.
- Students will gain an insight into microscopic structures and chemical components of various regions of cells.
- Students will attain a comprehensive knowledge of functioning of cell and synchronization of activities of various organelles.
- Students will be able to learn about various signaling mechanism involved in a cell which ultimately leads to a visible physiological response.
- Students will be able to understand the architectural components involved in making cells rigid and how cells are connected to each other.
- Students will learn about molecular events involved in cell cycle.
- Students will apply the information gained in understanding the issues and conditions encountered if things go wrong with cell cycle and how our understanding of cell signaling generate drug targets.

Details of the Course:-

S. No.	Contents	Contact Hours
1	Use of fluorescence microscope and demonstration of nucleic acid by acridine orange or ethidium bromide.	2
2	Localization of Barr bodies.	2
3	Blood smear – differential staining.	2
4	Study of mitosis from onion root tips by making temporary squash preparation (staining with acetocarmine).	2
5	Vital staining of mitochondria.	2
6	Demonstration of cellular organelles including mitochondria, Golgi bodies etc.	2
7	Determination of absorption maximum of a solution.	2
8	Determination of relationship between absorption and various concentration of a solution using a colorimeter, spectrocolorimeter/spectrophotometer.	2
9	Isolation of Mitochondria.	2
10	Isolation of Chloroplast.	2
11	Determination of osmotic fragility of RBC membrane.	2

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Culture of Animal Cells – a manual of basic techniques 4th Edition. Freshney, R. I. (2000) John Wiley & Sons, New York.	2000
2.	Animal Cell Biotechnology. Spier, R. E. and Griffiths, J. B. (1988) Academic Press.	1988

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER I

Biochemistry & Enzymology Lab

Course Code: MMB-152 **Credit Units: 02**

Pre-requisite: Background information of biochemistry and enzymes.

Course Outcome:

- Students will be able to define biomolecules and buffers.
- Students will understand the structure and functions of biomolecules.
- Students will be able to classify and explain the role of various biomolecules in human body.
- Students will be able to analyze the causes of diseases on biochemical basis.
- Students will be able to understand various biochemical process and cell metabolism.
- Students will be able to classify enzymes and will understand kinetic properties.
- Students will be able to understand K_m and V_{max} for enzymatic equations.
- Students will be able to understand the application of enzymes in daily life.

Details of the Course:-

S. No.	Contents	Contact Hours
1	Preparation of various solution and preparation of buffer solution and calculation of pKa and buffer capacity.	2
2	Quantitative and qualitative estimation of reducing	2
3	Quantitative estimation of proteins	2
4	Method of DNA/ RNA detection and estimation.	2
5	Enzyme assay, partial purification and kinetic studies with reference to of Km and Vmax.	2
6	Polyacryamide gel electrophoresis.	2
7	Iodine value, saponification value and acid values.	2
8	Estimation of amino acids from biological samples with the help of standard curve.	2
9	Quantification of soluble proteins in biological samples in Bradford‟s method.	2
10	Isolation of casein from skimmed milk.	2
11	Determination of osmotic fragility of RBC membrane.	2

Suggested Books:

S. No.	Author/s/Book/Title/Publisher	Year
1.	Blanch, H.W., Clark, D.S. Biochemical Engineering Marcel Dekker	1997
	Bailey J.E. &Ollis, D.F., Biochemical Engineering Fundamentals (2nd Ed.) McGraw Hill	1986
2	Wiseman, Alan, Hand book of Enzyme Biotechnology (3rd Ed.), Ellis Harwood	1995
3	A. Lehninger, revised by Nelson and Cox, Principles of Biochemistry	2002
4	Van Holde and Ahern by Mathews, Biochemistry,. (3rd Ed.)	2002
5	White, Handler and R.B.Smith, Biochemistry (7th Ed.)	1983
6	L.Stryer Biochemistry (3rd Ed.)Freeman	1998
7	Voet and Voet Biochemistry	2001

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	**Viva-Voce**	**Practical Record**	
Weightage (%)	10	20	10	60

SEMESTER I

Bacteriology Lab

Course Code: MMB-153 **Credit Units: 02**

Pre-requisite: Basic information of biology and bacteriology.

Course Outcome:

At the end of the course, the students will be familiar with microbial technology. This would help students to launch themselves in industrial biotechnology which is the fastest growing industry in the developing country. After completion of the course the students should be able to

- Describe the cell organization of bacteria i.e. morphology, ultrastructure and organelles present in bacterial cells.
- Apply the knowledge of bacteriological techniques.
- Describe the nutritional and physical requirements for bacterial growth.
- Describe the principles involved in killing bacteria, and make recommendations on use of physical and chemical methods used to control microbial growth.
- Describe the dynamics of the growth of a bacterial population and how this growth can be measured.

Details of the Course:-

S. No.	Contents	Contact Hours
1	To prepare plates, butts, slants of sterilized culture media.	2
2	To demonstrate the technique for isolation of pure culture by streaking plate method, pour plate method, spread plate method and serial dilution method (Ten & Two fold).	2
3	To prepare the bacterial smear, fixation and demonstration of bacterial shape by simple and negative staining.	2
4	To study the bacterial morphology and its differentiation using Gram‟ s stain.	2
5	To evaluate alcohol as a skin disinfectant and to study the effectiveness of hand washing.	2
6	To study the germicidal effect of UV on bacterial growth.	2
7	To isolate the Staphylococci from human sin on MSA media.	2
8	To test the antibiotic sensitivity of an organism by disc diffusion method.	2
9	To study the effect of dye(s) on bacterial growth.	2
10	To study the viable and nonviable organisms in given culture by Viable Staining Techniques.	2
11	To show the effect of given antibiotic on bacterial culture and to isolate the antibiotic resistant mutant by Gradient Plate Technique.	2
12	To isolate & differentiate Staphylococcus aureus on MSA from milk source.	2
13	To perform biochemical tests.	2
14	To determine the MIC & MBC of given antibiotic substance.	2
15	To demonstrate the motility of a bacteria by Hanging drop method and wet slide test.	2

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Experiments in Microbiology, Plant Pathology and Biotechnology. 4th Edition. Aneja, K.R. (2003). New Age International Publishers, New Delhi. 5th ed.	2017
	References	
1.	Microbiology: A Laboratory Manual. Benjamin Cummings. 10th edition. Cappuccino J. and Sherman N. (2013)	2013
2.	Laboratory exercises in Microbiology by Harley Prescott. 7th edition, McGraw-Hill Higher Education.	2008
3.	Benson‟s Microbiology Application, laboratory Manual Concise version (2016) McGraw Hill Publisher- 14th ed	2016
4.	Applied Microbiology laboratory Manual (2016) Kendall Hunt Publisher- 5th Edition, Frances Duncan	2016

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER I

Virology Lab

Course Code: MMB-154 **Credit Units: 02**

Pre-requisite: Basic information of Virology

Course Outcome:

After completion of the course the students should be able to

- Differentiate the nature of viruses.
- Understand classification of viruses.
- Learn the methods of laboratory diagnosis of viruses using different techniques.
- Learn about different plant and animal viruses.

Details of the Course:-

S. No.	Contents	Contact Hours
1	Isolation of colipahges from sewage water sample.	3
2	One step growth curve for determination of virus titre.	3
3	Immunological assays for virus detection.	3
4	Screening of embryonated viable eggs and demonstration of virus cultivation.	6
5	Cultivation and morphological identification of animal cell lines.	3
6	Induction of lambda lysogen by UV radiations.	3
7	Studies on Specialized transduction .	3
8	Isolation of lambda DNA and their characterization.	3
9	Amplification of lambda DNA by PCR.	3
10	Phage typing of E.coli bacteriophages.	3

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Introduction to Modern Virology 4th Edition by Dimmock N J, Primrose S. B. 1994. Blackwell Scientific Publications. Oxford.	1994
	Reference Books	
1.	Virology 3 rd Edition by Conrat H.F., Kimball P.C. and Levy J.A. 1994. Prentice Hall, Englewood Cliff, New Jersey.	1994

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER I

Computer Applications & Biostatistics Lab

Course Code: MMB-155 **Credit Units: 02**

Pre-requisite: Basic knowledge of Computer Application and Biostatistics

Course Outcome:

- Students will learn to execute internal and external commands.
- Students will also be able to understand basic computer applications practically.

Details of the Course:-

S. No.	Contents	Contact Hours
1	Execute "Internal & External Commands" in MS-DOS.	2
2	Create any 3 ".txt" files in MS-DOS and Copy the contents of two files in one single file.	2
3	Create the "directory structure" in MS-DOS.	2
4	In MS-DOS, Change the dos prompt: With your name, current date, current time, change the prompt to its original path.	2
5	Create one MS-word file having name "INTRODUCTION" and apply "center alignment", Make the heading bold, Italic and underlined and do apply font style of heading as ―ALGERIAN‖ and size ―24‖ by including fields like: Name, Permanent Address, Current Address, Educational Qualification, Hobbies, and Aim etc. Insert table for "educational Qualification".	2
6	Create one MS-Word File for drawing a flow chart to calculate "Simple Interest", using shapes.	2
7	Create a table in MS-Excel having name BCA having fields: S.No, Student Name, sub1_marks, sub2_marks, sub3_marks, sub4_marks. Calculate the "sum" and "percentage" of all the students. Also draw "pie chart" for showing the student percentage.	2
8	Create one MS-excel for a "Automobile Garage" by having fields like "year", "Sale", "Car Name". Draw a "column chart" for year and Sale.	2
9	Create "Attendance letter" for class MCA and send this letter at the address of all the MCA students using "Mail Merge" option.	2
10	Create a Power Point presentation with the main title "INTERNET ". Also add the following topics like: HISTORY OF THE INTERNET, INTERNET TERMS, and ADAVANTAGES OF THE INTERNET in Slides.	2

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Norton, PESEr, -Introduction to Computers‖, McGraw-Hill.	2011
2.	\Leon, Alexis & Leon, Mathews, -Introduction to Computers‖, Leon Tech World.	2012
3.	Yashwant Kanetker, -Let us C‖,BPB.	2010
4.	Rajaraman, V., -Fundamentals of Computers‖,PHI.	2011
5.	Rajaraman, V., -Computer Programming in C‖,PHI.	2012

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER II

Immunology & Immunotechnology

Course Code: MMB-201 **Credit Units: 03**

Pre-requisite: Basic knowledge of immunology and diseases, and host-parasite interactions

Course Outcome:

- Students will be able to understand and appreciate the contribution of various scientists in unraveling the various facets of immune system and responses in our body.
- The knowledge of various types of immune responses along with the key players in the form of cells and organs of immune system will be absorbed by the students.
- Students will become familiar with concept of antigenicity and immunogenicity along with contribution of structural variability of antibody in eliciting immune response.
- The role of MHC molecule in graft rejection along with structure and function of various types of MHC in body will be understood by the students.
- Students will be able to understand the structure and function of Complement protein along with various pathways of their activation.
- The knowledge of various kinds of Hypersensitivity reactions will be imparted to students.
- Students will be able to understand various factors responsible for causation of tumor and subsequently cancer in the body.
- Students will become familiar with practical applications of various immunological methods like ELISA, RIA, and Immunoelectophoresis etc.
- Students will be able to understand the structure and function of various cells and organs of immune system.

Details of the Course:-

UNIT 1 : Fundamentals of Immunology

Components of innate and acquired immunity; phagocytosis; complement and inflammatory responses; haematopoesis; organs and cells of the immune system- primary and secondary lymphoid organs; Lymphatic system; Lymphocyte circulation; Lymphocyte homing; mucosal and cutaneous associated lymphoid tissue.(MALT & CALT); Mucosal Immunity; Antigens - immunogens, haptens; Major Histocompatibility Complex - MHC genes, MHC and immune responsiveness and disease susceptibility, HLA typing. Molecular basis of Immune responses

UNIT II :Humoral immune response:

Immunoglobulins-basic structure, classes and subclasses of immunoglobulins, antigenic determinants; multigene organization of immunoglobulin genes; B-cell receptor; immunoglobulinsuperfamily; principles of cell signaling; immunological basis of self –non-self discrimination; Kinetics of immune response, memory; B cell

maturation, activation and differentiation; generation of antibody diversity; Cell-mediated immune responses: T-cell maturation, activation and differentiation and T-cell receptors; Functional T Cell Subsets, ADCC; cytokines-properties, receptors and therapeutic uses; antigen processing and presentation- endogenous antigens, exogenous antigens, non-peptide bacterial antigens and super-antigens; Cell-cell co-operation, Hapten-carrier system, plantibodies.

UNIT III :Antigen-antibody interactions and Immonotechniques

Precipitation, agglutination and complement mediated immune reactions; Advanced immunological techniques - RIA, ELISA, western blotting, ELISPOT assay, immunofluorescence, flow cytometry and immunoelectron microscopy; Surface plasmon resonance, Biosenor assays for assessing ligand –receptor interaction, CMI techniques- lymphoproliferation assay, mixed lymphocyte reaction, cell cytotoxicity assays, apoptosis, microarrays, transgenic mice, gene knock out animals, hybridoma technology.

UNIT IV :Vaccinology

Active and passive immunization; live, killed, attenuated, sub unit vaccines; vaccine technology- role and properties of adjuvants, recombinant DNA and protein based vaccines, edible vaccines, reverse vaccinology; peptide vaccines, conjugate vaccines; Antibody genes and antibody engineering- chimeric and hybrid monoclonal antibodies; catalytic antibodies and generation of immunoglobulin gene libraries.Clinical Immunology and human healthImmunity to infection: bacterial, viral, fungal and parasitic infections (with examples from each group);

UNIT V :Hypersensitivity

Type I-IV; autoimmunity; types of autoimmune diseases; Treatment of autoimmune diseases; Transplantation – Immunological basis of graft rejection; clinical transplantation and immunosuppressive therapy; Tumor immunology – Tumor antigens; Immune response to tumors and tumor evasion of the immune system, Cancer immunotherapy; immunodeficiency-primary immunodeficiencies, acquired or secondary immunodeficiencies.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/ Reprint
	Text Books	
1.	Immunology, Goldsby RA, Kindt TJ, Osborne BA. Kuby‟s. 6th edition W.H. Freeman and Company, New York, 2007.	2007
2.	Essential Immunology, 10thed Roitt, Ivon; Delves, Peter (2001) Blackwell Scientific Publications Oxford.	2017
	References	
1.	Basic and Clinical Immunology, Peakman M, and Vergani D. 2nd ed). Immunology on Churchill Livingstone Publishers, Edinberg, 2009	2009
2.	Richard C and Geiffrey S. 6th edition. Wiley Blackwell Publication. 2009.	2009
3.	Janeway‟s Immunobiology, Murphy K, Travers P, Walport M., 7th edition Garland Science Publishers, New York. 2008.	2008

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

Molecular Biology & Recombinant DNA Technology

Course Code: MMB-202 **Credit Units: 03**

Pre-requisite: Basic information of cell biology and molecular biology dogma (replication, transcription, translation, restrictions enzymes and plasmids etc.)

Course Outcome:

To impart theoretical and practical knowledge on, tools, techniques, scope and applications of recombinant DNA Technology or genetic engineering to prepare students ready for research, industry and higher studies.

- The student will be familiar with the historical background and important milestones, biosafety and bioethics in genetic engineering.
- The student will be acquainted with tools of RDT like enzymes, vectors and hosts.
- The student will be acquainted with technical knowhow of gene cloning and expression and factors for optimizing the heterologous gene expression.
- The student will be acquainted with the techniques required for gainful applications of genetic engineering.
- The student will be able to apply RDT in different domains of life science, medical, agriculture, forensic and allied fields for the welfare of living beings.

Details of the Course:-

Unit I: Methods of Studying Biomolecules:

Density gradient sedimentation, zonal centrifugation, electrophoretic separation, agarose, polyacrylaide, pulse field electrophoreses, southern blotting, northern blotting, labeling – radioactive and non-radioactive labeling, isopycnic separation. DNA sequencing direct sequencing, indirect
sequencing, Maxam and Gilbert method, Sangers method, RNA sequencing.

Unit II: Nucleic acid hybridization:

Design and construction of probes, nick translation, chemical synthesis, hybridization, liquid hybridization, solid hybridization, determination of stringency conditions. Applications of nucleic acid hybridization. Systems that safeguard DNA – DNA repair mechanisms – photo reactivation, mismatch repair, recombination repair, SOS repair, DNA restriction and modification.

Unit III: Plasmid vectors:

Use of natural plasmids as vectors, artificial plasmid vectors, pSC 101, RI,pBR322, pUC 18/19, Tiplasmid vectors. Bacteriophage vectors – Insertion
vectors, replacement vectors, cosmid vectors, phagemid vectors, shuttlevectors and M13 based vectors. Restriction endonucleases – Type, I, II & III, restriction mapping, RFLP and RAPD. Genome libraries – construction and screening of genome libraries, chromosome walking, cDNA libraries.

Unit IV: Recombinant DNA:

Isolation of gene of interest: Construction of recombinant DNA, selection of DNA fragments for cloning, cDNA synthesis, chemical synthesis, gene synthesizers, ligation with RES, homopolymer tailing, blunt end ligation, linkers, monitoring restriction and ligation. Gene transformation techniques- Direct method-Indirect methods, Screening of recombinant. PCR – principles, types and applications, primer design and applications.

Unit V: Applications of Genetic Engineering:

Transgenic animal and plants; Knockouts; Gene therapy; DNA finger printing and DNA bar-coding for phylogenetic relationship; Production of recombinant therapeutics (vaccines/insulin); Gene editing technology (CRISPR-CAS). Human Genome Project.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Gene Cloning and DNA Analysis, An Introduction, T. A. Brown (7^{th} edition), Wiley-Blackwell	2015
2.	Recombinant DNA: Genes and Genomes - A Short Course, James D. Watson , Richard M. Meyers, Amy A. Caudy, Jan A. Witkowski, (3rd Edition), W.H. Freeman	2007
	Reference Books	
1.	Molecular Cloning: A Laboratory Manual, Michael R. Green; Joseph Sambrook, (Fourth Edition), CSHL Press	2012
2.	Principles of Gene Manipulation and Genomics, Primrose, S.B. and Twyman, R.M., (7th ed.) Blackwell Publishing	2006

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

Mycology & Phycology

Course Code: MMB-203 **Credit Units: 03**

Pre-requisite: Basic information of Fungus and Algae

Course Outcome:

After the successful completion of this course

- Students will be able to isolate fungi from soil.
- Students will be able to learn about the cultivation and preservation of fungi and algae.
- Students will be able to recognize the microscopic structure of fungi.
- Students will be able to recognize the microscopic structure of algae.

Details of the Course:-

Unit I: Introduction to fungi:

Occurrence and distribution, thallus structure, characteristics, nutrition, classification and reproduction. Introduction of fungi: Occurrence and distribution, somatic structure, hyphal growth, nutrition, heterothallism, sex hormones in fungi, physiological specialization in fungi, fungi and ecosystem; saprophytic parasitic, mutualistic and symbiotic relationship with plants and animals. Classification of fungi. Reproduction in fungi:
asexual, sexual and parasexual.

Unit II: Study of the different classes of fungi:

Salient features of division and sub division of Myxomycota, mastigomycota, ztgomycota, ascomycotina, basidiomycotina and deuetromycotina. Structure and reproduction of: Dictyostelium,
Allomyces, Pilobolus, Claviceps and Fusarium.

Unit III: Economic importance of fungi:

Economic importance of Mycorrhiza: ecto-, endo and ect-endo VAM, Fungi as insect symbionts, fungi as biocontrol agents, attack of fungi on other microorganisms, potential application in Agriculture, environment, industry, food. Role of fungi in bio deterioration of wood, paper, textile.
Mycotoxins, quorum sensing in fungi.

Unit IV: Salient Features of Algae:

Distribution, morphology and classification of algae.Isolation from soil and water, algal ecology, media and methods used for cultivating algae. Measurement of algal growth, strain selection and large scale cultivation. Symbiotic algae: Lichens, coral reef and sea sponges. Structure and
reproduction of important algae.

Unit V: Economic importance of algae:

Economic importance of algae as primary producers and commercial products. Uses of algae in heavy metal removal, algal blooms and toxins.Uses of algae with examples in agriculture, environment, industry and food.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Alexopoulos, C.J. and C.W. Mims 1979. Introduction to Mycology (3rd Ed.)Wiley Eastern Ltd., New Del	1979
2.	L. Barsanti, Paolo Gualtieri: Algae: anatomy, biochemistry, and biotechnology	2009
	Reference Books	
1.	Linda E. Graham, James Graham, James M. Graham: Algae (2009)	2009
2.	Burnett J.H., Publisher: Edward, Arnold Crane Russak: Fundamentals of Mycology.	2002

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

IPR, Biosafety & Bioethics

Course Code: MMB-204 **Credit Units: 03**

Pre-requisite: Basic knowledge of Biology and Biotechnology

Course Outcome:

- Students will understand with the importance of intellectual property and its protection under the constitution, able to classify patentable subject matter under the realm of Biotechnology.
- Students will be able to understand the protection of traditional knowledge
- Students will be able to apply their knowledge to deal with hazards related to biotechnology and the importance of biosafety in research.
- Students will be familiar with the basic principles of bioethics & will be able to analyze ethical issues related to biotechnology research.
- Students will be able to understand the concept of lab biosecurity.

Details of the Course:-

UNIT I : Introduction to Intellectual Property:

Types of IP: Patents, Trademarks, Copyright, Industrial Design, Traditional Knowledge, Geographical Indications, IPs of relevance to Biotechnology andfew Case Studies

UNIT II : Agreements and Treaties:

History of GATT & TRIPS Agreement;Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments

UNIT III :Concept of biosafety

Biorisk, Hazardous characteristics of the agent, Laboratory procedures, Good lab practices, Principles of biosafety, Biosafety levels to personnel, environment and Community

UNIT IV : Biosafety guidelines:

Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Cartagena Protocol.

UNIT V : Perceptions of ethical biotechnology

Morality, Legality and ethics, Principles of bioethics, Ethical conflicts in biotechnology, , Social and ethical implications of biological weapons, Ethical limits of biotechnology

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Sateesh, M.K., Bioethics and Biosafety, IK International Publishers	2008
2	Fleming, D.A., Hunt, D.L, Biological Safety Principles and Practices, Fourth Edition, ASM Press, Washington.	2006
	Reference Books	
1.	Srinivasan, K. and Awasthi, H.K., Law of Patents, Jain Book Agency	1997
2	Ganguli, P. Intellectual Property Rights: Unleashing the Knowledge. Tata McGraw-Hill Publishing Company.	2001

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

Bioinstrumentation Techniques

Course Code: MMB-205 **Credit Units: 03**

Pre-requisite: Basic understanding of molecular biology, Physics and chemistry

Course Outcome:

- Students will be able to define and explain the fundamental principles of modern biological techniques.
- Students will be able to understand types of chromatography on the basis of different mobile and stationary phases.
- Students will acquire knowledge about principle and applications of different types of electrophoresis.
- Students will be able to understand the general account of centrifugation, types and applications for the separation of different types of biomolecules.
- Students will be able to learn about the general principles and applications of different types of microscopy.
- Students will be able to learn about the basic working principle of biosensor and their applications
- Students will be able to understand basic principle of different types of spectroscopy and their role in biological sciences.
- Students will be able to apply their basic knowledge in characterization of biomolecules.

Details of the Course:-

UNIT I: Analytical separation methods:

Principles and techniques. Chromatography – general principle, application and types. Adsorption chromatography, partition chromatography. Gas Chromatography, liquid chromatography, paper chromatography.Thin layer chromatography, gel filtration chromatography. Ionexchange chromatography, affinity chromatography. HPPL/High Performance/Pressure Liquid chromatography.

UNIT II: Electrophoresis:

General principles, application, and types: paper electrophoresis, moving boundary methods, gel electrophoresis (native, denaturing & reducing). Disc gel electrophoresis, slab gel electrophoresis. isoelectrofocussing (IEF) isolactophoresis, molecular weight estimation. Centrifugation: basic principles common centrifuges used in laboratory (clinical high speed & ultracentrifuges). Types of rotors (fixed angle, swing bucket).Types of centrifugation: preparative, differential & density gradient. Ultra centrifugation: sedimentation rate: zonal centrifugation, equilibrium density gradient centrifugation sedimentation constants.

UNIT III: Basic knowledge of the principles and applications of microscopy:

light, phase contrast, fluorescence, confocal microscopy scanning and transmission electron microscopy

(SEM, TEM).

UNIT IV: Biosensors:

introduction & principles. First, second & third generation instruments cell based biosensors, enzymeimmunosensors.Spectroscopic methods: principles and applications of UV-visible,IR, NMR, ES Round X-ray. Spectroscopy.

UNIT V: Application of radioisotopes in biology:

Properties and units ofradioactivity. Radioactive isotopes and halflife Measurement of radioactivity: (basic knowledge) GM Counter,gamma counter, liquid scintillation counter. Tracer techniques (basic knowledge): autoradiography,radioimmunoassay, pitfalls of immunoassays, radio receptor assay. Safety rules in handling of radioisotopes and hazardous chemical.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Wilson K and Walker J. Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed., Cambridge University Press.	2010
2	Karp, G. Cell and Molecular Biology: Concepts and Experiments. 8th Edition. John Wiley& Sons. Inc.	2010
3.	Cooper, G.M. and Hausman, R.E.The Cell: A Molecular Approach. 7th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.	2016
	Reference Books	
1.	Swargiary, A. Biological Tools & Techniques (A textbook for UG/PG students of Life Sciences).	2017

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

Career Skills

Course Code: AEC-201 **Credit Units: 02**

Pre-requisite: English Language Skills & Sound Reasoning and Aptitude ability

Course Outcome:

- Exhibit competent writing that is reasonably proficient in correct grammar and sentence structure skills.
- Enhance the Vocabulary of the students to make them corporate ready.
- Improve the Logical ability among the students.
- Enhance the problem solving skills of the students.
- Improve the Quantitative ability of the students.
- Discover the key skills required to bridge the gap between campuses and corporate.

Details of the Course:-

Unit I: Sentence Corrections based on Topics:

Tenses & Concord

Sentence completion -Single word blank & Double blanks

Unit II: Basic Vocabulary Building:

Antonyms & synonyms

Idioms & Phrasal Verb

Advanced Analogy

Unit-III: Logical Reasoning:

Blood relation, seating/placing arrangements.

Unit-IV: Logical Reasoning:

Coding decoding, Direction sense test

Unit V: Quantitative Aptitude:

Percentage, Ratio, Ages, Profit& loss

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
	Reference Books	
1.	Chetananand Singh " English is Easy ,BSC Publishers 2^{ND} Edition	2009
2.	R.S Agarwal "Verbal and Non Verbal Reasoning"	2010
3	R.S Agarwal "Quantitative aptitude"	2012
4	Rawat & Rawat "Quantitative aptitude"	2017

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

Public Speaking II

Course Code: AEC-201a **Credit Units: 02**

Pre-requisite: Basic information of English Language

Course Outcome:

- Exhibit competent writing that is reasonably proficient in correct grammar and sentencestructure skills.
- Construct the vocabulary of the students to assist them acquire plethora of knowledge offoreign as well as indigenous languages.
- Maximize the capability of students pertaining to discussion initiation, carrying on and conclusion.
- Help demonstrate proficiency in written communication using appropriate style, structureand voice.
- Provide knowledge in the area of research.
- Utilize the already learnt grammar skills towards accurate usage of language.

Details of the Course:-

UNIT I:

Functional GrammarTenses
Parts of speech

g) Usage of parts of speech
h) Spotting errorsVoice

UNIT II:

Articles Reported Speech

UNIT III:

Basic Vocabulary BuildingPrefixes ,suffixes Homonyms
Idioms & ProverbsPhrasal verbs One word
substitutionRole plays

UNIT IV:

Group Discussions Interview SkillsWritten communication
Paragraphing paraphrasing summarizing,Email writing,

UNIT V: Proof readingScientific paper Writing Difference in scientific reports ,

Research articles, review articles , book chapters, Reading a scientific publication. literature review, writing research paper, review book chapter .Research work Presentation (oral /poster)

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Spoken English For India by R.K. Bansal and J.B. Harrison	1983
2.	A practical English Grammar By Thompson and Martinet – Oxford University Press	1986
3.	English is Easy By Chetananand Singh	2009
4.	A source book for English Learners By M.L. Tickoo- Orient Longman	2013
5	Professional Communication by Rajhans Gupta –Pragati Prakashan	2003
6.	Professional Communication By R.P. Singh –Oxford	2001

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

Effective writing skills II

Course Code: AEC-201b **Credit Units: 02**

Pre-requisite: Basic information of English Language writing.

Course Outcome:

- Exhibit competent writing that is reasonably proficient in correct grammar and sentencestructure skills.
- Construct the vocabulary of the students to assist them acquire plethora of knowledge offoreign as well as indigenous languages.
- Maximize the capability of students pertaining to discussion initiation, carrying on and conclusion.
- Help demonstrate proficiency in written communication using appropriate style, structureand voice.
- Provide knowledge in the area of research.
- Utilize the already learnt grammar skills towards accurate usage of language.

Details of the Course:-

UNIT I:

Functional GrammarTenses
Parts of speech

i) Usage of parts of speech
j) Spotting errorsVoice

UNIT II: Articles Reported Speech

UNIT III: Basic Vocabulary BuildingPrefixes ,suffixes
Homonyms Idioms & ProverbsPhrasal verbs One word substitution
Role plays

UNIT IV: Group Discussions Interview SkillsWritten communication
Paragraphing paraphrasing summarizing,Email writing,

UNIT V: Proof readingScientific paper Writing Difference in scientific reports , Research articles, review articles , book chapters, Reading a scientific publication. literature review, writing research paper, review book chapter .Research work Presentation (oral /poster)

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Spoken English For India by R.K. Bansal and J.B. Harrison	1983
2.	A practical English Grammar By Thompson and Martinet – Oxford University Press	1986
3.	English is Easy By Chetananand Singh	2009
4.	A source book for English Learners By M.L. Tickoo- Orient Longman	2013
5	Professional Communication by Rajhans Gupta –Pragati Prakashan	2003
6.	Professional Communication By R.P. Singh –Oxford	2001

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

English Grammer II

Course Code: AEC-201c **Credit Units: 02**

Pre-requisite: Basic information of English Language

Course Outcome:

- Exhibit competent writing that is reasonably proficient in correct grammar and sentencestructure skills.
- Construct the vocabulary of the students to assist them acquire plethora of knowledge offoreign as well as indigenous languages.
- Maximize the capability of students pertaining to discussion initiation, carrying on and conclusion.
- Help demonstrate proficiency in written communication using appropriate style, structureand voice.
- Provide knowledge in the area of research.
- Utilize the already learnt grammar skills towards accurate usage of language.

Details of the Course:-

UNIT I: Functional GrammarTenses
Parts of speech,Usage of parts of speech,Spotting errorsVoice

UNIT II: Articles Reported Speech

UNIT III: Basic Vocabulary BuildingPrefixes ,suffixes
Homonyms,Idioms & ProverbsPhrasal verbs One word substitution
Role plays

UNIT IV: Group Discussions Interview SkillsWritten communication
Paragraphing paraphrasing summarizing,Email writing,

UNIT V: Proof readingScientific paper Writing Difference in scientific reports , Research articles, review articles , book chapters, Reading a scientific publication. literature review, writing research paper, review book chapter .Research work Presentation (oral /poster)

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Spoken English For India by R.K. Bansal and J.B. Harrison	1983
2.	A practical English Grammar By Thompson and Martinet – Oxford University Press	1986
3.	English is Easy By Chetananand Singh	2009
4.	A source book for English Learners By M.L. Tickoo- Orient Longman	2013
5	Professional Communication by Rajhans Gupta –Pragati Prakashan	2003
6.	Professional Communication By R.P. Singh –Oxford	2001

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Semester II

Seminar & Research Orientation II

Course Code: SM-201 **Credit Units: 02**

Course Outcomes:

- Describe the measurable skills, abilities, knowledge or values.
- Students should be able to demonstrate as a result of a completing a course.
- They are student-centered rather than teacher-centered.
- They describe what the students will do, not what the instructor will teach.

Detail of the course

Research methods: Lectures, seminars, and practical exercises that cover themes like what constitutes scientific knowledge
Research problems: How to identify and work through research problems
Primary and secondary sources: How to become familiar with sources and critique them, and how to research secondary sources
Research databases: How to use research database tools
Research proposals: How to prepare preliminary interdisciplinary research proposals

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

Research Methodology II

Course Code: SM-201a **Credit Units: 02**

Course Outcomes:

- Students who complete this course will be able to understand and comprehend the basics in research methodology
- And applying them in research/ project work.
- This course will help them to select an appropriate research design.

Detail of the course:

Unit I : Foundations of Research:

Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance.

Unit II : Research Design:

Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches.

Unit III : Measurement:

Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size.

Unit IV : Data Analysis:

Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association. Interpretation of

Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism. 9. Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline.

Unit V: Use of tools / techniques for Research:

methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism

Suggested Books :

4. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
5. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
6. Research Methodology – C.R.Kothari 4. Select references from the Internet

Semester II General Proficiency

Course Code: GP-201 **Credit Units: 02**

Pre-requisite: Basic information of English Language

Course Outcome:

- Effective communication: The ability to exchange ideas and information in a way that builds trust and respect
- Critical and analytical thinking: The ability to explore issues and ideas before forming a conclusion
- Integrative thinking: The ability to synthesize knowledge across different domains and perspectives
- Preparing students to be engaged citizens: Preparing students to participate in political culture and thrive in a rapidly evolving world

Details of the Course:-

General language proficiency is the ability to read, write, listen, and speak in real-life situations. To test this, a test is usually developed for each skill with questions that are designed to imitate real life.
A syllabus is a guide to a course that includes course policies, rules, regulations, required texts, and a schedule of assignments and seminar.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

Enterprenuership Development and Business Communication II

Course Code: GP-201a **Credit Units: 02**

Pre-requisite: Basic information of Enterprenuership Development

Course Outcome:

- To familiarize the students, and make them understand with key concepts and processes in entrepreneurship and business communication.
- To provide context to the processes in the form of differences between small and large firms, and the economic environment.
- To introduce key debates around entrepreneurship and small businesses.
- To impart knowledge on different extension methods and approaches used for transfer of agricultural technology.
- To impart skills required for entrepreneurship development among the students for self-employment.

Details of the Course:-

Unit-I

Concept ofEntrepreneur, Entrepreneurship Development, Characteristics of entrepreneurs;

SWOT Analysis & achievement motivation, Government policy, and programs & institutions for entrepreneurship development.

Unit-II

Impact of economic reforms on Agribusiness/Agri-enterprises, Entrepreneurial Development Process.

Unit-III

Business Leadership Skills; developing organizational skills (controlling, supervising, problem-solving, monitoring & evaluation**).**

Unit-IV

Developing Managerial skills, Business Leadership Skills (Communication, direction, and motivation skills), Problem-solving skills

Unit-V

Supply chain management & Total quality management, Project Planning Formulation & report preparation; Financing of enterprise, Opportunities for agri-entrepreneurship & rural enterprise.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

Human Values and Moral Ethics II

Course Code: GP-201b **Credit Units: 02**

Course Outcome:

- Understanding life's purpose: Students become aware of their life's mission, vision, and goals.
- Developing virtues: Students learn to cultivate virtues and avoid vices.
- Understanding ethical personalities: Students learn to understand the metaphors of ethical personalities from various domains.
- Developing a positive outlook: Students develop a personality that allows them to view life in a positive way.
- Building strong relationships:

Unit I : Morals, values, and ethics:

This unit may cover topics such as integrity, work ethic, service learning, civic virtue, respect for others, living peacefully, caring, sharing, honesty, courage, valuing time, cooperation, commitment, empathy, self-confidence, character, and spirituality

Unit II : Engineering ethics:

This unit may cover topics such as the senses of engineering ethics, moral issues, types of inquiry, moral dilemmas, moral autonomy, models of professional roles, engineering as experimentation, research ethics, codes of ethics, industrial standards, and a balanced outlook on law

Unit III : Engineering ethics:

This unit may cover topics such as the senses of engineering ethics, moral issues, types of inquiry, moral dilemmas, moral autonomy, models of professional roles, engineering as experimentation, research ethics, codes of ethics, industrial standards, and a balanced outlook on law

Unit IV :Peer pressure, alcoholism, and drug abuse:

This unit may cover topics such as ethical values, causes, impact, laws, prevention, and the ill effects of smoking

Unit V : Global issues:

This unit may cover global issues
Indian and global case studies: This unit may cover Indian and global case studies

SEMESTER II

Life Management II

Course Code: GP-201c **Credit Units: 02**

- Goal setting: How to set SMART goals that are specific, measurable, achievable, realistic, and have a time frame.
- Prioritization: How to prioritize tasks and effectively manage time.
- Stress management: How to manage stress and improve work-life balance.
- Organization: How to organize work and use organization tools.
- Delegation: How to delegate tasks and assignments.

SEMESTER II

Immunology & Immunotechnology Lab

Course Code: MMB-251 **Credit Units: 02**

Pre-requisite: Basic knowledge of immunology

Course Outcome:

- Students will be able to understand/experience the immune system.
- Students will be able to understand related immunological techniques and apply them in medical laboratory profession.
- Students will be able to value role of immune system in different diseases.

Details of the Course:-

Sl. No.	Contents	Contact Hours
1	To make blood smear, stain and identify different leukocytes.	3
2	Separation of serum and plasma from blood.	3
3	To determine haemoglobin estimation	3
4	To determine blood group by haemagglutination test	3
5	To perform RPR test for detection of Syphilis infection	3
6	To perform immunoprecipitation techniques- a) Double immunodiffusion b) Radial immuno diffusion	3
7	Qualitative estimation of *Salmonella* infection	3
8	To perform Widal tube test for quantitative determination of *Salmonella* infection	3
9	Separation of lymphocyes from blood	3
10	To determine concentration of antigen by rocket immunoelectrophoresis	3
11	To perform different types of ELISA for determination of antigen or antibody titer a) Indirect ELISA b) Direct ELISA c) Competitive ELISA	3
12	To perform western Blotting.	3
13	To perform dot blot assay.	3
	Total	39

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Using Antibodies: A Laboratory Manual. Harlow & Lane (1998) Cold Spring Harbor Lab Press.	1998
	Reference Books	
1.	Immunological Techniques Made Easy. Cochet, et al (1998) Wiley Publishers, Canada	1998

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER II

Molecular Biology & Recombinant DNA Technology Lab

Course Code: MMB-252 **Credit Units: 02**

Pre-requisite: Basic experience of molecular biology techniques

Course Outcome:

- Students will be able to isolate and analyze DNA/plasmid DNA and protein.
- Students will be able to digest and ligate the DNA molecules.
- Students will be able to design primers and amplification of DNA by PCR.
- Students will be able to learn the techniques of cloning gene in plasmid vectors.
- Students will be able to screen the positive transformants with the gene cloned through reporter based assays.

Details of the Course:-

S. No.	Contents	Contact Hours
1	Isolation of Vector/plasmid DNA and its analysis	3
2	RNaseA digestion of isolated plasmid/vector DNA	3
3	Restriction digestion of DNA	3
4	Primer designing	3
5	Amplification of DNA by polymerase chain reaction	6
6	Ligation of DNA molecules	3
7	Competent cell formation	3
8	Transformation in *E. coli* .	6
9	Reporter gene assay for plasmid vectors	3
10	Expression of cloned gene in prokaryotic system	6

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Methods in yeast genetics: a Cold Spring Harbor Laboratory course manual. David C. Amberg, Daniel Burke, Jeffrey Strathern Cold Spring Harbor Laboratory Press, c2005 2005 ed.	2005
2.	Departmental Laboratory Manual	2018
	Reference Books	
1.	Molecular Cloning- A Laboratory Manual: 3 rd Edition, 2001, Vol. 1 -3 . Sambrook J and Russell D.W.(2001). Cold spring Harbor Laboratory Press, New York.	2001
2.	DNA cloning: A Practical Approach. Glover and Hames (2001) Oxford Univ. Press.	2001

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER II

Mycology & Phycology Lab

Course Code: MMB-253 **Credit Units: 02**

Pre-requisite: Basic information of Fungus and Algae

Course Outcome:

After the successful completion of this course

- Students will be able to isolate fungi from soil.
- Students will be able to learn about the cultivation and preservation of fungi and algae.
- Students will be able to recognize the microscopic structure of fungi.
- Students will be able to know various properties of fungi and algae.

Details of the Course:-

S. No.	Contents	Contact Hours
1	To study the colony morphology and microscopy of fungi.	3
2	Sampling of fungi from soil and air.	3
3	Various enzymatic assays of fungi.	3
4	DNA isolation of fungi.	9
5	Antimicrobial activity of some medicinal plants against certain isolated fungi.	3
6	Isolation of fungal pathogen from plants.	3
7	Isolation and partial purification of enzymes.	3
8	Study of the following genera through temporary and permanent slides: *Volvox, and Nostoc.*	2
9	Study of the following genera through temporary and permanent slides: Coleochaete, Vaucheria, Ectocarpus, Polysiphonia.	2

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Introduction to Fungi 3 rd Edition. John Webster and Roland W.S. Weber (2007). Cambridge.	2007
2.	Alexopoulus C.J, Mims C.W. and Blackwel M.I 1996. Introductory Mycology. John Wiley and Sons Inc.	1996
3.	Kumar HD. (1990). Introductory Phycology. 2nd edition. Affiliated East Western Press.	1990
4.	Microbiology 5 th Edition. Prescott, L. M.; Harley, J.P. and Klein, D.A. (2003) McGraw Hill, USA.	2003

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER III

Microbial Genetics

Course Code: MMB-301 **Credit Units: 03**

Pre-requisite: Basic knowledge of microbial genetics

Course Outcome:

- Students will be able to understand the current status of microbial genetics.
- Students will be able to understand the relevance of microbial genetics in Life Sciences.
- Students will be able explain different mechanisms of transfer of genetic materials in prokaryotes.
- Students will be able identify and distinguish genetic regulatory mechanisms at different levels.
- Students will be able to understand life cycles of different phages.
- Students will be able to know about transposons and transcription.

Details of the Course:-

Unit I: Historical Preview of Genetics:

Mendelian principles and classical genetics, Genetic concepts, use of microorganisms in genetic studies. Chemical basis of heredity – early concepts of genes – discovery of the chemical basis of heredity - experimental evidences – contributions of Griffith, Avery, Hershey and Chase, Fraenkel – Conrat. Structure of nucleic acids – Structure of DNA and its elucidation, types and different models of DNA, extra- chromosomal DNA. Structure of RNA. Organization of genetic material - Genome organization in viruses, bacteria and eukaryotes. Structure of nucleosome, chromatin and chromosome. Concept of phenotype and genotype, monohybrid (law of dominance and segregation), dihybrid (law of independent assortment). Applications of Mendel principles.

Unit II: Chromosomes and Genes:

Cell division and Cell Cycle, chromosomal aberrations, karyotype analysis- normal and abnormal karoyotype. Neurospora- Tetrad analysis and linkage detection - 2 point and 3 point crosses, chromatid and chiasma interference, Mitotic recombination in Neurospora and Aspergillus. B) Algal Genetics: Chlamydomonas - unordered tetrad analysis - Recombination and Mapping, Nucleocytoplasmic interactions and gene expression in Acetabularia. Extra nuclear (Cytoplasmic) inheritance. Heterothalism and Parasexuality.

Unit III: Perpetuation of genetic information:

Replication of DNA, evidence of semi-conservative replication. Mechanism and enzymology of DNA replication. Regulation of DNA replication. Replication of RNA. Co-linearity between genes and proteins - Central dogma, experimental evidences, components of protein synthesis.

Unit IV: Transcription and Translation:

Biosynthesis of RNA in prokaryotes and eukaryotes, DNA dependent RNA polymerase, initiation, elongation and termination of transcription. Post transcriptional processing - removal of intron transcripts, addition of 5‟ cap and 3 poly A tail, processing of mRNA, rRNA and tRNA. Reverse transcription. Genetic code and translation – Elucidation and salient features of genetic code, wobble concept, triplet codon usage. Involvement of ribosome in

translation, ribosome structure, initiation, elongation and termination of polypeptide chain synthesis, extra ribosomal factors, ribosome cycle, post translation modifications of proteins.

Unit IV: Regulation of gene expression:

Enzyme induction and repression, constitutive expression and housekeeping genes, Operon concept, negative and positive regulation, catabolite repression, regulation of lac Operon, trp Operon, arabinose Operon, divergent Operon, attenuator regulation, translational regulation, feedback inhibition. Genetic recombination – in bacteria; transformation, competence, lysogeny, generalized and restricted transduction, conjugation, sexduction, genetic and fine structure mapping. Transposable elements – recombination in bacteria, yeasts, maize and drosophila. Mutations – Nature and types, mutagenic agents –Physical, Chemical and biological. Phage µ mutagenesis, site directed mutagenesis. Detection of mutation – Ame‟s test, Mutation in – yeast, neurospora and chlamydomonas.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Snyder L. and Chapness W. Molecular Genetics of Bacteria 2007.2. Birge EA. 1981. Bacterial and Bacteriophage Genetics. Springer Verlag.	1981
2.	Gardner JE, Simmons MJ & Snustad DP. 1991. Principles of Genetics. John Wiley& Sons.	1991
	Reference Books	
1.	Lewin B.1999. Gene. Vols. VI, IX. John Wiley & Sons.	1999
2.	Maloy A & Friedfelder D. 1994. Microbial Genetics. Narosa.	1994

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

Medical Microbiology

Course Code: MMB-302 **Credit Units: 03**

Pre-requisite: Basic information of Medical Microbiology

Course Outcome:

Upon successful completion of this course the student will be able to:

- This course provides learning opportunities in the basic principles of medical microbiology and infectious disease.
- It covers mechanisms of infectious disease transmission, principles of aseptic practice, and the role of the human body‟s normal microflora.
- The course provides the conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause disease in the human body.
- It also provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.
- To understand the importance of pathogenic bacteria in human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue.
- Helps to understand the use of lab animals in medical field.
- Recall the relationship of this infection to symptoms, relapse and the accompanying pathology.
- Explain the methods of microorganisms‟ control, e.g. chemotherapy & vaccines. Solve problems in the context of this understanding.

Details of the Course:-

UNIT I: General Microbiology:

Morphology and classification of microorganisms. Growth, nutrition and multiplication of bacteria. Sterilization and Disinfection - Principles and use of equipment‟s of sterilization namely hot air oven, autoclave and serum inspissator, pasteurization, antiseptics and disinfectants. Immunology - antigen, Antibodies, Immunity, vaccines, types of vaccine and immunization schedule. Hospital acquired infection - Causative agents, transmission methods, investigation, prevention and control of hospital Acquired infections.

UNIT II: Bacteriology:

Classification of bacteria, morphology, infections, lab diagnosis, treatment and prevention of common bacterial infections.Staphylococcus, Streptococcus, Pneumococcus, NeisseriaCorynebacteriumdiphtheriae, Clostridia, Enterobacteriaceae-Shigella, Salmonella, Klebsiella, E.coli, Proteus, Vibrio cholerae, Pseudomonas and Spirochetes.

UNIT III: Mycobacteriology & Parasitology:

Mycobacteria- classification, pathogenesis, lab diagnosis and prevention. Classification, infections and lab diagnosis of followingparasites. Entamoeba, Giardia, Malaria, Hookworm, Roundworm and Filarial worms.

UNIT IV: Mycology:

Morphology, disease caused and lab diagnosis of following fungi.Candida, Cryptococcus, Dermatophytes, opportunistic fungi (Aspergillus, Zygomycetes and Penicillium).

Unit V: Virology:

General properties of viruses, diseases caused lab diagnosis and prevention of following viruses, Herpes, Hepatitis, HIV, Dengue,Influenza, Chikungunya, Rabies and Poliomyelitis.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Microbiology by Lansing M. Prescott and John P. Harley and Donald Klein; Ed. 6th; McGraw-Hill Science, 2004.	2004
2.	Allen and William M Janda and Paul C Schreckenberger and Washington C Winn; Ed. 6th; Lippincott Williams & Wilkins, 2005.	2005
	Reference Books	
1.	Essentials of diagnostic microbiology by Lisa Anne Shimeld and Anne T. Rodgers; Delmar Publishers, 1999.	1999
2.	Medical Microbiology by Geo. Brooks and Karen C. Carroll and Janet Butel and Stephen Morse; Ed. 24th; McGraw-Hill Medical, 2007.	2007

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

Bioinformatics

Course Code: MMB-303 **Credit Units: 03**

Pre-requisite: Basic Knowledge of computer application

Course Outcome:

- Students will be able to understand the structure and function of computers along with its application in solving Biotechnology problems.
- Students will acquire the ability to retrieve, use and apply tremendous knowledge present in various databases for research purpose.
- Students will be able to perform interspecies genome analysis and also understand the phylogenetic relationship between different species.
- Students will become familiar with various application tools available for various purposes like protein structure prediction, primer designing, nucleic acid structure prediction and molecular mapping and imaging.
- The knowledge of various data generation techniques & intervention of Bioinformatics into it, in the form of softwares for generating restriction map, chromatograms etc. will be imparted to students.

Details of the Course:-

S. No.	Contents	Contact Hours
1	Basics of computer, input/ output tools; Application of computer in Biotechnology, Biological Databases for nucleic acids and proteins; Pubmed, NCBI and EBI. Retrieval of data from public Databases.	6
2	Bioinformatics resources on the internet Computational methods for sequence analysis; various approaches to nucleic acids and protein sequence analysis, Local and Global Alignment.	8
3	Genome Analysis and Gene Identification, Genome comparison and analysis; Phylogenetic Analysis, Comparative genomics and computers, Structural analysis of Nucleic acids	8
4	Application tools: Primer designing. Molecular imaging and design, Tools for molecular mapping, Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web. Prediction of 3- dimensional structure of proteins.	8
5	Introduction to Data generation Techniques and Bioinformatics Problem Posed by them- Restriction Digestion, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry.	8

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text/Reference Books	
1.	Bioinformatics: Principles and Applications.Ghosh Z. and Bibekanand M., OxfordUniversity Press, 2008.	2015
2.	Genome analysis and bioinformatics: a practical approach. T.R. Sharma, I.K.International Publishing House Pvt. Ltd., 2009.	2009
3.	Bioinformatics and Functional Genomics, Pevsner J. II Edition, Wiley-Blackwell, (2009).	2015
4.	Discovering Genomics, Proteomics and Bioinformatics, Campbell A. M., Heyer L. J.,II Edition. Benjamin Cummings, 2006.	2006
5.	Bioinformatics: A practical guide to analysis of genes and proteins, Andreas D. Baxevanis, Wiley Student edition,	2006
6.	Bioinformatics, Sequence and genome analysis by David W. Mount, Second Edition, CSHL Press, 2004	2004

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

Environmental Microbiology

Course Code: MMB-304 a **Credit Units: 03**

Pre-requisite: Basic knowledge of environmental science.

Course Outcome:

- Students will be able to acquire knowledge about environmental pollution- sources, effects and control measures.
- Students will understand the concept of BOD and analyze the need for different waste water treatment methods.
- Students will be able to understand and implement the methods and importance of solid waste management.
- Students will be able to understand the application of bioreactors.
- Students will be able to apply their knowledge about toxic compounds degradation using microbes.
- Students will understand the role of biopesticides.
- Students will analyze the national and international concern for environment for protecting the environment and sustainable development.
- Students will be able to understand the global issues related to environmental pollution.

Details of the Course:-

UNIT-I: Introduction to Microbial Ecology:

Evolution of Life on Earth; History and scope of ecology, Concept of autecology, synecology, population, community, biome. Ecological succession. Microorganism in aquatic Environment: major physical and chemical factors (light, temperature, gases, nutrients). Aquatic biota: phytoplankton, zooplankton, benthos, periphyton, macrophytes. Biofilms, Production in lakes, rivers, estuaries and wetlands. Nutrient dynamics in lakes, rivers, estuaries and wetlands.

UNIT-II: Aquatic Microbiology:

Fresh and marine ecosystem (estuaries, mangroves, deep sea, hydrothermal vents, salt pans, coral reefs). Zonation of water ecosystem; upwelling, eutrophication; food chain in aquatic ecosystems. Role of methanotrophs in ecosystem. Potability of water, microbial assessment of water, water purification. Ground water types and their contamination. Biofilm. Waste treatment: Sewage and effluent treatment; Primary, secondary and tertiary treatment, Solid waste treatment. Solid wastes as sources of energy and food.

UNIT-III: Aerobiology:

Airspora in different layers of the atmosphere, bioaerosol, assessment of air quality using air sampler based principles of sedimentation, impaction, impingement, suction and filtration. Brief account of transmission of airborne microbes, indoor and outdoor microbial quality. Allergy: Causes and tests for detection of allergy. Endotoxin in air and its hazards. Molecular methods for air quality assessment. Historical development of space microbiology, Life detection methods a) Evidence of metabolism (Gulliver) b) Evidence of photosynthesis (autotrophic andheterotrophic)

UNIT-IV: Role of microbes in degradation:

Biodegradation of xenobiotic – hydrocarbons, pesticides and plastics. Biodeterioration of wood, pulp and paper; Biosorption/ bioaccumulation of heavy metal. Bioremediation of soil, air and water: various methods, advantages and disadvantages. Bioleaching of iron, copper, gold and uranium.

UNIT-V: Global environmental problems:

Ozone depletion, UV-B, greenhouse effect and acid rain, their impact and biotechnological approaches for management. . Containment of acidmine drainage applying biomining [with reference to copper extraction from low grade ores].

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1	Alan Scragg, Environmental Biotechnology, Second Edition, Oxford University Press.	2005
2.	J., Pichtel, Waste Management Practices: Municipal, Hazardous and Industrial, Taylor and Francis.	2005
3.	B.C. Bhattacharya & Ritu Banerjee Environmental Biotechnology, Oxford Press.	2007
4.	Shree Nath Singh, Microbial Degradation of Xenobiotics, Springer Science & Business Media.	2011

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

Industrial Microbiology

Course Code: MMB-304 b **Credit Units: 03**

Pre-requisite: Basic knowledge of Industrial Microbiology.

Course Outcome:

- Students will be able to understand the technologies for microbial cell maintenance.
- Students will learn about bioprocess technology.
- Students will be able to understand fermenters.

Details of the Course:

UNIT -1 Technology of Microbial Cell Maintenance

Principles of Microbial growth, Methods to increase yield of microbes, Batch, fed- batch and continuous cultures (definition and kinetics). Strain preservation, maintenance and strain improvement by mutation of gene transfer processes. Microbial culture selection with high yield potential. Commercial Production of Microorganisms.

UNIT -2 Production of Primary Metabolites

A brief outline of processes for the production of some commercially important organic acids (e.g. citric acid, lactic acid, acetic acid etc.,); amino acids (glutamic acid, phenyalanine, aspartic acid etc.,) and alcohols (ethanol, butanol etc.,)

UNIT -3 Production of Secondary Metabolites

Study of productionprocesses for various classes of secondary metabolites: antibiotics: betalactams (penicillin, cephalosporin etc.), aminoglycosides (streptomycin etc.,) macrolides (erythromycin), vitamins and steroids.

UNIT -4 Design and construction of a Fermentors:

Body construction; construction material; Aeration and agitation systems; Stirrer glands and bearings; Baffles; Valves and steam traps; Pressure- control valves; computer applications in fermentation technology; specialized bioreactors; membrane bioreactors; tower bioreactors; fluidized bed bioreactors; Immobilized system and packed bed reactors and Photobioreactors.

UNIT -5 Production Modern Biotechnology Products

Production of recombinant proteins having therapeutic and diagnostic applications, production of vaccines. Production of monoclonalantibodies. Products of plant and animal cell culture.

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	W. Crueger and A. Crueger. Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.	2000
2.	P.F. Stanbury and A. Whitaker-Principle of Fermentation Technology; Pergamon Press	1988
3	A.H. Patel. Industrial Microbiology. 1st edition, Macmillan India Limited.	1996
	Reference Books	
1.	L.E. Casida. Industrial Microbiology. 1st edition. Wiley Eastern Limited.	1991
2	M. L. Shuler and F. Kargi-Bioprocess Engineering: Basic Concepts" by, 2nd Edition, Pearson Education	2001

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

Watershed Wastland Manegement

Course Code: MMB-304c **Credit Units: 03**

Course Outcomes:

- Restoring ecological balance
- Promoting economic development
- Improving the socio-economic condition of disadvantaged sections
- Generating employment
- Alleviating poverty
- Empowering the community

Details of Course

Unit I: Watershed management

The process of improving the quality of water and other natural resources in a watershed through land use and water management practices.

Unit II: Soil conservation

Measures such as terracing, contouring, and mulching can help reduce soil erosion, improve soil health, and increase agricultural productivity.

Unit III: Groundwater recharge methods

Methods to improve and increase the production of timbers, fodder, and wildlife resources.

Unit IV: Integrated watershed management

A holistic plan that combines different practices such as agronomic, engineering, forestry, and community-based practices.

Unit V:Runoff and floods

Changes in land use and climate change can significantly influence watershed hydrologic processes and water quality.

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Singh, R.V. (2000). (Ed.) Watershed planning and management. Yash Publishing House, Bikaner, Rajasthan, India.	2000
2.	Raju, K.V., Aziz, A., Sundaram, M.S.S., Sekher, M., Wani, S.P. and Sreedevi, T.K. (2008). Guildelines for Planning and Implementation of Watershed Development Program in India: A Review. Global Theme on Agroecosystems Report 48. Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.	1988
3	Sharma, R. (2002). Watershed Development Adaptation Strategy for Climate Change. Paper presented in South Asia expert	2002
	Reference Books	
1.	Darvishan, K., Gholami, L., Ghorghi, J.H., Spalevic, V., Kord, A.K., Amini, M. (2016). Effect of exclosure on runoff, sediment	2016

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

Biochemical Engineering

Course Code: MMB-304d **Credit Units: 03**

- Problem solving: Identifying, formulating, and solving complex engineering problems
- Engineering design: Applying engineering design to create solutions that meet needs while considering safety, public health, and other factors
- Communication: Communicating effectively with a variety of audiences
- Ethics: Recognizing ethical and professional responsibilities in engineering situations
- Teamwork: Functioning effectively in a team to establish goals & plan tasks.

Unit I : Material and Energy Balance:

Students learn the fundamental concepts of chemical engineering design and calculations.

Unit II : Pollution control:

Topics include air pollution, water pollution, solid waste management, and radioactive pollution.
Process control, Biochemical engineering

Unit III : Thermodynamics:

A core topic in chemical engineering. Mass transfer: A core topic in chemical engineering.
Chemical reactions: A core topic in chemical engineering.nstrumentation and process control
Plant design and economics

Unit IV : Mathematics:

A common subject in chemical engineering, as engineers use math to make important decisions.
Fluid mechanics and mechanical operations,Heat transfer

Unit V : Chemical Reaction Engineering:

A course that involves designing and analyzing chemical reactors. Students often find this course challenging because of the complex mathematical models required.

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Soil Microbiology by Prof. N.S. Subba Rao, Fourth edition, Oxford and IBH Publishing Co. Pvt, Ltd., New Delhi	2000
2.	Introduction to soil microbiology. Alexander M. (1977) John Wiley & Sons, Inc., New York.	1977
	Reference Books	
1.	Modern Soil Microbiology, Dirk J, Elas V, Trevors JT, Wellington, EMH (1997) Marcel Dekker INC, New York	1997

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

Agriculture Microbiology

Course Code: MMB-305 a **Credit Units: 03**

Pre-requisite: Basic knowledge of Agriculture Microbiology.

Course Outcome:

- Students will be able to understand the microorganisms of soil and nutrient cycle.
- Students will learn about the role of enzymes and toxins in pathogenesis.
- Students will understand about the physical and chemical control of plant diseases.
- Students will learn about Biofertilizers & Mycorrhizae.

Details of the Course:

UNIT-1

Microorganisms of soil. Rhizosphere and phyllosphere microflora. Brief account of Microbial interactions: antagonism, symbiosis, mutualism, commensalisms, synergism and parasitism. Nutrient cycle: Carbon cycle , nitrogen cycle, phosphorous cycle and sulphur cycle.

UNIT-2

Role of enzymes and toxins in pathogenesis. Fungal diseases of plants: Rusts of wheat, linseeds; late blight of potato; red rot of sugarcane. Bacterial diseases of plants: Citrus canker, blight of rice. Viral diseases of plants: Leaf curl of Papaya, vein clearing of lady‟s finger.

UNIT-3

Physical and chemical control of plant diseases. Bacterial control of insect pests: Bacillus thuringiensis as bacterial insecticide. Viral control of insect pests: Nuclear polyhedrosis visuses (NPV) and cytoplasmic polyhedrosis viruses (CPV). Fungal control of insect pests: *Entomopathogenic fungi : Metarhinium anisopliae, Beauveria bassiana, Verticillium lecani, Hirsutella thompsoni*

UNIT-4

Storage fungi: Categories of storage fungi, conditions during storage in relation to damage of seeds, harmful effects. Mycotoxins and their effect on human being. General idea about quarantine. Production of biogas and alcohol from agricultural wastes.

UNIT-5

Biofertilizers: Types, production and application. Mycorrhizae: Types and their application in agriculture and forestry. Vermicomposting. Reclamation of waste agricultural land by microorganisms.

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Soil Microbiology by Prof. N.S. Subba Rao, Fourth edition, Oxford and IBH Publishing Co. Pvt, Ltd., New Delhi	2000
2.	Introduction to soil microbiology. Alexander M. (1977) John Wiley & Sons, Inc., New York.	1977
	Reference Books	
1.	Modern Soil Microbiology, Dirk J, Elas V, Trevors JT, Wellington, EMH (1997) Marcel Dekker INC, New York	1997

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

Food Microbiology

Course Code: MMB-305 b **Credit Units: 03**

Pre-requisite: Basic knowledge of food microbiology.

Course Outcome:

- Students will be able to know about the microorganisms important in food microbiology.
- Students would know about the factors influencing microbial growth in food.
- Students will understand various food borne diseases.
- Students will also have knowledge of microbiology of milk.
- Students will understand microorganisms as source of food.

Details of the Course:

UNIT-1

Microorganisms important in food microbiology: molds, yeast and bacteria – general characteristics, classification and importance. Principles of food preservation, preservation by use of high temperature, low temperature, drying and dessication. Chemical preservatives and additives. Preservation by radiation.

UNIT-2

Factors influencing microbial growth in food: Extrinsic and intrinsic factors. Microbial spoilage of food. Chemical changes caused by the microorganisms during spoilage. Spoilage of fish, meat, poultry, eggs, fruits and vegetables. Detection of spoilage and characterization.

UNIT-3

Classification of food borne diseases. Food borne infections: Brucella, Bacilllus cereus, Clostridium perfringens, Yersinia enterocolitica and Escherichia, Salmonella spp. Food intoxication: Staphylococcal intoxication, Clostridial poisoning (Clostridium Botulinum). Food adulteration and prevailing food standards in India.

UNIT-4

Microbiology of Milk: Sources of microorganisms in milk and types of microorganisms in milk. Microbiological examination of milk (standard plate count, direct microscopic count, reductase, and phosphatase test). Dehydration and pasteurization of milk. Dairy products from microorganisms: Butter, yoghurt and cheese.

UNIT-5

Microorganisms as source of food: Single Cell Protein (SCP). Mushrooms and food value of mushrooms. Food conversions: Lactic acid conversions, soyabean conversions and Bakery. Microbiological estimation of food: Sample collection, preparation and analysis techniques.

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Food science By Norman N. Potler, Joseph H. Hotchkiss. Fourth edition, CBS Publishers and Distributors, New Delhi	2006
2.	Food Microbiology , by William C. Frazier and Dennis C. Westhoff, Fourth edition, Tata McGrawHill Publishing Company Limited, New Delhi	1997-1979
3.	Modern Food Microbiology by James M. Jay, Fourth Edition, CBS Publishers and Distributors, New Delhi.	1959
4.	Bains W. Biotechnology from A to Z. Oxford Univ. Press.	1993
	Reference Books	
1.	Introduction to Food Biotechnology. Author; Perry Johnson.	2002

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

Agricultural Journalism

Course Code: MMB-305c **Credit Units: 03**

Course Outcomes

- Students will understand and analyze the current events and issues that are occurring in agriculture.
- Students will understand and analyze how current events and issues affect your future in agriculture.
- Students will be able to recognize and examine the relationships between inputs and outputs in their agricultural field to make effective and profitable decisions.

Unit I: Print Journalism. Introduction to journalism:

basic terminology: history of Indian press and printing: printing processes; attributes of a reporter: news syndicates and agencies: concept, sources and elements of news: press releases: flash messages: kinds of feature: feature, article and editorial writing: types and sources of editorials: principles of editing; heading writing; illustrations; principles of design and layout; brief introduction to recent trends in mass media; cultural imperialism, media activism, agenda setting, gate keepin.

Unit II: Online Journalism. Introduction to online journalism:

basic terminology; a technical history of the web and early online media; comparative media characteristics (Print and online); online writing and story structure; issues in online research and information gathering; concept of interactive and its tools; ethical dilemmas in online journalism; blogging and participatory journalism; issues concerning blogging; online advertising; virtual community formation v/s atomization; massification v/s individuation of news; understanding difference between web edition and e-edition of newspapers; extensions of new media e.g. RSS feeds, podcasting and wireless paper; convergence.

Unit III: Media Planning and Advertising.

Introduction to advertising, its orgin and growth; terminology; advertising – its classification, objectives, strategies at different levels and its future; marketing mix, promotional mix and the communication process; structure of advertising industry – advertising agencies; advertising coverage; types of advertising media; advertising codes, regulations and ethics; consumer redressal forums; advertising and social issues; controversial advertising; issues concerning surrogate advertising; constructing an advertisement; types of consumers and buying motives; media selection and scheduling; difference between advertising and PR; media planning and buying; brand positioning.

Unit IV:Agricultural and Development Journalism.

Meaning, scope and importance of development journalism; problems of rural development; development agencies; development media theory and 3 democratic participant theory; dominant paradigm v/s participatory approach; human development index; making sense of development statistics; determinates of development; nation building and uplifting quality of life; agriculture and rural development schemes; agricultural news story structure, agricultural media dynamics and ethics; editing scientific papers, policy reports; public understanding and media coverage of environmental issues; use of traditional media; rural press; contribution of vernacular press; role of IT in agricultural and rural development; Right to communicate and News World Communication Order; WTO.

Unit IV: Ethics.

Ethical reporting, code of ethics; social responsibility; invasion of privacy; sting operations and ethical

issues; organizational pressures in media ethics; fundamental rights, especially freedom of speech and expression; freedom and accountability of press; laws in India; official secrecy; laws of sedition; defamation, libel and slander; contempt of court; contempt of legislature; privileges of the parliament and press; press council and press commission; copyright laws; registration of journals; Information Technology Act 2000 and cyber Right to Information Act 2005; media's role promotion of human right; editor's freedom; case studies.

Suggested Readings:

1. Nelson, William; Doerfert, David; Meyers, Courtney; Baker, Matt; Akers, Cindy; Yamada, Masaru; Nanseki, Teruaki; Roberts, Owen (2014-12-01). "An Examination of the International Federation of Agricultural Journalists' Involvement in Agriculture Knowledge Mobilization". Journal of Applied Communications. 98 (4). doi:10.4148/1051-0834.1095. ISSN 1051-0834.
2. ^ Marti, Donald B. (1980). "Agricultural Journalism and the Diffusion of Knowledge: The First Half-Century in America". Agricultural History. 54 (1): 28–37. ISSN 0002-1482. JSTOR 3742591.
3. ^ Scruggs, C. G.; Moseley, Smith W. (1979). "The Role of Agricultural Journalism in Building the Rural South". Agricultural History. 53 (1): 22–29. ISSN 0002-1482. JSTOR 3742856.
4. ^ Shulman, Stuart W. (1999). "The Progressive Era Farm Press: A Primer on a Neglected Source of Journalism History". Journalism History. 25 (1): 26–35. doi:10.1080/00947679.1999.12062507. ISSN 0094-7679.
5. ^ Pawlick, Thomas (2001). The Invisible Farm: The Worldwide Decline of Farm News and Agricultural Journalism Training. Rowman & Littlefield. ISBN 978-0-8304-1582-3.
6. ^ Reisner, Ann; Walter, Gerry (1994-09-01). "Journalists' views of advertiser pressures on agricultural news". Journal of Agricultural and Environmental Ethics. 7 (2): 157–172. doi:10.1007/BF02349035. ISSN 1573-322X.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

Poultry Production & Management

Course Code: MMB-305d **Credit Units: 03**

Course Outcomes:

- Students will be able to know about the importance and contribution of poultry in meat sector in India as well as whole world.
- Students will be able to recognized different characteristics Indian and foreign breeds of chicken.
- Student will be able to learn different aspects of poultry such as its management of chicks, broiler and layer, their feeding and water requirement and feed manufacturing.
- Student will be able to learn about various environmental conditions and different equipment used to maintain those conditions.
- Student will get information related to housing requirement of poultry such as floor space, different housing system their advantages and disadvantages.
- Student will be able to know about various disease and vaccination which are used for poultry at different stage of their life.

Detail of the course:

Unit 1 Indian poultry Industry

Importance of poultry farming and poultry development in India. Present status and future prospectus of poultry Industry.Classification of poultry based on genetics Utility

Unit -2 Scientific Poultry Keeping

Modern breeds of Chicken. Present day egg production lines- meat production lines. Mini breeds- dwarfism in mini-Leghorns

Unit-3 Diversified Poultry

Ducks and Geese-classification- rearing system-classification-advantage. Guinea fouls - guinea fowl farming in India-Production-varieties. Emu-rearing- Economical aspects-commercial products

Unit-4 Desi Chickens:

Indigenous breeds and economical aspects of desi chicken. Indigenous breeds-Aseel-Chittagong-Kadaknath-Bursa.Improved varieties in IndiaGiriraja-Vanaraja-Girirani-Kalinga brown, Gramapriya,Swarnandhra

Unit -5 Breeds from Central Avian Research Institute – Izatnagar

CARI Nirbheek - CARI- Shyama-HITCARI (Naked Neck Cross).CARI- Priya Layer, CARI- Sonali Layer,

CARIBRO-VISHAL, CARI-RAINBRO, Nandanam chicken-I, Nandanam Chicken-II, Nandanm-Quail

Suggested books:

1. Text Book of Poultry Science, P V Sreenivasaiah, Write and Print Publications, ISBN No. 9788192970592, 8192970590
2. Poultry Science Practices, Nilothpal Ghosh, CBS Publication & Distributions, 2015
3. Principles of Poultry Science, 1996, CAB Publishers, ISBN 9780851991221
4. A Text Book of Animal Husbandry, C. C. Banerjee, Oxford and IBH, Publish Co, ISBN: 9788120412606

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Semester III

Seminar & Research Orientation III

Course Code: SM-301 **Credit Units: 02**

Course Outcomes:

- Describe the measurable skills, abilities, knowledge or values.
- Students should be able to demonstrate as a result of a completing a course.
- They are student-centered rather than teacher-centered.
- They describe what the students will do, not what the instructor will teach.

Detail of the course

Research methods: Lectures, seminars, and practical exercises that cover themes like what constitutes scientific knowledge
Research problems: How to identify and work through research problems
Primary and secondary sources: How to become familiar with sources and critique them, and how to research secondary sources
Research databases: How to use research database tools
Research proposals: How to prepare preliminary interdisciplinary research proposals

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

Research Methodology III

Course Code: SM-301a **Credit Units: 02**

Course Outcomes:

- Students who complete this course will be able to understand and comprehend the basics in research methodology
- And applying them in research/ project work.
- This course will help them to select an appropriate research design.

Detail of the course:

Unit I : Foundations of Research:

Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance.

Unit II : Research Design:

Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches.

Unit III : Measurement:

Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size.

Unit IV : Data Analysis:

Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association. Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism. 9. Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline.

Unit V: Use of tools / techniques for Research:

methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism

Suggested Books :

7. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
8. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
9. Research Methodology – C.R.Kothari 4. Select references from the Internet

Course Code: GP-301 **Credit Units: 02**

Pre-requisite: Basic information of English Language

Course Outcome:

- Effective communication: The ability to exchange ideas and information in a way that builds trust and respect
- Critical and analytical thinking: The ability to explore issues and ideas before forming a conclusion
- Integrative thinking: The ability to synthesize knowledge across different domains and perspectives
- Preparing students to be engaged citizens: Preparing students to participate in political culture and thrive in a rapidly evolving world

Details of the Course:-

General language proficiency is the ability to read, write, listen, and speak in real-life situations. To test this, a test is usually developed for each skill with questions that are designed to imitate real life.
A syllabus is a guide to a course that includes course policies, rules, regulations, required texts, and a schedule of assignments and seminar.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

Enterprenuership Development and Business Communication III

Course Code: GP-301a **Credit Units: 02**

Pre-requisite: Basic information of Enterprenuership Development

Course Outcome:

- To familiarize the students, and make them understand with key concepts and processes in entrepreneurship and business communication.
- To provide context to the processes in the form of differences between small and large firms, and the economic environment.
- To introduce key debates around entrepreneurship and small businesses.
- To impart knowledge on different extension methods and approaches used for transfer of agricultural technology.
- To impart skills required for entrepreneurship development among the students for self-employment.

Details of the Course:-

Unit-I

Concept ofEntrepreneur, Entrepreneurship Development, Characteristics of entrepreneurs;

SWOT Analysis & achievement motivation, Government policy, and programs & institutions for entrepreneurship development.

Unit-II

Impact of economic reforms on Agribusiness/Agri-enterprises, Entrepreneurial Development Process.

Unit-III

Business Leadership Skills; developing organizational skills (controlling, supervising, problem-solving, monitoring & evaluation**).**

Unit-IV

Developing Managerial skills, Business Leadership Skills (Communication, direction, and motivation skills), Problem-solving skills

Unit-V

Supply chain management & Total quality management, Project Planning Formulation & report preparation; Financing of enterprise, Opportunities for agri-entrepreneurship & rural enterprise.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

Human Values and Moral Ethics III

Course Code: GP-301b **Credit Units: 02**

Course Outcome:

- Understanding life's purpose: Students become aware of their life's mission, vision, and goals.
- Developing virtues: Students learn to cultivate virtues and avoid vices.
- Understanding ethical personalities: Students learn to understand the metaphors of ethical personalities from various domains.
- Developing a positive outlook: Students develop a personality that allows them to view life in a positive way.
- Building strong relationships:

Unit I : Morals, values, and ethics:

This unit may cover topics such as integrity, work ethic, service learning, civic virtue, respect for others, living peacefully, caring, sharing, honesty, courage, valuing time, cooperation, commitment, empathy, self-confidence, character, and spirituality

Unit II : Engineering ethics:

This unit may cover topics such as the senses of engineering ethics, moral issues, types of inquiry, moral dilemmas, moral autonomy, models of professional roles, engineering as experimentation, research ethics, codes of ethics, industrial standards, and a balanced outlook on law

Unit III : Engineering ethics:

This unit may cover topics such as the senses of engineering ethics, moral issues, types of inquiry, moral dilemmas, moral autonomy, models of professional roles, engineering as experimentation, research ethics, codes of ethics, industrial standards, and a balanced outlook on law

Unit IV :Peer pressure, alcoholism, and drug abuse:

This unit may cover topics such as ethical values, causes, impact, laws, prevention, and the ill effects of smoking

Unit V : Global issues:

This unit may cover global issues
Indian and global case studies: This unit may cover Indian and global case studies

SEMESTER III

Life Management III

Course Code: GP-301c **Credit Units: 02**

- Goal setting: How to set SMART goals that are specific, measurable, achievable, realistic, and have a time frame.
- Prioritization: How to prioritize tasks and effectively manage time.
- Stress management: How to manage stress and improve work-life balance.
- Organization: How to organize work and use organization tools.

Delegation: How to delegate tasks and as

SEMESTER III

Microbial Genetics Lab

Course Code: MMB-351 **Credit Units: 02**

Pre-requisite: Basic information of Microbial Genetics.

Course Outcome:

After completion of the course the students will be able to

- Learn about principle and working of laboratory instruments.
- Acquire a comprehensive knowledge on techniques followed in study of genetic mutation.
- Become familiar with technical requirements, concepts and general procedures in molecular biology and implement the knowledge in research work.
- Learn and implement different strategies to isolate genomic and plasmid DNA from cells.
- Learn the methods of DNA transformation, transduction and conjugation for future recombinant techniques.

Details of the Course:-

Note: A college must offer 70%of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available.

S. NO.	CONTENTS	CONTACT HOURS
1	Inactivation of microorganisms by different mutagens.	3
2	Production, isolation and characterization of mutants.	3
3	Determination of mutation rate.	3
4	Isolation, characterization and curing of plasmids.	3
5	Preparation of competent cells.	3
6	Transformation of *E.coli* using plasmid DNA.	3
7	Demonstration of genetic recombination in bacteria by conjugation.	3
8	To isolate total RNA and mRNA from bacteria.	3
9	To isolate and produce UV induced auxotrophic mutants by replica plating method.	3

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
	Reference Books	
1	Snyder L. and Chapness W. Molecular Genetics of Bacteria 2007.	2007
2	Birge EA. 1981. Bacterial and Bacteriophage Genetics. Springer Verlag.	1981
3	Maloy A & Friedfelder D. 1994. Microbial Genetics. Narosa.	1994

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER III

Medical Microbiology Lab

Course Code: MMB-352 **Credit Units: 02**

Pre-requisite: Basic information of Medical Microbiology.

Course Outcome:

Upon successful completion of this course the student will be able to:

- This course provides learning opportunities in the basic principles of medical microbiology and infectious disease.
- The course provides the conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause disease in the human body.
- It also provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.
- To understand the importance of pathogenic bacteria in human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue.

Details of the Course:-

S. No.	Contents	Contact Hours
1	Preparation and sterilization of different culture media (e.g. Blood agar, chocolate agar, nutrient agar, nutrient broth, McConkey agar).	3
2	To obtain pure cultures from the given microbial culture by streak plating and spread' plating techniques.	3
3	To carry out different Gram staining of the given bacterial culture.	3
4	To demonstrate motility in the given bacterial culture using the Hanging Drop method.	6
5	To carry out Zeihl-Nelson staining to detect acid fast bacteria in the given sputum sample.	3
6	To determine the antibiotic sensitivity profile of the given microbial culture using Kirby-Bauer method.	6
7	To carry out the following biochemical tests: Catalase test, Urease test, Indole test, Methyl red test, Voges-Prauskauer test, Citrate test, Lysine iron agar, Triple sugar iron, Sugar fermentation tests (glucose, maltose, sucrose).	6
8	To prepare temporary mounts from cultures/clinical specimens and observe permanent slides of the following: *Rhizopus, Mucor, Aspergillus fumigates, Aspergillus flavus, Candida albicans, Blastomyces dermatidis, Penicillium marneffei, Nocardia, Histoplasma capsulatum*	3

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Ananthanarayan R. and Paniker C.K.J. Textbook of Microbiology. 8th edition, University Press Publication	2009
2.	Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. Jawetz, Melnick and Adelberg‟s Medical Microbiology. 26th edition. McGraw Hill Publication	2013
3.	Goering R., Dockrell H., Zuckerman M. and Wakelin D. Mims‟ Medical Microbiology. 4th edition. Elsevier	2007
4.	Willey JM, Sherwood LM, and Woolverton CJ. Prescott, Harley and Klein‟s Microbiology.9th edition. McGraw Hill Higher Education	2013

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER III

Bioinformatics Lab

Course Code: MMB-353 **Credit Units: 02**

Pre-requisite: Basic Knowledge of computer application.

Course Outcome:

- Students will be able to understand basics of internet and computers along with information on various databases.
- Students will be able to understand application of bioinformatics in biotechnology.
- Students will be able to understand sequence alignment and various algorithms for it.
- Students will be able to understand and interpret sequence annotation and its retrieval.
- The information about various biologically important databases will be made available to students.

Details of the Course:-

Note: A college must offer 70% of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available.

S. NO.	CONTENTS	CONTACT HOURS
1	Introduction to various databases of proteins, nucleic acids. Primary, secondary and composite databases.	3
2	BLAST, FASTA, DOT PLOT.	3
3	MSA using various free tools.	3
4	Phylognetic predictions.	3
5	Prediction of structure of proteins and nucleic acids.	3
6	ORF prediction and its validation.	3
7	Primer designing.	3
8	Restriction mapping.	3
9	Epitope prediction using various online tools.	3
10	Data mining tool and its practical applications in a case study.	3

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text/Reference Books	
1.	Bioinformatics: Principles and Applications.Ghosh Z. and Bibekanand M., OxfordUniversity Press, 2008.	2015
2.	Genome analysis and bioinformatics: a practical approach. T.R. Sharma, I.K.International Publishing House Pvt. Ltd., 2009.	2009
3.	Bioinformatics and Functional Genomics, Pevsner J. II Edition, Wiley-Blackwell, (2009).	2015
4.	Discovering Genomics, Proteomics and Bioinformatics, Campbell A. M., Heyer L. J.,II Edition. Benjamin Cummings, 2006.	2006
5.	Bioinformatics: A practical guide to analysis of genes and proteins, Andreas D. Baxevanis, Wiley Student edition,	2006
6.	Bioinformatics, Sequence and genome analysis by David W. Mount, Second Edition, CSHL Press, 2004	2004

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER IV

Project/Dissertation

Course Code: MMB-401 **Credit Units: 16**

Course Contents:

- Six Months of Fourth Semester of the M.Sc. Curriculum is devoted to project/dissertation.
- Students, with the help of their mentor and faculty colleagues will identify a lab in India & abroad for the research work.
- The student should stay for a minimum prescribed Semester period at the place of work.
- Students not staying for the prescribed period will be marked absent as per the University Rules.
- At the end of their project the students shall submit the dissertation as per the Guidelines prescribed below.

The Aims of the Project

The aim of the project is to provide the students with an opportunity to further their intellectual and personal development in the chosen field by undertaking a significant practical unit of activity, having an educational value at a level commensurate with the award a M.Sc. Degree.

Objectives

- To provide the students an opportunity to demonstrate the ability to devise, select and use a range of methodologies appropriate to the chosen topic of research.
- To allow students to show the application of skills of data collection, critical analysis and concept synthesis necessary for formation of defensible conclusions and/or recommendations.
- To allow students the opportunity to demonstrate ability to draw appropriate conclusions argued from the evidence presented. [Should the research produce negative or inconclusive results, the conclusions should be critically examined to ascertain the reasons].
- To provide a forum to demonstrate the skills of structuring and present a balanced informed, complete, clear and concise written argument.

Dissertation Guidelines

The Dissertation Topic

It is important to distinguish here between „dissertation topic" and „dissertation title". The topic is the specific area that you wish to investigate. The title may not be decided until the dissertation has been written so as to reflect its content properly.

Few restrictions are placed on the choice of the topic. Normally the topic is expected to be:

• Relevant to Microbiology;

• related to one or more of the subjects or areas of study within the core program and specialisation stream;

• clearly focused so as to facilitate an in-depth approach, subject to the availability of adequate sources of information and to the knowledge of students;

• Value and interest to the students and their personal and professional development.

Dissertation format

All students must follow the following rules in submitting their dissertation.

• Front page should provide title, name of the student, name of degree and the date of submission.

• Second page should contain the certificate received from the organization/University from where the student has completed his/her project work.

• The next page should be the table of contents giving page references for each chapter and section.

• The next page should be the table of graphs, figures and tables giving legends and page numbers.

• Next to follow should be following in the sequence given below:

• Abbreviations used (if any)

• Introduction

• State-of-Art

• Material & Methods

• Results

• Discussion

• Summary (approximately 500 words)

• Conclusion

• Future Prospects

• References: After this concluding chapter, students should give a list of all the references they have used. These should be cross - references with the text. For articles from journals, the following details are required e.g.

Schloter M, Assmus B and Hartmann A (1995) the use of immunological methods to detect and identify bacteria in the environment. Biotech Adv 13: 75-90

For books, the following details are required

Bahera BK and Varma A (2003) Green Energy from Waste Biomass, Capital Book Company, New Delhi, India

For book chapter

Mukherji KG, Mandeep and Varma A (1998) Mycorrhizosphere microorganisms: screening and evaluation. (Ed) Varma A. In: Mycorrhiza Manual. Springer-Verlag, Germany, pp 85-97

• Finally, you should give any appendices. These should only include relevant statistical data or material that cannot be fitted into the above categories.

• List of Publications (if any) by the students should be attached in the end.

Guidelines for the assessment of the dissertation

While evaluating the dissertation, faculty guide will consider the following aspects:

1. Has the student made a clear statement of the objective or objective(s).
2. If there is more than one objective, do these constitute parts of a whole?
3. Has the student developed an appropriate analytical framework for addressing the problem at hand.
4. Is this based on up-to-date developments in the topic area?
5. Has the student collected information / data suitable to the frameworks?
6. Are the materials & methods employed by the student to analyse the data / information appropriate and relevant?
7. Has the student succeeded in drawing conclusion form the analysis?
8. Do the conclusions relate well to the objectives of the project?

Examination Scheme:

Components	Theme of Project	Quality of Project
Weightage (%)	30	70

Shobhit University, Gangoh

(Established by UP Shobhit University Act No. 3, 2012)

School of Biological Engineering and Sciences

Ordinances, Regulations & Syllabus

For

Bachelor of Science (B.Sc.) Three Year Programme

Semester Pattern
(w.e.f. session 2017-18)

Revised and approved in the year 2020 (13th meeting of Board of Studies)

(Scheme & syllabus from 2020-2024)

PEOs: Program Educational Objectives POs: Program Outcomes PSOs: Program Specific Outcomes

Name of the Department: Department of Microbiology

Name of the Program: B.Sc. Microbiology

Duration of the degree: 3 Years

Microbiology programme endeavors to instill in students the skills to identify individual microbial species, use aseptic techniques to grow them in pure culture, safely handle and examine them by microbiological methods. The knowledge of microbiology will enable the students to improve the quality of human lives in relation to environment, fighting disease and to exploit microbes in the production of food. Microbiology plays a key role in genetic engineering and other modern biotechnologies such as antibiotic production and the exploitation of new sources of food and energy. The regimens for this program are specifically designed to allow students to fulfill below program educational objectives:

Program Educational Objectives (PEOs)

PEO 1: The graduates will learn the importance of microorganisms in environment, brewing, food processing and preservation, pharmaceuticals and biotechnology industries.

PEO 2: The graduates will be provided with understanding of healthcare systems especially in pathological, immunological and environmental monitoring laboratories.

PEO 3: The graduates will demonstrate the skills necessary to understand and apply scientific concepts and reasoning, including the analysis and interpretation of various types of data.

Program Specific Outcomes (PSOs)

Students who graduate with a Bachelor of Science in Microbiology will

PSO 1: Acquire knowledge on fundamentals of Microbiology.

PSO 2: Understand details of bacterial, fungal, algal and viral morphology and physiology.

PSO 3: Competently be able to cultivate and characterize bacterial and fungal forms.

PSO 4: Grasp the fundamental concepts of immunity and the contribution of organs and cells in the development of immune response.

PSO 5: Gain insight into the various aspects of microbial genetics.

PSO 6: Be proficient on cloning vectors and rDNA technology.

PSO 7: Assimilate technical skills on microbial genetics and molecular biology.

PSO 8: Realize the application oriented aspects of Microbiology.

PSO 9: Understand the concepts and development of microbial diseases in animals & plants.

PSO 10: Realize the principles of prevention and treatment of microbial diseases.

Program Outcomes Objectives (POOs)

Upon completion of B.Sc. Microbiology programme, the students will be able to:

POO 1: demonstrate advanced knowledge and understand the central facts and concepts of microbiology.

POO 2: acquire knowledge and understanding of organism biology and genetics, evolution, molecular biology and basic biological chemistry.

POO 3: instill the intellectual skills to analyze and solve biology-related problem, formulate and test hypothesis using experimental design.

POO 4: demonstrate an understanding of professional ethics in science and of the principles that can guide ethical decision-making in biological controversies.

POO 5: explore the scientific literature effectively and use computational tools.

POO 6: communicate ideas and principles effectively through oral presentations, computer based tools and writtn reports.

POO 7: manage resources, time and work independently as well as in multi-disciplinary team towards a common goal/outcome.

Course Components of Academic Programme

B.Sc. (Microbiology)

Minimum Duration : 6 Semesters (3 Years)

Maximum Duration : 8 Semesters (4 Years)

Total Number of Credits : 149 Credits

Course Components		Credits
1.	**Compulsory Course**	
I.	Foundation Course (FC)	00
II.	Core Course (CC)	86
2.	**Elective Course**	
I.	Departmental Electives (GE, DE)	34
II.	Interdepartmental Electives (IE)	04
3.	**Discipline-Centric Ability Enhancement Course**	
I.	Seminar (SM)	05
II.	Project (PJ)/ Dissertation (DS)	06
III.	Skill (SEC) and Ability Enhancement Course (AEC)	08
IV.	Comprehensive (CM)	00
4.	**General Course**	
I.	Human Values, Health Care and Professional Ethics (HP)	00
II.	Healthy Living and Fitness (HF)	00
III.	Disaster Management (DM)	00
IV.	General Proficiency (GP)	06
5.	**Audit Course**	

Requirement of Awards of Degree: - Total Credits: - 149; CGPA>=4.5 and any other conditions as per regulation and ordinances.

Summary Sheet B.Sc.

(Microbiology)

Semester	Credit				Total
	CC	DCAEC (AEC/SK/SM/PJ)	DE/IE	GC	
I	12	03	08	01	24
II	12	03	06	01	22
III	18	03	04	01	26
IV	18	03	04	01	26
V	20	01	04	01	26
VI	06	06	12	01	25
Total	**86**	**19**	**38**	**06**	**149**

Core Courses: CC
Discipline-Centric Ability Enhancement Course: DCAEC Ability Enhancement Course: AEC
Skill Course: SEC Departmental
Electives: DE General Course: GC
Interdepartmental Electives: IE

B.Sc. (Microbiology)
PROGRAMME STRUCTURE

FIRST SEMESTER

Course Code	Course Title	Component	(L)	(T)	(P)	Credits
BMB-101 / **BMB-101 a/ BMB-101 b**	Cell Biology/ Introductory Biology /Fundamentals of Biology	CC	3	1	0	4
BMB-102	Inorganic & Physical Chemistry	CC	3	1	0	4
BMB-103	Computer Fundamentals	GE	2	0	0	2
BMB-104	Ecology & Environment Management	GE	3	1	0	4
PC-101/ **PC-101 a/ PC-101 b**	Professional Communication/ Personality Development/Personal Grooming	AEC	2	0	0	2
BMB-151	Cell Biology Lab	CC	0	0	2	2
BMB-152	Inorganic & Physical Chemistry Lab	CC	0	0	2	2
BMB-153	Computer Fundamentals Lab	GE	0	0	2	2
SM-101/ **SM-101 a**	Seminar/Ethics of Research	SM	0	0	1	1
GP-101 / **GP-101 a/ GP-101 b**	General Proficiency-I/ Physical Education & Yoga/Health & Nutrition	GP	0	0	1	1
	TOTAL					**24**

SECOND SEMESTER

Course Code	Course Title	Component	(L)	(T)	(P)	Credits
BMB-201/ **BMB-201 a/ BMB-201 b**	Organic & Analytical Chemistry/Observational Chemistry/Basic & Applied Chemistry	CC	3	1	0	4
BMB-202 / **BMB-202 a/ BMB-202 b/ BMB-202 c**	Elements of Biochemistry/ Fundamentals of Biochemistry/Introductory Human Physiology/Chemicals and Health	CC	3	1	0	4
BMB-203 / **BMB-203 a/ BMB-203 b/ BMB-203 c**	Introduction to General Microbiology/ Elements of Microbiology/Chemical Microbiology/Microbial Technology	GE	3	1	0	4
BMB-204 / **BMB-204 a**	Career Skills/ Life Skills	AEC	2	0	0	2
BMB-251	Organic & Analytical Chemistry Lab	CC	0	0	2	2
BMB-252	Elements of Biochemistry Lab	CC	0	0	2	2
BMB-253	Introduction to General Microbiology Lab	GE	0	0	2	2
SM-201	Seminar	SM	0	0	1	1
GP-201	General Proficiency-II	GP	0	0	1	1
	TOTAL					**22**

THIRD SEMESTER

Course Code	Course Title	Component	(L)	(T)	(P)	Credits
BMB-301/ **BMB-301a/ BMB-301b/ BMB-301c**	Microbial Genetics/Inheritance & Evolutionary Microbiology/Microbiological Basis of Inheritance/Food Engineering	CC	3	1	0	4
BMB-302/ **BMB-302a**	Bacteriology & Virology/Global Ecology	CC	3	1	0	4
BMB-303/ **BMB-303a**	Mycology & Phycology/Public health & pandemics	CC	3	1	0	4
BMB-304	Biofertilizers and Biopesticide	SEC	2	0	0	2
BMB-305/ **BMB-305a**	Biomathematics and Biostatistics/Elementary Mathematics	GE	3	1	0	4
BMB-351	Microbial Genetics Lab	CC	0	0	2	2
BMB-352	Bacteriology & Virology Lab	CC	0	0	2	2
BMB-353	Mycology & Phycology Lab	CC	0	0	2	2
SM-301	Seminar	SM	0	0	1	1
GP-301/ **GP-301a/ GP-301b**	General Proficiency-III/Psychology/Sociology	GP	0	0	1	1
	TOTAL					**26**

FOURTH SEMESTER

Course Code	Course Title	Component	(L)	(T)	(P)	Credits
BMB-401 / **BMB-401a/ BMB-401b/ BMB-401c**	Molecular Biology/Economic Biology/Gender Studies/International Business in Dairy Science	CC	3	1	0	4
BMB-402/ **BMB-402a BMB-402b/ BMB-402c/ BMB-402d**	Immunology/Anthropology/Neurobiology/Nanotechnology/Aerobiology	CC	3	1	0	4
BMB-403/ **BMB-403a BMB-403b**	Microbial Physiology & Metabolism/Entomology /Agrostology	CC	3	1	0	4
BMB-404/ **BMB-404a/ BMB-404b**	Pharmaceutical Microbiology/Medicinal Microbiology/Epidemiology	SEC	2	0	0	2
BMB-405 / **BMB-405 a**	I.P.R., Bioethics & Biosafety/ Biogeography	IE	3	1	0	4
BMB-451	Molecular Biology Lab	CC	0	0	2	2
BMB-452	Immunology Lab	CC	0	0	2	2
BMB-453	Microbial Physiology & Metabolism Lab	CC	0	0	2	2
SM-401	Seminar/	SM	0	0	1	1
GP-401/ **GP-401a**	General Proficiency-IV/Animal Behavior	GP	0	0	1	1
	TOTAL					**26**

FIFTH SEMESTER

Course Code	Course Title	Component	(L)	(T)	(P)	Credits
BMB-501 / **BMB-501 a**	Medical Microbiology/ Medicinal Microbiology	CC	3	1	0	4
BMB-502 / **BMB-502 a**	Recombinant DNA Technology/ Microbial Technology	CC	3	1	0	4
BMB-503 **BMB-503a**	Bio-Analytical Tools/Instrumentation	CC	3	1	0	4
BMB-504 / **BMB-504 a**	Food and Dairy Microbiology/ Palaentology	DE	3	1	0	4
BMB-551	Medical Microbiology Lab	CC	0	0	2	2
BMB-552	Recombinant DNA Technology Lab	CC	0	0	2	2
BMB-553	Bio-Analytical Tools Lab	CC	0	0	2	2
BMB-554	Food and Dairy Microbiology Lab	CC	0	0	2	2
SM-501	Seminar	SM	0	0	1	1
GP-501	General Proficiency-V	GP	0	0	1	1
	TOTAL					**26**

SIXTH SEMESTER

Course Code	Course Title	Component	(L)	(T)	(P)	Credits

BMB-601/ **BMB-601 a/ BMB-601 b**	Microbiological Analysis of Air and Water/Hospital Management/Soil & Water Microbiology	DE	3	1	0	4
BMB-602/ **BMB-602 a BMB-602 b**	Marine Microbiology/Veterinary Science/Biodiversity	CC	3	1	0	4
BMB-603/ **BMB-603a/ BMB-603b**	Bioinformatics/Developmental biology and embryology/Population biology	DE	3	1	0	4
BMB-651	Microbiological Analysis of Air and Water Lab	DE	0	0	2	2
BMB-652	Marine Microbiology Lab	CC	0	0	2	2
BMB-653	Bioinformatics Lab	DE	0	0	2	2
BMB-604	Project/Dissertation	PJ	0	0	6	6
GP-601	General Proficiency-VI	GP	0	0	1	1
	TOTAL					**25**

Project/Dissertation

Note: Students must submit their project report in June /July and the same would be evaluated for 6 credit units, which would be included in the Sixth Semester marks.

Examination Scheme:

Components	**Attendance**	**Class Test**	**Assignment/ Project/Seminar/Quiz**	**EE**
Weightage (%)	10	20	10	60

SEMESTER I

Cell Biology

Course Code: BMB-101 **Credit Units: 04**

Pre-requisite: Basic information of Cell Biology

Course Outcome:

- Basic chemical composition of living matter.
- Structural characteristics of prokaryotic and eukaryotic cells.
- Taxonomy and characteristics of the major kingdoms.
- Mechanics of membrane transport.
- Basic concepts of bioenergetics, photosynthesis, and cellular respiration.
- Mechanics of cellular reproduction.
- Mendelian genetics and genetic change.
- Nucleic acids and basic concepts of protein synthesis and gene regulation.

Details of the Course:-

UNIT I: Cell:

Introduction and classification of organisms by cell structure, cytosol, Compartmentalization of eukaryotic cells, cell fractionation Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model

UNIT II: Cell Membrane and Permeability:

Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport. Sex-limited and sex-influenced inheritance, Transposons. Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments

UNIT III: Endoplasmic reticulum:

Endoplasmic reticulum: Structure, function including role in protein segregation.
Golgi complex: Structure, biogenesis and functions including role in protein secretion.
Lysosomes: Vacuoles and micro bodies: Structure and functions Ribosomes: Structures and function including role in protein synthesis.

UNIT IV: Mitochondria:

Structure and function, Genomes, biogenesis. Chloroplasts: Structure and function, genomes, biogenesis. Nucleus: Structure and function, chromosomes and their structure. Extracellular Matrix: Composition, molecules that mediate cell adhesion

UNIT V: Membrane receptors:

For extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction. Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Molecular Biology of cell, 4th ed. Alberts, Bruce (et.*al) (2002)* Garland Science Publishing, New York.	2002
2.	Cell Biology- Smith and Wood by Chapman and Hall. Cell Biology: Organelle structure and function, Sadava, D E. (2004) Panima pub., New Delhi. Cell and Molecular Biology, 8th ed. Robertis, Edp De and Robertis Emf De (2002) Lippincott Williams and Wilkins Pvt. Ltd., (International Student Edition) Philadelphia.	2004, 2002

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

Introductory Biology

Course Code: BMB-101a **Credit Units: 04**

Course Objectives:

- To introduce students to the fundamental concepts of biology.
- To provide an understanding of the structure and function of cells and organisms.
- To explore the principles of genetics, evolution, ecology, and diversity of life.
- To develop an appreciation for the role of biology in everyday life and its applications in health, medicine, and environmental science.

Unit 1: Introduction to Biology and the Scientific Method

- Definition and scope of Biology
- Branches of Biology: Molecular Biology, Genetics, Ecology, Evolution, and Physiology
- The scientific method: Observations, Hypothesis, Experimentation, Data analysis, and Conclusion
- Basic laboratory techniques and safety measures

Unit 2: Cell Biology

- Structure of cells: Prokaryotic vs. Eukaryotic
- Functions of cellular components (e.g., nucleus, mitochondria, ribosomes, endoplasmic reticulum, Golgi apparatus)
- The Plasma Membrane: Structure and function
- Cellular processes: Diffusion, osmosis, active transport
- Cell division: Mitosis and Meiosis

Unit 3: Biochemistry and Biomolecules

- Atoms and molecules: Elements, compounds, and chemical bonds
- Water and its properties
- Major biological molecules: Carbohydrates, proteins, lipids, nucleic acids
- Enzyme structure and function
- Metabolism: Cellular respiration and photosynthesis

Unit 4: Genetics

- Mendelian genetics: Laws of inheritance, dominant and recessive traits
- DNA structure and function
- Gene expression: Transcription and translation
- Genetic variation: Mutations and genetic recombination
- Principles of heredity and modern genetics

Unit 5: Evolution and Natural Selection

- The theory of evolution: Charles Darwin's contribution
- Mechanisms of evolution: Natural selection, genetic drift, gene flow, mutation
- Evidence for evolution: Fossils, comparative anatomy, molecular biology
- Speciation and adaptation

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Molecular Biology of cell, 4th ed. Alberts, Bruce (et.*al) (2002)* Garland Science Publishing, New York.	2002
2.	Cell Biology- Smith and Wood by Chapman and Hall. Cell Biology: Organelle structure and function, Sadava, D E. (2004) Panima pub., New Delhi. Cell and Molecular Biology, 8th ed. Robertis, Edp De and Robertis Emf De (2002) Lippincott Williams and Wilkins Pvt. Ltd., (International Student Edition) Philadelphia.	2004, 2002

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Fundamentals of Biology

Course Code: BMB-101b **Credit Units: 04**

Course Objectives:

- To provide students with a basic understanding of biological principles.
- To explore the structure and function of living organisms at the molecular, cellular, and systemic levels.
- To introduce fundamental concepts in genetics, evolution, ecology, and human biology.
- To foster scientific inquiry and an appreciation for the relevance of biology in daily life, health, and the environment.

Unit 1: Introduction to Biology and the Scientific Method

- Overview of biology and its branches (molecular biology, genetics, ecology, physiology, etc.)
- The role of biology in understanding life and solving global challenges.
- The scientific method: Observation, hypothesis formation, experimentation, and data analysis.
- Laboratory safety and basic laboratory techniques.

Unit 2: Basic Biochemistry

- Elements of life: Atoms, molecules, and chemical bonds.
- Water properties and importance in biological systems.
- Macromolecules: Carbohydrates, proteins, lipids, and nucleic acids.
- Enzymes: Structure, function, and their role in metabolism.

Unit 3: Cell Structure and Function

- The cell theory: All living organisms are made up of cells.
- Prokaryotic vs. Eukaryotic cells.
- Organelles and their functions: Nucleus, mitochondria, ribosomes, endoplasmic reticulum, Golgi apparatus.
- The plasma membrane: Structure and function.
- Cellular transport: Diffusion, osmosis, active transport.

Unit 4: Cell Division and Genetics

- Mitosis: Stages of cell division, significance, and regulation.
- Meiosis: Differences between meiosis and mitosis, genetic diversity.
- Basics of inheritance: Mendel's Laws, dominant and recessive traits.
- DNA structure and function: The double helix, replication, and transcription.
- Gene expression: Transcription and translation processes.

Unit 5: Evolutionary Biology

- The theory of evolution by natural selection (Charles Darwin).
- Evidence supporting evolution: Fossil records, comparative anatomy, molecular biology.
- Adaptation and survival in changing environments.
- The concept of speciation and evolutionary processes.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Molecular Biology of cell, 4th ed. Alberts, Bruce (et.*al) (2002)* Garland Science Publishing, New York.	2002
2.	Cell Biology- Smith and Wood by Chapman and Hall. Cell Biology: Organelle structure and function, Sadava, D E. (2004) Panima pub., New Delhi. Cell and Molecular Biology, 8th ed. Robertis, Edp De and Robertis Emf De (2002) Lippincott Williams and Wilkins Pvt. Ltd., (International Student Edition) Philadelphia.	2004, 2002

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

Inorganic & Physical Chemistry

Course Code: BMB-102 **Credit Units: 04**

Pre-requisite: Basic information of Chemistry

Course Outcome:

- Understand periodic properties and its application in the characterization of chemical compounds
- Understand the various properties of materials depending upon bond formation.
- Utilize the concept of hardness in the purification of water for industrial and domestic purpose
- Distinguish the rate laws and application to different chemical reaction mechanism
- Learn and apply the concepts of analytical chemistry for sample analysis by chemical methods
- Learn the basic concepts of Chemistry and its application in different fields

Details of the Course:-

UNIT I: Periodic Properties:

Position of elements in the periodic table, effective nuclear charge, atomic and ionic radii, ionization energy, electron affinity and electronegativity definition, methods of determination, trends in periodic table and applications in predicting and explaining the chemical behavior.

UNIT II: Atomic and Molecular Structure:

VSPER theory and its application for structure of NH_3, NH_4^+, H_2O, H_3O^+, SO_2 and XeF_4 Molecular Orbital Theory, Formation of homo and heteronuclear diatomic molecules Hydrogen Bonding and its application
Metallic Bonding (Band theory); role of doping
Coordination compounds: Introduction, Werner‟s coordination theory, naming of compounds.

UNIT III: Water Chemistry:
Hardness of water and its measurement, Softening of water by L-S process, Zeolite process and Reverse osmosis process, Ion Exchange process, Calgon Process, Numerical problems based on L-S Process, Zeolite Process and hardness of water.

UNIT IV: Chemical Kinetics:

Ionic reactions and molecular reactions, Molecularity and Order of reactions, Integrated equations of 1st, 2nd and zero order reactions, Activation Energy and Activated complexes, numerical problems based upon them.

UNIT V: Analytical Chemistry:

Qualitative and Quantitative Chemistry, Volumetric and Gravimetric Analysis; Principles of Volumetric Analysis; Concept of pH, buffer, Henderson equation, Concept of strength and concentration of solution; Normality, Molarity, Molality and interconversion of strength Titration-Principles and Classification: Redox, Acid-Base, Complexometric, Redox and Precipitation, Oxidation Number and calculation of oxidation number in compounds.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	University Chemistry, B.H.Mahan	1987
2.	Chemistry, Principles and Application, M.J. Sienko and R.A. Plane	1980
	Reference Books	
1.	Inorganic Chemistry, J.D.Lee	2008
2.	Fundamentals of Analytical Chemistry, Skoog and West	2013
3.	Physical Chemistry, Atkins	2009

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

Computer Fundamentals

Course Code: BMB-103 **Credit Units: 02**

Pre-requisite: Basic knowledge of Computer application

Course Outcome:

A student who successfully fulfills the course requirements will be able to

- be able to define and appropriately use information technology terms;
- be able to identify computer hardware components and describe their function;
- be able to describe the essential elements of the computer's architecture and discuss how this architecture functions;
- be able to describe the characteristics and representations of data, and interpret and compare data in different representations;
- be able to identify and describe telecommunication components;
- be able to describe the characteristics of operating systems and compare different operating systems;
- be able to use a hypertext markup language to produce basic Web documents;
- be able to discuss the general trends in technologies including examples of leading edge developments;
- be able to compare the roles of different sectors of the information technology.

Details of the course: -

Unit I: Computer Basics:

Introduction, Characteristics of a Computer, Criteria for Using Computers, History of Computers, Generations of Computer, Classification of Computers, Applications of Computer, Basic Components of PC, Computer Architecture.

Unit II: Number Systems:

Introduction, Classification of Number System, Types of Number System, Conversions from One Base to Another, Conversion using Shortcut Method.

Unit III: Hardware and Software:

Introduction, Computer Memory, Secondary Memory, Computer Peripherals, Output Devices, Software requirements.
Windows XP: Introduction, Features, Comparison between Professional and Home edition, Windows XP installation, Activating Windows XP, Security features of Windows XP, Accessing User Accounts, and Getting Help.

Unit IV: MS Word:

Introduction, Windows 2007 Interface, Customizing the Word Application, Document Views, Basic Formatting in MS Word 2007, Advanced Formatting, Navigating through a Word Document, Performing a Mail Merge, A Quick Look at Macros, Printing Documents, Print Preview.
Excel 2007: Introduction, Workbook, Worksheet, Formatting in excel, Advanced formatting in Excel, Working with formulas, Printing worksheets.
MS PowerPoint: Introduction, Creating a Presentation, Basic Formatting in PowerPoint, Advanced Formatting, Using Templates, Inserting charts, Inserting tables, Printing presentations.

Unit V: Security and Networking:

Introduction, Simple Fine Sharing, Internet Information Services, Peer to Peer Networking

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Norton, Peter, "Introduction to Computers", McGraw-Hill.	2005
2	Rajaraman, V., "Fundamentals of Computers",PHI.	2005
3	PK SINHA "Computer Fundamentals", BPB	Fourth edition
4	Yashwant Kanetker, "Let us C",BPB.	2005

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

Ecology and Environment Management

Course Code: BMB-104 **Credit Units: 04**

Pre-requisite: Basic knowledge of Environmental science

Course Outcome:

- Students will be able to understand the importance of environment.
- Be able to explain the development of ecosystem, concept of biodiversity and energy and nutrient pathway.
- Students will be able to understand ecological sustainability, ecological efficiencies, homeostasis and limiting factors.
- Students will gain new insights about different remediation procedures.
- Students will be able to use critical thinking skills related to hazardous wastes, pesticides, metals, radiations etc. and its impact on health.
- Students will be able to apply the knowledge of scientific methods to solve environmental problems.

Details of the course:

UNIT-I:

Our Environment: Geological consideration of Atmosphere, Hydrosphere, Lithosphere. Basic concepts of Ecology: Development of Ecosystem, major divisions of ecology, Auto ecology of species, population structure and dynamics.

UNIT II:

Structure and function of ecosystem. Strata of an ecosystem. Energy transfer in an Ecosystem. Food chain, food web, Energy budget, Production & decomposition in a system. Ecological efficiencies.

UNIT III:

Trophic structure & ecological pyramids, Bio-geochemical cycles (N, C, and P cycles). Cybernetics & Homeostasis, Environmental monitoring and impact assessment.

UNIT-IV:

Radiation and chemical toxicology: Radiation ecology, chemical toxicants, ecotoxicology. Detection of Environmental pollutant. Indicators & detection systems.

UNIT-V:

Environmental biotechnologies, Biotechnologies in protection and preservation of environment- case studies. Bioremediation, Waste disposal.

Suggested Books:

1. P.D. Sharma. (2011). Ecology and Environment. 11th edition.
2. Rastogi Publication. Chapman, J.L., Reiss, M.J. 1999. Ecology: Principles and applications (2nd edition) Cambridge, University Press.
3. Divan Rosencraz, Environmental laws and policies in India, Oxford Publication.
4. Ghosh, S.K., Singh, R. 2003. Social forestry and forest management. Global Vision Publishing House.
5. Joseph, B., Environmental studies, Tata Mc Graw Hill.

Examination Scheme:

Components	**Internal Assessment**			**External Evaluation**
	Attendance	**Class Test**	**Assignment/ Project/Seminar/Quiz**	
Weightage (%)	10	20	10	60

SEMESTER I

Professional Communication

Course Code: PC-101 **Credit Units: 02**

Pre-requisite: Basic information of English Language & Communication

Course Outcome:

- Sharpen grammatical skills of the students, to facilitate easy choice of available options.
- Construct the vocabulary of the students to assist them acquire plethora of knowledge of foreign as well as indigenous languages.
- Demonstrating advanced relationship building skills through written communication.
- Exhibit competent writing that is reasonably proficient in correct grammar and sentence structure skills.
- Develop an understanding of effective nonverbal expressions, etiquette and interpersonal skills to instill confidence in students.
- Improve awareness regarding the factors at play when communicating with audience of diverse backgrounds in the global business environment.

Details of the Course:-

Unit I: Functional Grammar:

Parts of speech, Tenses, Voice.

Unit II: Basic Vocabulary Building:

List of commonly used conversational words. Indianism: Exposure to common words in Indian English and with natives of English. Pronunciation of some common words.

Unit-III: Written communication:

Application and Business letter, Memorandum & Report.

Unit-IV: Analytical Skills:

Para jumbles, Analogy

Unit V: Basic Presentation Skills

Role plays based on body language, Role plays based on dining, telephone and social etiquette.

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books/ Reference Books	
1.	Michael Swan" Practice English Usage", Oxford University press 3rd Edition	2006
2.	Chetananand Singh " English is Easy ,BSC Publishers 2ND Edition	2009

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

Personality Development

Course Code: PC-101a **Credit Units: 02**

Course Objectives:-

The **Course Objectives** for a **Personality Development program** are designed to focus on the specific skills and attributes that students will develop throughout the course. These objectives guide students toward becoming well-rounded individuals, enhancing their personal, professional, and social capabilities. Below are key course objectives for a Personality Development program:

Unit 1: Introduction to Personality Development

- **Definition of Personality**
  - Nature vs. Nurture in Personality Development
  - Key factors influencing personality: Genetics, Environment, Experience
- **Importance of Personality in Life**
  - How personality affects personal and professional life
  - Building self-confidence and self-esteem
  - Role of first impressions

Unit 2: Self-Awareness and Self-Improvement

- **Understanding Self-Awareness**
  - Self-assessment tools (e.g., SWOT Analysis)
  - Identifying strengths and weaknesses
- **Personal Reflection**
  - Journaling exercises for introspection
  - Identifying personal values and goals
- **Setting Personal Development Goals**
  - SMART Goals (Specific, Measurable, Achievable, Relevant, Time-bound)
  - Action plan and progress tracking

Unit 3: Communication Skills

- **Verbal Communication**
  - Art of speaking clearly and effectively
  - Expanding vocabulary and improving pronunciation
  - Public speaking and addressing an audience
  - Developing persuasive communication skills
- **Non-Verbal Communication**
  - Importance of body language, posture, gestures, and facial expressions
  - Eye contact and its significance

- Developing emotional intelligence through non-verbal cues
- **Active Listening**
  - Techniques for effective listening
  - Overcoming barriers to listening
  - Empathy in communication

Unit 4: Building Self-Confidence and Self-Esteem

- **Confidence vs. Arrogance**
  - Understanding the difference
  - Exercises to boost self-confidence (positive affirmations, body language)
- **Handling Criticism and Rejection**
  - Developing resilience and emotional strength
  - Managing failure and learning from mistakes
- **Public Speaking and Presentation Skills**
  - Overcoming the fear of public speaking
  - Structuring effective presentations
  - Engaging the audience through storytelling

Unit 5: Emotional Intelligence

- **Understanding Emotional Intelligence (EQ)**
  - The five components of EQ: Self-awareness, Self-regulation, Motivation, Empathy, Social skills
- **Managing Emotions**
  - Techniques for emotional regulation (e.g., mindfulness, stress management)
  - Overcoming negative emotions (anger, anxiety, frustration)
- **Empathy and Social Skills**
  - Building empathy for better relationships
  - Understanding and responding to the emotions of others

Unit 6: Interpersonal Skills and Relationships

- **Building Positive Relationships**
  - The importance of trust and respect in relationships
  - Effective conflict resolution techniques
  - The art of networking and making connections
- **Teamwork and Collaboration**
  - Working effectively in teams
  - Understanding different personalities and adapting
  - Leadership vs. followership
- **Etiquette and Manners**
  - Basic manners and social etiquette
  - Professional etiquette for workplace and business settings
  - Dining etiquette and cultural sensitivity

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER I

Personal Grooming

Course Code: PC-101b **Credit Units: 02**

- **Objective**: Students will develop the necessary soft skills for career success, including networking, personal branding, interview techniques, and the ability to handle workplace challenges. They will also learn how to balance professional ambitions with personal fulfillment.
- **Outcome**: Graduates will be **career-ready**, equipped with the skills and confidence needed to succeed in their chosen professions, achieve career advancement, and maintain a fulfilling life balance.

Unit 1: Introduction to Personal Grooming

- Definition of Personal Grooming and its Importance
- Self-Image and Confidence
- Building a Grooming Mindset: How Grooming Affects Perception
- Psychological Aspects of Grooming: How Grooming Impacts Social and Professional Interactions
- The Role of Personal Grooming in Career Success

Practical Activities:

- Self-assessment exercises: Evaluate current grooming habits.
- Reflection: How grooming influences personal and professional life.

Unit 2: Personal Hygiene and Self-Care

- Basic Hygiene: Skincare, Haircare, Nailcare

- Oral Hygiene and Breath Care
- The Importance of Regular Baths and Clean Clothing
- Choosing the Right Skincare Products for Different Skin Types
- The Role of Sleep, Exercise, and Nutrition in Grooming

Practical Activities:

- Personal hygiene routine practice
- Demonstration of proper skincare, hair care, and nail care routines
- Discussing and practicing good sleep habits and nutrition for skin health

Unit 3: Dress Code and Personal Styling

- Dress Code: Understanding Different Occasions (Casual, Business Casual, Formal)
- Dressing for Your Body Type: Clothing Styles that Suit Different Figures
- Color Theory: Understanding the Right Colors for You
- Choosing the Right Fabrics and Accessories
- The Importance of Fit: Tailoring and Alterations
- Professional Dressing: How to Dress for Interviews, Office, and Business Meetings
- Casual Grooming: Dressing for Social and Informal Events

Practical Activities:

- Wardrobe assessment and organizing clothing
- Creating and evaluating outfits for different occasions
- Personal styling sessions: Understanding how to mix and match
- Makeup and grooming for different occasions

Unit 4: Haircare and Hairstyles

- Haircare Basics: Types of Hair and the Right Products
- Understanding Haircuts and Hairstyles for Different Face Shapes
- Hair Coloring, Conditioning, and Styling Techniques
- The Role of Hair in Personal Grooming: Professional vs Casual Styles
- Daily Hair Care Routine: How to Maintain Healthy Hair

Practical Activities:

- Hair consultation and analysis (types of hair, suitable hairstyles)
- Demonstration of quick, easy, and professional hairstyles
- Self-care tips for healthy hair

Unit 5: Grooming for Men and Women

- Gender-Specific Grooming: Grooming Essentials for Men vs. Women
- Men's Grooming: Skincare, Haircare, and Facial Hair Grooming
- Women's Grooming: Skincare, Makeup, and Haircare
- Nail Care: Manicure and Pedicure Basics
- Choosing Perfumes and Fragrances

Practical Activities:

- Hands-on workshops: Manicure, pedicure, and facial grooming for both men and women
- Grooming demonstrations for different gender-specific needs
- Makeup basics for women: Everyday look vs. Professional look

Unit 6: Body Language, Posture, and Communication

- The Role of Body Language in Grooming
- Posture: How to Stand, Walk, and Sit with Confidence
- Gestures, Eye Contact, and Facial Expressions
- Verbal and Non-Verbal Communication: Voice Modulation and Listening Skills
    - How to Improve First Impressions through Body Language and Communication

Practical Activities:

- Body language exercises: Posture correction and confidence-building exercises
- Practice verbal communication and listening skills
- Role-playing: Professional and casual conversations, first impressions

Unit 7: Professional Etiquette and Social Manners

- Introduction to Professional Etiquette
- Workplace Behavior: Punctuality, Respect, and Responsibility
- How to Greet People: Handshakes, Bowing, and Other Gestures
- Dining Etiquette: Business Lunches and Formal Events
- Meeting Etiquette: Greetings, Small Talk, and Networking
- Etiquette for Digital Communication (Emails, Video Calls, Social Media)
- Handling Criticism and Compliments Gracefully

Recommended Textbooks and Reading Material

1. **"Research Ethics: A Philosophical Guide to the Responsible Conduct of Research"** by Gary Comstock
    - A comprehensive introduction to the ethical principles and practices in research.
2. **"The Ethics of Research with Human Subjects"** by Thomas A. Schwandt
    - Focuses on the ethical issues in human research, with practical examples.
3. **"Ethical Issues in Research"** by William P. L. M. Ritchie
    - Covers a wide range of ethical dilemmas across different research domains.
4. **The Belmont Report: Ethical Principles and Guidelines for the Protection of Human Subjects of**

Research (1979)

- A foundational document outlining ethical guidelines for human subject research.

5. **"Scientific Integrity"** by Frances M. H. Wang
   - A guide to understanding research integrity, misconduct, and ethical decision-making.

6. Examination Scheme:

7.

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER I

Cell Biology Lab

Course Code: BMB-151 **Credit Units: 02**

Pre-requisite: Basic information of Cell Biology

Course Outcome:

- Students will learn about the varieties of plants and their diversity.
- Students will gain a comprehensive knowledge on categories of plants and apply the same in identification of monocots and dicots
- Students will become familiar with plant cell anatomy.
- Students will be able to learn about the functioning of plant cell and understand their importance in plant life.
- Students will be able to implement different strategies to test the present of storage food material in plant parts.
- Students will be able to understand the methods of solute and solvent uptake in plant cells and their role in life processes.
- Students will be able to analyze the mechanism of transpiration by different plants.
- Students will be able to learn the mechanism underlying seed growth and development.

Details of the Course:-

S. No.	Contents	Contact Hours
1	Study the effect of temperature and organic solvents on semi permeable membrane.	2
2	Demonstration of dialysis.	2
3	Study of plasmolysis and de-plasmolysis.	2
4	Cell fractionation and determination of enzyme activity in organelles using sprouted seed or any other suitable source.	2
5	Study of structure of any Prokaryotic and Eukaryotic cell Microtomy: Fixation, block making, section cutting, double staining of animal t issues like liver, oesophagus, stomach, pancreas, intestine, kidney, ovary, testes	2
6	Cell division in onion root tip/ insect gonads.	2
7	Preparation of Nuclear, Mitochondrial & cytoplasmic fractions.	2

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER I

Inorganic & Physical Chemistry Lab

Course Code: BMB-152 **Credit Units: 02**

Pre-requisite: Basic information of Chemistry

Course Outcome:

- Understand the volumetric analysis
- Analyze the water quality parameter.
- Determine viscosity, surface tension and their applications.
- Estimate the constituents in ores and bleaching powder sample.

Details of the Course:-

S. No.	Contents	Contact Hrs.
1	To determine the alkalinity of the given water sample containing carbonate (CO_3^{2-}) ions and bicarbonate (HCO_3^-) ions by titrating it against standard HCl solution [N/10] using phenolphthalein and methyl orange as indicators.	2
2	To determine the alkalinity of the given water sample containing carbonate (CO_3^{2-}) ions and hydroxide (OH^-) ions by titrating it against standard HCl solution [N/10] using phenolphthalein and methyl orange as indicators.	2
3	To determine the chloride ion (Cl^-) content in the given water sample by Argentometric method (Mohr‟s method) using N/50 $AgNO_3$ as a standard solution and potassium chromate (K_2CrO_4) as an internal indicator.	2
4	To dESErmine the temporary and permanent hardness of given water sample by titrating it against standard solution of M/100 Ethylene Diamine Tetra acetic Acid (EDTA) using Eriochrome black-T (EBT) as an internal indicator.	2
5	To determine the coefficient of viscosity of the given sample solution by Ostwald‟s viscometer (Viscosity of water = 0.0101 Poise).	2
6	To determine the ferrous ion (Fe^{++}) content in given sample solution of Mohr‟s salt ($FeSO_4.(NH_4)_2SO_4.6H_2O$) by titrating it against standard N/30 potassium dichromate ($K_2Cr_2O_7$) solution by using potassium ferricyanide K_3 [Fe (CN) $_6$] as an external indicator.	2
7	To determine the surface tension of the given sample solution by drop number method.	2

8	To determine the percentage of available chlorine in the given sample of 1 gram bleaching powder by titrating it against standard solution of N/25 sodium thiosulphate ($Na_2S_2O_3$) using starch $(C_6H_{10}O_5)_n$ as an internal indicator.	2
9	To determine the equivalent weight of iron by chemical displacement method using standard solution of N/25 sodium thiosulphate ($Na_2S_2O_3$) and starch $(C_6H_{10}O_5)_n$ as an internal indicator. (The equivalent weight of copper is 63.5).	2
10	To determine the Copper (Cu^{++}) ion content in the given sample of copper ore (blue vitriol) by titrating it against standard N/30 sodium thiosulphate solution using KI and starch as indicator by Iodometeric titration.	2

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Sunita Rattan, " Practical Chemistry", S.K. Kataria & Sons Delhi, Indi, 2nd Edition (2009)	2009
2.	Shashi Chawala , "Practical Chemistry", Dhanpat Rai and Company, India 3rd Edition (2012)	2012

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Experiments in Plant Physiology: A Laboratory Manual. Bajracharya, D., Narosa publishers, New Delhi	1999
2.	Practicals in Plant Physiology and Biochemistry. Bala, M. Gupta, S. , Gupta N.K. and Sangha, M.K. , Scientific Publishers, India	2016

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER I

Computer Fundamentals Lab

Course Code: BMB-153 **Credit Units: 02**

Pre-requisite: Basic knowledge of Computer application

Course Outcome:

- Students will learn to execute internal and external commands.
- Students will also be able to understand basic computer applications practically.

Details of the Course:-

S. No.	Contents	Contact Hours
1	Execute "Internal & External Commands" in MS-DOS.	2
2	Create any 3 ".txt" files in MS-DOS and Copy the contents of two files in one single file.	2
3	Create the "directory structure" in MS-DOS.	2
4	In MS-DOS, Change the dos prompt: With your name, current date, current time, change the prompt to its original path.	2
5	Create one MS-word file having name "INTRODUCTION" and apply "center alignment", Make the heading bold, Italic and underlined and do apply font style of heading as ―ALGERIAN‖ and size ―24‖ by including fields like: Name, Permanent Address, Current Address, Educational Qualification, Hobbies, and Aim etc. Insert table for "educational Qualification".	2
6	Create one MS-Word File for drawing a flow chart to calculate "Simple Interest", using shapes.	2
7	Create a table in MS-Excel having name BCA having fields: S.No, Student Name, sub1_marks, sub2_marks, sub3_marks, sub4_marks. Calculate the "sum" and "percentage" of all the students. Also draw "pie chart" for showing the student percentage.	2
8	Create one MS-excel for a "Automobile Garage" by having fields like "year", "Sale", "Car Name". Draw a "column chart" for year and Sale.	2
9	Create "Attendance letter" for class MCA and send this letter at the address of all the MCA students using "Mail Merge" option.	2
10	Create a Power Point presentation with the main title "INTERNET ". Also add the following topics like: HISTORY OF THE INTERNET, INTERNET TERMS, and ADAVANTAGES OF THE INTERNET in Slides.	2

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Norton, PESEr, —Introduction to Computers‖, McGraw-Hill.	2011
2.	\Leon, Alexis & Leon, Mathews, —Introduction to Computers‖, Leon Tech World.	2012
3.	Yashwant Kanetker, —Let us C‖,BPB.	2010
4.	Rajaraman, V., —Fundamentals of Computers‖,PHI.	2011
5.	Rajaraman, V., —Computer Programming in C‖,PHI.	2012

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER I

Ethics of Research

Course Code: SM-101a **Credit Units: 02**

Course Outcomes (COs):

By the end of the **Ethics of Research** course, students will be able to:

1. Understand the core ethical principles that govern research practices.
2. Identify and resolve ethical issues in research scenarios.
3. Apply ethical guidelines for informed consent and participant privacy in human research.
4. Make ethical decisions based on ethical frameworks and critical analysis.
5. Evaluate and ensure ethical treatment of animal subjects in research.
6. Recognize and prevent research misconduct, including plagiarism, falsification, and fabrication.
7. Promote ethical collaboration in international and cross-cultural research settings.
8. Conduct research with integrity and accountability, maintaining ethical standards.
9. Address emerging ethical issues in new areas of research, such as AI and genetic research.
10. Navigate ethical review processes, ensuring compliance with institutional and regulatory guidelines.

Details of the course:

Unit 1: Introduction to Research Ethics

- Definition of Research Ethics and its importance
- Key ethical principles in research: Honesty, Integrity, Transparency, and Accountability
- Historical background of research ethics (e.g., Nuremberg Code, Declaration of Helsinki, Belmont Report)
- Ethical challenges in contemporary research
- The role of ethical review boards (IRBs, Ethics Committees)
- Overview of the ethical guidelines and frameworks across disciplines

Unit 2: Ethical Guidelines for Human Research

- The concept of informed consent: purpose, process, and challenges
- Privacy, confidentiality, and data protection in human research
- Vulnerable populations in research: Children, elderly, prisoners, and those with mental disabilities
- Ethical issues in surveys, interviews, and experiments with human participants
- Risks and benefits in human research: Minimizing harm
- Ethical considerations in clinical trials and medical research

Unit 3: Ethical Guidelines for Animal Research

- Ethical considerations in animal research
- The 3Rs principle (Replacement, Reduction, Refinement) in animal research
- Animal welfare and humane treatment in experimental research

- Legal and institutional regulations regarding animal research
- Ethical alternatives to animal experimentation
- Case studies of ethical concerns in animal research

Unit 4: Research Integrity and Misconduct

- Definitions of research misconduct: Fabrication, Falsification, and Plagiarism (FFP)
- The consequences of research misconduct on society, science, and individuals
- Whistleblowing and the role of research institutions in preventing misconduct
- Procedures for investigating allegations of misconduct
- The impact of publication ethics: Peer review, authorship issues, and conflicts of interest
- Strategies for promoting research integrity and good practices in research
- Case studies of misconduct in research and lessons learned

Unit 5: Ethical Decision-Making in Research

- Ethical decision-making models in research
- Balancing ethical principles in research practice
- Addressing dilemmas in qualitative vs. quantitative research
- Ethical challenges in interdisciplinary research
- Ethical challenges in emerging research fields (e.g., AI, genetic engineering, climate change)
- Conflict of interest in research: Definition, disclosure, and management

Unit 6: Global Research Ethics and Cultural Sensitivity

- Ethical challenges in cross-cultural research
- Ethics in international research collaborations
- Ethics of conducting research in developing countries
- Ethical concerns in research involving indigenous populations
- Global guidelines and conventions (e.g., CIOMS, UNESCO guidelines)
- Ethical issues in the publication of international research findings

Examination Scheme

Components	**Internal Assessment**			**External Evaluation**
	Attendance	**Class Test**	**Assignment/ Project/Seminar/Quiz**	
Weightage (%)	10	20	10	60

General Proficiency-I

Course Code: GP-101 **Credit Units: 01**

Pre-requisite: Basic information of English Language

Course Outcome:

- ·Effective communication: The ability to exchange ideas and information in a way that builds trust and respect
- ·Critical and analytical thinking: The ability to explore issues and ideas before forming a conclusion
- ·Integrative thinking: The ability to synthesize knowledge across different domains and perspectives
- ·Preparing students to be engaged citizens: Preparing students to participate in political culture and thrive in a rapidly evolving world

Details of the Course:-

General language proficiency is the ability to read, write, listen, and speak in real-life situations. To test this, a test is usually developed for each skill with questions that are designed to imitate real life.

A syllabus is a guide to a course that includes course policies, rules, regulations, required texts, and a schedule of assignments and seminar.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

Physical Education & Yoga

Course Code: GP-101a **Credit Units: 01**

Course Outcomes (COs):

By the end of the **Physical Education & Yoga** course, students will be able to:

1. **Understand and apply** core concepts in physical education and fitness.
2. **Perform and teach** a wide range of **yoga asanas** and pranayama techniques for physical and mental well-being.
3. **Design and implement** fitness programs for individuals and groups.
4. **Assess physical fitness** and guide others in improving strength, flexibility, endurance, and cardiovascular health.
5. Use **yoga and physical activity** to promote **mental well-being**, stress relief, and emotional balance.
6. Demonstrate knowledge of **sports injury prevention** and provide **first aid**.
7. Use **yoga therapeutically** to address specific health conditions.
8. Teach and lead others in **yoga classes** and **fitness sessions**.
9. Foster a **holistic approach to health**, combining physical activity, nutrition, and mental wellness.
10. Commit to a **lifetime of learning** and professional development in the fields of **physical education**, **yoga**, and **health & wellness**.

1. **Unit I: Fundamentals of Physical Education**

    - Introduction to Physical Education
    - History and Development of Physical Education
    - Importance of Physical Fitness and Health
    - Concepts of Physical Education, Sports, and Wellness
    - Role of Physical Education in Personal Development

2. **Unit II: Basics of Yoga & Meditation**
    - **Module 1**: Introduction to Yoga and its History
    - **Module 2**: Yoga Philosophy (Yoga Sutras of Patanjali)
    - **Module 3**: The Eight Limbs of Yoga (Ashtanga Yoga)
    - **Module 4**: Basic Asanas (Postures) and their Benefits
    - **Module 5**: Introduction to Pranayama (Breathing Techniques)
    - **Module 6**: The Role of Meditation in Yoga and Mental Health
3. **Elective/Optional Paper I: Sports and Recreation**
    - **Module 1**: Understanding the Importance of Sports in Physical Education
    - **Module 2**: Organizing Sports Events and Competitions
    - **Module 3**: Sports Psychology: Motivation and Performance
    - **Module 4**: Nutrition and Hydration in Sports
    - **Module 5**: Injury Prevention and First Aid in Sports

Practical Component:

- Practical Sessions on Organizing Sports Events

- Basic Training Techniques for Sports (e.g., Sprinting, Long Jump)

Unit III: Advanced Physical Fitness

- **Module 1**: Advanced Training Methods (Strength, Endurance, Flexibility)
- **Module 2**: Designing a Fitness Program
- **Module 3**: The Science of Body Composition and Weight Management
- **Module 4**: Cardio and Aerobic Training Techniques
- **Module 5**: Monitoring and Assessing Fitness Progress

Practical Component:

- Practical Application of Fitness Assessment Tools
- Designing and Implementing a Fitness Routine (Based on Personal Goals)

Unit IV: Advanced Yoga Practices

- **Module 1**: Deep Dive into Asanas: Advanced Postures
- **Module 2**: Therapeutic Applications of Yoga for Health
- **Module 3**: Pranayama and Breath Control Techniques (Advanced)

Unit V: Sports Medicine and Injury Prevention

- **Module 1**: Common Sports Injuries and their Prevention
- **Module 2**: Anatomy and Physiology for Sports Medicine
- **Module 3**: Rehabilitation and Recovery in Sports
- **Module 4**: Basics of Massage Therapy for Sports Recovery
- **Module 5**: Using Technology and Equipment in Injury Prevention

Examination Scheme:

Components	**Internal Assessment**			**External Evaluation**
	Attendance	**Class Test**	**Assignment/ Project/Seminar/Quiz**	
Weightage (%)	10	20	10	60

SEMESTER I

Health & Nutrition

Course Code: GP-101b **Credit Units: 02**

Course Objectives:

CO-1. Understand the Fundamental Concepts of Nutrition

CO-2. Identify Nutrient Functions and Sources

CO-3. Examine Digestive Process and Nutrient Absorption

CO-4. Evaluate Impact on Chronic Diseases

Unit 1: Introduction to Health and Nutrition

Define health and nutrition.
Understand the importance of nutrition in maintaining overall health and preventing diseases.
Introduce basic nutritional principles and food groups.
What is health? Physical, mental, and social health.
The relationship between diet and health.
Nutrients: macronutrients vs. micronutrients
Nutrition guidelines and the role of public health organizations (e.g., WHO, USDA).

Unit 2: Macronutrients: Carbohydrates, Proteins, and Fats

Understand the role of each macronutrient in the body.
Identify food sources for carbohydrates, proteins, and fats.
Learn about the metabolism and energy production from macronutrients.
Key Topics:
Carbohydrates: Types (simple vs. complex), function, glycemic index, and food sources.
Proteins: Amino acids, essential vs. non-essential proteins, protein needs for various life stages.
Fats: Saturated, unsaturated, and trans fats; essential fatty acids, cholesterol, and healthy fat choices.
Assessment:
Create a food diary and identify the macronutrient composition of the foods you eat for a week.
Multiple-choice quiz on macronutrients.

Unit 3: Micronutrients: Vitamins and Minerals

Understand the function of vitamins and minerals in maintaining health.
Learn about the signs and symptoms of deficiencies and toxicities.
Identify major food sources of essential vitamins and minerals.
Vitamins: Fat-soluble (A, D, E, K) vs. water-soluble (B-complex, C), their functions, deficiencies, and toxicity.Minerals: Major minerals (calcium, iron, magnesium) vs. trace minerals (zinc, iodine, copper).Antioxidants and their role in disease prevention.

Unit 4: The Digestive System and Nutrient Absorption

Understand how the digestive system processes food and absorbs nutrients.
Learn about enzymes, digestion, and the role of gut microbiota.
Discuss common digestive disorders and their nutritional implications.
Anatomy of the digestive system: Mouth, stomach, small intestine, large intestine.
Enzymes and hormones in digestion.
The role of the gut microbiota in health and disease.
Digestive disorders: IBS, celiac disease, food intolerances, etc.

Examination Scheme:

Components	**Internal Assessment**			**External Evaluation**
	Attendance	**Class Test**	**Assignment/ Project/Seminar/Quiz**	
Weightage (%)	10	20	10	60

SEMESTER II

Organic & Analytical Chemistry

Course Code: BMB-201 **Credit Units: 04**

Pre-requisite: Basic information of Organic Chemistry

Course Outcome:

After completion of the course students will be able to:

- Understand the basic concepts of different purification techniques of organic compound.
- Explain the mechanism of organic reactions.
- Apply basic concepts of organic chemistry in determining the types of organic reactions.
- Categories various types of polymer and their uses.
- Importance of spectroscopy in organic chemistry, biotechnology and engineering applications.
- Predict the importance of organic reactions in daily life.

Details of the Course:-

UNIT I: Purification of Organic Compounds:

Crystallization, Sublimation, Distillation, Fractional Distillation, Distillation under reduced pressure, Steam distillation, Extraction with solvent, Principle and applications of chromatography in organic chemistry, High Performance Liquid Chromatography – Principle and applications.

UNIT II: Bonding in Organic Compounds:

Nature of covalent bond and its orbital representation, Hybridization, bond energy, polarity of bond & dipole moment of molecules, inductive effect, hydrogen bond, conjugation, resonance.

Homolytic & heterolytic fission of bonds, electrophiles & nucleophiles, Reaction intermediates: carbocation, carbanion and free radicals – stability, geometry, hybridization & generation.

UNIT III: Mechanistic Organic Chemistry:

Resonance and Aromaticity in aromatic compounds. Addition reactions, Substitution reactions, Elimination reactions & Rearrangement reactions in organic chemistry, Mesomerism and Orientation in aromatic substitution reactions.

UNIT IV: Polymers:

Polymerization, degree of polymerization, functionality of monomer, Classification of polymers on the basis of tacticity, mode of formation, structure of monomer unit, Mechanism of addition polymerization, Preparation, Properties and uses of Kevlar & PMMA, Plastics: definition, preparation, classification and applications, Fibers – Preparation, properties and uses of Nylon- 6,6 Nylon and Dacron, Conducting polymers: Polyacetylene, Polyaniline, Mechanism of Conduction, doping; Applications of Conducting polymers. Bio-degradable Polymers.

UNIT V: Advanced Analytical Chemistry:

General theory of spectroscopy. Principle of UV-VIS, IR, NMR, and Mass spectroscopy. Applications of spectroscopic techniques in structure elucidation of organic compounds.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	University Chemistry, B.H.Mahan	1987
2.	Chemistry, Principles and Application, M.J. Sienko and R.A. Plane	1980
	Reference Books	
1.	Physical Chemistry, P.W. Atkins	2009
2.	Organic Chemistry, I.L.Final (Vol-1, Vol-2)	2002
3.	Fundamentals of Molecular Spectroscopy, C.N. Banwell	1994

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

Observational Chemistry

Course Code: BMB-201a **Credit Units: 04**

Pre-requisite: Basic information of Organic Chemistry

Course Outcomes
CO-1 Develop Proficiency in Laboratory Techniques
CO-2 Enhance Observational and Analytical Skills
CO-3 Understand and Identify Chemical Reactions
CO-4 Investigate the Physical Properties of Matter
CO-5 Conduct Qualitative Analysis of Inorganic Compounds

Unit 1: Introduction to Observational Chemistry and Laboratory Safety

Introduction to basic principles of observational chemistry, the importance of laboratory safety, and the role of qualitative and quantitative analysis in understanding chemical processes.

Unit 2: Physical Properties of Matter

Exploration of the physical properties of matter that can be observed and measured without changing the chemical identity of substances.

- State of matter (solid, liquid, gas) and phase transitions
- Color, texture, density, melting and boiling points
- Solubility and miscibility tests
- Viscosity, surface tension, and refractive index

Unit 3: Chemical Reactions and Observations

Focus on understanding different types of chemical reactions and observing the changes that occur during these processes.

- Indicators of chemical reactions (color change, gas evolution, precipitate formation, heat change)
- Types of reactions: synthesis, decomposition, single replacement, double replacement, combustion, redox
- Acid-base reactions, precipitation reactions, oxidation-reduction reactions
- Energy changes during reactions (exothermic and endothermic reactions)

Unit 4: Qualitative Analysis of Inorganic Compounds

Observing the chemical properties of common inorganic compounds, especially metal salts, through qualitative analysis techniques.

- Flame tests for metal ions (e.g., sodium, potassium, calcium, copper)
- Identification of cations and anions in unknown samples
- Precipitation reactions and solubility rules
- Use of reagents to test for specific ions (e.g., silver nitrate for chloride ions

Unit 5: Gas Laws and Observations

Investigating the behavior of gases and performing experiments to observe how gases respond to changes in temperature, pressure, and volume.

- Boyle's Law, Charles's Law, Avogadro's Law, Ideal Gas Law
- Observing the behavior of gases under various conditions (e.g., pressure, temperature)
- Diffusion and effusion of gases
- Real vs. ideal gases

Examination Scheme:

Components	**Internal Assessment**			**External Evaluation**
	Attendance	**Class Test**	**Assignment/ Project/Seminar/Quiz**	
Weightage (%)	10	20	10	60

SEMESTER II

Basic & Applied Chemistry

Course Code: BMB-201b **Credit Units: 04**

Course Objectives:

CO-1 Develop a solid understanding of core chemical concepts such as atomic structure, chemical bonding, and thermodynamics.

CO-2 Gain hands-on experience in applying chemical principles through laboratory techniques and experiments.

CO-3 Analyze and interpret various chemical reactions and predict outcomes based on fundamental principles.

CO-4 Solve quantitative problems using stoichiometry, including calculations involving moles, concentrations, and reaction yields.

CO-5 Understand the behavior and properties of different states of matter and their transitions under varying conditions.

Unit 1: Introduction to Chemistry and Matter

Basic Concepts:
Definition of Chemistry, Branches of Chemistry (Physical, Organic, Inorganic, Analytical, Biochemistry).
Types of Matter: Elements, Compounds, Mixtures.
Classification of Matter: Homogeneous and Heterogeneous.
Chemical vs Physical Properties and Changes.
Measurements and Units (SI units, dimensional analysis).
Matter and Its Properties:
States of Matter: Solid, Liquid, Gas, and Plasma.
Properties of Solids, Liquids, and Gases.
Atomic and Molecular Theory of Matter.

Unit 2: Atomic Structure and Periodicity

Atomic Structure:
Structure of the Atom: Subatomic particles (protons, neutrons, electrons).
Atomic Number, Mass Number, Isotopes, Isobars.
Bohr's Model and Quantum Mechanical Model of the Atom.

Electron Configuration and Aufbau Principle.
Atomic Orbitals and Quantum Numbers.
Periodic Table and Periodicity:
Mendeleev's Periodic Table and Modern Periodic Law.
Trends in the Periodic Table: Atomic size, Ionization energy, Electron affinity, Electronegativity.
Periodic Properties and Their Applications.

Unit 3: Chemical Bonding and Molecular Structure
Types of Chemical Bonds:
Ionic Bonding: Formation of ionic compounds, properties.
Covalent Bonding: Electron sharing, Lewis structures, polar vs nonpolar covalent bonds.
Metallic Bonding: Properties of metals.
Intermolecular Forces: Hydrogen bonding, van der Waals forces.
Molecular Geometry:
VSEPR Theory (Valence Shell Electron Pair Repulsion Theory).
Hybridization and Bonding Orbitals.
Molecular Polarity.

Unit 4: Stoichiometry and Chemical Reactions Stoichiometry:
Mole Concept, Molar Mass, Avogadro's Number.
Balancing Chemical Equations.
Limiting Reactant, Excess Reactant, Theoretical and Percent Yield.
Types of Chemical Reactions:
Synthesis, Decomposition, Single and Double Displacement.
Combustion Reactions.
Redox Reactions: Oxidation, Reduction, and Balancing Redox Equations.
Acid-Base Reactions: Bronsted-Lowry Theory, Lewis Acid-Base Concept.

Unit 5: Thermodynamics and Kinetics
Thermodynamics:
Laws of Thermodynamics.
Heat, Work, and Internal Energy.
Enthalpy, Entropy, and Free Energy.
Thermochemical Calculations and Hess's Law.
Chemical Kinetics:
Rate of Chemical Reactions.
Rate Laws, Reaction Order, and Rate Constants.
Activation Energy and Arrhenius Equation.
Factors Affecting Reaction Rates: Temperature, Concentration, Catalysts.

Examination Scheme:

Components	**Internal Assessment**			**External Evaluation**
	Attendance	**Class Test**	**Assignment/ Project/Seminar/Quiz**	

Weightage (%)	10	20	10	60

SEMESTER II

Elements of Biochemistry

Course Code: BMB-202 **Credit Units: 04**

Pre-requisite: Basic understanding of biomolecules and concepts of general chemistry

Course Outcome:

- Students will be able to define biomolecules and buffers.
- Students will understand the structure and functions of biomolecules.
- Students will be able to classify and explain the role of various biomolecules in human body.
- Students will be able to analyze the causes of diseases on biochemical basis.
- Students will be able to understand various biochemical process and cell metabolism.

Details of the

Course:- Unit I:

A historical prospective, Amino acids & Proteins**:** Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.

Unit II:

Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines,. Biologically important nucleotides,

Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA.

Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein‟s and their biological functions.

Unit III:

Lipids: Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol.

Unit IV:

Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites, enzyme specificity: types & theories, Biocatalysts from extreme thermophilic and hyperthermophilic archaea and bacteria. Role of: NAD^+, $NADP^+$, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxal phosphate,lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions

Unit V:

Carbohydrates Metabolism: Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. ß-oxidation of fatty acids.

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1	Biochemistry, Lubert Stryer, 8th Edition, WH Freeman, 2015	2015
2	Harper‟s illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M.Botham, PESEr J. Kennelly, Victor W. Rodwell, P. Anthony Weil. 30th Edition, McGrawHill, 2015.	2015
3	Biochemistry by Mary K.Campbell & Shawn O.Farrell, 9th Edition, Cenage Learning, 2018.	2018
4	Biochemistry, Donald Voet and Judith Voet, 4th Edition, Publisher: John Wiley andSons,	2010
	Reference Books	
1	The Organic Chemistry of Enzyme-catalyzed Reactions Richard B. Silverman Academic Press	2002

2	Practical Enzymology Hans Bisswanger Wiley–VCH 2012.	2012
3	Fundamentals of Enzyme Kinetics Athel Cornish-Bowden Portland Press 4th edition, 2012.	2012
4	Fundamentals of Enzymology Nicholas Price and Lewis Steven Oxford University Press 3rd edition 2009.	2009

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

Fundamentals of Biochemistry

Course Code: BMB-202a **Credit Units: 04**

Course Objectives:

- Introduce students to the core chemical principles that govern biochemical processes.
- Study the structure and biological roles of proteins, lipids, nucleic acids, and carbohydrates.
- Understand key metabolic pathways (e.g., glycolysis, citric acid cycle) and their regulation and energy transfer.
- Explore enzyme mechanisms, kinetics, and regulation, including coenzyme and cofactor roles.
- Explain DNA replication, transcription, and translation as part of the central dogma of molecular biology.

Unit 1: Introduction to Biochemistry and Biomolecules

Overview of Biochemistry: Definition, scope, and importance of biochemistry in biology and medicine, Water and pH: Properties of water, pH, buffers, and their biological significance.

Biomolecules: Classification and structure of biomolecules (carbohydrates, proteins, lipids, nucleic acids),Basic Chemical Principles: Atomic structure, chemical bonds, and

4.	**UNIT-4** • Food preservation methods. • Radappertization, radicidation, and radurization of foods. • Legal status of food irradiation, effect of irradiation on food constituents.	12
5.	**UNIT-5** • Storage stability food preservation with low temperature, high temperature and drying. • Indicator and food-borne pathogens. Rheology of food production.	6

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	N.Jogdan Industrial Biotechnology, Himalaya Publishing House	2006
2.	Perlman D. Annual Reports of Fermentation Processes.	1997-1979
3.	Prescott SC & Dunn CG.. Industrial Microbiology. McGraw Hill.	1959
4.	Bains W. Biotechnology from A to Z. Oxford Univ. Press.	1993
	Reference Books	
1.	Introduction to Food Biotechnology. Author; Perry Johnson.	2002

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

Bacteriology & Virology

Course Code: BMB-302 **Credit Units: 04**

Pre-requisite: Basic information of Bacteriology and Virology.

Course Outcome:

After completion of the course the students should be able to

- Describe the cell organization of bacteria i.e. morphology, ultrastructure and organelles present in bacterial cells.
- Apply the knowledge of bacteriological techniques.
- Describe the nutritional and physical requirements for bacterial growth.
- Describe the principles involved in killing bacteria, and make recommendations on use of physical and chemical methods used to control microbial growth.
- Describe the dynamics of the growth of a bacterial population and how this growth can be measured.
- Describe bacterial taxonomy and classification.
- Differentiate the nature of viruses.
- Understand classification of viruses.
- Learn the methods of laboratory diagnosis of viruses using different techniques.
- Learn about different plant and animal viruses.

Details of the Course:-

Unit – I: Cell Organization:

Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella, fimbriae and pili.
Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, Archaebacterial cell wall, Gram and acid fast staining mechanisms, lipopolysaccharide (LPS), sphaeroplasts, protoplasts, and L-forms. Effect of antibiotics and enzymes on the cell wall.
Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes.
Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids
Endospore: Structure, formation, stages of sporulation.

Unit – II: Bacterial growth and control:

Culture media: Components of media, Synthetic or defined media, Complex media, enriched media, selective media, differential media, enrichment culture media Pure culture isolation: Streaking, serial dilution and plating methods, cultivation, maintenance and stocking of pure cultures, cultivation of anaerobic bacteria Growth: Binary fission, phases of growth.

Unit – III: Bacterial Systematics and Taxonomy:

Taxonomy, nomenclature, systematics, types of classifications
Morphology, ecological significance and economic importance of the following groups:
Archaea: methanogens, thermophiles and halophiles
Eubacteria: Gram negative and Gram positive
Gram negative:
Non-proteobacteria– Deinococcus, Chlamydiae, Spirochetes
Alpha proteobacteria- Rickettsia, Rhizobium, Agrobacterium
Gamma proteobacteria –Escherichia,Shigella,Pseudomonas
Gram positive: Low G+C: Mycoplasma, Bacillus, Clostridium, Staphylococcus High G+C: Streptomyces, Frankia

Unit – IV: Nature, Properties and Classification of Viruses:

Properties of viruses; general nature and important features Subviral particles; viroids, prions and their importance Isolation and cultivation of viruses.
Morphological characters: Capsid symmetry and different shapes of viruses with examples Viral multiplication in the Cell: Lytic and lysogenic cycle Description of important viruses: salient features of the viruses infecting different hosts - Bacteriophages (T4 & Lambda); Plant (TMV & Cauliflower Mosaic Virus), Human (HIV & Hepatitis viruses).

Unit – V: Role of Viruses in Disease and its prevention:

Viruses as pathogens: Role of viruses in causing diseases Prevention and control of viruses: Viral vaccines, interferons and antiviral compounds.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Pelczar Jr., M.J., Chan, E.C.S. and Krieg, Noel R., Microbiology, McGraw Hill (2003) 5th ed.	2003
2.	Dimmock, NJ, Easton, AL, Leppard, KN. Introduction to Modern Virology.6th edition, Blackwell Publishing Ltd.	2007
	References	
1.	Microbiology 10th Edition. Prescott, L.M.; Harley, J.P. and Klein, D.A. (2003) McGraw Hill, USA.	2016
2.	Foundations in Microbiology 10th edition, Kathleen Park Talaro and Barry Chess.	2017
3.	Microbiology- An Introduction. Tortora, G.J., Funke, B.R., and Case, C.L., , Pearson Education (2015)12th ed.	2015
4.	Principles of Virology, Vol I and Vol II, 4th Edition, Jane Flint, Vincent Racaniello, Glenn Rall, Anna Marie Skalka, (2015), American Society of Microbiology	2015

5.	Srivastava S and Srivastava PS. Understanding Bacteria. Kluwer Academic Publishers,Dordrecht	2009
6.	Plant Viruses, Diseases and Their Management, Kajal Kumar Biswas, IK. International Publishing House Pvt Ltd, 2016.	2016
7.	Animal cell culture and Virology, S. Nandi, New India Publishing agency, 1st ed. (2009)	2009
8.	Textbook of Medical Virology, Mishra B, CBS Publishing, 1st edition, 2018	2018

Examination Scheme:

Components	**Internal Assessment**			**External Evaluation**
	Attendance	**Class Test**	**Assignment/ Project/Seminar/Quiz**	
Weightage (%)	10	20	10	60

SEMESTER III

Global Ecology

Course Code: BMB-302a **Credit Units: 04**

Pre-requisite: Basic knowledge of Environmental science

Course Outcomes (CO):

Upon successful completion of the **Global Ecology** course, students will be able to:

1. **CO1:** Understand and explain fundamental ecological principles, processes, and interactions in the context of global environmental systems.
2. **CO2:** Analyze the impact of human activities on the environment and global ecosystems.
3. **CO3:** Evaluate the causes and consequences of global environmental challenges, including climate change, biodiversity loss, and pollution.
4. **CO4:** Develop and propose sustainable solutions and conservation strategies to address global ecological issues.
5. **CO5:** Use scientific tools and methods, such as GIS, fieldwork, and ecological modeling, to study global ecological problems.

Detail of the course:-

Unit 1: Introduction to Ecology and Global Environmental Systems

- **Introduction to Ecology**
  - Definition and scope of ecology
  - Levels of ecological organization (individual, population, community, ecosystem, biome, biosphere)
- **Basic Ecological Processes**
  - Energy flow in ecosystems: producers, consumers, and decomposers
  - Biogeochemical cycles: carbon, nitrogen, phosphorus, and water cycles
  - Ecosystem functioning and biodiversity
- **Human-Ecosystem Interactions**
  - Human influence on natural systems
  - Ecological footprint and sustainability concepts

Unit 2: Earth's Biomes and Global Ecosystems

- **Biomes of the World**
  - Characteristics of major terrestrial biomes: tropical rainforests, deserts, temperate forests, tundra, and grasslands
  - Aquatic ecosystems: freshwater and marine ecosystems (lakes, rivers, coral reefs, oceans)
- **Ecosystem Services**

- Ecosystem functions and services: provisioning, regulating, cultural, and supporting
- The importance of biodiversity and healthy ecosystems in global environmental stability

Unit 3: Biodiversity, Conservation, and Global Sustainability

- **Types of Biodiversity**
  - Genetic, species, and ecosystem diversity
  - Hotspots of biodiversity and endemism
- **Threats to Biodiversity**
  - Habitat destruction, fragmentation, and degradation
  - Invasive species, over-exploitation, climate change, and pollution
- **Conservation Strategies**
  - Protected areas and wildlife corridors
  - Restoration ecology and biodiversity hotspots
  - Sustainable development and the role of international agreements (CBD, CITES, etc.)

Unit 4: Climate Change and Global Environmental Challenges

- **Climate Change Science**
  - The greenhouse effect and the role of greenhouse gases
  - Evidence and impacts of climate change (temperature rise, melting glaciers, sea-level rise)
  - Climate change models and future projections
- **Global Warming and Climate Change Effects**
  - Effects on weather patterns, ecosystems, and biodiversity
  - Impacts on human societies, agriculture, and water resources
- **Mitigation and Adaptation Strategies**
  - Carbon sequestration, renewable energy, and geoengineering
  - Adaptation strategies in vulnerable regions

Unit 5: Pollution and Environmental Degradation

- **Types of Pollution**
  - Air, water, soil, noise, and plastic pollution
  - Point-source vs. non-point-source pollution
- **Pollution's Impact on Global Ecosystems**
  - Eutrophication, acid rain, and ocean acidification
  - Plastic pollution and microplastics in oceans
  - Toxic chemicals and their ecological and health impacts
- **Waste Management and Pollution Control**
  - Recycling, waste-to-energy technologies, and zero-waste initiatives
  - International policies on pollution control (e.g., Paris Agreement, Basel Convention)

Unit 6: Global Conservation and Environmental Policy

- **International Environmental Agreements**
  - The role of the United Nations, Kyoto Protocol, Paris Agreement
  - Global environmental treaties and their effectiveness
- **Environmental Ethics and Justice**

- Ethical dilemmas in conservation and environmental protection
- Environmental justice: inequality and access to environmental resources

- **Policy Tools for Environmental Management**
  - Ecological restoration, sustainable resource management, and conservation laws
  - Role of NGOs and international organizations in global environmental governance

Unit 7: Sustainable Development and Global Ecology

- **Sustainability Concepts**
  - Definitions and principles of sustainability (environmental, economic, social sustainability)
  - The role of ecological footprint and carbon footprint in sustainability assessments
- **Sustainable Agriculture and Forestry**
  - Agroecology, organic farming, sustainable land-use practices
  - Forest conservation and sustainable forestry management
- **Urban Sustainability**
  - Green cities, sustainable architecture, and urban ecology
  - Sustainable transportation and waste management systems

Unit 8: Emerging Global Ecological Issues and Future Directions

- **Emerging Environmental Issues**
  - Ocean acidification, biodiversity loss, and the sixth mass extinction
  - Genetic engineering and synthetic biology in environmental conservation
- **Global Environmental Challenges in the 21st Century**
  - Population growth, resource depletion, and environmental equity
- **The Role of Technology in Global Ecology**
  - Role of biotechnology, renewable energy, and environmental monitoring technologies
  - Citizen science, big data, and artificial intelligence in ecological research

Suggested Books:

1. "Essentials of Ecology" by G. Tyler Miller & Scott Spoolman
2. "Global Ecology: Understanding Global Environmental Change" by H. R. S. U.
3. "Introduction to Environmental Studies" by Andrew Friedland and Rick Relyea

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

Mycology & Phycology

Course Code: BMB-303 **Credit Units: 04**

Pre-requisite: Basic information of Fungus and Algae

Course Outcome:

After the successful completion of this course

- Students should be able to know about various groups of fungi and algae.
- As most of the fungi are seen through naked eyes, students will be able to recognize them.
- Students will also have an idea about the pros and cons of fungi and algae.
- Students should be able to know about economic importance of fungi and algae.

Details of the Course:-

Unit I:

History of Mycology, Classification of fungi, Morphology, microscopy and structure of fungi

Unit II: General Overview Phylums:-

Chytridiomycota (The chytrids), Zygomycota (The conjugated fungi), Ascomycota (The sac fungi), Basidiomycota (The club fungi), Deutromycota (The imperfecti fungi).

Unit III:

Symbiotic association of fungi, Nutrition requirements

Unit IV:

Parasexual Cycles, Alcoholic fermentation, Fungus like organisms, Rusts and Smuts, Fungal disease of plants and humans

Unit V:

Classification and application of algae: General classification, Life cycle, thallus organisation and occurrence – (i) Chlorophyceae (ii) Charophyceae (iii) Diatoms (iv) Xanthophyceae (v) Phaeophyceae (vi) Rhodophyceae: (vii) Cyanobacteria

Lichens, Economic importance of algae with examples in agriculture, environment, industry and food.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books/Reference Books	
1.	Introduction to Fungi 3 rd Edition. John Webster and Roland W.S. Weber (2007). Cambridge.	2007
2.	An Introduction to Mycology. R.S. Mehrotra and K.R. Aneja (2005). New age International Publishers.	2005
3.	Kumar HD. (1995). *The Text Book on Algae*. 4th edition. Affiliated East Western Press	1995

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

Public Health and Pandemics

Course Code: BMB-303a **Credit Units: 04**

Pre-requisite: Basic understanding of diseases and their pathogenesis

Course Outcome:

Students will be able to learn and understand the concepts of how human system works in altered and diseased stage under the influence of various internal and external stimuli.

Details of the

Course:-Unit I:

Introduction:

History of pathology, basic definitions and familiarization with the common terms used in pathology, techniques used in pathology.

Cellular Adaptations, Cell Injury and Cell Death:

Causes and mechanisms of cell injury: reversible and irreversible injury, Cellular responses: Hyperplasia, Hypertrophy, Atrophy, Metaplasia, Necrosis, Apoptosis, subcellular and intracellular response, (with suitable examples of diseases), Cellular ageing.

Unit II: Role of Inflammation in diseases (with suitable examples):

General features of acute and chronic inflammation: Vascular changes, cellular events, termination of acute inflammatory response. Cells and molecular mediators of inflammation, morphological effects and outcome of acute inflammation. Systemic effects of chronic inflammation, granulomatous inflammation.

Unit III: Tissue Renewal And Repair, Healing And Fibrosis:

Mechanism of tissue regeneration, role of ECM, repair by healing, scar formation and fibrosis, cutaneous wound healing, tissue remodelling in liver (mechanism of fibrosis and cirrhosis).

Unit IV: Hemodynamic Pathology:

Edema, hyperaemia, congestion, haemorrhage, haemostasis and thrombosis, Embolism,

Infarction and shock and hypertension,**Nutritional diseases:** Protein energy malnutrition, deficiency diseases of vitamins and minerals, nutritional excess and imbalances. Role and effect of metals (Zinc Iron and Calcium) and their deficiency diseases.

Unit V: Cell proliferation: Cancer:

Definitions, nomenclature, characteristics of benign and malignant neoplasms, grading and staging of cancer, biology of tumor growth, mechanism of tumor invasion and metastasis, carcinogens and cancer, concept of oncogenes, tumor suppressor genes, DNA repair genes and cancer stem cells.

Pathophysiology diseases:

A. Aetiology and Pathophysiology of: Diabetes, Arteriosclerosis, Myocardial infarction, restrictive and obstructive respiratory diseases (COPD), Parkinson, Schizophrenia, Silicosis

B. Infectious Diseases: Pathogenesis of diseases and overview of modes of infections, prevention and control with suitable examples like Typhoid, Dengue

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Robbins and Cotran Pathologic Basis of Disease, 8th edition (2009), Vinay Kumar, Abul K. Abbas, Jon C. Aster, Nelson Fausto; Saunders Publishers, ISBN-13: 978-1416031215.	2009
2.	Medical Laboratory Technology Methods and Interpretations Volume 1 and 2, 6th edition (2009), Ramnik Sood; Jaypee Brothers Medical Publishers, ISBN-13: 978-8184484496.	2009
	Reference Books	
1.	General and Systematic Pathology, 2nd edition (1996), J., Ed. Underwood and J. C. E. Underwood; Churchill Livingstone, ISBN-13: 978-0443052828.	1996
2.	Robbins Basic Pathology, 9th edition (2012), Kumar, Abbas, Fausto and Mitchell; Saunders Publication, ISBN-13: 978-1437717815.	2012

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

Biofertilizers and Biopesticide

Course Code: BMB-304 **Credit Units: 02**

Pre-requisite: Basic information of Biofertilizers and Biopesticide

Course Outcome:

After completion of the course the students should be able to

- Learn the basic concept of microbial interactions.
- Understand the role of microbes as Biofertilizers.
- Learn basic understanding of role of microbes as bioinsecticides.

Details of the Course:-

UNIT-I: Biofertilizers:

General account of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers.
Symbiotic N2 fixers: Rhizobium - Isolation, characteristics, types, inoculum production and field application, legume/pulses plants; Frankia- Isolation, characteristics, non-leguminous crop symbiosis. Cyanobacteria, Azolla- Isolation, characterization, mass multiplication, Role in rice cultivation, Crop response, field application.

UNIT-II: Non - Symbiotic Nitrogen Fixers:

Free living *Azospirillum*, *Azotobacter*- free isolation, characteristics, mass inoculums, production and field application.

UNIT-III: Phosphate Solubilizers:

Phosphate solubilizing microbes (bacteria and fungi) - Isolation, characterization, mass inoculum production, field application.

UNIT-IV: Mycorrhizal Biofertilizers:

Importance of mycorrizal inoculum, types of mycorrhizae and associated plants, Mass inoculums production of Ectomycorrhizae and VAM, field applications of Ectomycorrhizae and VAM.

UNIT-V: Bioinsecticides:

General account of microbes used as bioinsecticides and their advantages over synthetic pesticides, *Bacillus thuringiensis*, production, Field applications, Viruses – cultivation and field applications (Baculovirus).

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Saleem F and Shakoori AR. Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG	2012
2.	Aggarwal SK. Advanced Environmental Biotechnology, APH publication.	2005
	References	
1.	Kannaiyan, S. Bioetchnology of Biofertilizers, CHIPS, Texas.	2003
2.	Mahendra K. Rai. Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.	2005
3.	Reddy, S.M. et. al. Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.	2002

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

Biomathematics and Biostatistics

Course Code: BMB-305 **Credit Units: 04**

Pre-requisite: Basic knowledge of Bio Mathematics and Bio Statistics

Course Outcome:

- Students will understand the use of mathematics and the significance of their application.
- Students will be able to understand the concept of Biostatistics.
- Understand the concept of Calculus.
- Explain the application of probability for Bio Students.
- Students will be able to understand sampling theory.
- Students will be able to learn Basic concept of Algebra.

Details of the Course:-

UNIT-I: Introduction of Bio statistics:

Introductory Statistics, Measure of central tendency: Mean Mode, Median. Measure of Dispersion: Standard Deviation, Variance, Moments, Skewness and Kurtosis.

UNIT-II: Probability:

Basic probability and laws. Random variable, variable (Discrete and Continuous), Probability density function and probability mass function. Distribution Binomial, Poisson and normal (without proof).

UNIT-III: Statistical methods:

Sampling parameters Difference between sample and Population parametric and nonparametric statistics, Chi-square test.

UNIT-IV: Basic concepts of Algebra (Linear and quadratic):

Progression: arithmetic progression, geometric progression and harmonic progression (with application in practicals).

UNIT-V: Calculus:

Basic concepts of differentiation and Integration, Coordinate 2D, straight line, properties of straight line, area of a triangle.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	C.B.Gupta, S.R.Singh and Mukesh Kumar "Engineering Mathematics for Semesters III and IV", McGraw Hill Education	2016
2.	Riyaz Ahmad Khan " Introduction to Remedial Mathematics" S.Chand Publication	2010
	Reference Books	
1.	A. Edmondson and D, Druce: Advanced Biology Statistics, Oxford University Press	1996
2.	W. Danial Biostatistics: A foundation for Analysis in Health Sciences, John Wiley and Sons inc	2004

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

Elementary Mathematics

Course Code: BMB-305a **Credit Units: 04**

Pre-requisite: Basic information of Mathematics and Biostatistics

Course Outcome:

A student who successfully fulfills the course requirements will be able to

- define and appropriately use information technology terms;
- identify computer hardware components and describe their function;
- describe the essential elements of the computer's architecture and discuss how this architecture functions;
- describe the characteristics and representations of data, and interpret and compare data in different representations;
- identify and describe telecommunication components;
- describe the characteristics of operating systems and compare different operating systems;
- use a hypertext markup language to produce basic Web documents;
- discuss the general trends in technologies including examples of leading edge developments;
- Compare the roles of different sectors of the information technology.

Details of the course:

S. No.	Contents	Contact Hours
1	Introducing Computer System Evolution Of Computers, Generations of Computer, Characteristics Of Computers, Functions Of Computers, Advantages, Disadvantages Of Computers, Computer Applications ,The parts of a Computer system, Types Of Computers. Storing Data: Types of storage devices, Memory Hierarchy. Essential computer hardware, software. Computer Input Devices: Keyboard, Mouse, Webcam, Joystick and Output devices: Monitor, Printer, Plotters. Data representation	8
2	Using Operating System Operating system basics- The purpose of operating system, Type of operating system, providing a user interfaces. Networks and the Internet Networking basics – The uses of a network, Common types of networks. Network topologies. What is the Internet? Internet‟s major services, Understanding the world wide web.	8

3	Algorithms and Flowcharts Algorithms, Flowcharts, Divide and computer strategy, Writing algorithms and drawing flowcharts for simple exercises – Swapping contents of 2 variables, Largest of given three numbers, Solving a given quadratic equation, Factorial Of a given integer Constants, Variable and Data types Characters set, C tokens, Keywords and identifiers, Constants, Variables, Data types, Declaration of variables.	8

	Operators and Expressions. Decision making and branching Decision making with *if* statement, simple if statement, the if « H O statement, nesting of L I « H statements. The H O V H ladder, the switch statement, the: operator, the go to statement. Decision making and looping The *while* statement, the *do* statement, The *for* statement, jumps in loops.	
4	Introduction of Bio statistics Introductory Statistics, Measure of central tendency: Mean, Mode, Median. Measure of Dispersion: Standard Deviation, Variance, Moments, Skewness and Kurtosis.	10
5	Statistical methods Sampling parameters Difference between sample and Population parametric and nonparametric statistics, Chi-square test.	8

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books/ Reference Books	
1.	Norton, Peter, "Introduction to Computers", McGraw-Hill.	2005
2.	Rajaraman, V., "Fundamentals of Computers",PHI.	2005
3.	PK SINHA "Computer Fundamentals", BPB	Fourth edition
4.	Yashwant Kanetker, "Let us C",BPB.	2004
5.	A. Edmondson and D, Druce: Advanced Biology Statistics, Oxford University Press	1996
6.	W. Danial Biostatistics: A foundation for Analysis in Health Sciences, John Wiley and Sons inc	2004
7.	Rajaraman, V., "Computer Programming in C",PHI.	2005

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

Microbial Genetics Lab

Course Code: BMB-351 **Credit Units: 02**

Pre-requisite: Basic information of Microbial Genetics Lab

Course Outcome:

After completion of the course the students will be able to

- Learn about principle and working of laboratory instruments.
- Acquire a comprehensive knowledge on techniques followed in study of genetic mutation.
- Become familiar with technical requirements, concepts and general procedures in molecular biology and implement the knowledge in research work.
- Learn and implement different strategies to isolate genomic and plasmid DNA from cells.
- Learn the methods of DNA transformation, transduction and conjugation for future recombinant techniques.

Details of the Course:-

S. No.	Contents	Contact Hours
1	Preparation of Master and Replica Plates.	3
2	Study the effect of chemical (HNO_2) and physical (UV) mutagens on bacterial cells.	3
3	Study survival curve of bacteria after exposure to ultraviolet (UV) light.	3
4	Isolation of Plasmid DNA from *E.coli.*	3
5	Study different conformations of plasmid DNA through Agarose gel electrophoresis.	3
6	Demonstration of Bacterial Conjugation.	3
7	Demonstration of bacterial transformation and transduction.	3
8	Demonstration of AMES test.	3
9	Isolation of genomic DNA from bacteria.	3
10	To isolate naturally occurring mutants from soil.	3

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text/Reference Books	
1.	Principles and techniques of Practical Biochemistry: K. Wilson and J. Walker, Cambridge University Press, Cambridge.	2002
2.	Practical Genetics Paperback – August, by Jones (Author), Rickards (Author), Publisher: Open Univ Pr	1991

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER III

Bacteriology & Virology Lab

Course Code: BMB-352 **Credit Units: 02**

Pre-requisite: Basic information of Bacteriology and Virology

Course Outcome:

After completion of the course the students will be able

- To learn good laboratory practices.
- To learn the principle and working of microbiology instruments and equipment in accordance with current laboratory safety protocol.
- To utilize the microbial flora for various applications.
- To learn microbiology laboratory techniques.

Details of the Laboratory Course:-

Note: A college must offer 70% of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available.

S. No.	Contents	Contact Hours
1.	Preparation of different media: Complex media-Nutrient agar, McConkey agar, EMB agar.	2
2.	Simple staining, Negative staining, Gram‟s staining, Capsule staining, Endospore staining	5
3.	Isolation of pure cultures of bacteria by streaking method.	2
4.	Preservation of bacterial cultures by various techniques.	2
5.	Estimation of CFU count by spread plate method/pour plate method.	2
6.	Motility by hanging drop method.	2
7.	Isolation of coliphages from sewage water sample.	2
8.	One step growth curve for determination of virus titre.	2
9.	Immunological assays for virus detection.	2
10.	Cultivation and morphological identification of animal cell lines.	2

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Experiments in Microbiology, Plant Pathology and Biotechnology. 4th Edition. Aneja, K.R. (2003). New Age International Publishers, New Delhi. 5th ed.	2017
	References	
1.	Microbiology: A Laboratory Manual. Benjamin Cummings. 10th edition. Cappuccino J. and Sherman N. (2013)	2013
2.	Laboratory exercises in Microbiology by Harley Prescott. 7th edition, McGraw-Hill Higher Education.	2008
3.	Benson‟s Microbiology Application, laboratory Manual Concise version (2016) McGraw Hill Publisher- 14th ed	2016
4.	Applied Microbiology laboratory Manual (2016) Kendall Hunt Publisher- 5th Edition, Frances Duncan	2016

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER III

Mycology & Phycology Lab

Course Code: BMB-353 **Credit Units: 02**

Pre-requisite: Basic information of Fungus and Algae

Course Outcome:

After the successful completion of this course

- Students will be able to isolate fungi from soil.
- Students will be able to learn about the cultivation and preservation of fungi and algae.
- Students will be able to recognize the microscopic structure of fungi.
- Students will be able to recognize the microscopic structure of algae.

Details of the Course:-

S. No.	Contents	Contact Hours
1	To study cultivation and preservation of fungus under laboratory conditions.	2
2	Field trip to nearby forest area of Shobhit University and sample collection.	2
3	Isolation of fungi from fungal infected fruits or bread.	2
4	Isolation of fungi from soil.	2
5	To study morphology, microscopy of isolated fungi.	2
6	Various enzyme production by fungi (plate assay).	2
7	Effect of pH and temperature on fungus.	2
8	Study of the following genera through temporary and permanent slides: *Volvox, and Nostoc.*	2
9	Study of the following genera through temporary and permanent slides: Coleochaete, Vaucheria, Ectocarpus, Polysiphonia.	2

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Introduction to Fungi 3 rd Edition. John Webster and Roland W.S. Weber (2007). Cambridge.	2007
2.	Alexopoulus C.J, Mims C.W. and Blackwel M.I 1996. Introductory Mycology. John Wiley and Sons Inc.	1996
3.	Kumar HD. (1990). Introductory Phycology. 2nd edition. Affiliated East Western Press.	1990
4.	Microbiology 5 th Edition. Prescott, L. M.; Harley, J.P. and Klein, D.A. (2003) McGraw Hill, USA.	2003

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

General Proficiency-III

Course Code: GP-301 **Credit Units: 01**

Pre-requisite: Basic information of English Language

Course Outcome:

- ·Effective communication: The ability to exchange ideas and information in a way that builds trust and respect
- ·Critical and analytical thinking: The ability to explore issues and ideas before forming a conclusion
- ·Integrative thinking: The ability to synthesize knowledge across different domains and perspectives
- ·Preparing students to be engaged citizens: Preparing students to participate in political culture and thrive in a rapidly evolving world

Details of the Course:-

General language proficiency is the ability to read, write, listen, and speak in real-life situations. To test this, a test is usually developed for each skill with questions that are designed to imitate real life.
A syllabus is a guide to a course that includes course policies, rules, regulations, required texts, and a schedule of assignments and seminar.

Examination Scheme:

Components	**Internal Assessment**			**External Evaluation**
	Attendance	**Class Test**	**Assignment/ Project/Seminar/Quiz**	
Weightage (%)	10	20	10	60

Pshycology

Course Code: GP-301 a **Credit Units: 01**

Pre-requisite: Basic information of Psychology

Course Outcome:

- · Define and explain core concepts in psychology, including behavior, mental processes, sensation, perception, and learning.
- · Apply theories from different areas of psychology (cognitive, behavioral, humanistic, etc.) to real-world problems.

Details of the Course:-

Psychology is the scientific study of behavior and mental processes. The course syllabus typically covers various branches of psychology, including biological, cognitive, developmental, social, clinical, and abnormal psychology. It explores human behavior in different contexts, using both theoretical and empirical approaches.

Examination Scheme:

Components	**Internal Assessment**			**External Evaluation**
	Attendance	**Class Test**	**Assignment/ Project/Seminar/Quiz**	
Weightage (%)	10	20	10	60

Sociology

Course Code: GP-301b **Credit Units: 01**

Pre-requisite: Basic information of Sociology

Course Outcome:

- Understand Sociological Concepts
- Conduct Sociological Research
- Analyze Social Institutions

Details of the Course:-

Sociology is the scientific study of society, human behavior, social relationships, and the structures that shape individuals' lives. The sociology course typically covers topics ranging from social institutions (family, education, religion) to issues like class, race, gender, and global inequalities. It involves understanding social processes, patterns of behavior, and the impact of social forces on individuals and groups.

Examination Scheme:

Components	**Internal Assessment**			**External Evaluation**
	Attendance	**Class Test**	**Assignment/ Project/Seminar/Quiz**	
Weightage (%)	10	20	10	60

SEMESTER IV

Molecular Biology

Course Code: BMB-401 **Credit Units: 04**

Pre-requisite: Basic information of Cell Biology

Course Outcome:

- Students will gain an understanding of molecular biology of nucleus and its effect of functioning of an organism.
- Students will understand the concepts of DNA, RNA and will develop an insight into the mechanism of DNA replication in the cell.
- Students will learn about the physiochemical reasons of damage of DNA and their effect on body functioning and will be able to analyze the in vivo mechanism of repair of DNA

damage and recombination processes.

- Students will develop an understanding of formation of RNA, different mechanisms in prokaryotes and eukaryotes and processing of final transcriptional products.
- Students will be able to understand the process of protein formation and its control.
- Students will be able to analyze the mechanisms of gene expression and its regulation.

Details of the Course:-

UNIT-I: Structure of nucleotides and nucleic acids:

Structures and types of DNA and RNA, packaging of genetic material in prokaryote sand eukaryotes

UNIT-II: DNA replication:

Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, Replication enzymes

UNIT-III: DNA damage, repair and homologous recombination

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, Nonhomologous end joining. Homologous recombination: models and mechanism.

UNIT-IV: Transcription and RNA processing:

Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains
Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5‟ cap formation, polyadenylation, splicing, rRNA and tRNA splicing.

UNIT-V: Regulation of gene expression and translation

Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation. Posttranslational modifications of proteins.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Genes IX, Lewin, Benjamin, Jones and Bartlett.	2008
	Reference Books	
1.	Molecular Biology of the Gene, James D Watson et. al., (5^{th} Edition,) Pearson	2009

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER IV

Economic Biology

Course Code: BMB-401a **Credit Units: 04**

Pre-requisite: Basic information of Economic Biology

Course Outcome:

- Students will gain an understanding of molecular biology of nucleus and its effect of functioning of an organism.
- Students will understand the concepts of DNA, RNA and will develop an insight into the mechanism of DNA replication in the cell.
- Students will learn about the physiochemical reasons of damage of DNA and their effect on body functioning and will be able to analyze the in vivo mechanism of repair of DNA damage and recombination processes.
- Students will develop an understanding of formation of RNA, different mechanisms in prokaryotes and eukaryotes and processing of final transcriptional products.
- Students will be able to understand the process of protein formation and its control.
- Students will be able to analyze the mechanisms of gene expression and its regulation.

Pre-requisite: In-depth knowledge of Molecular Biology

Details of the Course:-

Unit I: Introduction and scope of RDT:

Recombinant DNA, Milestones in genetic engineering, Biosafety and Bioethics, Overview of Scope and Applications of Recombinant DNA Technology. Isolation of nucleic acid (plasmid, DNA and RNA), quantification and its purity.

Unit II: Tools and strategies of molecular cloning:

Enzymes in Recombinant DNA Technology and its applications: Nucleases, Restriction endonucleases, DNA Polymerases, Terminal transferase, Reverse transcriptase, Kinase and Phosphatase, DNA ligases (T4 DNA ligase and *E.coli* DNA ligase).

Structure and strategies of cloning and screening of vectors based upon: Plasmids, Cosmids, Phages, Artificial Chromosomes (BAC and YAC), and hybrid vectors, shuttle vectors, plant vectors (*Agrobacterium* and virus based), expression vectors.

Unit III: Gene Cloning and Expression:

Cloning and screening strategies (including directional cloning): Cutting and joining

vector and insert DNA, transformation of recombinant DNA in host, methods for screening of Transformants. Introduction to gene expression (Prokaryotic and eukaryotic expression). Synthesis of cDNA, Construction of cDNA library and genomic DNA library.

Unit IV: Methods in RDT:

DNA, RNA and Protein analysis: Agarose gel electrophoresis, SDS-PAGE, Gel Shift Assay. Blotting techniques: Southern-, Northern- and Western blotting, probe labeling and hybridization; Polymerase Chain Reaction: Principle, methodology and application; variants of PCR. Molecular markers and their applications; DNA microarray analysis; Chromosome walking; Site directed mutagenesis.

Unit V: Application of RDT:

Transgenic Technology: Types approaches and application (Plant and Animals); Gene therapy: Principles, strategies and ethics of human gene therapy; DNA Fingerprinting and application of DNA technology in forensics and parental disputes; Products of recombinant DNA technology: human therapeutic- insulin, hGH, recombinant vaccines.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Gene Cloning and DNA Analysis, An Introduction, T. A. Brown (7^{th} edition), Wiley-Blackwell	2015
2.	Recombinant DNA: Genes and Genomes - A Short Course, James D. Watson , Richard M. Meyers, Amy A. Caudy, Jan A. Witkowski, (3rd Edition), W.H. Freeman	2007
	Reference Books	
1.	Molecular Cloning: A Laboratory Manual, Michael R. Green; Joseph Sambrook, (Fourth Edition), CSHL Press	2012
2.	Principles of Gene Manipulation and Genomics, Primrose, S.B. and Twyman, R.M., (7th ed.) Blackwell Publishing	2006

Examination Scheme:

	Internal Assessment	

Components	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	External Evaluation
Weightage (%)	10	20	10	60

SEMESTER IV

Gender Studies

Course Code: BMB-401b **Credit Units: 04**

Pre-requisite: Basic information of Gender equality

Course Outcome

CO-1To familiarize the students with the terminologies related to Gender studies.
CO-2To elaborate the concept of patriarchy and its impact on women
CO-3To introduce students to the discipline of Women's Studies and Gender Studies and its perspectives.
CO-4To trace the evolution of Gender Studies from Women's Studies. Learning outcomes
CO-5Familiarity with fundamental concepts related to field of women and gender studies.

Unit I
Introduction: Gender Studies - Origin and growth; need for Gender Studies – objectives, nature and scope of Gender Studies. Establishment of Centre for Women's Studies under UGC guidelines 14H

Unit II
Basic Concepts: Meaning and definition: gender, sex, difference between gender and sex, gender equality, gender empowerment, gender roles, gender gap. Patriarchy and Matriarchy: Meaning and definition. Gender discrimination- meaning, forms and areas, Need for Gender Sensitization. Bio-social perspective of gender, gender socialization, gender stereotyping, gender bias 16H Page 5 of 34

Unit III
Multidisciplinary Nature of Gender Studies Multi-disciplinarity of gender studies, relationship with mainstream social sciences (Economics, Sociology, History, Literature, Anthropology, Psychology and Political Science) 14 H

Unit IV
Women's Studies and Gender Studies A paradigm shift: from Women's Studies to Gender Studies. Relevance of women/gender studies in Indian context 6 H

Unit V
Future of Gender Studies Gender studies as a profession- employment opportunities, constraints, emerging needs Role of UGC in promoting the women's and gender studies, future of gender studies

Recommended Readings

1. Maithreyi Krishnaraj (2006), Is 'Gender' Easy to Study? Some Reflections, Economic and Political Weekly, October 21
2. 2. Menon, Nivedita (1999), Gender and Politics In India, OUP, New Delhi.
3. 3. Neera Desai and MaithreyiKrishnaraj (1986), Women's Studies in India – Some Perspectives, Popular Prakashan Private Ltd, Mumbai.
4. 4. Vina Mazumdar (1985), Emergence of Women's Question and Role of Women's Studies, Occasional Paper, Centre for Women's Development Studies, New Delhi
5. 5. Mary E. John (2008), Women's Studies in India – A Reader, Penguin Books, New Delhi
6. 6. Neera Desai and Maithreyi Krishnaraj (1987), Women and Society in India, Ajantha Publications, New Delhi
7. 7. Burton, A. (1994) Burdens of History: British Feminists, Indian Women and Imperial Culture. University of North Carolina Press

SEMESTER IV

International Business in Dairy Science

Course Code: BMB-401c **Credit Units: 04**

Pre-requisite: Basic knowledge of food microbiology.

Course Outcome:

CO-1: Students will be able to know about the microorganisms important in food microbiology.
CO-2: Students would know about the factors influencing microbial growth in food.
CO-3: Students will understand various food borne diseases.
CO-4: Students will also have knowledge of microbiology of milk.
CO-4: Students will understand microorganisms as source of food.

Details of the Course:

Sl. No.	Contents	Contact Hours
1.	**UNIT-1** Microorganisms important in food microbiology: molds, yeast and bacteria – general characteristics, classification and importance. Principles of food preservation, preservation by use of high temperature, low temperature, drying and dessication. Chemical preservatives and additives. Preservation by radiation.	4
2.	**UNIT-2** Factors influencing microbial growth in food: Extrinsic and intrinsic factors. Microbial spoilage of food. Chemical changes caused by the microorganisms during spoilage. Spoilage of fish, meat, poultry, eggs, fruits and vegetables. Detection of spoilage and characterization.	10
3.	**UNIT-3** Classification of food borne diseases. Food borne infections: Brucella, Bacilllus cereus, Clostridium perfringens, Yersinia enterocolitica and Escherichia, Salmonella spp. Food intoxication: Staphylococcal intoxication, Clostridial poisoning (Clostridium Botulinum). Food adulteration and prevailing food standards in India.	9
4.	**UNIT-4** Microbiology of Milk: Sources of microorganisms in milk and types of microorganisms in milk. Microbiological examination of milk (standard plate count, direct microscopic count, reductase, and phosphatase test). Dehydration and pasteurization of milk. Dairy products from microorganisms: Butter, yoghurt and cheese.	12

5.	**UNIT-5** Microorganisms as source of food: Single Cell Protein (SCP). Mushrooms and food value of mushrooms. Food conversions: Lactic acid conversions, soyabean conversions and Bakery. Microbiological estimation of food: Sample collection, preparation and analysis techniques.	6

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Food science By Norman N. Potler, Joseph H. Hotchkiss. Fourth edition, CBS Publishers and Distributors, New Delhi	2006
2.	Food Microbiology , by William C. Frazier and Dennis C. Westhoff, Fourth edition, Tata McGrawHill Publishing Company Limited, New Delhi	1997-1979
3.	Modern Food Microbiology by James M. Jay, Fourth Edition, CBS Publishers and Distributors, New Delhi.	1959
4.	Bains W. Biotechnology from A to Z. Oxford Univ. Press.	1993
	Reference Books	
1.	Introduction to Food Biotechnology. Author; Perry Johnson.	2002

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER IV

Immunology

Course Code: BMB-402 **Credit Units: 04**

Pre-requisite: Basic information of microbiology, infection, immunity.

Course Outcome:

- Students will be able to define and explain the fundamental principles of modern immunology.
- Students will be able to *classify* antibodies on the basis of their structures and functions.
- Students will be able to *understand* related immunological techniques and *apply* them in medical laboratory profession.
- Students will *acquire* knowledge about processing and presentation of antigens by different methods.
- Student will be able to understand cell mediated immune response.
- Students will be able to value role of immune system in different diseases.
- Students will be able to *apply* their knowledge to healthy and disease contexts.

Details of the Course:-

UNIT – I: Introduction:

History: Concept of Innate and Adaptive immunity; Structure, Functions and Properties of: Immune Cells; and (Primary and secondary Lymphoid organs). Active and Passive Immunity.

UNIT – II: Antigens and Antibodies:

Antigen, Immunogen, Factorscontributing immunogenicity, Epitopes, Haptens; Adjuvants

Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); Monoclonal and Chimeric antibodies, Hybridoma Technique. Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, RIA, Immunofluoresence, Immunoelectron microscopy, Complement fixation test.

UNIT – III: Major Histocompatibility Complex and Complement System:

Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways). Components of the Complement system; Activation pathways (Classical, Alternative and Lectin pathways).

UNIT – IV: Generation of Immune Response:

Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response, T-cell receptor, T-cell maturation, activation and differentiation.

UNIT – V: Immunological Disorders, Tumor Immunity and vaccines:

Autoimmunity and Autoimmune diseases, Hypersensitivity- Type I Hypersensitivity, Type II Hypersensitivity, Type III Hypersensitivity, Type IV Hypersensitivity; Types of tumors, tumor Antigens, causes and therapy for cancers, Vaccine.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/ Reprint
	Text Books	
1.	Immunology, Goldsby RA, Kindt TJ, Osborne BA. Kuby‟s. 6th edition W.H. Freeman and Company, New York, 2007.	2007
2.	Essential Immunology, 10thed Roitt, Ivon; Delves, Peter (2001) Blackwell Scientific Publications Oxford.	2017
	References	
1.	Basic and Clinical Immunology, Peakman M, and Vergani D. 2nd ed). Immunology on Churchill Livingstone Publishers, Edinberg, 2009	2009
2.	Richard C and Geiffrey S. 6th edition. Wiley Blackwell Publication. 2009.	2009
3.	Janeway‟s Immunobiology, Murphy K, Travers P, Walport M., 7th edition Garland Science Publishers, New York. 2008.	2008

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER IV

Anthropology

Course Code: BMB-402a **Credit Units: 04**

Pre-requisite: Basic information of insects.

Course Outcome:

- After completion of the course the students will be able to
- Understand the microbial growth in different physiological conditions.
- Learn the phenomenon of nutrient utilization of microbes.
- Comprehend the concept of microbial respiration and their metabolism.

UNIT-1 Social anthropology:
history and subject matter; Relationship of social and cultural anthropology with sociology, psychology, history, economics and political science.

UNIT-2 Concepts of Society;
Pre-requisite of Human society Individual and Society; Group and its types; Community; Association and Institution Status and Role ;

Unit -3 Social fact;
Social Action; Social Structure , Function and Social Organisation ; Structural - Functionalism ; Social System ; Social Conflict

Unit -4 Techniques and methods:
Field work/ Ethnography and Survey Research Comparative and Historical Methods

References:

1. Metcalf Peter (2005) Anthropology: the basics. Abingdon (England), Routledge.
2. Ingold Tim (1994) Companion encyclopedia of anthropology. London, Routledge reference.
3. R.M MacIver & Charles H. Page (1950) Society : An Introductory Analysis. London, Macmillan
4. Ralph Linton (1936) The Study of Man. New York, Appelton Century Croft.
5. M. J. Herskovits (1974) Cultural Anthropology, New Delhi, Oxford and IBH Publications.
6. Roger Keesing (1984) An Introduction of Cultural Anthropology. NewYork, MacMillan.
7. Kingsley Davis (1948) Human Society, New York: MacMillan.
8. John Monaghan and Peter Just (2000) Social and Cultural Anthropology: A very Short Introduction. 9. Thomas Hylland Eriksen (2010) Small Places, Large Issues: An Introduction to Social and Cultural Anthropology.
10. Nigel Rapport and Joanna Overing (2006) Social and Cultural Anthropology: The Key Concepts .

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER IV

Neurobiology

Course Code: BMB-402b **Credit Units: 04**

Course Outcome

- Gain a strong foundation in the fundamental principles of neurobiology, including the physiology of neurons, synaptic transmission, and cellular mechanisms.
- Understand the molecular basis of neural signaling, including ion channels, receptors, and neurotransmitter systems.
- Identify and describe the key structures of the central and peripheral nervous systems (e.g., brain regions, spinal cord, sensory and motor pathways).
- Understand how neural circuits and networks contribute to sensory processing, motor control, and higher cognitive functions.

UNIT I Neural induction

Overview of early embryology +details of hydra, C. elegans (indentation), Drosophila (delamination), frog, zebrafish, chick and humans (invagination),'Organiser 'of differentiation- Spemann and Mangold experiments, Keller sandwich,Molecular nature of neural inducer- Noggin, chordin, follistatin, activing, BMP4-WNT signalling- important for formation of neural plate,Neuroblast induction-acheate scute, lateral inhibition and details – notch delta signalling pathway- important for formation of neuroblasts.

UNIT II Polarity and Segmentation

Overview of polarity and brain architecture, rhombomeres
AP-Axis in Drosophila-Bicoid and nanos, homeobox genes, ANT-C and BX-C in flies, effect of homeobox genes on hindbrain development in mammals,Upstream control of hox genes, transformers-RA, WNT-b-catenin, FGF Mesencephalon/metencephalon boundary organiser-WNT1, ENGRAILED1, FGF8,Forebrain development in mammals-pax genes,DV-axis polarity-sonic hedgehog(shh) induces the ventralisation (floorplate),Dorsal neural tube development- again WNT/BMP and shh signaling,Patterning the cerebral cortex-pax6, emx2, fgf8 and fgf18

UNIT III Genesis and Migration

Methods to visualise lineage and timing of a neurons birth-thymidine, BrdU, retroviral GFP, thymidine dating
Molecular control of neuron number-intrinsic proteins and also mitogens like FGF, IGF,What separates neurons from glia,Cerebral and cerebellar cortex formation
Molecular control of migration of neurons, adult neurogenesis

UNIT IV Determination and differentiation

Determination-various transcription factors involved (intracellular factors),Asymmetric cell division – eg NB, GMC, neuron – (numb and prospero) and drosophila eye,Local environmental factors- eg Drosophila eye imaginal disc (MF) and chick-quail transplant studies,Histogenesis-loss of competence Eg layers of the cortex by transplantation studies and retina by heterochronic experiments
Neuronal differentiation form neural stem cell, embryonic stem cell and induced pluripotent cell-basic principle and methodology

UNIT V Axon growth and guidance

Overview of growth cone and axonal pathfinding. Initial study,Guidance cues for growth cone – Netrin, Semaphorin and Ephrins,Substrates for growth of developing axon – Role of cell adhesion molecule,in growth cone guidance,Mechanism of axon guidance-guidance cues and the control of cytoskelata dynamic, localized translational of growth cone guidance, changing response to guidance cues,Axon regeneration

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	University Chemistry, B.H.Mahan	1987
2.	Chemistry, Principles and Application, M.J. Sienko and R.A. Plane	1980
	Reference Books	
1.	Physical Chemistry, P.W. Atkins	2009
2.	Organic Chemistry, I.L.Final (Vol-1, Vol-2)	2002
3.	Fundamentals of Molecular Spectroscopy, C.N. Banwell	1994

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER IV

Nanotechnology

Course Code: BMB-402c **Credit Units: 04**

Course outcomes

- Understand nanoscale materials: Learn about the unique properties of materials at the nanoscale
- Manipulate nanomaterials: Master techniques for synthesizing and manipulating nanomaterials
- Develop innovative applications: Create new devices and applications for various sectors

Unit I

Background to Nanoscience: Defination of Nano, Scientific revolution-Atomic Structure and atomic size, emergence and challengs of nanoscience and nanotechnology, carbon age-new form of carbon (CNT to Graphene), influence of nano over micro/macro, size effects and crystals, large surface to volume ration, surface effects on the properties.

Unit II

Types of nanostructure and properties of nanomaterials: One dimensional, Two dimensional and Three dimensional nanostructured materials, Quantum Dots shell structures, metal oxides, semiconductors, composites, mechanical-physical-chemical properties.

Unit III

Application of Nanomaterial: Ferroelectric materials, coating, molecular electronics and nanoelectronics, biological and environmental, membrane based application, polymer based application.

Unit IV

Surface Nanoscience: Introduction to surface active agents. Theory and applications.Types of surfactants. Classification, synthesis of surfactant - Shape, size and structure of surfactants. Micelle, Emulsions, Microemulsions & Gels. Kraft temperature, surfactant geometry and packing.

Unit V

Colloidal Nanoscience:Introduction to colloidal material, surface properties, origin of colloidal particles, preparation & characterization of colloidal particles. Applications of super hydrophilic hydrophobic surfaces, self-cleaning surfaces.Surface viscosity.

References:

1. Chemistry of nanomaterials: Synthesis, properties and applications by CNR Rao et.al.
2. Nanoparticles: From theory to applications – G. Schmidt, Wiley Weinheim 2004.
3. Instrument E L Principe, P Gnauck and P Hoffrogge, Microscopy and Microanalysis (2005), 11: 830- 831, Cambridge University Press.
4. Processing & properties of structural naonmaterials - Leon L. Shaw,
Nanochemistry: A Chemical Approach to Nanomaterials, Royal Society of Chemistry, Cambridge UK 2005.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER V

Medicinal Microbiology

Course Code: BMB-501a **Credit Units: 04**

Pre-requisite: Basic information of Medical Microbiology

Course Outcome:

Upon successful completion of this course the student will be able to:

CO1: Explain the morphology, physiology, and genetics of medically significant microorganisms (bacteria, viruses, fungi, and parasites).

CO2: Describe the mechanisms of microbial pathogenesis, including host-pathogen interactions and immune responses to infections.

CO3: Demonstrate knowledge of infectious diseases caused by various pathogens, their clinical manifestations, and methods of prevention.

Course Details:- Unit 1: Introduction to Microbiology

- History and scope of microbiology.
- Classification and taxonomy of microorganisms.
- Morphology and structure of bacteria, viruses, fungi, and parasites.
- Sterilization, disinfection, and biosafety practices in microbiology labs.

Unit 2: Bacterial Pathogenesis

- Bacterial growth, metabolism, and genetics.
- Mechanisms of pathogenicity: adhesion, invasion, toxins.
- Host-microbe interactions: immune evasion and immune responses.
- Important bacterial pathogens (e.g., *Escherichia coli, Staphylococcus aureus, Mycobacterium tuberculosis*).

Unit 3: Virology

- Structure and classification of viruses.
- Viral replication and pathogenesis.
- Laboratory diagnosis of viral infections.
- Key viruses (e.g., influenza, HIV, hepatitis viruses, coronaviruses).
- Vaccines and antiviral drugs.

Unit 4: Medical Mycology

- Fungal classification and structure.
- Pathogenic fungi and fungal diseases (e.g., *Candida, Aspergillus, Cryptococcus*).
- Laboratory diagnosis of fungal infections.
- Antifungal agents and resistance mechanisms.

Unit 5: Parasitology

- Classification and life cycles of medically important parasites.
- Protozoan infections (e.g., malaria, amoebiasis).
- Helminthic infections (e.g., schistosomiasis, tapeworms).
- Laboratory diagnosis and control of parasitic diseases.

Suggested Books:

- **Medical Microbiology" by Patrick R. Murray, Ken S. Rosenthal, and Michael A. Pfaller**
  - A comprehensive book covering the microbiology of pathogens, host defenses, and infectious diseases.
  - Focus: Clinical and diagnostic aspects with detailed illustrations.
- **"Sherris Medical Microbiology" by Kenneth J. Ryan and C. George Ray**
  - Offers a clinical approach to microbiology, highlighting mechanisms of disease.
  - Focus: Core concepts, concise explanations, and integrated case studies.

- **"Fields Virology" by David M. Knipe and Peter M. Howley**
  - The definitive text on virology, covering structure, replication, and clinical aspects of viruses.
  - Focus: Research-oriented, ideal for advanced studies.
- **"Medical Mycology" by D. R. Arora**
  - Covers fungal pathogens and associated diseases in detail.
  - Focus: Clinical and diagnostic perspectives on mycology.
- **"Parasitology: A Conceptual Approach" by Eric S. Loker and Bruce V. Hofkin**
  - Modern insights into parasitic organisms, their biology, and diseases.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER V

Recombinant DNA Technology

Course Code: BMB-502 **Credit Units: 04**

Pre-requisite: In-depth knowledge of Molecular Biology

Course Outcome:

- The student will be familiar with the historical background and important milestones, biosafety and bioethics in genetic engineering.
- The student will be acquainted with tools of RDT like enzymes, vectors and hosts.
- The student will be acquainted with technical knowhow of gene cloning and expression and factors for optimizing the heterologous gene expression.
- The student will be acquainted with the techniques required for gainful applications of genetic engineering.
- The student will be able to apply RDT in different domains of life science, medical, agriculture, forensic and allied fields for the welfare of living beings.

Details of the Course:-

Unit I: Introduction and scope of RDT:

Recombinant DNA, Milestones in genetic engineering, Biosafety and Bioethics, Overview of Scope and Applications of Recombinant DNA Technology. Isolation of nucleic acid (plasmid, DNA and RNA), quantification and its purity.

Unit II: Tools and strategies of molecular cloning:

Enzymes in Recombinant DNA Technology and its applications: Nucleases, Restriction endonucleases, DNA Polymerases, Terminal transferase, Reverse transcriptase, Kinase and Phosphatase, DNA ligases (T4 DNA ligase and *E.coli* DNA ligase).
Structure and strategies of cloning and screening of vectors based upon: Plasmids, Cosmids, Phages, Artificial Chromosomes (BAC and YAC), and hybrid vectors, shuttle vectors, plant vectors (*Agrobacterium* and virus based), expression vectors.

Unit III: Gene Cloning and Expression:

Cloning and screening strategies (including directional cloning): Cutting and joining vector and insert DNA, transformation of recombinant DNA in host, methods for screening of Transformants. Introduction to gene expression (Prokaryotic and eukaryotic

expression).Synthesis of cDNA, Construction of cDNA library and genomic DNA library.

Unit IV: Methods in RDT:

DNA, RNA and Protein analysis: Agarose gel electrophoresis, SDS-PAGE, Gel Shift Assay. Blotting techniques: Southern-, Northern- and Western blotting, probe labeling and hybridization; Polymerase Chain Reaction: Principle, methodology and application; variants of PCR. Molecular markers and their applications; DNA microarray analysis; Chromosome walking; Site directed mutagenesis.

Unit V: Application of RDT:

Transgenic Technology: Types approaches and application (Plant and Animals); Gene therapy: Principles, strategies and ethics of human gene therapy; DNA Fingerprinting and application of DNA technology in forensics and parental disputes; Products of recombinant DNA technology: human therapeutic- insulin, hGH, recombinant vaccines.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Gene Cloning and DNA Analysis, An Introduction, T. A. Brown (7^{th} edition), Wiley-Blackwell	2015
2.	Recombinant DNA: Genes and Genomes - A Short Course, James D. Watson , Richard M. Meyers, Amy A. Caudy, Jan A. Witkowski, (3rd Edition), W.H. Freeman	2007
	Reference Books	
1.	Molecular Cloning: A Laboratory Manual, Michael R. Green; Joseph Sambrook, (Fourth Edition), CSHL Press	2012
2.	Principles of Gene Manipulation and Genomics, Primrose, S.B. and Twyman, R.M., (7th ed.) Blackwell Publishing	2006

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER V

Microbial Technology

Course Code: BMB-502a **Credit Units: 04**

Pre-requisite: In-depth knowledge of Molecular Biology

Course Outcome:

The student will be familiar with the historical background and important milestones,

CO1: Explain the role of microorganisms in industrial, environmental, agricultural, and healthcare applications.

CO2: Describe the principles and techniques of microbial biotechnology, including fermentation, genetic engineering, and bioinformatics.

CO3: Analyze the applications of microbial enzymes, biofuels, biopolymers, and other bioproducts in various industries

.Details of the Course:-

Unit 1: Introduction to Microbial Technology

- Historical milestones in microbial biotechnology.
- Role of microorganisms in industry, healthcare, and environment.
- Types of microbes used in technology: bacteria, fungi, viruses, and algae.
- Basic tools and techniques in microbial technology (e.g., sterilization, culture methods).

Unit 2: Industrial Microbiology

- Fermentation technology: principles, types (submerged and solid-state), and scale-up.
- Industrially important microbes: *Saccharomyces cerevisiae, Aspergillus, Lactobacillus.*
- Production of primary metabolites (e.g., ethanol, organic acids) and secondary metabolites (e.g., antibiotics, vitamins).
- Bioreactors: design, operation, and process optimization.
- Downstream processing and product recovery.

Unit 3: Microbial Enzymes and Applications

- Types of microbial enzymes: amylases, proteases, lipases, cellulases.
- Enzyme production and immobilization techniques.
- Applications in food, pharmaceutical, and biofuel industries.
- Advancements in enzyme technology: directed evolution and recombinant enzymes.

Unit 4: Microbial Genetics and Genomics

- Genetic engineering in microbes: tools (plasmids, CRISPR, cloning vectors).
- Recombinant DNA technology and its applications.
- Microbial genomics: sequencing, annotation, and functional studies.

- Synthetic biology and metabolic engineering of microbes for desired products.

Unit 5: Environmental Microbial Technology

- Role of microbes in waste management: biodegradation and bioremediation.
- Microbial treatment of wastewater and solid waste.
- Microbial biofertilizers and biopesticides in sustainable agriculture.
- Role of algae in biofuel production and carbon sequestration.

Suggested Books:

- Microbial Biotechnology: Fundamentals of Applied Microbiology" by Alexander N. Glazer and Hiroshi Nikaido
- "Industrial Microbiology and Biotechnology" by Michael J. Waites, Neil L. Morgan, and John S. Rockey
- "Manual of Industrial Microbiology and Biotechnology" by Richard H. Baltz, Julian E. Davies, and Arnold L. Demain
- "Principles of Gene Manipulation and Genomics" by Sandy B. Primrose and Richard Twyman
- "Molecular Biotechnology: Principles and Applications of Recombinant DNA" by Bernard R. Glick, Jack J. Pasternak, and Cheryl L. Patten

Examination Scheme:

Components	**Internal Assessment**			**External Evaluation**
	Attendance	**Class Test**	**Assignment/ Project/Seminar/Quiz**	
Weightage (%)	10	20	10	60

SEMESTER V

Bio-Analytical Tools

Course Code: BMB-503 **Credit Units: 04**

Pre-requisite: Basic understanding of molecular biology, Physics and chemistry

Course Outcome:

- Students will learn about the different bio-analytical techniques.
- Students will be able to use critical thinking skills to trouble shoot problems as they occur and determine possible causes.
- Students will be able to apply the knowledge of bio analytical techniques to the most commonly performed laboratory practices.

Course Details:-

Unit I:

Simple microscopy, phase contrast microscopy, dark field microscopy, florescence and electron microscopy (TEM and SEM).

Unit II:

Principle and law of absorption, fluorimetry, colorimetry, spectrophotometry (UV/visible).

Unit III:

Basic principle of Centrifugation, Speed based types of centrifugation, cell fractionation techniques, isolation of sub- cellular organelles and particles.

Unit IV:

Introduction to the principle of chromatography. Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC.

Unit V:

Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), Agarose-gel electrophoresis, pulse field gel electrophoresis, immuno- electrophoresis, isoelectric focusing, Western blotting. Introduction to Biosensors and Nanotechnology and their applications**.**

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Shu-Kun, L. Physical Biochemistry: Principles and Applications. By David Sheehan , 2nd Edition. John Wiley & Sons Ltd.	2000
2	Karp, G. Cell and Molecular Biology: Concepts and Experiments. 8th Edition. John Wiley& Sons. Inc.	2010
3.	Cooper, G.M. and Hausman, R.E.The Cell: A Molecular Approach. 7th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.	2016
	Reference Books	
1.	Swargiary, A. Biological Tools & Techniques (A textbook for UG/PG students of Life Sciences).	2017

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER V

Bio-Analytical Tools

Course Code: BMB-503a **Credit Units: 04**

Pre-requisite: Basic understanding of molecular biology, Physics and chemistry

Course Outcome:

CO1: Explain the principles and working mechanisms of instruments used in microbiological research and diagnostics.
CO2: Describe the role of advanced technologies such as microscopy, spectroscopy, chromatography, and electrophoresis in microbial studies.
CO3: Understand the applications of molecular and biophysical tools in the analysis and characterization of microorganisms.
CO4: Develop proficiency in the operation, calibration, and maintenance of microbiological instruments.
CO5: Perform experiments involving techniques such as PCR, chromatography, flow cytometry, and mass spectrometry for microbial analysis.

Course Details:- Unit 1: Introduction to Instrumentation in Microbiology

- Overview of the role of instrumentation in microbiology.
- Basics of measurement and calibration.
- Good laboratory practices (GLP) and biosafety in handling instruments.
- Maintenance and troubleshooting of laboratory equipment.

Unit 2: Microscopy Techniques

- **Optical Microscopy**: Bright-field, dark-field, phase-contrast, and fluorescence microscopy.
- **Electron Microscopy**: Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM).
- **Confocal Laser Scanning Microscopy**: Principles and applications in microbial imaging.
- Sample preparation techniques for microscopy.

Unit 3: Spectroscopy and Colorimetry

- **UV-Visible Spectroscopy**: Principles, instrumentation, and applications in microbial growth analysis and enzyme kinetics.
- **Fluorescence Spectroscopy**: Applications in detecting microbial metabolites.
- **Infrared (IR) Spectroscopy**: Identification of microbial cell components.
- **Colorimetry**: Principles and use in biochemical assays.

Unit 4: Chromatography Techniques

- Principles and types of chromatography.

- **Thin-Layer Chromatography (TLC)**: Separation of microbial metabolites.
- **Gas Chromatography (GC)**: Analysis of volatile compounds.
- **High-Performance Liquid Chromatography (HPLC)**: Quantitative analysis of antibiotics and other metabolites.
- Applications of chromatography in microbial product purification.

Unit 5: Electrophoresis Techniques

- Principles of electrophoresis and gel matrix preparation.
- **Agarose Gel Electrophoresis**: DNA/RNA analysis.
- **Polyacrylamide Gel Electrophoresis (PAGE)**: Protein profiling and molecular weight determination.
- **Isoelectric Focusing**: Applications in protein separation.
- **Pulse Field Gel Electrophoresis (PFGE)**: Microbial genome analysis.

Suggested Books:

1. "Principles of Instrumental Analysis" by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch
2. "Instrumental Methods of Analysis" by Willard, Merritt, Dean, and Settle
3. "Biophysical Chemistry: Principles and Techniques" by Avinash Upadhyay, Kakoli Upadhyay, and Nirmal Nath
4. "Fundamentals of Light Microscopy and Electronic Imaging" by Douglas B. Murphy and Michael W. Davidson
5. "Electron Microscopy: Methods and Protocols" edited by John Kuo

SEMESTER V

Food and Dairy Microbiology

Course Code: BMB-504 **Credit Units: 04**

Pre-requisite: Basic understanding of Food and Dairy Microbiology

Course Outcome: After completion of the course the students will be able to

- Learn and understand the microbial spoilage of food.
- Understand the principles and methods of food preservation.
- Understand the fermented foods and food borne diseases.

Details of the Course:-

Unit I: Foods as a substrate for microorganisms:

Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general.

Unit II: Microbial spoilage of various foods:

Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods.

Unit III: Principles and methods of food preservation:

Principles, physical methods of food preservation: temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids, SO_2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins.

Unit IV: Fermented foods:

Dairy starter cultures fermented dairy products: yogurt, acidophilus milk, koumiss, kefir, dahi and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tempeh, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.

Unit V: Food borne diseases:

Food intoxications: Staphylococcus aureus, Clostridium botulinum and mycotoxins; Food infections: Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli, Salmonellosis, Shigellosis, Yersinia enterocolitica, Listeria monocytogenes and Campylobacter jejuni.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.	1995
2.	Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.	1987
	Reference Books	
1.	Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.	1993
2.	Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.	1996

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER V

Palentologylogy

Course Code: BMB-504 **Credit Units: 04**

Pre-requisite: **Basic understanding of Palentologylogy**

Course Outcome: After completion of the course the students will be able to

CO1: Demonstrate an understanding of the fundamental principles and concepts of paleontology, including fossil formation, fossilization processes, and the history of life on Earth.

CO2: Describe the major events in the history of life, including the evolution and extinction of organisms, using evidence from the fossil record.

CO3: Understand and explain the role of paleontology in reconstructing past climates, ecosystems, and evolutionary processes.

Details of the Course:-

Unit 1: Introduction to Paleontology

- **Overview of Paleontology**: Definition, scope, and significance in understanding Earth's history.
- **History of Paleontology**: Key milestones in the development of paleontological science.
- **Branches of Paleontology**: Invertebrate paleontology, vertebrate paleontology, paleobotany, micropaleontology, an ichnology.
- **Fossils**: Types of fossils (body fossils, trace fossils, chemical fossils), fossilization process, and taphonomy.
- **Dating of Fossils**: Relative dating vs. absolute dating, principles of stratigraphy, and radiometric dating methods.

Unit 2: Principles of Stratigraphy

- **Stratigraphy and Paleontology**: Introduction to stratigraphy and its significance in paleontology.
- **Principles of Stratigraphy**: Law of superposition, law of original horizontality, law of lateral continuity, and biostratigraphy.
- **Sequence Stratigraphy**: Concepts and methods used to interpret fossil sequences.
- **Stratigraphic Correlation**: Techniques for correlating rock layers across regions using fossils.
- **Lithostratigraphy vs. Biostratigraphy**: Differences and uses of lithology and fossil content for stratigraphic correlation.

Unit 3: Fossilization and Fossil Preservation

- **Modes of Fossilization**: Permineralization, casting, molding, carbonization, and amber preservation.
- **Taphonomy**: Study of how organisms decay, become fossilized, and are preserved.
- **Biases in the Fossil Record**: Preservation potential, environmental factors, and geological processes affecting fossilization.
- **Microfossils**: Types and significance of microfossils in paleoenvironmental reconstruction.
- **Exceptional Fossils**: Lagerstätten and the preservation of soft tissues.

Unit 4: Paleobotany

- **Early Plants and Evolution**: Origin and early evolution of plants.
- **Plant Fossils**: Types of plant fossils (wood, leaves, spores, and pollen).
- **Plant Fossilization**: Processes involved in the fossilization of plants and examples of famous plant fossils.
- **Paleoclimate Reconstruction**: Using plant fossils to reconstruct past climates.
- **Mesozoic and Cenozoic Plant Evolution**: Key developments in plant evolution during the Mesozoic and Cenozoic eras.

Unit 5: Invertebrate Paleontology

- **Introduction to Invertebrates**: Classification and major groups (sponges, cnidarians, mollusks, arthropods, echinoderms, etc.).
- **Fossilization of Invertebrates**: Preservation of shells, exoskeletons, and soft-bodied organisms.
- **Key Invertebrate Fossils**: Trilobites, brachiopods, ammonites, gastropods, and bivalves.
- **Biostratigraphy and Invertebrates**: Using invertebrate fossils for stratigraphic dating and correlation.
- **Ecology of Invertebrate Fossils**: Paleoecology of ancient invertebrates and their environments.

Suggested Books:

- "Principles of Paleontology" by David M. Raup and Steven M. Stanley
- "Paleontology: A Brief History of Life" by Kent C. Condie
- "In the Blink of an Eye: How Vision Sparked the Big Bang of Evolution" by Andrew Parker
- Stratigraphy and Sedimentation" by Donald R. Prothero

- "Principles of Stratigraphy" by W. S. MacLeod
- "Geologic Time: Scale and Correlation" edited by D. H. Tarling

SEMESTER V

Medical Microbiology Lab

Course Code: BMB-551 **Credit Units: 02**

Pre-requisite: Basic information of Medical Microbiology Lab

Course Outcome:

Upon successful completion of this course the student will be able to:

- This course provides learning opportunities in the basic principles of medical microbiology and infectious disease.
- It covers mechanisms of infectious disease transmission, principles of aseptic practice, and the role of the human body"s normal microflora.
- The course provides the conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause disease in the human body.
- It also provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.
- To understand the importance of pathogenic bacteria in human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue.
- Helps to understand the use of lab animals in medical field.
- Recall the relationship of this infection to symptoms, relapse and the accompanying pathology.
- Explain the methods of microorganisms control, e.g. chemotherapy & vaccines. Solve problems in the context of this understanding.

Details of the Course:-

Sl. No.	Contents	Contact Hours
1	Study of composition and use of important differential media for identification of bacteria: EMBAgar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS	3
2	Study of bacterial flora of skin by swab method	3
3	Perform antibacterial sensitivity by Kirby-Bauer method	3
4	Identification of human blood groups.	3
5	To perform Total Leukocyte Count of the given blood sample.	3
6	To perform Differential Leukocyte Count of the given blood sample.	3
7	To separate serum from the blood sample (demonstration).	3
8	To perform immunodiffusion by Ouchterlony method.	3

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Ananthanarayan R. and Paniker C.K.J. Textbook of Microbiology. 8th edition, University Press Publication	2009
2.	Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. Jawetz, Melnick and Adelberg‟s Medical Microbiology. 26th edition. McGraw Hill Publication	2013
3.	Goering R., Dockrell H., Zuckerman M. and Wakelin D. Mims‟ Medical Microbiology. 4thedition. Elsevier	2007
4.	Willey JM, Sherwood LM, and Woolverton CJ. Prescott, Harley and Klein‟s Microbiology.9th edition. McGraw Hill Higher Education	2013

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER V

Recombinant DNA Technology Lab

Course Code: BMB-552 **Credit Units: 02**

Pre-requisite: Basic experience of molecular biology techniques

Course Outcome:

- Students will be able to isolate and analyze DNA/plasmid DNA and protein.
- Students will be able to digest and ligate the DNA molecules.
- Students will be able to design primers and amplification of DNA by PCR.
- Students will be able to learn the techniques of cloning gene in plasmid vectors.
- Students will be able to screen the positive transformants with the gene cloned through reporter based assays.

Details of the Course:-

S. No.	Contents	Contact Hours
1	Isolation of Vector/plasmid DNA	3
2	Quantification of Nucleic acid and determination of its purity	3
3	Isolation of protein	3
4	Restriction digestion of DNA and its analysis by AGE	6
5	Ligation of DNA molecules	3
6	Primer designing	3
7	Polymerase chain reaction	6
8	Preparation of compESEnt cells	3
9	Transformation in bacteria and reporter gene assay	3

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Methods in yeast genetics: a Cold Spring Harbor Laboratory course manual. David C. Amberg, Daniel Burke, Jeffrey Strathern Cold Spring Harbor Laboratory Press, c2005 2005 ed.	2005
2.	Departmental Laboratory Manual	2018
	Reference Books	
1.	Molecular Cloning- A Laboratory Manual: 3 rd Edition, 2001, Vol. 1 -3 . Sambrook J and Russell D.W.(2001). Cold spring Harbor Laboratory Press, New York.	2001
2.	DNA cloning: A Practical Approach. Glover and Hames (2001) Oxford Univ. Press.	2001

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER V

Bio-Analytical Tools Lab

Course Code: BMB-553 **Credit Units: 02**

Pre-requisite: Basic knowledge of immunology and molecular biology

Course Outcome:

- Students will gain new insights about different bioanalytical procedures.
- Students will be able to use critical thinking to develop skill to trouble shoot the prblems as they occur and to determine the possible causes.
- Students will be able to apply the knowledge of basic practical to the most commonly performed applications in the bioanalysis.

Details of the Course:-

S. No.	Contents	Contact Hours
1	Native gel electrophoresis of proteins	3
2	SDS-polyacrylamide slab gel electrophoresis of proteins under reducing conditions	3
3	Preparation of the sub-cellular fractions of rat liver cells	3
4	Preparation of protoplasts from leaves	6
5	Separation of amino acids by paper chromatography	3
6	To identify lipids in a given sample by TLC	3
7	To verify the validity of Beer‟s law and determine the molar extinction coefficient of NADH	6

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Shu-Kun, L. Physical Biochemistry: Principles and Applications. By David Sheehan , 2nd Edition. John Wiley & Sons Ltd.	2000
2	Karp, G. Cell and Molecular Biology: Concepts and Experiments. 8th Edition. John Wiley& Sons. Inc.	2010
3.	Cooper, G.M. and Hausman, R.E.The Cell: A Molecular Approach. 7th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.	2016
	Reference Books	
1.	Swargiary, A. Biological Tools & Techniques (A textbook for UG/PG students of Life Sciences).	2017

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER V

Food and Dairy Microbiology Lab

Course Code: BMB-554 **Credit Units: 02**

Pre-requisite: Basic understanding of Food and Dairy Microbiology

Course Outcome: After completion of the course the students will be able to

- Gain knowledge about fermentation techniques used in food and dairy industry.
- Understand the role of microorganisms in fermentation.
- Gain skills to control fermentation process.
- Learn the microbiology of different types of fermented food products.

Details of the Course:-

S. No.	Contents	Contact Hours
1	Bacterial counts of food samples.	2
2	Quantitative analysis of milk by standard plate count method.	2
3	Isolation and counting of fecal bacteria in water.	2
4	Test of quality of milk by methylene blue dye reduction test.	2
5	Detection of mastitis through milk test.	2
6	Isolation of bacteria and fungi from spoiled food.	2
7	Microbial populations in fruit juices, soft drinks and ice-cream.	2
8	Isolation of microorganisms from curd.	2
9	Isolation of lipolytic organisms from butter.	2
10	Visit to microbiology based food industry and observe the unit operation procedures.	2

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.	1995
2.	Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.	1987
	Reference Books	
1.	Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.	1993
2.	Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.	1996

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

General Proficiency-V

Course Code: GP-501 **Credit Units: 01**

Pre-requisite: Basic information of English Language

Course Outcome:

- ·Effective communication: The ability to exchange ideas and information in a way that builds trust and respect
- ·Critical and analytical thinking: The ability to explore issues and ideas before forming a conclusion
- ·Integrative thinking: The ability to synthesize knowledge across different domains and perspectives
- ·Preparing students to be engaged citizens: Preparing students to participate in political culture and thrive in a rapidly evolving world

Details of the Course:-

General language proficiency is the ability to read, write, listen, and speak in real-life situations. To test this, a test is usually developed for each skill with questions that are designed to imitate real life.

A syllabus is a guide to a course that includes course policies, rules, regulations, required texts, and a schedule of assignments and seminar.

Examination Scheme:

Components	**Internal Assessment**			**External Evaluation**
	Attendance	**Class Test**	**Assignment/ Project/Seminar/Quiz**	
Weightage (%)	10	20	10	60

SEMESTER VI

Microbiological Analysis of Air and Water

Course Code: BMB-601 **Credit Units: 04**

Pre-requisite: Basic information of air and water microbiology.

Course Outcome:

- Students will become familiar with aeromicrobiology.
- Students will be able to learn the collection of air sample and its analysis.
- Students will be familiarized with the water microbiology and control measures.
- Students will be able to explain the microbiological analysis of water.

Details of the Course:-

Unit I: Aeromicrobiology:

Bioaerosols, Air borne microorganisms (bacteria, Viruses, fungi, each from every category) and their impact on human health, and environment, significance in food and pharma industries and operation theatres, allergens.

Unit II: Air Sample Collection and Analysis:

Bioaerosol sampling, air samplers, methods of analysis, CFU, culture media for bacteria and fungi, Identification characteristics.

Unit III: Control Measures:

Fate of bioaerosols, inactivation mechanisms – UV light, HEPA filters, desiccation, Incineration.

Unit IV: Water Microbiology:

Water borne pathogens, water borne diseases.

Unit V: Microbiological Analysis of Water:

Sample Collection, Methods to detect portability of water samples: (a) standard qualitative procedure: presumptive/MPNtests, confirmed and completed tests for fecal coliforms (b) Membrane filter technique. Control measures by precipitation, chemical disinfection, filtration.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	da Silva N, Taniwaki MH, Junqueira VC, Silveira N, Nascimento MS, Gomes RAR (2012) Microbiological Examination Methods of Food and WaterA Laboratory Manual, CRC Press.	2012
2.	Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.	2000
	Reference Books	
1.	Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.	2009
2.	Hurst CJ, Crawford RL, Garland JL, Lipson DA (2007) Manual of Environmental Microbiology, 3rd edition, ASM press.	2007

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER VI

Hospital Management

Course Code: BMB-601a **Credit Units: 04**

Pre-requisite: Basic information of Hospital management

Course Outcome:

C**O1**: Demonstrate a comprehensive understanding of the healthcare system, hospital operations, and the role of hospital management in the delivery of quality healthcare services.

CO2: Understand key concepts in healthcare management such as hospital organization, patient care management, healthcare policies, and legal and ethical aspects of hospital administration.

CO3: Explain the various functional areas of hospital management, including finance, human resources, marketing, information systems, and logistics, and how they contribute to the overall effectiveness of the institution.

CO4: Apply analytical tools and management techniques to solve operational, financial, and strategic issues in hospital management.

CO5: Use healthcare data to analyze hospital performance, improve decision-making, and develop strategies to optimize hospital operations and patient care services.

Details of the Course:-

Unit 1: Introduction to Healthcare and Hospital Management

- **Healthcare System Overview**: Structure, components, and functions of healthcare systems.
- **Introduction to Hospital Management**: Importance and challenges in managing hospitals.
- **Types of Healthcare Organizations**: Public vs private hospitals, general vs specialized hospitals.
- **Hospital Organization Structure**: Key departments, staff roles, and inter-departmental collaboration.
- **Healthcare Delivery Models**: Models of healthcare delivery (e.g., primary, secondary, and tertiary care).

Unit 2: Hospital Administration and Organizational Structure

- **Management Functions**: Planning, organizing, staffing, leading, and controlling in hospital settings.
- **Hospital Organizational Structure**: Hierarchy, governance, and administration of healthcare facilities.
- **Leadership in Healthcare**: Leadership theories, leadership styles, and their application in healthcare.
- **Human Resource Management in Hospitals**: Recruitment, training, performance management, and workforce planning in healthcare organizations.
- **Role of Hospital Administrator**: Responsibilities, skills, and competencies of a hospital manager.

Unit 3: Financial Management in Hospitals

- **Healthcare Financial Management**: Principles of hospital finance, budgeting, and financial reporting.
- **Revenue Management**: Billing, coding, and insurance reimbursements in hospitals.
- **Cost Management and Control**: Cost structures, cost-benefit analysis, and cost control in hospital settings.
- **Financial Planning and Forecasting**: Budgeting, cash flow management, and financial decision-making.

- **Healthcare Insurance Systems**: Overview of public and private insurance models, claims processing, and reimbursement.

Unit 4: Hospital Operations Management

- **Hospital Operations and Logistics**: Managing hospital resources, procurement, and supply chain management.
- **Patient Flow and Bed Management**: Techniques to manage patient intake, bed occupancy, and discharge planning.
- **Quality Assurance and Improvement**: Implementing and maintaining quality standards in patient care.
- **Hospital Information Systems (HIS)**: Role of information systems in managing hospital data, Electronic Health Records (EHR), and telemedicine.
- **Facility Management**: Maintenance of hospital infrastructure, safety protocols, and disaster preparedness.

Unit 5: Patient Care and Service Delivery

- **Patient-Centered Care**: Concepts and practices of patient care, focusing on patient satisfaction and experience.
- **Medical and Nursing Services Management**: Coordination of medical, nursing, and allied health services in hospitals.
- **Clinical Pathways and Protocols**: Standardization of treatment processes and clinical guidelines.
- **Patient Safety and Risk Management**: Identifying and mitigating risks, ensuring patient safety.
- **Healthcare Marketing and Public Relations**: Strategies for patient retention, hospital branding, and reputation management.

Suggested Books:

- **"Hospital Administration and Management" by S. L. Goel & Rajeev Kumar**
- "Hospital and Health Services Administration: Principles and Practices" by S. A. Begum
- "Principles of Hospital Administration and Planning" by B.M. Sakharkar

- "Healthcare Systems: A Global Perspective" by C. R. K. Rao
- "Introduction to Health Care Management" by Sharon B. Buchbinder & Nancy H. Shanks
- "Health Care USA: Understanding Its Organization and Delivery" by Harry A. Sultz & Kristina M. Young

SEMESTER VI

Soil and Water Microbiology

Course Code: BMB-601b **Credit Units: 04**

Pre-requisite: Basic information of Hospital management

Course Outcome:

CO1: Demonstrate a comprehensive understanding of the types of microorganisms (bacteria, fungi, protozoa, algae, viruses) present in soil and water ecosystems.

CO2: Identify the different microbial communities in diverse soil and water environments and their role in ecosystem functioning.

CO3: Explain the fundamental microbial processes involved in nutrient cycling in soil and water (e.g., nitrogen fixation, carbon cycling, phosphorus solubilization).

CO4: Analyze the role of microorganisms in the biogeochemical cycles (nitrogen, carbon, sulfur, phosphorus) in soil and water ecosystems.

Details of the Course:-

Unit 1: Introduction to Soil and Water Microbiology

- **Overview of Microbiology**: Basics of microbiology, types of microorganisms (bacteria, fungi, viruses, protozoa, algae).
- **Soil and Water Ecosystems**: Basic concepts of soil and water ecosystems, significance of microorganisms in these environments.
- **Environmental Microbiology**: Role of microorganisms in the environment, biogeochemical cycles, and environmental sustainability.
- **Soil and Water Interactions**: Interaction between soil microorganisms and water bodies, influence on soil structure, water retention, and quality.

Unit 2: Soil Microbiology

- **Soil Composition**: Understanding soil as an ecosystem—minerals, organic matter, and soil texture.
- **Soil Microbial Communities**: Types of microorganisms in soil (bacteria, fungi, actinomycetes), and their distribution in different soil environments.
- **Microbial Activities in Soil**: Microbial processes involved in nutrient cycling—nitrogen fixation, carbon cycling, phosphorus solubilization, sulfur oxidation.
- **Soil Enzyme Activity**: Role of enzymes in soil, degradation of organic matter, and nutrient transformation.
- **Microbial Ecology of Soil**: Soil microbial diversity, environmental factors affecting microbial communities (temperature, moisture, pH, oxygen levels).

Unit 3: Water Microbiology

- **Water Microorganisms**: Microbial communities in freshwater and marine ecosystems—bacteria, protozoa, and algae.
- **Microbial Ecology of Aquatic Environments**: Distribution and role of microorganisms in rivers, lakes, ponds, and oceans.
- **Water Quality and Contamination**: Microbial indicators of water quality (e.g., coliforms), waterborne diseases, and sources of contamination (e.g., sewage, industrial waste).

- **Microbial Pathogens in Water**: Pathogenic microorganisms in water—bacteria (e.g., E. coli), viruses, protozoa, an their impact on human health.
- **Water Treatment and Purification**: Biological treatment methods, microbial bioremediation of polluted water, rol of microorganisms in wastewater treatment.

Unit 4: Microbial Biogeochemical Cycles

- **Nitrogen Cycle**: Role of microorganisms in nitrogen fixation, nitrification, denitrification, and ammonia oxidation.
- **Carbon Cycle**: Microbial degradation of organic matter, respiration, methane production, and carbon dioxide releas .
- **Sulfur Cycle**: Role of sulfur-reducing and sulfur-oxidizing bacteria in sulfur cycling.
- **Phosphorus Cycle**: Microbial role in phosphorus solubilization and mobilization in soil and water.
- **Iron, Manganese, and Other Nutrient Cycles**: Microbial interactions with other elements in the environment.

Unit 5: Soil and Water Pollution and Bioremediation

- **Pollutants in Soil and Water**: Types of pollutants (organic, inorganic, heavy metals) and their impact on soil and water ecosystems.
- **Microbial Degradation of Pollutants**: Role of microorganisms in breaking down pollutants, bioremediation techniques, and enhancing microbial activity for cleanup.
- **Bioremediation in Soil**: In situ and ex situ bioremediation methods, applications in agriculture and environmental management.
- **Bioremediation in Water**: Microbial treatment of wastewater, oil spills, and other water pollutants.
- **Heavy Metal Contamination**: Impact of heavy metals (e.g., lead, arsenic) on microbial communities and strategies or removal using microbial processes.

Suggested Books:

- Gerard J. Tortora, Berdell R. Funke, Christine L. Case
- Joanne Willey, Linda Sherwood, Christopher J. Woolverton
- Marjorie Kelly Cowan, Kathleen Park Talaro

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER VI

Marine Microbiology

Course Code: BMB-602 **Credit Units: 04**

Pre-requisite: In-depth knowledge of marine microbiology.

Course Outcome:

- The student will be able to understand marine environment.
- The student will be able to know the methods of marine microbiology.
- The student will be able to know role of microbes in ocean processes.
- The students will be able to know recent trends in marine microbiology.

Details of the Course:-

UNIT I: Marine Environment:

World‟s oceans & Seas, Physio – Chemical properties of marine water, marine microbial habitat: water column, sediments, costal ecosystems, mangroves salt marshes. Bio-films & Microbial mats. Microbial life at surface of living & nonliving systems and microbial interactions. Quorum sensing in marine microbes and significance. Metabolic diversity and importance of microbial communities, Photo trophy & primary productivity.

UNIT II: Methods in Marine Microbiology:

Sampling methods of different habitat of oceans and screening by CLSM & FCM. Importance of Culturable & non-Cultural microorganisms. Molecular tools to study marine diversity. Limitations of analysis of nucleic acid directly from marine environment.

UNIT III: Role of Microbes in ocean processes:

Bioenergetics, Carbon & Nitrogen cycling in ocean, Photosynthesis and Primary productivity. Eutrophication of coastal areas. Microbial loop in ocean food web. Microbial processes and climate change. Bio – fouling & bio – deterioration, indicator organisms and pollution control. Symbiosis of microalgae with animals: Chemoautotrophic prokaryotes with animals. Symbionts of sponges, mixotrophy in protists. Metabolic consortia and mutualism between prokaryotes.

UNIT IV: Marine Microbes:

Bacterial and viral disease of fresh water, seawater, aqua culture: fish, bivalve mollusks, Crustaceans, corals. Diagnosis methods. Control of diseases. Biodegradation and Bioremediation of marine pollutants (oil, Organic comp. etc.).

UNIT V: Recent trends in Marine Microbiology:

Recently identified microorganisms of marine ecosystem, there applications in present and future industries.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Munn, C. 2011. Marine Microbiology: Ecology and Applications. GS Publications. PP- 648.	2011
2	Sekwon Kim. 2013. Marine Microbiology: Bioactive compounds and Biotechnological applications. Wiley VCH.	2013
	Reference Books	
1.	Paul, J. 2001. Marine Microbiology. Academic Press. PP-666.	2001

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER VI

Vetinary Sciences

Course Code: BMB-602a **Credit Units: 04**

Pre-requisite: In-depth knowledge of Vetinary science

The student will be able to understand marine environment.

- Understand the anatomy, physiology, and pathology of animals and the role of the veterinarian in maintaining animal health
- Develop skills in diagnosing and treating common and complex diseases in animals, using appropriate diagnostic and therapeutic methods.
- Gain proficiency in performing routine and emergency surgeries, managing post-operative care, and applying advanced surgical techniques..

Details of the Course:-

- **Unit 1: Introduction to Veterinary Science**
  - Overview of veterinary science and animal health care
  - Veterinary profession and its importance
  - Veterinary ethics and laws
- **Unit 2: Anatomy and Physiology**
  - Animal cell structure and functions
  - Organ systems: Digestive, respiratory, circulatory, and reproductive systems
  - Comparative anatomy in domestic animals
- **Unit 3: Animal Husbandry and Management**
  - Livestock farming: Cattle, sheep, goats, and poultry
  - Animal breeding and genetics
  - Animal nutrition and feeding systems
- **Unit 4: Microbiology and Immunology**
  - Microbial flora in animals
  - Animal pathogens (bacteria, fungi, viruses)
  - Immune system response and vaccination

Suggested Books:

- Textbook of Veterinary Internal Medicine"
- Veterinary Surgery: Small Animal"
- Veterinary Microbiology and Microbial Disease"

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER VI

Biodiversity

Course Code: BMB-602b **Credit Units: 04**

Pre-requisite: In-depth knowledge of biodiversity

The student will be able to understand biodiversity

- Demonstrate an understanding of the different levels and types of biodiversity (species, genetic, and ecosystem diversity).
- Analyze biodiversity using various methods and indices, including species richness, evenness, and diversity indices.
- Critically assess the impact of human activities on biodiversity, including habitat destruction, climate change, and overexploitation.

Details of the Course:-

Unit 1: Concept and Importance of Biodiversity

- Definition of biodiversity: species, genetic, and ecosystem diversity
- Importance of biodiversity for ecosystem stability and human well-being
- Biodiversity at global, regional, and local levels

Unit 2: Levels of Biodiversity

- Species diversity, genetic diversity, and ecosystem diversity
- Measuring biodiversity (species richness, evenness, and diversity indices)
- Methods of biodiversity assessment and monitoring

Unit 3: Evolution and Origin of Biodiversity

- Theories of evolution (Darwinism, Neo-Darwinism)
- Speciation and the process of adaptive radiation
- Origin of biodiversity in different ecological zones

- **Unit 4: Biogeography and Distribution of Biodiversity**

- Global patterns of biodiversity (latitudinal gradients, endemism)
- Major biomes of the world (tropical forests, deserts, grasslands, etc.)
- Human impact on the distribution of biodiversity

Suggested Books:

- "Biodiversity"
- **"Conservation Biology: Evolution in Action"**
- **"Biodiversity and Conservation"**

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER VI

Bioinformatics

Course Code: BMB-603 **Credit Units: 04**

Pre-requisite: Basic knowledge of computer application

Course Outcome:

- Students will be able to understand basics of internet and computers along with information on various databases.
- Students will be able to understand application of bioinformatics in biotechnology.
- Students will be able to understand sequence alignment and various algorithms for it.
- Students will be able to understand and interpret sequence annotation and its retrieval.
- The information about various biologically important databases will be made available to students.

Details of the Course:-

UNIT – I:

History of Bioinformatics, Basics of Internet and Computers, Various databases, Bioinformatics and its role in central dogma of molecular biology.

UNIT – II:

The notion of Homology, Sequence Information Sources, EMBL, GenBank, Entrez, Unigene, Understanding the structure of each source and using it on the web.

UNIT – III:

Various Sequences tools, Pairwise Alignments, Introducing to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment, Phylogenetic Analysis.

UNIT – IV:

Searching Databases, SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission, Genome Annotation, Pattern and repeat finding, Gene identification tools.

UNIT – V:

Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web. Introduction of Data Generating Techniques and Bioinformatics problem posed by them-Restriction Digestion, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text/Reference Books	
1.	Bioinformatics: Principles and Applications.Ghosh Z. and Bibekanand M., OxfordUniversity Press, 2008.	2015
2.	Genome analysis and bioinformatics: a practical approach. T.R. Sharma, I.K.International Publishing House Pvt. Ltd., 2009.	2009
3.	Bioinformatics and Functional Genomics, Pevsner J. II Edition, Wiley-Blackwell, (2009).	2015
4.	Discovering Genomics, Proteomics and Bioinformatics, Campbell A. M., Heyer L. J.,II Edition. Benjamin Cummings, 2006.	2006
5.	Bioinformatics: A practical guide to analysis of genes and proteins, Andreas D. Baxevanis, Wiley Student edition,	2006
6.	Bioinformatics, Sequence and genome analysis by David W. Mount, Second Edition, CSHL Press, 2004	2004

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER VI

Developmental biology and embryology

Course Code: BMB-603a **Credit Units: 04**

Pre-requisite: Basic knowledge of Developmental biology and embryology

Course Outcome:

- Describe the key events in the development of organisms, from fertilization to adulthood, including cellular division, differentiation, and morphogenesis..
- Understand the molecular and genetic basis of development, including gene expression regulation, transcription factors, signaling pathways, and the role of master regulators in cell differentiation.
- Explain the processes of fertilization, cleavage, gastrulation, and neurulation, and their importance in shaping the embryonic body plan.

Details of the Course:-

Unit 1: Introduction to Developmental Biology

- Basic concepts of developmental biology
- Historical background and importance of model organisms (e.g., Drosophila, Xenopus, mouse, chick)
- Overview of developmental stages (zygote to adult)

Unit 2: Fertilization

- Process of fertilization in animals and plants
- Molecular events during fertilization
- Mechanisms of sperm-egg interaction and activation

Unit 3: Early Embryonic Development

- Cleavage and formation of the blastula
- Development of the germ layers (ectoderm, mesoderm, endoderm)
- Patterning of the embryo and axis formation (e.g., anterior-posterior, dorsal-ventral)

Unit 4: The Role of Genes in Development

- Gene expression regulation in early development
- Transcription factors and signaling pathways
- Master regulators in development (e.g., Hox genes, morphogens)

Suggested Books:

- Developmental Biology"
- "Molecular Biology of the Cell"
- Embryology: A Color Atlas"

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER VI

Population biology

Course Code: BMB-603b **Credit Units: 04**

Pre-requisite: Basic knowledge of Population biology

Course Outcome:

- Describe and analyze different population growth models (exponential and logistic) and their applicability in real-world scenarios.
- Apply Hardy-Weinberg equilibrium and understand the role of genetic drift, migration, mutation, and natural selection in shaping population genetics.
- Examine the interactions between species (competition, predation, mutualism) and understand their impact on population size and distribution.

Details of the Course:-

Unit 1: Introduction to Population Biology

- Definition and scope of population biology
- Basic concepts: population, population density, dispersion, and growth
- Historical development of population biology

Unit 2: Population Growth and Regulation

- Exponential and logistic growth models
- Carrying capacity and density-dependent vs. density-independent factors
- Factors influencing population regulation (food, predation, disease, competition)

Unit 3: Life History Strategies

- Life history theory: r-strategists vs. K-strategists
- Reproductive strategies and their impact on population dynamics
- Age structure, generation time, and reproductive investment

Unit 4: Population Genetics

- Hardy-Weinberg equilibrium
- Gene flow, genetic drift, mutation, and selection
- Evolutionary forces shaping population genetic structure

Suggested Books:

- "Population Ecology: A Unified Study of Animals and Plants"
- "Introduction to Population Ecology"
  - "Principles of Population Genetics"

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER VI

Microbiological Analysis of Air and Water Lab

Course Code: BMB-651 **Credit Units: 02**

Pre-requisite: Basic information of air and water microbiology.

Course Outcome:

- Students will become familiar with aeromicrobiology.
- Students will be able to learn the collection of air sample and its analysis.
- Students will be familiarized with the water microbiology and control measures.
- Students will be able to explain the microbiological analysis of water.

Details of the Course:-

Note: A college must offer 70%of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available.

S. NO.	CONTENTS	CONTACT HOURS
1	Introduction to the Basic Microbiology Laboratory Practices and Equipments.	2
2	Analysis of air and water - pH, moisture content, water holding capacity, percolation, capillary action.	2
3	Isolation of microbes (bacteria & fungi) from contaminated water.	2
4	Isolation and enumeration of bacteria from air.	2
5	Assessment of microbiological quality of water.	2
6	Determination of BOD of waste water sample.	2
7	Assessment of microbiological quality of air.	2
8	Determination of COD of waste water sample.	2

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	da Silva N, Taniwaki MH, Junqueira VC, Silveira N, Nascimento MS, Gomes RAR (2012) Microbiological Examination Methods of Food and WaterA Laboratory Manual, CRC Press.	2012
2.	Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.	2000
	Reference Books	
1.	Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.	2009
2.	Hurst CJ, Crawford RL, Garland JL, Lipson DA (2007) Manual of Environmental Microbiology, 3rd edition, ASM press.	2007

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER VI

Marine Microbiology Lab

Course Code: BMB-652 **Credit Units: 02**

Pre-requisite: Basic information of Marine Microbiology

Course Outcome:

- The student will acquire practical skills of marine environment.
- The student will be able to know the methods of marine microbiology.
- The student will be able to know role of microbes in ocean processes.
- The students will be able to know recent trends in marine microbiology.

Details of the Course:-

S. No.	Contents	Contact Hours
1	Isolation and identification of microbes from mangroves, coastal waters and sediments with special emphasis on sample collection methodology, collection trips in boats/ trawlers.	2
2	Assessment of salt requirement of marine isolates from different ecosystem.	2
3	Analysis of physico-chemical parameters.	2
4	Study of biofilm microorganisms.	2
5	Hydrolytic enzyme profiling of the marine bacterial isolates.	2
6	Nitrification and denitrification by the marine bacterial isolates.	2

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Hunter-Cevera, J., Karl, D. and Buckley, M., Marine Microbial Diversity: the key to Earth‟s habitability, American Academy of Microbiology.	2005
2.	Munn, C. Marine Microbiology: ecology and applications, Garland Science, Taylor and Francis group, N.Y.	2018
	Reference Books	
1.	Oliver, J. D. (1982) Taxonomic scheme for the identification of marine bacteria by Deep Sea Research Part A. Oceanographic Research Papers, 29 (6): 795 -798.	1982

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER VI

Bioinformatics Lab

Course Code: BMB-653 **Credit Units: 02**

Pre-requisite: Basic knowledge of computer application

Course Outcome:

- Students will be able to understand basics of internet and computers along with information on various databases.
- Students will be able to understand application of bioinformatics in biotechnology.
- Students will be able to understand sequence alignment and various algorithms for it.
- Students will be able to understand and interpret sequence annotation and its retrieval.
- The information about various biologically important databases will be made available to students.

Details of the Course:-

Note: A college must offer 70% of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available.

S. NO.	CONTENTS	CONTACT HOURS
1	Introduction to various databases of proteins, nucleic acids. Primary, secondary and composite databases.	3
2	BLAST, FASTA, DOT PLOT	3
3	MSA using various free tools.	3
4	Phylognetic predictions.	3
5	Prediction of structure of proteins and nucleic acids	3
6	ORF prediction and its validation	3
7	Primer designing	3
8	Restriction mapping	3
9	Epitope prediction using various online tools	3
10	Data mining tool and its practical applications in a case study	3

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text/Reference Books	
1.	Bioinformatics: Principles and Applications.Ghosh Z. and Bibekanand M., OxfordUniversity Press, 2008.	2015
2.	Genome analysis and bioinformatics: a practical approach. T.R. Sharma, I.K.International Publishing House Pvt. Ltd., 2009.	2009
3.	Bioinformatics and Functional Genomics, Pevsner J. II Edition, Wiley-Blackwell, (2009).	2015
4.	Discovering Genomics, Proteomics and Bioinformatics, Campbell A. M., Heyer L. J.,II Edition. Benjamin Cummings, 2006.	2006
5.	Bioinformatics: A practical guide to analysis of genes and proteins, Andreas D. Baxevanis, Wiley Student edition,	2006
6.	Bioinformatics, Sequence and genome analysis by David W. Mount, Second Edition, CSHL Press, 2004	2004

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER VI

Project/Dissertation

Course Code: BMB-604 **Credit Units: 6**

Course Contents:

- Forty five days of Sixth Semester of the B.Sc. Curriculum is devoted to major project/field work.
- Students, with the help of their mentor and faculty colleagues will identify a lab in India & abroad for the research work.
- The student should stay for a minimum prescribed Semester period at the place of work.
- Students not staying for the prescribed period will be marked absent as per the University Rules.
- At the end of their project the students shall submit the dissertation as per the Guidelines prescribed below.

The Aims of the Project

The aim of the project is to provide the students with an opportunity to further their intellectual and personal development in the chosen field by undertaking a significant practical unit of activity, having an educational value at a level commensurate with the award a B.Sc. Degree.

Objectives

- To provide the students an opportunity to demonstrate the ability to devise, select and use a range of methodologies appropriate to the chosen topic of research.
- To allow students to show the application of skills of data collection, critical analysis and concept synthesis necessary for formation of defensible conclusions and/or recommendations.
- To allow students the opportunity to demonstrate ability to draw appropriate conclusions argued from the evidence presented. [Should the research produce negative or in conclusive results, the conclusions should be critically examined to ascertain the reasons].
- To provide a forum to demonstrate the skills of structuring and present a balanced informed complete, clear and concise written argument.

Dissertation Guidelines

The Dissertation Topic

It is important to distinguish here between „dissertation topic" and „dissertation title". The topic is the specific area that you wish to investigate. The title may not be decided until the dissertation has been written so as to reflect its content properly.

Few restrictions are placed on the choice of the topic. Normally the topic is expected to be:

- Relevant to Microbiology;
- related to one or more of the subjects or areas of study within the core program and specialisation stream;
- clearly focused so as to facilitate an in-depth approach, subject to the availability of adequate sources of information and to the knowledge of students;
- Value and interest to the students and their personal and professional development.

Dissertation format

All students must follow the following rules in submitting their dissertation.

- Front page should provide title, name of the student, name of degree and the date of submission.
- Second page should contain the certificate received from the organization/University from where the student has completed his/her project work.
- The next page should be the table of contents giving page references for each chapter and section.
- The next page should be the table of graphs, figures and tables giving legends and page numbers.
- Next to follow should be following in the sequence given below:
- Abbreviations used (if any)
- Introduction
- State-of-Art
- Material & Methods
- Results
- Discussion
- Summary (approximately 500 words)
- Conclusion

• Future Prospects

• References: After this concluding chapter, students should give a list of all the references they have used. These should be cross - references with the text. For articles from journals, the following details are required e.g.

Schloter M, Assmus B and Hartmann A (1995) the use of immunological methods to detect and identify bacteria in the environment. Biotech Adv 13: 75-90

For books, the following details are required

Bahera BK and Varma A (2003) Green Energy from Waste Biomass, Capital Book Company, New Delhi, India

For book chapter

Mukherji KG, Mandeep and Varma A (1998) Mycorrhizosphere microorganisms: screening and evaluation. (Ed) Varma A. In: Mycorrhiza Manual. Springer-Verlag, Germany, pp 85-97

• Finally, you should give any appendices. These should only include relevant statistical data or material that cannot be fitted into the above categories.

• List of Publications (if any) by the students should be attached in the end.

Guidelines for the assessment of the dissertation

While evaluating the dissertation, faculty guide will consider the following aspects:

1. Has the student made a clear statement of the objective or objective(s).
2. If there is more than one objective, do these constitute parts of a whole?
3. Has the student developed an appropriate analytical framework for addressing the problem at hand.
4. Is this based on up-to-date developments in the topic area?
5. Has the student collected information / data suitable to the frameworks?
6. Are the materials & methods employed by the student to analyse the data / information appropriate and relevant?
7. Has the student succeeded in drawing conclusion form the analysis?
8. Do the conclusions relate well to the objectives of the project?

Examination Scheme:

Components	Theme of Project	Quality of Project
Weightage (%)	**30**	**70**

General Proficiency-VI

Course Code: GP-601 **Credit Units: 01**

Pre-requisite: Basic information of English Language

Course Outcome:

- ·Effective communication: The ability to exchange ideas and information in a way that builds trust and respect
- ·Critical and analytical thinking: The ability to explore issues and ideas before forming a conclusion
- ·Integrative thinking: The ability to synthesize knowledge across different domains and perspectives
- ·Preparing students to be engaged citizens: Preparing students to participate in political culture and thrive in a rapidly evolving world

Details of the Course:-

General language proficiency is the ability to read, write, listen, and speak in real-life situations. To test this, a test is usually developed for each skill with questions that are designed to imitate real life.

A syllabus is a guide to a course that includes course policies, rules, regulations, required texts, and a schedule of assignments and seminar.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Shobhit University, Gangoh

(Established by UP Shobhit University Act No. 3, 2012)

School of Biological Engineering & Sciences

Ordinances, Regulations & Syllabus

For

Master of Science in Microbiology (M.Sc.) Two Year Programme
Semester Pattern
(w.e.f. session 2017-18)

(Scheme & syllabus from 2017-2019)

PEOs: Program Educational Objectives POs: Program Outcomes PSOs: Program Specific

OutcomesName of the Department: Department of Microbiology

Name of the Program: M.Sc. Microbiology

Duration of the degree: 2 Years

M. Sc. (Microbiology) course combines the concepts of biology and chemistry to understand living things and their relationship with the ecosystem. The course covers the study of microorganisms and their effect onhuman life. M.Sc. in Microbiology is an advanced course that helps students understand the microbes such as virus, bacteria, fungi, algae etc. at a deeper level. Students also learn the role of theses microorganism in waste management and the production of fermented foods. Throughout M.Sc. Microbiology course, studentsstudy the detailed microbiology topics and interdisciplinary subjects.

M.Sc. Microbiology has a significant role in pharmaceuticals, agriculture, brewery and manufacturing of commercial products. The practical, research-based project and laboratory work throughout the M.Sc. Microbiology helps candidates excel at the workplace with required skills and knowledge.

Program Educational Objectives (PEOs)

PEO 1: The objective of the Master's Program in Microbiology is to equip the students to gain bimolecular knowledge and analytical skills at an advanced level.

PEO 2: The program emphasizes to apply knowledge acquired about prokaryotic and eukaryotic cellular processes, interaction of microorganisms among themselves, with physical and chemical agents and higher order organisms in environment and biological systems to various conditions.

PEO 3: The laboratory training in addition to theory is included so that the students will acquire the skills to qualify for a broad range of positions in research, industry, consultancy, education and public administration, or for further education in a doctoral program.

PEO 4: Students will be able to address broad range of fields including biopolymer chemistry, marine biochemistry, environmental biotechnology, food science, microbiology, microbial genetics, molecular biology and systems biology.

Program Outcomes (POs)

The Masters in Microbiology Program will address the increasing need for skilled scientific manpower with an understanding of research ethics involving microorganisms to contribute to application, advancement and impartment of knowledge in the field of microbiology and molecular biology globally. The laboratory training will empower them to prepare for careers in broad range fields. The M.Sc. Microbiology student will have:

Program Specific Outcomes (PSOs)

PSO 1: Acquires and demonstrates competency in laboratory safety. Develops routine and specialized microbiological laboratory skills applicable to research, hospitals and industries.

PSO 2: Applies statistical and bioinformatics tools for interpretation of biological data and gains expertise in Computational Biology.

PSO 3: Acquires knowledge of structural and enzymatic properties of microbes and fermentation engineering, to develop human / environment friendly products or processes.

PSO 4: Gets familiarized with principles and techniques of various basic and analytical instruments used inlaboratories.

PSO 5: Recognizes the importance of IPR and Patenting. Gain Entrepreneurial skills to initiate Startup.

PSO 6: Gets trained in bimolecular mechanisms involved in life processes, health and diseases.

PSO 7: Gains proficiency in related disciplines such as Molecular Biology, Pharmaceutical Sciences, Nanobiotechnology and Immunology.

PSO 8: Explores the life forms at cellular, molecular and nano levels. Understands amazing properties ofmicrobial world and appreciates the beauty of microbial life forms.

PSO 9: Assesses the role of microbes in improving soil quality and agricultural output through sustainablemicrobiological applications.

PSO 10: Work as Health care professionals in the fields of laboratory management, hospital and communityservices, in development & preparation of Study material for visually challenged.

Programme Outcome Objectives (POO's)

POO 1 Demonstrate a comprehensive understanding of core business concepts, theories, and practices across various disciplines, including finance, marketing, management, and operations.

POO 2 Apply critical thinking and analytical skills to solve complex business problems and make informed decisions based on quantitative and qualitative data.

POO 3 Exhibit effective verbal and written communication skills, enabling clear presentation of ideas and persuasive arguments in diverse business contexts.

POO 4 Work effectively in teams, demonstrating leadership, interpersonal skills, and the ability to manage group dynamics to achieve common goals.

POO 5 Understand and apply ethical principles and social responsibility in business decision-making, recognizing the impact of business actions on society and the environment.

POO 6 Analyze and appreciate the impact of globalization on business practices and strategies, and demonstrate cultural awareness in diverse business environments.

POO 7 Utilize modern technology and information systems to enhance business operations, including data analysis tools and management software.

POO 8 Foster an entrepreneurial mindset by identifying opportunities, assessing risks, and developing innovative solutions to create value in the marketplace.

POO 9 Commit to ongoing personal and professional development, recognizing the importance of staying current with industry trends and advancements.

POO 10 Develop and implement effective business strategies that align with organizational goals and respond to market dynamics.

Course Components of Academic Programme

M.Sc. (Microbiology)

Minimum Duration: 4 Semesters (2 Years)

Maximum Duration: 6 Semesters (3 Years)

Total Number of Credits: 93 Credits

	Course Components	Credits
1.	**Compulsory Course**	
I.	Foundation Course (FC)	00
II.	Core Course (CC)	61
2.	**Elective Course**	
I.	Departmental Electives (DE)	06
II.	Interdepartmental Electives (IE)	00
3.	**Discipline-Centric Ability Enhancement Course**	
I.	Seminar (SM)	03
II.	Project (PJ)/ Dissertation (DS)	16
III.	Skill (SK) and Ability Enhancement Course (AEC)	04
IV.	Comprehensive (CM)	00
4.	**General Course**	
I.	Human Values, Health Care and Professional Ethics (HP)	00
II.	Healthy Living and Fitness (HF)	00
III.	Disaster Management (DM)	00
IV.	General Proficiency (GP)	03
5.	**Audit Course**	

Requirement of Awards of Degree: - Total Credits: - 93; CGPA>=4.5 and anyother conditions as per regulation and ordinances.

Summary Sheet M.Sc. (Microbiology)

Semester	Credit				Total
	CC	DCAEC (AEC/SK/SM/PJ)	DE	GC	
I	25	3	0	1	29
II	21	3	0	1	25
III	15	1	6	1	23
IV	00	16	0	0	17
Total	**61**	**23**	**6**	**3**	**93**

Core Courses: CC
Discipline-Centric Ability Enhancement Course: DCAEC
Ability Enhancement Course: AEC
Skill Course: SEC
Departmental Electives: DEGeneral Course: GC

M.Sc. (Microbiology) PROGRAMME STRUCTURE

FIRST SEMESTER

Course Code	Course Title	Category	(L)	(T)	(P)	Credits
	Core Courses					
CMBE-501/ **CMBE-501a**	Biochemistry/Cell & Developmental Biology	CC	3	0	0	3
CMBE-503 **CMBE-503a CMBE-503b**	Bacteriology/Pandemics/Soil Microbiology	CC	3	0	0	3
CMBE-505 **CMBE-505a**	Virology/Plant Virology	CC	3	0	0	3
CMBE-507 **CMBE-507a**	Mycology & Phycology/Medicinal Chemistry	CC	3	0	0	3
CMBE-551	Biochemistry Lab	CC	3	0	0	3
CMBE-553	Bacteriology, Virology & Mycology & Phycology Lab					
CMBE-581 **CMBE-581a**	Seminar-I/Personality Development					
	TOTAL					**24**

SECOND SEMESTER

Course Code	Course Title	Category	(L)	(T)	(P)	Credits
	Core Courses					
CMBE-502 **CMBE-502a CMBE-502b**	Molecular Biology/Inheritance Biology/Cytology	CC	4	0	0	4
CMBE-504 **CMBE-504a CMBE-504b CMBE-504c**	Immunotechnology/ Fundamentals of Infections and Immunity/Human Pathology/ Human Physiology & Anatomy	CC	4	0	0	4
CMBE-506/ **CMBE-506a/ CMBE-506b/ CMBE-506c**	Microbial Genetics/ Medical Oncology/Radiation Biophysics/Forensic Science	CC	4	0	0	4
CMBE-508 **CMBE-508a CMBE-508b**	Microbial Physiology and Development/Animal Tissue Culture/Animal Biotechnology	CC	4	0	0	4
CMBE-510 **CMBE-510a**	Research Methodology/ Research Ethics	CC	3	0	0	3
CMBE-552	Molecular Biology Lab	CC	-	-	2	2
CMBE-554	Microbial Genetics & Microbial Physiology Lab	CC	-	-	2	2
CMBE-582	Seminar II	CC	-	-	-	1
	TOTAL					**24**

THIRD SEMESTER

Course Code	Course Title	Category	(L)	(T)	(P)	Credits
	Core Courses					
CMBE-601 **CMBE-601a** **CMBE-601b** **CMBE-601c** **CMBE-601d** **CMBE-601e**	Recombinant DNA Technology/Nanobiotechnology/ Genetic Engineering/Genomics & Proteomics/ Gene Therapy/ Grey Biotechnology	CC	4	0	0	4
CMBE-603 **CMBE-603a**	Cellular Microbiology/Molecular Diagnostics	CC	4	0	0	4
CMBE-605 **CMBE-605a**	Medical Microbiology/Medical lab Diagnostic	CC	4	0	0	4
CMBE-607	Microbial Technology	CC	4	0	0	4
CMBE-651	Recombinant DNA Technology Lab	CC	-	-	3	3
CMBE-653	Medical Microbiology Lab	CC	-	-	3	3
CMBE-655	Minor Project/Field work	CC	-	-	-	2
	TOTAL					**24**

FOURTH SEMESTER

Course Code	Course Title	Category	(L)	(T)	(P)	Credits
	Discipline-Centric Ability Enhancement Course					
CMBE-692	Dissertation	CC	-	-	-	12
	TOTAL					**12**

Dissertation

Note: Students must submit their dissertation report immediately on return from summer vacation inJune /July and the same would be evaluated for 16 credit units, which would be included in the Fourth Semester marks.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

BIOCHEMISTRY

Course Code: CMBE-501 **Credit Units: 03**

Pre-requisite: Basic knowledge of Biochemistry

Course Outcome:

- Understanding chemical properties
- Learning how the chemical properties of molecules determine how they interact and react with each other
- Understanding chemical reactions
- Learning about different types of chemical reactions and how living organisms use them
- Understanding metabolism
- Learning about human biotransformations (metabolism) and how they influence disease and toxic states
- Laboratory skills
- Learning how to use basic laboratory skills and apparatus to obtain reproducible data from biochemical experiments

Details of the Course:-

UNIT I: Thermodynamic principles:

First law of thermodynamics, isothermal process, entropy, second law of thermodynamics, reversible and irreversible process, free energy, chemical potential, Gibbs free energy, redox potential. Interaction in biological system: Role of water and weak interaction– hydrogen bonds, electrostatic bonds, hydrophobic interactions, Van-der Wals forces, buffers and pH scale.

UNIT II: Carbohydrates: Basic structure and function, properties of monosaccharides, disaccharides and polysaccharides, isomerism, mutarotation and functions.
Lipids: Fatty acids, glycerol, phospholipids, sphingolipids, sterols, lipoproteins, prostaglandins.
Amino acids, peptides and proteins: Common structural features, classification by R group, non-protein amino acids, essential amino acids, Zwitter ion structures, isoelectric point, acid-base properties, pKa, primary, secondary, tertiary and quaternary structures of proteins, Ramachandran plot. **Nucleic acids:** Nitrogenous bases, nucleosides, nucleotides, structural polymorphism of DNA (A, B and Z-DNA) and RNA, biological functions of nucleotides.

UNIT III: Metabolism-I

Carbohydrate metabolism: Glycolysis, TCA cycle, Glyoxylate cycle, pentose phosphate pathway, gluconeogenesis, glycogenolysis and glycogenesis, feedback regulation of metabolic pathways.
Mitochondrial ETS and oxidative phosphorylation: Inhibitors and uncouplers of phosphorylation, anaplerotic pathway and substrate level phosphorylation,
Chloroplastic ETS and photophosphorylation: Pigment centres, light harvesting complexes.

UNIT IV: Metabolism-II

Lipids: Fatty acid biosynthesis, acetyl CoA carboxylase, fatty acid synthase, desaturase and elongase, fatty acid oxidation. Biosynthesis and degradation of amino acids. Biosynthesis and degradation of purines and pyrimidines, nucleosides and nucleotides, salvage pathway.

UNIT V: Enzymes:
General characteristics, classification and catalytic power of enzymes, activation energy, steady state enzyme kinetics, Michaelis-Menton equation, vitamins, coenzymes and metal cofactors, enzyme inhibition, activation of enzymes, multienzyme complexes.

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Willey, J.M., Sherwood, L.M. and Woolverton, C.J. 2008. Prescott, Harley and Klein's Microbiology (7th eds.). Mc Graw Hill, USA	2008
2.	Subbarao, M.S. 2007. Soil Microbiology (4th eds.). Oxford and IBH, New Delhi.	2007
3.	Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. 2008. Microbiology (5th eds.). Tata Mc Graw Hill, New Delhi	2008
4.	Dubey, R.C. and Maheswari, D.K. 2008. A text book of Microbiology (2nd eds.). S. Chand Publications	2008
5.	Sullia, S.B. and Shantaram, S. 2005. General Microbiology (2nd eds.). Oxford and IBH Publications.	2005

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

CELL & DEVELOPMENTAL BIOLOGY

Course Code: CMBE-501a **Credit Units: 03**

Pre-requisite: Basic information of Cell & Developmental Biology

Course Outcome:

- Students will acquire knowledge about basics of cell biology.
- Students will learn about how various functions of organelles and their working.
- Students will gain an insight into microscopic structures and chemical components of variousregions of cells.
- Students will attain a comprehensive knowledge of functioning of cell and synchronization ofactivities of various organelles.
- Students will be able to learn about various signaling mechanism involved in a cell whichultimately leads to a visible physiological response.
- Students will be able to understand the architectural components involved in making cellsrigid and how cells are connected to each other.
- Students will learn about molecular events involved in cell cycle.
- Students will apply the information gained in understanding the issues and conditions encountered if things go wrong with cell cycle and how our understanding of cell signaling generate drug targets.

Details of the Course:-

UNIT I: Introduction to prokaryotes, eukaryotes & cell theory

Introduction to microscopy Plasma Membrane: structure – organization, lipid bilayer, proteins &glycol conjugates, liposomes, functions – ionic transport, types of transport (symport, antiport, active & passive), and channel proteins. Intracellular compartmentalization: structure, organization and functions of nucleus, mitochondria, lysosome, Golgi body chloroplast, peroxisome, endoplasmic reticulum (rough and smooth)

UNIT II: Vesicular traffic in the secretary and endocytic pathway:

Transport from endoplasmic reticulum through the golgi network to lysosome, endocytosis, exocytosis, molecular mechanisms of vesicular transport and the maintenance of compartments diversity.

UNIT III: Cell signaling: general mechanistic principles:

Types of signaling, GPCR, RTK with examples, CalciumSignaling, Mechanism of Chemotaxis, signal transductionand vision Significance of vesicular trafficking and cell signaling Cell motility andshape: structure and functions, microfilaments microtubules and intermediate filament.

UNIT IV: Integrating cell into tissue:

Cell-cell adhesion and communication, cell matrix adhesion, extra cellular matrix: collagen & non-collagen

components. Cell cycle, molecular events and regulation.
Cell division: general strategy and regulation, molecular mechanism of mitosis and meiosis. Regulation of cell cycle Role of cyclins / cdks in the initiation of replication.

UNIT V: Cancer-Biology:

Types of cancer, onset of cancer, proto-oncogenes and tumor suppresser genes, oncogenic mutations affecting cell proliferation, cell cycle and genome stability. Programmed cell death &unprogrammed cell death. Expression patterns of proteins & enzymes during cellproliferation Molecular signaling of cancer Aetiology of Cancer.

UNIT VI: Introduction to Developmental Biology

History and Basic Concepts, Basics of model systems: Vertebrate Model Systems,Invertebrate and Plant Model Systems, basic patterning and development plan of model Plan, initial division pattern, and evolution anddevelopment biology

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Molecular Biology of cell, 4th ed. Alberts, Bruce (et.*al) (2002)* Garland Science Publishing, New York.	2002
2.	Cell Biology- Smith and Wood by Chapman and Hall. Cell Biology: Organelle structure and function, Sadava, D E.(2004) Panima pub., New Delhi. Cell and Molecular Biology, 8th ed. Robertis, Edp De and RobertisEmf De (2002) Lippincott Williams and Wilkins Pvt. Ltd., (International Student Edition) Philadelphia.	2004, 2002

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

BACTERIOLOGY

Course Code: CMBE-503 **Credit Units: 03**

Pre-requisite: Basic information of Bacteriology

Course Outcome:

- Identifying and differentiating structures
- Learning to recognize, identify, and differentiate the internal and external structures of microbial cells
- Understanding functions
- Learning to explain the function of structures in bacterial and fungal cells that are important for causing disease
- Understanding bacteriology's role

Unit I : Basics in Biochemistry:

Brief history and scope of microbiology, Classification of micro-organisms, culture techniques, methods of isolation and identification of microbes. Staining of microbes: simple, special and differential staining.

Unit II : Microorganisms– Bacteria:

Morphology and structure of bacteria. Structural organization of bacterial cell wall, gram positive and gram negative bacteria, archaebacteria, actinobacteria. Nutritional requirement and growth curve, autotropic and heterotropic bacteria, batch and continuous cultures of microbes, pure cultures, growth inhibitory substances, physical and chemical methods of microbial control. Microbial genetics, transformation, conjugation, transduction in bacteria.

Unit III : Microorganisms- Fungi:

Characteristic feature, morphology, structure, nutrition, metabolism and reproduction of economically important fungi. Mycotoxicoses

Unit IV Microorganisms- Viruses:

Ultrastructure, multiplication of viruses, Isolation, cultivation of viruses, Bacterial viruses, animal viruses, plant viruses, Viroids, prions.

Unit V Medical Microbiology:

Diseases caused by bacteria, mycoplasma, fungi, virus and their symptoms. Biotechnological methods to deal with diseases caused by microorganisms.

Unit VI: Biotechnological applications of microorganisms:

Classification of microbial products Equipments and accessories for industrial processes- fermenters, scaling-up of processes, downstream processing of products. Microbiological processes for production of organic acid, solvents, antibiotics, enzymes, exo- and endo-polysaccharides. Beverage fermentation-beer, wine, liquor fermentation. Microbiology of milk, dairy and food, preservation of food, food additives and supplements. Genetic engineering of microbes for industrial uses. Microorganisms for bioremediation, sewage treatment, biofertilizers, biopesticides, biofuels, biogas, bioenergy, microbial leaching of ores.

SUGGESTED BOOKS:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Goldsby, R.A., Kindt, T.J. and Osborne, B.A. Kuby's Immunology (4th eds.). W H Freeman and Company.	2008
2.	Playfair, J. and Bancroft, G. 2007. Infection and Immunity (3rd eds.). Oxford University Press.	2007
3.	Willey, J.M., Sherwood, L.M. and Woolverton, C.J. 2008. Prescott, Harley and Klein's Microbiology (7th eds.). Mc Graw Hill, USA.	2008
4.	Chakravarty, A.K. 2008. Immunology and Immunotechnology (3rd eds.). Oxford University Press.	2008

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

PANDEMICS

Course Code: CMBE-503a **Credit Units: 03**

Pre-requisite: Basic information of Animal kingdom system

Course Outcome:

- Students will be able to *define* and explain the fundamental principles of digestion.
- Students will be able to *understand* comparative circulation system, nervous system,endocrine system and excretory system.
- Students will *acquire* knowledge about the function of different types of organs indifferent animal kingdom.

Details of the Course:-

UNIT – I: Digestion and Respiration:
Comparative aspects of Digestion in invertebrate and vertebrate (general account), human:Mechanism of digestion and absorption of carbohydrates, Proteins, Lipids and Nucleic acids. Composition of bile, saliva, pancreatic, gastric and intestinal juice.

Comparative aspects of Respiration in invertebrate and vertebrate (general account), human: Exchange of gases, Transport of O_2 and CO_2, Oxygen dissociation curve, Chloride shift.

UNIT – II: Circulation:

Comparative aspects of Circulation in invertebrate and vertebrate (general account), Human: Composition of blood, Plasma proteins & their role, blood cells, Haematopoiesis, Mechanism of coagulation of blood.

Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heartbeat.

UNIT – III: Muscle physiology and osmoregulation:

Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction.Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation.

UNIT – IV: Nervous System:

Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, salutatory conduction, Neurotransmitters.

UNIT – V: Endocrine System:

Mechanism of action of hormones (insulin and steroids). Different endocrine glands – Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.	2006
	Reference Books	
1.	Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons,Inc.	2006

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

SOIL MICROBIOLOGY

Course Code: CMBE-503b **Credit Units: 03**

Pre-requisite: Basic information of Animal kingdom system

Course Outcome:

- Students will be able to *define* and explain the fundamental principles of digestion.
- Students will be able to *understand* comparative circulation system, nervous system,endocrine system and excretory system.
- Students will *acquire* knowledge about the function of different types of organs indifferent animal kingdom.

UNIT 1: Growth and reproduction in bacteria:

Asexual reproduction methods, bacterial population logarithmic representation, growth phases, generation time calculation, and specific growth rate

UNIT II: Microbes in human health and environment:

Important human diseases and their causative agents, immunity, primary and secondary immune response, antigens, antibodies, and vaccines

UNIT III: Environmental microbiology

Microbial interactions such as mutualism, commensalism, and parasitism

UNIT IV: Application of microorganisms

Bio-pesticides, bio-fertilizers, biodegradation, bio-deterioration, and bioremediation

UNIT V: Soil as a habitat for microorganisms

Microorganisms in soil and their significance: bacteria,fungi, algae, protozoa, rhizosphere and rhizoplane. Biogeochemical cycles: C, N and role ofmicroorganisms.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
1.	Madigan MT, Martinko JM, Dunlap PV and Clark DP. Brock Biology ofMicroorganisms. Pearson International Edition	2006
2.	Cappucino J and Sherman N. Microbiology: A Laboratory Manual. PearsonEducation Limited	2008
3.	Wiley JM, Sherwood LM and Woolverton CJ. Prescott's Microbiology. McGrawHill International.	2007
4.	Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill BookCompany	2010
5.	Atlas RM. Principles of Microbiology. WM.T. Brown Publishers	2006

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

VIROLOGY

Course Code: CMBE-505 **Credit Units: 03**

Pre-requisite: Basic knowledge of Viruses

Course Outcome:
Students will be able to differentiate the nature of viruses, laboratory diagnosis of viruses using different techniques and classification of viruses.

Unit I: Basics in Microbiology:

Brief history and scope of microbiology Classification of micro-organisms, culture techniques, methods of isolation and identification of microbes. Staining of microbes: simple, special and differential staining.

Unit II: Microorganisms– Bacteria:

Morphology and structure of bacteria. Structural organization of bacterial cell wall, gram positive and gram negative bacteria, archaebacteria, actinobacteria. Nutritional requirement and growth curve, autotropic and heterotropic bacteria, batch and continuous cultures of microbes, pure cultures, growth inhibitory substances, physical and chemical methods of microbial control. Microbial genetics, transformation, conjugation, transduction in bacteria.

Unit III: Microorganisms- Fungi:

Characteristic feature, morphology, structure, nutrition, metabolism and reproduction of economically important fungi. Mycotoxicoses

Unit IV: Microorganisms- Viruses:
Ultrastructure, multiplication of viruses Isolation, cultivation of viruses Bacterial viruses, animal viruses, plant viruses. Viroids, prions.

Unit V: Medical Microbiology:
Diseases caused by bacteria, mycoplasma, fungi, virus and their symptoms. Biotechnological methods to deal with diseases caused by microorganisms.

Unit VI: Biotechnological applications of microorganisms:
Classification of microbial products Equipments and accessories for industrial processes- fermenters, scaling-up of processes, downstream processing of products. Microbiological processes for production of organic acid, solvents, antibiotics, enzymes, exo- and endo-polysaccharides. Beverage fermentation- beer, wine, liquor fermentation.Microbiology of milk, dairy and food, preservation of food, food additives and supplements.Genetic engineering of microbes for industrial uses. Microorganisms for bioremediation, sewage treatment, biofertilizers, biopesticides, biofuels, biogas, bioenergy, microbial leaching of ores.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
1.	Nelson, D.L. and Cox, M.M. 2007. Lehninger Principle of Biochemistry (4th eds.). W. H. Freeman and Co	2007
2.	Berg, J.M., Tymoczko, J.L. and Stryer, L. 2007. Biochemistry (6th eds.). W.H. Freeman and Co.	2007
3.	Voet, D.J., Voet, J.G. and Pratt, C.W. 2008. Fundamentals of Biochemistry (3rd eds.). John Wiley Sons Inc	2008
4.	Satyanarayana, U. and Chakrapani, U. 2007. Essentials of Biochemistry (2nd eds.). Books and allied Pvt. Ltd	2007
5.	Murray, R.K., Granner, D.K. and Rodwell, V.W. Harper's illustrated biochemistry (27th eds.) Mc Graw Hill, USA.	2006

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

PLANT VIROLOGY

Course Code: CMBE-505a Credit Units: 03

Pre-requisite: Basic information of Plant Virology.

Course Outcome:

After completion of the course the students should be able to

- Describe the cell organization of bacteria i.e. morphology, ultrastructure and organelles present in bacterial cells.
- Apply the knowledge of bacteriological techniques.
- Describe the nutritional and physical requirements for bacterial growth.
- Describe the principals involved in killing bacteria, and make recommendations on use of physical and chemical methods used to control microbial growth.
- Describe the dynamics of the growth of a bacterial population and how this growth can be measured.
- Describe bacterial taxonomy and classification.
- Differentiate the nature of viruses.
- Understand classification of viruses.
- Learn the methods of laboratory diagnosis of viruses using different techniques.
- Learn about different plant and animal viruses.

Details of the Course:-

Unit – I: Cell Organization:

Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella, fimbriae and pili. Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, Archaebacterial cell wall, Gram and acid fast staining mechanisms, lipopolysaccharide (LPS), sphaeroplasts, protoplasts, and L-forms. Effect of antibiotics and enzymes on the cell wall.
Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes.
Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids Endospore: Structure, formation, stages of sporulation.

Unit – II: Bacterial growth and control:

Culture media: Components of media, Synthetic or defined media, Complex media, enriched media, selective media, differential media, enrichment culture media Pure culture isolation: Streaking, serial dilution and plating methods, cultivation, maintenance and stocking of pure cultures, cultivation of anaerobic bacteria Growth: Binary fission, phases of growth.

Unit – III: Bacterial Systematics and Taxonomy:

Taxonomy, nomenclature, systematics, types of classifications
Morphology, ecological significance and economic importance of the following groups: Archaea:

methanogens, thermophiles and halophiles
Eubacteria: Gram negative and Gram positive Gram negative:
Non-proteobacteria– Deinococcus, Chlamydiae, Spirochetes Alpha proteobacteria- Rickettsia, Rhizobium, Agrobacterium Gamma proteobacteria –Escherichia,Shigella,Pseudomonas
Gram positive: Low G+C: Mycoplasma, Bacillus, Clostridium, Staphylococcus High G+C: Streptomyces, Frankia

Unit – IV: Nature, Properties and Classification of Viruses:

Properties of viruses; general nature and important features Subviral particles; viroids, prions and their importance Isolation and cultivation of viruses.
Morphological characters: Capsid symmetry and different shapes of viruses with examples Viral multiplication in the Cell: Lytic and lysogenic cycle Description of important viruses: salient features of the viruses infecting different hosts - Bacteriophages (T4 & Lambda); Plant (TMV & Cauliflower Mosaic Virus), Human (HIV & Hepatitis viruses).

Unit – V: Role of Viruses in Disease and its prevention:

Viruses as pathogens: Role of viruses in causing diseases Prevention and control of viruses: Viral vaccines, interferons and antiviral compounds.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
1.	Microbiology 10th Edition. Prescott, L.M.; Harley, J.P. and Klein, D.A. (2003) McGraw Hill, USA.	2016
2.	Foundations in Microbiology 10th edition, Kathleen Park Talaro and Barry Chess.	2017
3.	Microbiology- An Introduction. Tortora, G.J., Funke, B.R., and Case, C.L., , Pearson Education (2015)12th ed.	2015
4.	Principles of Virology, Vol I and Vol II, 4th Edition, Jane Flint, Vincent Racaniello, Glenn Rall, Anna Marie Skalka, (2015), American Society of Microbiology	2015

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	

Weightage (%)	10	20	10	60

SEMESTER I

MYCOLOGY & PHYCOLOGY

Course Code: CMBE-507 **Credit Units: 03**

Pre-requisite: Basic information of Fungus and Algae

Course Outcome:

After the successful completion of this course

- Students should be able to know about various groups of fungi and algae.
- As most of the fungi are seen through naked eyes, students will be able to recognize them.
- Students will also have an idea about the pros and cons of fungi and algae.
- Students should be able to know about economic importance of fungi and algae.

Details of the Course:- Unit I:

History of Mycology, Classification of fungi, Morphology, microscopy and structure of fungi

Unit II: General Overview Phylums:-

Chytridiomycota (The chytrids), Zygomycota (The conjugated fungi), Ascomycota (The sac fungi), Basidiomycota (The club fungi), Deutromycota (The imperfecti fungi).

Unit III:

Symbiotic association of fungi, Nutrition requirements

Unit IV:

Parasexual Cycles, Alcoholic fermentation, Fungus like organisms, Rusts and Smuts, Fungal disease of plants and humans

Unit V:

Classification and application of algae: General classification, Life cycle, thallus organisation and occurrence – (i) Chlorophyceae (ii) Charophyceae (iii) Diatoms (iv) Xanthophyceae (v) Phaeophyceae (vi) Rhodophyceae: (vii) Cyanobacteria

Lichens, Economic importance of algae with examples in agriculture, environment, industry and food.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books/Reference Books	
1.	Introduction to Fungi 3 rd Edition. John Webster and Roland W.S. Weber (2007). Cambridge.	2007
2.	An Introduction to Mycology. R.S. Mehrotra and K.R. Aneja (2005). New age International Publishers.	2005
3.	Kumar HD. (1995). *The Text Book on Algae*. 4th edition. Affiliated East Western Press	1995

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

MEDICINAL CHEMISTRY

Course Code: CMBE-507a **Credit Units: 03**

Pre-requisite: Basic information of chemistry and drug development

Course Outcome:

After the successful completion of this course

- Students will be able to explain the relationship between structure and biological activity of various drug molecules.
- Students will be able to understand the most of various classes of drug molecules.

Details of the Course:-

Unit I: General Introduction and Drug target classification

Definition and scope of drug design.

Proteins as drug targets: Receptors – receptor role, ion channels, membrane bound enzyme activation, agonist and antagonists, concept of inverseagonist, desensitization and sensitization of receptors, affinity, efficacy and potency. Enzymes – Enzyme inhibitors (competitive,non-competitive, suicide inhibitors), medicinal use of enzyme inhibitors. Nucleic acids as drug targets: Classes of drugs that interact with DNA:DNA intercalators and DNA alkylators.

Unit II: Physicochemical principles of drug action

Partition coefficient, drug dissolution, acid base properties, surface activity, bioavailablity, stereochemical aspects of drug action.

Unit III: Drug receptor interactions

Kinetic analysis of ligand receptor interactions using scatchard plot, double reciprocal plot, Hill plot, forces involved, relationship between dose and effect (graded and quantal response).

Unit IV: Principles of drug design

Introduction to SAR, strategies in the search for new lead compounds, analogue synthesis versus rational drug design, concept of prodrugs.

Unit V: Drug discovery and pharmainformatics

Drug discovery pipeline, drug target identification and validation for microbial pathogen, selection of gene unique to the pathogen, screening for its presence in other microbes andhuman host, Drug Databases, PubChem, Calculating drug-like properties, introduction to rational drug design methods, optimization of lead compounds, protein3D structure and bindings it analysis, similarity based virtual screening using online tools.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books/Reference Books	
1.	Introduction to Medicinal Chemistry, 4th edition (2009), Graham l. Patrick, Oxford University Press. ISBN-13: 978-0199234479.	2009
2.	The Organic Chemistry of Drug Design and DrugAction,2nd edition(2004),Richard B. Silvermann, Elsevier, Academic Press. ISBN-13: 978-0126437324.	2004

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER I

BIOCHEMISTRY LAB

Course Code: CMBE-551 **Credit Units: 02**

Course Outcomes:

- This course regarded as an introduction to basic biochemistry
- And will be useful for students who want to study clinical chemistry.
- The course uses simple protocols and available materials and instruments to understand Biochemical substances.
- Some experiments were put to teach students how to work independently in the any Lab. -
- Modern lab researchers should know the principles of the biochemical methods of analysis and to learn the main theoretical statements.
- For it, medical Lab Science students have to get the minimum of manual skills during a research of biochemistry, eg. Measuring out solutions and biological liquids, centrifugation, colorimetry of colored solutions, determination of pH, peculiarities of the technique of enzyme investigations etc.
- The given manual contains the Descriptions of the biochemical methods of analysis which all the skills are required in.

Detail of the Course:

- **Introduction:** to the Biochemistry, Safety Rule, Lab report.
- **Lab 1:** Carbohydrate Qualitative tests.
- **Lab2:** Carbohydrate quantitative tests.
- **Lab 3:** Amino acids and protein qualitative tests.
- **Lab 4:** Quantitative determination of proteins by biuret reagent.
- **Lab 5:** Lipids Qualitative tests.
- **Lab 6:** Vitamins, Qualitative and Quantitative tests.
- **Lab 7**: Amino acids titration curves.
- **Lab 8**: RNA preparation and Qualitative tests.
- **Lab 9:** Horizontal and Vertical Electrophoresis.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Culture of Animal Cells – a manual of basic techniques 4th Edition. Freshney, R. I. (2000) John Wiley & Sons, New York.	2000
2.	Animal Cell Biotechnology. Spier, R. E. and Griffiths, J. B. (1988) Academic Press.	1988

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

SEMESTER I

BACTERIOLOGY, VIROLOGY & MYCOLOGY & PHYCOLOGY LAB

Course Code: CMBE-553 **Credit Units: 02**

Course Outcome:

After completion of the course the students should be able to

- Differentiate the nature of bacteria, algae, fungi & viruses.
- Understand classification of microorganism.
- Learn the methods of laboratory diagnosis of viruses using different techniques.
- Learn about different plant and animal viruses.

Course Details

1. Isolation of colipahges from sewage water sample.
2. One step growth curve for determination of virus titre.
3. Immunological assays for virus detection.
4. Screening of embryonated viable eggs and demonstration of virus cultivation.
5. Cultivation and morphological identification of animal cell lines.
6. Induction of lambda lysogen by UV radiations.
7. Studies on Specialized transduction .
8. Isolation of lambda DNA and their characterization.
9. Amplification of lambda DNA by PCR.
10. Phage typing of E.coli bacteriophages.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Virology 3 rd Edition by Conrat H.F., Kimball P.C. and Levy J.A. 1994. Prentice Hall, Englewood Cliff, New Jersey.	1994
2.	Introduction to Modern Virology 4th Edition by Dimmock N J, Primrose S. B. 1994. Blackwell Scientific Publications. Oxford.	1994

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage	10	20	10	60

(%)				

SEMESTER I

SEMINAR I

Course Code: CMBE-581 **Credit Units: 02**

Course Outcomes:

- Describe the measurable skills, abilities, knowledge or values.
- Students should be able to demonstrate as a result of a completing a course.
- They are student-centered rather than teacher-centered.
- They describe what the students will do, not what the instructor will teach.

Detail of the course

Research methods: Lectures, seminars, and practical exercises that cover themes like what constitutes scientific knowledge
Research problems: How to identify and work through research problems
Primary and secondary sources: How to become familiar with sources and critique them, and how to research secondary sources
Research databases: How to use research database tools
Research proposals: How to prepare preliminary interdisciplinary research proposals

Examination Scheme:

Components	**Internal Assessment**			**External Evaluation**
	Attendance	**Class Test**	**Assignment/ Project/Seminar/Quiz**	
Weightage (%)	10	20	10	60

SEMESTER I

PERSONALITY DEVELOPMENT

Course Code: CMBE-581a **Credit Units: 02**

Course Outcomes:

- Discovering strengths
- Promoting well-being
- Improving academic performance
- Demonstrating adaptability, persistence, dependability, and resilience
- Seeking and considering feedback from others
- Employing self-reflection to gain insight

Course Detail:

Improved attitude: People can develop a more positive outlook on life.
Better employment prospects: Self-confidence can help people appear more trustworthy and productive, which can lead to better employment opportunities.
Improved relationships: People can develop better relationships with coworkers and become role models for others.
Better communication: People can develop effective communication skills, such as active listening and using clear language.
Better emotional intelligence: People can learn to understand their feelings, turn intentions into action, and build stronger relationships.
Better time management: People can learn to organize their time more efficiently.
Holistic development: People can contribute to their holistic development.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

MOLECULAR BIOLOGY

Course Code: CMBE-502 **Credit Units: 04**

Pre-requisite: Basic information of Cell Biology

Course Outcome:

- Students will gain an understanding of molecular biology of nucleus and its effect of functioning of an organism.
- Students will understand the concepts of DNA, RNA and will develop an insight into the mechanism of DNA replication in the cell.
- Students will learn about the physiochemical reasons of damage of DNA and their effect on body functioning and will be able to analyze the in vivo mechanism of repair of DNA damage and recombination processes.
- Students will develop an understanding of formation of RNA, different mechanisms in prokaryotes and eukaryotes and processing of final transcriptional products.
- Students will be able to understand the process of protein formation and its control.
- Students will be able to analyze the mechanisms of gene expression and its regulation.

Details of the Course:-

UNIT-I: Structure of nucleotides and nucleic acids:

Structures and types of DNA and RNA, packaging of genetic material in prokaryote sand eukaryotes.

UNIT-II: DNA replication:

Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, Replication enzymes.

UNIT-III: DNA damage, repair and homologous recombination

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, Nonhomologous end joining. Homologous recombination: models and mechanism.

UNIT-IV: Transcription and RNA processing:

Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains.
Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5‟ cap formation, polyadenylation, splicing, rRNA and tRNA splicing.

UNIT-V: Regulation of gene expression and translation

Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation. Posttranslational modifications of proteins.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Genes IX, Lewin, Benjamin, Jones and Bartlett.	2008
	Reference Books	
1.	Molecular Biology of the Gene, James D Watson et. al., (5th Edition,) Pearson	2009

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

INHERITANCE BIOLOGY

Course Code: CMBE-502a Credit Units: 04

Course Outcomes:

- Students will be able to develop an understanding of mechanism and importance of genetic material in prokaryotes and eukaryotes, RNA processing, formation of DNA from RNA and its applications.
- Students will be able to understand the concept of expression of inheritance through genetic code, methods of protein formationand underlying mechanisms in prokaryotes and eukaryotes.
- Students will be able to evaluate the regulation processes in genes of higher and lower organisms.

Details of the course:-

Unit – 1 DNA Structure and Mutagenesis

Historical developments in genetics, discovery of DNA and experimental evidence, Structure of Circular DNA molecule, Primary, Secondary, Tertiary and Quaternary structure of DNA, Watson and Crick model of double stranded DNA the law of DNA constancy and C value paradox and topological manipulations. DNA replication: DNA replication mechanism, enzymes involved in DNA replication and models of DNA replication. Molecular basis of spontaneous and induced mutations [physical and chemical mutagenic agents], Types of mutation: point, frameshift, lethal, conditional lethal, inversion and deletion, null mutation, reversion of mutations, intra and intergenic suppression mutations. Environmental mutagenesis, toxicity testing and population genetics. Systems that safeguard DNA. DNA methylation and DNA repair mechanisms - excision, mismatch, SOS , photoreactivation, recombination repair and glycocylase system.

Unit – 2 Prokaryotic Transcription and Translation

Organization of transcriptional units and regulation of gene expression Mechanism of transcription of prokaryotes-Structure and function of RNA polymerase, [DNA foot printing], termination and antitermination – N proteins and nut sites in DNA binding proteins, enhancer sequences and control of transcription, RNA processing (Capping, polyadenylation, splicing, introns and exons) Ribonucleoprotein, structure of mRNA, rRNA, tRNA. Direction of protein synthesis, RNA template, direction with experimental proof, tRNA as adaptor, ribosomes and their organization in prokaryotes, polycistronic mRNA in bacteria, initiation of translation in bacteria, small sub-units, its accessory factors, SD sequence in bacteria, initiator tRNA, elongation of translation, translocation and termination mechanisms. Post-translational modification. Salient features of genetic code.

Unit – 3 Regulation of gene expression in prokaryotes

Operon concept, co-ordinated control of structural genes, stringent response, catabolite repression, instability of bacterial RNA, positive regulation in E.coli [Arabinose operon] and negative regulation in E.coli [lac operon], inducers and repressors, regulation by attenuation by trp operon.

Unit – 4 Genetic recombination

Genetic recombination processes: Role of rec proteins in homologous recombination. Conjugation: Discovery, F+, F- and Hfr cells, types of Hfr; F+ and F- and Hfr and F- genetic crosses. Mechanism of conjugation. Sexduction, conjugational transfer of colicinogenic and resistance transfer factors. Genetic mapping. Plasmid Replication and Incompitability, Control of copy number.
Transposons – Insertion sequences and composite transposons, phages as transposons replicative, non-replicative and conservative transposition. Mutations i.e. deletions, inversions and frameshift due to transposition. Mechanism of transposition, controlling elements of maize – autonomous and non-autonomous elements. Types of transposons and their properties.

Unit – 5 Phage Genetics
T4 virulent phage: structure, life cycle, genetic map and DNA replication. Lamda temperate phage: Structure, genetic map, lytic and lysogenic cycle, lysogenic repression and phage immunity. [Lambda regulon] applications of phages in microbial genetics.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
1.	Microbial Genetics by Maloy ET. Al. 1994. Jones and Bartlett Publishers.	1994
2.	Molecular Genetics of Bacteria by J. W. Dale. 1994. John Wiley and Sons	1994
3.	Modern Microbial Genetics. 1991 by Streips and Yasbin. Niley Ltd.	1991
4.	Moleculat Biology of the Gene 4th Edition by J.D. Watson, N.H. Hoppkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. 1987, The Benjamin / Cummings Publications Co. Inc. California.	1987

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

CYTOLOGY

Course Code: CMBE-502b **Credit Units: 04**

Pre-requisite: Basic information of Cell Biology

Course Outcome:

- Basic chemical composition of living matter.
- Structural characteristics of prokaryotic and eukaryotic cells.
- Taxonomy and characteristics of the major kingdoms.
- Mechanics of membrane transport.
- Basic concepts of bioenergetics, photosynthesis, and cellular respiration.
- Mechanics of cellular reproduction.
- Mendelian genetics and genetic change.
- Nucleic acids and basic concepts of protein synthesis and gene regulation.

Details of the Course:-

UNIT I: Cell:

Introduction and classification of organisms by cell structure, cytosol, Compartmentalization of eukaryotic cells, cell fractionation Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model

UNIT II: Cell Membrane and Permeability:

Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport. Sex-limited and sex-influenced inheritance, Transposons. Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments

UNIT III: Endoplasmic reticulum:

Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion. Lysosomes: Vacuoles and micro bodies: Structure and functions Ribosomes: Structures andfunction including role in protein Synthesis.

UNIT IV: Mitochondria:

Structure and function, Genomes, biogenesis. Chloroplasts: Structure and function, genomes,

biogenesis. Nucleus: Structure and function, chromosomes and their structure. Extracellular Matrix: Composition, molecules that mediate cell adhesion

UNIT V: Membrane receptors:

For extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction. Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Molecular Biology of cell, 4th ed. Alberts, Bruce (et.*al)(2002)* Garland Science Publishing, New York.	2002
2.	Cell Biology- Smith and Wood by Chapman and Hall. Cell Biology: Organelle structure and function, Sadava, D E. (2004) Panima pub., New Delhi. Cell and Molecular Biology, 8th ed. Robertis, Edp De and RobertisEmf De (2002) Lippincott Williams and Wilkins Pvt. Ltd., (International Student Edition) Philadelphia.	2004, 2002

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

Immunotechnology

Course Code: CMBE-504 Credit Units: 04

Pre-requisite: Basic information of Immunotechnology

Course Outcome:

- Students will acquire knowledge about processing and presentation of immune system.
- Student will be able to understand cell mediated immune response.
- Students will be able to value role of immune system in different diseases.
- Students will be able to apply their knowledge to technologies related to immunology.

Details of the course:

UNIT I:

Introduction to Immunology: History and terminology, innate and acquired immunity, active and passive immunity, immune responses, cells (T-cells, B-cells) and organs of immune system, cell mediated and humoral immunity, cytokines, toll-like receptors.

UNIT II:

Antibody: Classification, isotypes, fine structure**,** biosynthesis of immunoglobulin, rearrangement of genes and class switching, complement system.
Antigen: Nature of antigens, haptens, adjuvants, vaccines.

UNIT III:

MHC complex: Function, structure and MHC restriction.

UNIT IV:

Principles of virulence and pathogenicity: Host-parasite interactions.
Transplantation and tumor immunology: Tumor cell immunity, transplantation of tissues and organs, relationship between donor and recipient, role of MHC molecules in allograft rejection, bone marrow and haematopoietic stem cell transplantation, tumor antigen, tumor immunoprophylaxis.
Autoimmune diseases: Autoimmune hemolytic anemia, systemic lupus erythematosus, multiple sclerosis, rheumatoid arthritis, AIDS, diabetes mellitus.

Inflammation and hypersensitivity: Hypersensitivity reactions, inflammasome.

UNIT V:

Applied immunotechnology: Antigen-antibody interaction, affinity and avidity, agglutination and precipitation reactions, immunoflourescence, fluorescence activated cell sorting analysis.

Antibody engineering: Hybridoma and monoclonal antibody (Mab), recombinant antibody molecules, human and humanized antibodies, uses of Mab.

Antigen engineering: ELISA, RIA, immunodiffusion, immunoelectrophoresis, immunoblotting, antibody for diagnosis, antibody for therapy, cytokine therapy

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	1. Willey, J.M., Sherwood, L.M. and Woolverton, C.J. 2008. Prescott, Harley and Klein's Microbiology (7th eds.). Mc Graw Hill, USA.	2008
2.	Playfair, J. and Bancroft, G. 2007. Infection and Immunity (3rd eds.). Oxford University Press.	2007
3.	Chakravarty, A.K. 2008. Immunology and Immunotechnology (3rd eds.). Oxford University Press.	2008
4.	Tizard. 2008. Immunology: An introduction (4th eds.). Cengege learning.	2008
5.	Rao, C.V. 2008. Immunology: A text book. Narosa Publishing House.	2008

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

FUNDAMENTALS OF INFECTIONS AND IMMUNITY

Course Code: CMBE-504a **Credit Units: 04**

Pre-requisite: Basic information of microbiology, infection, immunity.

Course Outcome:

- Students will be able to define and explain the fundamental principles of modern immunology.
- Students will be able to *classify* antibodies on the basis of their structures and functions.
- Students will be able to *understand* related immunological techniques and *apply* them inmedical laboratory profession.

Details of the course

UNIT-I: Introduction:

History: Concept of Innate and Adaptive immunity; Structure, Functions and Properties of: Immune Cells; and (Primary and secondary Lymphoid organs). Active and Passive Immunity.

UNIT – II: Antigens and Antibodies:

Antigen, Immunogen, Factorscontributing immunogenicity, Epitopes, Haptens; Adjuvants

Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); Monoclonal and Chimeric antibodies, Hybridoma Technique. Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, RIA, Immunofluoresence, Immunoelectron microscopy, Complement fixation test.

UNIT – III: Major Histocompatibility Complex and Complement System:

Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways). Components of the Complement system; Activation pathways (Classical, Alternative and Lectin pathways).

UNIT – IV: Generation of Immune Response:

Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response, T-cell receptor, T-cell maturation, activation and differentiation.

UNIT – V: Immunological Disorders, Tumor Immunity and vaccines:

Autoimmunity and Autoimmune diseases, Hypersensitivity- Type I Hypersensitivity, Type II Hypersensitivity, Type III Hypersensitivity, Type IV Hypersensitivity; Types of tumors, tumor Antigens, causes and therapy for cancers, Vaccine.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/ Reprint
	Text Books	
1.	Immunology, Goldsby RA, Kindt TJ, Osborne BA. Kuby‟s. 6th edition W.H. Freeman and Company, New York, 2007.	2007
2.	Essential Immunology, 10th ed Roitt, Ivon; Delves, Peter (2001) Blackwell Scientific Publications Oxford.	2017
	References	
1.	Basic and Clinical Immunology, Peakman M, and Vergani D. 2nd ed).Immunology on Churchill Livingstone Publishers, Edinberg, 2009	2009
2.	Richard C and Geiffrey S. 6th edition. Wiley Blackwell Publication. 2009.	2009
3.	Janeway‟s Immunobiology, Murphy K, Travers P, Walport M., 7th edition Garland Science Publishers, New York. 2008.	2008

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

HUMAN PATHOLOGY

Course Code: CMBE-504b **Credit Units: 04**

Pre-requisite: Basic understanding of diseases and their pathogenesis

Course Outcome:

Students will be able to learn and understand the concepts of how human system works in altered and diseased stage under the influence of various internal and external stimuli.

Details of the Course:-

Unit I:

History of pathology, basic definitions and familiarization with the common terms used inpathology, techniques used in pathology.

Cellular Adaptations, Cell Injury and Cell Death:

Causes and mechanisms of cell injury: reversible and irreversible injury, Cellular responses: Hyperplasia, Hypertrophy, Atrophy, Metaplasia, Necrosis, Apoptosis, subcellular and intracellular response, (with suitable examples of diseases), Cellular ageing.

Unit II: Role of Inflammation in diseases (with suitable examples):

General features of acute and chronic inflammation: Vascular changes, cellular events, termination of acute inflammatory response. Cells and molecular mediators of inflammation, morphological effects and outcome of acute inflammation. Systemic effects of chronic inflammation, granulomatous inflammation.

Unit III: Tissue Renewal And Repair, Healing And Fibrosis:

Mechanism of tissue regeneration, role of ECM, repair by healing, scar formation and fibrosis, cutaneous wound healing, tissue remodelling in liver (mechanism of fibrosis and cirrhosis).

Unit IV: Hemodynamic Pathology:

Edema, hyperaemia, congestion, haemorrhage, haemostasis and thrombosis, Embolism, Infarction and shock and hypertension.

Nutritional diseases: Protein energy malnutrition, deficiency diseases of vitamins and minerals, nutritional excess and imbalances. Role and effect of metals (Zinc Iron and Calcium) and their deficiency diseases.

Unit V: Cell proliferation: Cancer:

Definitions, nomenclature, characteristics of benign and malignant neoplasms, grading and staging of cancer, biology of tumor growth, mechanism of tumor invasion and metastasis, carcinogens and cancer, concept of oncogenes, tumor suppressor genes, DNA repair genes and cancer stem cells.

Pathophysiology diseases:

A. Aetiology and Pathophysiology of: Diabetes, Arteriosclerosis, Myocardial infarction, restrictive and obstructive respiratory diseases (COPD), Parkinson, Schizophrenia, Silicosis

B. Infectious Diseases: Pathogenesis of diseases and overview of modes of infections, prevention and control with suitable examples like Typhoid, Dengue

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Robbins and Cotran Pathologic Basis of Disease, 8th edition (2009), Vinay Kumar, Abul K. Abbas, Jon C. Aster, Nelson Fausto; SaundersPublishers, ISBN-13: 978-1416031215.	2009
2.	Medical Laboratory Technology Methods and Interpretations Volume1 and 2, 6th edition (2009), Ramnik Sood; Jaypee Brothers Medical Publishers, ISBN-13: 978-8184484496.	2009
	Reference Books	
1.	General and Systematic Pathology, 2nd edition (1996), J., Ed. Underwood and J. C. E. Underwood; Churchill Livingstone, ISBN-13:978-0443052828.	1996
2.	Robbins Basic Pathology, 9th edition (2012), Kumar, Abbas, Fausto andMitchell; Saunders Publication, ISBN-13: 978-1437717815.	2012

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

HUMAN PHYSIOLOGY & ANATOMY

Course Code: CMBE-504c **Credit Units: 04**

Pre-requisite: Basic information of Animal kingdom system

Course Outcome:

- Students will be able to define and explain the fundamental principles of heart.
- Students will be able to understand comparative Respiratory system, Renal Physiology, Reproductive system, Endocrine system and Gastrointestinal system.

- Students will acquire knowledge about the function of different types of organs in different animal kingdom.

Details of the Course:-

Unit I: Scope of Physiology and Anatomy:

Definition of various terms used in Anatomy. Structure of cell, function of its components with special reference to mitochondria and microsomes. Elementary tissues: Elementary tissues of the body, i.e. epithelial tissue, muscular tissue, connective tissue and nervous tissue. Skeltal System: Structure and function of Skelton .Classification of joints and their function. Joint disorders.

Unit II: Cardiovascular and Respiratory System:

Composition of blood, functions of blood elements. Blood group and coagulation of blood. Brief information regarding disorders of blood. Name and functions of lymph glands. Structure and functions of various parts of the heart .Arterial and venous system with special reference to the names and positions of main arteries and veins. Blood pressure and its recording. Brief information about cardiovascular disorders.

Respiratory system: Various parts of respiratory system and their functions, physiology of respiration.

Unit III: Urinary, Muscular and Central Nervous System:

Urinary System: Various parts of urinary system and their functions, structure and functions of kidney. Physiology of urine formation. Patho-physiology of renal diseases and edema. Muscular System: Structure of skeletal muscle, physiology of muscle contraction. Names, positions, attachments and functions of various skeletal muscles. physiology of neuromuscular junction.

Central Nervous System: Various parts of central nervous system, brain and its parts, functions and reflex action. Anatomy and physiology of automatic nervous system.

Unit IV: Sensory Organs and Digestive System:

Sensory Organs: Elementary knowledge of structure and functions of the organs of taste, smell, ear, eye and skin. Physiology of pain.

Digestive System: names of various parts of digestive system and their functions. structure and functions of liver, physiology of digestion and absorption.

Unit V: Endocrine system and Reproductive System:

Endocrine System: Endocrine glands and Hormones. Location of glands, their hormones andfunctions. pituitary, thyroid. Adrenal and pancreas.

Reproductive system: Physiology and Anatomy of Reproductive system.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books/References	
1.	Guytonand Hall Textbook of Medical Physiology,11th edition(2006),J.E.Hall;WB Saunders and Company, ISBN-13: 978-1416045748.	2006
2.	Human Physiology, 9th edition (2006), Stuart I. Fox; Tata McGraw Hill, ISBN-13: 9780077350062.	2006
3.	Principles of Anatomy and Physiology, 13th edition (2011),Gerard J. Tortora and Bryan H. Derrickson; Wiley andSons, ISBN-13:978-0470565100.	2011

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

MICROBIAL GENETICS

Course Code: CMBE-506 **Credit Units: 04**

Pre-requisite: Basic information of Genetics & Molecular Biology

Course Outcome:

- Students will become familiar with basic principles of genetics and underlying mechanisms

- Students will acquire a comprehensive knowledge on molecular basis of cellular activities and mechanisms involved.
- Students will be able to learn about the concepts (structures, arrangements, functions) of nucleic acids and implement their knowledge in replication of lower and higher organisms' genetic material.
- Students will gain an insight into the molecular biology of cancer. They will be able to analyze the factors leading to damage of genetic material and in vivo mechanisms to combat these damages.

Details of the Course:-

UNIT I : Basic principles of inheritance and exception to Mendelian laws. Gene interaction, complementation, linkage, chromosomal aberrations. Population genetics: Hardy –Weinberg law. Quantitative genetics and applications

UNIT II : Chemical and Physical properties of nucleic acids: Nucleosides & Nucleotides. Structural and types of RNA and DNA. The Watson- Crick Model. DNA as genetic material. Different forms of DNA. Topological properties of DNA. DNA reassociation kinetics and cot curve. Packaging of DNA in the prokaryotic nucleoid andeukaryotic chromosomes. Genomic Organization: Unique DNA, Repetitive DNA, Transposable elements.

UNIT III : Mechanism of DNA replication in prokaryotes and eukaryotes, DNA Polymerases. DNA damage, DNA repair and recombination mechanism. Retrovirus and introduction to cancer, oncogenes, tumour suppressor genes.

UNIT IV : Mechanism of transcription in prokaryotes and eukaryotes. Posttranscriptional processing of RNA**:** (Capping- polyadenylation, splicing, RNA editing).Reverse transcription

UNITV : Mechanism of translation in prokaryotes and eukaryotes. Post translational modifications. Concept of genetic code. Gene expression and regulation in prokaryotes (Lac operon and **tryptophan operon). Gene expression and regulation in eukaryotes, Gene Silencing, RNA Interference.**

Suggested Books:

S. No.	**Name of Authors/Books/Publishers**	**Year of Publication/Reprint**
	Text Books	
1.	Genes IX, Lewin, Benjamin, Jones and Bartlett	2008
2.	Molecular Biology of the Gene, James D Watson et. al.,	2009

	(5th Edition) Pearson.	
	Reference Books	
1.	Molecular Biology of the Cell. Alberts et. al. (5 th edn)	2007
2.	Molecular Cell Biology. Lodish et. al. (6 th edn.)	2008
3.	Principles of Genetics, E J Gardner et. al., (8th Ed.,)	2011

Examination Scheme:

Components	**Internal Assessment**			**External Evaluation**
	Attendance	**Class Test**	**Assignment/ Project/Seminar/Quiz**	
Weightage (%)	10	20	10	60

SEMESTER II

MEDICAL ONCOLOGY

Course Code: CMBE-506a **Credit Units: 04**

Pre-requisite: Basic knowledge of Medical Oncology.

Course Outcome:

- Students would know about the cell cycle, its regulation and carcinogenesis.
- Students will be able to know about the basics of cancer and its types.
- Students will understand about the cancer diagnosis.
- Students will also have knowledge of cancer therapy.

Details of the Course:

UNIT-1

Modulations of Cell- Cell cycle- ligands and receptors, cell- cellinteractions, integrins, invasions by cancerous cells, angiogenesis,morphogens, mechanism of deregulation of cell cycle during cancer, Apoptosis.

UNIT-2

Types of tumor-Benign and malignant tumor, localized and metastasis disease, tumor classification-WHO classification, staging and grading, degree of malignancy, types of chromosomal translocations, Relationship between oncogene products and growth factors- Src, Wnt, GAP**.**

UNIT-3

Carcinogenesis-Oncogenic mutations in growth promoting proteins,Mutations causing loss of cell cycle control, evasion of growth inhibitory signals, cancer genes (oncogenes and tumor suppressor genes), necrosis.

UNIT-4

Cancer Diagnosis-Cancer Imaging Techniques, Drug targeting and anti-cancer delivery system, Targeted delivery of anticancer agents usingNanoparticles, colloidal systems for the delivery of anticancer agents.

UNIT-5

Cancer therapy-Modulations of immunue response, immunotherapy, Conventional chemotherapy, photodynamic therapy of cancer, Critical analysis of cancer therapy, Cancer vaccines.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Cell and Molecular Biology, 8th Edition, Eduardo D. P. DeRobertis, E. M. F. De Robertis Lippincott Williams & Wilkins, 2010	2010
2.	The Cell: A Molecular Approach, 6th Edition Geoffrey M. Cooper ASM Press, 2013.	2013
3.	Cell and Molecular Biology: Concepts and Experiments, 6th Edition Gerald Karp John Wiley & Sons, Inc. 2010	2010
4.	Molecular Biology of Cancer: Mechanisms, Targets and Therapeutics, Lauren Pecorino, Oxford University Press, 2008	2008
	Reference Books	
1.	Introduction to Cancer Biology, Robin Hesketh, Cambridge University Press, 2013	2013

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

RADIATION BIOPHYSICS

Course Code: CMBE-506b Credit Units: 04

Pre-requisite: Basic knowledge of Radiation Biology & Medical Physics.

Course Outcome:

At the end of this course, the student should be able:

- To describe the various types of radiation and their biological impact on living cells and tissue at the DNA, cellular, organ and whole animal levels.
- To describe applications of radiation in the research laboratory and to medicine, withemphasis on radiation oncology.
- To employ independent learning strategies to self-evaluate and update professional knowledge of innovations in medical radiation physics.
- To identify medical radiation related instrumentation and apply techniques associated with diagnostic imaging and radiation oncology.

Details of the Course:

UNIT-1

Introduction of radiations, basic concept of radioisotopes, types of radioactivedecay (gamma and beta emitter), half-life, detection and measurement of radioactivity methods based upon ionization (GM counter), methods based upon excitation (scintillation counter). Use of radioisotopes in cell biology in understanding of DNA replication (bidirectional and theta replication), transcription (labeling of RNA) and labeling of protein using labeled amino acid. Use of radioisotopes in biology: Autoradiography, radioisotopes in diagnosis (thyroid disorders, cancer) and therapy (radiotherapy). Effect of radiations (ionizing and non-ionizing) on living systems, radiation induced damage to cell (chromosome and DNA damage), precautions and safety measures in handling radioisotopes.

UNIT-2

Electromagnetic spectrum, properties of non-ionizing and ionizing radiation& their biological effects, radiation units, radioactive decay, ionisation power of radiations, binding energy of nucleus, concept of stable and unstable nuclei, different regions of ionising radiations in detectors, hazards of non- ionizing radiation and their control, medical application of radiation sources principles of detection and different methods of counting and counters, dosimetry of high-energy photons, electrons and ions, mapping of gamma detector output.

UNIT-3

Biological effects of UV radiation, UV in treatment of skin disorders, Biological effects of LASER, application of LASER, application ofmicrowave radiation and ultrasonic waves, chromosome aberration and gene mutation, molecular aspects of radiation damage and repair, somatic and genetic effects of radiation.

UNIT-4

Application of ionizing radiation in industry, agriculture and research, internally administered isotopes, radio-iodine in thyroid function analysis, principles of isotope dilution analysis, circulation time, renal, liver and lung function analysis, principles of X-ray diagnosis, high kV radiography, special procedures such as topography, fluoroscopy, stereoscopy, image intensifiers and television monitoring,

UNIT-5

Biomedical imaging techniques and principles of analogue and digital imaging, Ultrasound imaging, nuclear magnetic resonance imaging, X-ray imaging and CT scan, Principle of tomographic techniques, computerised tomography, position emission tomography, application and interpretation of images.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Roy R.R& Nigam B.P. Nuclear Physics, Theory and Experiment, Wiley.	2016
2.	Knoll G.F. Radiation detection and measurements, John Wiley.	2014
	Reference Books	
1.	Coggle J.E. Biological Effects of Radiation. 2 nd edition, Taylor & Francis	2006

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

FORENSIC SCIENCE

Course Code: CMBE-506c **Credit Units: 0**4

Pre-requisite: Basic knowledge of Forensic Science.

Course Outcome:

- Students will be able to understand about the basics and different branches of Forensic Sciences.
- Students will be able to know about the working and functioning of Forensic science laboratories.
- Students will learn the Police science, its role in criminal investigation and prevention of crime.
- Students will be able to know how forensic scientists operate and use scientific evidence in a legal context.
- Students will be able to learn the methods of securing, searching and documenting crime scenes.

Details of the Course:

UNIT -1

Definition and scope of Forensic Science, History and Development of Forensic Science, Development of Forensic Science in India. Scope and development of forensic science, Forensic science in India, Growth of Core laboratories, set up in country.

UNIT -2

Introduction to crime, Sociological aspect in society, Types of crimes, Crimes in India, Crime Scene Management, Crime Scene procedures, Protection of crime scene physical evidence-Scientific collection of physical evidence, Crime scene management in man made and natural disaster.

UNIT -3

Duties of forensic scientist, Various divisions of crime investigation – Toxicology Biology Serology Chemistry Physics Ballistics Prohibition Document and other divisions.

UNIT -4

Specialised facilities offered by forensic science laboratory – DNA fingerprinting Polygraph Narco analysis, Brain electrical oscillation, signature proficiency (BEOSP).
Cyber forensic, Tape and video authentication, Speaker identification etc.

UNIT -5

Concepts of psychology, History of psychology, modern perspectives, types of psychological professionals psychology, The science and research methods, professional and ethical issues in psychology.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Introduction to Forensic Science in Crime Investigation –Dr.Rukmani Krishnamurty, Selective and Scientific Books, 1stedition 2011.	2011
2.	Criminalistics - An Introduction to Forensic Science-RichardSaferstein, Pearson Prentice Hall, 8thEdition	2006
3	Introduction to Psychology, Morgan, King, Weiss and Schopler, VII edition, (1989) McGraw Hill, India.	1989
	Reference Books	
1.	Abnormal psychology & modern life, Carson RC & Butcher JN (10th Ed) Harper- Collins	2007
2	The Counseling process Patterson, Lewis E.&Welfel, Elizabeth Reynold – [2000] Hilgard.	2000

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

MICROBIAL PHYSIOLOGY AND DEVELOPMENT

Course Code: CMBE-508 **Credit Units: 04**

Pre-requisite: Basic information of biology and microbiology.

Course Outcome:

At the end of the course, the students will be familiar with microbial technology. This wouldhelp students to launch themselves in industrial biotechnology which is the fastest growing industry in the developing country.

Details of the Course:-

UNIT I:

Introduction to bacteria, fungi, and viruses, structural and cellular organelles differences among different types and classes ; biochemical/microscopic/molecular methods to differentiatearchaea, eubacteria and eukaryotes; microbial evolution, systematicsand taxonomy- new approaches to bacterial taxonomy, classificationincluding ribotyping, characteristics of primary domains, taxonomy,nomenclature and Bergey's manual, ribosomal RNA sequencing.

UNIT II:

Prokaryotic growth patterns and functions - microbial nutrition and growth - arithmetic and geometric growth expression, growth kinetics, growth curve, measurement of growth and growth yields, synchronous growth, continuous culture, diauxic growth, culture collection and maintenance of cultures.

UNIT III:

Microbial regulation of gene expression (attenuation and negative regulation with e.g. *trp* and *lac* operon), transfer of genetic material: plasmids, transposons, transduction, transformation and conjugation. Mutations and their chemical basis; mutagens and their use in biotechnology; modes of recombination; comparative prokaryotic genomics.

UNIT IV:

Normal micro flora of skin, oral cavity, gastrointestinal tract; entry ofpathogens into the host, types of toxins (exo, endo, entro) and their modeof actions, plant -microbe interactions, microbial pathogenesis -disease reservoirs; epidemiological terminologies; infectious disease transmission.

UNIT V:

Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins, broad spectrum antibiotics, antibiotics from prokaryotes, antifungal antibiotics; mode of action, resistance to antibiotics.Bacteriophage therapy. Potential targets for drug design.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Pelczar Jr., M.J., Chan, E.C.S. and Krieg, Noel R., Microbiology,McGraw Hill (2003) 5th ed.	2003
2.	Stanier, R.Y., Ingraham, J.L. and Wheelis, M.L., General Microbiology, MacMillan (2007) 5thed.	2007
	References	
1.	Microbiology 10th Edition. Prescott, L.M.; Harley, J.P.and Klein, D.A. (2003) McGraw Hill, USA.	2016
2.	Foundations in Microbiology 10th edition, KathleenPark Talaro and Barry Chess.	2017
3.	Microbiology- An Introduction. Tortora, G.J., Funke, B.R., andCase, C.L., , Pearson Education (2015)12th ed.	2015
4.	Principles of Virology, Vol I and Vol II, 4th Edition, Jane Flint, Vincent Racaniello, Glenn Rall, Anna Marie Skalka, (2015), American Society of Microbiology	2015
5.	Comparative Plant Virology, Roger Hull, 2nd ed. Elsevier, Academic Press. (2009)	2009
6.	Plant Viruses, Diseases and Their Management, Kajal KumarBiswas, IK. International Publishing House Pvt Ltd, 2016.	2016
7.	Animal cell culture and Virology, S. Nandi, New India Publishing agency, 1st ed. (2009)	2009
8.	Textbook of Medical Virology, Mishra B, CBS Publishing, 1stedition, 2018	2018

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage	10	2	10	60

(%)		0		

SEMESTER II

ANIMAL TISSUE CULTURE

Course Code: CMBE-508a **Credit Units: 0**4

Pre-requisite: Basic information of materials chemistry, biochemistry, materials strength, celltissue biology.

Course Outcome:

To introduce students to the concepts underlie the mechanical and biological properties ofsynthetic and natural biomaterials and tissue engineering principles and scaffolding techniques.

- The students will be able to explain the concepts of stress and strain, and the parameters usedto characterize the physical bulk and surface properties of materials.
- The students will be able to describe the composition, structure and mechanical properties of the main classes of biomaterials- metals, ceramics, polymers, composites and the bodytissues; explain and give an example of how composition, structure and treatment modify the mechanical properties.
- The students will be able to explain how to determine the mechanical parameters of materials experimentally; interpret the results of tests and data sheets according to international standards.
- The students will be able to describe the interactions of biomaterials with the biological environment – stability, corrosion, histo-cyto and hemo-compatability; explain how these interactions are assessed and influenced by material choice and modification.
- The students will be able to describe and the developments of biomaterials for regenerative therapies and tissue engineering; give an example of tissue engineering technique.
- The students will be able to describe and give an example of how biomaterials are used to fabricate devices for clinical use.

Details of the Course:-

Unit –I

Introduction of biomaterial, types of biomaterials, advantages anddisadvantages, Bio ceramics for implant coating, calcium phosphates,hydroxy epilates Ti6Al4V and other biomedical alloys, implant and tissue interaction.

Unit –II

Advantages of Nanomaterials use as implants, biological response ofimplanted materials, desirable and undesirable reactions of the body with implanted materials, Materials used for orthopaedic implants,bioceramics, modes of failure.

Unit –III

Materials used for dental, modes of dental implant failure, weardebris, materials used for cartilage and vascular, bladder, modes of cartilage implant, vascular implant, implant failure study, modes of bladder implant failure.

Unit- IV

Protein interactions with implanted materials, cellular recognition ofProteins adsorbed on material surfaces, adhesion, migration, differentiation, Cellular Extra cellular Matrix deposition leading totissue regeneration, foreign-body response, inflammatory response.

Unit- V

Tissue engineering Introduction, Stem cells, Morphogenesis, Generation of tissue in the embryo, Tissue homeostasis, Cellular signaling, Extracellular matrix as a biologic scaffold for tissue engineering, Scaffold fabrication, bioactive scaffold, Natural polymers in tissue engineering applications, Degradable polymers for tissue engineering.

Suggested Books:

S. No.	**Name of Authors/Books/Publishers**	**Year of Publication/Reprint**
	Text Books	
1.	William A. Goddard, Sergey Edward Lyshevski, Donald W. Brenner (Ed) Handbook of Nanoscience, Engineering and Technology CRC press 2003	2003
2.	Mark A. Ratner, Daniel Ratner (Ed) Nanotechnology; a gentleintroduction to the next big idea; Prentice Hall PTR; 2003.	2003
	Reference Books	
1.	Joachim Schummer, Davis Baird (Ed) NanotechnologyChallenges: implications for philosophy, Ethics and society ; World scientific ; 2006	2006
2.	Richard S. Silberglitt, Philip S. Anton, James Schneider (Ed.).The global technology revolution: Bio/nano/materials trends and	2001

	their synergies with information; Rand corporation;2001	

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage(%)	10	20	10	60

SEMESTER II

ANIMAL BIOTECHNOLOGY

Course Code: CMBE-508b Credit Units: 04

Pre-requisite: Basic information of Animal Biology

Course Outcome:

- Students will be able to understand various applications of biotechnology for livestock improvement.
- Students will develop skills for animal cells culture in laboratory.
- Students will learn about the cloning and livestock genetic characterization.
- Students will learn methods of micromanipulation.
- Students will be able to analyze the causes of different animal diseases and their diagnostics.

Details of the Course:-

Unit I:

Structure and organization of animal cell and equipments and material for animal cell culture technology. Primary cell culture & establishment of cell lines. History of Animal cell culture medium-balanced salt solution and simple growth medium role of CO_2 serum and supplements. Serum and protein free defined media.

Unit II:

Viability and cytotoxicity measurement, cell characterization,growth kinetics.
Scaling-up of animal cell culture. Cell synchronization, Cellcloning & micro manipulation.

Unit III:

Recombinant approaches to vaccine production; Hybridoma technology; Diagnostic assays based on Antigen-antibody; radioi-mmunoassay and enzyme immunoassays;Immunoblotting; Nucleic acid Restriction endonuclease
analysis; PCR, Real time PCR; Nucleic acid sequencing;Animal disease diagnostic kits; Probiotics.

Unit IV:

Cryopreservation of sperms and ova of livestock; Artificial insemination; Super ovulation; in vitro fertilization; Culture ofembryos; Cryopreservation of embryos; Embryo transfer; Embryo-splitting; Embryo sexing; Micromanipulation of animal embryos.

Unit V:

Transgenic animal technology and its different applications; Animal cloning- basic concepts; Cloning from embryonic cellsand adult cells; Ethical, social and moral issues related tocloning; in situ and ex situ preservation of germplasm; in uterotesting of foetus for genetic defects; Pregnancy diagnostic kits;

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Brown, T.A. Molecular biology Labfax II: Gene analysis. II Edition. Academic Press, California,USA.	1988
2.	Butler, M. Animal cell culture and technology: The basics. II Edition. Bios scientific publishers.	2004
	Reference Books	
1.	Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA	2009
2.	Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K (2007). Recombinant DNA- genes and genomes- A short course.III Edition. Freeman and Co., N.Y., USA.	2007

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

Research Methodology

Course Code: CMBE-510 Credit Units: 03

Pre-requisite: Basic information of Animal Biology

Course Outcome:

- Describe the measurable skills, abilities, knowledge or values.
- Students should be able to demonstrate as a result of a completing a course.
- They are student-centered rather than teacher-centered.
- They describe what the students will do, not what the instructor will teach.

Details of the Course:-

Unit-I: Meaning of Research - Function of Research Meaning of Research - Function of Research ,Characteristics of Research ,Steps involved in Research ,Research in Pure and Applied Sciences - Inter Disciplinary Research Factors which hinder Research ,Significance of Research - Research and scientific methods ,Research Process,Criteria of good Research ,Problems encountered by Researchers ,Literature review.

Unit - II: Identification of Research Problem Selecting the Research problem ,Necessity of defining the problem ,Goals and Criteria for identifying problems for research. Perception of Research problem ,Techniques involved in defining the problem ,Source of problems, Personal consideration. Methods of investigation-sampling techniques and theories, editing, classification and tabulation of data, and frequency distribution of data.

Unit- III: Research Design Formulation of Research design ,Need for Research design ,Features of a good design ,Important concepts related to Research design. Different research designs ,Basic principles of experimental designs ,Computer and internet in designs.

Unit-IV: Interpretation and Report Writing Meaning and Technique of interpretation ,Precautions in interpretation ,Significance of report writing ,Different steps in writing a report ,Layout of a Research report. Types of report ,Mechanics of writing a research report ,Precautions for writing a research report ,Conclusion.

Unit -V: Statistical Techniques and Tools Introduction of statistics, Functions, Limitations, Measures of central tendency - Arithmetic mean ,Median ,Mode ,Standard deviation – Co-efficient of variation (Discrete serious and continuous serious) ,Correlation - Regression Multiple Regression. Sampling distribution ,Standard error ,Concept of point and interval estimation ,Level of significance ,Degree of freedom ,Analysis of variance ,One way and two way classified data ,'F'-test.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	A Hand Book of Methodology of Research, Rajammall, P. Devadoss and K. Kulandaivel, RMM Vidyalaya press, 1976.	1976
2.	Research Methodology Methods & Techniques, C.R. Kothari – New Age international Publishers, Reprint 2008.	2008
3.	Thesis and Assignment Writing, J. Anderson, Wiley Eastern Ltd., 1997.	1997
4.	Research Methodology, Mukul Gupta, Deepa Gupta – PHI Learning Private Ltd., New Delhi, 2011.	2011
5.	Fundamentals of Mathematical statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand & Sons, New Delhi,1999.	1999

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

RESEARCH ETHICS

Course Code: CMBE-510a Credit Units: 03

Pre-requisite: Basic information of Animal Biology

Course Outcome:

- Describe the ethics related to the research.
- Students should be able to demonstrate an ethical experiment.
- They are student-centered rather than teacher-centered.
- They describe what the students will do, not what the instructor will teach.

Details of the Course:-

Unit I:

Introduction to Philosophy, definition, nature and scope, concept, branches. Ethics: definition, moral philosophy, nature of moral judgments and reactions.

Unit II:

Scientific conduct (ethics with respect to science and research, Intellectual honest and research integrity.

Unit III:

Scientific Misconducts: Falsification, Fabrification, and Manipulation, Selective reporting and misrepresentation of data.

Unit IV:

Publication Ethics- Definition, introduction and importance, best practices and guide lines, identification of publication misconduct, complaints and appeals.

Unit V:

Predatory publishers and journals, approved and peer reviewed, research journals, plagiarism and how to detect plagiarism.

SEMESTER II

MOLECULAR BIOLOGY LAB

Course Code: CMBE-552 Credit Units: 02

Pre-requisite: Basic information of laboratory techniques used in molecular biology.

Course Outcomes:

- This course regarded as an introduction to basic Molecular biology techniques.
- The course uses simple protocols and available materials and instruments to understand Molecular materials.
- For it, medical Lab Science students have to get the minimum of manual skills during a research of molecular biology, eg. DNA isolation, electrophoresis, buffer preparation, PCR, etc.
- The given manual contains the Descriptions of the molecular methods of analysis which all the skills are required in.

Detail of the Course:

1. **Laboratory Safety and Techniques:** Safety regulations, aseptic techniques, pipette use, and basic laboratory equipment.
2. **DNA Isolation and Quantification:** Isolation of genomic DNA and plasmid DNA, DNA quantification using spectrophotometry.
3. **Polymerase Chain Reaction (PCR):** Basic PCR principles, designing primers, PCR optimization, and analysis of PCR products.
4. **Agarose Gel Electrophoresis:** Separation and visualization of DNA fragments.
5. **Restriction Enzyme Digestion:** Restriction enzyme digestion of DNA, analysis of restriction fragments.
6. **DNA Cloning:** Ligation of DNA fragments into vectors, transformation of competent cells, and selection of recombinant clones.
7. **Protein Expression and Purification:** Induction of protein expression, cell lysis, and protein purification techniques (e.g., affinity chromatography).
8. **Molecular Biology Applications:** Techniques like DNA sequencing, real-time PCR

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	S. K. Gakhar, Monika Miglani, Ashwani Kumar; Molecular Biology: A Laboratory Manual	2013

2.	Gloria Doran, Essentials of Molecular Biology, 2018	2018

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

MICROBIAL GENETICS & MICROBIAL PHYSIOLOGY LAB

Course Code: CMBE-554 **Credit Units: 02**

Pre-requisite: Basic information of laboratory techniques used in microbial genetics & microbial physiology.

Course Outcomes:

- Develop practical skills in aseptic techniques, microbial culture, and laboratory techniques.
- Learn to design experiments, analyze data, and draw conclusions.
- Gain understanding of microbial growth, metabolism, genetic mechanisms, and biotechnological applications.
- Acquire problem-solving skills and adapt to experimental challenges.

Detail of the Course:

1. Aseptic Techniques: Mastering sterile techniques for handling microorganisms.
2. Media Preparation: Preparing various culture media (solid and liquid) for bacterial growth.
3. Microbial Growth Curve: Monitoring bacterial growth over time using spectrophotometry.
4. Effect of Physical and Chemical Factors on Microbial Growth: Studying the impact of factors like temperature, pH, and antibiotics.
5. Genetic Transformation: Introducing foreign DNA into bacteria using techniques like heat shock and electroporation.
6. DNA Isolation and Purification: Extracting and purifying genomic DNA and plasmid DNA.
7. PCR and Gel Electrophoresis: Amplifying specific DNA sequences and analyzing them using gel electrophoresis.
8. Microbial Enzyme Assays: Measuring enzyme activity under different conditions to understand metabolic pathways.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Singh B.D., Singh R.P.; Microbial Physiology and Microbial Genetics, 2017	2017
2.	P.M. Swami; Laboratory manual on Biotechnology, Rastogi Publication, 2008	2008

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

SEMINAR II

Course Code: CMBE-582 **Credit Units: 02**

Course Outcomes:

- Describe the measurable skills, abilities, knowledge or values.
- Students should be able to demonstrate as a result of a completing a course.
- They are student-centered rather than teacher-centered.
- They describe what the students will do, not what the instructor will teach.

Detail of the course

Research methods: Lectures, seminars, and practical exercises that cover themes like what constitutes scientific knowledge
Research problems: How to identify and work through research problems
Primary and secondary sources: How to become familiar with sources and critique them, and how to research secondary sources
Research databases: How to use research database tools
Research proposals: How to prepare preliminary interdisciplinary research proposals

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

RECOMBINANT DNA TECHNOLOGY

Course Code: CMBE-601 **Credit Units: 04**

Pre-requisite: In-depth knowledge of Recombinant DNA Technology

Course Outcome:

- The student will be familiar with the historical background and important milestones, biosafety and bioethics in genetic engineering.
- The student will be acquainted with tools of RDT like enzymes, vectors and hosts.
- The student will be acquainted with technical knowhow of gene cloning and expression and factors for optimizing the heterologous gene expression.
- The student will be acquainted with the techniques required for gainful applications of genetic engineering.
- The student will be able to apply RDT in different domains of life science, medical, agriculture, forensic and allied fields for the welfare of living beings.

Details of the Course:-

Unit I: Introduction and scope of RDT:

Recombinant DNA, Milestones in genetic engineering, Biosafety and Bioethics, Overview of Scope and Applications of Recombinant DNA Technology. Isolation of nucleic acid (plasmid, DNA and RNA), quantification and its purity.

Unit II: Tools and strategies of molecular cloning:

Enzymes in Recombinant DNA Technology and its applications: Nucleases, Restriction endonucleases, DNA Polymerases, Terminal transferase, Reverse transcriptase, Kinase and Phosphatase, DNA ligases (T4 DNA ligase and *E.coli* DNA ligase).
Structure and strategies of cloning and screening of vectors based upon: Plasmids, Cosmids, Phages, Artificial Chromosomes (BAC and YAC), and hybrid vectors, shuttle vectors, plant vectors (*Agrobacterium* and virus based), expression vectors.

Unit III: Gene Cloning and Expression:

Cloning and screening strategies (including directional cloning): Cutting and joining vector and insert DNA, transformation of recombinant DNA in host, methods for screening of Transformants. Introduction to gene expression (Prokaryotic and eukaryotic expression). Synthesis of cDNA, Construction of cDNA library and genomic DNA library.

Unit IV: Methods in RDT:

DNA, RNA and Protein analysis: Agarose gel electrophoresis, SDS-PAGE, Gel Shift Assay. Blotting

techniques: Southern-, Northern- and Western blotting, probe labeling and hybridization; Polymerase Chain Reaction: Principle, methodology and application; variants of PCR. Molecular markers and their applications; DNA microarray analysis; Chromosome walking; Site directed mutagenesis.

Unit V: Application of RDT:

Transgenic Technology: Types approaches and application (Plant and Animals); Gene therapy: Principles, strategies and ethics of human gene therapy; DNA Fingerprinting and application of DNA technology in forensics and parental disputes; Products of recombinant DNA technology: human therapeutic- insulin, hGH, recombinant vaccines.

Suggested Books:

S. No.	**Name of Authors/Books/Publishers**	**Year of Publication/Reprint**
	Text Books	
1.	Gene Cloning and DNA Analysis, An Introduction, T. A. Brown (7^{th} edition), Wiley-Blackwell	2015
2.	Recombinant DNA: Genes and Genomes - A Short Course, James D. Watson , Richard M. Meyers, Amy A. Caudy, Jan A. Witkowski, (3rd Edition), W.H. Freeman	2007
	Reference Books	
1.	Molecular Cloning: A Laboratory Manual, Michael R. Green; Joseph Sambrook, (Fourth Edition), CSHL Press	2012
2.	Principles of Gene Manipulation and Genomics, Primrose, S.B. and Twyman, R.M., (7th ed.) Blackwell Publishing	2006

Examination Scheme:

Components	**Internal Assessment**			**External Evaluation**
	Attendance	**Class Test**	**Assignment/ Project/Seminar/Quiz**	
Weightage (%)	10	20	10	60

SEMESTER III

NANOTECHNOLOGY

Course Code: CMBE-601a **Credit Units: 0**4

Unit I

Background to Nanoscience: Defination of Nano, Scientific revolution-Atomic Structure and atomic size, emergence and challengs of nanoscience and nanotechnology, carbon age-new form of carbon (CNT to Graphene), influence of nano over micro/macro, size effects and crystals, large surface to volume ration, surface effects on the properties.

Unit II

Types of nanostructure and properties of nanomaterials: One dimensional, Two dimensional and Three dimensional nanostructured materials, Quantum Dots shell structures, metal oxides, semiconductors, composites, mechanical-physical-chemical properties.

Unit III

Application of Nanomaterial: Ferroelectric materials, coating, molecular electronics and nanoelectronics, biological and environmental, membrane based application, polymer based application.

Unit IV

Surface Nanoscience: Introduction to surface active agents. Theory and applications.Types of surfactants. Classification, synthesis of surfactant - Shape, size and structure of surfactants. Micelle, Emulsions, Microemulsions & Gels. Kraft temperature, surfactant geometry and packing.

Unit V

Colloidal Nanoscience:Introduction to colloidal material, surface properties, origin of colloidal particles, preparation & characterization of colloidal particles. Applications of super hydrophilic hydrophobic surfaces, self-cleaning surfaces.Surface viscosity.

Suggested Books:

S. No.	**Name of Authors/Books/Publishers**	**Year of Publication/Reprint**
	Reference Books	
1.	Chemistry of nanomaterials: Synthesis, properties and applications by CNR Rao et.al.	2012
2.	Nanoparticles: From theory to applications – G. Schmidt, Wiley Weinheim 2004.	2004
3.	Instrument E L Principe, P Gnauck and P Hoffrogge, Microscopy and Microanalysis (2005), 11: 830- 831, Cambridge University Press.	2005

4.	Processing & properties of structural naonmaterials - Leon L. Shaw, Nanochemistry: A Chemical Approach to Nanomaterials, Royal Society of Chemistry, Cambridge UK 2005.	2005

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

GENETIC ENGINEERING

Course Code: CMBE-601b Credit Units: 04

Pre-requisite: In-depth knowledge of Genetic Engineering.

Course Outcome:

- The student will be familiar with the historical background and important milestones,biosafety and bioethics in genetic engineering.
- The student will be acquainted with tools of RDT like enzymes, vectors and hosts.
- The student will be acquainted with technical knowhow of gene cloning and expression andfactors for optimizing the heterologous gene expression.

Details of the Course:-

Unit I: Introduction and scope of RDT:

Recombinant DNA, Milestones in genetic engineering, Biosafety and Bioethics, Overview of Scope and Applications of Recombinant DNA Technology. Isolation of nucleic acid (plasmid, DNA and RNA), quantification and its purity.

Unit II: Tools and strategies of molecular cloning:

Enzymes in Recombinant DNA Technology and its applications: Nucleases, Restriction endonucleases, DNA Polymerases, Terminal transferase, Reverse transcriptase, Kinase andPhosphatase, DNA ligases (T4 DNA ligase and *E.coli* DNA ligase).
Structure and strategies of cloning and screening of vectors based upon: Plasmids, Cosmids, Phages, Artificial Chromosomes (BAC and YAC), and hybrid vectors, shuttle vectors, plant vectors (*Agrobacterium* and virus based), expression vectors.

Unit III: Gene Cloning and Expression:

Cloning and screening strategies (including directional cloning): Cutting and joining vector and insert DNA, transformation of recombinant DNA in host, methods for screening of Transformants. Introduction to gene expression (Prokaryotic and eukaryotic expression). Synthesis of cDNA, of cDNA library and genomic DNA library.

Unit IV: Methods in RDT:

DNA, RNA and Protein analysis: Agarose gel electrophoresis, SDS-PAGE, Gel Shift Assay. Blotting techniques: Southern-, Northern- and Western blotting, probe labeling and hybridization; Polymerase

Chain Reaction: Principle, methodology and application; variants of PCR. Molecular markers and their applications; DNA microarray analysis; Chromosome walking; Site directed mutagenesis.

Unit V: Application of RDT:

Transgenic Technology: Types approaches and application (Plant and Animals); Gene therapy: Principles, strategies and ethics of human gene therapy; DNA Fingerprinting and application of DNA technology in forensics and parental disputes; Products of recombinant DNA technology: human therapeutic- insulin, hGH, recombinant vaccines.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Gene Cloning and DNA Analysis, An Introduction, T. A. Brown (7^{th} edition), Wiley-Blackwell	2015
2.	Recombinant DNA: Genes and Genomes – A Short Course, James D. Watson , Richard M. Meyers, Amy A. Caudy, Jan A. Witkowski, (3^{rd} Edition), W.H. Freeman	2007
	Reference Books	
1.	Molecular Cloning: A Laboratory Manual, Michael R. Green; Joseph Sambrook, (Fourth Edition), CSHL Press	2012
2.	Principles of Gene Manipulation and Genomics, Primrose, S.B. and Twyman, R.M., (7^{th} ed.) Blackwell Publishing	2006

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

GENOMICS & PROTEOMICS

Course Code: CMBE-601c **Credit Units: 0**4

Pre-requisite: In-depth knowledge of genomics and proteomics.

Course Outcome:

- The student will be able to understand human genome, genome sequencing approaches, genome mapping, next generation DNA sequencing platforms and molecular markers.
- The student will be able to know the methods of functional genomics, gene annotation and modern techniques of gene editing, deletion and silencing.
- The student will be able to know introductory account of sub branches of genomics e.g comparative genomics, epigenomics, metagenomics, 78harmacogenomics etc. and selected model organisms used in genomic studies.
- The students will be able to know Proteomics and Transcriptomics along with its methods and application.

Details of the Course:-

UNIT I: Structural Genomics:

The Genome: Components and their organization; Genome mapping; Genetic and Physical mapping; Genome sequencing: shotgun sequencing and Clone contig methods; Conventional methods of DNA sequencing and next generation DNA sequencing strategies; Human Genome project.

UNIT II: Functional genomics:

Gene discovery-forward and reverse genetics approaches; Molecular mapping and taggingmutagenesis-insertional mutagenesis, directed mutagenesis by homologous recombination, Loss of function and gain of function mutants; RNA interference and Antisense technology; Gene editing technology.

UNIT III:

Introduction to Comparative genomics, Epigenetic and Epigenomics, Toxicogenomics, Pharmacogenomics and Metagenomics.
Model Organisms: *Saccharomyces cerevisiae* (yeast), Mus *musculus* (Mouse), *Arabidopsis thalina* (Thale Cress) etc.

UNIT IV: Proteome and Proteomics:

2D SDS-PAGE, Isolation and sequence analysis of spots by Mass Spectroscopy; Cell free protein synthesis in wheat germ cells and Rabbit reticulocyte lysate; Protein-Protein Interaction:Yeast Two Hybrid System and Phage display.

UNIT V:

Introduction to Transcriptomics; Quantitative (Real-Time) PCR, Nucleic acid Micro-arrays: andits applications.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Genome 4, T. A. Brown (4th Ed.), Garland Science, New York	2017
2.	Molecular Biology the Gene, James D Watson et. Al., (5th Edition) Pearson.	2009
3.	Recombinant DNA: Genes and Genomes – A Short Course, James D. Watson , Richard M. Meyers, Amy A. Caudy, Jan A.Witkowski, (3rd Edition), W.H. Freeman	2007
	Reference Books	
1.	Lewin‟s Gene XI, Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick, (11 ed), Jones and Bartlett learning.	2014
2.	Principles of Gene Manipulation and Genomics, Primrose, S.B. and Twyman, R.M., (7th ed.) Blackwell Publishing	2006

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	

Weightage (%)	10	20	10	60

SEMESTER III

GENE THEARPY

Course Code: CMBE-601d Credit Units: 04

Pre-requisite: In-depth knowledge of genes and gene therapy

Course Outcomes:

- The student will be acquainted with the techniques required for gainful applications ofgene therapy.
- The student will be able to apply gene modification techniques for better hereditary of life science, medical, agriculture, forensic and allied fields for the welfare of living beings.

Detail of the course:

Unit I

Systematic position of microorganisams in the living world. Classification of microorganisms: Haeckel's three kingdom concept, Whittaker's five kingdom concept, three domain concept of Carl Woese, Historical account of bacterial classification. Detailed account of bacterial classification according to the 1st edition of Bergey's Manual of Systematic Bacteriology (up to sections); Detailed account of bacterial classification according to the 2nd edition of Bergey's Manual of Systematic Bacteriology (up to orders).

Unit II

Characteristics, classification and economic importance of the following sections (Bergey's Manual of Systematic bacteriology 1st edition). Spirochetes, Gram – negative aerobic rods and cocci: Facultative anaerobic Gram - negative rods, Rickettsia and Chlamydia; Mycoplasma, Endospore-forming Gram - positive rods and cocci; Mycobacteria, Anoxygenic photosynthetic bacteria and Oxygenic photosynthetic bacteria; Aerobic chemolithotrophic bacteria, Archaea and Actinomycetes

Unit III

Brief account of discovery of viruses, chemical composition of viruses; morphology, architecture, principles of symmetry with reference to T4, TMV, Adeno, Polio, Influenza, Rhabdo, Reo and HIV viruses. Nucleic acid diversity in viruses; sub viral particlessatellite viruses, viroids, DI particles and prions; Taxonomy of viruses: classification and nomenclature of viruses as per ICTV; Isolation, purification, cultivation, assay and characterization of plant, animal and bacterial viruses.

Unit IV

Life cycles of bacterial viruses; one step growth curve, lytic and lysogenic cycles with reference to T4, _ and _ X 174. Importance of phages; Classification and nomenclature of plant viruses, replication of TMV and CaMV; Classification and replication of animal viruses (Adeno, Influenza, Herpes, Hepatitis and Retro viruses); Transmission and management of plant and animal viral diseases (interferons, antiviral drugs and vaccines etc.)

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Sneath, P.H.A .and R.R. Sokal 1973 Numerical taxonomy .The Principles and Practice of Numerical Classification, San Francisco. W.H. Freeman	1973
2.	Sneath, P.H.A 1989 Analysis and Interpretation of sequence data for bacterial Systematic. The view of a Numerical taxonomist .Syst.Appl.Microbiol.12:15-31	1989
3.	Tom Parker, M. Lerline , H.Collier,1990,Principles of Bacteriology, Virology and Immunity, VIII Ed.	1990
4.	Woese,C.R.,Kandler,O. and M.L.Wheelis 1990 Towards a natural System of organisms: Proposal for the Domains Archea, Bacteria and Eucarya. Proc. Nati, Acad, Sci. ,87: 4576- 4570	1990
5.	Garrity George, M. Edieor-In Cheaf 2005 Bergey's Manual of Systematic Bacteriology II Ed. (Vol- I-V) .J.Brenner,K.R.Krieg, J.T.Stanly. Editors. Springer-Verlog	2005
6.	Prescott, L.M., J.P Harley and D.AKlein, 2007 Microbiology VII Ed. Mc Grow Hill,	2007

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

GREY BIOTECHNOLOGY

Course Code: CMBE-601e **Credit Units: 0**4

Pre-requisite: In-depth knowledge of environmental science and biotechnology implications

Course Outcome:

- The student will be able to understand human genome, genome sequencing approaches, genome mapping, next generation DNA sequencing platforms and molecular markers.
- The student will be able to know the methods of functional genomics, gene annotation and modern techniques of gene editing, deletion and silencing.
- The student will be able to know introductory account of sub branches of genomics e.g comparative genomics, epigenomics, metagenomics, pharmcogenomics etc. and selected model organisms used in genomic studies.
- The students will be able to know Proteomics and Transcriptomics along with its methods and application.

UNIT I: Bioremediation
The two main types of bioremediation are in situ and ex situ. Bioremediation is a biological clean-up process that uses microorganisms to eliminate chemical contamination.
UNIT II: Bioaugmentation
This process involves introducing indigenous and exogenous strains to increase the activity of enzymes that treat contaminated soil and water.
UNIT III: Bioventing
This is a cost-effective and efficient technology that remediates petroleum-contaminated sites by circulating air through the sub-surface.
UNIT IV: Biocatalysts
Biocatalysts have emerged as enablers in gray biotechnology. Some topics related to biocatalysts include:
Economics of biocatalytic processes Non-aqueous enzymology Enzyme immobilization Flow biocatalysis Whole cell biocatalysis and co-enzyme regeneration

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Vandevivere and W. Verstraete, Environmental Applications, edited by C. Ratledge and B. Kristiansen, (Cambridge university Press, New York, 2006)	2006
2.	G. Bitton, in Wastewater Microbiology (Wiley-Liss/Wiley, Hoboken, 2005)	2005

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

CELLULAR MICROBIOLOGY

Course Code: CMBE-603 **Credit Units: 04**

Pre-requisite: Basic information of Cell Biology

Course Outcome:

- Students will acquire knowledge about basics of cell biology.
- Students will learn about how various functions of organelles and their working.
- Students will gain an insight into microscopic structures and chemical components of variousregions of cells.
- Students will attain a comprehensive knowledge of functioning of cell and synchronization ofactivities of various organelles.
- Students will be able to learn about various signaling mechanism involved in a cell whichultimately leads to a visible physiological response.
- Students will be able to understand the architectural components involved in making cellsrigid and how cells are connected to each other.
- Students will learn about molecular events involved in cell cycle.
- Students will apply the information gained in understanding the issues and conditions encountered if things go wrong with cell cycle and how our understanding of cell signaling generate drug targets.

Details of the Course:-

Unit I:

Introduction to prokaryotes, eukaryotes & cell theory, Introduction to microscopy, Plasma Membrane: structure – organization, lipid bilayer, proteins &glycoconjugates, liposomes, functions – ionic transport, types of transport (symport, antiport, active & passive), channel proteins, Intracellular compartmentalization: structure, organization and functions of nucleus, mitochondria, lysosome, golgi body chloroplast, peroxisome, endoplasmic reticulum (rough and smooth).

Unit II:
Vesicular traffic in the secretary and endocytic pathway: transport from endoplasmic reticulum through the golgi network to lysosome, endocytosis, exocytosis, molecular mechanisms of vesicular transport and the maintenance of compartments diversity.
Cell signaling: general mechanistic principles
Types of signaling, GPCR, RTK with examples, CalciumSignaling, Mechanism of Chemotaxis, signal transduction and vision.

Unit III:
Vesicular traffic in the secretary and endocytic pathway: transport from endoplasmic reticulum through the golgi network to lysosome, endocytosis, exocytosis, molecular mechanisms of vesicular transport and the maintenance of compartments diversity. Cell signaling: general mechanistic principles Types of signaling, GPCR, RTK with examples, CalciumSignaling, Mechanism of Chemotaxis, signal transduction and vision Significance of vesicular trafficking and cell signaling

Unit IV:
Cancer-Biology: Types of cancer, onset of cancer, proto- oncogenes and tumor suppresser genes, oncogenic mutations affecting cell proliferation, cell cycle and genome stability.
Programmed cell death &unprogrammed cell death.
Expression patterns of proteins & enzymes during cellproliferation

Unit V:
Introduction to Developmental Biology, History and Basic Concepts, Basics of model systems: Vertebrate Model Systems,Invertebrate and Plant Model Systems, basic patterning and development plan of model Plan, initial division pattern, and evolution and development biology

Suggested Books:

S. No.	**Name of Authors/Books/Publishers**	**Year of Publication/Reprint**
	Reference Books	
1.	Molecular Biology of cell, 4th ed. Alberts, Bruce (et.*al)(2002)* Garland Science Publishing, New York.	2002
2.	Cell Biology- Smith and Wood by Chapman and Hall. Cell Biology: Organelle structure and function, Sadava, D E. (2004) Panima pub., New Delhi. Cell and Molecular Biology, 8th ed. Robertis, Edp De and RobertisEmf De (2002) Lippincott Williams and Wilkins Pvt. Ltd., (International Student Edition) Philadelphia.	2004, 2002

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

MOLECULAR DIAGNOSTIC

Course Code: CMBE-603a **Credit Units: 04**

Pre-requisite: Basic knowledge of immunology and molecular biology

Course Outcome:

- Students will gain new insights about different diagnostic procedures.
- Students will be able to use critical thinking skills to trouble shoot problems as they occurand determined possible causes
- Students will be able to apply the knowledge of molecular testing to the most commonly performed applications in the clinical laboratory.

Details of the Course:-

UNIT I: Enzyme Immunoassays:

Solid phases, Comparison of enzymes, conjugation of enzymes, Use of polyclonal or monoclonal antibodies, Immunoblotting, Radioimmunoassay.

UNIT II: Molecular methods in diagnostics:

Applications of PCR, RFLP, Nuclear hybridization methods LAMP method in transgenics.

UNIT III: Prenatal diagnosis:

Invasive techniques - Amniocentesis, Fetoscopy, Chorionic Villi Sampling (CVS), Non-invasive techniques - Ultrasonography, X-ray, TIFFA.

UNIT IV: Biochemical diagnostics:

Inborn errors of metabolism, haemoglobinopathies, mucopolysaccharidoses, lipidoses, andglycogen storage disorders.

UNIT V: Automation in microbial diagnosis:

Rapid diagnostic approach including technical purification and standardization of antigen andspecific antibodies.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Buckingham, L., Flaws, M,L., Molecular Diagnostics: Fundamentals, Methods, & Clinical Applications, F A Davis Co., Philadelphia.	2007
2.	Grody, W.W., Nakamura, R.M., Kiechle, F.K. & Strom, C., Molecular Diagnostics: Techniques and Applications for the Clinical Laboratory, Academic Press	2009
	Reference Books	
1.	Ananthanarayan, R. & Paniker, C.K.J., Textbook o fMicrobiology. 7th edition, University Press Publication.	2005
2	Kindt, T J, Goldsby, R.A., Osborne, B.A. & Kuby, J., Immunology, 6th Edition, W.H. Freeman, New York	2007

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTTER III

MEDICAL MICROBIOLOGY

Course Code: CMBE-605 **Credit Units: 0**4

Pre-requisite: Basic information of Medical Microbiology

Course Outcome:

Upon successful completion of this course the student will be able to:

- This course provides learning opportunities in the basic principles of medical microbiology and infectious disease.
- It covers mechanisms of infectious disease transmission, principles of aseptic practice, and therole of the human body‟s normal microflora.
- The course provides the conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause disease in the human body.
- It also provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.
- To understand the importance of pathogenic bacteria in human disease with respect toinfections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue.
- Helps to understand the use of lab animals in medical field.
- Recall the relationship of this infection to symptoms, relapse and the accompanying pathology.
- Explain the methods of microorganisms‟ control, e.g. chemotherapy & vaccines. Solveproblems in the context of this understanding.

Details of the Course:-

UNIT I: General Microbiology:

Morphology and classification of microorganisms. Growth, nutrition and multiplication of bacteria. Sterilization and Disinfection - Principles and use of equipment‟s of sterilization namely hot air oven, autoclave and serum inspissator,pasteurization, antiseptics and disinfectants. Immunology - antigen, Antibodies, Immunity, vaccines, types of vaccine and immunization schedule. Hospital acquired infection - Causative agents, transmission methods, investigation, prevention and control of hospital Acquired infections.

UNIT II: Bacteriology:

Classification of bacteria, morphology, infections, lab diagnosis, treatment and prevention of common bacterial infections.Staphylococcus, Streptococcus, Pneumococcus, Neisseria, Corynebacteriumdiphtheriae, Clostridia, Enterobacteriaceae

- Shigella, Salmonella, Klebsiella, E.coli, Proteus, Vibrio cholerae, Pseudomonas and Spirochetes.

UNIT III: Mycobacteriology & Parasitology:

Mycobacteria- classification, pathogenesis, lab diagnosis andprevention. Classification, infections and lab diagnosis of followingparasites. Entamoeba, Giardia, Malaria, Hookworm, Roundworm and Filarial worms.

UNIT IV: Mycology:

Morphology, disease caused and lab diagnosis of following fungi.Candida, Cryptococcus, Dermatophytes, opportunistic fungi (Aspergillus, Zygomycetes and Penicillium).

Unit V: Virology:

General properties of viruses, diseases caused lab diagnosis and prevention of following viruses, Herpes, Hepatitis, HIV, Dengue,Influenza, Chikungunya, Rabies and Poliomyelitis.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Microbiology by Lansing M. Prescott and John P. Harley and Donald Klein; Ed. 6th; McGraw-Hill Science, 2004.	2004
2.	Allen and William M Janda and Paul C Schreckenberger and Washington C Winn; Ed. 6th; Lippincott Williams & Wilkins,2005.	2005
	Reference Books	
1.	Essentials of diagnostic microbiology by Lisa Anne Shimeld andAnne T. Rodgers; Delmar Publishers, 1999.	1999
2.	Medical Microbiology by Geo. Brooks and Karen C. Carroll andJanet Butel and Stephen Morse; Ed. 24th; McGraw-Hill Medical, 2007.	2007

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

MEDICAL LAB DIAGNOSTIC

Course Code: CMBE-605a **Credit Units: 0**4

Pre-requisite: Basic understanding of diseases and their pathogenesis

Course Outcome:

Students will be able to learn and understand the concepts of how human system works in alteredand diseased stage under the influence of various internal and external stimuli.

Details of the Course:-Unit I: Introduction:

History of pathology, basic definitions and familiarization with the common terms used in pathology, techniques used in pathology.

Cellular Adaptations, Cell Injury and Cell Death:

Causes and mechanisms of cell injury: reversible and irreversible injury, Cellular responses: Hyperplasia, Hypertrophy, Atrophy, Metaplasia, Necrosis, Apoptosis, subcellular and intracellular response, (with suitable examples of diseases), Cellular ageing.

Unit II: Role of Inflammation in diseases (with suitable examples):

General features of acute and chronic inflammation: Vascular changes, cellular events, termination of acute inflammatory response. Cells and molecular mediators of inflammation, morphological effects and outcome of acute inflammation. Systemic effects of chronic inflammation, granulomatous inflammation.

Unit III: Tissue Renewal And Repair, Healing And Fibrosis:

Mechanism of tissue regeneration, role of ECM, repair by healing, scar formation and fibrosis, cutaneous wound healing, tissue remodelling in liver (mechanism of fibrosis and cirrhosis).

Unit IV: Hemodynamic Pathology:

Edema, hyperaemia, congestion, haemorrhage, haemostasis and thrombosis, Embolism, Infarction and shock and hypertension.

Nutritional diseases: Protein energy malnutrition, deficiency diseases of vitamins and minerals, nutritional excess and imbalances. Role and effect of metals (Zinc Iron and Calcium) and their deficiency diseases.

Unit V: Cell proliferation: Cancer:

Definitions, nomenclature, characteristics of benign and malignant neoplasms, grading and staging of cancer, biology of tumor growth, mechanism of tumor invasion and metastasis, carcinogens and cancer, concept of oncogenes, tumor suppressor genes, DNA repair genes and cancer stem cells.

Pathophysiology diseases:

A. Aetiology and Pathophysiology of: Diabetes, Arteriosclerosis, Myocardial infarction, restrictive and obstructive respiratory diseases (COPD), Parkinson, Schizophrenia, Silicosis

B. Infectious Diseases: Pathogenesis of diseases and overview of modes of infections, prevention and control with suitable examples like Typhoid, Dengue

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Robbins and Cotran Pathologic Basis of Disease, 8th edition (2009), Vinay Kumar, Abul K. Abbas, Jon C. Aster, Nelson Fausto; SaundersPublishers, ISBN-13: 978-1416031215.	2009
2.	Medical Laboratory Technology Methods and Interpretations Volume1 and 2, 6th edition (2009), Ramnik Sood; Jaypee Brothers Medical Publishers, ISBN-13: 978-8184484496.	2009
	Reference Books	
1.	General and Systematic Pathology, 2nd edition (1996), J., Ed. Underwood and J. C. E. Underwood; Churchill Livingstone, ISBN-13:978-0443052828.	1996
2.	Robbins Basic Pathology, 9th edition (2012), Kumar, Abbas, Fausto andMitchell; Saunders Publication, ISBN-13: 978-1437717815.	2012

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

MICROBIAL TECHNOLOGY

Course Code: CMBE-607 **Credit Units: 04**

Pre-requisite: Basic information of biotechnology and microbiology.

Course Outcome:

At the end of the course, the students will be familiar with microbial technology. This would help students to launch themselves in industrial biotechnology which is the fastest growing industry in the developing country.

Details of the Course:-

Unit I:

Introduction of microbes, taxonomy and classification, Introduction to bacteria, fungi, and viruses, structural and cellular organelles differences among different types and classes, biochemical/microscopic/molecular methods to differentiate archaea, eubacteria and eukaryotes; microbial evolution, systematics and taxonomy- new approaches to bacterial taxonomy, classification including ribotyping, characteristics of primary domains, taxonomy, nomenclature and Bergey's manual, ribosomal RNA sequencing.

Unit II:

Prokaryotic growth patterns and functions - microbial nutrition and growth - arithmetic and geometric growth expression, growth kinetics, growth curve, measurement of growth and growth yields, synchronous growth, continuous culture, diauxic growth, culture collection and maintenance of cultures.

Unit III:

Microbial regulation of gene expression (attenuation and negative regulation with e.g. trp and lac operon), transfer of genetic material: plasmids, transposons, transduction, transformation and conjugation.

Mutations and their chemical basis; mutagens and their use in biotechnology; modes of recombination; comparative prokaryotic genomics.

Unit IV:

Normal micro flora of skin, oral cavity, gastrointestinal tract; entry of pathogens into the host, types of toxins (exo, endo, entro) and their mode of actions, plant -microbe interactions, microbial pathogenesis –disease reservoirs; epidemiological terminologies; infectious disease transmission.

Unit V:

Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins, broad spectrum antibiotics, antibiotics from prokaryotes. Antifungal antibiotics; mode of action, resistance to antibiotics. Bacteriophage therapy. Potential targets for drug design.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Pelczar Jr., M.J., Chan, E.C.S. and Krieg, Noel R., Microbiology, McGraw Hill (2003) 5th ed.	2003
2.	Stanier, R.Y., Ingraham, J.L. and Wheelis, M.L., General Microbiology, MacMillan (2007) 5thed.	2007
	Reference Books	
1.	Microbiology 10th Edition. Prescott, L.M.; Harley, J.P. and Klein, D.A. (2003) McGraw Hill, USA.	2003
2.	Foundations in Microbiology 10th edition, Kathleen Park Talaro and Barry Chess.	2017

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

RECOMBINANT DNA TECHNOLOGY LAB

Course Code: CMBE-651 **Credit Units: 03**

Pre-requisite: Basic experience of molecular biology techniques

Course Outcome:

- Students will be able to isolate and analyze DNA/plasmid DNA and protein.
- Students will be able to digest and ligate the DNA molecules.
- Students will be able to design primers and amplification of DNA by PCR.
- Students will be able to learn the techniques of cloning gene in plasmid vectors.
- Students will be able to screen the positive transformant with the gene cloned through reporter based assays.

Details of the Course:-

1. Isolation of Vector/plasmid DNA and its analysis
2. RNaseA digestion of isolated plasmid/vector DNA
3. Restriction digestion of DNA
4. Primer designing
5. Amplification of DNA by polymerase chain reaction
6. Ligation of DNA molecules
7. Competent cell formation
8. Transformation in *E. coli*
9. Reporter gene assay for plasmid vectors
10. Expression of cloned gene in prokaryotic system

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Methods in yeast genetics: a Cold Spring Harbor Laboratory course manual. David C. Amberg, Daniel Burke, Jeffrey Strathern Cold Spring Harbor Laboratory Press, c2005 2005 ed.	2005
2.	Departmental Laboratory Manual	2018
	Reference Books	
1.	Molecular Cloning- A Laboratory Manual: 3 rd Edition, 2001, Vol. 1 -3 . Sambrook J and Russell D.W.(2001). Cold spring Harbor Laboratory Press, New York.	2001
2.	DNA cloning: A Practical Approach. Glover and Hames (2001) Oxford Univ. Press.	2001

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

MEDICAL MICROBIOLOGY LAB

Course Code: CMBE-653 **Credit Units: 03**

Pre-requisite: Basic information of Medical Microbiology Lab

Course Outcome:

Upon successful completion of this course the student will be able to:

- This course provides learning opportunities in the basic principles of medical microbiology and infectious disease.
- It covers mechanisms of infectious disease transmission, principles of aseptic practice, and the role of the human body‟s normal microflora.
- The course provides the conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause disease in the human body.
- It also provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.

Details of the Course:-

1. Study of composition and use of important differential media for identification of bacteria: EMBAgar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS
2. Study of bacterial flora of skin by swab method
3. Perform antibacterial sensitivity by Kirby-Bauer method
4. Identification of human blood groups.
5. To perform Total Leukocyte Count of the given blood sample.
6. To perform Differential Leukocyte Count of the given blood sample.
7. To separate serum from the blood sample (demonstration).
8. To perform immunodiffusion by Ouchterlony method.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Ananthanarayan R. and Paniker C.K.J. Textbook of Microbiology. 8th edition, University Press Publication	2009
2.	Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. Jawetz, Melnick and Adelberg‟s Medical Microbiology. 26th edition. McGraw Hill Publication	2013
3.	Goering R., Dockrell H., Zuckerman M. and Wakelin D. Mims‟ Medical Microbiology. 4thedition. Elsevier	2007
4.	Willey JM, Sherwood LM, and Woolverton CJ. Prescott, Harley and Klein‟s Microbiology.9th edition. McGraw Hill Higher Education	2013

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

MINOR PROJECT/ FIELD WORK

Course Code: CMBE-653 **Credit Units: 02**

Course Outcome:

- Forty five days of Sixth Semester of the B.Sc. Curriculum is devoted to major project/field work.
- Students, with the help of their mentor and faculty colleagues will identify a lab in India & abroad for the research work.
- The student should stay for a minimum prescribed Semester period at the place of work.
- Students not staying for the prescribed period will be marked absent as per the University Rules.
- At the end of their project the students shall submit the dissertation as per the Guidelines prescribed below.

The Aims of the Project

The aim of the project is to provide the students with an opportunity to further their intellectual and personal development in the chosen field by undertaking a significant practical unit of activity, having an educational value at a level commensurate with the award a B.Sc. Degree.

Objectives

- To provide the students an opportunity to demonstrate the ability to devise, select and use a range of methodologies appropriate to the chosen topic of research.
- To allow students to show the application of skills of data collection, critical analysis and concept synthesis necessary for formation of defensible conclusions and/or recommendations.
- To allow students the opportunity to demonstrate ability to draw appropriate conclusions argued from the evidence presented. [Should the research produce negative or in conclusive results, the conclusions should be critically examined to ascertain the reasons].
- To provide a forum to demonstrate the skills of structuring and present a balanced informed complete, clear and concise written argument.

Examination Scheme:

Components	Theme of Project	Quality of Project
Weightage (%)	30	70

SEMESTER IV

Industrial Training/ Presentation

CMBE-692- Dissertation

Course Objective:
The students are expected to utilize their scheduled periods by undertaking the project that would be completed during the semester. Every student shall undertake a major Project. The major Project shall be undertaken in some biotechnology industry or laboratory of repute. Each student shall be assigned to a faculty who shall continuously monitor the progress of the Project in the concerned laboratory or industry. The faculty, in consultation with the concerned scientist of the industry/laboratory, shall decide the topic of the project. At the conclusion of the project the student shall submit a seminar and a dissertation. The dissertation shall be evaluated by the internal faculty/examiner. The student then shall have to appear for the viva voce examination.

Guidelines for Project file:
Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation. Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student. Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critiqued by the faculty guide and corrected by the student at each stage. The File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation.

In general, the File should be comprehensive and include:
• A short account of the activities that were undertaken as part of the project;
• A statement about the extent to which the project has achieved its stated goals.
• A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;
• Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project;
• Any problems that have arisen that may be useful to document for future reference.

Report Layout
The report should contain the following components:

Title or Cover Page.
The title page should contain the following information: Project Title; Student's Name; Course; Year; Supervisor's Name.

Acknowledgements (optional)
Acknowledgment to any advisory or financial assistance received in the course of work may be given.

Abstract
A good "Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph

should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project

Table of Contents
Titles and subtitles are to correspond exactly with those in the text.

Introduction
Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.

Materials and Methods
This section should aim at experimental designs, materials used. Methodology should be mentioned in details including modifications if any.

Results and Discussion
Present results, discuss and compare these with those from other workers, etc. In writing these section, emphasis should be given on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow.

Note that in writing the various secions, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary never write in “point” form.

Conclusion
A conclusion should be the final section in which the outcome of the work is mentioned briefly.

Future prospects

Appendices
The Appendix contains material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.

References / Bibliography
This should include papers and books referred to in the body of the report. These should be ordered alphabetically on the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognized system. Examples:

For research article:
Voravuthikunchai SP, Lortheeranuwat A, Ninrprom T, Popaya W, Pongpaichit S, Supawita T. (2002) Antibacterial activity of Thai medicinal plants against enterohaemorrhagic Escherichia coli O157: H7. Clin Microbiol Infect , **8** (suppl 1): 116–117.

For book:

Kowalski,M.(1976) Transduction of effectiveness in Rhizobium meliloti. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), **7**: 63-67

Assessment for Project file:

Essentially, marking will be based on the following criteria: the quality of the report, the technical merit of the project and the project execution. Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in.

The File should fulfill the following **assessment objectives:**

- **Range of Research Methods used to obtain information**
- **Execution of Research**
- **Data Analysis**
  Analyze Quantitative/ Qualitative information Control Quality
- **Draw Conclusions**
- **Reference for further information:**
  Clifford Hawkins and Marco Sorgi; Research: How to Plan, Speak and write about it; Narosa Publishing House, New Delhi 1994

Shobhit University, Gangoh

(Established by UP Shobhit University Act No. 3, 2012)

School of Biological Engineering and Sciences

Ordinances, Regulations & Syllabus

For

Bachelor of Science (B.Sc.) Three Year Programme

Semester Pattern

(w.e.f. session 2017-18)

Approved and adopted in the year 2017 (Ist meeting of Board of Studies)

(Scheme & syllabus from 2017-2019)

PEOs: Program Educational Objectives POs: Program Outcomes PSOs: Program Specific Outcomes

Name of the Department: Department of Microbiology

Name of the Program: B.Sc. Microbiology

Duration of the degree: 3 Years

Microbiology programme endeavors to instill in students the skills to identify individual microbial species, use aseptic techniques to grow them in pure culture, safely handle and examine them by microbiological methods. The knowledge of microbiology will enable the students to improve the quality of human lives in relation to environment, fighting disease and to exploit microbes in the production of food. Microbiology plays a key role in genetic engineering and other modern biotechnologies such as antibiotic production and the exploitation of new sources of food and energy. The regimens for this program are specifically designed to allow students to fulfill below program educational objectives:

Program Educational Objectives (PEOs)

PEO 1: The graduates will learn the importance of microorganisms in environment, brewing, food processing and preservation, pharmaceuticals and biotechnology industries.

PEO 2: The graduates will be provided with understanding of healthcare systems especially in pathological, immunological and environmental monitoring laboratories.

PEO 3: The graduates will demonstrate the skills necessary to understand and apply scientific concepts and reasoning, including the analysis and interpretation of various types of data.

Program Specific Outcomes (PSOs)

Students who graduate with a Bachelor of Science in Microbiology will

PSO 1: Acquire knowledge on fundamentals of Microbiology.

PSO 2: Understand details of bacterial, fungal, algal and viral morphology and physiology.

PSO 3: Competently be able to cultivate and characterize bacterial and fungal forms.

PSO 4: Grasp the fundamental concepts of immunity and the contribution of organs and cells in the development of immune response.

PSO 5: Gain insight into the various aspects of microbial genetics.

PSO 6: Be proficient on cloning vectors and rDNA technology.

PSO 7: Assimilate technical skills on microbial genetics and molecular biology.

PSO 8: Realize the application oriented aspects of Microbiology.

PSO 9: Understand the concepts and development of microbial diseases in animals & plants.

PSO 10: Realize the principles of prevention and treatment of microbial diseases.

Program Outcomes Objectives (POOs)

Upon completion of B.Sc. Microbiology programme, the students will be able to:

POO 1: demonstrate advanced knowledge and understand the central facts and concepts of microbiology.

POO 2: acquire knowledge and understanding of organism biology and genetics, evolution, molecular biology and basic biological chemistry.

POO 3: instill the intellectual skills to analyze and solve biology-related problem, formulate and test hypothesis using experimental design.

POO 4: demonstrate an understanding of professional ethics in science and of the principles that can guide ethical decision-making in biological controversies.

POO 5: explore the scientific literature effectively and use computational tools.

POO 6: communicate ideas and principles effectively through oral presentations, computer based tools and writtn reports.

POO 7: manage resources, time and work independently as well as in multi-disciplinary team towards a common goal/outcome.

B. Sc. (Microbiology) PROGRAMME STRUCTURE(2019-20)

FIRST SEMESTER

Course Code	Course Title	Component	(L)	(T)	(P)	Credits
CMBE-101 / **CMBE-101 a/ CMBE-101 b**	Biochemistry and Metabolism/ Introductory Biology /Fundamentals of Biology	CC	3	0	0	3
CMBE-103/ **CMBE-103a**	Cell Biology/Inorganic & Physical Chemistry	CC	3	0	0	3
CMBE-105/ **CMBE-105a**	Environmental Sciences/Agro Biotechnology	CC	3	0	0	3
CMBE-151	Biochemistry and Metabolism Lab	CC	-	--	1	1
CMBE-153	Cell Biology Lab	CC	-	-	1	1
CMBE-155	Environmental Sciences Lab	CC	-	-	1	1
Generic Electives (Select any one of following)						
GMBE-101/ **GMBE-101a**	Biosafety and Bioethics/Computer Fundamentals	GE	3	-	-	3
GMBE-103/ G**MBE-103a/ GMBE-103b/ GMBE-103c**	Intellectual Property Rights for Biologist/General Proficiency/Physical Education & Yoga/Health & Nutrition	GE	3	-	-	3
Ability Enhancement Compulsory Course						
AECC-103/ **AECC-103a/ AECC-103b**	Elementary Maths/Statistics/Basic and Applied Mathematics	AECC	2	-	-	2
	TOTAL					**17**

Course Code	Course Title	Component	(L)	(T)	(P)	Credits
CMBE-102/ **CMBE-102 a/ CMBE-102b/ CMBE-102c**	Inheritance Biology/Organic & Analytical Chemistry/Observational Chemistry/Basic & Applied Chemistry	CC	3	0	0	3
CMBE-104 / **CMBE-104 a/ CMBE-104 b/ CMBE-104 c/ CMBE-104 d**	Introduction and Scope of Microbiology/Elements of Biochemistry/ Fundamentals of Biochemistry/Introductory Human Physiology/Chemicals and Health	CC	3	0	0	3
CMBE-106	Biostatistics	CC	3	0	0	3
CMBE-152	Inheritance Biology Lab	CC	-	-	1	1
CMBE-154	Introduction and Scope of Microbiology Lab	CC	-	-	1	1
Generic Electives (Select any one of following)						
GMBE-103	Bridging Information Technology and Biotechnology	GE	3	0	0	3
GMBE-104	Bacteriology	GE	3	0	0	3
GMBE-153	Bridging Information Technology and Biotechnology Lab	GE	-	-	1	1
GMBE-154	Bacteriology Lab	GE	-	-	1	1
Ability Enhancement Compulsory Course						
AECC-102	Professional Communication	AECC	2	-	-	2
	TOTAL					**17**

SECOND SEMESTER

Course Code	Course Title	Component	(L)	(T)	(P)	Credits
CMBE-201/ **CMBE-201a/ CMBE-201b/ CMBE-201c**	Virology/Inheritance & Evolutionary Microbiology/Microbiological Basis of Inheritance/Food Engineering	CC	3	1	0	4
CMBE-203/ **CMBE-203a**	Environmental Microbiology/Global Ecology	CC	3	1	0	4
CMBE-205/ **CMBE-205 a**	Medical Microbiologv/Public health & pandemics	CC	3	1	0	4
CMBE-251	Virology Lab	CC	-	-	1	1
CMBE-253	Environmental Microbiology Lab	CC	-	-	1	1
CMBE-255	Medical Microbiolov Lab	CC	0	0	2	2
Generic Electives						
GMBE-203	Microbial Metabolism	GE	3	1	0	4
Skill Enhancement Couse						
SMBE201	Seminar	SM	0	0	1	1
	TOTAL					**26**

Course Code	Course Title	Component	(L)	(T)	(P)	Credits
CMBE-202 / **CMBE-202a/ CMBE-202b/ CMBE-202c**	Immunology/Economic Biology/Gender studies/International Business in dairy science	CC	3	1	0	4
CMBE-204/ **CMBE-204a/ CMBE-204b/ CMBE-204c/ CMBE-204d**	Molecular Biology/ Anthropology/Neurobiology/Nanotechnology/Aerobiology	CC	3	1	0	4
CMBE-206 **CMBE-206a CMBE-206b CMBE-206c**	Recombinant DNA Technology/Microbial Physiology & Metabolism/Entomology /Agrostology	CC	3	1	0	4
CMBE-252	Immunology Lab	CC	-	-	1	1
CMBE-254	Molecular Biology Lab	CC	-	-	1	1
CMBE-256	Recombinant DNA Technology Lab	CC	-	-	1	1
Generic Electives (Select any one of the following)						
GMBE-202	Microbes in Environment	GE	3	0	0	3
GMBE-202	Microbes in Sustainable Agriculture and Development	GE	3	0	0	3
Skill Enhancement Course						
SMBE-202	Management of Human Microbial Disease	GP	3	1	0	4
	TOTAL					**22**

THIRD SEMESTER

Course Code	Course Title	Component	(L)	(T)	(P)	Credits
CMBE-301/ **CMBE-301a/ CMBE-301b/ CMBE-301c/**	Bioinformatics/Microbiological Analysis of Air and Water/Hospital Management/Soil & Water Microbiology	CC	3	1	0	4
CMBE-303/ **CMBE-303a/ CMBE-301b/**	Instrumentation and Biotechniques/Marine Microbiology/Veterinary Science.	CC	3	1	0	4
DMBE-301/ **DMBE-301a/ DMBE-301b**	Food and Dairy Microbiology/Developmental biology and embryology/Population biology	CC	3	1	0	4
CMBE-351	Bioinformatics Lab	CC	-	-	1	1
CMBE-353	Instrumentation and Biotechniques Lab	CC	-	-	1	1
DMBE-351	Minor Project	CC	-	-	-	1

Generic Electives						
GMBE-201	Genetic Engineering and Biotechnology	GE	3	0	0	3
GMBE-503	Genome Organisation and Function	GE	3	0	0	3
Skill Enhancement Course (Select anyone of following)						
SMBE-501	Industrial Biotechnology	SEC	3	1	0	4
SMBE-551	Industrial Biotechnology Lab	SEC	-	-	1	1
DMBE-305	Food Fermentation Techniques	SEC	3	1	0	4
DMBE-355	Food Fermentation Techniques Lab	SEC	-	-	1	1
	TOTAL					**20**

Course Code	Course Title	Component	(L)	(T)	(P)	Credits
CMBE-302 / **CMBE-302a**	Plant Pathology/ Medicinal Microbiology	CC	3	1	0	4
CMBE-304 / **CMBE-304a/ CMBE-304b**	Marine Microbiology/Soil and Water Analysis of Microbes/Palaentology	CC	3	1	0	4
CMBE-602/ **CMBE-602a**	Microbial Technology /Bio-Analytical Tools	CC	3	1	0	4
CMBE-310 / **CMBE-310 a**	Major Project	CC	-	-	-	6
Generic Electives (Select any one of the following)						
GMBE-602	Entrepreneurship Development	GE	3	1	0	4
DMBE-304	Microbial quality Control in Food and Pharmaceutical Industries	GE	3	1	0	4
Skill Enhancement Course (Select anyone of following)						
DMBE-302	Microbiological Analysis of Air and Water	SEC	3	1	0	4
SMBE-604	Animal Biotechnology	SEC	3	1	0	4
	TOTAL					**22**

Project/Dissertation

Note: Students must submit their project report in June /July and the same would be evaluated for 6 credit units, which would be included in the Sixth Semester marks.

Examination Scheme:

Components	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	10	20	10	60

Semester-I

BIOCHEMISTRY AND METABOLISM

Course Code: CMBE-101 **Credit Units: 03**

Course Outcome

1. **Molecular Foundations**: Understand the structure and function of biomolecules such as carbohydrates, proteins, lipids, and nucleic acids.
2. **Metabolic Pathways**: Analyze key metabolic pathways (glycolysis, Krebs cycle, oxidative phosphorylation) and their regulation.
3. **Enzyme Kinetics**: Explain enzyme mechanisms, kinetics, and the role of cofactors in biochemical reactions.
4. **Energy and Metabolism**: Relate the biochemical basis of energy production, storage, and utilization in living organisms.
5. **Disease and Applications**: Apply knowledge of metabolic dysfunctions to understand diseases and biotechnological advancements.

Unit 1: Bioenergetics

First and second laws of Thermodynamics. Definitions of Gibb's Free Energy, enthalpy, and Entropy and mathematical relationship among them, Standard free energy change an equilibrium constant, Coupled reactions and additive nature of standard free energy change, Energy rich compounds: Phosphoenolpyruvate, 1,3- Bisphosphoglycerate, Thioesters, ATP.

Unit 2: Carbohydrates

Families of monosaccharides: aldoses and ketoses, trioses, tetroses, pentoses, and hexoses. Stereo isomerism of monosaccharides, epimers, Mutarotation and anomers of glucose. Furanose and pyranose forms of glucose and fructose, Haworth projection formulae for glucose; chair and boat forms of glucose, Sugar derivatives, glucosamine, galactosamine, muramic acid, N- acetyl neuraminic acid, Disaccharides; concept of reducing and non-reducing sugars, occurrence and Haworth projections of maltose, lactose, and sucrose, Polysaccharides, storage polysaccharides, starch and glycogen. Structural Polysaccharides, cellulose, peptidoglycan and chitin.

Unit 3: Lipids

Definition and major classes of storage and structural lipids. Storage lipids. Fatty acids structure and functions. Essential fatty acids. Triacyl glycerols structure, functions and properties. Saponification Structural lipids. Phosphoglycerides: Building blocks, General structure, functions and properties. Structure of phosphatidylethanolamine and phosphatidylcholine, Sphingolipids: building blocks, structure of sphingosine, ceramide. Special mention of sphingomyelins, cerebrosides and gangliosides, Lipid functions: cell signals, cofactors,prostaglandins, Introduction of lipid micelles, monolayers, and bilayers.

Unit 4: Proteins

Functions of proteins, Primary structures of proteins: Amino acids, the building blocks of proteins. General formula of amino acid and concept of zwitterion. Titration curve of amino acid and its Significance, Classification, biochemical structure and notation of standard protein amino acids, Ninhydrin reaction. Natural modifications of amino acids in proteins hydrolysine, cystine and hydroxyproline, Non protein amino acids: Gramicidin, beta-alanine, D-alanine and D- glutamic acid, Oligopeptides: Structure and functions of naturally occurring glutathione and insulin and synthetic aspartame, Secondary structure of proteins: Peptide unit and its salient features. The alpha helix, the beta pleated sheet and their occurrence in proteins, Tertiary and quaternary structures of proteins. Forces holding the polypeptide together. Human haemoglobin structure, Quaternary structures ofproteins.

Unit 5: Enzymes

Structure of enzyme: Apoenzyme and cofactors, prosthetic group-TPP, coenzyme, NAD,metal cofactors, Classification of enzymes, Mechanism of action of enzymes: active site, transition state complex and activation energy. Lock and key hypothesis, and Induced Fit hypothesis. Significance of hyperbolic, double reciprocal plots of enzyme activity, Km, and allosteric mechanism. Definitions of terms – enzyme unit, specific activity and turnover number, Multienzyme complex: pyruvate dehydrogenase; isozyme: lactate dehydrogenase, Effect of pH and temperature on enzyme activity. Enzyme inhibition: competitive- sulfa drugs; non- competitive-heavy metal salts.

Unit 6: Vitamins

Classification and characteristics with suitable examples, sources and importance.

References:

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning.
2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by ChurchillLivingstone.
3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed.,W.H.Freeman.
4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company.
5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H.Freeman and Company.
6. Willey MJ, Sherwood, LM & Woolverton C J (2013) Prescott, Harley and Klein'sMicrobiology by. 9th Ed., McGrawHill.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
ightage(%)	10	20	10	60

INTRODUCTORY BIOLOGY

Course Code: CMBE--101a Credit Units: 03

Pre-requisite: Basic information of Introductory Biology

Course Outcome:

1. Basic chemical composition of living matter.
2. Structural characteristics of prokaryotic and eukaryotic cells.
3. Taxonomy and characteristics of the major kingdoms.
4. Mechanics of membrane transport.
5. Basic concepts of bioenergetics, photosynthesis, and cellular respiration.
6. Mechanics of cellular reproduction.
7. Mendelian genetics and genetic change.

8. Nucleic acids and basic concepts of protein synthesis and gene regulation.

Details of the Course:-

UNIT I: Cell:

Introduction and classification of organisms by cell structure, cytosol, Compartmentalization of eukaryotic cells, cell fractionation Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model

UNIT II: Cell Membrane and Permeability

Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport. Sex-limited and sex- influenced inheritance, Transposons. Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments

UNIT III: Endoplasmic reticulum:

Endoplasmic reticulum: Structure, function including role in protein segregation.
Golgi complex: Structure, biogenesis and functions including role in protein secretion.
Lysosomes: Vacuoles and micro bodies: Structure and functions Ribosomes: Structures andfunction including role in protein Synthesis.

UNIT IV: Mitochondria:

Structure and function, Genomes, biogenesis. Chloroplasts: Structure and function, genomes, biogenesis. Nucleus: Structure and function, chromosomes and their structure. Extracellular Matrix: Composition, molecules that mediate cell adhesion

UNIT V: Membrane receptors:

For extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction. Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristicsand molecular basis of cancer.

Suggested Books:

1. **Molecular Biology of the Cell, 4th ed.** Authors: Bruce Alberts et al.Year of Publication: 2002 Publisher: Garland Science Publishing, New York
2. **Cell Biology** Authors: Smith and Wood Publisher: Chapman and Hall
3. **Cell Biology: Organelle Structure and Function** Author: Sadava, D. E.Year of Publication: 2004 Publisher: Panima Publishing, New Delhi
4. **Cell and Molecular Biology, 8th ed.** Authors: Robertis, Edp De, and Robertis Emf De Year of Publication: 2002 Publisher: Lippincott Williams and Wilkins Pvt. Ltd., Philadelphia (International Student Edition)

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

FUNDAMENTALS OF BIOLOGY

Course Code: CMBE--101b **Credit Units: 03**

Pre-requisite: Basic information of Introductory Biology

Course Outcome:

1. Basic chemical composition of living matter.
2. Structural characteristics of prokaryotic and eukaryotic cells.
3. Taxonomy and characteristics of the major kingdoms.
4. Mechanics of membrane transport.
5. Basic concepts of bioenergetics, photosynthesis, and cellular respiration.
6. Mechanics of cellular reproduction.
7. Mendelian genetics and genetic change.
8. Nucleic acids and basic concepts of protein synthesis and gene regulation.

Details of the Course:-

UNIT I: Cell Membrane and Permeability:

Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport. Sex-limited and sex- influenced inheritance, Transposons. Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments

UNIT II: Cell:

Introduction and classification of organisms by cell structure, cytosol, Compartmentalization of eukaryotic cells, cell fractionation Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model

UNIT III: Endoplasmic reticulum:

Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion.
Lysosomes: Vacuoles and micro bodies: Structure and functions Ribosomes: Structures andfunction including role in protein Synthesis.

UNIT IV: Mitochondria:

Structure and function, Genomes, biogenesis. Chloroplasts: Structure and function, genomes, biogenesis. Nucleus: Structure and function, chromosomes and their structure. Extracellular Matrix: Composition, molecules that mediate cell adhesion

UNIT V: Membrane receptors:

For extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction. Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristicsand molecular basis of cancer.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Reference Books	
1.	Molecular Biology of cell, 4th ed. Alberts, Bruce (et.*al) (2002)* Garland Science Publishing, New York.	2002
2.	Cell Biology- Smith and Wood by Chapman and Hall. Cell Biology: Organelle structure and function, Sadava, D E. (2004) Panima pub., New Delhi. Cell and Molecular Biology, 8th ed. Robertis, Edp De and Robertis Emf De (2002) Lippincott Williams and Wilkins Pvt. Ltd., (International Student Edition) Philadelphia.	2004, 2002

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

CELL BIOLOGY

Course Code: CMBE-103 Credit Units: 03

Pre-requisite: Basic information of Cell Biology

Course Outcome:

1. Understand the basic cell components and processes.
2. Know membrane structure, function, and transport mechanisms.
3. Comprehend cell communication and signal transduction.
4. Understand cell division and regulation.
5. Know sexual reproduction and inheritance patterns.
6. Understand cancer development and characteristics.
7. Know stem cell properties and applications.
8. Stay updated on recent advancements in cell biology.

Details of the Course:-

Unit 1: Structure and organization of Cell

Cell Organization: Eukaryotic (Plant and animal cells) and prokaryotic, Plasma membrane:Structure and transport of small molecules, Cell Wall: Eukaryotic cell wall, Extra cellular matrix and cell matrix interactions, Cell-Cell Interactions: adhesion junctions, tight junctions, gapjunctions, and plasmodesmata (only structural aspects), Mitochondria, chloroplasts andperoxisomes, Cytoskeleton: Structure and organization of actin filaments, association of actinfilaments with plasma membrane, cell surface protrusions, intermediate filaments, microtubules.

Unit 2: Nucleus

Nuclear envelope, nuclear pore complex and nuclear lamina, Chromatin – Molecular organization, Nucleolus.

Unit 3: Protein Sorting and Transport

Ribosomes, Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, protein folding, processing and quality control in ER, smooth ER and lipid synthesis, export of proteins and lipids, Golgi Apparatus – Organization, protein glycosylation, protein sorting and export from Golgi Apparatus, Lysosomes.

Unit 4: Cell Signalling

Signalling molecules and their receptors, Function of cell surface receptors, Pathways of intra-cellular receptors – Cyclic AMP pathway, cyclic GMP and MAP kinase pathway.

Unit 5: Cell Cycle, Cell Death and Cell

Eukaryotic cell cycle and its regulation, Mitosis and Meiosis, Development of cancer, causes andtypes Programmed cell death, Stem cells, Embryonic stem cell, induced pleuripotent stem cells .

References:

1. Hardin J, Bertoni G and Kleinsmith LJ. (2010). Becker's World of the Cell. 8th edition. Pearson.

2. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.

3. De Robertis, EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.

4. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASMPress & Sunderland, Washington, D.C.; Sinauer Associates, MA.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Course Code: CMBE--103a Credit Units: 03

Pre-requisite: Basic information of Chemistry

Course Outcome:

a) Understand periodic properties and its application in the characterization of chemical compounds
b) Understand the various properties of materials depending upon bond formation.
c) Utilize the concept of hardness in the purification of water for industrial and domestic purpose
d) Distinguish the rate laws and application to different chemical reaction mechanism
e) Learn and apply the concepts of analytical chemistry for sample analysis by chemical methods
f) Learn the basic concepts of Chemistry and its application in different fields

Details of the Course:-

UNIT I: Periodic Properties:

Position of elements in the periodic table, effective nuclear charge, atomic and ionic radii, ionization energy, electron affinity and electronegativity definition, methods of determination, trends in periodic table and applications in predicting and explaining the chemical behavior.

UNIT II: Atomic and Molecular Structure:

VSPER theory and its application for structure of NH_3, NH_4^+, H_2O, H_3O^+, SO_2 and XeF_4 Molecular Orbital Theory, Formation of homo and heteronuclear diatomic molecules Hydrogen Bonding and its application

Metallic Bonding (Band theory); role of doping

Coordination compounds: Introduction, Werner‟s coordination theory, naming of compounds.

UNIT III: Water Chemistry:

Hardness of water and its measurement, Softening of water by L-S process, Zeolite process and Reverse osmosis process, Ion Exchange process, Calgon Process, Numerical problems based on L-S Process, Zeolite Process and hardness of water.

UNIT IV: Chemical Kinetics:

Ionic reactions and molecular reactions, Molecularity and Order of reactions, Integrated equations of 1st, 2nd and zero order reactions, Activation Energy and Activated complexes, numerical problems based upon them.

UNIT V: Analytical Chemistry:

Qualitative and Quantitative Chemistry, Volumetric and Gravimetric Analysis; Principles of Volumetric Analysis; Concept of pH, buffer, Henderson equation, Concept of strength and concentration of solution; Normality, Molarity, Molality and interconversion of strength Titration-Principles and Classification: Redox, Acid-Base, Complexometric, Redox and Precipitation, Oxidation Number and calculation of oxidation number in compounds.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	University Chemistry, B.H.Mahan	1987
2.	Chemistry, Principles and Application, M.J. Sienko and R.A. Plane	1980
	Reference Books	
1.	Inorganic Chemistry, J.D.Lee	2008
2.	Fundamentals of Analytical Chemistry, Skoog and West	2013
3.	Physical Chemistry, Atkins	2009

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

ENVIRONMENTAL SCIENCES

Course Code: CMBE-105 **Credit Units: 03**

Pre-requisite: Basic Knowledge of Environmental science

Course Outcome:

1. Understand ecosystems, biodiversity, and ecological processes.
2. Analyze pollution types, sources, and impacts.
3. Understand climate change causes, impacts, and mitigation strategies.
4. Evaluate sustainable resource management practices.
5. Analyze environmental policies and regulations.
6. Conduct environmental impact assessments.
7. Utilize monitoring techniques and data analysis.

Details of the Course:-

Unit 1: Introduction to environmental studies

Multidisciplinary nature of environmental studies; Scope and importance; Need for public awareness.

Unit 2: Ecosystems

What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems:

a) Forest ecosystem

b) Grassland ecosystem

c) Desert ecosystem

d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Unit 3: Natural Resources: Renewable and Non-renewable Resources

Land resources and land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit 4: Biodiversity and Conservation

Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots, India as a mega-biodiversitynation; Endangered and endemic species of India, Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ andEx-

situ conservation of biodiversity. Biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Unit 5: Environmental Pollution

Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution. Nuclear hazards and human health risks. Solid waste management: Control measures of urban and industrial waste. Pollution case studies.

Unit 6: Environmental Policies & Practices

Sustainability and sustainable development. Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture. Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

References:

1. Bharuch, E. 2003, Textbook for Environmental Studies, University Grants Commission, New Delhi and Bharati Vidyapeeth Institute of Environmental Education and Research, Pune. 361.
2. Carson, Rachel. 1962. Silent Spring (Boston: Houghton Mifflin, 1962), Mariner Books, 2002.
3. Gleeson, B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

AGROBIOTECHNOLOGY

Course Code: CMBE-105a **Credit Units: 03**

Pre-requisite: Basic knowledge of environmental science.

Course Outcome:

- Students will be able to acquire knowledge about environmental pollution- sources, effects and control measures.
- Students will understand the concept of BOD and analyze the need for different waste water treatment methods.
- Students will be able to understand and implement the methods and importance of solid waste management.
- Students will be able to understand the application of bioreactors.
- Students will be able to apply their knowledge about toxic compounds degradation using microbes.
- Students will understand the role of biopesticides.
- Students will analyze the national and international concern for environment for protecting the environment and sustainable development.
- Students will be able to understand the global issues related to environmental pollution.

UNIT-I

Environmental Pollution: types of pollution, methods for the measurement of pollution, Methodology of environmental management- the problem solving approach, its limitations.

Air pollution and its control through Biotechnology. Water pollution ant its control: Water as a scarce natural resource. Need for water management, Measurement of water pollution, sources of water pollution.

UNIT-II

Microbiology of Waste water Treatments, Aerobic Process: Activated sludge, Oxidation ditches, trickling filter, rotations discs, rotating drums, oxidation ponds.

Anaerobic processes: Anaerobic digestion, anaerobic filters. Up flow anaerobic sludge blanket reactors.Treatment schemes for waste waters of dairy, distillery, tannery, sugar antibiotic industries.

UNIT-III Solid wastes: sources and management composting, vermicomposting and methane production). Hospital wastes, hazardous wastes and their management.Biopesticides in integrated pest management.

UNIT-IV

Microbiology of degradation of Xenobiotics in EnvironmentEcological consideration, decay behaviour & degradative plastics; Hydrocarbons, oil pollution, & pesticides. Bioremediation of contaminated soils and waste land.

UNIT-V

Basic concepts of Environmental impact Assessment (EIA) Restoration of waste land/degraded ecosystem. Global Environmental Problems: Ozone depletion, UV-B,green- house effect and acid rain, their impact and biotechnological approaches for management.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1	Alan Scragg, Environmental Biotechnology, Second Edition, Oxford University Press.	2005
2.	J., Pichtel, Waste Management Practices: Municipal, Hazardous and Industrial, Taylor and Francis.	2005
3.	B.C. Bhattacharya & Ritu Banerjee Environmental Biotechnology, Oxford Press.	2007
4.	Shree Nath Singh, Microbial Degradation of Xenobiotics, Springer Science & Business Media.	2011

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Biochemistry and Metabolism Lab

Course Code: **CMBE-151** **Credit Units**: **01**

Pre-requisite: Basic knowledge of biochemistry and cellular metabolism.

Course Outcome:

After completion of the course, students will be able to:

1. Understand the principles of biochemical analysis and metabolic processes.
2. Perform qualitative and quantitative estimation of biomolecules.
3. Analyze enzyme kinetics and metabolic pathways.
4. Gain proficiency in the preparation and handling of biological samples.
5. Apply biochemical techniques to study metabolic functions in living systems.

Details of the Laboratory Course:

Note: A college must offer 70% of the below-listed experiments. The remaining 30% experiments may be modified by the college according to available facilities.

S. No.	Contents	Contact Hours
1	**Qualitative Tests for Biomolecules**: Detection of carbohydrates, proteins, and lipids in biological samples.	2
2	**Quantitative Estimation of Glucose**: Using the DNSA or glucose oxidase-peroxidase (GOD-POD) method.	3
3	**Protein Estimation**: Lowry's method or Bradford assay.	3
4	**Enzyme Assay**: Study of enzyme activity (e.g., amylase or urease) and calculation of specific activity.	3
5	**Enzyme Kinetics**: Determination of Km and Vmax of an enzyme using Lineweaver-Burk plots.	3
6	**Lipid Analysis**: Extraction of lipids by Folch or Bligh and Dyer method.	2
7	**Estimation of Nucleic Acids**: Quantification of DNA and RNA using spectrophotometry.	3
8	**Chromatographic Techniques**: Separation of amino acids or sugars by paper or thin-layer chromatography (TLC).	3
9	**pH and Buffer Preparation**: Understanding buffer systems and their role in metabolism.	2
10	**Estimation of Cholesterol**: Colorimetric method or enzymatic assay.	2

Suggested Books:

Text Books

1. **Biochemistry Laboratory: Modern Theory and Techniques** – Rodney Boyer, Pearson, 2nd Edition, 2012.
2. **Introduction to Practical Biochemistry** – David Plummer, McGraw Hill Education, 2009.

3. **Practical Biochemistry for Colleges** – Pattabiraman T. N., Gajanan Book Publishers, 2010.

References

1. **Fundamentals of Biochemistry** – Donald Voet, Judith Voet, Wiley, 5th Edition, 2021.
2. **Principles of Biochemistry** – Lehninger, Nelson, and Cox, W.H. Freeman, 7th Edition, 2017.
3. **Biochemical Methods** – S. Sadasivam and A. Manickam, New Age International Publishers, 2nd Edition, 2005.
4. **Experimental Biochemistry** – Switzer and Garrity, W.H. Freeman, 3rd Edition, 1999.

Examination Scheme:

Components	Project Proposal	Execution of the Work	Practical Skills	Final Report	Oral Presentation
Weightage (%)	10%	30%	20%	20%	20%

Cell Biology Lab

Course Code: CMBE-153 Credit Units: 01

Pre-requisite: Basic information of Cell Biology

Course Outcome:

a) Students will learn about the varieties of plants and their diversity.
b) Students will gain a comprehensive knowledge on categories of plants and apply the same in identification of monocots and dicots
c) Students will become familiar with plant cell anatomy.
d) Students will be able to learn about the functioning of plant cell and understand their importance in plant life.
e) Students will be able to implement different strategies to test the present of storage food material in plant parts.
f) Students will be able to understand the methods of solute and solvent uptake in plant cells and their role in life processes.
g) Students will be able to analyze the mechanism of transpiration by different plants.
h) Students will be able to learn the mechanism underlying seed growth and development.

Details of the Course:-

S. No.	Contents	Contact Hours
1	Study the effect of temperature and organic solvents on semi permeable membrane.	2
2	Demonstration of dialysis.	2
3	Study of plasmolysis and de-plasmolysis.	2
4	Cell fractionation and determination of enzyme activity in organelles using sprouted seed or any other suitable source.	2

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint

	Reference Books	
1.	Experiments in Plant Physiology: A Laboratory Manual. Bajracharya, D., Narosa publishers, New Delhi	1999
2.	Practicals in Plant Physiology and Biochemistry. Bala, M. Gupta, S. , Gupta N.K. and Sangha, M.K. , Scientific Publishers, India	2016

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

Environmental Sciences Lab

Course Code: **CMBE-155** **Credit Units**: **01**

Pre-requisite: Basic knowledge of environmental science and ecological principles.

Course Outcome:

After completion of the course, students will be able to:

1. Analyze the physical, chemical, and biological parameters of environmental samples.
2. Develop skills to monitor pollution levels in air, water, and soil.
3. Understand techniques for assessing biodiversity and ecosystem health.
4. Explore sustainable solutions to mitigate environmental problems.
5. Conduct environmental impact analysis using scientific tools and techniques.

Details of the Laboratory Course:

Note: A college must offer 70% of the below-listed experiments. The remaining 30% experiments may be modified by the college according to available facilities.

S. No.	Contents	Contact Hours
1	**Analysis of Water Quality**: Determination of pH, turbidity, and total dissolved solids (TDS), and dissolved oxygen (DO).	3
2	**Chemical Oxygen Demand (COD) and Biochemical Oxygen Demand (BOD)**: Measurement in water samples.	3
3	**Soil Analysis**: Determination of pH, moisture content, and organic matter.	3
4	**Air Quality Monitoring**: Estimation of particulate matter and gaseous pollutants using air samplers.	3
5	**Biodiversity Assessment**: Quadrant method for species richness and abundance in a terrestrial habitat.	3
6	**Wastewater Treatment**: Study of physical, chemical, and biological treatment methods.	3
7	**Heavy Metal Analysis**: Detection of metals in water and soil samples using spectrophotometry.	3
8	**Study of Eutrophication**: Observation of algal blooms and their impact on aquatic ecosystems.	2
9	**Vermicomposting**: Setting up a vermicomposting unit and observing its progress.	3
10	**Ecological Footprint Assessment**: Calculation and interpretation of human impact on the environment.	2

Suggested Books:

Text Books

1. **Environmental Science: A Global Concern** – William Cunningham and Mary Cunningham, McGraw Hill Education, 14th Edition, 2018.
2. **Textbook of Environmental Studies for Undergraduate Courses** – Erach Bharucha, University Grants Commission (UGC), 3rd Edition, 2013.

References

1. **Fundamentals of Ecology** – Eugene P. Odum and Gary W. Barrett, Cengage Learning, 5th Edition, 2005.
2. **Environmental Monitoring and Assessment** – D. Adriano and J. Fridovich, Springer, 2004.
3. **Practical Environmental Analysis** – M. S. Cresser, Royal Society of Chemistry, 1994.
4. **Environmental Chemistry** – A. K. De, New Age International Publishers, 9th Edition, 2017.

Examination Scheme:

Components	Attendance	Viva-Voce	Practical Record	Final Practical Exam
Weightage (%)	10%	20%	10%	60%

BIOSAFETY AND BIOETHICS

Course Code**: GMBE-101** **Credit Units**: **03**

Course Outcome

1. **Understand Biosafety Protocols**: Apply biosafety measures in research and laboratory settings.
2. **Analyze Ethical Issues**: Critically assess ethical challenges in biotechnology, including gene editing and biopiracy.
3. **Apply Bioethics in Research**: Use bioethical principles in human/animal research and biotechnological applications.
4. **Comprehend Regulations**: Understand global and national biosafety laws and frameworks.
5. **Propose Ethical Solutions**: Develop solutions for bioethical dilemmas in biotechnology and innovation.

Unit 1: Introduction to Biosafety and Bioethics

- **Overview of Biosafety**: Definition, importance, principles, and goals of biosafety.
- **Introduction to Bioethics**: Definition, significance, key principles (autonomy, justice, beneficence, non-maleficence).
- **Interconnection of Biosafety and Bioethics**: Ethical considerations in biosafety management and biotechnology.

Unit 2: Biosafety in Biotechnology and Laboratory Practices

- **Biosafety Levels**: Description of different biosafety levels (BSL-1 to BSL-4) and their relevance in laboratory settings.
- **Biosafety Protocols and Guidelines**: Procedures for handling biological agents, recombinant DNA, and genetically modified organisms (GMOs).
- **Risk Assessment**: Process of identifying hazards, risk evaluation, and management in biological research.
- **Personal Protective Equipment (PPE)**: Types, uses, and best practices in biosafety.
- **Laboratory Design and Waste Management**: Containment measures, disposal of biohazardous waste, and laboratory facility requirements.

Unit 3: Ethical Considerations in Biotechnology and Research

- **Ethical Issues in Genetic Engineering**: Gene editing (CRISPR), genetically modified organisms (GMOs), and designer organisms.
- **Use of Human and Animal Subjects**: Ethical guidelines for experimentation involving humans and animals in research (Institutional Review Boards, informed consent, animal welfare).
- **Environmental Ethics**: Environmental impact of biotechnology (biosafety concerns related to GMOs, synthetic biology, and environmental releases).
- **Public Engagement and Policy Making**: The role of the public, ethical review boards, and policymakers in guiding and overseeing biotechnological research.

Unit 4: Biosafety Regulations and Guidelines

- **International Biosafety Regulations**: Cartagena Protocol on Biosafety, BWC (Biological Weapons Convention), WHO guidelines, FAO regulations.
- **National Biosafety Laws and Frameworks**: Overview of biosafety laws in India and other countries, including the National Biotechnology Regulatory Authority (NBRA) in India, Genetic Engineering Appraisal Committee (GEAC).
- **Regulations on GMOs**: Legal framework for the release, import, and export of GMOs and their products, including GM crops and pharmaceuticals.
- **Biosafety in Agriculture and Food Industry**: Guidelines for field trials, commercial release of GM crops, and biosafety in food products.

Unit 5: Ethical Issues in Modern Biotechnology

- **Biopiracy**: Definition, ethical concerns, case studies (e.g., neem patent controversy, Hoodia case).
- **Biodiversity and Access to Genetic Resources**: Ethical issues related to access and benefit-sharing under the Convention on Biological Diversity (CBD).
- **Synthetic Biology and Bioengineering**: Ethical questions surrounding the creation of artificial life, biohacking, and biotechnological manipulation of ecosystems.
- **Patents and Ownership of Biotechnological Innovations**: Ownership, patenting of life forms, ethical concerns about patenting genes, and the commodification of biological resources.

Unit 6: Case Studies in Biosafety and Bioethics

- **Biosafety Breaches and Failures**: Examination of historical biosafety incidents, such as the 2001 anthrax attacks, laboratory-acquired infections.
- **Ethical Dilemmas in Biotechnology**: Review of controversial case studies such as cloning (Dolly the sheep), gene therapy, and the commercialization of genetic research.
- **Regulatory Failures and Ethical Oversight**: Analysis of instances where lack of proper ethical review or biosafety measures led to public health risks or ethical concerns (e.g., the Tuskegee syphilis study, gene editing of embryos).
- **International and National Bioethics Panels**: Study of ethical committees like the National Bioethics Commission (India), UNESCO's bioethics committee, and their role in setting guidelines.

Unit 7: Key Business Concerns in Biotechnology, Biosafety, and Bioethics

- **Regulation of Biotech Companies**: Business regulations for biotech companies, including biosafety compliance, risk management, and ethical standards.
- **Intellectual Property and Ethics**: Ethical issues around patenting biotechnology products, traditional knowledge, and access to genetic resources.
- **Corporate Responsibility**: Role of companies in maintaining biosafety standards, ethical conduct in genetic research, and transparency in business practices.
- **Biotechnology and Public Health**: Ethical dilemmas in commercialization of biotechnological innovations and their implications for public health policies.

References:

1. **Biosafety and Bioethics in Biotechnology**, David T. Lee, 2nd Edition, 2019.
2. **Biotechnology: Ethics, Law, and Policy**, D. J. Whelan, 3rd Edition, 2018.
3. **Introduction to Biotechnology Ethics**, Dr. P. R. Joshi, 2021.
4. **Biosafety: Principles and Practices**, Michael R. O'Brien, 4th Edition, 2020.

Computer Fundamentals

Course Code: GMBE-101a **Credit Units: 03**

Pre-requisite: Basic knowledge of Computer application

Course Outcome:

A student who successfully fulfills the course requirements will be able to

1. be able to define and appropriately use information technology terms;
2. be able to identify computer hardware components and describe their function;
3. be able to describe the essential elements of the computer's architecture and discuss howthis architecture functions;
4. be able to describe the characteristics and representations of data, and interpret and compare data in different representations;
5. be able to identify and describe telecommunication components;
6. be able to describe the characteristics of operating systems and compare differentoperating systems;
7. be able to use a hypertext markup language to produce basic Web documents;
8. be able to discuss the general trends in technologies including examples of leading edge developments;
9. be able to compare the roles of different sectors of the information technology.

Details of the course:

-Unit I: Computer Basics:

Introduction, Characteristics of a Computer, Criteria for Using Computers, History of Computers, Generations of Computer, Classification of Computers, Applications of Computer, Basic Components of PC, Computer Architecture.

Unit II: Number Systems:

Introduction, Classification of Number System, Types of Number System, Conversions from One Base to Another, Conversion using Shortcut Method.

Unit III: Hardware and Software:

Introduction, Computer Memory, Secondary Memory, Computer Peripherals, Output Devices, Software requirements.
Windows XP: Introduction, Features, Comparison between Professional and Home edition, Windows XP installation, Activating Windows XP, Security features of Windows XP, Accessing User Accounts, Getting Help.

Unit IV: MS Word:

Introduction, Windows 2007 Interface, Customizing the Word Application, Document Views, Basic Formatting in MS Word 2007, Advanced Formatting, Navigating through a Word Document, Performing a Mail Merge, A Quick Look at Macros, Printing Documents, Print Preview.
Excel 2007: Introduction, Workbook, Worksheet, Formatting in excel, Advanced formatting in Excel, Working with formulas, Printing worksheets.
MS PowerPoint: Introduction, Creating a Presentation, Basic Formatting in PowerPoint, Advanced Formatting, Using Templates, Inserting charts, Inserting tables, Printing presentations.

Unit V: Security and Networking:
Introduction, Simple Fine Sharing, Internet Information Services, Peer to Peer Networking
Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Norton, Peter, "Introduction to Computers", McGraw-Hill.	2005
2	Rajaraman, V., "Fundamentals of Computers",PHI.	2005
3	PK SINHA "Computer Fundamentals", BPB	Fourth edition
4	Yashwant Kanetker, "Let us C",BPB.	2005

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Course Code: GMBE-103 **Credit Units: 03**

1. **Understand IPR Concepts**: Gain a foundational understanding of intellectual property rights (IPR) and their importance in biological research.
2. **Identify Different IPR Types**: Recognize and differentiate between copyrights, trademarks, patents, and trade secrets.
3. **Apply Patent Law**: Understand patent processes and apply knowledge to biotechnological inventions.
4. **Analyze IPR in Biotechnology**: Evaluate ethical and legal issues surrounding biotechnological innovations and genetic resources.
5. **Commercialize IPR**: Develop strategies for managing and commercializing intellectual property in the biotechnology industry.

Unit 1: Introduction to IPR

Importance of IPR, advantages of IP protection, relationship with trade, Product / design patent and Terminologies.

Unit 2: Types of IPRs

Copyrights, trademarks, Trade Secrets, Patents, and Geographical indicators, IC layout design, plant variety protection.

i. **Copyrights -** Nature of Copyright, Author & ownership of Copyright, Rights Conferred by Copyright, Assignment, Transmission, Licensing of Copyrights, Copyright Societies, Office, Board, Registration of Copyrights & Appeals, International Conventions, Copyright pertaining to Software/Internet, Database, Copyright Protection/Database Protection, IP issues in cyber space, Legal Position in USA/Indian Law/WIPO Copyright Treaty.

ii. **Trademarks-** Meaning of Trademarks, Different kinds of marks (brand names, logos, signatures, symbols), Use of a Mark, Registration of Trademarks-Procedure, Opposition to Registration-Procedure, What Marks are Registrable/Not Registrable, Concurrent Registration, Similarity of Marks, Assignment/Transmission/Licensing of Trademarks, Infringement of Trademarks, Passing off Action.

iii. Patents-

i. General Introduction: Definition, Product / Process /Design Patents Claims, Dates Associated with patent, Patent Life and Geographical Boundaries, Patent Infringement, Utilization of Intellectual Assets, Ownership of Patents.

ii. Patent Search, Patent Databases & Library (USPTO, WIPO, EPO), PracticalSearch

Training.

iii. Patent Terminology: (Abstract, Summary, Background, Drawings, Description, Claims).

iv. Geographical Indicators- Nature of Geographical Indicators, Conditions & Procedure for Registration, Offences, Penalties.

nit 3: Highlights of Indian patent Law (as amended in 2005)

Elements of patentability - Patentable subject matter, Utility, novelty and non-obviousness, Patentability of biotechnological inventions –, biochemical and software. Worldwide patent protection Paris Convention, World Trade Organization, World Intellectual Property organization, TRIPS Agreement, PCT, UPOV convention, Convention on Biological Diversity, Biopiracy, Traditional knowledge and benefit sharing.

Unit 4: Case studies

(a) Infringement cases; (b) Biopiracy cases (Hoodia case, the Quinoa case, the Enola bean case, The neem patents); (c) Traditional knowledge and IP system; (d) Patents as assets; (e) Trade secrets; (f) Drug pricing as a result of patent filing. (f) Patenting of genetically-engineered micro-organism (Diamond Vs Chakravarthy); (g) Recent cases related to the provisions of Section 3(d) of The Patents Act (Novartis vs Generic Manufacturers, Roche vs Cipla, Astra Zeneca Vs Natco Pharma).

Unit 5: Key Business concerns in commercializing Intellectual Property Rights

Competition and Confidentiality issues, Antitrust Laws; Employee Confidentiality; Assignment of Intellectual Property Rights; Technology Transfer Agreements; Intellectual Property Issues in the Sale of Business. Future Developments of Intellectual Property Rights–Indian Traditional Medicine & IP Protection, Folklore, Patenting of Life Forms, International-Traditional Medicines & Health Foods.

References:

1. Law Relating to Intellectual Property Rights, V K Ahuja, ISBN 9788131251652, 3rd Edition 2017.

Examination Scheme:

	Internal Assessment	

Components	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	External Evaluation
Weightage (%)	10	20	10	60

General Proficiency

Course Code: GMBE-103a **Credit Units: 03**

Course Outcome:

After completion of the course, students will be able to:

1. Develop effective communication and interpersonal skills.
2. Enhance problem-solving and decision-making abilities in academic and professional settings.
3. Foster ethical and responsible behavior in the workplace and society.
4. Strengthen team collaboration and leadership skills.
5. Build a professional attitude with proficiency in report writing and presentation.

Details of the Course:

Note: A college must cover at least 70% of the topics listed below. The remaining 30% may be modified according to institutional requirements and resources.

S. No.	Contents	Contact Hours
1	**Communication Skills**: Verbal and non-verbal communication, active listening, and feedback.	3
2	**Technical Writing**: Preparation of lab reports, project proposals, and scientific documentation.	3
3	**Presentation Skills**: Use of visual aids, structuring content, and delivering effective presentations.	3
4	**Time Management**: Techniques to prioritize and manage academic and professional tasks efficiently.	2
5	**Teamwork and Leadership**: Collaborative exercises and role-playing to enhance group dynamics.	3
6	**Critical Thinking and Problem Solving**: Case studies and situational analysis exercises.	3
7	**Professional Ethics**: Discussion on ethics in research, laboratory safety, and societal responsibilities.	3
8	**Career Development Skills**: Resume writing, interview preparation, and professional networking.	3
9	**Basics of Data Representation**: Graphical representation of data and use of statistical tools in microbiology.	2
10	**Soft Skills Development**: Conflict resolution, adaptability, and stress management techniques.	3

Suggested Books:

Text Books

1. **Soft Skills** – G. R. K. Murthy, Pearson Education, 1st Edition, 2014.
2. **The Elements of Style** – William Strunk Jr. and E.B. White, Pearson, 4th Edition, 2000.

References

1. **Developing Communication Skills** – Krishna Mohan and Meera Banerjee, Macmillan India Ltd., 2nd Edition, 2009.
2. **Technical Communication: Principles and Practice** – Meenakshi Raman and Sangeeta Sharma, Oxford University Press, 3rd Edition, 2018.
3. **Soft Skills for Personality Development** – S. Balasubramanian, Wiley, 2012.

Examination Scheme:

Components	Attendance	Viva-Voce	Practical Record	Presentation/Skill Assessment
Weightage (%)	10%	20%	10%	60%

Course Code: GMBE-103B **Credit Units**: 03

Pre-requisite: Basic understanding of physical fitness and interest in yoga.

Course Outcome:

After completion of the course, students will be able to:

1. Understand the importance of physical activity for overall health.
2. Learn the principles and practices of yoga for mental and physical well-being.
3. Develop knowledge about fitness regimes and their applications.
4. Manage stress through physical exercises and relaxation techniques.
5. Build awareness of lifelong fitness practices.

Details of the Course:

S. No.	Contents	Contact Hours
1	Introduction to Physical Education: Importance and benefits of fitness and exercise.	2
2	Basics of Yoga: History, significance, and types of yoga.	3
3	Asanas and Pranayama: Practice of basic postures and breathing techniques.	3
4	Stress Management Techniques: Relaxation, meditation, and mindfulness.	2
5	Fitness Activities: Aerobics, stretching, and bodyweight exercises.	3

Suggested Books*:*

Yoga for Health and Wellness – K. Pattabhi Jois, New Age Publishers, 2016.

1. **Fitness and Wellness** – Werner W. K. Hoeger, 13th Edition, Cengage Learning, 2020.

2. Examination Scheme:

Components	Attendance	Practical Skills	Participation	Final Assessment
Weightage (%)	10%	20%	30%	40%

Health and Nutrition

Course Code: GMBE-103C **Credit Units**: 03

Pre-requisite: Basic understanding of food and health.

Course Outcome:

After completion of the course, students will be able to:

1. Understand the principles of balanced nutrition and dietary requirements.
2. Identify the role of nutrients in maintaining health.
3. Develop knowledge about lifestyle diseases and their prevention through diet.
4. Learn the importance of food safety and hygiene.
5. Promote healthy living practices for individuals and communities.

Details of the Course:

S. No.	Contents	Contact Hours
1	Basics of Nutrition: Macronutrients and micronutrients, their sources and functions.	3
2	Balanced Diet: Concept, components, and formulation.	2
3	Malnutrition and Lifestyle Diseases: Causes, prevention, and management.	3
4	Food Safety: Hygiene practices and foodborne illnesses.	2
5	Dietary Guidelines: Planning diets for various age groups and health conditions.	3

Suggested Books:

1. **Nutrition Science** – B. Srilakshmi, New Age International, 8th Edition, 2021.
2. **Modern Nutrition in Health and Disease** – A. Catharine Ross, Lippincott, 12th Edition, 2020.

Examination Scheme:

Components	Attendance	Assignments	Practical Knowledge	Final Exam
Weightage (%)	10%	20%	30%	40%

ELEMENTARY MATHS

Course Code: AECC-103 **Credit Units: 02**

1. **Master Basic Mathematical Concepts**: Understand fundamental mathematical principles like arithmetic, algebra, and geometry.

2. **Apply Problem-Solving Techniques**: Develop skills to solve real-world mathematical problems using appropriate methods.
3. **Understand Mathematical Relationships**: Recognize patterns, functions, and relationships in mathematical equations and expressions.
4. **Use Mathematical Tools and Techniques**: Apply basic tools (e.g., calculators, graphs) to analyze and solve mathematical problems.
5. **Develop Logical and Analytical Thinking**: Enhance critical thinking and logical reasoning through mathematical exercises and proofs.

UNIT 1: Principle of Mathematical Induction

Process of the proof by induction, motivating the application of the method by looking at natural numbers as the least inductive subset of real numbers. The principle of mathematical induction and simple applications.

UNIT 2: Complex Numbers and Quadratic Equations

Need for complex numbers, especially -1, to be motivated by inability to solve every quadratic equation. Brief description of algebraic properties of complex numbers. Argand plane and polar representation of complex numbers. Statement of Fundamental Theorem of Algebra, solution of quadratic equations in the complex number system, Square-root of a Complex number.

UNIT 3: Linear Inequalities

Linear inequalities, Algebraic solutions of linear inequalities in one variable and their representation on the number line. Graphical solution of linear inequalities in two variables. Solution of system of linear inequalities in two variables - graphically.

UNIT 4: Permutations and Combinations

Fundamental principle of counting. Factorial *n*. Permutations and combinations derivation of formula and their connections, simple applications.

UNIT 5: Binomial Theorem

History, statement and proof of the binomial theorem for positive integral indices. Pascal's triangle, general and middle term in binomial expansion, simple applications.

UNIT 6: Sequence and Series

Sequence and Series. Arithmetic Progression (A.P.), Arithmetic Mean (A.M.), Geometric Progression (G.P.), general term of a G.P., sum of *n* terms of a G.P. Arithmetic and geometric series, infinite G.P. and its sum, geometric mean (G.M.). Relation between A.M. and G.M. Sum

to *n* terms of the special seriesUNIT 7: Integral

Definite integrals as a limit of a sum. Fundamental Theorem of Calculus (without proof). Basic properties of definite integrals and evaluation of definite integrals. Integration as inverse process of differentiation. Integration of a variety of functions by substitution,

by partial fractions and by parts, only simple integrals of the type –

$$\int \frac{dx}{x^2 \pm a^2}, \int \frac{dx}{\sqrt{x^2 \pm a^2}}, \int \frac{dx}{\sqrt{a^2 - x^2}}, \int \frac{dx}{ax^2 + bx + c}, \int \frac{dx}{\sqrt{ax^2 + bx + c}},$$

$$\int \frac{(px + q)}{ax^2 + bx + c} dx, \int \frac{(px + q)}{\sqrt{ax^2 + bx + c}} dx, \int \sqrt{a^2 \pm x^2} dx \text{ and } \int \sqrt{x^2 - a^2}\, dx,$$

$$\int \sqrt{ax^2 + bx + c}\ dx \text{ and } \int (px + q)\sqrt{ax^2 + bx + c}\ dx$$

to be evaluated.

UNIT 8: Probability

Multiplications theorem on probability. Conditional probability, independent events, total probability, Bayes' theorem. Random variable and its probability distribution, mean and variance of haphazard variable. Repeated independent (Bernoulli) trials and Binomial distribution.

References:

1.11th and 12th NCERT Mathematics.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

INHERITANCE BIOLOGY

Course Code: CMBE-102 **Credit Unit: 03**

1. **Understand Genetic Principles**: Grasp basic principles of inheritance, including Mendelian genetics and patterns of heredity.

2. **Analyze Genetic Crosses**: Apply Punnett squares and other tools to predict genetic outcomes in offspring.
3. **Explore Genetic Variability**: Understand the role of mutations, genetic recombination, and chromosomal variations in inheritance.
4. **Study Inheritance Mechanisms**: Learn about non-Mendelian inheritance patterns such as incomplete dominance, co-dominance, and sex-linked traits.
5. **Relate Genetics to Evolution**: Connect inheritance patterns to evolutionary processes and genetic diversity in populations.

Unit 1: Introduction to Genetics

Historical developments, Model organisms in genetic analyses and experimentation: Escherichia coli, Saccharomyces cerevisiae, Neurospora crassa, Caenorhabditis elegans, Drosophila melanogaster, Arabidopsis thaliana.

Unit 2: Mendelian Principles

Mendel's Laws: Dominance, segregation, independent assortment, deviation from Mendelian inheritance, Rediscovery of Mendel's principles, Chromosome theory of inheritance: Allele, multiple alleles, pseudoallele, complementation tests, Extensions of Mendelian genetics: Allelic interactions, concept of dominance, recessiveness, Incomplete dominance and co-dominance, Multiple alleles, Epistasis, penetrance and expressivity.

Unit 3: Linkage and Crossing over

Linkage and recombination of genes, Cytological basis of crossing over, Crossing over at four-strand stage, Molecular mechanism of crossing over, mapping, Homologous and non- homologous recombination, including transposition, site-specific recombination.

Unit 4: Extra-Chromosomal Inheritance

Rules of extra nuclear inheritance, Organelle heredity - Chloroplast mutations in Chlamydomonas, mitochondrial, mutations in Saccharomyces, Maternal effects – Shell coiling inLimnaea peregra Infectious heredity - Kappa particles in Paramecium.

Unit 5: Characteristics of Chromosomes

Structural organization of chromosomes - centromeres, telomeres and repetitive DNA, Packaging DNA molecules into chromosomes, Concept of euchromatin and heterochromatin, Normal and abnormal karyotypes of human chromosomes, Chromosome banding, Giant chromosomes:

Polytene and lampbrush chromosomes, Variations in chromosome structure: Deletion, duplication, inversion and translocation, Variation in chromosomal number and structural abnormalities - Klinefelter syndrome, Turner syndrome, Down syndrome.

Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. Polygenic inheritance, heritability and its measurements, QTL mapping.

References:

1. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India.
2. Snustad DP, Simmons MJ (2011). Principles of Genetics. 6th Ed. John Wiley and Sons Inc.
3. Weaver RF, Hedrick PW (1997). Genetics. 3rd Ed. McGraw-Hill Education.
4. Klug WS, Cummings MR, Spencer CA, Palladino M (2012). Concepts of Genetics. 10th Ed. Benjamin Cummings.
5. Griffith AJF, Wessler SR, Lewontin RC, Carroll SB. (2007). Introduction to Genetic Analysis.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

Organic & Analytical Chemistry

Course Code: CMBE-102a **Credit Units: 03**

Pre-requisite: Basic information of Chemistry

Course Outcome:

1. Understand periodic properties and its application in the characterizationof chemical compounds
2. Understand the various properties of materials depending upon bond formation.
3. Utilize the concept of hardness in the purification of water for industrialand domestic purpose
4. Distinguish the rate laws and application to different chemical reaction mechanism
5. Learn and apply the concepts of analytical chemistry for sample analysisby chemical methods
6. Learn the basic concepts of Chemistry and its application in different fields

Details of the Course:-

UNIT I: Periodic Properties:

Position of elements in the periodic table, effective nuclear charge, atomic and ionic radii, ionization energy, electron affinity and electronegativity definition, methods of determination, trends in periodic table and applications in predicting and explaining the chemical behavior.

UNIT II: Atomic and Molecular Structure:

VSPER theory and its application for structure of NH_3, NH_4^+, H_2O, H_3O^+, SO_2 and XeF_4 Molecular Orbital Theory, Formation of homo and heteronuclear diatomic molecules Hydrogen Bonding and its application
Metallic Bonding (Band theory); role of doping
Coordination compounds: Introduction, Werner‟s coordination theory, naming of compounds.

UNIT III: Water Chemistry:

Hardness of water and its measurement, Softening of water by L-S process, Zeolite process and Reverse osmosis process, Ion Exchange process, Calgon Process, Numerical problems based on L-S Process, Zeolite Process and hardness of water.

UNIT IV: Chemical Kinetics:

Ionic reactions and molecular reactions, Molecularity and Order of reactions, Integrated equations of 1st, 2nd and zero order reactions, Activation Energy and Activated complexes, numerical problems based upon them.

UNIT V: Analytical Chemistry:

Qualitative and Quantitative Chemistry, Volumetric and Gravimetric Analysis; Principles of Volumetric Analysis; Concept of pH, buffer, Henderson equation, Concept of strength and concentration of solution; Normality, Molarity, Molality and interconversion of strength Titration-Principles and Classification: Redox, Acid-Base, Complexometric, Redox and Precipitation, Oxidation Number and calculation of oxidation number in compounds.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	University Chemistry, B.H.Mahan	1987
2.	Chemistry, Principles and Application, M.J. Sienko and R.A. Plane	1980
	Reference Books	
1.	Inorganic Chemistry, J.D.Lee	2008
2.	Fundamentals of Analytical Chemistry, Skoog and West	2013
3.	Physical Chemistry, Atkins	2009

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

OBSERVATIONAL CHEMISTRY

Course Code: CMBE-102b **Credit Units: 03**

Pre-requisite: Basic information of Chemistry

Course Outcome:

1. Understand periodic properties and its application in the characterizationof chemical compounds
2. Understand the various properties of materials depending upon bond formation.
3. Utilize the concept of hardness in the purification of water for industrialand domestic purpose
4. Distinguish the rate laws and application to different chemical reaction mechanism
5. Learn and apply the concepts of analytical chemistry for sample analysisby chemical methods
6. Learn the basic concepts of Chemistry and its application in different fields

Details of the Course:-

UNIT I: Periodic Properties:

Position of elements in the periodic table, effective nuclear charge, atomic and ionic radii, ionization energy, electron affinity and electronegativity definition, methods of determination, trends in periodic table and applications in predicting and explaining the chemical behavior.

UNIT II: Atomic and Molecular Structure:

VSPER theory and its application for structure of NH_3, NH_4^+, H_2O, H_3O^+, SO_2 and XeF_4 Molecular Orbital Theory, Formation of homo and heteronuclear diatomic molecules Hydrogen Bonding and its application
Metallic Bonding (Band theory); role of doping
Coordination compounds: Introduction, Werner‟s coordination theory, naming of compounds.

UNIT III: Water Chemistry:

Hardness of water and its measurement, Softening of water by L-S process, Zeolite process and Reverse osmosis process, Ion Exchange process, Calgon Process, Numerical problems based on L-S Process, Zeolite Process and hardness of water.

UNIT IV: Chemical Kinetics:

Ionic reactions and molecular reactions, Molecularity and Order of reactions, Integrated equations of 1st, 2nd and zero order reactions, Activation Energy and Activated complexes, numerical problems based upon them.

UNIT V: Analytical Chemistry:

Qualitative and Quantitative Chemistry, Volumetric and Gravimetric Analysis; Principles of Volumetric Analysis; Concept of pH, buffer, Henderson equation, Concept of strength and concentration of solution; Normality, Molarity, Molality and interconversion of strength Titration-Principles and Classification: Redox, Acid-Base, Complexometric, Redox and Precipitation, Oxidation Number and calculation of oxidation number in compounds.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	University Chemistry, B.H.Mahan	1987
2.	Chemistry, Principles and Application, M.J. Sienko and R.A. Plane	1980
	Reference Books	
1.	Inorganic Chemistry, J.D.Lee	2008
2.	Fundamentals of Analytical Chemistry, Skoog and West	2013
3.	Physical Chemistry, Atkins	2009

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

BASIC AND APPLIED CHEMISTRY

Course Code: CMBE-102c Credit Units: 03

Pre-requisite: Basic information of Chemistry

Course Outcome:

1. Understand periodic properties and its application in the characterizationof chemical compounds
2. Understand the various properties of materials depending upon bond formation.
3. Utilize the concept of hardness in the purification of water for industrialand domestic purpose
4. Distinguish the rate laws and application to different chemical reaction mechanism
5. Learn and apply the concepts of analytical chemistry for sample analysisby chemical methods
6. Learn the basic concepts of Chemistry and its application in different fields

Details of the Course:-

UNIT I: Periodic Properties:

Position of elements in the periodic table, effective nuclear charge, atomic and ionic radii, ionization energy, electron affinity and electronegativity definition, methods of determination, trends in periodic table and applications in predicting and explaining the chemical behavior.

UNIT II: Atomic and Molecular Structure:

VSPER theory and its application for structure of NH_3, NH_4^+, H_2O, H_3O^+, SO_2 and XeF_4 Molecular Orbital Theory, Formation of homo and heteronuclear diatomic molecules Hydrogen Bonding and its application
Metallic Bonding (Band theory); role of doping
Coordination compounds: Introduction, Werner‟s coordination theory, naming of compounds.

UNIT III: Water Chemistry:

Hardness of water and its measurement, Softening of water by L-S process, Zeolite process and Reverse osmosis process, Ion Exchange process, Calgon Process, Numerical problems based on L-S Process, Zeolite Process and hardness of water.

UNIT IV: Chemical Kinetics:

Ionic reactions and molecular reactions, Molecularity and Order of reactions, Integrated equations of 1st, 2nd and zero order reactions, Activation Energy and Activated complexes, numerical

problems based upon them.

UNIT V: Analytical Chemistry:

Qualitative and Quantitative Chemistry, Volumetric and Gravimetric Analysis; Principles of Volumetric Analysis; Concept of pH, buffer, Henderson equation, Concept of strength and concentration of solution; Normality, Molarity, Molality and interconversion of strength Titration-Principles and Classification: Redox, Acid-Base, Complexometric, Redox and Precipitation, Oxidation Number and calculation of oxidation number in compounds.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	University Chemistry, B.H.Mahan	1987
2.	Chemistry, Principles and Application, M.J. Sienko and R.A. Plane	1980
	Reference Books	
1.	Inorganic Chemistry, J.D.Lee	2008
2.	Fundamentals of Analytical Chemistry, Skoog and West	2013
3.	Physical Chemistry, Atkins	2009

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Statistics

Course Code**: AECC-103A** **Credit** Units**: 02**

Pre-requisite: Basic mathematical skills.

Course Outcome:

After completion of the course, students will be able to:

1. Apply statistical tools for analyzing experimental data.
2. Understand probability concepts and their applications in biological studies.
3. Perform hypothesis testing and data interpretation.
4. Use graphical and tabular methods for data presentation.
5. Enhance research skills through statistical analysis.

Details of the Course:

S. No.	Contents	Contact Hours
1	Introduction to Statistics: Importance, scope, and types of data.	4
2	Descriptive Statistics: Mean, median, mode, standard deviation, and variance.	4
3	Probability Concepts: Basics and applications in biological systems.	4
4	Hypothesis Testing: t-test, chi-square test, and ANOVA.	4
5	Data Representation: Graphs, charts, and tables for experimental results.	4

Suggested Books:

1. **Biostatistics: A Foundation for Analysis in Health Sciences** – Wayne W. Daniel, Wiley, 10th Edition, 2013.
2. **Introduction to Biostatistics** – P. N. Arora and P. K. Malhan, Himalaya Publishing, 2017.

Examination Scheme:

Components	Attendance	Assignments	Midterm Exam	Final Exam
Weightage (%)	10%	20%	20%	50%

Course Code**: AECC-103B** **Credit Units**: **02**

Pre-requisite: Basic mathematical understanding.

Course Outcome:

After completion of the course, students will be able to:

1. Develop mathematical skills required for biological data analysis.
2. Understand applications of matrices, calculus, and algebra in microbiology.
3. Solve biological problems using differential equations.
4. Perform numerical methods for data interpretation.
5. Apply mathematical models in research and analysis.

Details of the Course:

S. No.	Contents	Contact Hours
1	Matrices and Determinants: Basics and applications in biological systems.	4
2	Calculus: Differentiation, integration, and their uses in microbial growth analysis.	4
3	Algebra: Basic concepts and solving biological equations.	4
4	Differential Equations: Solving equations related to population dynamics and enzymatic reactions.	4
5	Basics of Numerical Methods: Interpolation and regression analysis.	4

Suggested Books:

1. **Mathematics for Biological Scientists** – Mike Aitken and W. Heard, Garland Science, 2009.
2. **Mathematics for Biologists** – E. Batschelet, Springer, 3rd Edition, 1979.

Examination Scheme:

Components	Attendance	Assignments	Midterm Exam	Final Exam
Weightage (%)	10%	20%	20%	50%

INHERITANCE BIOLOGY

Course Code: CMBE-102 Credit Unit: 03

6. **Understand Genetic Principles**: Grasp basic principles of inheritance, including Mendelian genetics and patterns of heredity.
7. **Analyze Genetic Crosses**: Apply Punnett squares and other tools to predict genetic outcomes in offspring.
8. **Explore Genetic Variability**: Understand the role of mutations, genetic recombination, and chromosomal variations in inheritance.
9. **Study Inheritance Mechanisms**: Learn about non-Mendelian inheritance patterns such as incomplete dominance, co-dominance, and sex-linked traits.
10. **Relate Genetics to Evolution**: Connect inheritance patterns to evolutionary processes and genetic diversity in populations.

Unit 1: Introduction to Genetics

Historical developments, Model organisms in genetic analyses and experimentation: Escherichia coli, Saccharomyces cerevisiae, Neurospora crassa, Caenorhabditis elegans, Drosophila melanogaster, Arabidopsis thaliana.

Unit 2: Mendelian Principles

Mendel's Laws: Dominance, segregation, independent assortment, deviation from Mendelian inheritance, Rediscovery of Mendel's principles, Chromosome theory of inheritance: Allele, multiple alleles, pseudoallele, complementation tests, Extensions of Mendelian genetics: Allelic interactions, concept of dominance, recessiveness, Incomplete dominance and co-dominance, Multiple alleles, Epistasis, penetrance and expressivity.

Unit 3: Linkage and Crossing over

Linkage and recombination of genes, Cytological basis of crossing over, Crossing over at four-strand stage, Molecular mechanism of crossing over, mapping, Homologous and non- homologous recombination, including transposition, site-specific recombination.

Unit 4: Extra-Chromosomal Inheritance

Rules of extra nuclear inheritance, Organelle heredity - Chloroplast mutations in Chlamydomonas,

mitochondrial, mutations in Saccharomyces, Maternal effects – Shell coiling inLimnaea peregra Infectious heredity - Kappa particles in Paramecium.

Unit 5: Characteristics of Chromosomes

Structural organization of chromosomes - centromeres, telomeres and repetitive DNA, Packaging DNA molecules into chromosomes, Concept of euchromatin and heterochromatin, Normal and abnormal karyotypes of human chromosomes, Chromosome banding, Giant chromosomes: Polytene and lampbrush chromosomes, Variations in chromosome structure: Deletion, duplication, inversion and translocation, Variation in chromosomal number and structural abnormalities - Klinefelter syndrome, Turner syndrome, Down syndrome.

Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. Polygenic inheritance, heritability and its measurements, QTL mapping.

References:

6. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India.

7. Snustad DP, Simmons MJ (2011). Principles of Genetics. 6th Ed. John Wiley and Sons Inc.

8. Weaver RF, Hedrick PW (1997). Genetics. 3rd Ed. McGraw-Hill Education.

9. Klug WS, Cummings MR, Spencer CA, Palladino M (2012). Concepts of Genetics. 10th Ed. Benjamin Cummings.

10. Griffith AJF, Wessler SR, Lewontin RC, Carroll SB. (2007). Introduction to Genetic Analysis.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Organic & Analytical Chemistry

Course Code: CMBE-102a **Credit Units: 03**

Pre-requisite: Basic information of Chemistry

Course Outcome:

7. Understand periodic properties and its application in the characterizationof chemical compounds
8. Understand the various properties of materials depending upon bond formation.
9. Utilize the concept of hardness in the purification of water for industrialand domestic purpose
10. Distinguish the rate laws and application to different chemical reaction mechanism
11. Learn and apply the concepts of analytical chemistry for sample analysis by chemical methods
12. Learn the basic concepts of Chemistry and its application in different fields

Details of the Course:-

UNIT I: Periodic Properties:

Position of elements in the periodic table, effective nuclear charge, atomic and ionic radii, ionization energy, electron affinity and electronegativity definition, methods of determination, trends in periodic table and applications in predicting and explaining the chemical behavior.

UNIT II: Atomic and Molecular Structure:

VSPER theory and its application for structure of NH_3, NH_4^+, H_2O, H_3O^+, SO_2 and XeF_4 Molecular Orbital Theory, Formation of homo and heteronuclear diatomic molecules Hydrogen Bonding and its application
Metallic Bonding (Band theory); role of doping
Coordination compounds: Introduction, Werner‟s coordination theory, naming of compounds.

UNIT III: Water Chemistry:

Hardness of water and its measurement, Softening of water by L-S process, Zeolite process and Reverse osmosis process, Ion Exchange process, Calgon Process, Numerical problems based on L-S Process, Zeolite Process and hardness of water.

UNIT IV: Chemical Kinetics:

Ionic reactions and molecular reactions, Molecularity and Order of reactions, Integrated equations of 1st, 2nd and zero order reactions, Activation Energy and Activated complexes, numerical

problems based upon them.

UNIT V: Analytical Chemistry:

Qualitative and Quantitative Chemistry, Volumetric and Gravimetric Analysis; Principles of Volumetric Analysis; Concept of pH, buffer, Henderson equation, Concept of strength and concentration of solution; Normality, Molarity, Molality and interconversion of strength Titration-Principles and Classification: Redox, Acid-Base, Complexometric, Redox and Precipitation, Oxidation Number and calculation of oxidation number in compounds.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	University Chemistry, B.H.Mahan	1987
2.	Chemistry, Principles and Application, M.J. Sienko and R.A. Plane	1980
	Reference Books	
1.	Inorganic Chemistry, J.D.Lee	2008
2.	Fundamentals of Analytical Chemistry, Skoog and West	2013
3.	Physical Chemistry, Atkins	2009

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

OBSERVATIONAL CHEMISTRY

Course Code: CMBE-102b **Credit Units: 03**

Pre-requisite: Basic information of Chemistry

Course Outcome:

7. Understand periodic properties and its application in the characterizationof chemical compounds
8. Understand the various properties of materials depending upon bond formation.
9. Utilize the concept of hardness in the purification of water for industrialand domestic purpose
10. Distinguish the rate laws and application to different chemical reaction mechanism
11. Learn and apply the concepts of analytical chemistry for sample analysis by chemical methods
12. Learn the basic concepts of Chemistry and its application in different fields

Details of the Course:-

UNIT I: Periodic Properties:

Position of elements in the periodic table, effective nuclear charge, atomic and ionic radii, ionization energy, electron affinity and electronegativity definition, methods of determination, trends in periodic table and applications in predicting and explaining the chemical behavior.

UNIT II: Atomic and Molecular Structure:

VSPER theory and its application for structure of NH_3, NH_4^+, H_2O, H_3O^+, SO_2 and XeF_4 Molecular Orbital Theory, Formation of homo and heteronuclear diatomic molecules Hydrogen Bonding and its application
Metallic Bonding (Band theory); role of doping
Coordination compounds: Introduction, Werner‟s coordination theory, naming of compounds.

UNIT III: Water Chemistry:

Hardness of water and its measurement, Softening of water by L-S process, Zeolite process and Reverse osmosis process, Ion Exchange process, Calgon Process, Numerical problems based on L-S Process, Zeolite Process and hardness of water.

UNIT IV: Chemical Kinetics:

Ionic reactions and molecular reactions, Molecularity and Order of reactions, Integrated equations of 1st, 2nd and zero order reactions, Activation Energy and Activated complexes, numerical problems based upon them.

UNIT V: Analytical Chemistry:

Qualitative and Quantitative Chemistry, Volumetric and Gravimetric Analysis; Principles of Volumetric Analysis; Concept of pH, buffer, Henderson equation, Concept of strength and concentration of solution; Normality, Molarity, Molality and interconversion of strength Titration-Principles and Classification: Redox, Acid-Base, Complexometric, Redox and Precipitation, Oxidation Number and calculation of oxidation number in compounds.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	University Chemistry, B.H.Mahan	1987
2.	Chemistry, Principles and Application, M.J. Sienko and R.A. Plane	1980
	Reference Books	
1.	Inorganic Chemistry, J.D.Lee	2008
2.	Fundamentals of Analytical Chemistry, Skoog and West	2013
3.	Physical Chemistry, Atkins	2009

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

BASIC AND APPLIED CHEMISTRY

Course Code: CMBE-102c **Credit Units: 03**

Pre-requisite: Basic information of Chemistry

Course Outcome:

7. Understand periodic properties and its application in the characterizationof chemical compounds
8. Understand the various properties of materials depending upon bond formation.
9. Utilize the concept of hardness in the purification of water for industrialand domestic purpose
10. Distinguish the rate laws and application to different chemical reaction mechanism
11. Learn and apply the concepts of analytical chemistry for sample analysis by chemical methods
12. Learn the basic concepts of Chemistry and its application in different fields

Details of the Course:-

UNIT I: Periodic Properties:

Position of elements in the periodic table, effective nuclear charge, atomic and ionic radii, ionization energy, electron affinity and electronegativity definition, methods of determination, trends in periodic table and applications in predicting and explaining the chemical behavior.

UNIT II: Atomic and Molecular Structure:

VSPER theory and its application for structure of NH_3, NH_4^+, H_2O, H_3O^+, SO_2 and XeF_4 Molecular Orbital Theory, Formation of homo and heteronuclear diatomic molecules Hydrogen Bonding and its application

Metallic Bonding (Band theory); role of doping

Coordination compounds: Introduction, Werner‟s coordination theory, naming of compounds.

UNIT III: Water Chemistry:

Hardness of water and its measurement, Softening of water by L-S process, Zeolite process and Reverse osmosis process, Ion Exchange process, Calgon Process, Numerical problems based on L-S Process, Zeolite Process and hardness of water.

UNIT IV: Chemical Kinetics:

Ionic reactions and molecular reactions, Molecularity and Order of reactions, Integrated equations of 1st, 2nd and zero order reactions, Activation Energy and Activated complexes, numerical

problems based upon them.

UNIT V: Analytical Chemistry:

Qualitative and Quantitative Chemistry, Volumetric and Gravimetric Analysis; Principles of Volumetric Analysis; Concept of pH, buffer, Henderson equation, Concept of strength and concentration of solution; Normality, Molarity, Molality and interconversion of strength Titration-Principles and Classification: Redox, Acid-Base, Complexometric, Redox and Precipitation, Oxidation Number and calculation of oxidation number in compounds.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	University Chemistry, B.H.Mahan	1987
2.	Chemistry, Principles and Application, M.J. Sienko and R.A. Plane	1980
	Reference Books	
1.	Inorganic Chemistry, J.D.Lee	2008
2.	Fundamentals of Analytical Chemistry, Skoog and West	2013
3.	Physical Chemistry, Atkins	2009

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

INTRODUCTION AND SCOPE OF MICROBIOLOGY

Course Code: CMBE-104 **Credit Unit: 03**

1. **Understand Microbiology Fundamentals**: Grasp the basic principles and concepts of microbiology, including microorganisms and their classification.
2. **Identify Microbial Diversity**: Recognize various types of microorganisms such as bacteria, viruses, fungi, and protozoa.
3. **Understand Microbial Physiology**: Learn about the structure, function, and metabolism of microorganisms.
4. **Explore Microbial Applications**: Understand the role of microbes in various fields like medicine, agriculture, and industry.
5. **Recognize Microbial Impact**: Appreciate the significance of microbiology in public health, disease prevention, and environmental sustainability.

UNIT 1: History of Development of Microbiology

Fundamentals, History and Evolution of Microbiology. Classification of microorganisms: Microbial taxonomy, criteria used including molecular approaches, Microbial phylogeny and current classification of bacteria. Microbial Diversity: Distribution and characterizationProkaryotic and Eukaryotic cells, Morphology and cell structure of major groups ofmicroorganisms eg. Bacteria, Algae, Fungi, Protozoa and Unique features of viruses.

UNIT 2: Cultivation and Maintenance

Cultivation and Maintenance of microorganisms: Nutritional categories of microorganisms, methods of isolation, Purification and preservation.

UNIT 3: Microbial Growth, Metabolism and Reproduction

Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria. Microbial Metabolism: Metabolic pathways, amphi-catabolic and biosynthetic pathways. Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria.

UNIT 4: Sterilization

Control of Microorganisms: By physical, chemical and chemotherapeutic Agents.

UNIT 5: Water and Food Microbiology

Water Microbiology: Bacterial pollutants of water, coliforms and non-coliforms. Sewage composition and its disposal. Food Microbiology: Important microorganism in food Microbiology: Moulds, Yeasts, bacteria. Major food born infections and intoxications, Preservation of various types of foods. Fermented Foods.

References:

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.

2. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.

3. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition.Pearson Education Limited.

4.Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.

5. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER II

Elements of Biochemistry

Course Code: CMBE-104a **Credit Units: 03**

Pre-requisite: Basic understanding of biomolecules and concepts of general chemistry

Course Outcome:

1. Students will be able to define biomolecules and buffers.
2. Students will understand the structure and functions of biomolecules.
3. Students will be able to classify and explain the role of various biomolecules in human body.
4. Students will be able to analyze the causes of diseases on biochemical basis.
5. Students will be able to understand various biochemical process and cell metabolism.

Details of the

Course:-UnitI:

A historical prospective, Amino acids & Proteins**:** Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.

Unit II:

Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines,. Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA.

Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein‟s and their biological functions.

Unit III:

Lipids: Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol.

Unit IV:

Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites, enzyme specificity: types & theories, Biocatalysts from extreme thermophilic and hyperthermophilic archaea and bacteria.

Role of: NAD^+, $NADP^+$, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxal phosphate,lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions

Unit V:

Carbohydrates Metabolism: Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. ß-oxidation of fatty acids.

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1	Biochemistry, Lubert Stryer, 8th Edition, WH Freeman, 2015	2015
2	Harper‟s illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M.Botham, PESEr J. Kennelly, Victor W. Rodwell, P. Anthony Weil. 30th Edition, McGrawHill, 2015.	2015

3	Biochemistry by Mary K.Campbell & Shawn O.Farrell, 9th Edition, Cenage Learning, 2018.	2018
4	Biochemistry, Donald Voet and Judith Voet, 4th Edition, Publisher: John Wiley andSons,	2010
	Reference Books	
1	The Organic Chemistry of Enzyme-catalyzed Reactions Richard B. Silverman Academic Press	2002
2	Practical Enzymology Hans Bisswanger Wiley–VCH 2012.	2012
3	Fundamentals of Enzyme Kinetics Athel Cornish-Bowden Portland Press 4th edition, 2012.	2012
4	Fundamentals of Enzymology Nicholas Price and Lewis Steven Oxford University Press 3rd edition 2009.	2009

Examination Scheme:

Components	**Internal Assessment**			**External Evaluation**
	Attendance	**Class Test**	**Assignment/ Project/Seminar/Quiz**	
Weightage (%)	10	20	10	60

SEMESTER II

Fundamentals of Biochemistry

Course Code: CMBE-104b Credit Units: 03

Pre-requisite: Basic understanding of biomolecules and concepts of general chemistry

Course Outcome:

1. Students will be able to define biomolecules and buffers.
2. Students will understand the structure and functions of biomolecules.
3 .Students will be able to classify and explain the role of various biomolecules in human body.
4 .Students will be able to analyze the causes of diseases on biochemical basis.
5 Students will be able to understand various biochemical process and cell metabolism.

Details of the

Course:-UnitI:

A historical prospective, Amino acids & Proteins**:** Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation

and renaturation of proteins. Fibrous and globular proteins.

Unit II:

Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines,. Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA.

Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein‟s and their biological functions.

Unit III:

Lipids: Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol.

Unit IV:

Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites, enzyme specificity: types & theories, Biocatalysts from extreme thermophilic and hyperthermophilic archaea and bacteria.

Role of: NAD^+, $NADP^+$, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxal phosphate,lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions

Unit V:

Carbohydrates Metabolism: Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. ß-oxidation of fatty acids.

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1	Biochemistry, Lubert Stryer, 8th Edition, WH Freeman, 2015	2015

2	Harper‟s illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M.Botham, PESEr J. Kennelly, Victor W. Rodwell, P. Anthony Weil. 30th Edition, McGrawHill, 2015.	2015
3	Biochemistry by Mary K.Campbell & Shawn O.Farrell, 9th Edition, Cenage Learning, 2018.	2018
4	Biochemistry, Donald Voet and Judith Voet, 4th Edition, Publisher: John Wiley andSons,	2010
	Reference Books	
1	The Organic Chemistry of Enzyme-catalyzed Reactions Richard B. Silverman Academic Press	2002
2	Practical Enzymology Hans Bisswanger Wiley–VCH 2012.	2012
3	Fundamentals of Enzyme Kinetics Athel Cornish-Bowden Portland Press 4th edition, 2012.	2012
4	Fundamentals of Enzymology Nicholas Price and Lewis Steven Oxford University Press 3rd edition 2009.	2009

Examination Scheme:

Components	**Internal Assessment**			**External Evaluation**
	Attendance	**Class Test**	**Assignment/ Project/Seminar/Quiz**	
Weightage (%)	10	20	10	60

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SEMESTER II

Introductory Human Physiology

Course Code: CMBE-104c **Credit Units: 03**

Pre-requisite: Basic information of Animal kingdom system

Course Outcome:

i. Students will be able to *define* and explain the fundamental principles of heart.
ii. Students will be able to *understand* comparative Respiratory system, Renal Physiology, Reproductive system, Endocrine system and Gastrointestinal system.
iii. Students will *acquire* knowledge about the function of different types of organs in different animal kingdom.

Details of the Course:-

Unit I: Scope of Physiology and Anatomy:

Definition of various terms used in Anatomy. Structure of cell, function of its components with special reference to mitochondria and microsomes. Elementary tissues: Elementary tissues of the body, i.e. epithelial tissue, muscular tissue, connective tissue and nervous tissue. Skeltal System: Structure and function of Skelton .Classification of joints and their function. Joint disorders.

Unit II: Cardiovascular and Respiratory System:

Composition of blood, functions of blood elements. Blood group and coagulation of blood. Brief information regarding disorders of blood. Name and functions of lymph glands. Structure and functions of various parts of the heart .Arterial and venous system with special reference to the names and positions of main arteries and veins. Blood pressure and its recording. Brief information about cardiovascular disorders.

Respiratory system: Various parts of respiratory system and their functions, physiology of respiration.

Unit III: Urinary, Muscular and Central Nervous System:

Urinary System: Various parts of urinary system and their functions, structure and functions of kidney. Physiology of urine formation. Patho-physiology of renal diseases and edema. Muscular System: Structure of skeletal muscle, physiology of muscle contraction. Names, positions, attachments and functions of various skeletal muscles. physiology of neuromuscular junction.

Central Nervous System: Various parts of central nervous system, brain and its parts, functionsand reflex action. Anatomy and physiology of automatic nervous system.

Unit IV: Sensory Organs and Digestive System:

Sensory Organs: Elementary knowledge of structure and functions of the organs of taste, smell,ear, eye and skin. Physiology of pain.

Digestive System: names of various parts of digestive system and their functions. structure andfunctions of liver, physiology of digestion and absorption.

Unit V: Endocrine system and Reproductive System:

Endocrine System: Endocrine glands and Hormones. Location of glands, their hormones andfunctions. pituitary, thyroid. Adrenal and pancreas.

Reproductive system: Physiology and Anatomy of Reproductive system.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books/References	
1.	Guytonand Hall Textbook of Medical Physiology,11th edition(2006),J.E.Hall;WB Saunders and Company, ISBN-13: 978-1416045748.	2006
2.	Human Physiology, 9th edition (2006), Stuart I. Fox; Tata McGraw Hill, ISBN-13: 9780077350062.	2006
3.	Principles of Anatomy and Physiology, 13th edition (2011),Gerard J. Tortora and Bryan H. Derrickson; Wiley andSons, ISBN-13: 978-0470565100.	2011

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Chemicals and Health

Course Code: CMBE-104d **Credit Units**: 03

Pre-requisite: Basic knowledge of chemistry and biology.

Course Outcome:

After completing this course, students will be able to:

1. Understand the role of chemicals in human health and the environment.
2. Analyze the health effects of exposure to natural and synthetic chemicals.
3. Learn the mechanisms of chemical toxicity and detoxification pathways.
4. Explore the regulations and guidelines for chemical safety and management.
5. Evaluate the benefits and risks of chemicals in food, medicine, and industry.

Details of the Course:

S. No.	Contents	Contact Hours
1	**Introduction to Chemicals and Health**: Overview of natural and synthetic chemicals, their roles, and impact on human health.	6
2	**Toxicology of Chemicals**: Basic principles of toxicology, dose-response relationships, and types of chemical toxicity.	6
3	**Routes of Chemical Exposure**: Inhalation, ingestion, dermal absorption, and injection; acute vs. chronic exposure.	6
4	**Environmental Chemicals and Health**: Pesticides, heavy metals, endocrine disruptors, and their long-term health effects.	6
5	**Chemicals in Food and Water**: Additives, preservatives, contaminants, and their health implications.	6
6	**Pharmaceutical Chemicals**: Benefits and side effects of drugs, drug interactions, and resistance.	6
7	**Chemical Safety and Regulations**: National and international guidelines for chemical usage, disposal, and safety.	6
8	**Emerging Concerns**: Nanoparticles, microplastics, and new synthetic chemicals impacting health.	6

Suggested Books:

Text Books

1. **Casarett and Doull's Essentials of Toxicology** – Curtis Klaassen and John B. Watkins, McGraw-Hill, 3rd Edition, 2015.
2. **Principles of Toxicology** – Karen Stine and Thomas M. Brown, CRC Press, 3rd Edition, 2015.

References

1. **Introduction to Environmental Toxicology: Molecular Substructures to Ecological Landscapes** – Wayne G. Landis, CRC Press, 5th Edition, 2017.
2. **Handbook on Chemicals and Health** – Edited by Nicholas A. Ashford and Claudia Miller, Cambridge University Press, 2nd Edition, 2015.
3. **Silent Spring** – Rachel Carson, Houghton Mifflin, 50th Anniversary Edition, 2012.

Examination Scheme:

Components	Attendance	Assignments	Midterm Exam	Final Exam
Weightage (%)	10%	20%	30%	40%

This syllabus provides a broad understanding of the interplay between chemicals and human health,

BIOSTATISTICS

Course Code: CMBE-106 **Credit Unit: 03**

1. **Understand Statistical Concepts**: Grasp fundamental statistical concepts such as probability, data distribution, and hypothesis testing.
2. **Analyze Biological Data**: Apply statistical methods to analyze and interpret biological and experimental data.
3. **Use Statistical Tools**: Gain proficiency in using statistical software for data analysis and visualization.
4. **Conduct Statistical Inference**: Make inferences about populations based on sample data, including confidence intervals and significance tests.
5. **Interpret Statistical Results**: Develop the ability to interpret and communicate statistical findings in biological research and health studies.

Unit 1

Variable and attribute, Population vs. Sample, Census vs. Sample survey, Arrangement of data,Frequency distribution.

Unit 2

Line diagram, Bar Diagram, Pie chart and Histograms.

Unit 3

Measures of Central Tendency: Arithmetic Mean, Median and Mode.

Unit 4

Variance, Standard deviation, Standard error of mean, standard score.

Unit 5

Testing of hypothesis and goodness of fit: Null Hypothesis, Level of Significance, Probability,Normal Distribution, Error of inference, Student's t-test, Paired t-test, Fisher's

t-test, and Chi- square test.

References:

1. H. S. Bear: Understanding Calculus, John Wiley and Sons (Second Edition); 2003.

2. E. Batschelet: Introduction to Mathematics for Life Scientists,Springer Verlag, InternationalStudent Edition, Narosa Publishing House, New Delhi (1971, 1975).

3. A. Edmondson and D. Druce: Advanced Biology Statistics, Oxford University Press; 1996.

4. W. Danial: Biostatistics: A foundation for Analysis in Health Sciences, John Wiley and SonsInc; 2004.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Inheritance Biology Laboratory

Course Code: CMBE-152 **Credit Units**: 01

Pre-requisite: Basic knowledge of genetics and inheritance principles.

Course Outcome:

After completion of the course, students will be able to:

1. Perform experiments demonstrating Mendelian and non-Mendelian inheritance patterns.
2. Analyze genetic variations using laboratory techniques.
3. Use pedigree analysis to study inheritance in human populations.
4. Understand molecular basis and tools for studying heredity.
5. Apply knowledge of inheritance in real-world biological research.

Details of the Laboratory Course:

S. No.	Contents	Contact Hours
1	**Study of Mendelian Genetics**: Monohybrid and dihybrid crosses using model organisms (e.g., Drosophila or plants).	3
2	**Chi-Square Analysis**: Statistical validation of observed and expected genetic ratios.	2
3	**Pedigree Analysis**: Interpretation and construction of family trees for genetic disorders.	2
4	**DNA Isolation and Visualization**: Extraction of genomic DNA and analysis by gel electrophoresis.	3
5	**Mutation Studies**: Analysis of phenotypic effects of induced or spontaneous mutations.	3
6	**Sex Linkage and Inheritance Patterns**: Study of sex-linked traits using model organisms or simulated datasets.	2
7	**Polygenic Traits Analysis**: Study of quantitative inheritance (e.g., kernel color in maize).	2
8	**Epistasis and Gene Interactions**: Experimental demonstration of gene interactions.	3
9	**Human Chromosomal Analysis**: Study of karyotypes to identify chromosomal abnormalities.	2
10	**Use of Genetic Databases**: Introduction to bioinformatics tools for inheritance analysis.	2

Suggested Books:

Text Books

1. **Principles of Genetics** – D. Peter Snustad and Michael J. Simmons, Wiley, 7th Edition, 2020.
2. **Genetics: Analysis and Principles** – Robert J. Brooker, McGraw Hill, 6th Edition, 2020.

References

1. **Practical Manual of Genetics and Cytogenetics** – A.K. Sharma, New Age Publishers, 2017.
2. **Genetics: Laboratory Investigations** – Thomas L. Mertens and Robert D. Hammersmith, Pearson, 14th Edition, 2014.

Examination Scheme:

Components	Attendance	Practical Record	Viva-Voce	Final Practical Exam
Weightage (%)	10%	20%	20%	50%

Introduction and Scope of Microbiology Laboratory

Course Code: CMBE-154 **Credit Units**: 01

Pre-requisite: Basic knowledge of biology and laboratory safety practices.

Course Outcome:

After completion of the course, students will be able to:

1. Understand the fundamental principles of microbiology laboratory practices.
2. Perform basic microbiological techniques for isolation and identification of microorganisms.
3. Apply aseptic techniques to ensure contamination-free experiments.
4. Gain practical knowledge of microbial growth and their applications.
5. Explore the relevance and scope of microbiology in various fields.

Details of the Laboratory Course:

S. No.	Contents	Contact Hours
1	**Introduction to Laboratory Safety and Practices**: Understanding biosafety levels, proper disposal of microbial waste.	2
2	**Microscopy**: Use and handling of compound microscope; observation of microbial cells using prepared slides.	3
3	**Aseptic Techniques**: Methods for sterilization, disinfection, and handling microbial cultures safely.	3
4	**Preparation of Culture Media**: Preparation of nutrient agar and nutrient broth.	3
5	**Isolation of Microorganisms**: Streak plate, spread plate, and pour plate techniques.	3
6	**Staining Techniques**: Simple staining, Gram staining, and observation of results.	3
7	**Growth Curve Analysis**: Study of microbial growth under controlled conditions.	3
8	**Quantification of Microbes**: Serial dilution and estimation of colony-forming units (CFU).	3
9	**Applications of Microbiology**: Case studies in food, health, and industrial microbiology.	2

Suggested Books:

Text Books

1. **Experiments in Microbiology, Plant Pathology, and Biotechnology** – K.R. Aneja, New Age International
2. Publishers, 5th Edition, 2017.
3. **Microbiology: A Laboratory Manual** – Cappuccino J. and Sherman N., Pearson, 10th Edition, 2013.

References

1. **Laboratory Exercises in Microbiology** – Harley J.P. and Prescott L.M., McGraw-Hill, 9th Edition, 2013.
2. **Benson's Microbiological Applications** – Alfred E. Brown, McGraw Hill, 14th Edition, 2016.

Examination Scheme:

Components	Attendance	Practical Record	Viva-Voce	Final Practical Exam
Weightage (%)	10%	20%	20%	50%

Bridging Information Technology and Biotechnology

Course Code: GMBE-103 **Credit Units**: 03

Pre-requisite: Basic understanding of biotechnology and computer applications.

Course Outcome:

After completion of the course, students will be able to:

1. Understand the role of information technology in advancing biotechnology research and applications.
2. Learn bioinformatics tools for data analysis and interpretation.
3. Explore computational approaches for biological sequence alignment, modeling, and simulation.
4. Develop skills in managing biological databases and data visualization.
5. Apply IT solutions to solve real-world problems in biotechnology.

Details of the Course:

S. No.	Contents	Contact Hours
1	**Introduction to IT in Biotechnology**: Role of computational tools in genomics, proteomics, and systems biology.	4
2	**Biological Databases**: Understanding primary and secondary databases like GenBank, PDB, and Swiss-Prot.	4
3	**Sequence Analysis**: Concepts of sequence alignment (pairwise and multiple), tools like BLAST and ClustalW.	4
4	**Data Visualization Tools**: Techniques to represent complex biological data graphically using software like R, Python, or Cytoscape.	4
5	**Molecular Modeling**: Basics of protein structure prediction, molecular docking, and simulations.	4
6	**Bioinformatics Tools**: Introduction to software tools like MEGA, T-Coffee, and Primer3.	4
7	**Application in Omics**: Genomics, transcriptomics, proteomics, and metabolomics integration using computational tools.	4
8	**Case Studies**: Applications of IT in drug discovery, agriculture, and personalized medicine.	2

Suggested Books:

Text Books

1. **Bioinformatics: Sequence and Genome Analysis** – David W. Mount, Cold Spring Harbor Laboratory Press, 2nd Edition, 2004.
2. **Introduction to Bioinformatics** – Arthur M. Lesk, Oxford University Press, 5th Edition, 2019.

References

1. **Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids** – R. Durbin, S.R. Eddy, A. Krogh, and G. Mitchison, Cambridge University Press, 1998.
2. **Bioinformatics: Principles and Applications** – Zhumur Ghosh and Bibekanand Mallick, Oxford University Press, 2011.

3. **Essential Bioinformatics** – Jin Xiong, Cambridge University Press, 2006.

Examination Scheme:

Components	Attendance	Assignments	Midterm Exam	Final Exam
Weightage (%)	10%	20%	30%	40%

This syllabus provides an interdisciplinary foundation in bioinformatics and computational biology, preparing students to harness IT solutions for addressing challenges in modern biotechnology.

Breeding Information Technology Lab

Course Code: GMBE-153 **Credit Units**: **01**

Pre-requisite: Basic knowledge of Genetics and Biotechnology

Course Outcome:
After completion of the course, the students will be able to:

1. Understand good laboratory practices in the context of breeding data management.
2. Gain hands-on experience with bioinformatics tools and software used in breeding programs.
3. Analyze genetic data and interpret results to support plant and animal breeding decisions.
4. Learn to apply molecular markers and genomic data for breeding purposes.
5. Utilize statistical and computational methods for breeding program design and evaluation.

Details of the Laboratory Course:
Note: A college must offer 70% of the below listed experiments. The remaining 30% experiments may be modified by the college according to facilities available.

Details of the Laboratory Course:
Note: A college must offer 70% of the below listed experiments. The remaining 30% experiments may be modified by the college according to facilities available.

S. No.	Contents	Contact Hours
1	Introduction to Bioinformatics Tools for Breeding: Software like TASSEL, QTL Cartographer, etc.	2
2	Data Collection and Analysis: Using breeding data for statistical analysis and interpretation.	3
3	Molecular Marker Analysis: Application of SSR, SNP, and RAPD markers in breeding.	3
4	Marker-Assisted Selection: Identifying and selecting genetic markers for breeding programs.	2
5	Genomic Selection: Introduction to genomic selection and its application in breeding.	3
6	Design and Evaluation of Breeding Programs: Statistical methods for designing breeding strategies.	3
7	QTL Mapping: Identifying Quantitative Trait Loci using genetic data.	3
8	Gene Editing Tools in Breeding: Practical applications of CRISPR/Cas9 in plant and animal breeding.	3

S. No.	Contents	Contact Hours
9	Simulation of Breeding Programs: Using simulation software to predict outcomes of breeding efforts.	3
10	Ethical Considerations in Breeding and Biotechnology: Discussion on ethical issues in breeding research.	2

Suggested Books:

Text Books

1. **Plant Breeding and Biotechnology** – R.K. Jain, 2nd Edition, Oxford & IBH Publishing, 2010.
2. **Principles of Plant Genetics and Breeding** – George Acquaah, Wiley-Blackwell, 2012.
3. **Introduction to Statistical Methods in Genetics** – K.P. Singh, New Age International, 2007.

References

1. **Genomics and Breeding for Climate-Resilient Crops** – Parvaiz Ahmad, Springer, 2016.
2. **Biotechnology in Agriculture and Forestry** – Vol. 58, Springer, 2006.
3. **Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins** – Baxevanis, A.D. & Ouellette, B.F., Wiley-Blackwell, 2010.
4. **Principles of Animal Breeding and Genetics** – Allendorf, F.W., University of California Press, 2016.

BACTERIOLOGY

Course Code: GMBE-104 **Credit Unit: 03**

1. **Understand Bacterial Classification**: Grasp the classification, structure, and characteristics of different types of bacteria.
2. **Study Bacterial Growth and Physiology**: Learn about bacterial metabolism, growth conditions, and environmental influences.
3. **Identify Bacterial Infections**: Recognize pathogenic bacteria and their role in human, animal, and plant diseases.
4. **Apply Laboratory Techniques**: Develop skills in culturing, isolating, and identifying bacteria in the laboratory.
5. **Understand Antimicrobial Resistance**: Explore mechanisms of bacterial resistance to antibiotics and methods for controlling bacterial infections.

Unit 1: Cell organization

Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella, fimbriae and pili. Cell wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls,Archaebacterial cell wall, Gram and acid-fast staining mechanisms, lipopolysaccharide (LPS),Sphaeroplasts, protoplasts, and L-forms. Effect of antibiotics and enzymes on the cell wall. CellMembrane: Structure, function and chemical composition of bacterial and archaeal cell.Membranes.Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome andplasmids. Endospore: Structure, formation, stages of sporulation.

Unit 2: Bacteriological techniques

Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria, and accessing non- culturable bacteria, Microscopy.

Unit 3: Growth and nutrition

Nutritional requirements in bacteria and nutritional categories; Culture media: components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, indicator, enriched and enrichment media Physical methods of microbial control: heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation

Chemicalmethods of microbial control: disinfectants, types and mode of action.

Unit 4: Reproduction in Bacteria

Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate.

Unit 5: Bacterial Systematics

Aim and principles of classification, systematics and taxonomy, concept of species, taxa, strain; Conventional, molecular and recent approaches to polyphasic bacterial taxonomy, evolutionary Chronometers, rRNA oligonucleotide sequencing, signature sequences, and protein sequences.

References:

2. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers.

3. Black JG. (2008). Microbiology: Principles and Explorations. 7th edition. Prentice Hall.

4. Madigan MT, and Martinko JM. (2014). Brock Biology of Micro-organisms. 14th edition.

5. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Bacteriology Lab

Course Code: BMB-154 **Credit Units: 01**

Pre-requisite: Basic information of Bacteriology and Virology

Course Outcome:

After completion of the course the students will be able

1. To learn good laboratory practices.
2. To learn the principle and working of microbiology instruments and equipment in accordance with current laboratory safety protocol.
3. To utilize the microbial flora for various applications.
4. To learn microbiology laboratory techniques.

Details of the Laboratory Course:-

Note: A college must offer 70% of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available.

S. No.	Contents	Contact Hours
1.	Preparation of different media: Complex media-Nutrient agar, McConkey agar, EMB agar.	2
2.	Simple staining, Negative staining, Gram‟s staining, Capsule staining, Endospore staining	5
3.	Isolation of pure cultures of bacteria by streaking method.	2
4.	Preservation of bacterial cultures by various techniques.	2
5.	Estimation of CFU count by spread plate method/pour plate method.	2
6.	Motility by hanging drop method.	2
7.	Isolation of coliphages from sewage water sample.	2
8.	One step growth curve for determination of virus titre.	2
9.	Immunological assays for virus detection.	2
10.	Cultivation and morphological identification of animal cell lines.	2

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Experiments in Microbiology, Plant Pathology and Biotechnology. 4th Edition. Aneja, K.R. (2003). New Age International Publishers, New Delhi. 5th ed.	2017
	References	
1.	Microbiology: A Laboratory Manual. Benjamin Cummings. 10th edition. Cappuccino J. and Sherman N. (2013)	2013
2.	Laboratory exercises in Microbiology by Harley Prescott. 7th edition, McGraw-Hill Higher Education.	2008
3.	Benson‟s Microbiology Application, laboratory Manual Concise version (2016) McGraw Hill Publisher- 14th ed	2016
4.	Applied Microbiology laboratory Manual (2016) Kendall Hunt Publisher- 5th Edition, Frances Duncan	2016

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

PROFESSIONAL COMMUNICATION

Course Code: AECC-102 **Credit Unit: 02**

1. **Enhance Communication Skills**: Develop effective verbal, non-verbal, and written communication skills for professional settings.
2. **Master Business Writing**: Learn to write clear and concise emails, reports, memos, and proposals.
3. **Improve Presentation Skills**: Gain proficiency in preparing and delivering professional presentations.
4. **Understand Communication Etiquette**: Understand and apply proper professional behavior and etiquette in diverse communication contexts.
5. **Collaborate Effectively**: Strengthen interpersonal skills for successful teamwork, negotiation, and conflict resolution in professional environments.

Unit 1: Fundamentals of Communication

Technical Communication: features: Distinction between General and Technical communication; Language as a tool of communication; Levels of communication: Interpersonal, Organizational, Mass communications; the flow of Communication: Downward, Upward, Lateral of Horizontal Importance of technical communication; Barriers to Communication**.**

Unit 2: Constituents of Technical Written Communication

Words and Phrases: Word formation. Synonyms and Antonyms; Homophones; Selectvocabulary of about 500-1000 New words; Correct Usage: all Parts of Speech; Modals; Concord; Articles; Infinitives; Requisites of Sentence Construction: Paragraph Development: Techniques and Methods- Inductive, Deductive, Spatial, Linear, Chronological etc; The Art of Condensation-various steps.

Unit 3: Business Communication

Principles, Sales & Credit letters; Claim and Adjustment Letters; Job application and Resumes. Reports: Types; Significance; Structure, Style & Writing of Reports. Technical Proposal; Parts; Types; Writing of Proposal; Significance. Negotiation & Business Presentation skills.

Unit 4: Presentation Strategies and Listening Skills.

Defining Purpose; Audience & Local; Organizing Contents; Preparing Outline; Audio-visual Aids;

Nuances of Delivery; Body Language; Dimensions of Speech: Syllable; Accent; Pitch; Rhythm; Intonation; Paralinguistic features of voice; Listening Skills: Active Listening, Passive Listening. Methods for improving Listening Skills.

Unit 5: Value-Based Text Readings

Following essays form the suggested textbook with emphasis on Mechanics of writing.

(i) Humanistic and Scientific Approaches to Human Activity by Moody E. Prior

(ii) The Language of Literature and Science by A. Huxley

(iii) Man and Nature by J. Bronowski

(iv) The Social Function of Literature by Ian Watt

(v) Science and Survival by Barry Commoner

(vi) The Mother of the Sciences by A. J. Bahm.

References:

1. Improve Your Writing ed. V.N.Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.

2. Technical Communication: A Practical Approach: Madhu Rani and Seema Verma- Acme Learning, New Delhi-2011.

3. Technical Communication- Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press,2007, New Delhi.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

VIROLOGY

Course Code: CMBE-201 Credit Unit: 04

1. **Understand Viral Classification**: Learn the classification, structure, and types of viruses.
2. **Study Viral Replication**: Grasp the processes of viral replication and life cycles in host cells.
3. **Identify Viral Diseases**: Recognize the role of viruses in causing diseases in humans, animals, and plants.
4. **Explore Antiviral Mechanisms**: Understand the mechanisms of antiviral drugs and immune responses against viral infections.
5. **Apply Laboratory Techniques**: Develop skills in isolating, culturing, and identifying viruses using laboratory methods.

Unit 1: Nature and Properties of Viruses

Discovery of viruses, nature and definition of viruses, general properties, concept of viroids, virusoids, satellite viruses and Prions. Theories of viral origin Structure of Viruses: Capsid symmetry, enveloped and non-enveloped viruses Isolation, purification and cultivation of viruses, Classification and nomenclature of different groups of viruses.

Unit 2: Bacteriophages

Diversity, classification, one-step multiplication curve, lytic and lysogenic phages (lambda phage) concept of early and late proteins, regulation of transcription in lambda phage.

Unit 3: Viral Transmission, Salient features of viral nucleic acids and Replication

Viral Transmission, Salient features of viral nucleic acids and Replication, Persistent, non-persistent, vertical and horizontal, Unusual bases (TMV,T4 phage), overlapping genes (ϕX174, Hepatitis B virus), alternate splicing (HIV), terminal redundancy (T4 phage), terminal cohesive ends (lambda phage), partial double stranded genomes (Hepatitis B), long terminal repeats(retrovirus), segmented (Influenza virus), and non-segmented genomes (picornavirus), capping and tailing (TMV), Interaction of viruses with cellular receptors and entry of viruses. Replication strategies of viruses as per Baltimore classification (phi X 174, Retroviridae, Vaccinia, Picorna), Assembly, maturation and release of virions.

Unit 4: Viruses and Cancer

Introduction to oncogenic viruses, Types of oncogenic DNA and RNA viruses: Concepts of oncogenes and proto-oncogenes.

Unit 5: Prevention & control of viral disease

Prevention & control of viral diseases, Antiviral compounds and their mode of action, Interferonand their mode of action, General principles of viral vaccination.

References:

1. Dimmock, NJ, Easton, AL, Leppard, KN (2007). Introduction to Modern Virology. 6th edition, Blackwell Publishing Ltd.
2. Carter J and Saunders V (2007). Virology: Principles and Applications. John Wiley and Sons.
3. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM (2004). Principles of Virology, Molecular biology, Pathogenesis and Control·2nd edition. ASM press Washington DC.
4. Levy JA, Conrat HF, Owens RA. (2000). Virology. 3rd edition. Prentice Hall publication, New Jersery.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

INHERITANCE AND EVOLUTIONARY MICROBIOLOGY

Course Code:CMBE-201a Credit Units: 04

Pre-requisite: Basic knowledge of microbial cells.

Course Outcome:

After completion of the course the students should be able

6. To understand the structural similarities and differences among microorganisms and the unique structure/function relationships of prokaryotic cells.
7. To understand the science of microbiology, its development and importance in human welfare.
8. To apply laboratory practices used in the study of microorganisms.
9. To recognize and compare structure and function of microbes and factors affecting microbial growth.
10. To explain and apply aseptic microbiological techniques in the laboratory and check sources of microbial contamination and their control.

Details of the

Course:-Unit – I:

History and scope of microbiology, Development of Microbiology, various branches of microbiology and applications of microbiology. Classification of microorganisms, Microbial Taxonomy- criteria used including molecular approaches. Microbial phylogeny and Bergey‟s manual.

Unit – II:

Introduction to bacteria, Morphology (size, shape and arrangement of cells), Ultra structure of bacteria, cell wall and cell membrane: structure, composition and function. Eubacteria, archaebacteria, Gram positive and Gram negative bacteria, acid-fast and non-acid-fast bacteria.

Unit – III:

Principles of microbial nutrition, Basic nutritional requirement of bacteria for carbon, nitrogen, sulphur and growth factors. Nutritional categories of microorganisms. Cultivation and Maintenance of Microorganisms, Culture media: principle and types, Methods of isolation, purification and preservation. Pure culture techniques.

Unit – IV:

Microbial Growth, Growth curve (normal and biphasic) and generation time, aerobic and anaerobic culture, shaker and still culture, asynchronous and synchronous growth, growth curve generation time, growth kinetics, batch and continuous cultures. Measurement of growth, factors affecting growth. Control of Bacteria, Different modes of sterilization. Physical and chemical agents-examples and mode of action.

Unit – V:

Introduction to Virology, Morphology and ultra-structure, types on the basis of morphology, isolation and cultivation of viruses. Bacterial Viruses (Bacteriophage), Structure, life cycle and application, antiviral agents.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Pelczar Jr., M.J., Chan, E.C.S. and Krieg, Noel R., Microbiology, McGraw Hill (2003) 5th ed.	2003
2.	Stanier, R.Y., Ingraham, J.L. and Wheelis, M.L., General Microbiology, MacMillan (2007) 5thed.	2007
	References	
1.	Microbiology 10th Edition. Prescott, L.M.; Harley, J.P. and Klein, D.A. (2003) McGraw Hill, USA.	2016
2.	Foundations in Microbiology 10th edition, Kathleen Park Talaro and Barry Chess.	2017
3.	Microbiology- An Introduction. Tortora, G.J., Funke, B.R., and Case, C.L., , Pearson Education (2015)12th ed.	2015
4.	Principles of Virology, Vol I and Vol II, 4th Edition, Jane Flint, Vincent Racaniello, Glenn Rall, Anna Marie Skalka, (2015), American Society of Microbiology	2015
5.	Comparative Plant Virology, Roger Hull, 2nd ed. Elsevier, Academic Press. (2009)	2009
6.	Plant Viruses, Diseases and Their Management, Kajal Kumar Biswas, IK. International Publishing House Pvt Ltd, 2016.	2016
7.	Animal cell culture and Virology, S. Nandi, New India Publishing agency, 1st ed. (2009)	2009
8.	Textbook of Medical Virology, Mishra B, CBS Publishing, 1st edition, 2018	2018

SEMESTER III

MICROBIOLOGICAL BASIS OF INHERITANCE

Course Code: CMBE-201b Credit Units: 04

Pre-requisite: Basic information of Cell Biology

Course Outcome:

- Students will be able to *define* and explain the fundamental laws of genetics
- Students will be able to *understand* the main modes of Mendelian and non-Mendelian inheritance
- Students will *acquire* knowledge about the chromosome structure, sex linked chromosomes and inherited disorders
- Students will be able to *understand* how alterations in chromosome number or structure may cause various types of diseases
- To describe how mutation is caused in DNA and how DNA damage can be repaired
- Students will be able to *value* role of Genetics within a population and in causing evolution
- Students will be able to *apply* their knowledge to healthy and disease contexts.

Details of the Course:-

Unit – I: Principles of heredity and variation:

Mendel and his experiments, monohybrid crosses, incomplete dominance and codominance, dihybrid crosses, multiple alleles (blood group systems), epistasis, lethal genes. Probability in prediction and analysis of genetic data, pedigree analysis.
Genes and chromosomes: General features of chromosomes, cell division. Chromosomal theory of inheritance, variation in chromosome number and structure, gene concept, gene structure.

Unit – II: Molecular organization of chromosomes:

Genome size and evolutionary complexity, supercoiling of DNA, structure of bacterial chromosome, structure of eukaryotic chromosome, satellite DNA, barr bodies and types of chromosomes- salivary gland chromosomes, lamp brush chromosomes, nucleosome model, sex determination. Sex-linked, sex-limited and sex- influenced inheritance, Transposons.

Unit – III: Gene linkage and chromosome mapping:

Linkage and recombination of genes in a chromosome, crossing over and genetic mapping, gene mapping by 2-point and three point test crosses

Unit – IV: Gene mutation and DNA repair:

Classification of mutations, detection of mutations, spontaneous mutations, application of mutagen, chemical mutagen, radiation induced mutations, Forward mutation, Reverse mutation, nutritional mutation.

Unit – V: Population Genetics and Evolution:

Hardy-Weinberg principle, allele frequencies and genotype frequencies, random mating. Genetics and evolution (Mutation and migration, natural selection, random genetics drift). Concept of population size, inbreeding.
Quantitative Genetics: Quantitative heritability inheritance, causes of variation.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Genetics: Analysis of Genes and Genomes.5 th edition. Hartl, D. L. and Jones, E.W., Jones and Bartlet Publishers, Boston.	2001
2.	Genetics. 5th edition. Russell, P.J., Addison Wesley Longman, Inc., California.	1998
3	Principles of Genetics. E J Gardner et. al., (8th Ed.,)	2011
	Reference Books	
1.	Basic Genetics. Miglani, G.S., Narosa Publishing House, New Delhi	2000
2.	Genetics: Analysis and Principles. Brooker, R.J. McGraw Hill, New York.	1999

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

FOOD ENGEINEERING

Course Code: CMBE-201c Credit Units: 04

Pre-requisite: Basic knowledge of food technology

Course Outcome:

- Students will be able to know about the basics of food technology.
- Students would know about the microorganisms associated with food.
- Students will understand various principles of food technology.
- Students will also have knowledge of food preservation methods.

UNIT-1

History of microorganisms in food, historical developments. Role and significance of microorganisms in foods. Intrinsic and Extrinsic. Parameters of foods that affect microbial growth. Basic principles, unit operations, and equipment involved in the commercially important food processing methods and unit operations.

UNIT-2

Microorganisms in fresh meats and poultry, processed meats, seafood‟s, fermented and fermented dairy products and miscellaneous food products. Starter cultures, cheeses, beer, wine and distilled spirits, SCP, medical foods, probiotics and health benefits of fermented milk and foods products.

Brewing, malting, mashing, hops, primary & secondary fermentation: Biotechnological improvements: catabolic repression, High gravity brewing, B-glucan problem, getting rid of diacetyl. Beer, wine and distilled spirits.

UNIT-3

Nutritional boosts and flavor enhancers: Emerging processing and preservation technologies for milk and dairy products.Microbiological examination of surfaces, air sampling, metabolically injured organisms. Enumeration and detection of food-borne organisms. Bioassay and related methods.

UNIT-4

Food preservation methods.Radappertization, radicidation, and radurization of foods. Legal status of food irradiation, effect of irradiation on foodconstituents.

UNIT-5

Storage stability food preservation with low temperature, hightemperature and drying.

Indicator and food-borne pathogens. Rheology of food production.

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	N.Jogdan Industrial Biotechnology, Himalaya Publishing House	2006
2.	Perlman D. Annual Reports of Fermentation Processes.	1997-1979
3.	Prescott SC & Dunn CG.. Industrial Microbiology. McGraw Hill.	1959
4.	Bains W. Biotechnology from A to Z. Oxford Univ. Press.	1993
	Reference Books	
1.	Introduction to Food Biotechnology. Author; Perry Johnson.	2002

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

ENVIRONMENTAL MICROBIOLOGY

Course Code: CMBE-203 **Credit Unit: 04**

Unit 1: Microorganisms and their Habitats

Structure and function of ecosystems.Terrestrial Environment: Soil profile and soil microflora Aquatic Environment: Microflora of fresh water and marine habitats. Atmosphere: Aeromicroflora and dispersal of microbes. Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels. Microbial succession in decomposition of plant organic matter.

Unit 2: Microbial Interactions

Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation. Microbe-Plant interaction: Symbiotic and non symbiotic interactions Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria.

Unit 3: Biogeochemical Cycling

Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin. Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction. Phosphorus cycle: Phosphate immobilization and solubilisation. Sulphur cycle: Microbes involved in sulphur cycle.

Unit 4: Waste Management

Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill). Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment.

Unit 5: Water Potability

Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests.

References:

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.

2. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14th edition. Pearson/ Benjamin Cummings.

3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.

4. Okafor, N (2011). Environmental Microbiology of Aquatic & Waste systems. 1st edition, Springer, New York.

5. Singh A, Kuhad, RC & Ward OP (2009). Advances in Applied Bioremediation. Volume 17, Springer-Verlag, Berlin Hedeilberg.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III

GLOBAL ECOLOGY

Course Code: CMBE-203a **Credit Units: 04**

Pre-requisite: Basic knowledge of Environmental science

Course Outcome:

- Students will be able to understand the importance of environment.
- Be able to explain the development of ecosystem, concept of biodiversity and energyand nutrient pathway.
- Students will be able to understand ecological sustainability, ecological efficiencies,homeostasis and limiting factors.
- Students will gain new insights about different remediation procedures.
- Students will be able to use critical thinking skills related to hazardous wastes, pesticides, metals, radiations etc. and its impact on health.
- Students will be able to apply the knowledge of scientific methods to solve environmental problems.

Details of the course:-

UNIT-I:

Our Environment: Geological consideration of Atmosphere, Hydrosphere, Lithosphere. Basic concepts of Ecology: Development of Ecosystem, major divisions of ecology, Auto ecology of species, population structure and dynamics.

UNIT II:

Structure and function of ecosystem. Strata of an ecosystem. Energy transfer in an Ecosystem. Food chain, food web, Energy budget, Production & decomposition in a system. Ecological efficiencies.

UNIT III:

Trophic structure & ecological pyramids, Bio-geochemical cycles (N, C, and P cycles). Cybernetics & Homeostasis, Environmental monitoring and impact assessment.

UNIT-IV:

Radiation and chemical toxicology: Radiation ecology, chemical toxicants, ecotoxicology. Detection of Environmental pollutant. Indicators & detection systems.

UNIT-V:

Environmental biotechnologies, Biotechnologies in protection and preservation of environment- case studies. Bioremediation, Waste disposal.

Suggested Books:

1. P.D. Sharma. (2011). Ecology and Environment. 11th edition. Rastogi Publication.
2. Chapman, J.L., Reiss, M.J. 1999. Ecology: Principles and applications (2nd edition) Cambridge, University Press.
3. Divan Rosencraz, Environmental laws and policies in India, Oxford Publication.
4. Ghosh, S.K., Singh, R. 2003. Social forestry and forest management. Global Vision Publishing House.
5. Joseph, B., Environmental studies, Tata Mc Graw Hill.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

MEDICAL MICROBIOLOGY

Course Code: CMBE-205 Credit Unit: 04

Course Outcome

1. **Microbial Classification**: Understand the classification, structure, and physiology of medically important microorganisms.
2. **Pathogenesis**: Explain mechanisms of microbial infections, host-pathogen interactions, and immune responses.
3. **Diagnosis**: Demonstrate knowledge of laboratory techniques for identifying pathogens and diagnosing infectious diseases.
4. **Antimicrobial Strategies**: Analyze the principles of antimicrobial agents, resistance mechanisms, and their clinical applications.
5. **Public Health Impact**: Apply knowledge of epidemiology and infection control to prevent and manage infectious diseases.

Unit 1: Normal microflora of the human body and host pathogen interaction

Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract. Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections.

Unit 2 Sample collection, transport and diagnosis

Collection, transport and culturing of clinical samples, principles of different diagnostic tests (ELISA, Immunofluorescence, Agglutination based tests, Complement fixation, PCR, DNA probes).

Unit 3: Bacterial diseases

List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control. Respiratory Diseases: Streptococcus pyogenes, Haemophilus influenzae, Mycobacterium tuberculosis. Gastrointestinal Diseases: Escherichia coli, Salmonella typhi, Vibrio cholerae, Helicobacter pylori. Others: Staphylococcus aureus, Bacillus anthracis, Clostridium tetani.

Unit 4: Viral diseases

List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control. Polio, Herpes, Hepatitis, Rabies, Dengue, AIDS, Influenza with brief description of swine flu, Ebola, Chikungunya,

Japanese Encephalitis.

Unit 5: Protozoan diseases

List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control. Malaria, Kala-azar.

Unit 6: Fungal disease

Brief description of each of the following types of mycoses and one representative disease to be studied with respect to transmission, symptoms and prevention.Cutaneous mycoses: Tinea pedis (Athlete's foot), Systemic mycoses: Histoplasmosis, Opportunistic mycoses: Candidiasis.

References:

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication.
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication.
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier.
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education.
5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SEMESTER III99

PUBLIC HEALTH & PANDEMICS

Course Code: CMBE-205a **Credit Units: 04**

Pre-requisite: Basic information of Animal kingdom system

Course Outcome:

- Students will be able to *define* and explain the fundamental principles of digestion.
- Students will be able to *understand* comparative circulation system, nervous system, endocrine system and excretory system.
- Students will *acquire* knowledge about the function of different types of organs in different animal kingdom.

Details of the Course:-

UNIT – I: Digestion and Respiration:

Comparative aspects of Digestion in invertebrate and vertebrate (general account), Human: Mechanism of digestion and absorption of carbohydrates, Proteins, Lipids and Nucleic acids. Composition of bile, saliva, pancreatic, gastric and intestinal juice.

Comparative aspects of Respiration in invertebrate and vertebrate (general account), Human: Exchange of gases, Transport of O_2 and CO_2, Oxygen dissociation curve, Chloride shift.

UNIT – II: Circulation:

Comparative aspects of Circulation in invertebrate and vertebrate (general account), Human: Composition of blood, Plasma proteins & their role, blood cells, Haematopoiesis, Mechanism of coagulation of blood.

Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heartbeat.

UNIT – III: Muscle physiology and osmoregulation:

Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction.

Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation.

UNIT – IV: Nervous System:

Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, salutatory conduction, Neurotransmitters.

UNIT – V: Endocrine System:

Mechanism of action of hormones (insulin and steroids). Different endocrine glands – Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.	2006
	Reference Books	
1.	Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons,Inc.	2006

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Virology Lab

Course Code: CMBE-251 **Credit Units**: **01**

Pre-requisite: Basic knowledge of Microbiology and Virology

Course Outcome:
After completion of the course, the students will be able to:

1. Learn and apply good laboratory practices in virology.
2. Understand the principles and working of virology laboratory instruments and equipment, adhering
3. to current safety protocols.
4. Isolate and identify viruses using different virological techniques.
5. Gain hands-on experience with virus cultivation and characterization methods.
6. Understand the use of immunological assays for virus detection and diagnosis.

Details of the Laboratory Course:
Note: A college must offer 70% of the below-listed experiments. The remaining 30% experiments may be modified by the college according to available facilities.

S. No.	Contents	Contact Hours
1	**Preparation of media for virus culture**: Preparing media for growing animal and plant viruses.	2
2	**Virus Cultivation**: Isolation and cultivation of viruses using cell cultures and eggs.	3
3	**Virus Titration**: Determination of virus titer using plaque assay method.	3
4	**Simple Staining and Negative Staining**: Visualizing viruses using electron microscopy and light microscopy.	3
5	**Identification of viral morphology**: Using microscopy techniques to observe viral structures.	2
6	**Immunological Assays for Virus Detection**: Performing ELISA and immunofluorescence for virus identification.	3
7	**Plaque Assay**: Quantification of infectious virus particles using the plaque method.	2
8	**One-step Growth Curve**: Plotting a growth curve of a virus in culture to analyze replication kinetics.	2
9	**Viral Inactivation Test**: Testing the effectiveness of disinfectants or treatments on virus inactivation.	2
10	**PCR-based Viral Detection**: Amplification of viral genomes using Polymerase Chain Reaction (PCR).	3

Suggested Books:

Text Books

1. **Virology: Principles and Applications** – John S. Oxford, Wiley-Blackwell, 2010.
2. **Medical Virology** – M.K. Bhan, New Age International, 2016.
3. **Fundamentals of Molecular Virology** – Nicholas H. Acheson, Wiley-Blackwell, 2011.

References

1. **Virology: A Laboratory Manual** – Gary W. Carter and John D. Lister, Elsevier, 2017.
2. **Laboratory Manual of General Virology** – Edward K. Wagner, 4th Edition, Wiley-Blackwell, 2010.
3. **Viral Pathogenesis: Basic Science and Clinical Applications** – Richard K. Schenkel, McGraw-Hill, 2013.
4. **Principles of Virology: Molecular Biology, Pathogenesis, and Control** – Shapiro, R.E., 4th Edition, American Society of Microbiology, 2012.

Examination Scheme:

Components	Internal Assessment	External Evaluation
Attendance	10%	
Viva-Voce	20%	
Practical Record	10%	
Weightage		60%

This syllabus outlines the core practical experiments and learning outcomes for a Virology Laboratory course, focusing on virus isolation, cultivation, detection, and characterization, along with related molecular techniques.

Environmental Microbiology Lab

Course Code: **CMBE-253** **Credit Units: 01**

Pre-requisite: Basic knowledge of Microbiology and Environmental Science

Course Outcome:

After completion of the course, the students will be able to:

1. Learn good laboratory practices in the context of environmental microbiology.
2. Understand and operate various microbiological instruments used in environmental monitoring.
3. Identify and analyze microbial populations in different environmental samples.
4. Gain hands-on experience with techniques for assessing environmental pollution and its effects on microbial communities.
5. Understand the role of microorganisms in environmental processes like bioremediation, nutrient cycling, and waste management.

Details of the Laboratory Course:
Note: A college must offer 70% of the below-listed experiments. The remaining 30% experiments may be modified by the college according to available facilities.

S. No.	Contents	Contact Hours
1	**Preparation of different media for environmental samples**: Nutrient agar, Sabouraud's agar, MacConkey agar.	2
2	**Isolation of bacteria from soil, water, and air samples**: Using serial dilution and plating methods.	3
3	**Determination of Total Viable Count (TVC)**: Estimation of bacterial population in environmental samples.	3
4	**Detection of Waterborne Pathogens**: Isolation and identification of coliforms from water samples.	2
5	**Biochemical Oxygen Demand (BOD) Test**: Determining BOD to assess organic pollution in water.	2
6	**Fecal Coliform Test**: Perform a presumptive, confirmed, and completed test for fecal coliforms in water.	2
7	**Microbial Indicators of Pollution**: Detection of microbial indicators such as E. coli, Enterococcus in water.	2
8	**Bioremediation Techniques**: Isolating and identifying microorganisms capable of degrading pollutants.	3
9	**Nutrient Cycling**: Estimation of nitrogen-fixing bacteria in soil samples.	2
10	**Air Quality Monitoring**: Isolation of airborne bacteria using sedimentation or filtration methods.	2

Suggested Books:

Text Books

1. **Environmental Microbiology** – Maier, R.M., Pepper, I.L., and Gerba, C.P., 4th Edition, Academic Press, 2015.
2. **Microbiology of the Environment** – B.R. Binks and J.D. Salter, Wiley-Blackwell, 2004.
3. **Environmental Microbiology: From Soil to Wastewater** – S. S. M. R. Husain, CRC Press, 2009.

References

1. **Environmental Microbiology Laboratory Manual** – Jay A. Repp, Pearson Education, 2016.
2. **Manual of Environmental Microbiology** – C. J. Hurst et al., 3rd Edition, ASM Press, 2007.
3. **Applied Environmental Microbiology** – Charles M. A. P. Eppley, Elsevier, 2008.
4. **Microbial Ecology in Growing Systems** – G. P. Stent, Springer, 2012.

Examination Scheme:

Components	Internal Assessment	External Evaluation
Attendance	10%	
Viva-Voce	20%	
Practical Record	10%	
Weightage		60%

This syllabus outlines core practical experiments and learning outcomes for an **Environmental Microbiology** Laboratory course, focusing on the identification, isolation, and characterization of microorganisms from various environmental samples, as well as assessing environmental pollution and remediation processes.

Medical Microbiology Lab

Course Code: CMBE-255 **Credit Units: 02**

Pre-requisite: Basic information of Medical Microbiology Lab

Course Outcome:

Upon successful completion of this course the student will be able to:

6.This course provides learning opportunities in the basic principles of medical microbiology and infectious disease.
7.It covers mechanisms of infectious disease transmission, principles of aseptic practice, and the role of the human body‟s normal microflora.
8.The course provides the conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause disease in the human body.
9.It also provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.
10. To understand the importance of pathogenic bacteria in human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue.
11. Helps to understand the use of lab animals in medical field.
12. Recall the relationship of this infection to symptoms, relapse and the accompanying pathology.
13. Explain the methods of microorganisms control, e.g. chemotherapy & vaccines. Solve problems in the context of this understanding.

Details of the Course:-

Sl. No.	Contents	Contact Hours
1	Study of composition and use of important differential media for identification of bacteria: EMBAgar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS	3
2	Study of bacterial flora of skin by swab method	3
3	Perform antibacterial sensitivity by Kirby-Bauer method	3
4	Identification of human blood groups.	3
5	To perform Total Leukocyte Count of the given blood sample.	3
6	To perform Differential Leukocyte Count of the given blood sample.	3

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Ananthanarayan R. and Paniker C.K.J. Textbook of Microbiology. 8th edition, University Press Publication	2009
2.	Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. Jawetz, Melnick and Adelberg‟s Medical Microbiology. 26th edition. McGraw Hill Publication	2013
3.	Goering R., Dockrell H., Zuckerman M. and Wakelin D. Mims‟ Medical Microbiology. 4thedition. Elsevier	2007
4.	Willey JM, Sherwood LM, and Woolverton CJ. Prescott, Harley and Klein‟s Microbiology.9th edition. McGraw Hill Higher Education	2013

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

MICROBIAL METABOLISM

Course Code: GMBE-203 **Credit Unit: 04**

Course Outcome

1. **Metabolic Diversity**: Understand the metabolic processes unique to microorganisms, including autotrophy, heterotrophy, and chemolithotrophy.
2. **Catabolic Pathways**: Explain energy production through microbial catabolic pathways like glycolysis, fermentation, and respiration.
3. **Anabolic Pathways**: Analyze microbial biosynthesis of macromolecules such as nucleotides, amino acids, and lipids.
4. **Regulation of Metabolism**: Understand the regulation of microbial metabolic pathways in response to environmental changes.
5. **Biotechnological Applications:** Apply microbial metabolism knowledge to industrial, environmental, and medical biotechnology.

Unit 1: Microbial Growth and Effect of Environment on Microbial Growth

Definitions of growth, Batch culture, Continuous culture, generation time and specific growth rate, Temperature and temperature ranges of growth pH and pH ranges of growth, Effect of solute and water activity on growth, Effect of oxygen concentration on growth, Nutritional categories of microorganisms.

Unit 2: Nutrient uptake and Transport

Passive and facilitated diffusion, Primary and secondary active transport, concept of uniport, symport and antiport, Group translocation, Iron uptake.

Unit 3: Chemoheterotrophic Metabolism - Aerobic Respiration

Concept of aerobic respiration, anaerobic respiration and fermentation, Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway, TCA cycle, Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial, ETC, electron transport phosphorylation, uncouplers and inhibitors.

Unit 4: Chemoheterotrophic Metabolism- Anaerobic respiration and fermentation

Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate /nitrite and nitrate/ammonia respiration; fermentative nitrate reduction) Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways.

Unit 5: Chemolithotrophic and Phototrophic Metabolism

Introduction to aerobic and anaerobic chemolithotrophy with an example each. Hydrogen oxidation (definition and reaction) and methanogenesis (definition and reaction), Introduction to phototrophic metabolism - groups of phototrophic microorganisms, anoxygenic vs. oxygenic photosynthesis with reference to photosynthesis in green bacteria and cyanobacteria.

References:

1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.

2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons.

3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India.

4. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag.

5. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Seminar

Course Code: SMBE- 201 **Credit Units**: 01

Pre-requisite: Basic understanding of microbiology and scientific communication.

Course Outcome:

After completion of the course, students will be able to:

1. Develop skills in literature review and research analysis.
2. Enhance scientific communication and presentation skills.
3. Critically analyze recent advancements in microbiology and related fields.
4. Demonstrate the ability to prepare and deliver structured oral presentations.
5. Engage in discussions and respond to scientific queries effectively.

Details of the Course:

S. No.	Contents	Contact Hours
1	**Introduction to Scientific Seminars**: Objectives, structure, and evaluation criteria.	2
2	**Literature Review Skills**: Identifying, evaluating, and summarizing relevant scientific literature.	4
3	**Topic Selection**: Choosing and justifying a seminar topic based on recent trends in microbiology.	2
4	**Scientific Writing**: Preparing seminar abstracts, outlines, and handouts.	4
5	**Presentation Techniques**: Creating slides, using visuals, and effective verbal communication.	4
6	**Seminar Delivery**: Individual presentation on selected topics followed by Q&A sessions.	6
7	**Peer Review and Feedback**: Evaluating peer presentations and providing constructive feedback.	3
8	**Report Submission**: Preparing and submitting a detailed report of the seminar topic.	2

Suggested Books:

Text Books

1. **Scientific Presentation: A Guide for the Scientists and Engineer** – Jean-Luc Lebrun, World Scientific Publishing, 2nd Edition, 2011.
2. **How to Write and Illustrate a Scientific Paper** – Bjorn Gustavii, Cambridge University Press, 3rd Edition, 2017.

References

1. **Presenting Science: A Practical Guide to Giving a Good Talk** – Cigdem Issever and Ken Peach, Oxford University Press, 2016.
2. **Effective Scientific Communication** – Christina M. Griego and Yumi Wilcox, Springer, 2020.

Examination Scheme:

Components	Abstract and Topic Justification	Presentation Delivery	Q&A Performance	Report Submission	Peer Review Participation
Weightage (%)	10%	40%	20%	20%	10%

IV SEMESTER IMMUNOLOGY

Course Code: CMBE-202 Credit Unit: 04

Course Outcome

1. **Metabolic Diversity**: Understand the metabolic processes unique to microorganisms, including autotrophy, heterotrophy, and chemolithotrophy.
2. **Catabolic Pathways**: Explain energy production through microbial catabolic pathways like glycolysis, fermentation, and respiration.
3. **Anabolic Pathways**: Analyze microbial biosynthesis of macromolecules such as nucleotides, amino acids, and lipids.
4. **Regulation of Metabolism**: Understand the regulation of microbial metabolic pathways in response to environmental changes.
5. **Biotechnological Applications:** Apply microbial metabolism knowledge to industrial, environmental, and medical biotechnology.

Unit 1: Introduction

Concept of Innate and Adaptive immunity; Contributions of following scientists to the development of field of immunology - Edward Jenner, Karl Landsteiner, Robert Koch, Paul Ehrlich, Elie Metchnikoff, Peter Medawar, MacFarlane Burnet, Neils K Jerne, Rodney Porter and Susumu Tonegawa

Unit 2: Immune Cells and Organs

Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen.

Unit 3: Antigens

Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants

Unit 4: Antibodies

Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic), Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways), Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals); Killing Mechanisms by CTL and NK cells.

Unit 5: Immunological Disorders and Tumor Immunity

Types of Autoimmunity and Hypersensitivity with examples; Immunodeficiencies - Animal models (Nude and SCID mice), SCID, Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, Western blotting, Immunofluoresence, Flow cytometry, Immunoelectron microscopy.

References:

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.

2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology.11th edition WileyBlackwell Scientific Publication, Oxford.

3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freemanand Company, New York.

4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.

5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.

6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

IV SEMESTER ECONOMIC BIOLOGY

Course Code: CMBE-202a Credit Units: 04

Pre-requisite: Basic knowledge of immunology and molecular biology

Course Outcome:

- Students will gain new insights about different diagnostic procedures.
- Students will be able to use critical thinking skills to trouble shoot problems as they occur and determined possible causes
- Students will be able to apply the knowledge of molecular testing to the most commonly performed applications in the clinical laboratory.

Details of the Course:-

UNIT I: Enzyme Immunoassays:

Solid phases, Comparison of enzymes, conjugation of enzymes, Use of polyclonal or monoclonal antibodies, Immunoblotting, Radioimmunoassay.

UNIT II: Molecular methods in diagnostics:

Applications of PCR, RFLP, Nuclear hybridization methods LAMP method in transgenics.

UNIT III: Prenatal diagnosis:

Invasive techniques - Amniocentesis, Fetoscopy, Chorionic Villi Sampling (CVS), Non-invasive techniques - Ultrasonography, X-ray, TIFFA.

UNIT IV: Biochemical diagnostics:

Inborn errors of metabolism, haemoglobinopathies, mucopolysaccharidoses, lipidoses, and glycogen storage disorders.

UNIT V: Automation in microbial diagnosis:

Rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Buckingham, L., Flaws, M,L., Molecular Diagnostics: Fundamentals, Methods, & Clinical Applications, F A DavisCo., Philadelphia.	2007
2.	Grody, W.W., Nakamura, R.M., Kiechle, F.K. & Strom, C., Molecular Diagnostics: Techniques and Applications for the Clinical Laboratory, Academic Press	2009
	Reference Books	
1.	Ananthanarayan, R. & Paniker, C.K.J., Textbook of Microbiology. 7th edition, University Press Publication.	2005
2	Kindt, T J, Goldsby, R.A., Osborne, B.A. & Kuby, J., Immunology, 6th Edition, W.H. Freeman, New York	2007

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

IV SEMESTER GENDER STUDIES

Course Code: CMBE-202b Credit Units: 04

Objectives of the course

- To familiarize the students with the terminologies related to Gender studies.
- To elaborate the concept of patriarchy and its impact on women
- To introduce students to the discipline of Women's Studies and Gender Studies and its perspectives.
- To trace the evolution of Gender Studies from Women's Studies. Learning outcomes
- Familiarity with fundamental concepts related to field of women and gender studies.
- Understanding of multidisciplinary nature of the discipline.

Syllabus Unit I

Introduction: Gender Studies - Origin and growth; need for Gender Studies – objectives, nature and scope of Gender Studies. Establishment of Centre for Women's Studies under UGC guidelines 14H

Unit II

Basic Concepts: Meaning and definition: gender, sex, difference between gender and sex, gender equality, gender empowerment, gender roles, gender gap. Patriarchy and Matriarchy: Meaning and definition. Gender discrimination-meaning, forms and areas, Need for Gender Sensitization. Bio-social perspective of gender, gender socialization, gender stereotyping, gender bias 16H Page 5 of 34

Unit III

Multidisciplinary Nature of Gender Studies Multi-disciplinarity of gender studies, relationship with mainstream social sciences (Economics, Sociology, History, Literature, Anthropology, Psychology and Political Science) 14 H

Unit IV

Women's Studies and Gender Studies A paradigm shift: from Women's Studies to Gender Studies. Relevance of women/gender studies in Indian context 6 H

Unit V

Future of Gender Studies Gender studies as a profession- employment opportunities, constraints, emerging needs Role of UGC in promoting the women's and gender studies, future of gender studies

Recommended Readings

1. Maithreyi Krishnaraj (2006), Is 'Gender' Easy to Study? Some Reflections, Economic and Political Weekly, October 21
2. 2. Menon, Nivedita (1999), Gender and Politics In India, OUP, New Delhi.
3. 3. Neera Desai and MaithreyiKrishnaraj (1986), Women's Studies in India – Some Perspectives, Popular Prakashan Private Ltd, Mumbai.
4. 4. Vina Mazumdar (1985), Emergence of Women's Question and Role of Women's Studies, Occasional Paper, Centre for Women's Development Studies, New Delhi
5. 5. Mary E. John (2008), Women's Studies in India – A Reader, Penguin Books, New Delhi
6. 6. Neera Desai and Maithreyi Krishnaraj (1987), Women and Society in India, Ajantha Publications, New Delhi
7. 7. Burton, A. (1994) Burdens of History: British Feminists, Indian Women and Imperial Culture. University of North Carolina Press

INTERNATIONAL BUSINESS IN DAIRY SCIENCE

SEMESTER IV

Course Code: CMBE-202c **Credit Units: 04**

Pre-requisite: Basic knowledge of dairy microbiology.

Course Outcome:

- Students will be able to know about the microorganisms important in food microbiology.
- Students would know about the factors influencing microbial growth in food.
- Students will understand various food borne diseases.
- Students will also have knowledge of microbiology of milk.
- Students will understand microorganisms as source of food.

Details of the Course:

Sl. No.	Contents	Contact Hours
1.	**UNIT-1** Microorganisms important in food microbiology: molds, yeast and bacteria – general characteristics, classification and importance. Principles of food preservation, preservation by use of high temperature, low temperature, drying and dessication. Chemical preservatives and additives. Preservation by radiation.	4
2.	**UNIT-2** Factors influencing microbial growth in food: Extrinsic and intrinsic factors. Microbial spoilage of food. Chemical changes caused by the microorganisms during spoilage. Spoilage of fish, meat, poultry, eggs, fruits and vegetables. Detection of spoilage and characterization.	10
3.	**UNIT-3** Classification of food borne diseases. Food borne infections: Brucella, Bacilllus cereus, Clostridium perfringens, Yersinia enterocolitica and Escherichia, Salmonella spp. Food intoxication: Staphylococcal intoxication, Clostridial poisoning (Clostridium Botulinum). Food adulteration and prevailing food standards in India.	9
4.	**UNIT-4** Microbiology of Milk: Sources of microorganisms in milk and types of microorganisms in milk. Microbiological examination of milk (standard plate count, direct microscopic count, reductase, and phosphatase test). Dehydration and pasteurization of milk. Dairy products from microorganisms: Butter, yoghurt and cheese.	12

5.	**UNIT-5** Microorganisms as source of food: Single Cell Protein (SCP). Mushrooms and food value of mushrooms. Food conversions: Lactic acid conversions, soyabean conversions and Bakery. Microbiological estimation of food: Sample collection, preparation and analysis techniques.	6

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Food science By Norman N. Potler, Joseph H. Hotchkiss. Fourth edition, CBS Publishers and Distributors, New Delhi	2006
2.	Food Microbiology , by William C. Frazier and Dennis C. Westhoff, Fourth edition, Tata McGrawHill Publishing Company Limited, New Delhi	1997-1979
3.	Modern Food Microbiology by James M. Jay, Fourth Edition, CBS Publishers and Distributors, New Delhi.	1959
4.	Bains W. Biotechnology from A to Z. Oxford Univ. Press.	1993
	Reference Books	
1.	Introduction to Food Biotechnology. Author; Perry Johnson.	2002

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

MOLECULAR BIOLOGY

Course Code: CMBE-204 Credit Unit: 04

Course Outcome

1. **DNA and RNA Biology**: Understand the structure, replication, transcription, and translation of genetic material.
2. **Gene Regulation**: Explain mechanisms of gene expression and regulation in prokaryotes and eukaryotes.
3. **Molecular Techniques**: Demonstrate proficiency in molecular biology techniques such as PCR, electrophoresis, and cloning.
4. **Genetic Mutations**: Analyze the impact of mutations and DNA repair mechanisms on genome stability.
5. **Applications in Biotechnology**: Apply molecular biology concepts to advancements in genetic engineering, genomics, and therapeutic development

Unit 1: Structures of DNA and RNA / Genetic Material

DNA Structure: Miescher to Watson and Crick- historic perspective, DNA structure, Salient features of double helix, Types of DNA, Types of genetic material, denaturation and renaturation, cot curves. DNA topology – linking number, topoisomerases; Organization of DNA Prokaryotes,Viruses, Eukaryotes.RNA Structure, Organelle DNA -- mitochondria and chloroplast DNA.

Unit 2: Replication of DNA (Prokaryotes and Eukaryotes)

Bidirectional and unidirectional replication, semi- conservative, semi- discontinuous replication Mechanism of DNA replication: Enzymes and proteins involved in DNA replication –DNA polymerases, DNA ligase, primase, telomerase – for replication of linear ends Various models of DNA replication including rolling circle, D- loop (mitochondrial), Θ (theta) mode of replication and other accessory protein, Mismatch and excision repair.

Unit 3: Transcription in Prokaryotes and Eukaryotes

Transcription: Definition, difference from replication, promoter - concept and strength of promoter RNA Polymerase and the transcription unit Transcription in Eukaryotes: RNA polymerases, general Transcription factors.

Unit 4: Post-Transcriptional Processing

Split genes, concept of introns and exons, RNA splicing, spliceosome machinery, concept of alternative splicing, Polyadenylation and capping, Processing of rRNA, RNA interference: si

RNA, miRNA and its significance.

Unit 5: Translation (Prokaryotes and Eukaryotes)

Translational machinery, Charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides in both prokaryotes and eukaryotes, Fidelity of translation, Inhibitors of protein synthesis in prokaryotes and eukaryote.

Unit 6: Regulation of gene Expression in Prokaryotes and Eukaryotes

Principles of transcriptional regulation, regulation at initiation with examples from lac and trp operons, Sporulation in Bacillus,Yeast mating type switching , Changes in Chromatin Structure - DNA methylation and Histone Acetylation mechanisms.

References:

1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication.

2. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco.

3. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia.

4. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.

5. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

ANTHROPOLOGY

Course Code: CMBE-204a **Credit Unit: 04**

Course Outcomes

1. **Cultural Understanding**: Gain insight into the diversity of human cultures, traditions, and social behaviors across time and space.
2. **Biological Perspectives**: Understand human evolution, biological adaptations, and the interplay between biology and culture.
3. **Archaeological Methods**: Learn techniques for studying past civilizations through material remains and artifacts.
4. **Holistic Analysis**: Develop a comprehensive perspective on human societies by integrating cultural, biological, and linguistic aspects.
5. **Contemporary Applications:** Apply anthropological knowledge to address modern issues like globalization, health disparities, and social justice.

UNIT-1 Social anthropology:
history and subject matter; Relationship of social and cultural anthropology with sociology, psychology, history, economics and political science.

UNIT-2 Concepts of Society;
Pre-requisite of Human society Individual and Society; Group and its types; Community; Association and Institution Status and Role ;

Unit -3 Social fact;
Social Action; Social Structure , Function and Social Organisation ; Structural - Functionalism ; Social System ; Social Conflict

Unit -4 Techniques and methods:
Field work/ Ethnography and Survey Research Comparative and Historical Methods

References:

1. Metcalf Peter (2005) Anthropology: the basics. Abingdon (England), Routledge.
2. Ingold Tim (1994) Companion encyclopedia of anthropology. London, Routledge reference.
3. R.M MacIver & Charles H. Page (1950) Society : An Introductory Analysis. London, Macmillan
4. Ralph Linton (1936) The Study of Man. New York, Appelton Century Croft.
5. M. J. Herskovits (1974) Cultural Anthropology, New Delhi, Oxford and IBH Publications.
6. Roger Keesing (1984) An Introduction of Cultural Anthropology. NewYork, MacMillan.
7. Kingsley Davis (1948) Human Society, New York: MacMillan.
8. John Monaghan and Peter Just (2000) Social and Cultural Anthropology: A very Short Introduction. 9. Thomas Hylland Eriksen (2010) Small Places, Large Issues: An Introduction to Social and Cultural Anthropology.
10. Nigel Rapport and Joanna Overing (2006) Social and Cultural Anthropology: The Key Concepts .

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

NEUROBIOLOGY

Course Code: CMBE-204b **Credit Unit: 04**

1. **Neural Structure**: Understand the anatomy and physiology of the nervous system at cellular and systemic levels.
2. **Signal Transmission**: Explain the mechanisms of neuronal communication, including action potentials and synaptic transmission.
3. **Sensory and Motor Systems**: Analyze the neural basis of sensory processing and motor control.
4. **Neuroplasticity**: Explore the principles of neural development, plasticity, and regeneration.
5. **Neurological Disorders**: Apply knowledge of neurobiology to understand the basis of neurological and psychiatric diseases.

UNIT I Neural induction

・Overview of early embryology +details of hydra, C. elegans (indentation), Drosophila (delamination), frog, zebrafish, chick and humans (invagination).

・'Organiser 'of differentiation- Spemann and Mangold experiments, Keller sandwich.

・Molecular nature of neural inducer- Noggin, chordin, follistatin, activing, BMP4-WNT signalling- important for formation of neural plate.

・Neuroblast induction-acheate scute, lateral inhibition and details – notch delta signalling pathway- important for formation of neuroblasts.

UNIT II Polarity and Segmentation

・Overview of polarity and brain architecture, rhombomeres

・AP-Axis in Drosophila-Bicoid and nanos, homeobox genes, ANT-C and BX-C in flies, effect of homeobox genes on hindbrain development in mammals.

・Upstream control of hox genes, transformers-RA, WNT-b-catenin, FGF

・Mesencephalon/metencephalon boundary organiser-WNT1, ENGRAILED1, FGF8.

・Forebrain development in mammals-pax genes

・DV-axis polarity-sonic hedgehog(shh) induces the ventralisation (floorplate).

・Dorsal neural tube development- again WNT/BMP and shh signalling

・Patterning the cerebral cortex-pax6, emx2, fgf8 and fgf18

UNIT III Genesis and Migration

・Methods to visualise lineage and timing of a neurons birth-thymidine, BrdU, retroviral GFP, thymidine dating

・Molecular control of neuron number-intrinsic proteins and also

mitogens like FGF, IGF

- What separates neurons from glia
- Cerebral and cerebellar cortex formation
- Molecular control of migration of neurons, adult neurogenesis

UNIT IV Determination and differentiation

- Determination-various transcription factors involved (intracellular factors)
- Asymmetric cell division – eg NB, GMC, neuron – (numb and prospero) and drosophila eye
- Local environmental factors- eg Drosophila eye imaginal disc (MF) and chick-quail transplant studies
- Histogenesis-loss of competence Eg layers of the cortex by transplantation studies and retina by heterochronic experiments
- Neuronal differentiation form neural stem cell, embryonic stem cell and induced pluripotent cell-basic principle and methodology

UNIT V Axon growth and guidance

- Overview of growth cone and axonal pathfinding. Initial study
- Guidance cues for growth cone – Netrin, Semaphorin and Ephrins
- Substrates for growth of developing axon – Role of cell adhesion molecule in growth cone guidance
- Mechanism of axon guidance-guidance cues and the control of cytoskelata dynamic, localized translational of growth cone guidance, changing response to guidance cues
- Axon regeneration

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	University Chemistry, B.H.Mahan	1987
2.	Chemistry, Principles and Application, M.J. Sienko and R.A. Plane	1980
	Reference Books	
1.	Physical Chemistry, P.W. Atkins	2009

2.	Organic Chemistry, I.L.Final (Vol-1, Vol-2)	2002
3.	Fundamentals of Molecular Spectroscopy, C.N. Banwell	1994

Examination Scheme:

Components	**Internal Assessment**			**External Evaluation**
	Attendance	**Class Test**	**Assignment/ Project/Seminar/Quiz**	
Weightage (%)	10	20	10	60

NANOTECHNOLOGY

Course Code: CMBE-204c **Credit Unit: 04**

Course Outcomes

6. **Neural Structure**: Understand the anatomy and physiology of the nervous system at cellular and systemic levels.
7. **Signal Transmission**: Explain the mechanisms of neuronal communication, including action potentials and synaptic transmission.
8. **Sensory and Motor Systems**: Analyze the neural basis of sensory processing and motor control.
9. **Neuroplasticity**: Explore the principles of neural development, plasticity, and regeneration.
10. **Neurological Disorders**: Apply knowledge of neurobiology to understand the basis of neurological and psychiatric diseases.

Unit I

Background to Nanoscience: Defination of Nano, Scientific revolution-Atomic Structure and atomic size, emergence and challengs of nanoscience and nanotechnology, carbon age-new form of carbon (CNT to Graphene), influence of nano over micro/macro, size effects and crystals, large surface to volume ration, surface effects on the properties.

Unit II

Types of nanostructure and properties of nanomaterials: One dimensional, Two dimensional and Three dimensional nanostructured materials, Quantum Dots shell structures, metal oxides, semiconductors, composites, mechanical-physical-chemical properties.

Unit III

Application of Nanomaterial: Ferroelectric materials, coating, molecular electronics and nanoelectronics, biological and environmental, membrane based application, polymer based application.

Unit IV

Surface Nanoscience: Introduction to surface active agents. Theory and applications.Types of surfactants. Classification, synthesis of surfactant - Shape, size and structure of surfactants. Micelle, Emulsions, Microemulsions & Gels. Kraft temperature, surfactant geometry and packing.

Unit V

Colloidal Nanoscience:Introduction to colloidal material, surface properties, origin of colloidal particles, preparation & characterization of colloidal particles. Applications of super hydrophilic hydrophobic surfaces, self-cleaning surfaces.Surface viscosity.

References:

1. Chemistry of nanomaterials: Synthesis, properties and applications by CNR Rao et.al.
2. Nanoparticles: From theory to applications – G. Schmidt, Wiley Weinheim 2004.
3. Instrument E L Principe, P Gnauck and P Hoffrogge, Microscopy and Microanalysis (2005), 11: 830- 831, Cambridge University Press.
4. Processing & properties of structural naonmaterials - Leon L. Shaw,
Nanochemistry: A Chemical Approach to Nanomaterials, Royal Society of Chemistry, Cambridge UK 2005.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Aerobiology

Course Code: CMBE-204d **Credit Units**: 04

Pre-requisite: Basic knowledge of microbiology, plant pathology, and environmental science.

Course Outcome:

After completion of the course, students will be able to:

1. Understand the fundamental concepts of aerobiology and its applications.
2. Analyze the diversity and dynamics of airborne microorganisms and allergens.
3. Investigate the role of airborne particles in human health, agriculture, and environment.
4. Learn techniques for sampling and identification of bioaerosols.
5. Apply aerobiological knowledge in disease forecasting, air quality assessment, and biotechnology.

Details of the Course:

S. No.	Contents	Contact Hours
1	**Introduction to Aerobiology**: Definition, scope, and importance in health, agriculture, and environment.	6
2	**Sources of Bioaerosols**: Natural and anthropogenic sources, transport mechanisms, and deposition processes.	6
3	**Sampling and Analysis Techniques**: Methods of air sampling, culture-dependent and independent approaches, particle counting.	8
4	**Microbial Composition of Air**: Types of microorganisms (bacteria, fungi, viruses) in the air and their seasonal variations.	6
5	**Aerobiology and Human Health**: Allergens, respiratory infections, and immune responses caused by airborne particles.	6
6	**Agricultural Aerobiology**: Impact of airborne pathogens on crop diseases, spore dispersal, and prediction models.	6
7	**Environmental Applications**: Role of aerobiology in air quality monitoring, pollution studies, and climate change impact.	6
8	**Industrial and Forensic Applications**: Applications in biotechnological processes and forensic investigations.	4

Suggested Books:

Text Books

1. **Aerobiology** – Roger L. Edmonds, Springer, 1979.
2. **Introduction to Aerobiology** – Maureen E. Lacey and Jonathan S. West, Springer, 2006.

References

1. **Bioaerosols: Assessment and Control** – Harriet Burge, ACGIH, 2006.
2. **Fungal Spores and Disease in Plants and Animals** – Donald G. Cooley, Springer, 2013.
3. **Aerobiology in Climate Change and Environmental Monitoring** – Edited by Usha Kiran and Subodh Kumar, Springer, 2020.

Examination Scheme:

Components	Attendance	Assignments	Midterm Exam	Final Exam
Weightage (%)	10%	20%	30%	40%

RECOMBINANT DNA TECHNOLOGY

Course Code: CMBE-206 Credit Units: 04

Course Outcomes

1. **Molecular Tools**: Understand the principles and tools used in gene cloning and genetic engineering.
2. **Vector Design**: Learn the construction and application of cloning and expression vectors.
3. **Gene Manipulation**: Demonstrate proficiency in techniques like PCR, restriction digestion, and ligation.
4. **Applications**: Explore the use of recombinant DNA in medicine, agriculture, and industry.
5. **Ethics and Safety**: Analyze the ethical, legal, and biosafety considerations of genetic engineering.

Unit 1: Gene Recombination and Gene transfer

Bacterial Conjugation, Transformation, Transduction, Episomes, Plasmids, Microinjection, Electroporation, Microprojectile, Shot Gun method, Ultrasonication, Liposome fusion, Microlaser.

Unit 2: Changing genes

Site-directed mutagenesis and Protein engineering: Primer extension is a simple method for site directed mutation, PCR based site directed mutagenesis, Random mutagenesis, Use of Phage display techniques to facilitate the selection of mutant peptides, Gene shuffling, production of chimeric proteins.

Unit 3: Genetic engineering in animals

Production of transgenic mice, ES cells can be used for gene targeting in mice, Applications of gene targeting, Using Yeast to study Eukaryotic gene function, Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines, Transgenic animals, Production of proteins of Pharmaceutical value.

Unit 4: Genetic engineering in plants

Use of Agrobacterium tumefaciens and Arhizogenes, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors.

References:

1. Gene Cloning and DNA Analysis: An introduction 6th Edition; TA Brown, John Wiley &Sons.

2. Recombinant DNA Technology, Keya Chaudhuri, Teri Press - New Delhi, ISBN: 9788179933206, 8179933202.

MICROBIAL PHYSIOLOGY & METABOLISM

Course Code: CMBE-206a **Credit Units: 04**

Pre-requisite: Basic information of biology and microbiology.

Course Outcome:

At the end of the course, the students will be familiar with microbial technology. This would help students to launch themselves in industrial biotechnology which is the fastest growing industry in the developing country.

Details of the Course:-

S. No.	Contents	Contact Hours
1	**Introduction of microbes, taxonomy and classification** 11. Introduction to bacteria, fungi, and viruses, structural and cellular organelles differences among different types and classes ; biochemical/microscopic/molecular methods to differentiatearchaea, eubacteria and eukaryotes; microbial evolution, systematics and taxonomy- new approaches to bacterial taxonomy, classification including ribotyping, characteristics of primary domains, taxonomy, nomenclature and Bergey's manual, ribosomal RNA sequencing. **12. Microbiology Techniques** Important milestones in microbiology, methods in microbiology-principles of microbial nutrition, culture media, theory and practice of sterilization, pure culture techniques, minimal and enrichment culture techniques.	6
2	**Growth and nutrition:** Prokaryotic growth patterns and functions - microbial nutrition and growth - arithmetic and geometric growth expression, growth kinetics, growth curve, measurement of growth and growth yields, synchronous growth, continuous culture, diauxic growth, culture collection and maintenance of cultures.	7
3	**Microbial Genetics:** Microbial regulation of gene expression (attenuation and negative regulation with e.g. *trp* and *lac* operon), transfer of genetic material: plasmids, transposons, transduction, transformation and conjugation. Mutations and their chemical basis; mutagens and their use in biotechnology; modes of recombination; comparative prokaryotic genomics.	7 5
4	**Host-microbe interaction:** Normal micro flora of skin, oral cavity, gastrointestinal tract; entry of pathogens into the host, types of toxins (exo, endo, entro) and their mode of actions, plant -microbe interactions, microbial pathogenesis -disease reservoirs; epidemiological terminologies; infectious disease transmission	9
5	**Microbes based therapies:** Antimicrobial agents, sulfa drugs, antibiotics -penicillin and	8

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Pelczar Jr., M.J., Chan, E.C.S. and Krieg, Noel R., Microbiology, McGraw Hill (2003) 5th ed.	2003
2.	Stanier, R.Y., Ingraham, J.L. and Wheelis, M.L., General Microbiology, MacMillan (2007) 5thed.	2007
	References	
1.	Microbiology 10th Edition. Prescott, L.M.; Harley, J.P. and Klein, D.A. (2003) McGraw Hill, USA.	2016
2.	Foundations in Microbiology 10th edition, Kathleen Park Talaro and Barry Chess.	2017
3.	Microbiology- An Introduction. Tortora, G.J., Funke, B.R., and Case, C.L., , Pearson Education (2015)12th ed.	2015
4.	Principles of Virology, Vol I and Vol II, 4th Edition, Jane Flint, Vincent Racaniello, Glenn Rall, Anna Marie Skalka, (2015), American Society of Microbiology	2015
5.	Comparative Plant Virology, Roger Hull, 2nd ed. Elsevier, Academic Press. (2009)	2009
6.	Plant Viruses, Diseases and Their Management, Kajal Kumar Biswas, IK. International Publishing House Pvt Ltd, 2016.	2016
7.	Animal cell culture and Virology, S. Nandi, New India Publishing agency, 1st ed. (2009)	2009
8.	Textbook of Medical Virology, Mishra B, CBS Publishing, 1st edition, 2018	2018

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

ENTOMOLOGY

Course Code: CMBE-206b **Credit Units: 04**

Course Outcomes

1. Insect Biology: Understand the anatomy, physiology, and classification of insects.
2. Ecological Roles: Analyze the ecological importance of insects in ecosystems and their interactions with other organisms.
3. Insect Behavior: Explore the behavioral patterns and adaptations of insects.
4. Pest Management: Learn techniques for identifying and managing insect pests in agriculture and public health.
5. Applied Entomology: Apply knowledge of entomology in fields like pollination, biocontrol, and forensic science.

UNIT I Principles, utility and relevance:
insect body wall structure, cuticular outgrowths, colouration and special integumentary structures in insects, body tagmata, sclerites and segmentation.
UNIT II Head-
Origin, structure and modification; types of mouthparts and antennae, tentorium and neck sclerites.
UNIT III Thorax-
Areas and sutures of tergum, sternum and pleuron, pterothorax; Wings: structure and modifications, venation, wing coupling apparatus and mechanism of flight; Legs: structure and modifications.
UNIT IV Abdomen- Segmentation and appendages; Genitalia and their modifications; Embryonic and post-embryonic development; Types of metamorphosis. Insect sense organs (mechano-, photo- and chemoreceptors).
UNIT V insect segmentation, various tagmata and their appendages; preparation of permanent mounts of different body parts and their appendages of taxonomic importance including male and female genitalia. Sense organs.
REFERENCES
Chapman RF. 1998. The Insects: Structure and Function. Cambridge Univ. Press, Cambridge. David BV & Ananthkrishnan TN. 2004. General and Applied Entomology. Tata-McGraw Hill, New Delhi. Duntson PA. 2004. The Insects: Structure, Function and Biodiversity. Kalyani Publ., New Delhi. Evans JW. 2004. Outlines of Agricultural Entomology. Asiatic Publ., New Delhi. Richards OW & Davies RG. 1977. Imm's General Text Book of Entomology. 10th Ed. Chapman & Hall, London. Saxena RC & Srivastava RC. 2007. Entomology: At a Glance. Agrotech Publ. Academy, Jodhpur. Snodgross RE. 1993. Principles of Insect Morphology. Cornell Univ. Press, Ithaca.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Agrostology

Course Code: **CMBE-206c** **Credit Units**: **04**

Pre-requisite: Basic understanding of botany, plant taxonomy, and ecology.

Course Outcome:

After completion of the course, students will be able to:

1. Understand the taxonomy, anatomy, and physiology of grasses.
2. Identify and classify grass species based on their morphological and ecological characteristics.
3. Explore the ecological and economic importance of grasses in natural and managed ecosystems.
4. Analyze the role of grasses in agriculture, environmental management, and climate change mitigation.
5. Learn techni

Details of the Course:

S. No.	Contents	Contact Hours
1	**Introduction to Agrostology**: Definition, scope, and importance in ecology, agriculture, and industry.	6
2	**Taxonomy and Systematics of Grasses**: Morphological features, classification, and identification of grass families (Poaceae).	8
3	**Anatomy and Physiology of Grasses**: Structure of grass leaves, stems, and roots; photosynthesis (C3 and C4 pathways) in grasses.	6
4	**Ecological Role of Grasses**: Grassland ecosystems, biodiversity, and the role of grasses in soil conservation and carbon sequestration.	6
5	**Economic Importance of Grasses**: Food crops (rice, wheat, maize), fodder, turf, and industrial uses (paper, biofuels).	6
6	**Grasses in Agriculture**: Pasture management, forage quality, and their role in sustainable agriculture.	6
7	**Grass Propagation and Cultivation**: Methods of propagation, breeding techniques, and pest management in grass cultivation.	6
8	**Applications in Environmental Management**: Grasses for erosion control, phytoremediation, and landscaping.	6

Suggested Books:

Text Books

1. **Agrostology: A Textbook of Grasses** – R.J. Goel, Daya Publishing House, 1st Edition, 2017.
2. **Grasses of the World** – T.R. Soderstrom et al., Smithsonian Institution Press, 1986.

References

1. **Poaceae: Grass Family** – Edited by W.D. Clayton, Royal Botanic Gardens, Kew, 1986.
2. **Grassland Ecophysiology and Grazing Ecology** – G.A. McNaughton and J.B. Wilson, Cambridge University Press, 1995.

3. **Forage Crop Production** – C.J. Nelson, American Society of Agronomy, 3rd Edition, 2012.

Examination Scheme:

Components	Attendance	Assignments	Midterm Exam	Final Exam
Weightage (%)	10%	20%	30%	40%

Immunology Lab

Course Code: CMBE-252 **Credit Units: 01**

Pre-requisite: Basic understanding of Immunology

Course Outcome:

(vii) Students will be able to understand/experience the immune system.
(viii) Students will be able to understand related immunological techniques and apply them in medical laboratory profession.
(ix) Students will be able to value role of immune system in different diseases.

Details of the Course:-

S. No.	Contents	Contact Hours
1	Differential leucocytes count	2
2	Total leucocytes count	2
3	Total RBC count	2
4	Separation of serum from blood	2
5	ELISA	2

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Using Antibodies: A Laboratory Manual. Harlow & Lane (1998) Cold Spring Harbor Lab Press.	1998
	Reference Books	
1.	Immunological Techniques Made Easy. Cochet, et al (1998) Wiley Publishers, Canada	1998

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

Molecular Biology Lab

Course Code: CMBE-254 **Credit Units: 01**

Pre-requisite: Basic information of cell biology.

Course Outcome:

After completion of the course the students should be able

6. To learn about principle and working of laboratory instruments.
7. To acquire a comprehensive knowledge on molecular biology techniques.
8. To become familiar with technical requirements, concepts and general procedures in molecular biology and implement the knowledge in research work.
9. To learn and implement different strategies to isolate genomic and plasmid DNA from cells
10. To understand the methods to check purity of isolated nucleic acid samples.
11. To analyze the methods of DNA based methods of identification of unknown samples.
12. To learn the methods of DNA amplification for future recombinant techniques.

Details of the Laboratory Course:-

Note: A college must offer 70%of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available.

S. NO.	CONTENTS	CONTACT HOURS
1	Isolation of genomic DNA from eukaryotic cells.	2
2	Isolation of RNA from eukaryotic cells.	2
3	Isolation of proteins from eukaryotic cells.	2
4	Isolation of genomic DNA from prokaryotic cells.	2
5	Isolation of plasmid DNA from Prokaryotic cells.	2
6	Restriction mapping of plasmid DNA: This experiment involves single and double digestion of the plasmid with restriction enzymes.	2
7	Gel electrophoretic separation of DNA and molecular wt. determination.	2
8	Gel electrophoretic separation of RNA.	2

9	Gel electrophoretic separation of proteins.	2
10	Transblot analysis of DNA.	2
11	Gel Extraction of DNA.	2
12	PCR amplification of DNA: Visualization by gel electrophoresis.	2

Suggested Books:

1.	Molecular Cloning – A laboratory manual: 3rd Edition Vol. 1-3. Sambrook J and Russell D.W. (2001). Cold Spring Harbor laboratory Press, New York	2001

Examination Scheme:

Components	**Internal Assessment**			**External Evaluation**
	Attendance	**Viva-Voce**	**Practical Record**	
Weightage (%)	10	20	10	60

Recombinant DNA Technology Lab

Course Code: CMBE-256 **Credit Units: 01**

Pre-requisite: Basic experience of molecular biology techniques

Course Outcome:

6. Students will be able to isolate and analyze DNA/plasmid DNA and protein.
7. Students will be able to digest and ligate the DNA molecules.
8. Students will be able to design primers and amplification of DNA by PCR.
9. Students will be able to learn the techniques of cloning gene in plasmid vectors.
10. Students will be able to screen the positive transformants with the gene cloned through reporter based assays.

Details of the Course:-

S. No.	Contents	Contact Hours
1	Isolation of Vector/plasmid DNA	3
2	Quantification of Nucleic acid and determination of its purity	3
3	Isolation of protein	3
4	Restriction digestion of DNA and its analysis by AGE	6
5	Ligation of DNA molecules	3
6	Primer designing	3
7	Polymerase chain reaction	6
8	Preparation of compesent cells	3
9	Transformation in bacteria and reporter gene assay	3

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Methods in yeast genetics: a Cold Spring Harbor Laboratory course manual. David C. Amberg, Daniel Burke, Jeffrey Strathern Cold Spring Harbor Laboratory Press, c2005 2005 ed.	2005
2.	Departmental Laboratory Manual	2018
	Reference Books	
1.	Molecular Cloning- A Laboratory Manual: 3 rd Edition, 2001, Vol. 1 -3 . Sambrook J and Russell D.W.(2001). Cold spring Harbor Laboratory Press, New York.	2001
2.	DNA cloning: A Practical Approach. Glover and Hames (2001) Oxford Univ. Press.	2001

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

MICROBES IN ENVIRONMENT

Course Code: GMBE-202 Credit Units: 03

Course outcomes

1. **Insect Biology**: Understand the anatomy, physiology, and classification of insects.
2. **Ecological Roles**: Analyze the ecological importance of insects in ecosystems and their interactions with other organisms.
3. **Insect Behavior**: Explore the behavioral patterns and adaptations of insects.
4. **Pest Management**: Learn techniques for identifying and managing insect pests in agriculture and public health.
5. **Applied Entomology:** Apply knowledge of entomology in fields like pollination, biocontrol, and forensic science.

Unit 1: Microorganisms and their Habitats

Structure and function of ecosystems, Terrestrial Environment: Soil profile and soil microflora Aquatic Environment: Microflora of fresh water and marine habitats, Atmosphere: Aeromicroflora and dispersal of microbes, Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels.

Unit 2: Microbial Interactions

Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation, Microbe-Plant interaction: Symbiotic and non symbiotic interactions, Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria.

Unit 3: Biogeochemical Cycling

Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin, Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction, Phosphorus cycle: Phosphate immobilization and solubilisation, Sulphur cycle: Microbes involved in sulphur cycle, Other elemental cycles: Iron and manganese.

Unit 4: Waste Management

Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal

(composting and sanitary landfill), Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment.

Unit 5: Microbial Bioremediation

Principles and degradation of common pesticides, hydrocarbons (oil spills).

Unit 6: Water Potability

Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests.

References:

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.

2. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14th edition. Pearson/ Benjamin Cummings.

3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.

4. Okafor, N (2011). Environmental Microbiology of Aquatic & Waste systems. 1st edition, Springer, New York.

5. Singh A, Kuhad, RC & Ward OP (2009). Advances in Applied Bioremediation. Volume 17, Springer-Verlag, Berlin Hedeilberg.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT

Course Code: GMBE-202a Credit Units: 03

Course outcomes

1. **Insect Biology**: Understand the anatomy, physiology, and classification of insects.
2. **Ecological Roles**: Analyze the ecological importance of insects in ecosystems and their interactions with other organisms.
3. **Insect Behavior**: Explore the behavioral patterns and adaptations of insects.
4. **Pest Management**: Learn techniques for identifying and managing insect pests in agriculture and public health.
5. **Applied Entomology:** Apply knowledge of entomology in fields like pollination, biocontrol, and forensic science.

Unit 1: Soil Microbiology

Soil as Microbial Habitat, Soil profile and properties, Soil formation, Diversity and distribution of microorganisms in soil.

Unit 2: Mineralization of Organic & Inorganic Matter in Soil

Mineralization of cellulose, hemicelluloses, lignocelluloses, lignin and humus, phosphate, nitrate, silica, potassium.

Unit 3: Microbial Activity in Soil and Green House Gases

Carbon dioxide, methane, nitrous oxide, nitric oxide – production and control

Unit 4: Microbial Control of Soil Borne Plant Pathogens

Biocontrol mechanisms and ways, Microorganisms used as biocontrol agents against Microbial plant pathogens, Insects, Weeds.

Unit 5: Biofertilization, Phytostimulation, Bioinsecticides

Plant growth promoting bateria, biofertilizers – symbiotic (Bradyrhizobium, Rhizobium, Frankia), Non Symbiotic (Azospirillum, Azotobacter, Mycorrhizae, MHBs, Phosphate solubilizers, algae),

Novel combination of microbes as biofertilizers, PGPRs.

Unit 6: Secondary Agriculture Biotechnology

Biotech feed, Silage, Biomanure, biogas, biofuels – advantages and processing parameters.

References:

1. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,
2. Singh RS. (1998). Plant Diseases Management. 7th edition. Oxford & IBH, New Delhi.
3. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press,
4. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition.
5. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, AcademicPress.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

MANAGEMENT OF HUMAN MICROBIAL DISEASES

Course Code: SMBE-202 Credit Unit: 04

Course outcomes

6. **Insect Biology**: Understand the anatomy, physiology, and classification of insects.
7. **Ecological Roles**: Analyze the ecological importance of insects in ecosystems and their interactions with other organisms.
8. **Insect Behavior**: Explore the behavioral patterns and adaptations of insects.
9. **Pest Management**: Learn techniques for identifying and managing insect pests in agriculture and public health.
10. **Applied Entomology:** Apply knowledge of entomology in fields like pollination, biocontrol, and forensic science.

Unit 1: Importance of Diagnosis of Diseases

Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems, Disease associated clinical samples for diagnosis.

Unit 2: Collection of Clinical Samples

How to collect clinical samples (oral cavity, throat, skin, Blood, CSF, urine and faeces) and precautions required. Method of transport of clinical samples to laboratory and storage.

Unit 3: Direct Microscopic Examination and Culture

Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsastained thin blood film for malaria,Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, Distinct colony properties of various bacterial pathogens.

Unit 4: Serological and Molecular Methods

Serological Methods - Agglutination, ELISA, immunofluorescence, Nucleic acid based methods - PCR, Nucleic acid probes.

Unit 5: Kits for Rapid Detection of Pathogens

Typhoid, Dengue and HIV, Swine flu.

Unit 6: Testing for Antibiotic Sensitivity in Bacteria.

Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method.

References:

1. Ananthanarayan R and Paniker CKJ (2009). Textbook of Microbiology, 8th edition, Universities Press Private Ltd.

2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication.

3. Randhawa, VS, Mehta G and Sharma KB (2009) Practicals and Viva in Medical Microbiology 2nd edition, Elsevier India Pvt Ltd.

4. Tille P (2013) Bailey's and Scott's Diagnostic Microbiology, 13th edition, Mosby.

5. Collee JG, Fraser, AG, Marmion, BP, Simmons A (2007) Mackie and Mccartney Practical Medical Microbiology, 14th edition, Elsevier.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

BIOINFORMATICS

Course Code: CMBE-301 Credit Unit: 04

Course Outcomes

1. **Data Analysis**: Understand the principles of analyzing biological data using computational tools.
2. **Genomics and Proteomics**: Explore techniques for studying genomes, transcriptomes, and proteomes.
3. **Algorithm Development**: Apply algorithms for sequence alignment, phylogenetics, and molecular modeling.
4. **Database Management**: Learn to access, manage, and interpret biological databases.
5. **Applications**: Utilize bioinformatics in drug discovery, personalized medicine, and evolutionary studies.

Unit 1: Introduction to computational biology

What is computational biology and bioinformatics, internet and bioinformatics, chemoinformatics. Introduction to linux and common terminal commands.

Unit 2: Biological databases and genome browsers

Introduction to various databases and their classification (primary and secondary databases) e.g. NCBI, DDBJ, EMBL, ENSEMBL, UCSC and their use in laboratories: literature, sequence, structure, medical, enzymes and metabolic pathways databases.

Unit 3: Sequence alignment and visualization

Local and global sequence alignments (Needleman-Wunsch and Smith-Waterman algorithms), pair-wise (BLAST and FASTA algorithms) and multiple sequence alignment (Clustal W) and its importance. Theory behind BLAST- how Hidden Markov Model (HMM) can be used to model a family of unaligned sequences or a common motif within a set of unaligned sequences and further be used for discrimination and multiple alignment, BLAST score, amino acid substitution matrices, s-value and e-value, calculating the alignment score and significance of e and p value.

Unit 4: Phylogenetic analysis

Basics and tools for phylogenetic analysis, cladistics, tree-building methods (character anddistance

based methods), construction of phylogenetic trees (PHYLIP) and identifying homologs.

Unit 5: Microarray analysis

Introduction and use of DNA microarray to assay gene expression, designing of the experiment, analysis and biological interpretation, principle and applications of protein microarray.

References:

1. Bioinformatics: Sequence and Genome analysis, 2nd edition (2004), David W. Mount, Cold Spring Harbour Laboratory Press. ISBN-13: 978-0879697129.

2. Bioinformatics: A practical guide to the analysis of genes and proteins, 3rd edition (2004), Andreas D. Baxevanis and B.F. Francis Ouellette, John Wiley and Sons. ISBN-13: 978-0471478782.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

MICROBIOLOGICAL ANALYSIS OF AIR AND WATER

Course Code: CMBE-301a **Credit Unit: 04**

Course outcomes:

- Explain the importance of aseptic techniques in microbiological sampling.
- Describe various methods for sampling air and water.
- Identify the factors affecting microbial growth in air and water.
- Calculate microbial load in air and water samples.

Unit 1: Aeromicrobiology

Bioaerosols, Air borne microorganisms (bacteria, Viruses, fungi) and their impact on human health and environment, significance in food and pharma industries and operation theatres,allergens.

Unit 2: Air Sample Collection and Analysis

Bioaerosol sampling, air samplers, methods of analysis, CFU, culture media for bacteria and fungi, Identification characteristics.

Unit 3: Control Measures

Fate of bioaerosols, inactivation mechanisms – UV light, HEPA filters, desiccation, Incineration.

Unit 4: Water Microbiology

Water borne pathogens, water borne diseases.

Unit 5 Microbiological Analysis of Water

Sample Collection, Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive/MPN tests confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests.

References:

1. da Silva N, Taniwaki MH, Junqueira VC, Silveira N, Nascimento MS, Gomes RAR (2012)Microbiological Examination Methods of Food and WaterA Laboratory Manual, CRC Press.

2. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition.Benjamin/Cummings Science Publishing, USA.

3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.

4. Hurst CJ, Crawford RL, Garland JL, Lipson DA (2007) Manual of EnvironmentalMicrobiology, 3rd edition, ASM press.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

HOSPITAL MANAGEMENT

Course Code: CMBE-301b Credit Unit: 04

Course outcomes:

- to provide conceptual understanding of Management Concepts
- to familiarize the students with the contemporary issues in Management
- to understand and appreciate the human behaviour in organisations

UNIT - I Nature of Management -

Social Responsibilities of Business - Manager and Environment Levels in Management - Managerial Skills - Planning - Steps in Planning Process - Scope and Limitations - Short Range and Long Range Planning - Flexibility in Planning Characteristics of a sound Plan - Management by Objectives (MBO) - Policies and Strategies - Scope and Formulation - Decision Making - Techniques and Processes

UNIT – II An Overview of Staffing, Directing and Controlling

Functions - Organising - Organisation Structure and Design - Authority and Responsibility Relationships - Delegation of Authority and Decentralisation - Interdepartmental Coordination - Emerging Trends in Corporate Structure, Strategy and Culture - Impact of Technology on Organisational design - Mechanistic Vs Adoptive Structures - Formal and Informal Organisation

UNIT – III Perception and Learning -

Personality and Individual Differences - Motivation and Job Performance - Values, Attitudes and Beliefs - Stress Management - Communication TypesProcess - Barriers - Making Communication Effective

UNIT – IV Group Dynamics -

Leadership - Styles - Approaches - Power and Politics - Organisational Structure - Organisational Climate and Culture - Organisational Change and Development.

UNIT – V Comparative Management Styles and approaches -

Japanese Management Practices Organisational Creativity and Innovation - Management of Innovation - Entrepreneurial Management - Benchmarking - Best Management Practices across the world - Select cases of Domestic & International Corporations - Management of Diversity.

Suggested Books:

- Koontz, Weirich &Aryasri, PRINCIPLES OF MANAGEMENT, Tata McGraw-Hill, NewDelhi,2004
- Tripathi & Reddy, PRINCIPLES OF MANAGEMENT, Tata McGraw-Hill, New Delhi,2008
- Laurie Mullins, MANAGEMENT AND ORGANISATIONAL BEHAVIOUR, Pearson, NewDelhi,2007 Meenakshi Gupta, PRINCIPLES OF MANAGEMENT, PHI Learning, NewDelhi, 2009
- Fred Luthans, ORGANISA TIONAL BEHAVIOUR, TataMcGraw-Hill, NewDelhi
- Stephen Robbins, ORGANISATIONAL BEHAVIOUR, Pearson, New Delhi
- Ricky Griffin, MANAGEMENT: PRINCIPLES & APPLICATIONS, Cengage, NewDelhi,2008

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

SOIL & WATER MICROBIOLOGY

Course Code: CMBE-301c **Credit Unit: 04**

Course outcomes:

- To enrich students' knowledge and train them in epidemiology and Immunology.
- To present to the students the concept of epidemiology, chemotherapy, drug resistance and immune system.
- To inculcate sense of Scientific Responsibilities & Social Awareness.
- To familiarize students with epidemiology and Immunology .
- To introduce the basic concepts of epidemiology and Immunology.

Course detail:

Unit 1: Epidemiology

Aims and approaches of epidemiological studies. Basic measurements in Epidemiology. Measurement tools in epidemiology. Outline classification of epidemiological studies..Case control and cohort studies – Study design and application.

Unit II: Clinical trials of drugs and vaccines

Randomized control trials Concurrent parallel and cross-over trials and their applications. .Epidemiology of infectious diseases i. Sources and Reservoirs of Infection. Modes of Transmission of Infections. Disease Prevention and Control Measures.

Unit III: Introduction to Chemotherapy

.Classes of antibiotics.Selective toxicity, Bioavailability, MIC, MBC, LD50 .Antagonism and synergism in drugs.Concept of antibiotic sensitivity and drug resistance: (MDR,XDR,PDR).

Unit IV : Immunology

Immunity: Definition, Types innate and acquired, active and passive, humoral and cell mediated). Formation of blood cells (hematopoiesis): Myeloid and lymphoid lineages and differentiation process. Antigens and antibodies: definition and concept.

Unit V: Immunohematology

ABO and Rh blood group systems.Bombay blood group.Biochemistry of blood group substances.Inheritance of ABH antigens.Medico- legal applications of blood groups Active and Passive Immunization.Active Immunization -Whole organism vaccines i. Attenuated vaccines ii. Inactivated Vaccines iii. Recombinant vaccines iv. Conjugate vaccines v. Subunit vaccine vi.Toxoids.Passive Immunization Transfer of preformed antibodies.Latest Immunization schedule in India

Suggested Books :

YearBook TitleAuthor(s)2017Ananthanarayan and Paniker's Textbook of MicrobiologyReba Kanungo2004Collins and Lyne's Microbiological MethodsC. H. Collins, P. M. Lyne, J. M. Grange, J. O. III Falkingham2010Antibiotic and ChemotherapyR. Finch, D. Greenwood, R. Whitley, S. R. Norrby2019Park’s Preventive and Social medicineK. Park2013Medical Bacteriology Including Medical Mycology and AIDSN. C. Dey, T. K. Dey, D. SinhaZ

INSTRUMENTATION AND BIOTECHNIQUES

Course Code: CMBE-303 Credit Unit: 04

Course Outcomes

1. **Laboratory Techniques**: Master essential laboratory techniques in molecular biology and biotechnology.
2. **Instrumentation Skills**: Understand the principles and applications of instruments like spectrophotometers, chromatography, and PCR machines.
3. **Data Interpretation**: Analyze and interpret experimental data obtained through various biotechnological instruments.
4. **Biotech Applications**: Apply biotechnology techniques in fields like diagnostics, agriculture, and pharmaceuticals.
5. **Quality Control**: Learn the importance of quality control and standardization in biotechnology experiments.

Unit 1: Microscopy

Brightfield and darkfield microscopy, Fluorescence Microscopy, Phase contrast Microscopy, Confocal Microscopy, Electron Microscopy (Scanning and Transmission Electron Microscopy) and Micrometry.

Unit 2: Chromatography

Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography. Column packing and fraction collection. Gel filtration chromatography, ionexchange chromatography and affinity chromatography, GLC, HPLC.

Unit 3: Electrophoresis

Principle and applications of native polyacrylamide gel electrophoresis, SDS- polyacrylamide gel electrophoresis, 2D gel electrophoresis, Isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis.

Unit 4: Spectrophotometry

Principle and use of study of absorption spectra of biomolecules. Analysis of biomolecules using UV and visible range. Colorimetry and turbidometry.

Unit 5: Centrifugation

Preparative and analytical centrifugation, fixed angle and swinging bucket rotors. RCF and sedimentation coefficient, differential centrifugation, density gradient centrifugation and ultracentrifugation.

References:

1. Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed., Cambridge University Press.

2. Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company.

3. Willey MJ, Sherwood LM & Woolverton C J. (2013). Prescott, Harley and Klein's Microbiology. 9th Ed., McGraw Hill.

4. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.

5. De Robertis EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

MARINE MICROBIOLOGY

Course Code: CMBE-303a **Credit Unit: 04**

Course outcomes:

- Describe the major groups of marine microorganisms (bacteria, archaea, fungi, viruses, and protists).
- Explain the ecological roles of marine microorganisms in nutrient cycling, primary production, and biogeochemical processes.
- Discuss the factors influencing microbial diversity and distribution in marine environments.
- Explain the processes of microbial decomposition and mineralization of organic matter.
- Describe the role of marine microorganisms in biogeochemical cycles (carbon, nitrogen, sulfur, and phosphorus).
- Discuss the significance of microbial interactions with other organisms in marine food webs.

Unit 1: Marine Environment

World's oceans & Seas, Physio – Chemical properties of marine water, marine microbial habitat: water column, sediments, costal ecosystems, mangroves salt marshes. Bio-films & Microbial mats. Microbial life at surface of living & nonliving systems and microbial interactions. Quorum sensing in marine microbes and significance. Metabolic diversity and importance of microbial communities, Photo trophy & primary productivity.

Unit 2: Methods in Marine Microbiology

Sampling methods of different habitat of oceans and screening by CLSM & FCM. Importance of Culturable & non-Cultural microorganisms. Molecular tools to study marine diversity. Limitations of analysis of nucleic acid directly from marine environment.

Unit 3: Role of Microbes in ocean processes

Bioenergetics, Carbon & Nitrogen cycling in ocean, Photosynthesis and Primary productivity. Eutrophication of coastal areas. Microbial loop in ocean food web. Microbial processes and climate change. Bio – fouling & bio – deterioration, indicator organisms and pollution control. Symbiosis of microalgae with animals: Chemoautotrophic prokaryotes with animals. Symbionts of sponges, mixotrophy in protists. Metabolic consortia and mutualism between prokaryotes.

Unit 4: Marine Microbes

Bacterial and viral disease of fresh water, seawater, aqua culture: fish, bivalve mollusks, Crustaceans, corals. Diagnosis methods. Control of diseases. Biodegradation and Bioremediation of marine pollutants (oil, Organic comp. etc.).

Unit 5: Recent trends in Marine Microbiology

Recently identified microorganisms of marine ecosystem, there applications in present and future industries

Suggested books:

1. Munn, C. 2011. Marine Microbiology: Ecology and Applications. GS Publications. PP- 648.

2. Sekwon Kim. 2013. Marine Microbiology: Bioactive compounds and Biotechnologicalapplications. Wiley VCH.

3. Paul, J. 2001. Marine Microbiology. Academic Press. PP-666.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

VETERINARY SCIENCE

Course Code: CMBE-303b Credit Unit: 04

Course Outcomes:

- Understand the anatomical structure of domestic animals.
- Explain the physiological functions of various organ systems.
- Apply anatomical and physiological knowledge to diagnose and treat animal diseases.

- Understand the nutritional requirements of different animal species.
- Formulate balanced diets for various livestock and poultry.
- Evaluate the quality of feedstuffs.
- Apply principles of nutrition to improve animal health and productivity.

Unit 1: Animal Anatomy and Physiology

Gross Anatomy of Domestic Animals ,Histology of Animal Tissues, Physiology of Various Organ Systems (Digestive, Respiratory, Circulatory, Nervous, Endocrine, Reproductive)

Unit 2: Animal Nutrition and Feed Science

Nutrients and Their Functions, Feedstuffs: Classification and Composition, Feed Formulation and Ration Balancing, Ruminant Nutrition, Non-Ruminant Nutrition

Unit 3: Animal Reproduction and Genetics

Reproductive Physiology of Male and Female Animals, Artificial Insemination, Embryo Transfer Technology, Genetics and Breeding, Genetic Disorders in Animals

Unit 4: Animal Diseases

Infectious Diseases (Bacterial, Viral, Fungal, Parasitic), Non-Infectious Diseases (Nutritional, Metabolic, Toxic), Clinical Examination and Diagnosis, Disease Prevention and Control, Zoonotic Diseases

Unit 5: Animal Health and Welfare

Animal Welfare Principles, Humane Slaughter and Handling, Veterinary Public Health, Zoonotic Disease Control, Animal Ethics and Legislation.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Textbook of Veterinary Anatomy *by Sisson and Grossman*	1979
2.	Veterinary Physiology *by Cunningham and Klein*	2009
3.	Livestock Feeds and Feeding *by Morrison*	2009
4.	Animal Nutrition *by Church and Pond*	2002

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

FOOD AND DAIRY MICROBIOLOGY

Course Code: DMBE-301 Credit Unit: 04

Course Outcomes

1. **Microbial Contamination**: Understand the types and sources of microbial contamination in food and dairy products.
2. **Fermentation Processes**: Learn the role of microorganisms in food fermentation and dairy production.
3. **Food Preservation**: Analyze microbial control methods for food preservation, including pasteurization and refrigeration.
4. **Foodborne Pathogens**: Identify pathogenic microorganisms and their role in foodborne illnesses.
5. **Quality Control**: Apply microbiological techniques for assessing food safety and quality in food and dairy industries.

Unit 1: Foods as a substrate for microorganisms

Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general.

Unit 2: Microbial spoilage of various foods

Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods.

Unit 3: Principles and methods of food preservation

Principles, physical methods of food preservation: temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids, SO2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins.

Unit 4: Fermented foods

Dairy starter cultures fermented dairy products: yogurt, acidophilus milk, kumiss, kefir, dahi and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.

Unit 5: Food borne diseases

Food intoxications: Staphylococcus aureus, Clostridium botulinum and mycotoxins; Food infections: Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli, Salmonellosis, Shigellosis, Yersinia enterocolitica, Listeria monocytogenes and Campylobacter jejuni.

References:

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.

2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.

3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.

4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation.CAB International, Wallingford, Oxon.

5. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

DEVELOPMENTAL BIOLOGY AND EMBRYOLOGY

Course Code: DMBE-301a **Credit Unit: 04**

Course outcomes:

- Define key terms in developmental biology, such as differentiation, morphogenesis, and pattern formation.
- Explain the central dogma of molecular biology and its relevance to development.
- Describe the different stages of embryonic development, from fertilization to organogenesis.
- Understand the concept of cell fate determination and potency.
- Describe the process of fertilization, including sperm-egg recognition and fusion.
- Explain the early cleavage divisions and the formation of the blastula.
- Understand the process of gastrulation and the formation of germ layers.
- Describe the mechanisms of cell fate specification and differentiation.

Unit 1: Introduction to Developmental Biology

Basic concepts of development, central dogma of molecular biology, model organisms, techniques in developmental biology.

Unit 2: Fertilization and Early Embryonic Development

Gametogenesis, fertilization, cleavage, gastrulation, formation of germ layers.

Unit 3: Organogenesis and Morphogenesis

Neurulation, organogenesis, cell signaling pathways, morphogenesis.

Unit 4: Stem Cells and Regeneration

Stem cells, properties of stem cells, applications of stem cell research, regeneration.

Unit 5: Evolutionary Developmental Biology (Evo-Devo)

Evolutionary developmental biology, homology and analogy, genetic toolkit, heterochrony and heterotopy, evolution of novel structures and body plans

Suggested books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
1.	Principles of Developmental Genetics	2014

2.	Developmental Biology	2018
3.	Signaling Pathways in Development	2000
4.	Molecular Biology of the Cell	2015
5.	Stem Cell Biology	2011

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

POPULATION BIOLOGY

CourseCode:DMBE-303b **Credit Unit: 04**

Course Outcomes:

- Understand the fundamental concepts of population ecology, including population size, density, distribution, and growth rates.
- Apply mathematical models (exponential and logistic growth) to analyze population dynamics.
- Evaluate the impact of density-dependent and density-independent factors on population regulation.
- Explain the Hardy-Weinberg equilibrium principle and its assumptions.
- Analyze the effects of genetic drift, gene flow, and natural selection on population genetic structure.
- Apply quantitative genetics concepts to understand phenotypic variation and heritability.

Unit 1: Introduction to Population Ecology

Definition, scope, population characteristics, dynamics, growth models, life history strategies, population regulation.

Unit 2: Population Genetics

Hardy-Weinberg equilibrium, genetic drift, gene flow, natural selection, quantitative genetics, molecular evolution, conservation genetics.

Unit 3: Population Interactions

Interspecific interactions, intraspecific interactions, ecological niches, Lotka-Volterra models, community ecology, ecological succession.

Unit 4: Population Demography

Life tables, survivorship curves, reproductive rates, population projections, demographic transition, human population dynamics.

Unit 5: Conservation Biology

Biodiversity loss, conservation strategies, habitat fragmentation, population viability analysis,

wildlife management, ecosystem services.

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Principles of EcologyE.P. Odum	1983
2.	Fundamentals of EcologyEugene P. Odum	1971
3.	Ecology: Individuals, Populations, and CommunitiesM. Begon, J.L. Harper, C.R. Townsend	1996
4.	Population Ecology: A TreatiseBrian Dennis2014Population Ecology: A Unified ApproachAlan Berryman	2002
5.	Population Dynamics: A Theoretical and Empirical ApproachRobert M. May	1976

Bioinformatics Lab

Course Code: CMBE-351 **Credit Units: 01**

Pre-requisite: Basic knowledge of computer application

Course Outcome:

11. Students will be able to understand basics of internet and computers along with information on various databases.
12. Students will be able to understand application of bioinformatics in biotechnology.
13. Students will be able to understand sequence alignment and various algorithms for it.
14. Students will be able to understand and interpret sequence annotation and its retrieval.
15. The information about various biologically important databases will be made available to students.

Details of the Course:-

Note: A college must offer 70% of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available.

S. NO.	CONTENTS	CONTACT HOURS
1	Introduction to various databases of proteins, nucleic acids. Primary, secondary and composite databases.	3
2	BLAST, FASTA, DOT PLOT	3
3	MSA using various free tools.	3
4	Phylognetic predictions.	3
5	Prediction of structure of proteins and nucleic acids	3
6	ORF prediction and its validation	3
7	Primer designing	3
8	Restriction mapping	3
9	Epitope prediction using various online tools	3
10	Data mining tool and its practical applications in a case study	3

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text/Reference Books	
1.	Bioinformatics: Principles and Applications.Ghosh Z. and Bibekanand M., OxfordUniversity Press, 2008.	2015
2.	Genome analysis and bioinformatics: a practical approach. T.R. Sharma, I.K.International Publishing House Pvt. Ltd., 2009.	2009
3.	Bioinformatics and Functional Genomics, Pevsner J. II Edition, Wiley-Blackwell, (2009).	2015
4.	Discovering Genomics, Proteomics and Bioinformatics, Campbell A. M., Heyer L. J.,II Edition. Benjamin Cummings, 2006.	2006
5.	Bioinformatics: A practical guide to analysis of genes and proteins, Andreas D. Baxevanis, Wiley Student edition,	2006
6.	Bioinformatics, Sequence and genome analysis by David W. Mount, Second Edition, CSHL Press, 2004	2004

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

Instrumentation and Biotechniques Laboratory

Course Code: CMBE-353 **Credit Units: 01**

Pre-requisite: Basic knowledge of Biochemistry and Molecular Biology

Course Outcome:
After completion of the course, the students will be able to:

1. Understand the principles and applications of key bioinstrumentation tools.
2. Operate and troubleshoot laboratory instruments used in modern biological research.
3. Perform techniques such as spectrophotometry, chromatography, and electrophoresis.
4. Analyze biological samples using advanced laboratory techniques.
5. Integrate bioinstrumentation and biotechniques in molecular, biochemical, and cellular studies.

Details of the Laboratory Course:
Note: A college must offer 70% of the below-listed experiments. The remaining 30% experiments may be modified by the college according to available facilities.

S. No.	Contents	Contact Hours
1	**Principles and Operation of Spectrophotometer**: Measurement of absorption spectra and concentration using Beer-Lambert's law.	3
2	**Chromatographic Techniques**: Separation of biomolecules using thin-layer chromatography (TLC) and column chromatography.	3
3	**Electrophoresis**: Separation of proteins or nucleic acids using SDS-PAGE and agarose gel electrophoresis.	3
4	**Centrifugation Techniques**: Separation of cell components and biomolecules using differential and density gradient centrifugation.	3
5	**pH Meter Calibration and Use**: Measurement of pH for various biological samples and buffers.	2
6	**Fluorometry**: Use of fluorescence spectrophotometry for protein and DNA quantification.	2
7	**ELISA**: Perform Enzyme-Linked Immunosorbent Assay for antigen or antibody detection.	3
8	**Microscopy Techniques**: Observation of biological specimens using phase-contrast and fluorescence microscopy.	2
9	**Protein Estimation**: Estimation of proteins using Bradford or Lowry method.	3
10	**Molecular Techniques**: DNA extraction and its quantification using NanoDrop or spectrophotometer.	2

Suggested Books:

Text Books

1. **Principles and Techniques of Biochemistry and Molecular Biology** – Wilson, K., and Walker, J., Cambridge University Press, 2018.
2. **Practical Biochemistry** – David Plummer, McGraw Hill Education, 2009.
3. **Biophysical Chemistry: Principles and Techniques** – Upadhyay, Upadhyay, and Nath, Himalaya Publishing House, 2016.

References

1. **Bioinstrumentation** – Webster J.G., Wiley-Interscience, 2004.
2. **Techniques in Molecular Biology** – Vinay Sharma, Academic Press, 2017.
3. **Fundamentals of Bioanalytical Techniques and Instrumentation** – Sabari Ghoshal, PHI Learning, 2010.
4. **Analytical Biochemistry** – Holme and Peck, Pearson Education, 2014.

Examination Scheme:

Components	Internal Assessment	External Evaluation
Attendance	10%	
Viva-Voce	20%	
Practical Record	10%	
Weightage		60%

Minor Project

Course Code: **DMBE-351** **Credit Units**: **01**

Pre-requisite: Basic understanding of microbiological techniques and concepts.

Course Outcome:

After completion of the course, students will be able to:

1. Design and execute a research-based microbiological project.
2. Develop technical skills in handling microbiological tools and techniques.
3. Analyze experimental results and interpret findings scientifically.
4. Prepare scientific reports and presentations effectively.
5. Apply theoretical microbiological knowledge to practical and real-world problems.

Details of the Course:

- **Project Description**:
  The minor project will involve identifying a microbiological problem or question, formulating a hypothesis, conducting experiments, and reporting the findings. Students will work in small groups or individually under the guidance of a faculty member.
- **Suggested Topics** (examples):
  1. Isolation and characterization of bacteria from soil, water, or food samples.
  2. Antimicrobial activity of plant extracts or synthesized nanoparticles.
  3. Study of the role of probiotics in gut microbiota.
  4. Bioremediation potential of soil microorganisms.
  5. Microbial diversity analysis in a specific environment using culture and non-culture methods.
  6. Testing the efficiency of household disinfectants on microbial populations.
  7. Investigation of fungal species in a particular habitat (e.g., air, soil).
  8. Study of biofilm formation and its inhibition using natural or synthetic agents.
- **Project Workflow**:
  1. Identification of research topic and literature review (Week 1).
  2. Experimental design and resource allocation (Week 2).
  3. Conducting experiments and data collection (Weeks 3–6).
  4. Analysis of results and compilation of data (Week 7).
  5. Preparation of project report and presentation (Week 8).
- **Report Submission**:
  A comprehensive project report must be submitted, including an introduction, materials and methods, results, discussion, conclusion, and references.
- **Evaluation Scheme**:
- **Evaluation Scheme**:

Components	Project Proposal	Execution of the Work	Practical Skills	Final Report	Oral Presentation
Weightage (%)	10%	30%	20%	20%	20%

Suggested References:

1. **Research Methods in Microbiology** – Elsevier, 2014.
2. **Practical Microbiology** – R.C. Dubey and D.K. Maheshwari, S. Chand Publishing, 2021.
3. **Experiments in Microbiology, Plant Pathology, and Biotechnology** – K.R. Aneja, New Age International, 2017.
4. Relevant research articles and journal publications depending on the chosen topic.

Industrial Biotechnology Laboratory

Course Code: **SMBE-551** **Credit Units: 01**

Pre-requisite: Basic understanding of microbiology, molecular biology, and biochemistry.

Course Outcome:

After completion of the course, students will be able to:

1. Learn fermentation techniques and operate industrial bioprocess equipment.
2. Develop skills in the production and analysis of biotechnological products.
3. Understand the principles of enzyme kinetics and immobilization.
4. Explore microbial processes for the production of biofuels, antibiotics, and other bio-products.
5. Perform downstream processing techniques for product purification.

Details of the Laboratory Course:

Note: A college must offer 70% of the below-listed experiments. The remaining 30% experiments may be modified by the college according to available facilities.

S. No.	Contents	Contact Hours
1	**Screening of Industrially Important Microorganisms**: Isolation and characterization from soil or water.	3
2	**Submerged and Solid-State Fermentation**: Production of enzymes or bioactive compounds.	3
3	**Enzyme Kinetics Study**: Determination of Km and Vmax using a model enzyme (e.g., amylase, lipase).	3
4	**Immobilization Techniques**: Entrapment and activity assay of immobilized enzymes.	3
5	**Production of Alcohol/Biofuels**: Fermentation of sugars by Saccharomyces cerevisiae or other microbes.	3
6	**Antibiotic Production and Assay**: Penicillin production and antibacterial activity testing.	3
7	**Batch Fermentation**: Monitoring parameters like pH, temperature, and dissolved oxygen during a batch culture.	3
8	**Downstream Processing**: Product recovery using centrifugation, filtration, and solvent extraction.	3
9	**Bioassay Techniques**: Determining the biological activity of a product (e.g., vitamins, antibiotics).	2
10	**Bioplastic Production**: Synthesis and analysis of polyhydroxyalkanoates (PHA) from microbial cultures.	3

Suggested Books:

Text Books

1. **Industrial Microbiology** – Prescott and Dunn, CBS Publishers, 5th Edition, 2007.
2. **Principles of Fermentation Technology** – P. F. Stanbury, A. Whitaker, and S. J. Hall, Butterworth-Heinemann, 3rd Edition, 2016.
3. **Biochemical Engineering Fundamentals** – James E. Bailey and David F. Ollis, McGraw-Hill, 1986.

References

1. **Comprehensive Biotechnology** – Moo-Young, M., Pergamon Press, 2nd Edition, 2011.
2. **Biotechnology: A Laboratory Course** – Becker, J., and Caldwell, G., Academic Press, 1996.
3. **Manual of Industrial Microbiology and Biotechnology** – Demain and Solomon, ASM Press, 3rd Edition, 2010.
4. **Biotechnology: Concepts and Applications** – H. D. Kumar, East-West Press, 2007.

Examination Scheme:

Components	Project Proposal	Execution of the Work	Practical Skills	Final Report	Oral Presentation
Weightage (%)	10%	30%	20%	20%	20%

This syllabus emphasizes key practical aspects of Industrial Biotechnology, including fermentation, enzyme technology, product recovery, and bioprocess analysis, to prepare students for industrial and research roles in biotechnology.

GENETIC ENGINEERING AND BIOTECHNOLOGY

Course Code: GMBE-201 **Credit Unit: 03**

1. Molecular Tools: Understand the principles and tools used in gene cloning and genetic engineering.
2. Vector Design: Learn the construction and application of cloning and expression vectors.
3. Gene Manipulation: Demonstrate proficiency in techniques like PCR, restriction digestion, and ligation.
4. Applications: Explore the use of recombinant DNA in medicine, agriculture, and industry.
5. Ethics and Safety: Analyze the ethical, legal, and biosafety considerations of genetic engineering.

Unit 1: Introduction to genetic engineering

Milestones in genetic engineering and biotechnology, Restriction modification systems: Mode ofaction, applications of Type II restriction enzymes in genetic engineering, DNA modifying enzymes and their applications: DNA polymerases. Terminal deoxynucleotidyl transferase, kinases and phosphatases, and DNA ligases, Cloning: Use of linkers and adaptors Transformation of DNA: Chemical method, Electroporation Methods of DNA, RNA and Protein analysis: Agarose gel electrophoresis, Southern - and Northern - blotting techniques, dot blot, DNA microarray analysis, SDS-PAGE and Western blotting.

Unit 2: Vectors

Cloning Vectors: Definition and Properties, Plasmid vectors: pBR and pUC series, Bacteriophage lambda and M13 based vectors, Cosmids, BACs, YACs, Expression vectors: E.coli lac and T7 promoter-based vectors, yeast YIp, YEp and YCp vectors, Baculovirus based vectors, mammalian SV40-based expression vectors.

Unit 3: DNA Amplification and DNA sequencing

PCR: Basics of PCR, RT-PCR, Real-Time PCR, Genomic and cDNA libraries: Preparation and uses, Genome sequencing, Sanger's method of DNA Sequencing: traditional and automated sequencing.

Unit 4 Application of Genetic Engineering and Biotechnology

Gene delivery: Microinjection, electroporation, biolistic method (gene gun), liposome and viral mediated delivery, Agrobacterium - mediated delivery, Products of recombinant DNA technology: Products of human therapeutic interest - insulin, hGH, antisense molecules. Bt transgenic - cotton, brinjal, flavo savo tomato, Gene therapy, recombinant vaccine, protein engineering.

Unit 5 Intellectual Property Rights

Patents, Copyrights, Trademarks.

References:

1. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing,Oxford, U.K.

2. Clark DP and Pasternik NJ. (2009). Biotechnology: Applying the Genetic Revolution. ElsevierAcademic Press, USA.

3. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7thedition. Blackwell Publishing, Oxford, U.K.

4. Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. ColdSpring Harbor Laboratory Press.

5. Wiley JM, Sherwood LM and Woolverton CJ. (2013). Prescott, Harley and Klein's Microbiology. 8th edition, McGraw Hill Higher Education.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

GENOME ORGANISATION AND FUNCTION

Course Code: GMBE-503 **Credit Unit: 03**

Course outcomes:

- Explain the structure and organization of DNA, including the concept of the double helix.
- Describe the different levels of DNA packaging, from nucleosomes to chromosomes.
- Discuss the concept of genome size and its relationship to organismal complexity.
- Explain the semi-conservative mechanism of DNA replication.
- Describe the role of DNA polymerases and other enzymes in DNA replication.
- Discuss the various types of DNA repair mechanisms, including base excision repair, nucleotide excision repair, and mismatch repair.

Unit 1: Introduction to Genomics Genome structure, genome size and complexity, the human genome project, functional genomics, structural genomics, comparative genomics.

Unit 2: DNA Replication and Repair DNA replication mechanisms, DNA repair mechanisms, DNA damage and mutagenesis.

Unit 3: Transcription and RNA Processing Transcription initiation, elongation, and termination, RNA polymerase, RNA processing (capping, splicing, polyadenylation), RNA stability and degradation.

Unit 4: Translation and Protein Synthesis Genetic code, ribosome structure and function, translation initiation, elongation, and termination, protein folding and post-translational modifications.

Unit 5: Gene Regulation Gene regulation in prokaryotes and eukaryotes, transcriptional regulation, post-transcriptional regulation, translational regulation, epigenetic regulation.

Suggested books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text/Reference Books	
1.	Molecular Biology of the CellAlberts, Johnson, Lewis, Raff, Roberts, Walter	Various Editions
2.	Genetics: A Conceptual ApproachBenjamin A. Pierce.	Various Editions
3.	Principles of GeneticsD. Peter Snustad and Michael J. Simmons	Various Editions

4.	Molecular Biology of the GeneJames D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick	Various Editions
5.	BiologyT.A. BrownVarious Editions	Various Editions

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

INDUSTRIAL BIOTECHNOLOGY

Course Code:SMBE-501 Credit Unit: 03

Course outcomes:

Pre-requisite: Basic knowledge of biotechnology

Course Outcome:

- Students will be able to understand the technologies for microbial cell maintenance.
- Students will learn about bioprocess technology.
- Students will be able to understand fermenters.

Details of the Course:

UNIT -1

Technology of Microbial Cell Maintenance Principles of Microbial growth, Methods to increase yield of microbes, Batch, fed- batch and continuous cultures (definition and kinetics). Strain preservation, maintenance and strain improvement by mutation ofgene transfer processes. Microbial culture selection with high yield potential. Commercial Production of Microorganisms.

UNIT -2

Production of Primary Metabolites A brief outline ofprocesses for the production of some commercially important organic acids (e.g. citric acid, lactic acid, acetic acid etc.,); amino acids (glutamic acid, phenyalanine, aspartic acid etc.,) and alcohols (ethanol, butanol etc.,)

UNIT -3

Production of Secondary Metabolites Study of productionprocesses for various classes of secondary metabolites: antibiotics: betalactams (penicillin, cephalosporin etc.), aminoglycosides (streptomycin etc.,) macrolides (erythromycin), vitamins and steroids.

UNIT -4

Design and construction of a Fermentors: Body construction; construction material; Aeration and agitation systems;Stirrer glands and bearings; Baffles; Valves and steam traps; Pressure-control valves; computer applications in fermentation technology; specialized bioreactors; membrane bioreactors; tower bioreactors; fluidized bed bioreactors; Immobilized system and packed bedreactors and Photobioreactors.

UNIT -5

Production Modern Biotechnology Products Productionof recombinant proteins having therapeutic and diagnostic applications, production of vaccines. Production of monoclonal antibodies. Products of plant and animal cell culture.

Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	W. Crueger and A. Crueger. Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.	2000
2.	P.F. Stanbury and A. Whitaker-Principle of Fermentation Technology; Pergamon Press	1988
3	A.H. Patel. Industrial Microbiology. 1st edition, Macmillan India Limited.	1996
	Reference Books	
1.	L.E. Casida. Industrial Microbiology. 1st edition. Wiley Eastern Limited.	1991
2	M. L. Shuler and F. Kargi-Bioprocess Engineering: Basic Concepts" by, 2nd Edition, Pearson Education	2001

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

INDUSTRIAL BIOTECHNOLOGY LAB

Course Code:SMBE-551 Credit Unit: 01

Pre-requisite: Basic knowledge of cell biology, biotechnology.

Course Outcome:

After completion of the course the students will be able to

- To acquire a comprehensive knowledge on animal biotechnology and applications.
- To become familiar with technical requirements, concepts and general procedures in animal cell culture and implement the knowledge in research work.
- To learn and implement different strategies to grow store cell lines.
- To understand the methods to test cell viability.
- To visualize cell lines using different microscopic methods.

Details of the Course:-

Note: A college must offer 70%of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available.

S. NO.	CONTENTS	CONTACT HOURS
1	Preparation of animal cell culture medium.	3
2	Revival of cell line	3
3	Cell line counting	3
4	Cell line Viability testing (Trypan blue, MTT method)	3
5	Trypsinization (Cell passaging)	3
6	Storage of cell line	3
7	Isolation of Primary cell culture from Organs (Liver)	3
8	Imaging of cell line (Phase contrast microscopy, Fluorescence microscopy)	3
9	Sterilization of animal cell culture, serum and medium.	3

Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1	Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, R. Ian Freshney. 6th edition	2011

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20	10	60

FOOD FERMENTATION TECHNIQUES

Course Code: DMBE-305 Credit Unit: 04

1. Fermentation Basics: Understand the principles and processes of fermentation in food production.
2. Microorganism Roles: Learn the roles of yeast, bacteria, and molds in food fermentation.
3. Fermented Products: Explore the production and characteristics of various fermented foods like bread, yogurt, and beverages.
4. Fermentation Control: Analyze methods to control fermentation parameters for desired product outcomes.
5. Health Benefits: Examine the nutritional, sensory, and probiotic benefits of fermented foods.

Unit 1: Fermented Foods

Definition, types, advantages and health benefits

Unit 2: Milk Based Fermented Foods

Dahi, Yogurt, Buttermilk (Chach) and cheese: Preparation of inoculums, types of microorganisms and production process

Unit 3: Grain Based Fermented Foods

Soy sauce, Bread, Idli and Dosa: Microorganisms and production process

Unit 4: Vegetable Based Fermented Foods

Pickels, Saeurkraut: Microorganisms and production process

Unit 5: Fermented Meat and Fish

Types, microorganisms involved, fermentation process

Unit 6: Probiotic Foods

Definition, types, microorganisms and health benefits

References:

1. Hui YH, Meunier-Goddik L, Josephsen J, Nip WK, Stanfield PS (2004) Handbook of food and fermentation technology, CRC Press.

2. Holzapfel W (2014) Advances in Fermented Foods and Beverages, Woodhead Publishing.

3. Yadav JS, Grover, S and Batish VK (1993) A comprehensive dairy microbiology, Metropolitan.

4. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

FOOD FERMENTATION TECHNIQUES LAB

Course Code: DMBE-355 **Credit Unit: 01**

Course outcomes:

- Understand the fundamental principles of microbial fermentation.
- Identify various microorganisms involved in food fermentation.
- Explain the role of environmental factors (temperature, pH, oxygen, etc.) in fermentation
- Differentiate between various fermentation techniques (lactic acid, alcoholic, acetic acid,
- Understand the importance of starter cultures in fermentation.

1. **Lactic Acid Fermentation:**
   - **Foods:** Yogurt, sauerkraut, kimchi, pickles
   - **Microorganisms:** Lactic acid bacteria (LAB)
   - **Process:** Anaerobic fermentation of sugars into lactic acid, resulting in acidic products.
2. **Alcoholic Fermentation:**
   - **Foods:** Wine, beer, cider, sake
   - **Microorganisms:** Yeast
   - **Process:** Anaerobic conversion of sugars into alcohol and carbon dioxide.
3. **Acetic Acid Fermentation:**
   - **Foods:** Vinegar
   - **Microorganisms:** Acetic acid bacteria
   - **Process:** Aerobic oxidation of ethanol into acetic acid.
4. **Soy Sauce Fermentation:**
   - **Foods:** Soy sauce
   - **Microorganisms:** Aspergillus oryzae, yeast, bacteria
   - **Process:** A complex fermentation process involving koji mold, yeast, and bacteria, resulting in a salty, umami-rich sauce.
5. **Miso Fermentation:**
   - **Foods:** Miso paste
   - **Microorganisms:** Aspergillus oryzae, yeast, bacteria
   - **Process:** A fermentation process similar to soy sauce, but with different ratios of ingredients and longer fermentation times.
6. **Tempeh Fermentation:**
   - **Foods:** Tempeh
   - **Microorganisms:** Rhizopus oligosporus
   - **Process:** Fungal fermentation of soybeans, resulting in a protein-rich, fermented food.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Viva-Voce	Practical Record	
Weightage (%)	10	20 18	10	60

PLANT PATHOLOGY

Course Code: CMBE-302 Credit Unit: 04

Course outcomes

1. Disease Identification: Identify and classify plant diseases caused by fungi, bacteria, viruses, and other pathogens.
2. Pathogen-Host Interaction: Understand the mechanisms of plant-pathogen interactions and how diseases affect plant health.
3. Disease Management: Learn strategies for managing and controlling plant diseases, including chemical, biological, and cultural methods.
4. Plant Immune Response: Explore plant defense mechanisms and the molecular basis of plant immunity.
5. Impact on Agriculture: Assess the economic and ecological impact of plant diseases on agriculture and food security.

Unit 1: Introduction and History of plant pathology

Concept of plant disease- definitions of disease, disease cycle & pathogenicity, symptoms associated with microbial plant diseases, types of plant pathogens, economic losses and social impact of plant diseases. Significant landmarks in the field of plant pathology- Contributions of Anton DeBary, Millardet, Burrill, E. Smith, Adolph Mayer, Ivanowski, Diener, Stakman, H.H. Flor, Van Der Plank, molecular Koch's postulates. Contributions of eminent Indian plant pathologists.

Unit 2 Stages in development of a disease

Infection, invasion, colonization, dissemination of pathogens and perennation.

Unit 3 Plant disease epidemiology

Concepts of monocyclic, polycyclic and polyetic diseases, disease triangle & disease pyramid, Forecasting of plant diseases and its relevance in Indian context.

Unit 4 Host Pathogen Interaction

A. Microbial Pathogenicity

Virulence factors of pathogens: enzymes, toxins (host specific and non specific) growth regulators, virulence factors in viruses (replicase, coat protein, silencing suppressors) in disease development. Effects of pathogens on host physiological processes (photosynthesis, respiration, cell membrane

permeability, translocation of water and nutrients, plant growth and reproduction).

B. Genetics of Plant Diseases

Concept of resistance (R) gene and avirulence (avr) gene; gene for gene hypothesis, types of plant resistance: true resistance– horizontal & vertical, apparent resistance.

C. Defense Mechanisms in Plants

Concepts of constitutive defense mechanisms in plants, inducible structural defenses (histologicalcork layer, abscission layer, tyloses, gums), inducible biochemical defenses

[hypersensitive response (HR), systemic acquired resistance (SAR), phytoalexins, pathogenesis related (PR) proteins, plantibodies, phenolics, quinones, oxidative bursts].

Unit 5 Control of Plant Diseases

Principles & practices involved in the management of plant diseases by different methods, viz. regulatory - quarantine, crop certification, avoidance of pathogen, use of pathogen free propagative material, cultural - host eradication, crop rotation, sanitation, polyethylene traps and mulches, chemical - protectants and systemic fungicides, antibiotics, resistance of pathogens to chemicals. Biological - suppressive soils, antagonistic microbes-bacteria and fungi, trap plants genetic engineering of disease resistant plants- with plant derived genes and pathogen derived genes.

Unit 6 Specific Plant diseases

Study of some important plant diseases giving emphasis on its etiological agent, symptoms, Epidemiology and control.

A. Important diseases caused by fungi, White rust of crucifers - Albugo candida, Downy mildew of onion - Peronospora destructor Late blight of potato - Phytophthora infestans, Powderymildew of wheat - Erysiphe graminis, Ergot of rye - Claviceps purpurea, Black stem rust of wheat - Puccinia graminis tritici, Loose smut of wheat - Ustilago nuda, Wilt of tomato - Fusarium oxysporum f.sp. lycopersici, Red rot of sugarcane - Colletotrichum falcatum, Early blight of potato - Alternaria solani.

B. Important diseases caused by phytopathogenic bacteria: Angular leaf spot of cotton, bacterial leaf blight of rice, crown galls, and bacterial cankers of citrus.

C. Important diseases caused by phytoplasmas: Aster yellow, citrus stubborn.

D. Important diseases caused by viruses: Papaya ring spot, tomato yellow leaf curl, banana bunchy top, rice tungro.

E. Important diseases caused by viroids: Potato spindle tuber, coconut cadang cadang.

References:

1. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego.

2. Lucas JA. (1998). Plant Pathology and Plant Pathogens. 3rd edition. Blackwell Science, Oxford.

3. Mehrotra RS. (1994). Plant Pathology. Tata McGraw-Hill Limited.

4. Rangaswami G. (2005). Diseases of Crop Plants in India. 4th edition. Prentice Hall of India Pvt. Ltd., New Delhi.

5. Singh RS. (1998). Plant Diseases Management. 7th edition. Oxford & IBH, New Delhi.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Medicinal Microbiology

Course Code: CMBE-302a **Credit Units**: 03

Pre-requisite: Basic understanding of microbiology, bacteriology, and immunology.

Course Outcome:

After completion of this course, students will be able to:

1. Understand the relationship between microorganisms and human diseases.
2. Identify the major pathogens responsible for infectious diseases.
3. Learn the principles of microbial pathogenesis, diagnosis, and treatment.
4. Analyze the role of the immune system in defense against infections.
5. Develop skills for laboratory diagnosis and interpretation of microbial infections.

Details of the Course:

S. No.	Contents	Contact Hours
1	**Introduction to Medical Microbiology**: Role of microbiology in medicine, history, and scope of medical microbiology.	4
2	**Microbial Classification and Identification**: Bacteria, viruses, fungi, and parasites. Methods of identification and classification.	6
3	**Pathogenesis and Disease Mechanisms**: Virulence factors, microbial adhesion, invasion, immune evasion.	8
4	**Bacterial Infections**: Common bacterial pathogens, diseases caused by bacteria, diagnostic techniques, and antimicrobial therapy.	8
5	**Viral Infections**: Classification, structure, replication, and diseases caused by viruses (e.g., HIV, influenza, hepatitis).	8
6	**Fungal and Parasitic Infections**: Diseases caused by fungi (e.g., candidiasis, aspergillosis) and parasites (e.g., malaria, giardiasis).	6
7	**Microbial Diagnosis**: Laboratory techniques for diagnosing infections (e.g., Gram staining, PCR, ELISA, culture methods).	6
8	**Antimicrobial Resistance**: Mechanisms of resistance, multidrug-resistant organisms (MDRO), and strategies to combat resistance.	4
9	**Immunology in Medical Microbiology**: Role of the immune system in infection control, immunization, and diagnostic immunology.	6
10	**Hospital-Acquired Infections (HAIs)**: Epidemiology, control, and prevention of hospital-acquired infections.	4

Suggested Books:

Text Books

1. **Medical Microbiology** – Patrick R. Murray, Ken S. Rosenthal, and Michael A. Pfaller, Elsevier, 8th Edition, 2015.
2. **Sherris Medical Microbiology** – Kenneth J. Ryan, C. George Ray, McGraw-Hill, 6th Edition, 2018.

References

1. **Medical Microbiology: A Guide to Microbial Infections** – P.M. Johnson, Elsevier, 7th Edition, 2015.
2. **Medical Microbiology and Infection at a Glance** – Stephen Gillespie and Kathleen Bamford, Wiley-Blackwell, 2nd Edition, 2015.
3. **Clinical Microbiology Made Ridiculously Simple** – Mark Gladwin and William Trattler, MedMaster, 7th Edition, 2015.

Examination Scheme:

Components	Attendance	Assignments	Midterm Exam	Final Exam
Weightage (%)	10%	20%	30%	40%

MARINE MICROBIOLOGY

Course Code: CMBE-304 **Credit Unit: 04**

Course Outcomes

- Marine Microbial Diversity: Understand the diversity and ecological roles of microorganisms in marine environments.
- Microbial Ecosystems: Analyze the structure and function of marine microbial communities in various habitats.
- Biogeochemical Cycles: Explore the role of marine microorganisms in nutrient cycling and energy flow in marine ecosystems.
- Marine Pathogens: Identify marine microorganisms that contribute to disease in marine organisms and humans.
- Biotechnology Applications: Apply knowledge of marine microbes to biotechnological innovations in areas like bioremediation and biofuels.

Unit 1: Marine Environment

World's oceans & Seas, Physio – Chemical properties of marine water, marine microbial habitat: water column, sediments, costal ecosystems, mangroves salt marshes. Bio-films & Microbial mats. Microbial life at surface of living & nonliving systems and microbial interactions. Quorum sensing in marine microbes and significance. Metabolic diversity and importance of microbial communities, Photo trophy & primary productivity.

Unit 2: Methods in Marine Microbiology

Sampling methods of different habitat of oceans and screening by CLSM & FCM. Importance of Culturable & non-Cultural microorganisms. Molecular tools to study marine diversity. Limitations of analysis of nucleic acid directly from marine environment.

Unit 3: Role of Microbes in ocean processes

Bioenergetics, Carbon & Nitrogen cycling in ocean, Photosynthesis and Primary productivity. Eutrophication of coastal areas. Microbial loop in ocean food web. Microbial processes and climate change. Bio – fouling & bio – deterioration, indicator organisms and pollution control.

Symbiosis of microalgae with animals: Chemoautotrophic prokaryotes with animals. Symbionts

of sponges, mixotrophy in protists. Metabolic consortia and mutualism between prokaryotes.

Unit 4: Marine Microbes

Bacterial and viral disease of fresh water, seawater, aqua culture: fish, bivalve mollusks, Crustaceans, corals. Diagnosis methods. Control of diseases. Biodegradation and Bioremediation of marine pollutants (oil, Organic comp. etc.).

Unit 5: Recent trends in Marine Microbiology

Recently identified microorganisms of marine ecosystem, there applications in present and future industries.

References:

1. Munn, C. 2011. Marine Microbiology: Ecology and Applications. GS Publications. PP- 648.

2. Sekwon Kim. 2013. Marine Microbiology: Bioactive compounds and Biotechnological applications. Wiley VCH.

3. Paul, J. 2001. Marine Microbiology. Academic Press. PP-666.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Soil and Water Analysis of Microbes

Course Code: **CMBE-304a** **Credit Units: 03**

Pre-requisite: Basic understanding of microbiology, environmental science, and ecology.

Course Outcome:

After completion of this course, students will be able to:

1. Understand the microbial communities in soil and water ecosystems.
2. Learn the methods for isolation, identification, and quantification of soil and water microorganisms.
3. Explore the impact of soil and water microbes on environmental health and pollution control.
4. Develop skills in laboratory techniques for microbial analysis of environmental samples.
5. Gain practical experience in interpreting microbial data and its significance in environmental microbiology.

Details of the Course:

S. No.	Contents	Contact Hours
1	**Introduction to Soil and Water Microbiology**: Overview of microbial communities in soil and water, their ecological roles.	6
2	**Soil Microbes and Their Role**: Types of soil microorganisms (bacteria, fungi, actinomycetes), their functions in nutrient cycling, and soil fertility.	6
3	**Water Microbes and Their Role**: Types of microorganisms found in water (bacteria, algae, protozoa), and their role in aquatic ecosystems.	6
4	**Microbial Contamination of Soil and Water**: Pathogens in soil and water, waterborne diseases, and the impact of pollution.	6
5	**Techniques for Microbial Analysis in Soil**: Soil sampling, serial dilution, spread plate method, most probable number (MPN) method, and isolation of microbes.	6
6	**Techniques for Microbial Analysis in Water**: Water sampling, membrane filtration, MPN technique, and enumeration of coliforms.	6
7	**Biological Indicators of Soil and Water Quality**: Use of microbial indicators for assessing the health of soil and water ecosystems.	6
8	**Environmental Impact of Soil and Water Microbes**: Role of microbes in bioremediation, biodegradation, and nutrient cycling in polluted ecosystems.	6
9	**Microbial Ecology of Water Bodies**: Characterization of microbial communities in freshwater, marine, and wastewater environments.	6
10	**Microbial Water Treatment**: Biological methods for treating contaminated water and wastewater, such as activated sludge, biofilms, and bioreactors.	6

Suggested Books:

Text Books

1. **Soil Microbiology, Ecology, and Biochemistry** – Eldor A. Paul, Academic Press, 4th Edition, 2014.
2. **Water Microbiology: Methods and Protocols** – R. P. K. Nair, Springer, 2nd Edition, 2017.

References

1. **Environmental Microbiology: From the Environment to Human Health** – Ian L. Pepper and Charles P. Gerba, Academic Press, 3rd Edition, 2015.
2. **Microbiology of Waterborne Diseases** – D. M. Kay, Elsevier, 2nd Edition, 2019.
3. **Methods in Environmental Microbiology** – William G. Characklis and K. C. Marshall, Wiley-Interscience, 2003.

Examination Scheme:

Components	Attendance	Assignments	Midterm Exam	Final Exam
Weightage (%)	10%	20%	30%	40%

SEMESTER V

Paleontology

Course Code: CMBE-304b **Credit Units**: 03

Pre-requisite: Basic knowledge of biology, geology, and evolutionary concepts.

Course Outcome:

After completion of this course, students will be able to:

1. Understand the principles of paleontology and its importance in studying the history of life.
2. Learn about fossil types, fossilization processes, and fossil record.
3. Develop skills in identifying and classifying fossils.
4. Understand the concept of evolution through the study of ancient organisms.
5. Apply paleontological methods to interpret past climates, ecosystems, and evolutionary patterns.

Details of the Course:

S. No.	Contents	Contact Hours
1	**Introduction to Paleontology**: Definition, scope, importance of paleontology in understanding the history of life.	6
2	**Fossils and Fossilization**: Types of fossils (body fossils, trace fossils), fossilization processes (mineralization, impressions).	6
3	**The Fossil Record**: Stratigraphy, methods of dating fossils (relative dating, radiometric dating), principles of fossil distribution.	6
4	**Classification of Fossils**: Major groups of fossils (plants, animals, microorganisms), taxonomic classification of fossil organisms.	6
5	**Microfossils**: Study of microfossils (foraminifera, diatoms, pollen grains), their significance in paleoclimatology and paleoecology.	6
6	**Paleobiology and Evolution**: Evolutionary trends in fossil records, studying extinct organisms, theories of extinction.	6
7	**Paleoecology**: Reconstructing past environments using fossil evidence, interpreting ancient ecosystems, climate change through time.	6
8	**Paleontological Methods**: Fieldwork methods (excavation, collection), laboratory techniques (preparation, identification, analysis of fossils).	6
9	**Fossils and the Geologic Time Scale**: Understanding the geologic time scale, major periods of earth history, and significant fossil discoveries.	6
10	**Applications of Paleontology**: Paleontology in resource exploration (oil, coal), paleontology in understanding evolution and conservation.	6

Suggested Books:

Text Books

1. **Principles of Paleontology** – David M. Raup and Steven M. Stanley, W. H. Freeman, 3rd Edition, 2002.
2. **Invertebrate Paleontology and Evolution** – Richard A. Fortey, CRC Press, 4th Edition, 2014.

References

1. **Paleontology: A Brief History of Life** – Ian J. Thorpe, Wiley-Blackwell, 1st Edition, 2008.
2. **Field Guide to Fossils** – Jennifer A. Clack, University of Chicago Press, 2002.
3. **The Fossil Book: A Record of Prehistoric Life** – Gregory S. Paul, Sterling Publishing, 2008.

Examination Scheme:

Components	Attendance	Assignments	Midterm Exam	Final Exam
Weightage (%)	10%	20%	30%	40%

MICROBIAL TECHNOLOGY

Course Code: CMBE-602 **Credit Unit: 04**

Course Outcomes

1. **Microbial Applications**: Understand the role of microorganisms in the production of bioproducts, including antibiotics, enzymes, and biofuels.
2. **Genetic Engineering**: Apply genetic modification techniques to enhance microbial production capabilities.
3. **Fermentation Technology**: Learn fermentation processes for large-scale microbial production in industrial biotechnology.
4. **Bioremediation**: Analyze the use of microbes in the cleanup of environmental pollutants and waste management.
5. **Microbial Processes**: Explore the role of microorganisms in food, pharmaceutical, and agricultural biotechnology.

Course Outcomes

Unit 1: Microbial Biotechnology and its Applications

Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, and Mycorrhizae), environmental, and food technology**,** Use ofprokaryotic and eukaryotic microorganisms in biotechnological applications**,** geneticallyengineered microbes for industrial application: Bacteria and yeast.

Unit 2: Therapeutic and Industrial Biotechnology

Recombinant microbial production processes in pharmaceutical industries - Streptokinase, Recombinant vaccines (Hepatitis B vaccine), Microbial polysaccharides and polyesters, Microbial production of bio-pesticides, bioplastics, Microbial biosensors.

Unit 3: Applications of Microbes in Biotransformation

Microbial based transformation of steroids and sterols, Bio-catalytic processes and their industrial applications: Production of high fructose syrup and production of cocoa butter substitute.

Unit 4 Microbial Products and their Recovery

Microbial product purification: filtration, ion exchange & affinity chromatography techniques,

Immobilization methods and their application: Whole cell immobilization.

Unit 5 Microbes for Bio-energy and Environment

Bio-ethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass, Biogas production: Methane and hydrogen production using microbial culture. Microorganisms in bioremediation: Degradation of xenobiotics, mineral recovery, removal of heavy metals from aqueous effluents.

References:

1. Ratledge, C and Kristiansen, B. (2001). Basic Biotechnology, 2nd Edition, Cambridge University Press.

2. Demain, A. L and Davies, J. E. (1999). Manual of Industrial Microbiology and Biotechnology, 2nd Edition, ASM Press.

3. Swartz, J. R. (2001). Advances in Escherichia coli production of therapeutic proteins. Current Opinion in Biotechnology, 12, 195–201.

4. Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM, Woolverton CJ (2014), 9th edition, Mc Graw Hill Publishers.

5. Gupta PK (2009) Elements of Biotechnology 2nd edition, Rastogi Publications.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

Bioanalytical Tools

Course Code: CMBE-602a **Credit Units**: 04

Pre-requisite: Basic knowledge of biochemistry, molecular biology, and microbiology.

Course Outcome:

After completion of this course, students will be able to:

1. Understand the principles and applications of various bioanalytical techniques in biological research.
2. Learn about the different tools used for the analysis and characterization of biomolecules (proteins, nucleic acids, lipids, etc.).
3. Develop practical skills in using bioanalytical instruments for experimental analysis.
4. Apply bioanalytical methods for quality control, diagnostics, and research in biotechnology and medicine.
5. Analyze experimental data and interpret results obtained from bioanalytical techniques.

Details of the Course:

S. No.	Contents	Contact Hours
1	**Introduction to Bioanalytical Tools**: Overview of bioanalytical techniques, their importance in biological research.	4
2	**Spectrophotometry**: Principles of UV-Vis spectroscopy, applications in protein and nucleic acid quantification.	6
3	**Chromatography Techniques**: Basics of chromatography (paper, thin layer, gas, liquid chromatography), principles, applications, and types.	8
4	**Electrophoresis**: Gel electrophoresis (agarose, polyacrylamide), protein and nucleic acid separation, Western blotting, and applications.	8
5	**Mass Spectrometry**: Principles of mass spectrometry, types (MALDI, ESI), applications in proteomics and genomics.	6
6	**Fluorescence Spectroscopy**: Theory and applications of fluorescence, fluorophores, and their use in molecular biology.	6
7	**Nuclear Magnetic Resonance (NMR)**: Principles of NMR spectroscopy, application in structure elucidation of biomolecules.	6
8	**Enzyme-Linked Immunosorbent Assay (ELISA)**: Principles of ELISA, types (sandwich, competitive), applications in diagnostics and research.	6
9	**PCR and RT-PCR**: Polymerase chain reaction (PCR) principles, applications in gene amplification and diagnostics, RT-PCR for RNA analysis.	6
10	**Bioinformatics and Data Analysis**: Analysis and interpretation of data from bioanalytical techniques using software tools.	6

Suggested Books:

Text Books

1. **Bioanalytical Chemistry** – Suzanne E. Walker, John Wiley & Sons, 2nd Edition, 2009.
2. **Principles and Techniques of Biochemistry and Molecular Biology** – Keith Wilson and John Walker, Cambridge University Press, 7th Edition, 2018.

References

1. **Modern Techniques of Biochemistry** – David A. L. Davies and John W. Phillips, Oxford University Press, 3rd Edition, 2016.
2. **Bioanalytical Chemistry: Techniques and Applications** – Gary S. Glick and Edwin W. Lee, CRC Press, 2013.
3. **Fundamentals of Biochemistry: Life at the Molecular Level** – Donald Voet, Judith G. Voet, Wiley, 5th Edition, 2016.

Examination Scheme:

Components	Attendance	Assignments	Midterm Exam	Final Exam
Weightage (%)	10%	20%	30%	40%

Entrepreneurship Development

Course Code: GMBE-602 **Credit Units**: 03
Pre-requisite: Basic knowledge of business management, economics, and marketing.

Course Outcome:

After completion of this course, students will be able to:

1. Understand the key principles and practices of entrepreneurship and innovation.
2. Learn the process of identifying, developing, and launching new business ventures.
3. Develop skills for business planning, financial management, and marketing for start-ups.
4. Understand the challenges faced by entrepreneurs and the strategies for overcoming them.
5. Gain knowledge of government schemes, funding options, and support systems for entrepreneurs.

Details of the Course:

S. No.	Contents	Contact Hours
1	**Introduction to Entrepreneurship**: Definition, types of entrepreneurs, qualities of an entrepreneur, role of entrepreneurship in economic development.	6
2	**Idea Generation and Opportunity Recognition**: Techniques for generating business ideas, evaluating market opportunities, identifying customer needs.	6
3	**Business Planning and Feasibility Study**: Importance of a business plan, components of a business plan, conducting a feasibility study, SWOT analysis.	8
4	**Sources of Capital and Financial Management**: Identifying funding sources (bank loans, venture capital, angel investors), budgeting, financial projections, managing cash flow.	6
5	**Marketing and Sales Strategies**: Marketing strategies for new ventures, product pricing, promotion, and distribution, customer relationship management.	8
6	**Legal Framework for Entrepreneurship**: Business structures (sole proprietorship, partnerships, corporations), intellectual property, licenses, and regulations.	6
7	**Entrepreneurial Ecosystem and Government Support**: Government policies, schemes, and incentives for entrepreneurship, support from incubators, accelerators, and industry networks.	6
8	**Business Growth and Scaling**: Strategies for scaling a business, managing growth, risk management, building a brand.	6
9	**Challenges Faced by Entrepreneurs**: Common pitfalls and obstacles (financial, operational, market competition), risk-taking, decision-making, and coping strategies.	6
10	**Case Studies and Success Stories**: Analysis of successful entrepreneurs, their challenges and strategies for overcoming them, real-world examples from various industries.	6

Suggested Books:

Text Books

1. **Entrepreneurship: Theory, Process, Practice** – Donald F. Kuratko, Cengage Learning, 10th Edition, 2017.
2. **The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses** – Eric Ries, Crown Business, 2011.

References

1. **The Entrepreneur's Guide to Building a Successful Business** – Jonathan S. Haskel, Wiley-Blackwell, 2006.
2. **Entrepreneurship and Small Business Management** – David A. L. Davies, Pearson Education, 8th Edition, 2014.
3. **Business Model Generation** – Alexander Osterwalder & Yves Pigneur, Wiley, 2010.

Examination Scheme:

Components	Attendance	Assignments	Midterm Exam	Final Exam
Weightage (%)	10%	20%	30%	40%

Microbiological Quality Control in Food and Pharmaceutical Industries

Course Code: DMBE-304 **Credit Units**: 03

Pre-requisite: Basic knowledge of microbiology, food science, and pharmaceutical practices.

Course Outcome:

After completion of this course, students will be able to:

1. Understand the principles of microbiological quality control in the food and pharmaceutical industries.
2. Learn about the role of microbiological testing in ensuring product safety and quality.
3. Gain knowledge of the methods for detecting, identifying, and quantifying microorganisms in food and pharmaceutical products.
4. Apply microbiological techniques for contamination control, shelf-life studies, and validation of hygiene practices.
5. Understand regulatory standards and guidelines for microbiological quality control in these industries.

Details of the Course:

S. No.	Contents	Contact Hours
1	**Introduction to Microbiological Quality Control**: Definition, importance in food and pharmaceutical industries, regulatory standards.	6
2	**Microbial Contamination in Food and Pharmaceuticals**: Types of microorganisms in food and drugs (bacteria, yeasts, molds, viruses), sources of contamination.	6
3	**Microbiological Testing Methods**: Culture-based methods (agar plating, enrichment cultures), rapid diagnostic methods (PCR, ELISA, biosensors).	8
4	**Quality Control Techniques**: Sterility testing, microbiological limit tests, endotoxin testing, total viable count, and specific pathogen testing.	8
5	**Food Microbiology**: Role of microbiological control in food safety, spoilage microorganisms, pathogenic organisms in food, HACCP (Hazard Analysis and Critical Control Points).	6
6	**Pharmaceutical Microbiology**: Role of microbiological quality control in ensuring the safety and efficacy of drugs, validation of sterility, and antimicrobial efficacy.	6
7	**Environmental Monitoring and Control**: Cleanroom microbiology, monitoring air, surfaces, and equipment in manufacturing areas.	6
8	**Microbiological Validation and Documentation**: Procedures for validating microbiological tests, regulatory documentation, and compliance with GMP (Good Manufacturing Practices).	6
9	**Shelf-Life Studies and Stability Testing**: Techniques for evaluating microbial stability, shelf-life of products, packaging, and storage conditions.	6
10	**Emerging Trends in Microbiological Quality Control**: Advances in rapid detection technologies, automation, and microbiological safety in emerging food products and pharmaceuticals.	6

Suggested Books:

Text Books

1. **Microbiological Analysis of Food and Water** – Arun K. Chavan, Wiley-Blackwell, 2nd Edition, 2014.
2. **Pharmaceutical Microbiology** – Peter S. Hersey and Peter E. Dunne, Wiley, 5th Edition, 2008.

References

1. **Microbial Quality Assurance in the Food Industry** – John S. H. (Jr.), Springer, 2005.
2. **Food Microbiology: Fundamentals and Frontiers** – M. P. Doyle and L. R. Beuchat, ASM Press, 4th Edition, 2019.
3. **Microbiological Control in the Pharmaceutical Industry** – S. M. Bloomfield and J. M. Knapp, Academic Press, 2010.
4. **Manual of Food Quality Control** – FAO/WHO, 2009.

Examination Scheme:

Components	Attendance	Assignments	Midterm Exam	Final Exam
Weightage (%)	10%	20%	30%	40%

Microbiological Analysis of Air and Water

Course Code: DMBE-302 **Credit Units**: 03
Pre-requisite: Basic knowledge of microbiology, environmental science, and analytical techniques.

Course Outcome:

After completion of this course, students will be able to:

1. Understand the importance of microbiological analysis of air and water in environmental monitoring and public health.
2. Learn the techniques for the isolation, identification, and quantification of microorganisms from air and water samples.
3. Apply principles of microbial water quality testing and air sampling to real-world scenarios.
4. Interpret microbial contamination levels and their implications on health and safety standards.
5. Understand the regulatory standards for microbial levels in water and air and their role in environmental protection.

Details of the Course:

S. No.	Contents	Contact Hours
1	**Introduction to Microbiological Analysis**: Importance of microbiological analysis in environmental monitoring, microbial contamination in water and air, overview of standard methods.	6
2	**Airborne Microorganisms**: Types of microorganisms found in the air, sampling methods (settle plates, impactors, impingers), factors affecting airborne microbial distribution.	6
3	**Microbiological Sampling Techniques for Air**: Techniques for air sampling, analysis of air samples, use of impingers and air samplers.	6
4	**Waterborne Microorganisms**: Types of microorganisms found in water (bacteria, viruses, protozoa), sources of contamination, and public health risks.	6
5	**Sampling and Preservation of Water Samples**: Techniques for sampling water from different sources (groundwater, surface water, treated water), preservation of samples during transport.	6
6	**Microbiological Methods for Water Analysis**: Standard methods for microbial analysis (coliform testing, heterotrophic plate count, membrane filtration), detection of pathogenic microorganisms.	6
7	**Quantification of Microorganisms in Water**: Methods to estimate microbial load (most probable number, direct plate count), interpreting results.	6
8	**Regulatory Standards for Air and Water Quality**: WHO, EPA, and other regulatory guidelines for acceptable levels of microbial contaminants in water and air.	6
9	**Impact of Microbial Contamination on Human Health**: Waterborne diseases, air pollution, and associated health risks, case studies.	6
10	**Emerging Technologies in Microbial Monitoring**: Advances in rapid detection methods (PCR, biosensors, real-time monitoring systems), environmental health implications.	6

Suggested Books:

Text Books

1. **Standard Methods for the Examination of Water and Wastewater** – American Public Health Association (APHA), 23rd Edition, 2017.

2. **Environmental Microbiology: From the Environment to Human Health** – Ian L. Pepper, Charles P. Gerba, and Terry J. Gentry, Academic Press, 2017.

References

1. **Water Microbiology: Laboratory Manual** – M.J. Hocking, Springer, 2012.
2. **Manual of Environmental Microbiology** – C.J. Hurst, Elsevier Academic Press, 2007.
3. **Microbial Ecology of the Oceans** – D.L. Kirchman, Wiley-Blackwell, 2012.
4. **Microbial Contamination and Control in Water Systems** – D. W. Smith, Springer, 2009.

Examination Scheme:

Components	Attendance	Assignments	Midterm Exam	Final Exam
Weightage (%)	10%	20%	30%	40%

MAJOR PROJECT

Course Code: CMBE-310 **Credit Units: 6**

Course Contents:

• Forty five days of Sixth Semester of the B.Sc. Curriculum is devoted to major project/field work.

• Students, with the help of their mentor and faculty colleagues will identify a lab in India & abroad for the research work.

• The student should stay for a minimum prescribed Semester period at the place of work.

• Students not staying for the prescribed period will be marked absent as per the University Rules.

• At the end of their project the students shall submit the dissertation as per the Guidelines prescribed below.

The Aims of the Project

The aim of the project is to provide the students with an opportunity to further their intellectual and personal development in the chosen field by undertaking a significant practical unit of activity, having an educational value at a level commensurate with the award a B.Sc. Degree.

Objectives

• To provide the students an opportunity to demonstrate the ability to devise, select and use a range of methodologies appropriate to the chosen topic of research.

• To allow students to show the application of skills of data collection, critical analysis and concept synthesis necessary for formation of defensible conclusions and/or recommendations.

• To allow students the opportunity to demonstrate ability to draw appropriate conclusions argued from the evidence presented. [Should the research produce negative or inconclusive results, the conclusions should be critically examined to ascertain the reasons].

• To provide a forum to demonstrate the skills of structuring and present a balanced informed, complete, clear and concise written argument.

Dissertation GuidelinesThe Dissertation Topic

It is important to distinguish here between ‘dissertation topic’ and ‘dissertation title’. The topic is the specific area that you wish to investigate. The title may not be decided until the dissertation

has been written so as to reflect its content properly.

Few restrictions are placed on the choice of the topic. Normally the topic is expected to be:

• Relevant to Biotechnology;

• related to one or more of the subjects or areas of study within the core program and specialisation stream;

• clearly focused so as to facilitate an in-depth approach, subject to the availability of adequate sources of information and to the knowledge of students;

• Value and interest to the students and their personal and professional development.

Dissertation format

All students must follow the following rules in submitting their dissertation.

• Front page should provide title, name of the student, name of degree and the date of submission.

• Second page should contain the certificate received from the organization/University from where the student has completed his/her project work.

• The next page should be the table of contents giving page references for each chapter and section.

• The next page should be the table of graphs, figures and tables giving legends and page numbers.

• Next to follow should be following in the sequence given below:

• Abbreviations used (if any)

• Introduction

• State-of-Art

• Material & Methods

• Results

• Discussion

• Summary (approximately 500 words)

• Conclusion

• Future Prospects

• References: After this concluding chapter, students should give a list of all the references they have used. These should be cross - references with the text. For articles from journals, the following details are required e.g.

Schloter M, Assmus B and Hartmann A (1995) the use of immunological methods to detect and identify bacteria in the environment. Biotech Adv 13: 75-90

For books, the following details are required

Bahera BK and Varma A (2003) Green Energy from Waste Biomass, Capital Book Company, New Delhi, India

For book chapter

Mukherji KG, Mandeep and Varma A (1998) Mycorrhizosphere microorganisms: screening and evaluation. (Ed) Varma A. In: Mycorrhiza Manual. Springer-Verlag, Germany, pp 85-97

• Finally, you should give any appendices. These should only include relevant statistical data or material that cannot be fitted into the above categories.

• List of Publications (if any) by the students should be attached in the end.

Guidelines for the assessment of the dissertation

While evaluating the dissertation, faculty guide will consider the following aspects:

1. Has the student made a clear statement of the objective or objective(s).
2. If there is more than one objective, do these constitute parts of a whole?
3. Has the student developed an appropriate analytical framework for addressing the problem at hand.
4. Is this based on up-to-date developments in the topic area?
5. Has the student collected information / data suitable to the frameworks?
6. Are the materials & methods employed by the student to analyse the data / information appropriate and relevant?
7. Has the student succeeded in drawing conclusion form the analysis?
8. Do the conclusions relate well to the objectives of the project?

Examination Scheme:

Components	Theme of Project	Quality of Project
Weightage (%)	30	70

ENTREPRENEURSHIP DEVELOPMENT

Course Code: GMBE-602 Credit Units: 04

UNIT I INTRODUCTION

Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship.

UNIT II ESTABLISHING AN ENTERPRISE)

Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility.

UNIT III FINANCING THE ENTERPRISE

Importance of finance / loans and repayments, Characteristics of Business finance, Fixed capital management: Sources of fixed capital, working capital its sources and how to move for loans, Inventory direct and indirect raw materials and its management.

UNIT IV MARKETING MANAGEMENT

Meaning and Importance, Marketing-mix, product management – Product line, Product mix, stages of product like cycle, marketing Research and Importance of survey, Physical Distribution and Stock Management.

UNIT V ENTREPRENEURSHIP AND INTERNATIONAL BUSINESS

Meaning of International business, Selection of a product, Selection of a market for international business, Export financing, Institutional support for exports.

References:

1. Holt DH. Entrepreneurship: New Venture Creation.

2. Kaplan JM Patterns of Entrepreneurship.

3. Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand & Sons.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	21 10	60

MICROBIAL QUALITY CONTROL IN FOOD AND PHARMACEUTICAL INDUSTRIES

Course Code: DMBE-304 **Credit Unit: 04**

Unit 1: Microbiological Laboratory and Safe Practices

Good laboratory practices - Good laboratory practices, Good microbiological practices, Biosafety cabinets – Working of biosafety cabinets, using protective clothing, specification for BSL- 1, BSL-2, BSL-3. Discarding biohazardous waste – Methodology of Disinfection, Autoclaving & Incineration.

Unit 2: Determining Microbes in Food / Pharmaceutical Samples

Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts, Biochemical and immunological methods: Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products, Molecular methods - Nucleic acid probes, PCR based detection, biosensors.

Unit 3: Pathogenic Microorganisms of Importance in Food & Water

Enrichment culture technique, Detection of specific microorganisms - on XLD agar, Salmonella, Shigella Agar, Manitol salt agar, EMB agar, McConkey Agar, Saboraud Agar, Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 min Resazurin assay).

Unit 4: HACCP for Food Safety and Microbial Standards

Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations, Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water.

References:

1. Harrigan WF (1998) Laboratory Methods in Food Microbiology, 3rd ed. Academic Press

2. Garg N, Garg KL and Mukerji KG (2010) Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.

3. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer

4. Baird RM, Hodges NA and Denyer SP (2005) Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

MICROBIOLOGICAL ANALYSIS OF AIR AND WATER

Course Code: DMBE-302 Credit Unit: 04

Course Outcomes

1. **Microbial Applications**: Understand the role of microorganisms in the production of bioproducts, including antibiotics, enzymes, and biofuels.
2. **Genetic Engineering**: Apply genetic modification techniques to enhance microbial production capabilities.
3. **Fermentation Technology**: Learn fermentation processes for large-scale microbial production in industrial biotechnology.
4. **Bioremediation**: Analyze the use of microbes in the cleanup of environmental pollutants and waste management.
5. **Microbial Processes**: Explore the role of microorganisms in food, pharmaceutical, and agricultural biotechnology.

Unit 1: Aeromicrobiology

Bioaerosols, Air borne microorganisms (bacteria, Viruses, fungi) and their impact on human health and environment, significance in food and pharma industries and operation theatres,allergens.

Unit 2: Air Sample Collection and Analysis

Bioaerosol sampling, air samplers, methods of analysis, CFU, culture media for bacteria and fungi, Identification characteristics.

Unit 3: Control Measures

Fate of bioaerosols, inactivation mechanisms – UV light, HEPA filters, desiccation, Incineration.

Unit 4: Water Microbiology

Water borne pathogens, water borne diseases.

Unit 5 Microbiological Analysis of Water

Sample Collection, Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive/MPN tests confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests.

References:

1. da Silva N, Taniwaki MH, Junqueira VC, Silveira N, Nascimento MS, Gomes RAR (2012) Microbiological Examination Methods of Food and WaterA Laboratory Manual, CRC Press.

2. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.

3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.

4. Hurst CJ, Crawford RL, Garland JL, Lipson DA (2007) Manual of Environmental Microbiology, 3rd edition, ASM press.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60

ANIMAL BIOTECHNOLOGY

Course Code: SMBE-604 Credit Units: 04

Course outcomes

1. **Genetic Manipulation**: Understand techniques for genetic modification and cloning of animals for research and production.
2. **Animal Cell Culture**: Learn the principles of animal cell culture techniques for research and bioproduct development.
3. **Reproductive Biotechnology**: Explore reproductive technologies such as artificial insemination, embryo transfer, and gene editing in animals.
4. **Transgenic Animals**: Analyze the creation and applications of transgenic animals in medicine and agriculture.
5. **Ethical and Regulatory Issues**: Understand the ethical, legal, and regulatory considerations in animal biotechnology research and applications.

UNIT I

Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer.

UNIT II

Introduction to transgenesis. Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect. Animal diseases need help of Biotechnology – Foot-and mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis.

UNIT III

Animal propagation – Artificial insemination, Animal Clones. Conservation Biology – Embryo transfer techniques. Introduction to Stem Cell Technology and its applications.

UNIT IV

Genetic modification in Medicine - gene therapy, types of gene therapy, vectors in genetherapy,molecular engineering, human genetic engineering, problems & ethics.

References:

1. Brown, T.A. (1998). Molecular biology Labfax II: Gene analysis. II Edition. Academic Press, California,USA.

2. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers.

Examination Scheme:

Components	Internal Assessment			External Evaluation
	Attendance	Class Test	Assignment/ Project/Seminar/Quiz	
Weightage (%)	10	20	10	60