Department of Microbiology

UNIQUE FEATURES OF SYLLABI

- The students fascinated by microbiology to have good problem-solving skills and proficient in the field
- To prepare the student with high quality knowledge to catch up with challenging work in various fields of microbiology
- To provide an updated, modern syllabus with equal emphasis on skills to build up their value in job-oriented carrier
- To understand the scope of this field, to involve the students in research, industrial, environmental and Agricultural area
- To impact a comprehensive knowledge in Microbiology to the students in practical manner
- To develop the students for various job opportunities in the public and private sectors
- The curriculum has been designed to fulfill the needs of diverse class of learner to fulfill the needs of different professionals like medical lab technicians, teaching, research, food analyst and agricultural professionals
- This programme makes learner to develop communication, critical thinking and proficiency in the field of industrial sector
- This programme helps learners to acquire necessary skills to perform research, and start up entrepreneurship in the field of Microbiology
- It is a good base degree course for the purpose of higher research studies. They can avail wide employment opportunities and employability skills in the field of research and development

DEPARTMENT OF MICROBIOLOGY
(For Students Admitted from June 2024-25)

Vision:

Envisioning the eminent microbiologist with excellence in Teaching, Learning, Research and Community service to create diverse knowledgeable women for the future society.

Mission:

- To enlighten microbiologist in the field of food, environment, agricultural and industry.
- To facilitate young women with leadership qualities, professional skills and develop Entrepreneurship with ethical behavior
- To maintain a vibrant research culture

Programme Educational Objectives (PEO):

PEO1: To create and strengthen women leaders through disciplinary knowledge, professional skills and ethical sensitivity

PEO2: To transform students as successful entrepreneurs to face the modern challenges

PEO3: To nurture the students to invent, innovate and create solutions for current moral, ecological and economic issues

Programme Outcomes (PO):

In completion of all post graduate degree programme, the students will be enabling with

PO1: Disciplinary Knowledge: Acquiring knowledge of different dimensions in the related area of study and identifying the assumptions that frame thinking and actions

PO2: Effective communication: Ability to share thoughts, idea and applied skills of communications in its various perspectives through LSRW

PO3: Research Skill and Critical Thinking: Ability to plan, execute and report the results of an experiment and to draw conclusions from evidences and the capability to apply analytical thought by following scientific approach to knowledge development

PO4: Moral ethical awareness/ Reasoning: Ability to embrace moral/ ethical values in conducting one's life, about an ethical issues from multiple perspectives, and use ethical practices in all works and appreciating environmental and sustainability issues; and adopting unbiased and truthful actions in all aspects of work

PO5: Information/ Digital Literacy: Capability to use ICT in case of need and the ability to access, evaluate and use the relevant information

PO6: Problem solving: Ability to apply their competence to solve non-familiar everyday problems in real life situations

PO7: Self – directed and Lifelong Learning: Acquire the ability to engage in independent and lifelong learning through self-paced and self- directed learning to meet out the change in life

M.Sc., MICROBIOLOGY
(Two Year Regular Programme)
(For Students Admitted from June 2024-25)

Programme Specific Outcomes (PSO):

The graduates will be able to

PSO 1: Attain the knowledge relevant to the core concepts in microbiology

PSO 2: Develop the capabilities to comprehend and communicate scientific concepts

PSO 3: Acquire to apply the knowledge, skills, and values to fulfill the basic needs of society

PSO 4: Graduates will develop new ideas, perspectives and improve their research skill

PSO 5: Absorbs ethical, moral values and responsibilities of learning science

PSO 6: Ability to extract implicit and explicit from social media

PSO 7: Develop the potential to update the constantly evolving technolog

MSc MICROBIOLOGY
PROGRAMME STRUCTURE
PROGRAMME CODE - PMB

Semester	Subject code	Course	Subject Title	Hours/ Week	Credit	CIA Marks	ESE Marks	Total Marks
I	IMMBC11	Core I	General Microbiology	6	5	25	75	100
	IMMBC12	Core II	Biomolecules and Microbial Physiology	6	5	25	75	100
	IMMBC13	Core III	Molecular Biology and Microbial Genetics	6	5	25	75	100
	IMMBC141P	Core IV (Practical)	Lab course in General Microbiology, Biomolecules and Microbial Physiology, Molecular Biology and Microbial Genetics	6	5	25	75	100
	IMMBE1A/ IMMBE1B	DSE I	a. Algal Technology/ #Internship b. Enzymology	6	5	25	75	100
	IMMBX1/ IMMBX1O	Extra Credit-I	Life Science for Competitive Examination/Online Course*	-	2	-	100	100
	Total			**30**	**25+2**	**125**	**375+100**	**500+100**
	IMMBC211	Core V	Food Microbiology	6	5	25	75	100

			*Integrated courses- Principles of Downstream process in Bioprocess					
II	IMMBC221	Core VI	Environmental and Agricultural Microbiology	6	5	25	75	100
	IMMBC231	Core VII	Recombinant DNA Technology	6	5	25	75	100
	IMMBC241P	Core VIII (Practical)	Lab Course in Environmental, Agricultural and Food Microbiology	6	5	25	75	100
	IMMBE2A/ IMMBE21B	DSE II	a. Genomics and Proteomics/ b. Nanobiotechnology *Integrated courses- Biomedical Nanotechnology	6	5	25	75	100
	IMMBX2/ IMMBX2O	Extra Credit-II	Biofertilizer Production/Online Course*	-	2	-	100	100
	Total			**30**	**25+2**	**125**	**375 +100**	**500 +100**
III	IMMBC311	Core IX	Medical Microbiology #Internship	6	5	25	75	100
	IMMBC32	Core X	Immunology & Immunodiagnostics	6	5	25	75	100
	IMMBC331	Core XI	Basics of Research Methodology	6	5	25	75	100
	IMMBC341P	Core XII (Practical)	Lab Course in Medical Microbiology, Immunology and Immunodiagnostics	6	5	25	75	100
	IMMBE31A/ IMMBE31B	DSE III	a. Bioethics, Biosafety and IPR/ b. Bioinformatics	6	5	25	75	100
	IMMBX3/ IMMBX3O	Extra Credit-III	Employability Skills/ Online Course*	-	2	-	100	100
	Total			**30**	**25+2**	**125**	**375+100**	**500+100**

IV	IMMBC411	Core XIII	Environmental Microbial Technology	6	5	25	75	100
	IMMBC42PW	Core XIV	Project	18	15	100	100	200
			Library	6				
	IMMBX4	Compulsory Extra Credit-IV	Information Technology for Biologists/ Online Course*		2	-	100	100
	Total	**30**	**15+2**	**30**	**100+100**	**125**	**175+100**	**300+100**
	Grand Total			**120**	**90+8**	**700**	**1000 + 400**	**1700 + 400**

DSE- Discipline Specific Elective

* For online certification credit alone will be assigned on submission of certificate obtained through appearing for online examination from the spoken tutorial, EDX, NPTEL or Coursera and other MHRD, MOOCs.

DSE- Discipline Specific Elective

* For online certification credit alone will be assigned on submission of certificate obtained through appearing for online examination from the spoken tutorial, EDX, NPTEL or Coursera and other MHRD, MOOCs.

CORE I - GENERAL MICROBIOLOGY

(For Students Admitted from 2024-25)

Semester: I **Hours/week: 6**
Subject Code: IMMBC11 **Credit: 5**

Course Objectives:

1. To inculcate knowledge on fundamentals of microorganisms
2. To learn the structural organization, morphology and reproduction of microbes

Unit I **(18 hours)**

Introduction to Microbiology: History and development of Microbiology; Classification of microorganism – Binomial nomenclature, Haeckel's three kingdom concept, Whittaker's five kingdom concept, three domain concept of Carl Woese; Principle and classification of bacteria on the basis of Bergey's manual of Determinative Bacteriology; Molecular approaches in microbial classification, concept of microbial species.

Unit II **(18 hours)**

Bacteriology: Prokaryotic cell morphology – structure and function of Flagella, Fimbriae, Pili; Capsule – types, composition and function; Cell wall-cell walls of Gram negative, Gram positive, Halophiles, L–forms and Archaebacteria; Cell membrane – Fluid Mosaic Model, membrane functions; Intracytoplasmic inclusions – Nucleoid and Extra Chromosomal

material; Gas vesicles, Chlorosomes, Carboxysomes, Magnetosomes and Phycobilisomes; Reserve food materials – Polyhydroxybutyrate granules, Sulphur granules; Sporulation – Exospores and Endospores.

Unit III **(18 hours)**

Virology: Historical developments in Virology, general properties of viruses; Structure of viruses, Lytic and Lysogenic life cycle; Classification of viruses – ICTV classification, Baltimore classification, Prions, Viroids.

Techniques in virology-Virus Cultivation Methods – Embryonated eggs, Animal models, Cell Line; Viral assay, Virus Isolation and Purification, Laboratory identification of Viruses, Cytopathic effect.

Unit IV **(18 hours)**

Mycology: History and development of Mycology, structure and cell differentiation; Criteria for fungal classification – Habitat Morphology and Reproduction of Slime molds, Oomycetes, Zygomycotina, Ascomycotina, Basidiomycotina, Mastigomycotina and Deuteromycotina; Economic importance of fungi, Mycotoxins.

Lichens: classification, physiology and importance.

Unit V **(18 hours)**

Phycology: Distribution of Algae, Classification of algae, Thallus organization in algae, Reproduction in algae; Brief account of Chlorophyta, Bacillariophyta, Phaeophyta, Rhodophyta, Cyanobacteria and Prochlorons; Algal ecology; Applications of algae in Agriculture, Biofertilizer, Industrial application of algae, Medicinal importance, Nutritional value, Environmental implications.

Protozoa: Animal parasite: *Entamoeba histolytica* – general characteristics and reproduction.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Write down the history and development of microbiology and discuss the classification of microorganisms

CO2: Categorize the fungal and algal classification and its economic importance

CO3: Distinguish the basic groups of microbes – Archaea, Bacteria and Viruses and Eukaryotic microbes

CO4: Determine the detailed structure and function of prokaryotic cell organelles

CO5: Develop the basic knowledge on virus appearance and how to cultivate, isolate and identify viruses

Text Books:

1. Joanne W., Kathleen S., and Dorothy W., *Prescott's Microbiology*, McGraw Hill Education, India, ISE, Eleventh Edition, 2019.
2. Pelczar Jr. M.J., Chan E.C.S. and Kreig N.R., *Microbiology*, Mc-Graw Hill, 2021.

Reference Books:

1. Boyd R.F., *General Microbiology*, Times Mirror Mosby, USA, 2016.
2. Sharma O.P., *Textbook of Algae*, Tata McGraw Hill Publishing Co. Ltd, 2017.

Journals:

1. Journal of Bacteriology & Mycology.
2. European Journal of Clinical Microbiology & Infectious Diseases.
3. IMA Fungus

E- Resources:

1. https://nptel.ac.in/courses/102103015/
2. https://open.umn.edu/opentextbooks/BookDetail.aspx?bookId=404
3. www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635
4. www.grsmu.by/files/file/university/cafedry/.../files/essential_microbiology.pdf
5. https://microbiologyinfo.co/top-and-best-microbiology-books/

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	3	9	3	9	51
CO2	9	9	9	3	9	3	9	51
CO3	9	3	9	1	3	1	9	35
CO4	9	9	3	1	3	3	9	37
CO5	9	9	9	3	1	3	9	43
Total	45	39	39	11	25	13	45	217

Low-1 Medium-3 High-9

CORE II – BIOMOLECULES AND MICROBIAL PHYSIOLOGY

(For Students Admitted from 2024-25)

Semester: I **Hours/Week: 6**
Subject Code: IMMBC12 **Credit: 5**

Course Objectives:

1. To develop a sufficient background to students about the growth of microbes
2. To learn the microbial metabolism

Unit I **(18 hours)**

Biomolecules: Carbohydrates – Structure and Classification, Nucleic acids: Biosynthesis and regulation – DNA &RNA; Amino acids – Classification and chemical properties.

Proteins: Classification, Protein Structure – Primary Structure, Secondary Structure, Tertiary and Quaternary Structure; Enzymes – Nomenclature and Classification, Physical and Chemical Properties of enzymes; Vitamins – types of vitamins and their importance. Lipids – Classification.

Unit II **(18 hours)**

Metabolic Pathways: Carbohydrates Metabolism and its regulation – Glycolysis, TCA cycle, Oxidative phosphorylation, Pentose phosphate pathway and Gluconeogenesis; Biosynthesis of Fatty acids, Triglycerides, Phospholipids and Cholesterol; Oxidation of Fatty Acids.

Unit III **(18 hours)**

Biochemical components of microbial cell: Structure and functions of organelles of microbial cell, cell wall synthesis, role of cell wall and cell membrane in the functions of microbial cells; Membrane transport in bacteria-simple, group translocation, ABC transporters Protein export in bacteria –Type 1,2,3,4, Protein export pathways & antimicrobial therapy Iron - Siderophores & antimicrobial therapy.

Unit IV **(18 hours)**

Mode of Nutrition: Microbial growth **–** different Phases of growth, factors influencing microbial growth – Temperature, pH, Pressure, Salt Concentration, Nutrients; Synchronous growth and continuous cultivation, Classification of microorganisms based on nutrition requirements; Physiology and classification of organisms living in extreme environments – Thermophiles, Halophiles, Psychrophiles and Methanogens.

Unit V **(18 hours)**

Microbial Photosynthesis: Photoautotrophs; Photoorganotrophs; Photosynthetic pigments, Oxygenic and Anoxygenic types; Physiology of bacterial photosynthesis – Light reactions, Cyclic and Non-Cyclic Photophosphorylation; Factors affecting photosynthesis – Intrinsic and Extrinsic – Effect of light, CO_2, pH and Temperature on photosynthesis.

Course Outcomes:

After successful completion of the course, student will be able to

CO 1: Recite the metabolism of biomolecules and explain the regulations of carbohydrates and lipids

CO 2: Demonstrate the concepts on biochemical components & growth factors of microbial cell

CO 3: Illustrate the nutritional requirements, environmental adaptations and transport mechanisms of microbes

CO 4: Determine the overall biosynthetic and regulatory metabolism of microorganisms

CO 5: Elaborate the metabolism, regulations and to classify the cell organelle

Text Books:

1. Lansing M. Prescott, John P. Harley and Donald A. Klein's, *Microbiology*, 10th Edition, Mc- Graw Hill, 2015.
2. Satyanarayana U. and Chakrapani U., *Biochemistry*, Elsevier, Arunabha Sen Books and allied (P) Ltd, Kolkata, 5th Edition, 2020.

Reference Books:

1. Nelson, David L., and Cox, Michael M. Lehninger, *Principles of Biochemistry***,** United States, W. H. Freeman, 2021.
2. S. Meena kumari, *Microbial Physiology*, MJP Publisher, 2019.

Journals:

1. Microbial Physiology.
2. Physiology of the gastrointestinal tract.
3. Biomaterials.

E- Resources:

1. https://nptel.ac.in/courses/102/103/102103015/#
2. www.microbiologyonline.org.uk
3. www.cambridge.org ›Home › Academic › Life science › Microbiology and immunology

4. www.grsmu.by/files/file/university/cafedry/.../files/essential_microbiology.pdf
5. https://microbiologyinfo.com/top-and-best-microbiology-books/

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	3	1	3	9	43
CO2	3	9	9	3	3	1	3	31
CO3	9	3	9	3	3	9	9	45
CO4	3	9	3	9	1	1	9	35
CO5	9	3	9	1	1	3	9	35
Total	33	33	39	19	9	17	39	189

Low-1 Medium-3 High-9

CORE III - MOLECULAR BIOLOGY AND MICROBIAL GENETICS

(For Students Admitted from 2024-25)

Semester: I **Hours/Week: 6**
Subject Code: IMMBC13 **Credit: 5**

Course Objectives:

1. To get an overview on microbial genetics, concepts, theories and genetic tools
2. To be familiar with transcription and translation in details

Unit I **(18 hours)**

Genetic material: DNA and RNA as the genetic material, nucleic acid structure, types of DNA and RNA; Peptide Nucleic Acid (PNA).

DNA replication: Prokaryotic and Eukaryotic DNA replication models, extra chromosomal replicons, inhibitors of DNA replication; Nucleosome assembly and telomere.

DNA damage and repair: Mutagens – Physical and Chemical; Mechanism of repair – photo reactivation, excision repair, recombination repair; SOS and Adaptive responses and their regulation.

Unit II **(18 hours)**

Transcription: Mechanism of transcription in Prokaryotes & Eukaryotes and its regulation, Transcription Inhibitors, RNA transport, Post Transcriptional Modification; Genetic code, Wobble hypothesis.

Translation: Prokaryotic & Eukaryotic Translation, Translational Proof Reading, Translational Inhibitors, Post Translational Modifications.

Unit III **(18 hours)**

Genetics: Genetic Nomenclature, Types of Mutants, Isolation and Characterization of Mutants, Revertants and Reversion, Genetic Analysis of Mutants.

Genetic recombination: Homologous, Non Homologous, Site Specific Recombination, Genetic Mapping, Linkage and Multifactor Crosses, Deletion Mapping, Complementation and Intragenic Complementation.

Unit IV **(18 hours)**

Genetics of Phage λ: Biology of bacteriophage λ; Lytic growth of phage λ – DNA Replication and Phage production, Recombination in the λ life cycle; Lysogeny – Immunity and Repression, Molecular events in Lysogeny; Decision between Lysis and Lysogeny.

Unit V **(18 hours)**

Horizontal gene transfer methods: Transformation, Conjugation – *Hfr*, Triparental mating, Transduction – General and Specialized.

Transposable elements: Introduction to Transposable Elements – Discovery and Types; Retrotransposon – Mechanism, SINES and LINES, Transposons of *E.coli* and Yeast.

Course Outcomes:

After successful completion of the course, student will be able to

CO 1: Define central dogma and explain the structure of genetic materials in the cell
CO 2: Develop the molecular genetics and genome organizations in organisms
CO 3: Classify the mutation and the DNA repair mechanism
CO 4: Determine the life cycle of phage and its genetics
CO 5: Theorize the concept of recombination and gene transfer techniques

Text Books:

1. Berk, A., Amon, A., Krieger, M., Kaiser, C. A., Yaffe, M., Martin, K. C., Ploegh, H., Lodish, H., Bretscher, A. *Molecular Cell Biology.* United States: W.H. Freeman,2021.
2. Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Anthony Bretscher, HiddePloegh, Angelika, Amon Matthew P. Scott. *Molecular Cell Biology*, 7th Edition, W.H. Freeman, USA 2015.

Reference Books:

1. Simmons, Michael J., and Snustad, D. Peter**.** *Principles of Genetics***.** India, Wiley, 2015.
2. McGhee, Michelle, et al. *Molecular Biology*. Netherlands, Elsevier Science, 2018.

Journals:

1. The ISME journal.
2. Journal of Genetics & Genomics.
3. Progress in Molecular Biology and Translational Science.

E- Resources:

1. https://nptel.ac.in/courses/102/103/102103015/#
2. https://www.pdfdrive.com/biochemistry-genetics-molecular-biology-e18198970.html
3. https://sites.google.com/site/microbiologyacu2/home/fall/pharmaceutical-microbiology
4. http://fda.gov/downloads/ScienceResearch/FieldScience/UCM397228.pdf
5. https://www.wiley.com/en-us/Principles+of+Genetics%2C+7th+Edition-p-9781119142287#E- Book

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	1	9	3	9	43
CO2	3	9	9	1	3	9	9	43
CO3	3	3	9	3	9	9	9	45
CO4	3	3	9	9	3	3	9	39
CO5	9	3	9	3	1	9	9	43
Total	27	21	45	17	25	33	45	213

Low-1 Medium-3 High-9

CORE IV – LAB COURSE IN GENERAL MICROBIOLOGY, BIOMOLECULES AND MICROBIAL PHYSIOLOGY, MOLECULAR BIOLOGYAND MICROBIAL GENETICS

(For Students Admitted from 2024-25)

Semester: I **Hours/week: 6**
Subject Code: IMMBC141P **Credit: 5**

Course Objectives:

1. To familiarize in General Microbiology Techniques
2. To know about effect of environmental condition on microbes

List of Experiments: **(90 hours)**

1. Laboratory Safety measures
2. Pure culture techniques – Pour plate, Spread plate and Streak plate
3. Isolation and enumeration of microorganisms from soil sources
4. Staining methods – Simple Staining, Gram's Staining, Negative staining, Flagella staining, Endospore staining and Lactophenol Cotton Blue staining
5. Biochemical tests: a. IMVIC, b. Catalase, c. Oxidase, d. TSI test, e. ONPG test, f. Nitrate reduction test, g. Starch hydrolysis, h. Gelatin hydrolysis, i. Casein and j. Urease test
6. Isolation of Photosynthetic bacteria
7. Preparation of solutions:
    a. pH meter and preparation of buffers of pH range 2 to11
    b. Molarity and Molality calculation
    c. Preparation of 0.1 N acid and base i) NaOH ii) HCl iii) HNO_3
8. Determination of Carbohydrate by DNSA method
9. Estimation of Total Sugar by Anthrone method
10. Determination of pI value of Amino acids
11. Estimation of Amino acid by Ninhydrin method
12. Estimation of Protein by Lowry's and Bradford's method
13. Estimation of Total Lipids by Folch method
14. Estimation of DNA by Diphenyl Amine method
15. Estimation of RNA by Orcinol method
16. Isolation of genomic DNA and agarose gel electrophoresis

17. Separation of Protein by SDS-PAGE
18. Antibiotic sensitivity assay Kirby Bauer test
19. Separation of Amino acid by Paper Chromatography
20. Separation of Lipids by Thin Layer Chromatography

Course Outcomes:

After successful completion of the course, student will be able to

CO 1: List out the laboratory safety measures and illustrate the preparation of buffers and molar solution

CO 2: Apply the knowledge of Chromatography and Electrophoretic method in the field of molecular biology

CO 3: Perform to test antibiotic sensitivity

CO4: Validate the biomolecules like protein, amino acid by advanced molecular techniques

CO 5: Test to isolate and separate DNA and protein

Text Books:

1. Shukla Das., Rumpa Saha., *Microbiology Practical Manual*, CBS Publishers and Distributors, First Edition, 2020.
2. Karen Adeleman, Frederick M. Ausubel, Roger Brent, David D. Moore, Kevin Struhl, Koen Venken, *Current protocols in Molecular Biology*, John Wiley, 133(1), 2020.

Reference Books:

1. Talwar G.P., and Gupta S.K., *A Handbook of Practical and Clinical Immunology*, CBS publications, Second Edition, volume 1 and 2, 2017.
2. Broun Fred, Edwin, and A. Waksman, Selman. *Laboratory Manual of GeneralMicrobiology*, with Special Reference to the Microorganisms of the Soil. India, Alpha Editions, 2020.

Journals:

1. International Journal of Molecular Sciences.
2. Advances in Microbial Physiology.
3. Journal of Microbiology and Genetics.

E-Resources:

1. https://www.vlab.co.in/
2. http://biotech01.vlabs.ac.in/
3. https://nptel.ac.in/courses/102/103/102103017/
4. https://www.ncbi.nlm.nih.gov/guide/chemicals-bioassays/
5. https://www.pdfdrive.com/bensons-microbiological-applications-laboratory-manual-in-general- microbiology-short-version-e185416575.html

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	3	1	9	9	49
CO2	9	9	9	1	1	3	9	41
CO3	9	3	9	9	1	3	9	43
CO4	3	3	9	1	3	3	9	31
CO5	9	3	9	1	3	3	9	37
Total	39	27	45	15	9	21	45	201

Low-1 **Medium-3** **High-9**

Discipline Specific Elective I: a. ALGAL TECHNOLOGY
(For Students Admitted from 2024-25)

Semester: I **Hours/Week: 6**
Subject Code: IMMBE1A **Credit: 5**

Course Objectives:
1. To learn about algal cultivation methods
2. To know the application of algae

Unit I **(18 hours)**
Introduction to algae: History of Phycology; Classification of Algae – Fritsch's system, G.M. Smith system; Salient features of major classes – Prochlorophyta, Chlorophyta, Cyanophyta, Charophyta, Xanthophyta, Phaeophyta and Rhodophyta.

Unit II **(18 hours)**
Algal structure, division and growth: Ultrastructure of Prokaryotic and Eukaryotic Algal cells and their components – Cell Wall, Protoplasm, Flagella, Eye Spots, Chloroplast, Pyrenoid, Nucleus, Pigments and Reserve foods; Reproduction – Vegetative, Sexual, Asexual; Life cycle in algae, Eutrophication.

Unit III **(18 hours)**
Algal cultivation: Indoor and Outdoor Cultivation; Nutrients – carbon sources, growth kinetics; Factors affecting algal cultivation – Temperature, Water, Light, Culture depth, Agitation of Algal suspension, Oxygen transfer, Inoculum size, Evaporation, pH.

Unit IV **(18 hours)**
Algal Processing: Harvesting – Centrifugation, Auto Flocculation, Induced Flocculation, Filtration, Flotation, Microstrainer, Sand Filtration, Ion Exchange Method; Drying – Electrically Heated Drum Drying, Steam Heated Drum Drying, Cross Flow Air Drying, Vacuum Shelf Drying, Solar Drying; Yield, Chemical Composition, Storage and Packaging; Economics of Algal Industry.

Unit V **(18 hours)**
Applications of algae: Therapeutic properties of Microalgae; Food, animal feed; Fuel; Algal system in Effluent treatment; Role of algae in cosmetics; Biofertilizer – Physiology of nitrogen fixation, Algalization technology and N_2 fixation in symbiosis involving BGA.

Course Outcomes:
After successful completion of the course, student will be able to
CO 1: Name the classification of algae and explain the structure and function of cell organelles
CO 2: Identify the economic importance of algae
CO 3: Distinguish the cultivation methods of algae
CO 4: Justify the impact of algae on society
CO 5: Discuss the concepts of algal processing

Text Books:
1. Shukla, Dr M K, and M.K.Shukla, A. K. Kushwaha. *A Text Book of Algae:* For Degree

Students. N.p., Amazon Digital Services LLC - KDP Print US, 2020.
2. A.V.S.S. Sambamurty, *A Text Book of Algae*, Dreamtech Press, 2019.

Reference Books:

1. Santhakumaran, Prasanthkumar, Santhosh K. Kookal, Linu Mathew, and Joseph G. Ray. *"Bioprospecting of Three Rapid-Growing Freshwater Green Algae, Promising Biomass for Biodiesel Production."* Bioenergy Research, 2019.
2. Bharath, Gunasekaran, Velmurugan Aswini, and K. M. Gothandam. *"Algae and Food Safety."* Algae for Food: Cultivation, Processing and Nutritional Benefits, 2021.

Journals:

1. Science of the Total Environment.
2. Biomass, Biofuels, Biochemicals.
3. Bioresource Technology.

E- Resources:

1. https://www. samples.sainsburysebooks.co.uk/9781405172493_sample_380750.pdf
2. https://www.lawofalgae.wiki.zoho.com/Chapter-1 ---- Introduction-to-Algae-Bi
3. https:// www.northinlet.sc.edu/training/media/2012/..../Science-of-Algae.pdf
4. https:// www.dbs.nus.edu.sg/biofuel2012/... /22%20Borowitzka%20(ok).pdf
5. https://www.researchgate.net/publication/230652373_Economic_importance_of_algae

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	1	1	3	9	35
CO2	9	9	9	1	1	3	9	41
CO3	9	3	9	1	1	3	9	35
CO4	9	3	9	3	1	3	9	37
CO5	9	3	9	1	1	3	9	35
Total	45	21	45	7	5	15	45	183

Low-1 Medium-3 High-9

Discipline Specific Elective I: b. ENZYMOLOGY

(For Students Admitted from 2024-25)

Semester: I **Hours/week: 6**
Subject Code: IMMBE1B **Credit: 5**

Course Objectives:

1. Introduce students to various theoretical and practical aspects of enzymology
2. Stimulates their interest in the structure, function and kinetics of enzyme and their role as catalyst and regulator of metabolism

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Define enzymes and explain the basic concepts of specificity of enzymes, inhibition properties, types and characteristics

CO 2: Classify the assorted techniques of immobilization and its applications
CO 3: Establish on enzyme kinetics and mechanism of enzyme action
CO 4: Determine the enzymes in drug designing and their future potential
CO 5: Test various methods to isolate and purify enzymes

Unit I **(18 hours)**

Introduction to Enzymes: History of Enzymology, properties of enzymes, Classification of enzymes, Enzyme Nomenclature; Isolation and extraction of enzymes, purification of enzymes – Precipitation, Dialysis, Ultra Filtration and Chromatographic techniques; Free energy, Activation energy and Transition energy; Coenzymes.

Unit II **(18 hours)**

Enzyme Kinetics: Henry and Michaelis Menten plot, significance of K_m and K_{cat} Lineweaver-Burk plot; Active sites features, Lock and Key Model, Induced Fit Model; Enzyme Catalysis – General principles, Mechanism of action of enzymes – Chymotrypsin and Lysozyme; Factor influencing Enzyme activity – Temperature, pH, Concentration of Enzymes, Substrate and Product; Role of Metal Ions in Enzyme catalysis.

Unit III **(18 hours)**

Enzyme Specificity & Inhibition: Types of enzyme specificity – Group specific enzymes – relative group and absolute group, Stereospecific enzymes – optical and geometrical; Types of enzyme inhibition – Irreversible inhibitors and Reversible inhibitors – Competitive, Non–competitive & Uncompetitive Inhibitions.

Unit IV **(18 hours)**

Enzyme Immobilization: Immobilized enzymes – Definition, Characteristics – Principles & Techniques of Immobilization – Adsorption, Covalent Bonding, Entrapment, Cross-Linking, Encapsulation (advantages and disadvantages); Kinetics of immobilized enzyme reactions; Applications of immobilized enzymes.

Unit V **(18 hours)**

Recent advances and future prospects in Enzyme Technology: Multienzyme complex and Multifunctional enzymes, Enzymes and recombinant DNA technology, Enzyme Biosensors; Enzyme as diagnostic tools; Synthesis of Artificial enzymes, Enzymes & Bioinformatics, Rational Designing of enzymes – Site Directed Mutagenesis.

Text Books:

1. Palanivelu P., *Enzymes, Ribozymes and DNAzymes*, MKU Coop. Press Ltd., Madurai, Twentyfirst Century Publications, Second Edition, 2017.
2. Khan, M. Y., and Khan, Farha. *Principles of Enzyme Technology.* India, Phi Learning, 2015.

Reference Books:

1. Nicholes C. Price and Lewis Stevens, *Fundamentals of Enzymology*, Oxford University Press, Third Edition, 2017.
2. Baskar, G, K S. Kumar, and K Tamilarasan. *Enzyme Inhibition: Environmental and Biomedical Applications***.** Singapore : Bentham Science Publishers Pte Ltd.,2020.

Journals:

1. Journal of Food Biochemistry.
2. Journal of Physiology and Biochemistry.

3. International Journal of Biochemistry and Cell Biology.

E-Resources:

1. https://www.ikbooks.com/openPdf/9789381141595
2. https://www.pdfdrive.com/methods-in-enzymology-e45313687.html
3. https://www.worldcat.org/search?q=au%3APhillips%2C+Jo.&qt=hot_author
4. https://www.worldcat.org/search?q=au%3AAustin%2C+Rowan.&qt=hot_author
5. https://link.springer.com/article/10.1007/BF03245829

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	3	3	3	9	45
CO2	9	9	9	1	1	3	9	41
CO3	9	3	9	1	3	3	9	31
CO4	9	9	9	9	3	9	9	57
CO5	9	3	9	1	3	3	9	37
Total	45	33	45	15	13	21	45	217

Low-1 Medium-3 High-9

EXTRA CREDIT – LIFE SCIENCE FOR COMPETITIVE EXAMINATIONS

(For Students Admitted from 2024-25)

Semester: I **Hours per Week: -**
Subject Code: IMMBX1 **Credit: 2**

Course Objectives:

1. The diversity of metabolic processes occurring in biological system
2. To understand about the functional principles of Biotechnology

Unit I

Prokaryotic and Eukaryotic cells: Structure and ultrastructure; Structure and function of organelles – Chloroplast, Mitochondria, Vacuoles, Endoplasmic Reticulum, Golgi Apparatus, Ribosomes & Lysosomes, Nucleus, Nucleolus, Chromatin and Nucleosome; Mitosis and Meiosis.

Unit II

Structure and synthesis of DNA: Structure of mRNA, t-RNA & r-RNA; Structure of Proteins – Primary, Secondary, Tertiary and Quaternary; General properties of Enzymes and Amino acids.

Unit III

Concept of heredity and variation: Mendel's law of inheritance, Monohybrid Cross, Dihybrid Cross, Test Cross – Chromosomal basis of Inheritance, Incomplete Dominance, Epistasis, Mutation – Types.

Unit IV

Ecosystem: Concept, Structure, Function, Producers, Consumers and Decomposers of Ecosystem, Energy Flow, Food Web and Food Chain, Ecological Pyramids; Types of ecosystem; Pollution – Air, Water and Land; Global Warming and Disaster Management.

Unit V

Definition and scope of biotechnology: Restriction Enzymes, Plasmid – Types, Cloning Vectors pBR322, Methods of Gene transfer; Application of Genetic Engineering in the field of Agriculture –Herbicide and Pest Resistance plants & Medicine – Production of Recombinant Vaccines.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Recall the basic knowledge of life science and explain about the nucleic acids and protein synthesis

CO 2: Develop the applications in Biotechnology

CO 3: Distinguish the heredity and its related variations

CO 4: Determine on ecosystem and its types

CO 5: Discuss the changes in environment by the pollution & cyclone

Text Books:

1. Jeffrey C. Pommerville, *Fundamentals of Microbiology*, Jones & Bartlett Learning, Twelth Edition, 2021.
2. Weathers, Kathleen C., David L. Strayer, and Gene E. Likens, eds. *Fundamentals of Ecosystem Science.*Elsevier, 2021.

Reference Books:

1. Nelson D.L. and Cox M.M., *Lehninger Principles of Biochemistry*, Macmillan worth Publishers, Eighth edition, 2021.
2. Pelczar Jr. M.J., Chan E.C.S. and Kreig N.R., *Microbiology*, Mc. Graw Hill, 2021.

Journals:

1. Public Library of Science.
2. Journal of Molecular Structure.
3. Journal of BioScience.

E-Resources:

1. https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf
2. https://www.academia.edu/38901234/Prescott_Harley_Kleins_Microbiology_7th
3. https://kupdf.net/download/cell-biology-genetics-molecular-biology-evolution-and-ecology-verma-agarwal-2005_58fc9b38dc0d606b38959eeb_pdf
4. https://pdf.wecabrio.com/fermentation-microbiology-and-biotechnology.pdf
5. http://www.agrifs.ir/sites/default/files/27_Fermentation%20Microbiology%20and%20Biotechnology%20-2011.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	9	3	3	9	51
CO2	9	9	9	9	3	9	9	57
CO3	9	9	3	3	3	9	9	45
CO4	9	9	9	9	1	9	9	55
CO5	9	9	9	3	1	9	9	49
Total	45	45	39	33	11	39	45	257

Low-1 Medium-3 High-9

CORE V: FOOD MICROBIOLOGY

(For Students Admitted from 2024-25)

Semester: II **Hours/Week: 6**
Subject Code: IMMBC211 **Credit: 5**

Course Objectives:

1. To get overview of processing of various types of food
2. To get understanding of fermentation process and its industrial applications make aware of food borne disease

Unit I **(18 hours)**

Introduction: Food as a substrate for microorganisms, important microorganisms of food microbiology – Bacteria, Yeast, Molds; Factors influencing microbial growth in food, contamination of foods, general principles underlying spoilage, chemical changes caused by microorganisms.

Unit II **(18 hours)**

Food Preservation: Physical Methods – Asepsis, Drying, Filtration, Chilling and Freezing, Radiation, Pasteurization, Desiccation, Anaerobiosis, Canning, Controlled atmosphere; Bio preservatives, Chemical Preservatives – Salt, Sugar, Organic acid - Benzoic acid, Sorbic acid, Propionates, Acetic acid & Lactic acid, Nitrites, Nitrates, Sulphur dioxide, Ethylene dioxide, Propylene acid, Wood Smoker and Antibiotics, Microbial pigments as Additives.

Unit III **(18 hours)**

Contamination and spoilage of different groups of foods: Cereals and Cereal Products, Vegetables and Fruits, Meat and Meat Products, Fish and Fish Products, Milk and Milk Products, Eggs and Poultry, Canned food.

Unit IV **(18 hours)**

Food borne diseases: Bacterial (*Salmonella*, Diarrheagenic *E. coli, Vibrio parahaemolyticus, Clostridium perfringens and Listeria monocytogenes*) and Viral Food – borne diseases, Mycotoxins.

Indicators of food safety and Quality: Microbiological Criteria of foods and their significance, Food Inspection – Hazard analysis critical control point (HACCP), Rapid and automated analysis for detection of food contaminants – Application of immunological techniques in food industry.

Unit V **(18 hours)**

Fermented food products: Dairy products **–** Production of Cheese, Yoghurt, Kefir, Sour cream and Butter milk; Fermented vegetables, Fermented meat, Fermented fish, Fermented Indian foods; Role of microbes in fermented foods; Microbial cells as food – Single cell proteins, Mushroom; Beneficial Microbes as food – Probiotics **–** Potential and therapeutic applications – Lactobacilli – Homo and Hetero Lactic acid Fermentation, its nutritive value **–** Prebiotics and Synbiotics.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: List out the major microbes involved in food and explains the factors essential for the growth of microorganisms

CO 2: Illustrate discrete types of food preservation techniques

CO 3: Classify the principles of food spoilage microorganisms

CO 4: Value the extra knowledge on food safety and quality

CO 5: Tabulate the various kinds of microbes involved in fermented foods

Text Books:

1. William C. Frazier and Westhoff D.C, *Food Microbiology*, McGraw Hill Publications, New York, Fifth Edition, 2017.
2. Virendra Kumar Pandey, *Textbook of Food Microbiology*,INSC International Publishers, 2021.

Reference Books:

1. Foster W.M, *Food Microbiology***,** CBS Publishers and Distributors, Pvt Ltd, 2020.
2. Doyle, M.P., Diez-Gonzalez, F. and Hill, C. eds., *Food microbiology: fundamentals and frontiers*. John Wiley & Sons,2020.

Journals:

1. International Journal of Food Microbiology.
2. Journal of Microbiology, Biotechnology and Food Sciences.
3. Journal of Food and Dairy Technology.

E- Resources:

1. https://www.sciencedirect.com/science/article/pii/S002203021731055X
2. http://site.iugaza.edu.ps/mwhindi/files/ebooksclub.org_Principles_of_Fermentation_Technology.pdf
3. https://pdf.wecabrio.com/atlas-r-m-principles-of-microbiology.pdf
4. .https://www.sciencedirect.com/topics/food-science/food-fermentation
5. https://www.researchgate.net/publication/262419433_Microbiology_of_Fermented_Foods

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	9	9	3	1	9	9	49
CO2	9	9	9	3	3	9	9	51
CO3	9	9	9	9	1	9	9	55
CO4	9	9	9	9	3	9	9	57
CO5	9	9	9	3	1	9	9	49
Total	45	45	45	27	9	45	45	261

Low-1 Medium-3 High-9

CORE VI - ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

(For Students Admitted from 2024-25)

Semester: II **Hours/week: 6**
Subject Code: IMMBC221 **Credit: 5**

Course Objectives:

1. To create awareness on soil Microbiology and inculcate on environmental microbiology
2. To give knowledge on plant pathogen interaction and its control

Unit I **(18 hours)**

Environmental Microbiology: Characteristic Features of Environmental Micro Flora; Microorganisms and their environment – Temperature, Oxygen, Desiccation, Extreme Cold, Ionic Effect, Electricity, Osmotic Pressures, Radiant Energy, Hydrostatic Pressures, Mechanical Impact, Vibration, and Surface Forces.

Unit II **(18 hours)**

Air and Aquatic Microbiology: Aeromicrobiology – Droplet Nucleus–Aerosols – Air Borne Transmission of Microbes and Diseases; Assessment of air quality; Aquatic Microbiology – A brief introduction – Water borne Transmission of Microbes and Diseases; Assessment of water quality, Marine microbial habitats – Estuaries, Deep sea, Hydrothermal vents and Salt pans. Coral reefs – Types, bleaching and their microbial communities.

Unit III **(18 hours)**

Bioremediation and Biodegradation: Bioremediation – Types of bioremediation, Bioremediation of Surface Soil and Sludges; Principles and applications of Bioaccumulation, Bio magnification, Biodegradation; Degradation of biopolymers – Xylan, Lignin and Polyhydroxyalkanoates (Bio Plastics); Microbial Degradation of Hydrocarbons – Methane, alkanes; Biodegradation of pesticides. Bio corrosion, Bio leaching and Bio fouling.

Unit IV **(18 hours)**

Agricultural importance of microbes: Agro ecosystems – Populations in agro ecosystems, diversification of agro ecosystems; Outline of the threats to agro biodiversity and the need for conservation management – Impact of genetically modified crops; Microbial interactions – Plant and microbe, Microbe and Microbe interactions – Microbes involved in biogeochemical cycles – Nitrogen fixation, Sulphur fixation and Mobilization of nutrients, R: S ratio.

Unit V **(18 hours)**

Biological control of plant pathogens, pests, and weeds: Biopesticide – Characteristics, Advantages, types, formulation of pesticides; Microbial herbicides – Advantages of Herbicides, Formulation of Herbicides and its types; Constraints of Bio herbicides development, Bio insecticides – Characteristics, Advantages, Types, Formulation of insecticides.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Define Micro Flora and summarize the knowledge about marine habitats

CO 2: Critically demonstrate on an Agro Ecosystem

CO 3: Classifybiogeochemical cycles and influencing factors on environmental microbes

CO 4: Judge the assessment of air and water quality

CO 5: Discover how bio pesticides & herbicides are produced by using microbes

Text Books:

1. Mishra, Bibhuti B, Suraja K. Nayak, Swati Mohapatra, and Deviprasad Samantaray. *Environmental and Agricultural Microbiology: Applications for Sustainability,* 2021.
2. Willey, Joanne M, Linda Sherwood, Christopher J. Woolverton, and Lansing M. Prescott. Second Edition, *Prescott's Principles of Microbiology*. Boston: McGraw-Hill, 2020.

Reference Books:

1. John L. Havlin, Samuel L. Tisdale, Werner L. Nelson and James D. Beaton, *SoilFertility and Fertilizers*, 8th Edition, Pearson Education India, New Delhi, India, 2016.
2. Willey, Joanne M, Kathleen M. Sandman, and Dorothy H. Wood**.** *Prescott's Principles of Microbiology*, Second Edition, 2021.

Journals:

1. ASM Journal.
2. Environmental Microbiology.
3. Journals in Agricultural and Biological Science.

E- Resources:

1. https://www.brighthubengineering .com
2. www.onlinebiologynotes.com
3. http://www.jnkvv.org/PDF/02042020180252
4. https://microbenotes.com/category/agricultural-microbiology/
5. https: journals.asm.org/journal/aem

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	3	1	9	9	49
CO2	9	9	9	9	1	9	9	55
CO3	9	9	9	9	1	9	9	55
CO4	9	9	9	9	3	9	9	57
CO5	9	9	9	9	1	9	9	55
Total	45	45	45	39	7	45	45	271

Low-1 **Medium-3** **High-9**

CORE VII - RECOMBINANT DNA TECHNOLOGY

(For Students Admitted from 2024-25)

Semester: II **Hours/week: 6**
SubjectCode: IMMBC231 **Credit: 5**

Course Objectives:

1. To learn about the various enzymes involved in rDNATechnology
2. To know the principles of cDNA construction and amplification methods

Unit I **(18 hours)**

DNA modifying enzymes and their uses in Molecular Biology: Restriction enzymes, Sticky ends, Blunt ends; DNA Polymerase – Klenow fragment, DNA polymerase I, T4/T7 DNA Polymerase; Reverse Transcriptase; Terminal Transferases; T4 Polynucleotide Kinases & Alkaline Phosphatase; DNA dependent RNA Polymerases; DNA Ligases; Homopolymeric tailing; Adapters & linkers; Nucleases Bal31, S1 Nucleases, DNase I, Mung bean Nucleases, Ribonucleases, EXO III; Thermostable DNA Polymerases used in PCR.

Unit II **(18 Hours)**

Host cells and Vectors: Host cell – types, vectors in gene cloning – pBR322, pUC8, Lambda and M13 vectors, Cosmids, shuttle vectors, specialized vectors – Expression vectors, inducible vectors and gene fusion vectors, Artificial chromosomes (YACs, PACs, BACs, MACs and HACs).

Unit III **(18 Hours)**

Cloning strategies: Extraction of DNA – Microorganism, Plant, Animal; Insertion of foreign DNA into Host Cells – Transformation, Electroporation, Lipofection, Microinjection; Construction of genomic DNA libraries and cDNA libraries; Screening and analysis of recombinants; Preparation of radiolabelled / non-radiolabelled DNA & RNA probes; Southern, Northern, Dot blot, Zoo blot, Colony blot; Screening of genomic libraries with DNA probe, Immunological Screening for expressed genes.

Unit IV **(18 Hours)**

PCR and Sequencing: Principle, types- Conventional- Nested PCR, Multiplex PCR, Quantitative PCR, Arbitrary Primed PCR, Reverse Transcriptase PCR and Real Time and their applications; DNA sequencing – First generation DNA sequencing - Principle of Chemical and Enzymatic Methods, Next (Second) Generation Sequencing – Roche 454, Pyrosequencing, Illumina, Solid sequencing, Ion Torren sequencing, Third Generation Sequencing – Single Molecule Real Time Sequencing (SMRT), Nanopore Sequencing, RNA Sequencing.

Unit V **(18 Hours)**

Applications of rDNA technology in medicine: Insulin and interferon production, Molecular diagnosis of diseases – infectious diseases – tuberculosis, malaria & AIDS, genetic diseases – cystic fibrosis, sickle cell anemia& cancer; Clinical trials – Phases in Clinical trials, Bioethics – Ethical issues in clinical trials.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Discuss various types of DNA modifying enzymes and illustrate the host cells and

vectors in gene cloning
CO 2: Demonstrate the Applications of rDNA technology in medicine
CO 3: Focus on analytical techniques employed in DNA sequencing
CO 4: Validate the significance of Next generation sequencing
CO 5: Construct the strategies of cloning, extraction and construction of genomic DNA and cDNA libraries

Text Books:

1. Faraday, Patrick. *Principles and Techniques of Gene Manipulation*, 2018.
2. Glick, Bernard R, and Cheryl L. Patten. *Molecular Biotechnology: Principles and Applications of Recombinant DNA*, Fifth Edition, 2017.

Reference Books:

1. Janarthanan S. and Vincent S., *Practical Biotechnology: Methods and Protocols*, Universities Press India Pvt. Ltd, Hyderabad, 2020.
2. Snustad, D P, and Michael J. Simmons. *Principles of Genetics*, Seventh Edition, 2016.

Journals:

1. Journal of Human Molecular Genetics.
2. International Journal of Medical & Pharmaceutical Sciences.
3. Trends in Genetics.

E-Resources:

1. https://www.academia.edu/38901235/Principles of Gene Manipulation_and_Genomics
2. https://www.researchgate.net/publication/238328781_Recombinant_DNA_Genes_and genomes-A short_course_3rd_ed
3. https://dlscrib.com/download/t-a-brown-genomes-3_58c1b6c7e12e89e97fadd374_pdf
4. https://www.ebooknetworking.net/ebooks/principles-of-genetics-by-gardner.html
5. https://www.worldcat.org/title/a-text-book-of-biotechnology-biotechnology/oclc/1202232758?referer=br&ht=edition

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	9	9	9	9	57
CO2	9	9	9	9	3	9	9	57
CO3	9	9	9	9	9	9	9	63
CO4	9	9	9	9	9	9	9	63
CO5	9	9	9	9	1	9	9	55
Total	45	39	45	45	31	45	45	295

Low-1 Medium-3 High-9

CORE VIII - LAB COURSE IN ENVIRONMENTAL, AGRICULTURAL AND FOOD MICROBIOLOGY

(For Students Admitted from 2024-25)

Semester: II **Hours/week: 6**
Subject Code: IMMBC241P **Credit: 5**

Course Objective:

1. To make them expert in food Microbiology
2. To know the role of microbes in agriculture and environmental field

List of Experiments: **(90 hours)**

1. Assessment of water quality by MPN technique
2. Enumeration of microorganism from air, soil, phyllosphere and milk
3. Estimation of BOD and COD
4. Effect of temperature & pH on microbial growth, techniques for cultivation of anaerobic bacteria
5. Estimation of TS, TDS and TSS in water.
6. Isolation of free living and symbiotic nitrogen fixing bacteria from soil and rootnodule.
   i. *Azotobacter*
   ii. *Rhizobium*
   iii. *Phosphate solubilizingbacteria*
6. Isolation of *Cyanobacteria*
7. Examination of plant diseases

Bacterial Disease	**Fungal Disease**
Blight of rice	Tikka leaf spot of ground nut
Citrus canker,	Blast of rice
Brown rot of potato	Red rot of sugarcane

8. Staining of vesicular and Arbuscular mycorrhizae from plant root
9. Microbiological analysis of food products
10. Determination of the quality of milk sample by Dye Reduction Test, Phosphatase test
11. Isolation of Lactic acid bacteria from milk
12. Screening of seafood spoilage microbes.
13. Sauerkraut production.
14. Detection of metanil yellow in a given food sample.
15. Fermentative production of Citric acid and wine.
16. Cell immobilization using sodium alginate
17. Mushroom Cultivation

Course Outcomes:

After Successful completion of this course, student will be able to

CO 1: Identify the microorganisms from the water quality by MPN technique and discuss about them

CO 2: Classify various nitrogen fixing bacteria from various sources

CO 3: Point out the various plant diseases and Mycorrhizae

CO 4: Justify the microbiological analysis of food products and estimate BOD and COD

CO 5: Discuss the process involved in the fermentative production and mushroom cultivation

Text Books:

1. Marylynn V. yates et al., *Manual of Environmental Microbiology*, ASM Press, 4th Edition, 2016.
2. Neelima Gar et al., *Laboratory Manual of Food Microbiology*, Dreamtech Press, 1st Edition, 2020.

Reference Books:

1. Alfred Brown and Heidi Smith, *Benson's Microbiological Applications Laboratory Manual*, McGraw – Hill Education, Concise version, Fourteenth Edition, 2016.
2. Ahmed E. Yousef, Joy G. Waite-Cusic, Jennifer J. Perry, *Analytical Food Microbiology: A Laboratory Manual***,** John Wiley &sons, Inc. 2nd Edition,2022.

Journals:

1. International Journal Of Food Microbiology.
2. Journal of Applied and Environmental Microbiology.
3. Journals in Agricultural and Biological Sciences.

E-Resources:

1. https://www.researchgate.net/publication/264121707_Practical_Microbiology
2. https://books.google.com.np/books?id=QYI4xk9kOIMC&printsec=frontcover#v=onepage&q&f=false
3. https://faculty.washington.edu/korshin/Class-486/MicrobiolTechniques.pdf
4. https://nptel.ac.in/courses/127/105/127105018/
5. https://nptel.ac.in/courses/126/105/126105016/#

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	3	1	9	9	49
CO2	9	9	9	3	3	9	9	51
CO3	9	9	9	3	1	9	9	49
CO4	9	9	9	3	3	9	9	51
CO5	9	9	9	3	1	9	9	49
Total	45	45	45	15	9	45	45	249

Low-1 Medium-3 High-9

Discipline Specific Elective II: a. GENOMICS AND PROTEOMICS

(For Students Admitted from 2024-25)

Semester:II **Hours/week: 6**

Subject Code: IMMBE2A **Credit: 5**

Course Objectives:

1. To appraise the students to the vital concepts of technologies pertinent to Genomics and Proteomics
2. To apply the knowledge in scientific queries

Unit I **(18 hours)**

Introduction to Genomics: Human genome project - Structure and organization of prokaryotic genomes – Nuclear, Mitochondrial and Chloroplast genomes; Recognition of coding and noncoding regions and Annotation of genes, Coding sequences (CDS), Untranslated regions (UTR's), cDNA library, Expressed sequence tags (EST); Mapping of genomes – mapping strategies, linkage maps, slow and high-resolution physical mapping, Metagenomics.

Unit II **(18 hours)**

Structural Genomics: Gene prediction in prokaryotes and Eukaryotes, Gene networks – the need for Structural genomics, basic principles and approaches for target selection.

Functional genomics: Promoter and regulatory elements in prokaryotes and eukaryotes, Determination of function of unknown genes, patterns of gene expression SAGE, Microarray technology.

Unit III **(18 hours)**

Proteomics: Introduction to Proteomics, Methods of studying Proteins, Identification of Post Translationally Modified Proteins (2D Gel Electrophoresis), Determining the existence of Protein in complex mixture – MALDI-TOF, Establishing Protein-Protein interactions, Two hybrid analysis, Protein database.

Unit IV **(18 hours)**

Metabolomics: Concepts, Levels of metabolite analysis, Metabolomics in humans, Sample selection and handling, Overview of different methods used for analysis of metabolites; Metabolic regulation network at genome level; Basic concept of Metabolomic Engineering.

Unit V **(18 hours)**

Pharmacogenomics: Definition, Drug Designing – Targets, Characteristics of drugs, Discovery and Validation- ADME prediction– Drug Metabolizing Enzymes – Cyp 450 genes, anticipated benefits of Pharmacogenomics, barriers, Pharmacogenomics progress, Pharmacogenomics of alcoholism, Ethnicity and Pharmacogenomics.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Define Human genome project and explain the structure and organization of prokaryotic & eukaryotic genome

CO2: Discover about the pharmacogenomics and metabolomics

CO3: Investigate the expression of proteins by various proteomics techniques

CO4: Recommend the principles and approaches of structural & functional genomics for growing translational research

CO 5: Elaborately understand the principle of separation and identification of protein

Text Books:

1. Jonathan Pevsnern, *Bioinformatics and Functional Genomics*, Wiley Blackwell publications, New Jersey, Third Edition, 2015.
2. Cornelissen, Cynthia N, and Marcia M. Hobbs. *Microbiology*, Fourth Edition, 2020.

Reference Books:

1. Arthur M. Lesk, *Introduction to Genomics*, Oxford University Press, Third edition, 2017.
2. Devarajan Thangadurai, Jeyabalan Sangeetha,*Genomics and Proteomics: Principles,*

Technologies, and Applications. Canada, Apple Academic Press, 2015.

Journals:

1. International Journal of Genomics and Proteomics.
2. Human Genomics and Proteomics.
3. American Journal of Human Genetics.

E-Resources:

1. https://nptel.ac.in/courses/102/103/102103017/
2. https://nptel.ac.in/courses/102/101/102101076/
3. https://www.yumpu.com/en/document/view/37965603/genomics-applications-in-human-biologypdf
4. https://www.researchgate.net/publication/229675399_Proteomics_in_Practice_A_Laboratory_Manual_of_Proteome_Analysis
5. https://biokamikazi.files.wordpress.com/2013/06/gene-and-genomics.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	3	1	9	9	49
CO2	9	9	9	3	3	9	9	51
CO3	9	9	9	3	9	3	9	51
CO4	9	9	9	3	9	3	9	51
CO5	9	9	9	3	9	3	9	51
Total	45	45	45	15	31	27	45	253

Low-1 Medium-3 High-9

Discipline Specific Elective II: b. NANOBIOTECHNOLOGY

(For Students Admitted from 2024-25)

Semester: II **Hours/week: 6**
Subject Code: IMMBE21B **Credit: 5**

Course Objectives:

1. To provide an introduction to Nanobiotechnology
2. To make the students understand about the functional principles of nanobiotechnology

Unit I **(18 hours)**

Introduction to Nanotechnology: Definition, Evolution of Nanoscience, Need of Nanotechnology, Hurdles for Nanotechnology development, Factors involved in the manufacturing process of nanomaterials; Synthesis of nanomaterial – physical, chemical, Biosynthesis (Gold and silver), colloids and Nano filter, properties of nanoparticles – Agglomeration, Oswald Ripening, surface area to volume ratio, top down and bottom up approach.

Unit II **(18 hours)**

Tools used in nanotechnology research: Ultra Violet – Visible Spectroscopy, FTIR, XRD, Atomic Force Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy, Scanning Tunneling Microscopy, Magnetic Resonance Force Microscopy, Dynamic Light Scattering and Zeta Potentials.

Unit III **(18 hours)**

Nucleic acid based nanomaterials: DNA based artificial nanostructures; Fabrication, properties and application; Nucleic acid engineered nanomaterials and their applications; DNA lipoplexes – Lipofection efficiency *in vitro* and *in vivo*, Polymer controlled delivery of therapeutic nucleic acid.

Unit IV **(18 hours)**

Nanotechnology for drug development and medical applications: Nanotechnology for drug solubilization and drug delivery – toxicity; Nanomaterials in disease diagnosis; Nanotherapy for cancer, Interior artery expansions and joint replacement.

Unit V **(18 hours)**

Nanotechnology application in Environment: Cleaning the air with Nanotechnology; Nanotechnology for water treatment **–** Microbial nanoparticles; Possible harm from Nanomaterials; Nanoscience in India – Nanoscience education abroad – Looking at ethics and society.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Define Nanobiotechnology andexplain the biosynthesis and green synthesis of Nanomaterials

CO 2: Develop the process of fabrication, properties and application of Nucleic acid based artificial Nanomaterials

CO 3: Analyze the nanotechnology tools and techniques in research

CO 4: Assess the status of nanotechnology in India and its impacts

CO 5: Discuss the factors involved in the manufacturing process of Nanomaterials

Text Books:

1. Sougata Ghosh, Thomas Webster, *Nanobiotechnology, Microbes and Plant Assisted Synthesis of Nanoparticles, Mechanism and Applications*, 1st Edition- May20, 2021.
2. Saurabh Bhatia, *Nanotechnology in Drug Delivery, Fundamentals, Design, and Applications,* Apple Academic Press, 1st Edition- March 31, 2021.

Reference Books:

1. Saxena, Shailendra K, and S M. P. Khurana. *Nanobiomedicine***.**First Edition, 2020.
2. Ducruix A. and Giege R., *Crystallization of Nucleic acids and Proteins: A Practical Approach*, Oxford University Press, England, Second Edition, 2020.

Journals:

1. Journal of Nanobiotechnology.
2. International Journal of Nanomedicine.
3. Nanotoxicology.

E-Resources:

1. https://nptel.ac.in/courses/102/107/102107058/
2. https://nptel.ac.in/courses/118/104/118104008/
3. https://nptel.ac.in/courses/118/102/118102003/
4. https://academic.oup.com/clinchem/article-abstract/53/11/2002/5627223
5. https://www.karger.com/Article/Abstract/112961

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	3	3	3	9	45
CO2	9	9	9	3	9	9	9	57
CO3	9	9	9	3	9	9	9	57
CO4	9	9	9	1	9	9	9	55
CO5	9	9	9	3	9	9	9	57
Total	45	45	45	13	39	39	45	271

Low-1 Medium-3 High-9

EXTRA CREDIT- BIOFERTILIZER PRODUCTION

(For Students Admitted from 2024-25)

Semester: II **Hours/week: -**
Subject Code: IMMBX2 **Credit: 2**

Course Objectives:

1. To demonstrate the low cost media preparation and impact training of ecofriendly agricultural inputs in biofertilizer production
2. To distinguish the types of biofertilizers and methods of application in farmers field

Unit I

Biofertilizer – History, importance of fertilizer and their application to crops, Natural cycles associated with microorganisms – Carbon, Nitrogen, Phosphorous and Sulphur.

Unit II

Bacterial Biofertilizers – Free living forms; Characteristic features and nitrogen fixation process of *Azotobacter*, *Azospirillum*; Symbiotic forms – *Rhizobium*, Legume association – *Pseudomonas*, non-legume association; Cyanobacterial biofertilizers – *Nostoc*, *Anabaena*, *Gloeocapsa* and *Scytonema*.

Unit III

Fungal Biofertilizer – Ectomicorrhiza and Endomicorrhiza, *Vesicular Arbuscular Mycorrhiza – Glomus sp*; *Actinomycetes* as biofertilizers – actinomycetes association – *Frankia sp*.

Unit IV

Biomanures – A general account of Manures – Molds; Composts – Farm Yard Manure,

Oil Seed Cakes, Castor and Neem; Green Leaf Manures – *Gliricidia*, *Sesbania* and *Crotalaria*; Agro industrial wastes – Poultry manure and saw dust; Compost – vermicompost and microbial compost – pure culture technique, consortium; types of compost pit; Biodegradation of compost.

Unit V

Applications of Biofertilizers and biomanures – a combination of biofertilizer and manure applications with reference to soil, seed and leaf sprays; Laboratory and field application, cost benefit analysis of biofertilizer and bio manure production.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Tell about the biofertilizer production and explain the cycles associated with the microorganisms

CO 2: Illustrate the laboratory and field application of biofertilizers and biomanures

CO 3: Research the perception of biomanures from different agro and poultry wastes

CO 4: Determine the importance and association of fungal biofertilizers

CO5: Elaborate the significance of vermicompost and microbial compost by Biodegradation

Text Books:

1. Smith, Sally E, and D J. Read. *Mycorrhizal Symbiosis*. Amsterdam [etc.: Elsevier, Academic Press, Third Edition, 2017.
2. Sethi, Santosh K, and Siba P. Adhikary. *Microbial Biofertilizers in Organic Farming and Production Technology:* Biofertilizer Production, Formulation and their Cost Benefit Analysis, 2017.

Reference Books:

1. Kumar, H.D. *Agricultural Biotechnology*. New Delhi: Daya Publishing House, 2018.
2. A. K. Singh et al., *Biofertilizers: Volume 1: Advances in Bio-inoculants*. United Kingdom, Elsevier Science, 2021.

Journals:

1. Journal of Ecology.
2. Indian Journal of Applied Microbiology.
3. Frontiers in Ecology and the environment.

E- Resources:

1. https://www.routledge.com/HandbookofMicrobialBiofertilizers/Rai/p/book/9781560227052705
2. https://www.taylorfrancis.com/books/mono/10.1201/9780367805500/microbesbiofertilizers production-technology-borkar
3. https://www.slideshare.net/scm9961/handbook-of-biofertilizers-and-biopesticides
4. https://nptel.ac.in/courses/126/105/126105014/
5. https://www.google.co.in/search?hl=en&gbpv=1&dq=biofertilizer+production&printsec=frontcover&q=inpublisher:%22Elsevier+Science%22&tbm=bks&sa=X&ved=2ahUKEwjlkajTusf1AhVKwTgGHTrrDHEQmxMoAHoECBgQAg&sxsrf=AOaemvKPOPTQagJgrujzQt5mtkcOU6nErg:1642926634347

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	9	9	1	1	9	9	47
CO2	9	9	9	3	1	9	9	49
CO3	9	9	9	9	1	3	9	49
CO4	9	9	9	3	1	9	9	49
CO5	9	9	9	9	3	9	9	57
Total	45	45	45	25	7	39	45	251

Low-1 Medium-3 High-9

CORE IX - MEDICAL MICROBIOLOGY

(For Students Admitted from 2024-25)

Semester: III **Hours/week: 6**
Subject Code: IMMBC311 **Credit: 5**

Course Objectives:

1. To inculcate the role of normal flora and pathogenic microbes
2. To understand the pathogenesis of various diseases and clinical microbiological techniques

Unit I **(18 hours)**

Laboratory management: Biomedical Waste Management, Biosafety in containment laboratory; Collection and transport of Clinical samples; Normal Flora of Human Systems – Skin, Respiratory Tract, Gastrointestinal Tract and Genitourinary Tract; Nosocomial infections; Nucleic acid based microbial diagnostic techniques – LCR, NASBA and QBRDA; Host-microbe interaction – Transmissibility of pathogens.

Unit II **(18 hours)**

Bacterial Diseases: General characters, Pathogenesis, Laboratory diagnosis, Control measures **–** Tuberculosis, Leprosy, Typhoid, Cholera, Anthrax, Tetanus, Plague and Meningitis.

Unit III **(18 hours)**

Viral diseases: Morphology, Pathogenesis, Laboratory diagnosis and Control measures – DNA viruses – Hepatitis A & B virus; RNA viruses – Flavi virus – Dengue, Influenza virus, Zika virus; Retrovirus, Rubella virus, Rabies, Oncogenic viruses, COVID 19 and H_2N_2.

Unit IV **(18 hours)**

Fungal diseases: General characters, Pathogenesis, Laboratory diagnosis, Control measures – Mycoses – Superficial mycoses – Black Piedra, Dermatophytosis; Subcutaneous mycoses – Sporotrichosis, Mycetoma; Systemic mycoses – Histoplasmosis, Cutaneous mycoses, Candidiasis – UTI and Mucormycosis.

Protozoan diseases: General characters, Pathogenesis, Laboratory Diagnosis, Control measures – Amoebiasis, Giardiasis, Malaria, Teania.

Helminth disease: General characters, Pathogenesis, Laboratory Diagnosis, Control measures – Hook worm.

Unit V **(18hours)**

Microbial pharmaceutics: Classification of microbial antibiotics, General properties and drug action of Sulphonamides – Sulphadiazine, Sulphapyridine, Sulphathiazole, Sulphafurazole; Antibacterial chemicals – Bactericidal and Bacteriostatic Agents; Adverse Drug Reactions; Principles of Toxicity, Evaluation and Determination of LD_{50}, ED_{50} and Therapeutic index, Quality for Medicines and formulations.

Course Outcomes:

After successful completion of the course, student will be able to

CO 1: Define the basic concept and explain the maintenance of medical laboratory

CO 2: Interpret the antibiotics and its applications

CO3: Analyze the different types of diseases, pathogenicity, treatment and laboratory management

CO 4: Evaluate the bacterial pathogenicity and its retrieval

CO 5: Elaborate the concept of viral and protozoan infection

Text Books:

1. S. Rajan, *Medical Microbiology*. Canada, MJP Publisher, 2019.
2. Mahon, Connie R, Donald C. Lehman, and George Manuselis. *Textbook of Diagnostic Microbiology*, 2015.

Reference Books:

1. Gauri Devasthale, Dr. Rajashree Patwardhan, et al., *Medical Microbiology*, 2021.
2. Evinson, Warren E. *Review of Medical Microbiology and Immunology*. [S.l.] : Mc Graw Hill Education, 2022.

Journals:

1. International Journal of Medical Microbiology.
2. Journal of Clinical Microbiology.
3. Journal of Antimicrobial Chemotherapy.

E- Resources:

1. http://sutlib2.sut.ac.th/sut_contents/H109300.pdf
2. https://www.digimat.in/nptel/courses/medical/microbiology/MB11.html
3. https://nptel.ac.in/courses/102/103/102103015/
4. https://www.pdfdrive.com/review-of-microbiology-and-immunology-e176171213.html
5. https://booksca.ca/wp-content/uploads/XPreview/Pharmacology/3/sherris-medical-microbiology-7th-edition-by-kenneth-j-ryan.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	9	3	9	9	57
CO2	9	9	9	9	3	9	9	57
CO3	9	9	9	9	3	9	9	57
CO4	9	3	9	3	3	9	9	45
CO5	9	9	9	9	1	9	9	55
Total	45	39	45	39	13	45	45	271

Low-1 **Medium-3** **High-9**

CORE X – IMMUNOLOGY AND IMMUNODIAGNOSTICS

(For Students Admitted from 2024-25)

Semester: III **Hours/week: 6**
Subject Code: IMMBC32 **Credit : 5**

Course Objectives:

1. To provide knowledge on human immunity system
2. To understand the mechanism of antigen antibody reaction and to inculcate the principles of vaccine development

Unit I **(18 hours)**

Overview of the Immune system and CMI Cells involved in Immune system: Hematopoiesis, Lymphocytes, Mononuclear phagocytes, Antigen presenting cells, Granulocytes.

Lymphoid organ: Lymphatic system, Primary and Secondary lymphoid organs; Complement System – Pathways of complement activation, Regulation of complement system, Biological functions of complement system; Pathways of antigen processing and presentation.

Cell Mediated Immunity: General properties of effector T cells, Cytotoxic T Cells, Natural Killer cells, Antibody-dependent cell mediated cytotoxicity; T-cell dependent and T-cell independent defense mechanisms.

Unit II **(18 hours)**

Cancer Immunology: MHC – HLA – Malignant transformation of cells; Apoptosis, Oncogenes and cancer induction; Tumor antigens; Immune surveillance theory; Tumor evasion of the immune system; Cancer Immunotherapy.

Transplantation Immunology: Immunological basis of graft rejection, Mechanism of graft rejection; Immunosuppressive therapy – General and specific; Clinical transplant; Tolerance – central and peripheral tolerance to self-antigens; Mechanism of induction of natural tolerance; MHC – Types – HLA typing and applications.

Unit III **(18 hours)**

Immunodeficiency disorders: Phagocytic disorders – Chediak - Higashi syndrome; B-cell deficiency – Bruton's X-linked hypogammaglobulinemia; T-cell deficiency disorder – DiGeorge Syndrome; Combined B-cell & T-cell deficiency disorder – SCID (Severe combined immunodeficiency diseases), Wiskott-Aldrich syndrome; Complement deficiencies and Secondary immunodeficiency conditions carried by drugs, nutritional factors and AIDS.

Unit IV **(18 hours)**

Autoimmunity and autoimmune diseases: General consideration, Etiology, Clinical categories, Diagnosis and treatment; RA(Rheumatoid arthritis); SLE (Systemic Lupus Erythematosus); Myasthenia gravis; Grave's disease; Goodpasture syndrome, Autoimmune hemolytic disease; Pernicious anemia; Hypersensitivity – Type I, Type II, Type III and Type IV.

Unit V **(18 hours)**

Immunodiagnostics precipitation reactions: Immunodiffusion, Immunoelectrophoresis, Agglutination reactions – Bacterial agglutination, Hemagglutination, Passive agglutination, Reverse passive agglutination and agglutination inhibition; Radioimmuno assay, ELISA, ELI Spot, Western blotting technique, Complement fixation test, Immunofluorescence, Immunoelectron microscopy, Hybridoma technology.

Vaccine Production: Types of vaccine – Live, Attenuated, Capsular, Subunit, Recombinant, DNA and RNA vaccine.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Define the basic concepts of immunology and indicate the cells involved in immune system

CO 2: Gain knowledge on oncology and transplantation immunology

CO 3: Group and discuss critically about the immunodeficiency disorders

CO 4: Evaluate the advanced knowledge on immunodiagnostic methods

CO 5: Combining the knowledge on autoimmunity and autoimmune diseases

Text Books:

1. Jenni Punt, Sharon Stranford, Patricia Jones and Judy Owen, *Kuby Immunology*, Eighth Edition, Freeman & Company, New York, 2018.

2. Subhash Chandra Parija, *The Textbook of Microbiology and Immunology***,** Elsevier India; 3rd Edition, 2016.

Reference Books:

1. Roderick Nairn and Matthew Helbert, *Immunology for Medical Students*, Third Edition, Elsevier, 2017.
2. Kannan I., *Immunology*, MJP Publishers, Chennai, 2019.

Journals:

1. Journal of Microbiology, Immunology and Infection.
2. The Journal of Allergy and Clinical Immunology.
3. Molecular Immunology.

E-Resources:

1. https://www.academia.edu/29447385/Kuby_Immunology_pdf
2. https://icuadelaide.com.au/files/primary/physiology/immunology.pdf
3. https://microbenotes.com/category/immunology/
4. http://www.hhmi.org/biointeractive/immunology/lectures.html
5. https://www.academia.edu/24159312/immunology_for_medical_students

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	3	1	9	9	49
CO2	9	9	9	9	3	9	9	57
CO3	9	3	9	9	3	9	9	51
CO4	9	9	9	3	3	9	9	51
CO5	9	9	9	3	3	9	9	51
Total	45	39	45	27	13	45	45	259

Low-1 Medium-3 High-9

CORE XI: BASICS OF RESEARCH METHODOLOGY

(For Students Admitted from 2024-25)

Semester: III **Hours/week: 6**
Subject Code: IMMBC331 **Credit: 5**

Course Objectives:

1. To gain an understanding research methodology and the ethical issues
2. To develop the skill of scientific writing, art of result and data analysis

Unit I **(18 hours)**

Research: Selection of problems – stages in the execution of research; preparation of manuscript – report writing – format of journals – proof reading – plagiarism-citation, review article, research article, short communication, books and bibliography, thesis writing and research ethics.

Unit II **(18 hours)**

Journals: Standard of research journals – Web of Science, Scopus indexed journals, SCI journals and Predatory journals, Journal Metrics – impact factor, citation index, H-Index, i10 index.

Databases: Information retrieval – access to archives and databases, google scholar, PubMed, Shodganga, National Informatics Centre.

Unit III **(18 hours)**

Measures of dispersion: Sampling methods, random sampling, types of variables – qualitative and quantitative variables – continuous and discontinuous variables, scaling method – mean, standard deviation, standard error, coefficient of variation; elucidation with model sums.

Unit IV **(18 hours)**

Test of Significance: Basic ideas of significant test – Hypothesis testing, significance test and fixing levels of significance – statistical tables and their use –Data analysis using MS Excel, use of statistical software like COSTAT and STATISTICA.

Unit V **(18 hours)**

Principles and practice of statistical methods in biotechnological research: Simple Correlation and regression analysis; Chi-square test, student's t-test, ANOVA; Multivariate Analysis – Basic principles and applications of multiple regression analysis, Principal component analysis (PCA), Discriminant function analysis (DFA), Cluster analysis.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Observe the relationships among living things and interpret to solve biological problems among them
CO2: Develop research and inquiry
CO3: Research the analysis of human genome
CO4: Determine the gene expression
CO5: Designing new algorithms and software to extract information from large database

Text Books:

1. Indranil Saha, Bobby Paul, *Essentials of Biostatistics and Research Methodology***,** Third Edition, 2021.
2. C R kothari, Gaurav Garg, *ResearchMethodology : Methods And Techniques***,** New Age International Publishers; Fourth Edition, 2019.

Reference Books:

1. Bhushan, Brijender, Pawitar Dulari, and Ajay Bhushan. *Basics of Research Methodology: Research Methodology*, 2020.
2. Nayak, Jayanta Kumar, and Priyanka Singh. *Fundamentals of Research Methodology Problems and Prospects***.** SSDN Publishers & Distributors, 2021.

Journals:

1. IEEE Acess.
2. Journal of Research and Development.
3. Journal of Statistical software.

E-Resources:

1. https://explorable.com/defining-a-research-problem
2. http://130.18.86.27/faculty/warkentin/secure/9213/articles/Davis2000.pdf
3. http://www.biostathandbook.com/HandbookBioStatThird.pdf
4. https://www.researchgate.net/publication/221959634_Biostatistical_analysis
5. http://41.63.34.241:8080/jspui/handle/123456789/248

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	9	9	9	9	63
CO2	9	9	9	9	9	9	9	63
CO3	9	3	9	9	9	9	9	57
CO4	9	9	9	3	9	9	9	57
CO5	9	3	9	1	9	9	9	49
Total	45	33	45	31	45	45	45	289

Low-1 Medium-3 High-9

CORE XII - LAB COURSE IN MEDICAL MICROBIOLOGY, IMMUNOLOGY AND IMMUNODIAGNOSTICS

(For Students Admitted from 2024-25)

Semester: III **Hours/week: 6**
Subject Code: IMMBC341P **Credit: 5**

Course Objectives:

1. To develop knowledge of microbial organisms and their relevance of infectious diseases
2. To focus on practical application of immunological experimental advances in basic and medical science

List of Experiments: **(90 hours)**

1. Blood Collection and Blood grouping
2. Blood smear identification of leucocytes by Giemsa Stain
3. Separation of Leukocytes by Dextran method
4. Separation of Mononuclear cells by Lympho preparation.
5. Separation and characterization of Lymphocytes from blood and demonstration of Lymphocyte population.
6. Immunodiffusion – Simple, Double and Radial
7. Australian latex antigen test
8. Agglutination Test (ASO, CRP & RA)
9. Card Test (HBsAg & Pregnancy test)
10. RPR (rapid plasma reagin) test
11. Immunoblotting
12. Widal - slide test
13. Demonstration of ELISA

Course Outcomes:

After successful completion of this subject, student will be able to

CO 1: Identify to collect the blood sample from various parts and explain smear preparation

CO 2: Connect and get the thorough knowledge on separation of different types of blood cells

CO3: Examine the antigen-antibody interaction in immune diffusion and immune electrophoretic methods

CO 4: Estimate and perform various immunodiagnostic methods

CO 5: Discover the ideology for different kit methods in immunodiagnostics purpose

Text Books:

1. Abeer Feteih., Michael Fein., *The Manual of Allergy and Clinical Immunology***,** Taylor and Francis Ltd, 2021.

2. Alagappan R., *Manual of Practical Medicine*, Jaypee Brothers Medical Publishers, Sixth Edition, 2018.

Reference Books:

1. Talwar G.P. and Gupta S.K., *A Handbook of Practical and Clinical Immunology*, CBS publications, Second edition, volume 1 and 2, 2017.

2. Tobili Y.Sam - Yellowe, *Immunology: Overview and laboratory manual***,** springer, 2021.

Journals:

1. Journal of Medical Microbiology and Diagnosis.
2. International Journal of Medical Microbiology.
3. Journal of Immunological Methods.

E-Resources:

1. http://sutlib2.sut.ac.th/sut_contents/H109544.pdf
2. https://www.medbox.org/preview/5255d6e1-05d4-41a9-beb2-02b60e695ecc/doc.pdf
3. https://pdf.wecabrio.com/handbook-of-practical-and-clinical-immunology.pdf
4. http://amrita.vlab.co.in/?sub=3&brch=69
5. https://journals.squ.edu.om/index.php/squmj/article/download/1338/1292/0

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	3	1	9	9	49
CO2	9	9	9	3	1	9	9	49
CO3	9	3	9	9	1	9	9	49
CO4	9	9	9	3	1	9	9	49
CO5	9	9	9	3	3	9	9	51
Total	45	39	45	21	7	45	45	247

Low-1 Medium-3 High-9

Discipline Specific Elective III: a. BIOETHICS, BIOSAFETY & IPR
(For Students Admitted from 2024-25)

Semester: III **Hours/week: 6**
Subject Code: IMMBE31A **Credit: 5**

Course Objectives:

1. To provide an understanding of the ethical issues and innovation in addition to protection of the acquired intellectual property
2. To gain an understanding on research methodology and the importance of protection of intellectual property

Unit I **(18 hours)**

Bioethics: Introduction and principles of Bioethics; The use of nature; Different views of nature; Dynamic nature; Interfering with nature; Integrity of species; Reducing genetic diversity; Biological warfare; Public perception of science, General issues related to environmental release of genetically modified microorganisms.

Unit II **(18 hours)**

Ethics in Human Cloning: Introduction, Existing limits in human cloning, The realistic uses of human cloning, Ethical concerns regarding human cloning, The need for international regulations, Stem cell therapy and its related ethical issues in research.

Unit III **(18 hours)**

Biosafety: Introduction, Different levels of biosafety; Concept and issues, rational vs subjective perceptions of risks and benefits – relationship between risk hazard, exposure, and safe guards – biosafety concerns at the level of individuals, institutions, society, region country and the world – Lab associated infections- Institutional Bio-Safety Committee (IBSC).

Unit IV **(18 hours)**

Biosafety assessment (BSA): BSA of biotechnology and pharmaceutical products such as Drugs, Vaccines, Biomolecules; Good Laboratory Practices (GLP); Containments – Types; Basic Laboratory and Maximum Containment Laboratory. Biosafety assessment procedures in India and abroad.

Unit V **(18 hours)**

Intellectual Property Right: GATT and Intellectual property rights (IPR), forms of IPR, IPR in India, WTO Act and Convention on Biodiversity (CBD), Patent Co-operation Treaty (PCT), forms of patents and patentability, Objectives of the patent system, process of patenting, Indian and international agencies involved in IPR & patenting, Global scenario of patents and India's position, patenting of biological material, GLP, GMP.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Read out the overall concepts of Bioethics, Biosafety and demonstrate the fundamental aspects of IPR

CO2: Categorize ethical concerns regarding human cloning

CO3: Prioritize different levels of biosafety

CO4: Assess GATT, IPR, WTO Act and Convention on Biodiversity

CO5: Formulate the Biosafety assessment

Text Books:

1. Vikraman, Na. Best *Textbook of Bioethics Biosafety and Ipr:* For Medical/Pharmacy/Nursing/BE/B.TECH/BCA/MCA/ME/M.TECH/Diploma/B. Sc/M. Sc/Competitive Exams and Knowledge Seekers. N.p., Independently Published, 2020.
2. G., Sibi. *Intellectual Property Rights, Bioethics, Biosafety and Entrepreneurship in Biotechnology***.** India, I.K. International Publishing House Pvt. Limited, 2020.

Reference Books:

1. Nambisan, Padma. *An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology***.** United Kingdom, Elsevier Science, 2017.
2. M. K. Sateesh, *Bioethics And Biosafety*, Dreamtech press, First Edition, 2020.

Journals:

1. American Journal of Bioethics.
2. Biosafety and Health Journals.
3. Journal of Intellectual Property Rights.

E-Resources:

1. https://www.researchgate.net/publication/324770770_Bioethics_Shaleesha_A_Stanley
2. https://www.routledge.com/Ethics-and-Law-of-Intellectual-Property-Current-Problems-in Politics Science/Lenk-Hoppe/p/book/9781138275317
3. https://www.cdc.gov/labs/strong-lab-safety.html
4. https://nptel.ac.in/courses/109/106/109106137/
5. http://venturecenter.co.in/brc/doc/dbt/Recombinant-DNA-Safety-Guidelines.pdf

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	9	9	9	9	63
CO2	9	9	9	9	9	9	9	63
CO3	9	9	9	3	3	9	9	51
CO4	9	9	9	1	9	9	9	55
CO5	9	9	9	3	1	9	9	49
Total	45	45	45	25	31	45	45	281

Low-1 Medium-3 High-9

Discipline Specific Elective III: b. BIOINFORMATICS

(For Students Admitted from 2024-25)

Semester: III **Hours/week: 6**
Subject Code: IMMBE31B **Credit: 5**

Course Objectives:

1. To understand the programming languages applied in computational biology
2. To understand the methods and applications for sequence analysis, Phylogenetics and Protein modeling

Unit I **(18 hours)**

Introduction to Bioinformatics: Bioinformatics – Introduction and relation with molecular biological tools -FASTA, BLAST, BLAT, RASMOL, databases (Pubmed, PDB) and software (RASMOL and Ligand Explorer).

Unit II **(18 hours)**

Biological Database: Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Retrieving information and sequences from databases, Submission of nucleotide sequences in Gene Bank; Sequence alignment – Global vs local alignment, Pair wise alignment – ClustalW & Clustal Omega.

Unit III **(18 hours)**

Gene Prediction: Multiple sequence alignment – Methods and applications; Phylogenetic analysis –Distance matrix and Character based Methods; Maximum Parsimony, Maximum Likelihood, Phylogenetic tree evaluation, Jackknifing and bootstrapping application, Prediction of Genes – GENSCAN and Regulatory sequences in DNA.

Unit IV **(18 hours)**

Protein Structure: Introduction to Protein Structure – Secondary Structure Prediction – YASPIN, Tertiary Structure Prediction – I-TASSER; Protein Modelling – Principles of homology and comparative modeling; Sequence based prediction methods; Visualization of macromolecules using RASMOL and Swiss PDB Viewer.

Unit V **(18 hours)**

DNA Sequencing and Molecular Interaction: DNA sequencing chemistry and software needed; Sequence assembly and finishing; Primer designing, computing in Proteomics, Drug designing concepts; RNA structure analysis; Molecular docking, Principles and Applications – AutoDock, Discovery studio.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Define Bioinformatics and demonstrate their Network topologies

CO 2: Identify the biological databases

CO 3: Focus on molecular interaction

CO 4: Interpret the DNA sequencing software and proteomics tools

CO 5: Construct the gene and protein prediction tools

Text Books:

1. Arthur M. Lesk, *Introduction to Genomics*, Oxford University Press, Fifth edition, 2019.

2. Kollmar, Martin. *Gene Prediction***:** *Methods and Protocols*. , 2019.

Reference Books:

1. S.Balamurugan, Anand Krishnan, Dinesh Goyal, Balakumar Chandrasekaran, Boomi Pandi, *Computation in Bioinformatics***,** Wiley-Scrivener,1st Edition, 2021.
2. Vijai Singh, Ajay Kumar, *Advances in Bioinformatics***,** Springer,1st Edition, 2021.
3. Shanmughavel.P. 2005.Principles of Bioinformatics.Pointer Publishers. Jaipur, India

Journals:

1. Journal of Applied Bioinformatics and Computational Biology.
2. American Journal of Bioinformatics Research.
3. International Journal of Bioinformatics Research and Application.

E-Resources:

1. https://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering
2. http://amrita.vlab.co.in/index.php?sub=3&brch=273
3. http://amrita.vlab.co.in/index.php?sub=3&brch=274
4. http://amrita.vlab.co.in/index.php?sub=3&brch=275
5. http://www.ru.ac.bd/wpcontent/uploads/sites/25/2019/03/410_04_Baxevanis_Bioinformatics_-a-practical-guide-to-the-analysis-of-genes-and-proteins-Wiley.pdf

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	1	9	9	9	55
CO2	9	9	9	1	9	9	9	55
CO3	9	9	9	3	9	9	9	57
CO4	9	3	9	1	9	9	9	49
CO5	9	3	9	1	9	9	9	49
Total	45	33	45	7	45	45	45	265

Low-1 Medium-3 High-9

Core XIII – ENVIRONMENTAL MICROBIAL TECHNOLGY

(For Students Admitted from 2024-25)

Semester: IV **Hours/week: 6**
Subject Code: IMMBC411 **Credit: 5**

Course Objectives:

1. Understand the environment, ecosystem, and eutrophication
2. Identify the concept of some environmental phenomena such: bio-magnification, Eutrophication, Spring blooming, Self-purification.

Unit – I **(18 hours)**

Environment and Ecosystems : Definitions, biotic and abiotic environment. Environmental segments. Composition and structure of environment. Concept of biosphere, communities and ecosystems. Ecosystem characteristics, structure and function. Food chains, food webs and trophic structures. Ecological pyramids.

Unit – II **(18 hours)**

Eutrophication : Water pollution and its control: Need for water management. Sources of water pollution. Measurement of water pollution, Eutrophication: Definition, causes of eutrophication, and microbial changes in eutrophic bodies of water induced by various inorganic pollutants. Effects of eutrophication on the quality of water environment, factors influencing eutrophication. Qualitative characteristics and properties of eutrophic lakes. Measurement of degree of eutrophication. Algae in eutrophication, algal blooms, their effects and toxicity, colored waters, red tides, and cultural eutrophication. Physio-chemical and biological measures to control eutrophication

Unit –III **(18 hours)**

Effluent treatment techniques : Microbiology of wastewater and solid waste treatment: - Waste-types-solid and liquid waste characterization, physical, chemical, biological, aerobic, anaerobic, primary, secondary and tertiary treatments. Anaerobic processes: Anaerobic digestion, anaerobic filters, and upflow anaerobic sludge. Treatment schemes for effluents of dairy, distillery, tannery, sugar and antibiotic industries (Types, microbes used, types of Effluent Treatment Plants). Bioconversion of Solid Waste and utilization as fertilizer. Bioaccumulation of heavy metal ions from industrial effluents.

Unit – IV **(18 hours)**

Bioremediation : Bioremediation of Xenobiotics Microbiology of degradation of xenobiotics in the environment, ecological considerations, decay behaviour, biomagnification and degredative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants and pesticides. Genetically Modified Organisms released and its environmental impact assessment and ethical issues.

Unit – V **(18 hours)**

Global environmental problems: Ozone depletion, UV-B, green-house effect and acid rain, their impact and biotechnological approaches for management, Containment of acid mine drainage applying bio-mining [with reference to copper extraction from low grade ores].

Course outcomes

After successful completion of this course, student will be able to

CO1: List microorganisms in air, water, soil, extreme environment and man-made environment, its role and activities.

CO2: Understand and learn about various bioreactor and its usage, effluent recycle

CO3: Able to learn about waste water treatment, drinking water treatment, denitrification process.

CO4: Explain bioremediation, xenobiotics, and effluent treatment methods

CO5: Connect about global environmental problems

References

1. Bioremediation by Baker K.H. And Herson D.S. 1994.. MacGraw Hill Inc. N.Y.
2. Waste Water Engineering - Treatment, Disposal and Re-use by Metcalf and Eddy, Inc., Tata MacGraw Hill, New Delhi.
3. Pollution: Ecology and Biotreatment by Ec Eldowney, S. Hardman D.J. and Waite S. 1993. - Longman Scientific Technical.
4. Environmental Microbiology edited by Ralph Mitchell. A John Wiley and Sons. Inc.

5. Chemistry and Ecotoxicology of pollution. Edited by Des. W. Connell, G.J. Miller. Wiley Interscience Publications.
6. Environmental Biotechnology. Edited by C. F. Forster and D.A., John Wase. Ellis Horwood Ltd. Publication.
7. Advances in Waste Water Treatment Technologies. 1998. Volumes II and I by R. K. Trivedy. Global Science Publication.
8. Biocatalysis and Biodegradation: Microbial transformation of organic compounds. 2000 by Lawrence P. Wacekett, C. Douglas Hershberger. ASM Publications.
9. A Manual of Environmental Microbiology. 2nd Edition. 2001 by Christon J. Hurst (Chief Editor), ASM Publications.
10. Biodegradation and Bioremediation, Academic Press, San Diego.

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	9	9	9	9	63
CO2	9	9	9	9	9	9	9	63
CO3	9	3	9	9	9	9	9	57
CO4	9	9	9	3	9	9	9	57
CO5	9	3	9	1	9	9	9	49
Total	45	33	45	31	45	45	45	289

Low-1 Medium-3 High-9

Core XIV – PROJECT

(For Students Admitted from 2024-25)

Semester: IV **Hours/week: 18**
Subject Code: IMMBC42PW **Credit: 15**

Course Objectives:

1. To demonstrate capacity to improve student achievement, engagement and retention
2. To identify and discuss the complex issues inherent in selecting a research problem, selecting an appropriate research design, and implementing a research project.

Course Outcomes:

After successful completion of this course, student will be able to
CO1: Identify biological concepts and discuss the methodological information on the area of research
CO2: Develop microbiological concepts
CO3: Categorize the abilities in interpretation for their findings
CO4: Criteria to develop the skills in publication
CO5: Create new ideas on research

Project work to be done individually by the student in the department laboratory/ other reputed institution or university; the project work helps the students to obtain skills in laboratory techniques, to find solution to the problem of research by applying knowledge gained from the courses studied.

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	3	9	3	9	51
CO2	9	3	9	3	9	9	9	51
CO3	3	3	9	3	9	9	9	45
CO4	9	9	9	1	9	3	9	49
CO5	3	9	9	3	9	9	9	51
Total	33	33	45	13	45	33	45	247

Low-1 Medium-3 High-9

EXTRA CREDIT- INFORMATION TECHNOLOGY FOR BIOLOGISTS

(For Students Admitted from 2024-25)

Semester: IV **Hours/week: -**
Subject Code: IMMBX4 **Credit: 2**

Course Objectives:

1. To provide students with thorough understanding of the main development trends of information systems in biological sciences
2. To apply computational methods to search and analyze biological data stored indatabases

Unit I

Overview and organization of a computer system, storage, devices, memory, etc., parallel and cluster computing.

Unit II

Operating systems: Introduction, Process management, Memory management, File management, Device management and security; Introduction to proprietary software, Free and Open Source Software (FOSS).

Unit III

Computer Networking: Topologies and protocols, design networks, Networking gadgets (Router, Switch, etc.); Communication Links – Wire pairs, Coaxial cables, Fiber optics, Microwave, Satellite, etc.; Data security fundamentals and protection mechanism; An overview of Computer viruses and worms.

Unit IV

Internet: The Internet and its resources, Internet protocols and services; Web browsers and browser add-ons; Internet programming language – HTML; Basics in Web designing.

Unit V

Basic use of office applications: Toolbar buttons, Entering and editing texts, Formatting, Inserting and editing images, Orientation, Borders and shading, Bullets and numbering,

Creating and modifying tables; Basics of a spreadsheet – Columns, rows, cells; Tools using formulas, Formatting, creating charts and graphs; Presentation utilities – Creating, Editing presentations, Adding images, Charts, Motion and sound, Printing.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Define computer andillustrate the complete informations on computer
CO 2: Illustrate the detailed informations about Internet
CO 3: Research Analyze the operating systems and softwares
CO 4: Judge the knowledge on Basic computer applications
CO 5: Design Computer networking and Computer viruses

Text Books:

1. Peter Norton, *Introduction to Computers*, Seventh Edition, Tata McGraw Hill, 2017.
2. Fox, Richard. *Linux with Operating System Concepts*. United States, CRC Press, 2021.

Reference Books:

1. K. Reddy Pradeep, and G Sreehitha Reddy.*Operating Systems: Concepts***.** India, Notion Press Media Pvt. Limited, 2019.
2. Dr. Neetu Jabalia, N. Jaya Lakshmi, *Bioinformatics, System Biology and Big Data Analysis: Emerging Trends*, LAP LAMBERT Academic publishing, 2020.

Journals:

1. Journal of Computer Science and Systems Biology.
2. Computational and Structural Biotechnology Journal.
3. Research Journal of Informational Technology.

E-Resources:

1. https://www.nature.com/articles/nsmb0404-296
2. https://books.google.co.ls/books?id=qRvAKbf5kUgC
3. http://seimoku.inoxdvr.com/482.html
4. https://dl.acm.org/doi/abs/10.5555/3526
5. https://dl.acm.org/doi/pdf/10.5555/540365

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	1	9	3	9	49
CO2	9	9	9	1	9	3	9	49
CO3	9	9	9	1	9	3	9	49
CO4	9	9	9	1	9	3	9	49
CO5	9	9	9	1	9	3	9	49
Total	45	45	45	5	45	15	45	245

Low-1 Medium-3 High-9

B.Sc., MICROBIOLOGY
(Three Year Regular Programme)
(For Students Admitted from June 2024-25)

Programme Specific Outcomes:

The graduate will be able to

PSO 1: Gain both theoretical and practical knowledge about general microbiology

PSO 2: Inoculate the knowledge in relationship between microorganisms and human

PSO 3: Expertise in the techniques, which is the base for gaining scientific knowledge and insight about the subject.

PSO 4: Aware of their role and responsibility in handling and use of microbes

PSO 5: Able to use computer enable devices and able to manage resources.

PSO 6: Able to analyze and troubleshoot the problems in the field of microbiology

PSO 7: Enhance the excitement to become independent lifelong learners

Preamble

- Core VI (Lab course in Molecular Biology) Ex 12. Isolations of DNA from Marine sources is included. These changes also implemented in the I series sub code IBMBC32P

Skill Enhancement Courses

- SEC II (Lab course in Aquaculture)- in Experiment 1 the word CMFRI is removed. Experiment 10 Analysis of physico-chemical parameters affecting health of fishes in the tanks Experiment 11 Cultivation and extraction of carrageenan extraction from *Kappaphycus alvarezii* have been included. These changes also implemented in the I series sub code IBMBS24P
- SEC V (Lab Course in Vermiculture) two experiments Ex 8 & 9 Impact of different organic food sources on the growth and reproductive performance of composting earthworms *Eisenia fetida,* & Vermicomposting of different types of wastes using *Eisenia Foetida* have been added. These changes also implemented in the H series sub code HBMBE54P.
- SEC VI (Lab Course in Mushroom Cultivation) Experiment Ex 5. Cultivation of Button Mushrooms and Post-harvest techniques is added. These changes also implemented in the I series sub code IBMBS64P.

Open elective course

- OEC I (Lab course in Mushroom Cultivation) Experiment 9.mushroom soup is replaced as biriyani, Experiment Ex 5. Cultivation of Button Mushrooms and Post-harvest techniques is added. These changes also implemented in the current I series sub code **IBOE3MB1P.**
- OEC II (Lab course in Vermiculture) Experiment 1 introduction to ecology and environment can be replaced by the term vermiculture.

BSc MICROBIOLOGY
PROGRAMME CODE - UMB
PROGRAMME STRUCTURE

Sem	Subject code	Part	Course	Subject Title	Hours /Weeks	Credit	CIA	ESE	Total Marks
I	IBLT112/ IBLA111/ IBLH111	I	Language I	Tamil I / Basic Arabic I / General Hindi I	5	3	25	75	**100**
	IBLEIB12/ IBLEIIA22	II	Language II	Part II Language – Language through Literature I Level I (Basic)/ Language through Literature I Level II (Advanced)	5	3	25	75	**100**
	IBMBC111	III	Core I	Fundamentals of Microbiology	5	4	25	75	**100**
	IBMBC121P	III	Core II (Practical)	Lab Course in Fundamentals of Microbiology	6	5	25	75	**100**
	IBMBA13	III	AECC I	Biochemistry I	5	4	25	75	**100**
	IBMBS14	IV	SEC I	Introductory Virology	2	2	–	50	**50**
				Library/Browsing	1				
				Games/Remedial	1				
	Total				**30**	**21**	**125**	**425**	**550**
II	IBLT212/ IBLA211/ IBLH211	I	Language I	Tamil II / Basic Arabic II / General Hindi II	5	3	25	75	**100**
	IBLEIB22/ IBLEIIA22	II	Language II	Part II Language – Language through Literature II Level I (Basic)/ Language through Literature II Level II (Advanced)	5	3	25	75	**100**
	IBMBC211	III	Core III	Microbial Physiology	6	5	25	75	**100**
	IBMBC22P	III	Core IV (Practical)	Lab Course in Microbial Physiology	4	4	25	75	**100**
	IBMBA23	III	AECC II	Biochemistry II	5	4	25	75	**100**

	IBMBS241P	IV	SEC II	Lab course in Aquaculture	2	2	–	50	**50**
	IBES2	IV	GIC I	Environmental Science	2	2	–	50	**50**
	IBMBX2/ IBMBX2O		Extra Credit-I	Developmental Biology/*Online Course	–	2	–	100	**100**
				Games/Remedial	1				
	Total				**30**	**23+ 2**	**125**	**475 +100**	**600 + 100**
III	IBLT311/ IBLA31/ IBLH311	I	Language I	Tamil III / Classical Arabic Prose / General Hindi III	5	3	25	75	**100**
	IBLEIB32/ IBLEIIA32	II	Language II	Part II Language – Language through Literature III Level I (Basic)/ Language through Literature III Level II (Advanced)	5	3	25	75	**100**
	IBMBC31	III	Core V	Molecular Biology	4	4	25	75	**100**
	IBMBC321P	III	Core VI (Practical)	Lab Course in Molecular Biology	4	4	25	75	**100**
	IBMBA33	III	AECC I	Intellectual Property Rights	4	4	25	75	**100**
		IV	OEC I	Lab Course in Mushroom Cultivation #Internship	2	2	–	50	**50**
	IBMBS341	IV	SEC III	Bioinformatics *Integrated courses- Computer aided drug designing	2	2	–	50	**50**
	IBHR3	IV	GIC II	Human Rights	2	2	–	50	**50**
	IBXTN3	V	Extension Activities	NSS/CSS	2	2	100	–	**100**
	IBMBX3/ IBMBX3O		Extra Credit-II	Cell Biology/*Online Course	–	2	–	100	**100**
				Total	**30**	**26 + 2**	**225**	**525+ 100**	**750 + 100**
	IBLT41/ IBLA41/ IBLH411	I	Language I	Tamil IV / Hadeeth / General Hindi IV	5	3	25	75	**100**
	IBLEIB42/ IBLEIIA42	II	Language II	Part II Language – Language through Literature IV Level I	5	3	25	75	**100**
				(Basic)/ Language through Literature IV					

				Level II (Advanced)					
IV	IBMBC41	III	Core VII	Microbial Genetics	5	4	25	75	**100**
	IBMBC42	III	Core VIII	Medical Microbiology	4	4	25	75	**100**
	IBMBA431	III	AECC II	Bioinstrumentation	5	4	25	75	**100**
		IV	OEC II	Lab Course in Vermiculture	2	2	–	50	**50**
	IBLVE4	IV	GIC III	Life skills and Value Education	2	2	–	50	**50**
	IBMBS44P	IV	SEC IV (Practical)	Lab Course in Medical Lab Technology	2	2	–	50	**50**
	IBMBX4/ IBMBX4O		Extra Credit-III	Microbes in Human Welfare /*Online Course	–	2	–	100	**100**
	Total				**30**	**24 + 2**	**125**	**525 + 100**	**650 + 100**
V	IBMBC511	III	Core IX	Environmental and Agricultural Microbiology	6	5	25	75	**100**
	IBMBC52	III	Core X	Immunology #Internship	6	5	25	75	**100**
	IBMBC53P	III	Core XI (Practical)	Lab Course in Environmental and Agricultural Microbiology and Immunology	6	5	25	75	**100**
	IBMBE51A/ IBMBE51B	III	DSE I	a. Biostatistics / b. Food and Nutrition	4	4	25	75	**100**
	IBMBE51C/ IBMBE51D	III	DSE II	a. Biotechnological Techniques / b. Bionanotechnology	4	4	25	75	**100**
	IBMBS541P	IV	SEC V	Lab Course in Vermiculture	2	2	–	50	**50**
	IBWE5	IV	GIC IV	Women Entrepreneurship	2	2	–	50	**50**
	IBMBX5/ IBMBX5O		Extra Credit-IV	Skills for Employability Development/*Online Course		2	-	100	**100**
	Total				**30**	**27 + 2**	**125**	**475+ 100**	**600 + 100**

VI	IBMBC611	III	Core XII	Food Microbiology *Integrated courses- Bioreactor	6	4	25	75	**100**
	IBMBC621	III	Core XIII	Industrial Microbiology	5	4	25	75	**100**
	IBMBC631P	III	Core XIV (Practical)	Lab Course in Food and Industrial Microbiology, Microbial Genetics and Medical Microbiology	6	5	25	75	**100**
	IBMBC64PW	III	Core XV	Project	6	5	25	75	**100**
	IBMBE61A/ IBMBE6B	III	DSEIII	a. Marine Microbiology/ b. Public Health and Hygiene	4	4	25	75	**100**
	IBMBS641P	IV	SEC VI	Lab Course in Mushroom Cultivation	2	2	–	50	**50**
				Library	1	–	–	–	**–**
	IBMBX6/ IBMBX6O		Extra Credit - V	Life Science for Competitive Examination/*Online Course	–	2	-	100	**100**
Total					**30**	**24 + 2**	**125**	**425 + 100**	**550 + 100**
Grand total					**180**	**145 + 10**	**850**	**2850 + 500**	**3700 + 500**

Open Elective course Students other than BSc Microbiology:

Semester	Elective	Subject code	Subject title	H/W	Credit	CIA	ESE	Total
III	Open Elective course I	**IBOE3MB1P**	Lab Course in Mushroom Cultivation	2	2	-	**50**	**50**
IV	Open Elective course II	**IBOE4MB1P**	Lab Course in Vermiculture	2	2	-	**50**	**50**

H/W – Hours / Week, CIA – Continuous Internal Assessment, ESE – End Semester Examination

* For online certification credit alone will be assigned on submission of certificate obtained through appearing for online examination from spoken tutorial, EDX, NPTEL or Coursera and other MHRD MOOCs

CORE I – FUNDAMENTALS OF MICROBIOLOGY

(For Students Admitted from 2024-25)

Semester: I **Hours / Week: 5**

Subject Code: IBMBC111 **Credit: 4**

Course Objectives:

1. To build a strong foundation in the area of microbial cell structure, division, survival and propagation
2. To acquire an overall knowledge on the morphology and functions of the structures with the prokaryotes and eukaryotes.

Unit I **(15 hours)**

Introduction – Definition, Scope and History of Microbiology; Classification of Microorganisms **–** General Principles and Nomenclature – Haeckel's three kingdom concept, Whittaker's five kingdom concept; Contributions of Antonie Van Leeuwenhoek, Edward Jenner, Spallanzani, Robert Hook, Louis Pasteur, Robert Koch and John Needham.

Unit II **(15 hours)**

Microscopy – Simple and Bright field, Dark field, Phase contrast, Fluorescence and Electron Microscope**.** Introduction about Bergey's Manual – Archaea, Bacteria, Eukarya and Actinomycetes.

Unit III **(15 hours)**

Prokaryotes and Eukaryotes– Anatomy of prokaryotes and Eukaryotes, Ultra structure and function of capsule, slime layer, cell wall, Cytoplasmic membrane, Cilia, Flagella, Pili, Endospore, Genetic material and Plasmid. Difference between Prokaryotic and Eukaryotic cell. Mycoplasma

Unit IV **(15 hours)**

Mycology – General characteristic of fungi, Habitat, and Morphology, Reproduction and Fruiting bodies, types of spores produced. Biological and economic importance of fungi (*Aspergillus niger, Agaricus bisporus)*

Unit V **(15 hours)**

Phycology – General characteristics of algae, Habitat, Morphology, Pigments and Reproduction. Biological and economic importance of algae (*Cyanobacteria - Spirulina*). Brief introduction on lichens, Cultivation of fresh water and marine algae

Assignment: Fact sheets on Nobel Laureates can be submitted based on the contribution related to course from the list of noble laureates in Chemistry and Physiology or medicine.

Course Outcomes:

After successful completion of this course, students will be able to

CO 1: Discuss the basic concepts and list the history of Microbiology
CO 2: Identify the economically important microbes (Bacteria & Fungi)
CO 3: Elaborate the structure and functions of Prokaryotes
CO 4: Interpret the economically value fresh water and marine microbiology
CO 5: Innovate the cultivation methods of pigments producing marine algae

Text Books:

1. Lansing M. Prescott, John P. Harley and Donald A. Klein's, *Microbiology*, 10th Edition, McGraw-Hill, 2015.
2. Jeffrey C Pommerville. *Fundamentals of Microbiology*, MA Jones & Bartlett Learning. 12th Edition, 2022.

Reference Books:

1. Ananthanarayan. R. and Paniker C.K., *Text Book of Microbiology*, Orient Longman, 11th Edition, 2020
2. Black J.G., Microbiology: *Principles and Explorations*, John Wiley & Sons Ltd, 9th Edition, 2015.
3. Jeffrey C. Pommerville, Alcamo's *Fundamentals of Microbiology*, Jones and Bartlett publishers, Massachusetts, 10th Edition, 2017.

Journals:

1. Journal of Ultramicroscopy
2. Fungal Biology Reviews
3. Journal of Microbiological research

E-Resources:

1. https://nptel.ac.in/courses/102/103/102103015/#
2. https://bio.libretexts.org/Bookshelves/Microbiology
3. http://www.bamu.ac.in/Portals/0/B_Sc_Microbiology_I_Year_Sem_I_&_II.pdf
4. https://nzetc.victoria.ac.nz/tm/scholarly/tei-Bio13Tuat02-t1-body-d2.html
5. https://courses.lumenlearning.com/boundless-biology

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	1	9	1	1	3	27
CO2	1	3	9	9	9	1	3	35
CO3	3	3	9	3	9	3	9	39
CO4	3	3	9	9	3	3	9	39
CO5	3	3	3	9	3	3	3	27
Total	19	15	31	39	25	11	27	167

Low-1 Medium-3 High-9

CORE II – LAB COURSE IN FUNDAMENTALS OF MICROBIOLOGY

(For Students Admitted from 2024-25)

Semester: I **Hours/ Week:6**
Subject Code: IBMBC121P **Credit:5**

Course Objectives:

1. To provide practical knowledge and skill in the isolation and handling of microorganisms.
2. To know pure culture techniques and methods of culturing, preservation and maintenance of microorganisms.

List of Experiments:

1. Rules and precautions of microbiology laboratory
2. Equipment needed for microbiology laboratory
3. Types of culture media
4. Sterilization methods: Heat, Moist, radiation and chemical
5. Preparation of media for the culture of microorganisms:
   Liquid (Nutrient Broth)
   Solid (Stab and slant)
6. Pure culture methods:

Pour plate
Spreadplate
Streak plate – simple, zigzag, T streak, quadrant and radiant.

7. Cultural characters of Bacteria.
8. Enumeration of Bacteria &Fungi by serial dilution technique
9. Staining methods for microorganisms:
   a) Simple staining
   b) Gram's staining
   c) Capsular staining
   d) Acid fast staining
   e) Lactophenol cotton blue staining
   f) Endospore staining
   g) Wet mount preparation of protozoa
10. Bacterial motility – Hanging drop method
11. Observation of permanent slides to study the structural characteristic of Microalgae – *Cyanobacteria - Oscillatoria, Nostoc,Anabaena*
    Fungi – *Aspergillus, Penicillium, Rhizopus, Yeast*

Text Books:

1. Jeffrey C Pommerville, *Fundamental of Microbiology + Laboratory Fundamentals of Microbiology,* [S.I]: Jones & Bartlett Learning, 2021.
2. Fischbach F.T. and Dunning M.B., *A Manual of Laboratory and Diagnostic Tests,* Lippinocott Williams and Wilkins, Baltimore,11th Edition, 2021.

Reference Books:

1. Aneja K. R., *Experiments in Microbiology, Plant Pathology and Tissue Culture and Microbial Biotechnology*,WishwaPrakashan, New Delhi, 5th Edition,2018.
2. James G Cappuccino and Chand Welsh., *Microbiology – A Laboratory Manual*, Harlow, England Pearson,2018.
3. Jeffrey C. Pommerville, Alcamo's. *Fundamentals of Microbiology,* Jones and Bartlett publishers, Massachusetts, 10th Edition, 2017.

Journals:

1. Journal of Applied Sciences and Environmental Management
2. Journal of Microbiological research
3. International Journal of Applied Microbiology and Biotechnology

E-Resources:

1. https://mvi-au.vlabs.ac.in/
2. http://amrita.vlab.co.in/?sub=3&brch=76
3. https://www.vlab.co.in/
4. https://www.cdc.gov/infectioncontrol/guidelines
5. https://labmonk.com/to-study-bacterial-motility-by-using-hanging-drop-technique

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Recall the fundamentals of microbiology and explain the procedures & techniques of microbiology

CO 2: Demonstrate the types of culture media and sterilization technique

CO 3: Highlight theaseptic and pure culture techniques, preparation and viewing of sample under the microscope

CO 4: Explain and compare the structural characteristics of algae and fungi
CO 5: Experiment various biochemical and physiological methods to identify the microorganisms

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	9	1	3	3	37
CO2	1	3	3	9	3	3	1	23
CO3	3	3	1	3	9	9	3	31
CO4	9	9	3	3	1	3	1	29
CO5	3	9	9	3	9	1	9	43
Total	25	27	25	27	23	19	17	163

Low-1 Medium-3 High-9

SKILL ENHANCEMENT COURSE I – INTRODUCTORY VIROLOGY

(For Students Admitted from 2024-25)

Semester:I **Hours /Week: 2**
Subject Code:IBMBS14 **Credit:2**

Course Objectives:

1. The course will teach the strategies by which viruses spread within a host, and are maintained within populations.
2. The students will be able to understand the basic principles and methods of classification of viruses and an in-depth knowledge on T4, λ, M13 and HIV.

Unit I **(6 hours)**

Basics of virus – History of virology; General properties of viruses; Cultivation of viruses; Structure of viruses; Classification of viruses – ICTV and Baltimore classification. **Biology of sub-viral agents:** sat-RNAs, DI particles, viroids, virusoids and prions.

Unit II **(6 hours)**

Quantification and amplifications of viruses – Purification of viruses, Measurement of infectious units – Electron microscopy, Plaque assay, Haemagglutination assay, Fluorescent focus assay, Endpoint dilution assay.

Unit III **(6 hours)**

Bacterial viruses – Structure of bacteriophage – T_4 bacteriophages, Life cycle – Lytic (T_4 phages) and Lysogenic (phage lambda) life cycle.
Plant Viruses – Common plant viral diseases - TMV, Bunchy top of banana, Satellite virus, CaMv

Unit IV **(6 hours)**

Animal viruses – Morphology, Pathogenesis, Symptoms, Laboratory diagnosis prevention and treatment of Rinder pest, Blue tongue, Ranikhet virus, Foot and

mouthdisease

Unit V **(6 hours)**

Human Viruses – Morphology, Symptoms, Laboratory diagnosis, Prevention and treatment of Herpes, HIV, Hepatitis, HPV, Dengue, SARS, Corona Virus

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Define virology and discuss the concepts of structure and classification virus

CO 2: Illustrate knowledge on viral quantification methods

CO 3: Dissect the various plant and animal infections – its pathogenesis and treatment

CO 4: Deduct the Human viral infections - its pathogenesis and treatment

CO 5: Discuss insight the facts of replication of virus

Text Books:

1. Ananthanarayan.R. and Paniker C.K.J. *Text book of Microbiology*, orient Longman,11th Edition, 2020.
2. Baijayanthi Mala Mishra, *Text book of Medical Virology*, CBS Publisher and Distributor Pvt. Limited, 2018.

Reference Books:

1. Paul Hyman & Stephen T. Adedon, Coasster, *Viruses of Microorganisms*, Academic Press, 2018.
2. Paul Hyman &Srephen T. Abedon, *Viruses of microorganisms*, Caister academic Press, 2018.
3. Paul G Western, MV Michael Valentine, *Essentials of Bacteriology*, Wentworth press, 2016.

Journals:

1. Current Protocols in Microbiology
2. Journal of Medical Virology
3. Journal of Virology

E-Resources:

1. https://nptel.ac.in/courses/102/103/102103039/
2. https://www.basu.org.in/wp-content/uploads/2020/03/Fundamentals-of-Microbiology-1.pdf
3. https://www.sciencedirect.com/topics/medicine-and-dentistry/plaque-assay
4. https://jamanetwork.com/journals/jama/fullarticle/2768391
5. https://ejmo.org/10.14744/ejmo.2020.51418/

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	9	31	3	3	1	29
CO2	1	9	3	3	9	1	9	35
CO3	3	3	1	9	3	3	3	25
CO4	9	1	3	3	1	3	9	29
CO5	9	3	3	3	1	9	1	29

Total	25	25	19	19	17	19	23	147

Low-1 Medium-3 High-9

CORE III – MICROBIAL PHYSIOLOGY

(For Students Admitted from 2024-25)

Semester: II **Hours / Week: 6**
Subject Code: IBMBC211 **Credit: 5**

Course Objectives:

1. To develop clear understanding of various aspects of microbial physiology along with diverse metabolic pathways existing in bacteria in relation to its survival and propagation.
2. To enable students to better understand courses taught later such as microbial pathogenicity and biotechnology-based courses.

Unit I **(12 hours)**

Microbial Growth and Nutrition – Different Phase of growth – growth curve; generation time; Factors influencing microbial growth – Temperature, pH, Pressure, Salt concentration, Nutrients; Synchronous growth and continuous cultivation, Diauxic growth **–** Nutritional requirements of microorganisms – Autotrophs, Heterotrophs, Photoautotrophs, Chemo-organotrophs, Chemolithotrophs

Unit II **(12 hours)**

Microbial Physiology - Structure, function and Physiology of organism living in extreme environments – Thermopiles, Hyperthermophile, Halophiles, Psychrophiles and Methanogens

Unit III **(12 hours)**

Transport Mechanism – Biochemical properties of membrane model, Osmosis, Plasmolysis; Transport mechanisms – active, passive, facilitated diffusions – uniport, symport, antiport; Nernst equation – chelating transport system; siderophores

Unit IV **(12 hours)**

Photosynthesis and fermentation – Photosynthetic pigments - oxygenic and anoxygenic types; Light reaction in aerobic oxygenic phototropic bacteria (Cyanobacteria); Effect of light, CO_2, pH and temperature on photosynthesis **–** Autotrophic generation of ATP; Fixation of CO_2 – Calvin cycle, C_3 & C_4 pathways;

Unit V **(12 hours)**

Microbial metabolism - Biosynthesis of fatty acids (saturated and unsaturated) and sterol. Respiratory metabolism – EMP, HMP, ED pathways, Electron Transport Chain – Oxidative and Substrate level phosphorylation

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Observe bacterial growth curve and explain its effect on environmental factors
CO 2: Associate cyanobacteria to facilitate their application
CO 3: Classify the photosynthetic pathways
CO 4: Explain the transport mechanisms in microbes
CO 5: Improve knowledge on biosynthesis of fatty acids and their different pathways

Text Books:

1. Robert K. Poole, *Advances in microbial physiology*, San Diego: Elsevier Science & technology, Volume 52, 2021.
2. Madigan TM, Bender KS, Buckley DH, Satterly WM, Stahl DA. *Brock biology of microorganisms.* Hoboken Nj, Pearson Education. 2021.

Reference Books:

1. Sokatch, JR. *Bacterial Physiology and Metabolism*, Saint Louis: Elsevier science, 2014.
2. Byung Hong Kim and Geoffrey Michael Gadd, *Bacterial Physiology and metabolism*, United States of America by Cambridge University Press, New York, 2013.
3. James Drummond, Clay Fuqua, *The Physiology and Biochemistry of Prokaryotes*, David White, 4th Edition, 2012.

Journals:

1. Journal of Lipid Research
2. BMC System Biology
3. Journal of Microbiology and Genetics

E-Resources:

1. https://nptel.ac.in/courses/102/103/102103015/#
2. https://nptel.ac.in/content/storage2/courses/102103015/module6/lec3/1.html
3. https://wp.nyu.edu/biochemistry_2/wp-ontent/uploads/sites/1136/2015/04/Purine-Metabolism-de-novo-synthesis-and-salvage-pathway-2015.pdf
4. https://doi.org/10.1016/B978-0-12-391909-0.50015-3
5. https://pubmed.ncbi.nlm.nih.gov/6327016/

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	1	1	9	9	3	35
CO2	9	9	3	9	9	3	3	45
CO3	3	1	3	9	3	1	9	29
CO4	1	3	9	3	3	1	3	23
CO5	3	3	1	9	1	9	3	29
Total	25	19	17	31	25	23	21	161

Low-1 Medium-3 High-9

CORE IV – LAB COURSE IN MICROBIAL PHYSIOLOGY

(For Students Admitted from 2024-25)

Semester: II **Hours/ Week: 4**
Subject Code: IBMBC22P **Credits: 4**

Course Objectives:

1. To understand the microbial growth kinetics and understanding different physiological phenomenon.
2. To deliver hands-on experience of various enzymatic assays and determination of kinetic parameters

List of experiments:

1. Micrometry
2. Enumeration of bacteria – Haemocytometer
3. Determination of microbial growth curve - Turbidity method
4. Isolation of Cellulolytic bacteria from compost
5. Carbohydrate fermentation tests
6. Nitrate Reduction test
7. Starch hydrolysis
8. Gelatin hydrolysis
9. Lipid hydrolysis
10. Casein hydrolysis
11. Oxidase test
12. Catalase test
13. Coagulase test
14. IMViC test
15. TSI test
16. Urease test

Course Outcomes:

After successful completion of this course, the students will be able to

CO 1: Identify the bacteria and classify the isolated bacteria from different sources

CO 2: Demonstrate methods such as Micrometry, Haemocytometer and Turbidity method

CO 3: Comparing different biochemical test for microbial identification

CO4: Conclude the characters of various microorganisms based on the bacterial growth curve

CO 5: Predict the bacterial physiological changes using biochemical methods

Text Books:

1. *Fundamental of Microbiology + Laboratory fundamentals of microbiology*, by Jeffrey C Pommerville. [S.I]: Jones & Bartlett Learning. 2021
2. Cappuccino J. and Welsh C., *Microbiology A Laboratory Manual,* Pearson Benjamin Cummings,12th Edition ,2020.

Reference Books:

1. Michael T Madigan, Kelly S Bender, Daniel H Buckley, W Matthew Sattley, David Allan Stahl, *Brook Biology of microbiology*, Hoboken, NJ: Pearson

Education. 16th Edition, 2021.
2. Aneja K.R., Experiments in Microbiology**,** *Plant pathology and Tissue culture and microbial biotechnology*, New Age International Publishers, 5th Edition, 2017.
3. L.M.Prescott, J.P. Harley and D.A. Klein. *Microbiology*, McGraw Hill, Boston, 9th Edition, 2013.

Journals:

1. Journal of Clinical Microbiology
2. Microbiology and Molecular Biology reviews
3. Journal of Microbiology and Genetics

E-Resources:

1. https://mvi-au.vlabs.ac.in/
2. http://amrita.vlab.co.in/?sub=3&brch=76
3. https://www.vlab.co.in/
4. https://www.cnm.edu/programs-of-study/math-science-engineering/microbiology-lab-manual
5. https://www.dlsweb.rmit.edu.au/Toolbox/Laboratory/laboratory/studynotes/SNHaemo.htm

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	1	1	3	9	29
CO2	3	1	9	9	3	1	9	35
CO3	3	9	1	9	1	1	3	27
CO4	1	9	9	3	3	3	3	31
CO5	3	3	3	9	9	1	1	29
Total	19	25	25	31	17	9	25	151

Low-1 Medium-3 High-9

SKILL ENHANCEMENT COURSE II – LAB COURSE IN AQUACULTURE

(For Students Admitted from 2024-25)

Semester: II **Hours / Week: 2**
Subject Code: IBMBS241P **Credit: 2**

Course Objectives:

1. To gain knowledge on theory and practice on Aquatic Microbiology
2. To open avenues to the students as entrepreneurs in both self-employment and also to support the economy of the country through export.

List of Experiments:

1. Field visit to marine ornamental fish aquarium and hatchery unit
2. Describing nutritional requirements of fish and common aquarium fishes
3. Design and setting up of aquarium
4. Preparation of Fish feed
    i. Live (Artemia, Rotifer) and
    ii. Artificial feeds (Pellet food)
5. Breeding of live breeding fish and egg layers – Zebra fish, Guppies fish, Mollies fish and Betta Splenders (Bubble nest)
6. Breeding of Marine ornamental fish culture – Clown fish
7. Isolation of bacteria from fishes (Scales, gut, gills)
8. Water quality analysis and management in aquarium by MPN method
9. Visit to coastal area aquaculture, seaweed cultivation (Integrated fish farming)
10. Analysis of physico-chemical parameters affecting health of fishes in the tanks
11. Cultivation and extraction of carrageenan extraction from *Kappaphycus alvarezii*

Course Outcomes:

After successful completion of this course, the students will be able to

CO1: Gain the knowledge on the aquaculture practices and improve the preparation of fish feeds

CO2: Categorize the isolated bacteria from fish and analyse the importance of gut microflora

CO3: Analyse the sexual maturity in fish sample for breeding

CO4: Justify and gain experience through visiting fish aquarium and hatchery unit in CMFRI

CO5: Transform the seaweed cultivation methods as entrepreneurial skills

Text books:

1. Vinodh, S. Kannan, M. Ranchana, P. *Practical manual on fish Nutrition and Feed Technology*, 2017.
2. Robert R Stickney, Delbert M Gatlin. *Aquaculture: an introductory text.* Wallingford, Oxfordshire, Boston, MA: CAB International. 4th Edition 2022.

Reference Books:

1. Ronald W Hardy, *Fish Nutrition*. 2021. Elsevier.
2. Agust Einarsson, Asta Dia Oladottir, *Fisheries and Aquaculture: The Food Security of the Future*, 2020.
3. Chhorn Lim, *Nutrition and fish Health*. Taylor & Francis, 2017

Journals:

1. Journal of Aquatic Biology and Fisheries
2. Journal of Aquatic Biology
3. International Journal of Aquatic Science

E-Resources:

1. https://nptel.ac.in/courses/120/108/120108002/
2. https://nios.ac.in/media/documents/srsec314newE/PDFEL34B.pdf
3. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1082.5958&rep=rep1&type=pdf

4. https://fisheries.tamu.edu/files/2019/01/FST-269.pdf
5. http://www.scielo.org.co/scielo.00003

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	1	3	9	3	1	29
CO2	1	3	3	9	1	3	1	21
CO3	3	3	1	9	1	9	3	29
CO4	9	1	9	3	3	1	3	29
CO5	1	9	9	1	3	3	3	29
Total	23	19	23	25	17	19	11	137

Low-1 Medium-3 High-9

EXTRA CREDIT – DEVELOPMENTAL BIOLOGY

(For Students Admitted from 2024-25)

Semester: II **Hours / Week: -**
Subject Code: IBMBX2 **Credit: 2**

Course Objectives:

1. To understand the mechanisms of development and evolutionary processes have shaped life in its varied forms.
2. To Explore selected areas of developmental biology in depth to critically analyze, present, and discuss scientific material.

Unit I

Gametogenesis – Spermatogenesis and Oogenesis in mammals; menstrual cycle; monitoring of menstrual cycle; sperm banking.

Unit II

Cleavage and Gastrulation – interaction of sperm and egg – Sequence of events in sperm entry – Egg surface changes; Cell cleavage – pattern of cleavage, germ layers, Gastrulation mammals

Unit III

Morphogenesis and organogenesis – Cell aggregation and differentiation in mammals; organogenesis – development of eye, ear, kidney and heart.

Unit IV

Modern Embryology – In-vitro fertilization, artificial insemination, super ovulation; Application of embryonic stem cell.

Unit V

Contraception – planned Parenthood, birth control devices – hormonal birth control – Birth Control Pill, Injection Method, Intrauterine Device (IUD) and Intrauterine System (IUS), Emergency Contraceptive Pill (ECP), Barrier Methods of Birth Control

Course Outcomes:

After successful completion of the course, students will be able to

CO1: Discuss the theories of biology and summarize basic concepts related to developmental biology

CO2: Show and teach the techniques of In-vitro fertilization, artificial insemination and super ovulation

CO 3: Discover the organization in cell surface changes, cleavage and gastrulation

CO 4: Explain the development of eye, ear kidney and heart

CO 5: Elaborate Spermatogenesis and Oogenesis in mammals

Text Books:

1. Michael JF Barresi, Scott F Gilbert, *Developmental Biology***,** Sinauer Association, Inc., Publishers, 12th Edition, 2020.
2. Wolpert, L.Cheryll Tickle, Alfonso Martinez Arias**,** *Principles of Development*, Oxford University Press, 2018.

Reference Books:

1. Jamie A Davis, *Mechanisms of morphogenesis*. Amsterdam: Elsevier. 2013.
2. Balinsky B.I., *An Introduction to Embryology***,** W. B. Saunders Co, Philadelphia, 7th Edition, 2007.
3. Verma P.S., Agarwal V.K. and Tyagi, *Chordate Embryology***,** S. Chand & Co, Reprinted, 2006.

Journals:

1. Journal of Embryology & Developmental Biology
2. Journal of Developmental Biology
3. Frontiers in cell and Developmental Biology

E Resources:

1. https://organismalbio.biosci.gatech.edu/growth-and-reproduction/animal-development
2. https://www.intechopen.com/books/new-discoveries-in-embryology/human embryology
3. https://www.freebookcentre.net/Biology/Developmental-Biology-Books.html
4. https://www.e-libraryme.com/2019/12/developmental-biology.html
5. https://www.ncbi.nlm.nih.gov/books/NBK9983/

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	9	1	3	1	9	35
CO2	9	3	3	9	3	1	1	29
CO3	1	1	9	3	3	9	3	29
CO4	3	1	3	3	9	3	9	31
CO5	9	3	1	3	9	9	3	37
Total	25	17	25	19	27	23	25	161

Low-1 Medium-3 High-9

CORE V – MOLECULAR BIOLOGY

(For Students Admitted from 2024-25)

Semester: III **Hours / Week: 4**
Subject Code: IBMBC31 **Credit: 4**

Course Objectives:

1. To introduce the student to the advanced concepts in molecular biology.
2. To understand molecular mechanisms of DNA replication, DNA repair, transcription, translation, and gene regulation in prokaryotic and eukaryotic organisms.

Unit I **(12 hours)**

Nucleic acids – Structure of nucleic acids – Watson and Crick's double helix structure; types of DNA (A, B and Z forms); types of RNA – Structure of mRNA, t-RNA and r-RNA; Proof that DNA as genetic material (Griffith, Avery, Hershey and Chase experiments); Proof that RNA as a genetic material (Frannenkel and Conrat experiments)

Unit II **(12 hours)**

Replication – Central dogma of molecular biology – DNA Replication; Enzymes involved in DNA replication, Prokaryotic DNA and Eukaryotic telomere and its replication; Mode of DNA replication – semi conservative mode, theta mode and rolling circle mode; DNA Repair – Photo reactivation and Excision repair

Unit III **(12 hours)**

Transcription – Prokaryotic transcription and Eukaryotic transcription, Enzymes involved in Transcription, Transcriptional and post transcriptional modifications – 5' cap formation, 3' end processing and poly adenylation, splicing, editing

Unit IV **(12 hours)**

Translation – Genetic code – properties of genetic code, Wobble hypothesis, Prokaryotes and Eukaryotic translation, the translation machinery, Mechanism of initiation, elongation and termination, posttranslational modifications of proteins, unfolded protein responses (ER stress)

Unit V **(12 hours)**

Regulation of Gene expression – prokaryotes – The operon model **–** *Lac* operon and catabolic repression, *Trp* – operon (Repressible system) and attenuation, Regulation of gene expression in eukaryotes – transcriptional activation, galactose metabolism in yeast, gene silencing – RNAi, siRNA, Crispr Cas9

Course Outcomes:

After successful completion of the course, students will be able to
CO 1: Discuss the genome organization and label the structure of Nucleic acid
CO 2: Identify the process of central dogma
CO 3: Classify the enzymes involved in translation machinery

CO 4: Prioritize the reasons to justify, DNA as genetic material
CO 5: Revise how gene regulation occurs in both prokaryotes and eukaryotes

Text Books:

1. Harvey F Lodish., *Molecular cell biology*. Macmillan International High Education, Newyork, 9th edition, 2021
2. George Malacinski, Freifelder, *Essentials Of Molecular Biology*, Jones & Bartlett Publications,4th Edition, 2015.

References Books:

1. Lohar., *Cell and Molecular biology*, MJP publishers, Chennai, Reprint 2021.
2. David York, *An introduction to genetic engineering*, Syrawood Pub. House 2018.
3. Watson J.D., *Molecular Biology of the gene*, Pearson India: Chennai, 7th Edition, 2017.

Journals:

1. Journal of Molecular Biology
2. Journal of Molecular Biology reports
3. Journals of Genetics and Molecular Biology

E-Resources:

1. https://nptel.ac.in/courses/102/103/102103015/#
2. https://nptel.ac.in/courses/102/106/102106025/
3. https://nptel.ac.in/courses/102/103/102103013/
4. https://doi.org/10.1038/nbt936
5. https://doi.org/10.1016/j.gene.2005.06.037

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	1	3	3	9	3	31
CO2	3	1	3	9	9	3	1	29
CO3	1	3	9	3	9	1	3	29
CO4	3	9	3	1	3	9	3	31
CO5	9	3	1	9	1	3	3	29
Total	25	19	17	25	25	25	13	149

Low-1 Medium-3 High-9

CORE VI - LAB COURSE IN MOLECULAR BIOLOGY

(For Students Admitted from 2024-25)

Semester: III **Hours / Week: 4**
Subject Code: IBMBC321P **Credit: 4**

Course Objectives:

1. To isolate, analyze, and manipulate DNA, amplify DNA, fingerprint microbes, overexpress and purify recombinant proteins.

2. To become familiar with transferring genetic material into bacteria by transformation and conjugation methods.

List of Experiments:

1. Preparation of solutions and buffers – Molar and Normal solution
2. Isolation of genomic DNA from *E. coli*
3. Isolation of DNA from Yeast
4. Estimation of DNA by DPA method
5. Isolation of plasmid DNA by alkaline lysis method
6. Separation of DNA by Agarose Gel Electrophoresis
7. Isolation of RNA by Trizol method
8. Estimation of RNA by Orcinol method
9. Estimation of Protein by Lowry's and Bradford method
10. Separation of amino acids and microbial pigments by TLC and Paper Chromatography
11. Separation of Protein by SDS-PAGE
12. Isolation of DNA from Marine sources

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Compare various techniques and discuss the buffers preparation in molecular biology

CO 2: Interpret and perform the isolation of Chromosomal DNA from *E. coli* and yeast

CO 3: Focus on and understand the molecular technique

CO 4: Defend the separation methods of genome and protein molecules

CO 5: Develop the molecular technique to use isolate genome

Text Books:

1. Karen Adeleman, Frederick M. Ausubel, Roger Brent, David D. Moore, Kevin Struhl, Koen Venken, *Current protocols in Molecular Biology*, John Wiley, 133(1), 2020.
2. Sambrook J., Fritsch E. F. and Maniatis T., *Molecular cloning – A Laboratory Manual 2***,** Cold Spring Harbor Laboratory press, USA, 4th Edition, 2012.

Reference Books:

1. Lohar., Cell and Molecular biology, MJP publishers, Chennai, Reprint 2021
2. Watson J.D., *Molecular Biology of the Gene*, Pearson India: Chennai, 7th Edition, 2017.
3. Michael R. Green, Sambrook J., *Molecular cloning – A Laboratory Manual*, Cold Spring Harbor Laboratory press, USA, 4th Edition, 2014.

Journals:

1. Journal of Cell and Molecular Biology
2. Cellular and Molecular Life Sciences
3. Molecular Metabolism

E-Resources:

1. https://nptel.ac.in/courses/102/103/102103083/
2. https://nptel.ac.in/courses/102/103/102103017/
3. https://www.ncbi.nlm.nih.gov/guide/chemicals-bioassays/
4. http://biotech01.vlabs.ac.in/

5. http://mbvi-au.vlabs.ac.in/

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	9	1	3	1	9	29
CO2	3	9	3	9	1	3	3	31
CO3	9	3	1	3	3	3	9	31
CO4	1	9	3	3	9	9	1	35
CO5	1	3	9	3	3	3	1	23
Total	17	27	25	19	19	19	23	149

Low-1 Medium-3 High-9

ABILITY ENHANCEMENT COMPULSORY COURSE I – INTELLECTUAL PROPERTY RIGHTS

(For Students Admitted from 2024-25)

Semester: III **Hours /week: 4**
Subject Code: IBMBA33 **Credits: 4**

Course Objectives:

1. To impart basic knowledge of patenting, intellectual property rights, laws available and copyrights.
2. To impart basic knowledge of statistics and tools used for several quantitative analysis in microbiology. The course imparts necessary knowledge and skills required for organizing and carrying out entrepreneurial activities, developing the ability of analyzing and understanding business situations.

Unit I **(12 hours)**

Overview of Intellectual Property - Introduction to Intellectual Property: Types of IP - Patents, Trademarks, Copyright & Related Rights, Geographical Indications, Protection of GMOs IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies; Agreements and Treaties; History of GATT & TRIPS Agreement; Indian Patent Act 1970 & recent amendments

Unit II **(12 hours)**

Patents - Elements of Patentability; Novelty, Non-Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and license, Restoration of lapsed Patents, Surrender and Revocation of Patents

Unit III **(12 hours)**

Copyrights - Nature of Copyright - Registration Procedure, Term of protection, Ownership of copyright, Assignment and license of copyright - Infringement, Remedies & Penalties

Unit IV **(12 hours)**

Trademarks - Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non-Registrable Trademarks - Registration of Trademarks - Rights of holder and Trademarks registry and appellate board

Unit V **(12 hours)**

Other forms of IP - Procedure for registration, effect of registration and term of protection of Design - Geographical Indication (GI) - Plant Variety Protection: benefit sharing and farmers' rights -Layout Design protection

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: List the laws in IPR and describing the fundamental aspects of Intellectual Property Rights

CO 2: Apply the knowledge on patents filing.

CO 3: Investigate copyrights and its related rights and registration aspects

CO 4: Explore the current trends in IPR and Govt. steps in fostering IPR

CO 5: Extend the knowledge on trademarks and registration aspects

Text Books:

1. Nithyananda, K V., *Intellectual Property Rights: Protection and Management.* India, IN: Cengage Learning India Private Limited, 2019.
2. WR. Cornish, David Llewelyn, Tanya Frances Aplin, *Intellectual property: Patents, Copyright, Trademarks and allied rights.* Sweet and Maxwell, London. 2019.

Reference Books:

1. Stephen M McJohn. *Intellectual property*, Wolters Kluwer: New York, 2021
2. Ahuja, V K., *Law relating to Intellectual Property Rights.* India, IN: Lexis Nexis, 2017.
3. Alphen aanden Rijn. *Introduction to intellectual property: theory and practice* by World Intellectual Property Organization. The Netherlands: Kluwer Law International B.V. 2nd Edition, 2017.

Journals:

1. Journal of Intellectual Propery Rights
2. Intellectual Property Law Practice
3. The Journal of World Intellectual Property

E-Resources

1. https://nptel.ac.in/courses/109/106/109106137/
2. https://nptel.ac.in/courses/110/105/110105139/
3. https://nptel.ac.in/courses/102/103/102103013/
4. https://www.wipo.int/copyright/en/
5. https://www.jstor.org/stable/24108733

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	1	3	9	3	1	29
CO2	3	9	3	3	3	1	9	31
CO3	3	9	3	1	3	1	9	29
CO4	1	3	3	9	3	9	1	29
CO5	3	1	9	3	9	3	3	31
Total	19	25	19	19	27	17	23	149

Low-1 Medium-3 High-9

SKILL ENHANCEMENT COURSE III – BIOINFORMATICS

(For Students Admitted from 2024-25)

Semester: III **Hours / Week: 2**
Subject Code:IBMBS341 **Credits: 2**

Course Objectives:

1. To understand genome analysis, sequence analysis and protein analysis
2. To know the tools used in Bioinformatics.

Unit I **(6hours)**

Bioinformatics – Introduction, Definition, Scope, Applications of bioinformatics, Emerging areas of Bioinformatics

Biological databases and its types – Nucleic acid databases, Protein databases (Primary, Composite and Secondary), Specialized Genome databases: (SGD, TIGR, and ACeDB), Structural databases (CATH, SCOP, and PDBsum)

Practicals: Nucleic acid databases (NCBI, DDBJ, and EMBL), Retrieve sequence from NCBI Genome, Genbank, and Protein databases (Swissprot and Uniprot)

Unit II **(6hours)**

Sequence alignment – Dot matrix, local alignment, Global alignment, similarity searching using FASTA and BLAST

Multiple sequence alignment – Progressive and Iterative methods, alignment viewers, applications of multiple sequence alignment

Phylogenetic analysis – Phylogenetic trees, Distance based and character-based methods, automated tools for Phylogenetic analysis

Practicals: FASTA, BLAST, Clustal Omega.

Unit III **(6hours)**

OMICS: Genomics: Genome sequencing, Annotation and Assembly, Structural and Functional Genomics. Comparative Genomics

Proteomics: Protein structure prediction, 2D and 3D structure prediction, Homology modeling.

Metagenomics: Introduction- metagenome, shotgun metagenomics and pyrosequencing

Practicals: QUIIME 2™

Unit IV **(6hours)**

Chemoinformatics: Cheminformatics tools for drug discovery; Chemical Structure Representation (SMILE & SMART); Chemical databases - CSD, ACD, WDI, ChemBank, hazardous chemical database.

Practicals: PUBCHEM

UnitV **(6hours)**

Drug Discovery and design: Target identification, Target Validation, Lead Identification, lead optimization, preclinical Pharmacology &Taxology - Quantitative Structure Activity Relationship (2D & 3D). Combinatorial libraries & their design. High throughput screening, virtual screening, Lipinski's rule of five

Practicals: Autodoc, PYRx

Course Outcomes:

After successful completion of the course, students will be able to:

CO 1: Find the available bioinformatics tools and explain its application

CO 2: Discuss the databases related to genome and proteome

CO 3: Analyze software to extract information from database and sequencing tools

CO 4: Interpret the drug designing concepts using software

CO 5: Elaborate the development of phylogenetic trees

Text Books:

1. Lesk, *Introduction to Bioinformatics*, Oxford Publication, 5th Edition, 2019.
2. Henrik Christensen, *Introduction to bioinformatics in microbiology*. Cham Springer, 2018.
3. An Introduction to Bioinformatics Algorithms,2005 N.C. Jonesand P.A. Pevzner, Ane Books, New Delhi.

Reference Books:

1. Christina Marshall, Bioinformatics and functional genomics. Forest Hills, NY: Callisto Reference, 2019.
2. Victor Hart, Introduction to Bioinformatics. US: Tritech Digital Media, 2018.
3. Sushil Kumar, Bioinformatics: methods and applications, Book Enclave, Jaipur, India, 2016.
4. Shanmughavel. P. 2005. Principles of Bioinformatics. Pointer Publishers. Jaipur, India

Journals:

1. Journal of Bioinformatics and Computational Biology
2. Journal of Bioinformatics and System biology
3. Advances and Applications in Bioinformatics and Chemistry

E-References:

1. Tutorial from NCBI https://youtu.be/uYSvTsrdufQ
2. https://nptel.ac.in/courses/102/106/102106065/Bioinformatics virtual lab
2. https://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering
3. http://amrita.vlab.co.in/index.php?sub=3&brch=273
4. https://view.qiime2.org/

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	1	1	3	9	3	35
CO2	3	1	9	3	3	1	9	29
CO3	9	3	3	9	9	9	3	45
CO4	1	3	1	3	1	3	9	21
CO5	3	3	9	3	3	1	1	23
Total	25	19	23	19	19	23	25	153

Low-1 Medium-3 High-9

EXTRA CREDIT – CELL BIOLOGY

(For Students Admitted from 2024-25)

Semester: III **Hours / Week: -**
Subject Code:IBMBX3 **Credit:2**

Course Objectives:

1. To educate students about the fundamental concepts in eukaryotic cell biology.
2. To develop the knowledge in cell communication, regulation of cell cycle, and modern tools used to study cell biology.

Unit I **(12 hours)**

Introduction – Structure of Prokaryotic and Eukaryotic cell - Structure and function of Nucleus, Endoplasmic Reticulum, Golgi complex, Mitochondria, Chloroplast and Lysosomes; Organization of Nucleus and nuclear transport, Cytoskeletons (Microfilaments, Intermediate filaments, Microtubules and associated proteins).

Unit II **(12 hours)**

Ultra-structure of plasma membrane – Transport processes **–** active transport, ionophores and ion channels; Exo and endocytosis, Phago and pinocytosis; General morphology and functions of endoplasmic reticulum, Signal hypothesis; Ribosomes **–** Eukaryotic and Prokaryotic, Ribosomal proteins, Lysosomes and peroxisomes, Cell – cell interaction.

Unit III **(12 hours)**

Mitochondria – structure and biogenesis; Organization of Mitochondrial respiratory chain, mechanism of oxidative of Phosphorylation; Ultra structure of the Chloroplast, Photosynthesis – Photophosphorylation; Carbon dioxide fixation in C_3, C_4 and CAM plants, Photorespiration.

Unit IV **(12 hours)**

Cell cycle – Molecular events including cell cycle check points and CDK **–** Cyclin complexes and their role in cell cycle regulation, Cell Division – Amitosis, Mitosis & Meiosis, Apoptosis.

Unit V **(12 hours)**

Motile systems – Microtubules based motility, fast axonal transport, Cilia & Flagella; Actin based cell movement (Myosins), Filament based movement (muscle), Phototaxis and Chemotaxis.

Course Outcomes:

After successful completion of this course, the students will be able to

CO 1: Identify the cellular structure and discuss the functional aspects of cell

CO 2: Explain the complete information on Plasma membrane

CO 3: Reflect critically about the knowledge on structure and functions involved in cell organelles

CO 4: Master the core concepts about the structures involved in the motility of microorganisms

CO 5: Demonstrate the cell cycle and regulation

Text Books:

1. Harvey F Lodish., *Molecular cell biology*. Macmillan International High Education, Newyork, 9th Edition, 2021
2. Karp G., *Cell and Molecular biology:* Concepts and Experiments, John Wiley & Sons Inc., New York, 7th Edition, 2013.

Reference Books:

1. Karp, G., Iwasa J., Marshall WF. *Karp's Cell and Molecular Biology: Concepts and Experiments*, Hobokem (N.J): Wiley. 9th Edition. 2020.
2. Nalini Chandar, Susan Viselli. *Cell and Molecular Biology*. 2019. Philadelphia: Wolters Kluwer.
3. Cooper, G.M. *The Cell: A Molecular Approach*, Sinauer Associates, an imprint of Oxford University Press. 8th Edition, 2019

Journals:

1. Annual Review of Cell and Developmental Biology
2. Trends in Cell Biology
3. European Journal of Cell Biology

E-Resources:

1. https://nptel.ac.in/courses/102/103/102103083/
2. https://nptel.ac.in/courses/102/103/102103017/
3. https://www.ncbi.nlm.nih.gov/guide/chemicals-bioassays/
4. https://doi.org/10.1016/B978-0-12-123303-7.50008-9
5. https://doi.org/10.2307/1309599

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	1	9	3	1	9	35
CO2	9	1	3	9	3	3	1	29
CO3	9	3	3	1	9	9	3	37
CO4	3	3	9	3	1	1	9	29
CO5	1	1	9	1	3	9	3	27
Total	25	17	25	23	19	23	25	157

Low-1 Medium-3 High-9

CORE VII – MICROBIAL GENETICS

(For Students Admitted from 2024-25)

Semester: IV **Hours / Week: 5**
Subject Code: IBMBC41 **Credit: 4**

Course Objectives:

1. To understand how microorganisms can be used as tools to understand various biological phenomena.
2. To become familiar with methods of transfer of genetic material in bacteria and will understand the biology of lytic and lysogenic phages.

Unit I **(15 hours)**

Gene organization and mutation – Gene organization in Prokaryotes and Eukaryotes; Concept of mutations and mutagenesis - mutants, spontaneous mutation, induced mutation, DNA repair mechanism

Unit II **(15 hours)**

Plasmids and Recombination – Recombination – reciprocal recombination (Holliday model) and non-reciprocal recombination, site specific recombination

Plasmids – types, fertility factors, resistance factors, col plasmid, stringent and relaxed type replication

Unit III **(15 hours)**

Gene transfer techniques – Conjugation – F^+, F^- mating, Hfr mating, F' conjugation. Transformation – competent cells – mechanism, transduction – generalized and specialized.

Unit IV **(15 hours)**

Transposable elements – Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Eukaryotic transposable elements – Yeast (Ty retro transposon), Uses of transposons and transposition

Unit V **(15 hours)**

Phage genetics – Viruses: T_4 bacteriophage- characters, lifecycle of phages – lytic and lysogenic cycle (Lambda phages), Induction of lysogen

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Define gene organization and compare prokaryotes and eukaryotes
CO2: Categorise the mutation and recombination is important to the genetic diversity
CO 3: Investigate how bacteria exchange or obtain new gene from other livings
CO 4: Determine the life cycle of phage and its advantage and disadvantage
CO 5: Discuss about transposable elements both in prokaryotes and eukaryotes

Text Books:

1. Stanley Maloy & John Cronon, *Microbial genetics*, Narosha Publishing House, 2nd Edition, 2014.
2. Lavy Snyder, Windy Champness, *Molecular Genetics of Bacteria*, 4th Edition, 2013.

Reference Books:

1. Chikako Nishigori; Kaoru Sugasawa, *DNA repair disorders*, 2019.
2. Tina M Henkin; Joseph Edward Peters, Snyder & Champness. *Molecular genetics of bacteria*, Washington, 5th Edition, 2020.
3. Jeremy W. Dale, *Molecular genetics of Bacteria,* Wiley Blackwall, 5th Edition, 2016.

Journal:

1. Genetics and Genome Research
2. Journal of Mutation Research
3. Journal of Human Genetics

E Resources:

1. https://nptel.ac.in/courses/102/103/102103015/
2. https://nptel.ac.in/courses/102/106/102106025/
3. https://nptel.ac.in/courses/102/103/102103013/
4. https://www.worldcat.org/title/molecular-genetics-of-bacteria/oclc/881704910
5. http://www.lavoisier.eu/books/life-sciences

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	1	9	3	1	3	29
CO2	9	1	3	1	1	3	9	27
CO3	3	3	9	9	9	9	1	43
CO4	1	9	3	3	1	1	3	21
CO5	9	1	3	1	3	9	9	35
Total	25	23	19	23	17	23	25	155

Low-1 Medium-3 High-9

COREVIII – MEDICAL MICROBIOLOGY

(For Students Admitted from 2024-25)

Semester: IV **Hours / Week: 4**
Subject Code:IBMBC42 **Credit: 4**

Course Objectives:

1. To learn the basic concepts of medical microbiology and microbial pathogenesis.
2. To study the antimicrobial agents, epidemiology, and virulence factors associated with the pathogen

Unit I **(12 hours)**

Introduction – History and Developments in medical microbiology, Classification of Pathogenic and non-pathogenic Microorganisms; General characteristics of normal flora of the human body. Host microbe interaction: Transmissibility of pathogens – Air born, Vector- borne, Water and Food borne transmission, Collection, transportation and storage of clinical samples

Unit II **(12 hours)**

Bacterial diseases – Tuberculosis, Plague, Anthrax, Meningitis, Typhoid, Tetanus – infection, infection establishment, pathogenesis, symptoms, diagnosis, treatment,

Unit III **(12 hours)**

Fungal and Protozoan diseases – Mycoses – Dermatophytosis, Histoplasmosis, Cryptococcosis, Aspergillosis Pathogenesis, Diagnosis, and treatment; Amoebiasis, Giardiasis, Malaria – infection, infection establishment, pathogenesis, symptoms, diagnosis, treatment

Unit IV **(12 hours)**

Viral diseases– Hepatitis, Dengue, Rabies, Pox Virus, Rubella, Ebola, Zika, SARSCoV Causative agents– pathogenesis, symptoms, transmission, diagnosis, prevention and treatment.

Unit V **(12 hours)**

Antimicrobial Resistance – Antimicrobial resistance in clinical pathogens - MRSA, MDR TB, XDR TB, **Disease Control Methods –** Antibiotics – Classification of microbial antibiotics based on mode of action, Determination of the level of antimicrobial activity, Effective usage of antibiotic as per the guidelines of WHO, Antibiotic awareness week, Alternative to antibiotics – AYUSH treatment

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Listing normal and pathogenic microorganisms and identify the microorganism
CO 2: Categorise the diseases based on the infectious microorganisms
CO 3: Examine the effectiveness of the Bacterial, Fungal and viral infections
CO 4: Compare the air borne, food borne and water borne disease transmission
CO 5: Compile the normal flora and their interactions with human host

Text Books:

1. Ananthanarayan R. and Panicker C. K., Reba Kanungo, *Text Book of Microbiology*, Universities Press (India) Pvt. Ltd., 11th Edition, 2020.
2. Rajan S., *Medical Microbiology*, MJP Publishers, Chennai, first Edition, 2019.

Reference Books:

1. Patrick R Murray; Michael A Pfaller; Ken S Rosenthal**,** *Medical microbiology,* Ninth Edition, 2021.
2. Neeran Jasim, *Medical Mycology*, Saarbrucken LAP LAMBERT Academic Publishing, 2018.
3. T K Dey, *Medical Parasitology*, La Vergne: New Central Agency, 2020.

Journal:

1. International Journal of Medical Microbiology
2. Journal of Clinical Microbiology
4. Clinical Microbiology and Infection

E-References:

1. https://dth.ac.in/medical/courses/Microbiology/block-1/2/index.php
2. https://www.digimat.in/nptel/courses/medical/microbiology/MB11.html
3. https://nptel.ac.in/courses/102/103/102103015/

4. https://www.cdc.gov/library/sciclips/issues/index.html
5. https://nvbdcp.gov.in/index1.php?lang=1&level=1&sublinkid=5811&lid=3799

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	1	3	9	3	1	29
CO2	3	1	9	3	3	1	9	29
CO3	3	3	1	9	9	3	3	31
CO4	1	9	3	3	1	9	1	27
CO5	9	3	1	9	3	3	9	37
Total	25	19	15	27	25	19	23	153

Low-1 Medium-3 High-9

ABILITY ENHANCEMENT COMPULSORY COURSE II – BIOINSTRUMENTATION

(For Students Admitted from 2024-25)

Semester: IV **Hours / week: 5**
Subject Code:IBMBA431 **Credit: 4**

Course Objectives:

1. To provide knowledge & understanding of various advance instrument, radioisotopes and its application.
2. To gains knowledge of various spectroscopy, electrophoresis and its operation.

Unit I **(15 hours)**

Preparation of solutions – solute, solvent, molarity, buffer, normality, polarity, ppm, pH solution. pH meter – basic principles, Types of electrodes. Principles and applications of Micrometer and Haemocytometer.

Unit II **(15 hours)**

Chromatography – General principles and definitions, R*f* value; Paper chromatography – Descending and 2-D, TLC, HPTLC, Adsorption chromatography, Gas Liquid Chromatography – Mass Spectrometry, Gel filtration, Affinity Chromatography, Ion-exchange Chromatography, HPLC

Unit III **(15 hours)**

Spectrophotometry – Principle and applications of spectrophotometer – visible, ultra violet and infra-red; Atomic Absorption Spectroscopy. Colorimetry, turbidometry, FTIR.

Unit IV **(15 hours)**

Separation Techniques – Centrifugation – Basic principles of sedimentation, RCF and sedimentation coefficient; types of centrifuges – Preparative and analytical centrifugation; rotors – fixed angle and swinging bucket rotors, differential centrifugation, density gradient centrifugation and ultracentrifugation, sonicator and sonication. Filters – Seitz, HEPA, Membrane; Lyophilizer.

Unit V **(15 hours)**

Electrophoretic Techniques – Electrophoresis – Principle and application, SDS – PAGE, Isoelectric focusing, Pulsed field Electrophoresis and 2-D Gel Electrophoresis Blotting techniques – Principles and types (Northern, Western and Southern). Sequencing techniques and Polymerase chain reaction.

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Define the working principles and discuss the methods of bio-instrumental techniques

CO 2: Apply various techniques used for current research

CO 3: Analyse the principle and working technique for bioinstrumentation

CO 4: Defend the techniques which are involved in the research

CO5: Discover a new compound in this technique

Text Books:

1. David J Holme; Hazel Peck, *Analytical Biochemistry and Separation Techniques,* Publisher: New York, NY, U.S.A, First Edition, 2020.
2. Brown D.R., *Chromatography***,** Publishing House, New Delhi, 2005.

Reference Books:

1. Sanderson JB. *Understanding light microbiology,* Hoboken NJ: John Wiley & Sons Ltd. 1st Edition, 2019
2. Bhatia SC**.** *Bioinstrumentation,* Shree Publishers & Distributors: New Delhi, 2015
3. Murphy D B., Davidson M W., *Fundamentals of Light Microscopy and Electronic Imaging,* Wiley-Blackwell, 2012

Journals:

1. Medical Instrumentation
2. International Journal of Biological Instrumentation.
3. Journal of Biomedical Instrumentation and Applications

E-Resources:

1. https://nptel.ac.in/courses/102/103/102103044/
2. www.technologygateway
3. https://www.azolifesciences.com/amp/article/What-is-Gas-Chromatography-Mass- Spectrometry-(GC-MS).aspx
4. https://www.britannica.com/science/spectrophotometry
5. https://homogenizers.net

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	3	1	3	9	1	29
CO2	9	3	1	3	9	1	3	29
CO3	1	9	3	1	9	3	9	35
CO4	3	1	9	3	1	9	3	29
CO5	3	9	1	3	1	9	9	35
Total	19	31	17	11	23	31	25	157

Low-1 Medium-3 High-9

SKILL ENHANCEMENT COURSE IV –
LAB COURSE IN MEDICAL LAB TECHNOLOGY
(For Students Admitted from 2024-25)

Semester: IV **Hours / Week: 2**
Subject Code: IBMBS44P **Credit: 2**

Course Objectives:

1. To develop students' understanding of medical microbiology with hand on experience in the isolation of the bacteria from different sources
2. To establish the knowledge about microbial pathogenicity, biofilm formation and their antibiotics resistance pattern.

List of Experiments:

1. Medical Laboratory Technician Code – personal safety measures – Care in the Laboratory
2. Common Causes of Accidents in laboratory
3. Blood Sample collection, Separation and Transportation
4. Blood grouping– A, B, O, AB, H
5. Bleeding Time and Clotting Time
6. Total WBC and Total RBC
7. Differential Cell count
8. Estimation of Hemoglobin
9. Estimation of Blood Sugar, Urine Sugar, Urine Albumin and Deposits
10. Estimation of Bile Salt and Bile pigment (BSBP)
11. Erythrocytes Sedimentation Rate (E.S.R)
12. Agglutination test (ASO, CRP, RF)
13. Widal slide agglutination and tube dilution
14. Thyroid Profile - ELISA
15. Microscopic Examination of Sputum for Acid Fast Staining
16. Microscopic Examination of Malarial Parasites (Pf & Pv)
17. Microscopic Examination of Stool for Ova and Cyst
18. Rapid Lab Diagnosis: Blood - HIV, HBAgs,HCV
    Urine - Urine Pregnancy Test (UPT)
19. Biomedical Waste Management
20. Field visit of Hospital

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Discuss the basics of clinical laboratory and highlight the importance about various techniques
CO 2: Explain and justify the common accidents and their causes in the laboratory
CO 3: Group the students and find their blood groups by their own
CO 4: Recommend various diagnostic methods to find the basic blood analytics
CO 5: Develop lab for Rapid Lab Diagnosis methods like ELISA HIV, HBAgs,HCV

Text Books:

1. Sant M. *Textbook of medical Laboratory Technology*. CBS Publishers & Distributors Pvt Ltd, 2020.

2. Robert Bailey W, Patricia M Tile, *Bailey & Scott's diagnostic microbiology,* St. Louis Elsevier. 14th Edition, 2017.

Reference Books:

1. Patrick R Murray, Ken S Rosenthal, Michael A Pfaller, *Medical Microbiology*, Edinburgh: Elsevier, 2021.
2. Daniel Amsterdam, *Antibiotics in Laboratory Medicine.* Philadelphia: Wolters Kluwer. 6th Edition, 2015
3. Ranjan Kumar De, *Diagnostic Microbiology, (For DMLT Students),* Jaypee Brothers publishing, New Delhi, 2007.

Journals:

4. Biomedical and Pharmacology Journal
5. Indian Journal of Community Medicine
6. Archives of Pathology and Laboratory Medicine

E Resources:

1. https://www.digimat.in/nptel/courses/medical/pathology/PA11.html
2. https://nios.ac.in/online-course-material/vocational-courses/dmlt.aspx
3. https://ndma.gov.in/index.php/Resources/awareness/hospital-safety
3. http://applyonline.itmuniversity.org/Images/biochemistry/BSc_MLT.pdf
4. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2760796

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	1	3	3	1	3	3	23
CO2	3	1	1	3	1	9	3	21
CO3	1	3	9	3	3	1	9	29
CO4	3	9	1	9	1	3	3	29
CO5	1	3	3	1	3	9	1	21
Total	17	17	17	19	9	25	19	123

Low-1 Medium-3 High-9

EXTRA CREDIT III– MICROBES IN HUMAN WELFARE

(For Students Admitted from 2024-25)

Semester: IV **Hours / week: -**
Subject Code:IBMBX4 **Credit: 2**

Course Objectives:

1. To expose the significance of microbes in industries and agriculture
2. To study the role of microbes in research and development of various fields

Unit I

Microbes as food products – Fermented Indian foods, Single cell protein, mushroom and food spoilage organisms; Role of Yeast; Role of Lactobacilli in fermented foods

Unit II

Pharmaceuticals – Production of antibiotics, vaccines, hormones, vitamins, steroids, enzymes and amino acids; role of genetically transformed microorganisms in pharmaceuticals

Unit III

Agriculture – Biofertilizer, biocontrol of microbial pathogens – fungicides, biopesticides, plant growth promotors, secondary metabolites

Unit IV

Microbes in industries – Biopreservatives; waste water recycling; industrial effluent treatment; Dairy industries – importance of microbe in dairy and dairy products; **Microbial** Industrial enzymes – application in food, leather, textile, paper, detergent

Unit V

Microbial products – production of bread, cheese, yoghurt, probiotic drinks, soy sauce, wine and beer, biogas

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Define the beneficial microbes and explain their applications in various aspects

CO 2: Illustrate the industrially important microbes

CO 3: Examine the microbes using technique for human welfare

CO 4: Determine the concepts of these technique and other economically important microbial products.

CO 5: Elaborate the applications of microbial culture

Text Books:

1. Ananthanarayan. R. and Paniker C.K. *Text Book of Microbiology*, Orient Longman, 11th Edition, 2020.
2. Michael J. Pelczar I.R., Chan E.C.S and Noel R. Kreieg., *Microbiology*, Tata McGraw–Hill, New Delhi, Fifth Edition, 2004.

Reference Books:

1. Joanne M Wiley, Kathleen M Sandman, Dorothy H Wood. *Prescott's principles of microbiology*. McGraw Hill Education. 2nd Edition, 2021.
2. Robert W Hutkins. *Microbiology and Technology of Fermented Foods.* Wiley-Blackwell: New York. 2019.
3. Osman Erkmen, T Faruk Bozoglu. *Food Microbiology: Principles into practice.* Chichester, West Sussex; Hoboken, NJ: John Wiley & Sons, Inc. 2016.

Journals:

1. Frontiers in Microbiology
2. Annual Reviews
3. Biocatalysis and Agricultural Biotechnology

E Resources:

1. https://nptel.ac.in/courses/102/105/102105058/
2. nptel - https://youtube.com/playlist?list=PLwdnzlV3ogoVjMjiPfEA-a-lzKPuU-L29
3. CEC - https://youtu.be/D4YWV4wL1eM
4. Swayam - https://www.youtube.com/playlist?list=PLwdnzlV3ogoVjMjiPfEA-a

lzKPuU-L29

5. https://www.toppr.com/guides/biology/microbes-in-human-welfare/biofertilizers/

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	1	9	3	1	9	3	29
CO2	1	1	3	3	1	3	1	13
CO3	3	3	1	9	3	9	3	31
CO4	9	9	3	9	3	3	9	45
CO5	3	3	9	1	9	1	3	29
Total	19	17	25	25	17	25	19	147

Low-1 Medium-3 High-9

CORE IX – ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

(For Students Admitted from 2024-25)

Semester: V **Hours /Week: 6**
Subject Code: IBMBC511 **Credit: 5**

Course Objectives:

1. To make the students understand the role of microbes in agriculture, plant microbe interaction and to know the importance of biofertilizers and biopesticides.
2. To review the current views of microbial association in various environments.

Unit I **(18 hours)**

Ecosystem – Ecological hierarchy; Ecological succession of microorganism; Homeostasis; Adaptive mechanism among microorganisms – interaction between microbes, plants and animals. Microbial contamination of air **–** Sources of contamination – Biological indicators of air pollution; Enumeration of bacteria from air, Air sampling devices. Significance of air micro flora, Outline of Airborne diseases (Bacterial, Fungal and Viral); Air sanitation; Effect of Air pollution for plants and Humans.

Unit II **(18 hours)**

Waste water (sewage and industrial effluents) treatments – Primary, Secondary (Trickling Filter, Activated Sludge) and Tertiary treatments; Anaerobic treatment of industrial effluents; Hydrolysis, Fermentation and Methonogenesis. Conventional methods of waste water treatment– (Aerobic and Facultative ponds, AMS, Thin film technique and Sand filter), Biosorption.

Unit III **(18 hours)**

Biodegradation and bioremediation – **Solid waste management –** Landfills, Composting and Earthworm treatment; Recycling and processing of organic residues – Biodegradation of Xenobiotic compounds. Microbial treatment of oil pollution; Xenobiotics degradation using Superbugs (Heavy metals & Radionuclides)

Unit IV **(18 hours)**

Soil microbiology – Structure, Types, Physical and Chemical properties; Soil pollution, Bio-geo chemical cycles – Carbon, Nitrogen, Sulphur, Iron and Phosphorus.

Unit V **(18 hours)**

Agricultural microbiology – Biological nitrogen fixation – diazotrophs – free living, aerobic, symbiotic bacteria and cyanobacteria. Microbial interactions, interaction of microbes with plants and insects.

Biofertilizers – Microbes used as Biofertilizers, Mass multiplication, field application and crop response.

Biopesticide – Bacterial, Fungal and Viral; Recent advances in biological pest control

Course Outcomes:

After successful completion of the course, students will be able to

CO1: Identify the types of microorganisms and explain the role in environment

CO 2: Classify the application of microbes in agriculture field

CO 3: Categorizes the knowledge about waste water treatment

CO 4: Determine the microbes involved in biodegradation and bioremediation

CO 5: Develop the agricultural management for uses in microbes

Text Books:

1. Dubey R.C. and Maheswari D.K., *A Textbook of Microbiology*, S. Chand and Company Ltd, New Delhi, 2013.
2. E Paul E., *Soil Microbiology, Ecology and Biochemistry*, 4th Edition, Academic Press, Burlington, MA, USA, 2014

Reference Books:

1. Arceivala J., *Wastewater treatment for pollution control by soil,* Tata McGraw - Hill Publishing Company Limited, 3rd Edition, 2017.
2. Vierah Hulley., *Introduction to Environmental Management,* Ashland: Delve publishing**,** 1st Edition, 2020.
3. Pareek R P., Navneet Pareek., *Agricultural microbiology*, jodhpur, India:Scientific publishers, 1st Edition, 2019.

Journals:

1. Annals of applied biology
2. Journal of bacteriology
3. New phytologist

E- Resources:

1. https://nptel.ac.in/courses/126/105/126105016/#
2. https://nptel.ac.in/courses/126/105/126105013/
3. https://nptel.ac.in/courses/127/105/127105018/
4. https://nios.ac.in/online-course-material/sr-secondary-courses/enviornmental-science
5. https://nios.ac.in/media/documents/srsec314newE/PDFBIO.EL24.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	9	1	3	9	1	35
CO2	9	1	3	1	3	1	3	21
CO3	1	3	9	3	9	9	3	37
CO4	3	3	1	9	3	1	1	21
CO5	9	9	3	3	1	3	3	31
Total	25	25	25	17	19	23	11	145

Low-1 Medium-3 High-9

CORE X – IMMUNOLOGY

(For Students Admitted From 2024-25)

Semester: V **Hours / Week: 6**
Subject Code: IBMBC52 **Credit: 5**

Course Objectives:

1. To learn about the structural features and components of the immune system as well as their functions and responsiveness.
2. To understand the various components of the host immune system, their structure and organization, and functions to serve as the defense system of the body.

Unit I **(18 hours)**

History of Immunology – Contributions of following scientists in the field of immunology – Edward Jenner, Robert Koch, Paul Ehrlich, Louis Pasteur, Peter Medawar, Elie Metchnikoff, Joseph Lister and Susumu Tonegawa

Immune Cells and Organs – Structure, Functions and properties of immune cells – Stem cell, T cell, B cell, NK cell, Macrophage; Granulocytic cells – Neutrophil, Eosinophil, Basophil. Mast cell, Dendritic cell; and Immune Organs – Primary lymphoid Organs – Bone Marrow, Thymus; Secondary lymphoid organs – Lymph node, Spleen; GALT, MALT, CALT

Unit II **(18 hours)**

Antigen & Antibody – Characteristics of an Antigen, Haptens, Adjuvant, Epitopes; Structure & function of Immunoglobulins – IgG, IgA, IgM, IgD, IgE; Antigen and Antibody Interaction; Immune response – Primary & Secondary immune response; Elements of immunity – introduction, innate immunity, acquired immunity

Unit III **(18 hours)**

Complement and Effectors mechanisms – Complement – Classical and Alternative pathways; Major Histocompatibility Complex – Structure and types of MHC molecules (HLA); Hypersensitivity reactions – Type I, II, III, IV, Auto immunity – Myasthenia Gravis

Unit IV **(18 hours)**

Transplantation & Tumour immunology – Transplantation; Mechanism of graft rejection versus host rejection, clinical manifestation; Immunodeficiency; Immunosuppressive therapy; Tumor antigen – TATAs, TSTAs; Immune response to tumours

Unit V **(18 hours)**

Immunodeficiencies and Vaccines – Primary – SCID – B & T cell deficiencies, Secondary – AIDS. Types of Vaccines – Attenuated, Killed, Subunit vaccines, DNA Vaccines, Recombinant vector vaccines; Monoclonal antibodies production by using hybridoma technology & its application

Immunological Techniques – Immunodiffusion, Immunoelectrophoresis, ELISA, PCR

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Define the immunology and explain the immune system
CO 2: Discuss the role of Immunoglobulins
CO 3: Analyze antigen responses to microbial infections
CO 4: Explain the importance of vaccination in human health
CO 5: Develop monoclonal antibodies and their applications

Textbooks:

1. Jenni Punt, Sharon Stranford, *Kuby Immunology*, WH Freeman, 8th Edition, 2018.
2. Kuby R. A Goldsby, Thomas J. Kindt and Barbara A. Osborne., *Immunology*, 6th Edition, Freeman &Company, New York, 2002.

Reference Books:

1. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt., *Roitt's Essential Immunology*, Wiley-Blackwell, 13th Edition, 2017.
2. Matthew Helbert; Roderick Nair by *Immunology for medical students*, 2017.
3. Richard Coico, Geoffrey Sunshine, *Immunology: A Short Course*, Wiley-Blackwell, 7th Edition, 2015.

Journals:

1. The new england journal of medicine
2. The american journal of medicine
3. Journal of clinical oncology

E -Resources:

1. https://nptel.ac.in/courses/102/103/102103038/
2. https://nptel.ac.in/courses/104/108/104108055/
3. https://nptel.ac.in/courses/102/105/102105083/
4. https://books.google.com/books?hl=en&lr=&id=pcDfBwAAQBAJ&oi=fnd&pg
5. https://www.cabdirect.org/cabdirect/abstract/19432701768

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	1	3	1	3	9	3	29
CO2	1	3	1	9	9	3	9	35
CO3	3	9	3	3	1	3	1	23
CO4	3	9	1	9	3	1	1	27
CO5	9	3	9	3	3	1	1	29
Total	25	25	17	25	19	17	15	143

Low-1 **Medium-3** **High-9**

CORE XI – LAB COURSE IN ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY AND IMMUNOLOGY

(For Students Admitted from 2024-25)

Semester: V **Hours / Week: 6**
Subject Code: IBMBC53P **Credit: 5**

Course Objectives:

1. To provide practical knowledge in the isolation and characterization and to understand the plant-pathogen interaction.
2. To learn about the structural features of the immune system as well as their functions and responsiveness.

List of Experiments:

1. Isolation of free – living nitrogen fixing bacteria from soil – *Azotobacter*
2. Isolation of Symbiotic nitrogen fixing bacteria from root nodule – *Rhizobium*
3. Isolation of *Azospirillum, Cyanobacteria* from soil/ roots/water
4. Isolation of bacterial pathogens and fungal pathogens from infected plants
5. Isolation of phosphate solubilizing microorganisms from soil
6. Bacterial assessment of water – MPN
7. Determination of Biological Oxygen Demand (BOD)
8. Determination of Chemical Oxygen Demand (COD)
9. Estimation of Total solids (TS), total dissolved solids (TDS) and total suspended solids (TSS) in water
10. Microbial assessment of air quality – open plate method and air sampler technique
11. Isolation and counting of fecal bacteria from water
12. Immunodiffusion – Simple, Double and Radial
13. Immunoelectrophoresis
14. Australian latex antigen test
15. Agglutination Test (ELISA, HIV & Blood grouping)

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Observe the environmental microbes and discuss about the antigen antibody reaction
CO 2: Apply these techniques for agriculture, medical and industries purpose
CO 3: Classify a quality technique
CO 4: Evaluation of microbes in soil
CO 5: Design a technique for use in new pattern method

Text Books:

1. Aneja K. R., *Experiments in Microbiology, Plant pathology and Tissue culture and microbial biotechnology,* New Age International Publishers, 5th Edition, 2017.
2. Madigan MT, Martinko JM and Parker J, *Brock Biology of Microorganisms.* 14th Edition. Pearson/Benjamin Cummings, 2014.

Reference books:

1. Dubey R. C. and Maheshwari D. K., *Practical Microbiology,* S. Chand & Company Ltd, New Delhi, 2010
2. Atlas R.M. and Bortha R., *Microbial Ecology Fundamentals and Application*, LPE Pearson Education, Inc, 4th Edition, 2005.

3. Cappuccino and G. James, *Microbiology a laboratory manual*, Addison Wesley Publishing Company Inc. California, 4th Edition,1996.

Journals:

1. Journal of virology methods
2. Indian journal of paediatrics
3. The British journal of psychiatry

E Resources:

1. https://nptel.ac.in/courses/126/105/126105016/#
2. https://nptel.ac.in/courses/102/105/102105058/
3. https://nptel.ac.in/courses/126/105/126105014/
4. https://cdnsciencepub.com/doi/abs/10.4141/S00-091
5. https://lsspjournal.biomedcentral.com/articles/10.1186/s40504-021-00116-8

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	3	1	9	1	9	35
CO2	1	3	1	3	3	9	3	23
CO3	9	3	1	9	1	3	3	29
CO4	3	9	3	3	9	3	3	33
CO5	3	1	9	1	3	1	9	27
Total	19	25	17	17	25	17	27	147

Low-1 Medium-3 High-9

DISCIPLINE SPECIFIC ELECTIVE I: a. BIOSTATISTICS

(For Students Admitted from 2024-25)

Semester: V **Hours / Week: 4**
Subject Code: IBMBE51A **Credit: 4**

Course objectives:

a. To make aware of students, to use and apply the data in statistical tools
b. To emphasis the students for the application of biological databases to solve the problem in real research.

Unit I **(12 hours)**

Introduction to biostatistics – Definition, Statistical methods, Biological measurements, Kinds of biological data (Primary & secondary data), Function of statistics and limitation of statistics, Application of statics in health.

Unit II **(12 hours)**

Data Collection methods and presentations –Types of data **–** qualitative and quantitative data, discrete and continuous data, frequency and non-frequency data; Sampling and sampling design – Presentation of data (Diagrammatic, Tabular and Graphical representation)

Unit III **(12 hours)**

Measures of central tendency – Mean, Median, Mode, ANOVA (Analysis of Variance- one way and two way)

Unit IV **(12 hours)**

Measures of dispersion – Introduction **–** quartiles, deciles, percentiles, Standard deviation, Quartile deviation **–** correlation and regression

Unit V **(12 hours)**

Probability distribution – Types of Probability **(**Binomial, Normal, Poisson) – Theorems of probability – student T- test – Null and alternate hypothesis, type I and II errors, testing significance – use of statistical tables and levels of significance

Course Outcomes:

After successful completion of this course, the students will be able to

CO 1: Explain the statistics methods and find the functions & limitations on biostatistics

CO 2: Classify about the data collection and presentation of data

CO 3: Categorize the central tendency

CO 4: Demonstrate the measures of dispersion and probability distribution

CO 5: Develop the practical skills for applying statistical tools in research

Text Books:

1. Arora P.N. and Malhan P.K., *Biostatistics,* Himalaya publishing House, Mumbai Wayne W. Daniel, Chad L. Cross, *Biostatistics: A Foundation for Analysis in the Health Sciences,* Wiley Sciences Publisher, 10th Edition, 2012.

Reference Books:

1. Gupta S.P. *Statistical Methods,* Sultan chand & Sons, 5th Edition, 2010.
2. Sundar Rao P.S.S. and Richard J., *Introduction to Biostatistics and Research Methods,* Prentice Hall of India Pvt Ltd, New Delhi, 5th Edition, 2012.
3. Negi K.S.**,** *Methods in Biostatistics with latest MCQs,* A.T.I.B.S Publishers, India, 2013.

Journals:

1. International journal of energy and environmental engineering
2. Brain research bulletin
3. Renewable energy

E- Resources:

1. https://nptel.ac.in/courses/102/101/102101056/
2. https://books.google.com/books?hl=en&lr=&id=7tJMDwAAQBAJ&oi
3. https://books.google.com/books?hl=en&lr=&id=yn4yBgAAQBAJ&oi=fnd&pg
4. https://books.google.com/books?hl=en&lr=&id=7tJMDwAAQBAJ&oi=fnd&pg
5. http://www.bnemid.byethost14.com/BIOSTATICS%202.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	1	3	9	3	1	29
CO2	3	1	9	9	3	1	3	29
CO3	3	9	3	9	3	3	1	31
CO4	1	9	3	3	1	9	3	29
CO5	9	3	3	1	9	3	1	29
Total	25	25	19	25	25	19	9	147

Low-1 Medium-3 High-9

DISCIPLINE SPECIFIC ELECTIVE I: b. FOOD AND NUTRITION

Semester: V **Hours /Week:4**
Subject code: IBMBE51B **Credit:4**

Course Objectives:

1. To become familiar about the nutritive values of food.
2. To learn about the food sources from which we obtain vitamins.

UNIT-I **(12 hours)**

Sources of Food: Nutritive value of foods, Food Sources from which key vitamins are derived

UNIT-II **(12 hours)**

Digestive System: Digestion and absorption –Digestion at each stage of the digestive system, Dietary guidelines- Factors affecting food requirements. Planning and serving of family meals. Meals for all ages and occupations.

UNIT-III **(12 hours)**

Composition Of Food: Composition and value of the main foods in the diet - Milk, meat, fish, cheese, eggs, margarine and butter cereals (wheat, rice, maize, millets, oats) fruits and vegetables

UNIT-IV **(12 hours)**

Processing Of Food: Cooking of food -Transfer of heat by conduction, convection and radiation. Principles involved in the different methods of cooking – boiling, stewing, grilling, baking, roasting, frying, steaming, pressure cooking, cooking in a microwave oven, Canning processing and Frozen

UNIT-V **(12 hours)**

Food Preparation: Convenience foods- Foods partly or totally prepared by a food manufacturer – dehydrated, tinned, frozen, ready to eat. Intelligent use of these foods, Advantages and disadvantages

Course outcomes

After successful completion of this course, student will be able to

CO1: Become familiar with various compositions of food.

CO2: Well versed with digestion at each stages of digestive system.

CO3: Become familiar with different cooking methodologies.

CO4: Know the effect of the various diseases on nutritional status and nutritional and dietary requirements.

CO5: Be able to recommend and provide appropriate nutritional care for prevention / and treatment of the various diseases.

REFERENCE:

Kenneth F. Kiple, KriemhildConeè Ornelas, The Cambridge world history of food, Cambridge University Press, Ist ed,2000

TEXT BOOK:

Agarwal, Textbook of human nutrition, JP, 1 Ed, 2014

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	1	3	9	3	1	29
CO2	9	1	9	9	3	1	3	35
CO3	9	9	3	9	3	3	1	37
CO4	9	9	3	3	1	9	3	37
CO5	9	3	3	1	9	3	1	29
Total	45	25	19	25	25	19	9	167

Low-1 Medium-3 High-9

DISCIPLINE SPECIFIC ELECTIVE II: a. BIOTECHNOLOGICAL TECHNIQUES

(For Students Admitted from 2024-25)

Semester: V **Hours / Week: 4**
Subject Code: IBMBE51C **Credit: 4**

Course Objectives:

1. To understand microbes for the development of various product.
2. To enhance the knowledge of recombinant technology, bioreactors and optimization strategies for development and production processes.

Unit I **(12 hours)**

Introduction to biotechnology – Definition, Concept and Scope – History and achievements; Basic principles in rDNA technology; Restriction Enzymes – Types, Nomenclature, Mechanism of action; Cloning vectors – Plasmid – pBR322, pUC8; Viral vectors – M13, SV40, Cosmid, Phagemid, Shuttle vectors and its application

Unit II **(12 hours)**

Methods in biotechnology – Isolation of genomic and plasmid DNA, Agarose gel electrophoresis, 2D gel electrophoresis, Polyacrylamide gel electrophoresis, Blotting techniques – Southern, Northern and Western. Polymerase chain reaction – types, methods, application; DNA sequencing methods

Unit III **(12 hours)**

Nanobiotechnology – Introduction, types and synthesis of nanomaterials, Protein-based nanostructures, DNA-based nano structures, Applications of nanomaterial – Nanobiosensors, Drug and gene delivery, Disease nano-diagnostics and therapy; Risk potential of nanomaterials

Unit IV **(12 hours)**

Plant biotechnology – Plant tissue culture – Definition, Culture medium – MS and B5, Culture methods – Callus, Protoplast, Meristem culture and Embryo (somatic embryogenesis), *Agrobacterium tumefaciens* mediated gene transfer, synthetic seed technology

Unit V **(12 hours)**

Animal biotechnology – Transgenic Animal – Definition, Methods involved in the production of transgenic animals; Cloning **–** Mice, Fish, Sheep; Applications of transgenic animals in therapeutic protein production – Insulin and Interferon

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Identify the DNA and explain the DNA modifying enzymes
CO 2: Demonstrate the Identification of DNA, RNA and protein
CO 3: Develop the application of genetic engineering in animals, plants and human
CO 4: Discuss the fundamental principles of nanotechnology and their application
CO 5: Conclude the knowledge on the Biotechnological methods

Text Books:

1. Satyanarayana U. and Chakrapani U., *Biotechnology*, Books & Allied P(Ltd), Kolkata, 12th Edition, 2019.
2. Dubey R.C., *A Textbook of Biotechnology*, S. Chand & Company Ltd, New Delhi, 5th Edition, 2014

Reference Books:

1. Gupta P.K., *Elements of biotechnology*, Rastogi Publications, Meerut, Second edition, 2019
2. Jogdand S.N., *Gene Biotechnology*, Himalaya Publishing House, New Delhi, Fourth revised edition, 2016.
3. Ross Howe, *Manual of Industrial Microbiology and Biotechnology*, Publisher:White Press Academics, 2019.

Journals:

1. Researchgate.net
2. Springer nature
3. Proceedings of the Iee

E- Resources:

1. **https://nios.ac.in/media/documents/srsec314newE/PDFBIO.EL29.pdf**
2. https://nptel.ac.in/courses/102/103/102103013/
3. https://www.oecd.org/sti/emerging-tech/2097562.pdf
4. https://nptel.ac.in/courses/102/103/102103074/
5. https://nptel.ac.in/courses/102/103/102103045/

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	1	3	1	3	9	29
CO2	1	3	3	1	9	3	1	21
CO3	3	9	1	3	3	1	9	29
CO4	3	1	3	1	9	1	1	19
CO5	1	3	3	1	3	1	9	21
Total	17	19	11	9	25	9	29	119

Low-1 Medium-3 High-9

DISCIPLINE SPECIFIC ELECTIVE II: b. BIONANOTECHNOLOGY

(For Students Admitted from 2024-25)

Semester: V **Hours /Week: 4**
Subject Code: IBMBE51D **Credit: 4**

Course Objectives:

1. To understand the essential features of biology and nanotechnology that are converging to create the new area of bionanotechnology. To recognize the structural and functional principles of Bionanotechnology.
2. To introduce plant biotechnology, tissue culture and rDNA technology. To give insight into applications in industrial biotechnology and nano biotechnology

Unit I **(12 hours)**

Nanostructure and biomaterial – Bionanotechnology – Definition, History of bionanotechnology – Richard Feynman and his contributions; Classification of Nanostructures – 1D, 2D and 3D.

Unit II **(12 hours)**

Functional principles of bionanotechnology – Information storage – Nucleic acid, Ribosomes as assembler to construct proteins; Biocatalysts – Enzymes and its regulation

Unit III **(12 hours)**

Synthesis of Nanoparticles – Top down and Bottom up approaches; Green Synthesis of Nanoparticles (Silver and Gold), colloids; DNA-based nanostructures. Protein based nano structures.

Unit IV **(12 hours)**

Characterization of Nanoparticles – UV-Spectroscopy, FT-IR, XRD, SEM, TEM, Atomic force Microscopy.

Unit V **(12 hours)**

Nano medicine – Developing of nanodrug and carriers – liposomes, dendimers, vesicles, protocols for nanodrug administration; nanotechnology in diagnostics applications, materials used in diagnostics and therapeutic applications.

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Define the Bionanotechnology and classify the nanostructures and principles of Bionanotechnology

CO 2: Apply the creation of nanostructures based on biomolecules

CO 3: Illustrate the applications of nanoparticles as drugs in therapeutics and diagnosis

CO 4: Examine the analytical techniques involved in characterization of nanoparticles

CO 5: Develop the protocols for nanodrug and therapeutic applications

Text Books:

1. Viswanath Buddolla, *Recent developments in applied microbiology and biochemistry*. Publisher: London, United Kingdom ; San Diego, CA : Academic Press, Volume 2, 2020.
2. Satya Shila Singh, *Plants and microbes in an ever-changing environment* Publisher: Hauppauge, New York : Nova Science Publishers, 2017.

Reference Books:

1. David E. Reisner, Joseph D. Bronzino, *Bionanotechnology: Global Prospects*. CRC Press, 2008.
2. Viswanath Buddolla, *Recent developments in applied microbiology and biochemistry*, Publisher: London, United Kingdom ; San Diego, CA : Academic Press, Volume 2, 2020.
3. Sherron Sparks; Safari, *Nanotechnology*, Publisher: CRC Press, 1st Edition, 2017.

Journals:

1. Arabian journal of chemistry
2. American chemical society
3. International journal of pharmaceutical science review and research

E - Resources:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118451915
2. https://www.academia.edu/4881345/BioNanotechnology
3. https://nptel.ac.in/courses/118/106/118106019/
4. https://jnanobiotechnology.biomedcentral.com/
5. https://jnanobiotechnology.biomedcentral.com/articles

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	9	3	1	1	29
CO2	3	1	9	3	3	9	3	31
CO3	9	3	1	9	1	3	9	35
CO4	3	9	3	1	3	1	3	23
CO5	3	1	9	3	1	3	3	23
Total	27	17	25	25	11	17	19	141

Low-1 Medium-3 High-9

SKILL ENHANCEMENT COURSE V – LAB COURSE IN VERMICULTURE

(For Students Admitted From 2024-25)

Semester: V **Hours /Week: 2**
Subject Code: IBMBS541P **Credit: 2**

Course Objectives:

1. To understand the concepts of vermiculture and vermicomposting. To understand the characteristics of earthworm species suitable for vermiculture and vermicomposting.
2. To understand various applications of earthworms in organic solid waste management, soil fertility, and bioremediation.

List of Experiments:

1. Earthworms and types (ecological strategies).
2. Collection of local Earthworm sample.
3. Preparation and production of compost using endemic & exotic varieties of earthworms.
4. Preparation and production of compost Paper, Cardboard and Vegetable wastes.
5. Aerobic & Anaerobic composting.
6. Preparations of Vermiwash.
7. Effect of vermicomposting and vermiwash in the growth of *Trigonella foenum-graecum* (Fenugreek) seeds.
8. Impact of different organic food sources on the growth and reproductive performance of composting earthworms *Eisenia fetida*
9. Vermicomposting of different types of wastes using *Eisenia Foetida*
10. Field trip to Vermicomposting site.

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Define the core concepts about ecology and classify the types of earthworms

CO 2: Identify the local earthworms and their collection

CO 3: Emphasize understanding of the challenges that arise during the life cycle of earthworms

CO 4: Reveal about aerobic & anaerobic composting
CO 5: Explore the knowledge on Vermicomposting and gain entrepreneur idea

Text Books:

1. Clive A. Edwards Norman Q. Arancon Rhonda Sherman, *Vermiculture Technology Earthworms, Organic Wastes, and Environmental Management,* CRC Press, 2011.
2. Samantha Nugent, Earthworms, Publisher:New York : AV2, 2ed Edition, 2021.

Reference Books:

1. Megan Borgert-Spaniol, Earthworms, Minneapolis, MN : Bellwether Media, 2014.
2. Katheem K.S, Mahamad H.I, Shlrene Quaik, Sultan Ahmed Ismail. *Prospects of Organic Waste Management and the Significance of Earthworms,* Springer international publishing Switzerland, 2016.
3. Edwards, C.A., Arancon, N.Q. and Sherman, R. *Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management*, CRC Press, Boca Raton, FL. 2011.

Journals:

1. Journal of biological sciences
2. Internatinal journal of recycling of organic waste in agriculture
3. Cogent environment science

E - Resources

1. https://nptel.ac.in/courses/126/105/126105014/
2. http://www.digimat.in/nptel/courses/video/126105014/L14.html
3. https://nios.ac.in/online-course-material/vocational-courses.aspx
4. https://www.researchgate.net/publication/327841563_Vermicomposting
5. https://agrt.emu.ee/pdf/2019_2_olle1.pdf

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	1	3	3	9	3	31
CO2	9	3	3	1	9	3	1	29
CO3	3	1	9	1	3	9	3	29
CO4	3	9	3	1	1	3	9	29
CO5	1	3	1	9	3	1	3	21
Total	25	19	17	15	19	25	19	139

CORE XII – FOOD MICROBIOLOGY

(For Students Admitted from 2024-25)

Semester: VI **Hours / Week: 6**
Subject Code:IBMBC611 **Credit: 4**

Course Objectives:

1. To understand fermentation technologies and food quality analysis based on government organizations involved in food quality control.
2. To overview the food spoilage organisms, infection process and their outbreaks.

Unit I **(18 hours)**

Food as a substrate for microorganisms – Microorganisms important in food Microbiology – bacteria, yeast, molds; Factors affecting the growth of microorganisms in food – pH, Moisture, Oxidation – Reduction potential, Nutrient content and Inhibitory substances and Biological structure.

Unit II **(18 hours)**

Food Preservation – Principles of food preservation; Asepsis, Removal, Anaerobic conditions. Preservation: High Temperature, Low Temperature, Drying, Food Additives and radiation

Unit III **(18 hours)**

Contamination and Spoilage – Cereals, Vegetables and fruits, Meat and Meat products, Fish, Eggs, Poultry, Milk and Milk products, Canned Food

Unit IV **(18 hours)**

Fermented Food Products – Fermented dairy products – Cheese, yoghurt, kefir & acidophilus milk; Concept of Probiotics, Fermented vegetables – Sauerkraut, pickled cucumber; Fermented Meat – Sausages; Role of microbes in Wine & beer preparation

Unit V **(18 hours)**

Food borne infection and intoxication – Bacterial – *Staphylococcus*, *Clostridium*, *Vibrio*, *Escherichia coli* and *Salmonella*; Viral – Hepatitis; Protozoa – Giardiasis, Amoebiosis and Mycotoxins

Quality control aspects – Good Manufacturing Practices, Hazard Analysis Critical Control Points, Microbiological Quality Standards – FDA, HACCP, ISI, ISO.

Course Outcomes:

After successful completion of the course, student will be able to

CO 1: Define the food microbiology and outline the general principles of food Microbiology

CO 2: Classify the economically important of Bacteria, Yeast and Mold

CO 3: Find the pathogenic organisms involved in the spoilage & normal flora of the food

CO 4: Develop the fermentation technology behind the fermented food

CO 5: Justify the examination of food and microbiological quality control

Text Books:

1. Adams M.R., and M.O Moss., *Food Microbiology*, the Royal Society of Chemistry, Cambridge, 2018.
2. H L M Lelieveld., *Handbook of Hygiene Control in the Food Industry*, Duxford, UK : Woodhead Publishing 2st Edition 2016.

Reference Books:

1. Frazier W.C. and Westhoff D.C., *Food Microbiology*, McGraw Hill Education (India) Prt. Ltd, Chennai, 2014.
2. Arindam Kuila; Vinay Sharma, *Principles and applications of fermentation technology*, Publisher: Hoboken, New Jersey : Wiley, 2ed Edition, 2018.
3. Peter F Stanbury; Allan Whitaker; Stephen J Hall, *Principles of fermentation technology***,** Publisher: 3ed Edition, 2017.

Journals:

1. International journal of food microbiology
2. Food microbiology
3. Japanese journal of food microbiology

E - Resources:

1. https://nptel.ac.in/courses/126/105/126105013/
2. https://www.fsis.usda.gov/sites/default/files/media_file/2021
3. Swayam - https://www.youtube.com/playlist?list=PLwdnzlV3ogoVjMjiPfEA-a-lzKPuU-L29
4. https://www.cabdirect.org/cabdirect/abstract/19970401829
5. https://www.cabdirect.org/cabdirect/abstract/19840487927

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	1	3	3	9	3	1	23
CO2	1	9	1	1	3	1	3	19
CO3	3	9	3	3	1	3	3	25
CO4	3	3	9	3	3	9	1	31
CO5	9	3	1	9	1	3	3	29
Total	19	25	17	19	17	19	11	127

Low-1 Medium-3 High-9

CORE XIII – INDUSTRIAL MICROBIOLOGY

(For Students Admitted from 2024-25)

Semester: VI **Hours / Week: 5**
Subject Code:IBMBC621 **Credits: 4**

Course Objectives:

1. To apply the microbiology concepts toward the exploitation of microbial population for industrial and human benefits.
2. To development the microbial strains for large scale production and product recovery.

Unit I **(15 hours)**

Introduction to industrial microbiology – Brief history and developments in industrial microbiology; Isolation and Characterization of industrially important microbial strains – Strategies in selecting strain; Primary and Secondary screening, Strain improvement – mutation and recombinant DNA technology, preservation and maintenance of industrial strains

Unit II **(15 hours)**

Fermentation media – Media and ingredients for industrial fermentations **–** Crude and synthetic Media – Carbon, Nitrogen, Vitamin and Mineral Sources; Role of buffers, Precursors, Inhibitors, Inducers and Antifoams

Types of fermentation process – Batch, fed–batch and continuous fermentation

Sterilization: Sterilization of Instruments, Medium and Air

Unit III **(15 hours)**

Bioreactors – Components (design) of typical fermenter, types of fermenters- stirred tank, bubble column, airlift, packed bed, fluidized bed, tower and Photo bioreactor; **Measurement and control of fermentation parameters** – Control and monitoring of different parameters in fermenters – pH, Temperature, Dissolved oxygen, Foaming and Aeration and Computer automation

Unit IV **(15 hours)**

Down–Stream Processing – Removal of biomass from large scale, Filtration, Centrifugation, Cell disruption methods- Physical and Chemical, Solvent extraction, Precipitation, Chromatography, Ultrafiltration, Lyophilization and Spray drying

Unit V **(15 hours)**

Microbial Production of Industrial Products – Citric acid, Acetic acid (vinegar), Ethanol, Penicillin, Cyanocobolamine, Amylase, Cellulase, Wine and Beer; Enzyme immobilization; Recombinant products-Insulin, Growth hormones and Interferons.

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Define the type of industrial microbes and list the industrially important microbes

CO 2: Interpret the concepts of upstream and downstream processing of fermentation technology

CO 3: Investigate on the production of economical important microbial products

CO 4: Evaluate the bioreactors and controlling parameters

CO 5: Design the type of fermenter needed for large scale production

Text Books:

1. Casida L.E.J.R., *Industrial Microbiology*, New Age International Private Limited, 2nd Edition, 2019.
2. Patel A.H., *Text book of industrial microbiology,* Laxmi Publications, 2nd Edition, 2011.

Reference Books:

1. Prescott S.C. and Cecil G. Dunn's, *Industrial Microbiology*, Jodhpur Agrobios publications, 2011.
2. Stanbury I.F., Whittakar A., and Hall S.J., *Principles of fermentation technology*, 3rd Editon, Pergamon press, 2016.
3. David B Wilson; Hermann Sahm; Klaus-Peter Stahmann; Mattheos Koffas, *Industrial Microbiology*, Publisher: Newark : John Wiley & Sons, Incorporated, 2020.

Journals:

1. Journal of industrial microbiology
2. Journal of industrial microbiology and biotechnology
3. Journal of pharmacy

E- Resources:

1. https://nptel.ac.in/courses/102/105/102105058/

2. https://www.biologydiscussion.com/
3. https://www.mlsu.ac.in/econtents/1809_Bioreactor_Control.pdf
4. http://38.100.110.143/model/index.html
5. https://run.edu.ng/directory/oermedia/11934434415399.pdf

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	1	1	3	3	9	29
CO2	3	1	3	3	9	3	1	23
CO3	3	1	3	9	3	1	3	23
CO4	1	3	1	9	1	1	3	19
CO5	3	9	3	3	1	3	9	31
Total	19	17	11	25	17	11	25	125

Low-1 Medium-3 High-9

CORE XIV – LAB COURSE IN FOOD AND INDUSTRIAL MICROBIOLOGY, MICROBIAL GENETICS AND MEDICAL MICROBIOLOGY

(For Students Admitted from 2024-25)

Semester: VI **Hours/ Week: 6**
Subject Code: IBMBC631P **Credit: 5**

Course Objectives:

1. To provide practical knowledge and skills to analyses specific microorganisms in food and industries.
2. To make the students knowledgeable on production of various industrial products.

List of Experiments:

1. Enumeration of microorganisms from food product (spoiled food, milk)
2. Determination of the quality of milk sample by Dye Reduction Test, Phosphatase test and Turbidity test
3. Detection of sugar in honey
4. Portability analysis of drinking water by MPN method
5. Sauerkraut production
6. Screening of enzyme producing microorganisms (protease, amylase and cellulase)
7. Immobilization of yeast using sodium alginate
8. Alcohol fermentation by yeast
9. Isolation of antibiotic resistant mutant by gradient plate method
10. Isolation of antibiotic resistance mutant by replica plating
11. Preparation of competent cells
12. Databases related to genome and proteome to extract information from database and sequencing using software
13. Isolation of normal flora of skin, nose, throat
14. Testing of antimicrobial activity of the bacteria
15. Isolation and identification of *E. coli* from urine sample
16. Isolation and Identification of *Staphylococcus aureus* from pus sample
17. Determination of the effectiveness of certain antibiotics (Antibiotic Sensitivity Test)

18. Determination of Minimal Inhibitory Concentration (E-test).

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Identify the microbes and explain the microorganism from food sources
CO 2: Make use of the microbial test to check the quality of food
CO 3: Examine the microbes in food industrial
CO 4: Evaluate the industrial microbiology
CO 5: Formulate the new food product and fermentation methods

Text Books:

1. Tortora GJ, Funke BR, and Case CL. *Microbiology: An Introduction*. 9th Edition. Pearson Education., 2008.
2. Stanbury I.F., Whittakar A., and Hall S.J., *Principles of fermentation technology*, 3rd Editon, Pergamon press, 2016.

Reference Books:

1. Cappuccino& Natalie Sherman., *Microbiology A Laboratory Manual.*10th Edition, 2014.
2. Gunasekaran P., *Laboratory Manual in Microbiology*, New Age international Pvt Ltd Publisher, New Delhi, 2009.
3. Aneja K.R., Experiments in Microbiology, *Plant Pathology and Biotechnology*, New Age International Publishers, Revised Fourth Edition, 2005.

Journals:

1. Journal of clinical microbiology
2. International journal of medical microbiology
3. Reviews and research in medical microbiology

E -Resources

1. https://nptel.ac.in/courses/102/105/102105058/
2. https://www.hindawi.com/journals/jchem/2015/716125/
3. https://ijpsr.com/bft-article/immobilization-and-estimation-of-activity-of-yeast-cells-by-entrapment-technique-using-different-matrices/?view=fulltext
4. http://38.100.110.143/model/index.html
5. Estimation of Alcohol by Different Evaluative Methods and ... – IRJE

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	3	1	9	3	1	29
CO2	9	1	3	3	9	1	3	29
CO3	3	3	1	9	3	9	9	37
CO4	3	1	3	1	3	1	3	15
CO5	1	3	1	9	1	3	3	21
Total	19	17	11	23	25	17	19	131

Low-1 Medium-3 High-9

CORE – XV PROJECT

(For Students Admitted from 2024-25)

Semester: VI **Hours /Week: 6**
Subject Code: IBMBC64PW **Credit: 5**

Course Objectives:

1. To acquaint the student with various techniques used in contemporary research in microbiology that will be useful in successful completion of their project work in the fourth semester.
2. To develop skill to independently carry out research from designing experiment to analyzing results and presenting the result.

Course outcomes:

After successful completion of the course, students will be able to
CO 1: Observe the new research and Implement the innovative ideas in research
CO 2: Experience the research in the field of microbiology
CO 3: Designing the project to overcome the environmental problems
CO 4: Determine the experimental solution in future perspective
CO 5: Hypothesise, outcome of the result

Individual Projects are established for all UG students under DBT star scheme to develop their research skills. Project internal is evaluated on the basis of presentation of the project in the review meeting for 20 marks and attendance of 5 marks being computed as like as other papers.

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	1	9	1	3	3	3	23
CO2	3	3	1	3	9	3	9	31
CO3	9	1	3	3	9	9	3	37
CO4	1	3	9	1	1	3	3	21
CO5	3	9	3	1	3	1	1	21
Total	19	17	25	9	25	19	19	133

Low-1 Medium-3 High-9

DISCIPLINE SPECIFIC ELECTIVE III – a. MARINE MICROBIOLOGY

(For Students Admitted from 2024-25)

Semester: VI **Hours / Week: 4**
SubjectCode: IBMBE61A **Credit: 4**

Course Objectives:

1. To understand the different marine microorganisms found in seawater and their metabolic diversity, detection.
2. To emphasis the associations between microorganisms and other organisms, in beneficial and harmful aspects.

Unit I **(12 hours)**

Introduction to marine environment – Marine microbial habitats (estuaries, salt marshes, coastal ecosystems, coral reefs, water column, sediments); Marine Flora and Fauna – Phytoplankton and Zooplankton, sea grasses - their characteristics features; Types of marine microbes and their morphology –Bacteria, Fungi, Algae, Protozoa and marine Extremophiles.

Unit II **(12 hours)**

Microbial assessment–Methods of studying the marine microorganisms – collection, isolation, culture & identification based on morphological, physiological, biochemical characteristics and metagenomics; Preservation of marine microbes; Culture collection Centres (MTCC, ATCC, IMTECH, UTEX); Microbial nutrition – influence of environment factors on microbial growth, activity and distribution

Unit III **(12 hours)**

Role of Microbes in Marine Environment – Microbial nitrogen fixation; Carbon, nitrogen and phosphorus cycle; Decomposition of organic matter; role of Hyperthermophilic and barophilic microorganism, Bioleaching and Biodeteroriation of natural and synthetic materials

Unit IV **(12 hours)**

Seaweeds, Mangroves and their importance – Seaweeds; types – green, red, brown algae; Economical importance of seaweeds, seaweeds as a source of polysaccharides, seaweeds for removal of heavy metals; Mangroves – Characteristics, types and economical importance of mangroves, Kelps.

Unit V **(12 hours)**

Microbial Interaction – Seafood microbiology; normal genera associated with fish, food spoilage, fish & human pathogens; Indicator of pollution – faecal coliforms; Prevention & control

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Explain the marine microbes and observe on major forms of life in the marine environment

CO 2: Identify and classify the marine Microbes

CO 3: Analyse the preservation methods of marine microbes

CO4: Elucidate the microbial resources and its role in different biogeochemical cycles

CO 5: Discuss the economic importance of marine sources

Text Books:

1. Munn C., *Marine Microbiology: Ecology and Applications***,** Garland Science, New York, Second Edition, 2011.
2. Colin munn , *Marine microbiology* : ecology and applications, , 2015
3. Didier Montet and Ramesh C. Ray, *Aquaculture Microbiology and Biotechnology,* Volume Two, Science Publishers, 1st Edition, 2011.

Reference Books:

1. George Karleskint, Richard Turner, and James Small, *Introduction to Marine Biology*, Brooks Cole Publishers, 4th Edition, 2013.

2. Peter Castro; Michael E Huber; William C Ober; Claire E Ober, *Marine biology,* Publisher: New York (N.Y) : McGraw-Hill Education, 11th Edition, 2019.
3. Se-Kwon Kim, *Marine microbiology : bioactive compounds and biotechnological applications,* Publisher:Weinheim an der Bergstrasse, Germany : Wiley -VCH,, 4 th Edition,2013.

Journals:

1. Microbes in the Marine Environment – Research Gate
2. Frontiers in marine science
3. Environmental microbiology

E -Reference

1. https://www.researchgate.net › ...PDF
2. https://onlinelibrary.wiley.com/doi/abs/10.1002/9780470054581
3. https://www.researchgate.net/publication/265413799
4. https://www.britannica.com/science/seaweed
5. https://www.britannica.com/plant/mangrove

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	1	3	9	3	1	9	29
CO2	1	1	3	3	9	1	3	21
CO3	3	3	9	1	1	3	3	23
CO4	1	9	9	3	1	1	3	27
CO5	3	1	3	1	3	3	1	15
Total	11	15	27	17	17	9	19	115

Low-1 Medium-3 High-9

DISCIPLINE SPECIFIC ELECTIVE III – b. PUBLIC HEALTH AND HYGIENE

(For Students Admitted from 2024-25)

Semester: VI **Hours /Week: 4**
SubjectCode:IBMBE6B **Credit: 4**

Course Objectives:

1. To understand issues related to the present day healthcare system, management and human resources
2. To understand the planning, organization and legal considerations related to human diseases

Unit I **(12 hours)**

Personal Health – WHO definition of health – Personal hygiene, Cleanliness, habits, balanced diet; Life style and health, exercise, fitness practice; Yoga - aim, asanas, disease concept, basics about meditation for holistic health.

Unit II **(12 hours)**

Pollution and Health – Effects of air pollutants and health of man – Acid rain, automobile and industrial pollution: effect of oxides of carbon, sulphur and nitrogen. Water pollution and Soil Pollution – Effect of fertilizers, Pesticides, and Heavy metals on human health; Eutrophication; Sewage – disposal and treatment; Solid wastes management and Composting.

Unit III **(12 hours)**

Environment and disease –Water and air borne disease – Tuberculosis and respiratory infections, skin infections, cholera, Amoebiasis, Helminthiasis – diagnosis, precautions and remedial measures, Vector borne diseases – malaria, dengue, Chikungunya disease related to dietary deficiency – Measures to prevent manifestation of ill health; provision of clean drinking water.

Unit IV **(12 hours)**

Population and health–Population explosion – Urbanization and its impacts – occupational health hazards – Food contamination and additives – Measures to prevent manifestation of ill health; provision to provide clean drinking water, demerits of pesticides application of biopesticides and biofertilizers, proper diet with supplementation – Impact of junk food on human health and its manifestations.

Unit V **(12 hours)**

Health services and policies – Understanding, need and goals for various policies related to public health and organization – Health policy, nutritional policy, women policy, child policy; Union Ministry of Health and Family Welfare – objectives, schemes, implementation.

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Explain the hygiene and outline the attain knowledge in personal health

CO 2: Reveal the environmental condition in human health

CO 3: Impact of public hygiene in environmental pollution

CO 4: Interpret the issues related to environment affecting health and sustainable development

CO 5: Sympathize the public action against healthy environment

Text Books:

1. Ronald Bayer, *Public Health Ethics: Theory, Policy and Practice,* Oxford University Press, USA, 2008.
2. Katherine Smith, *Beyond evidence based policy in public health : the interplay of ideas,* Publisher: Basingstoke : Palgrave Macmillan, 2013.

Reference Books:

1. I Leslie Rubin; Joav Merrick, *Public Health*, Publisher: Hauppauge : Nova Science Publishers, 4th Edition, 2017.
2. Colleen M Flood; Wendy Litner; Stephen T Goudge; Heather MacIvor; Joanna Harrington, *Public health*, Publisher: Toronto, Ontario : LexisNexis, 1st Edition, 2019.
3. Thomas E Dorner, *Public Health*, Publisher: [Wien] facultas, 4th Edition, 2016.

Journals:

1. Publications of World Health Organization on Health and Diseases.
2. Journal of public health management and practice
3. Journal of healthcare and hygine

E -Resources:

1. http://www.careersinpublichealth.net/careers/public-health-microbiologist
2. https://ftp.iza.org/dp4340.pdf
3. https://www.researchgate.net/publication/47520014
4. https://www.mooc-list.com/tags/vaccines
5. https://www.mooc-list.com/course/vaccines-coursera

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	1	1	9	1	27
CO2	3	9	1	3	3	1	9	29
CO3	1	3	9	1	9	3	1	27
CO4	3	1	3	1	3	9	3	23
CO5	1	1	3	3	9	3	1	21
Total	17	17	19	9	25	25	15	127

Low-1 Medium-3 High-9

SKILL ENHANCEMENT COURSE VI – LAB COURSE IN MUSHROOM CULTIVATION

(For Students Admitted From 2024-25)

Semester: VI **Hours / Week: 2**
Subject Code:IBMBS641P **Credit: 2**

Course Objectives:

1. To acquire skills for engaging themselves in self-employment especially in the broad field of Mushroom Culture.
2. To understand the importance of mushroom cultivation and food preparation methods.

List of Experiments:

1. Key to differentiate edible and poisonous mushrooms
2. Preparation of nucleus culture, Mother spawn production and multiplication of spawn
3. Cultivation techniques of Oyster Mushroom
4. Cultivation techniques of Milky Mushroom
5. Cultivation of Button Mushrooms and Post-harvest techniques
6. Harvesting and post-harvest handling techniques
7. Constraints in production: adverse environmental factors, Pests and pathogens
8. Principles of marketing and marketing potentials
9. Industrial cum study tour to mushroom cultivation farms

Course Outcomes:

Mushroom cultivation lab facets the hands-on training for students to

CO 1: Define the mushroom culture and classify the basic types of mushroom and its} economic importance
CO 2: Apply on various mushroom cultivation techniques
CO 3: Examine an own unit of mushroom cultivation method
CO 4: Decide the candidates to go for self–employment
CO 5: Make up the handling techniques in mushroom form

Text Books:

1. Suman, B.C. and Sharma V.P., *Mushroom cultivation in India,* Eastern Book Corporation, 2021
2. Dr. C. D. Thapa, Dr. V. Prakasam, Sh. Mohinder Singh, *Mushroom Culture Horticulture ICAR*, November 10, 2016

Reference Books:

1. Stephen Russel, *The Essential Guide to Cultivating Mushrooms: Simple and Advanced Techniques for Growing Shiitake, Oyster, Lion's Mane, and Maitake Mushrooms at Home*, Storey Publishing, 2014
2. R C Ram, *Mushrooms and their Cultivation Techniques*, Publisher: Jaipur, Raj., India : Aavishkar Publishers, Distributors, 1st Edition, 2017.
3. Willoughby Arevalo; Carmen Elisabeth, *DIY Mushroom Cultivation : Growing Mushrooms at Home for Food, Medicine, and Soil*, Publisher: Gabriola Island, BC, Canada : New Society Publishers, 1st Edition, 2019.

Journals:

1. Journal of Science & Technology
2. International Journal of Advanced Research
3. Journal of king saud university - science

E - Resources:

1. https://nios.ac.in/online-course-material/vocational-courses/certificate-in-mushroom-production-revised-(618).aspx
2. https://agritech.tnau.ac.in/farm_enterprises/Farm%20enterprises_%20Mushroom.html
3. https://agritech.tnau.ac.in/farm_enterprises/Farm%20enterprises_%20Mushroom_Milky Milky.html
4. https://www.iihr.res.in/cultivation-technology-milky-mushroom
5. https://www.iihr.res.in/cultivation-technology-reishi-mushroom

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	1	1	3	9	1	3	21
CO2	1	9	1	9	3	3	1	27
CO3	9	3	3	1	1	3	9	29
CO4	3	9	3	3	1	1	3	23
CO5	3	9	9	1	3	1	1	27
Total	19	31	17	17	17	9	17	127

Low-1 Medium-3 High-9

OPEN ELECTIVE COURSES OFFERED FOR THE STUDENTS OTHER THAN BSc MICROBIOLOGY

Semester	Elective	Subject code	Subject title	Hours/ Week	Credit	CIA	ESE	Total
III	Open Elective Course I	IBOE3MB1P	Lab Course In Mushroom Cultivation	2	2	-	50	50
IV	Open Elective Course II	IBOE4MB1P	Lab Course In Vermiculture	2	2	-	50	50

OPEN ELECTIVE COURSE I: LAB COURSE IN MUSHROOM CULTIVATION

(For Students Admitted from 2024-25**)**

Semester: III **Hours/ Week: 2**
Subject Code: IBOE3MB1P **Credit: 2**

Course Objectives:

1. To make the students aware of basic concepts in morphology, taxonomy, anatomy of mushroom.
2. To engage students in self-employment through mushroom cultivation.

List of Experiments:

1. Introduction & types of mushroom
2. Key to differentiate edible and poisonous mushrooms
3. Nutritional values & global status of mushroom
4. Preparation of nucleus culture, Mother spawn production and multiplication of spawn
5. Cultivation techniques of selected mushroom species (oyster / milky)
6. Cultivation of Button Mushrooms and Post-harvest techniques
7. Harvesting and post-harvest handling techniques
8. Constraints in production – adverse environmental factors, pests and pathogens
9. Industrial cum study tour to mushroom cultivation farms
10. Preparation of food products of mushroom – Mushroom pickle, biriyani
11. Principles of marketing and marketing potentials

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Define the mushroom and classify the basic types of mushroom and its economic importance

CO 2: Expertise in various mushroom cultivation techniques

CO 3: Setup an own unit of mushroom cultivation firm

CO 4: Intend the candidates to go for self–employment

CO 5: Planning of new cultivation methods for better mushroom growth

Text Books:

1. Dr. C. D. Thapa, Dr. V. Prakasam, Sh. Mohinder Singh, *Mushroom Culture*, Horticulture ICAR, November 10, 2016.
2. Stephen Russel, *The Essential Guide to Cultivating Mushrooms: Simple and Advanced Techniques for Growing Shiitake, Oyster, Lion's Mane, and Maitake Mushrooms at Home*, Storey Publishing, 2014

Reference Books:

1. Suman, B.C. and Sharma V.P., *Mushroom cultivation in India*, Eastern Book Corporation, 2021.
2. R C Ram, *Mushrooms and their cultivation techniques*, Publisher: Jaipur, Raj., India : Aavishkar Publishers, Distributors, 1st Edition, 2017.
3. Willoughby Arevalo; Carmen Elisabeth, *DIY mushroom cultivation : growing mushrooms at home for food, medicine, and soil*, Publisher: Gabriola Island, BC, Canada : New Society Publishers, 1st Edition, 2019.

Journals:

1. International Journal of Advanced Research
2. Advances in Agriculture
3. International journal of agronomy

E Resources:

1. https://nios.ac.in/online-course-material/vocational-courses/certificate-in-mushroom-production-revised-(618).aspx
2. https://www.iihr.res.in/cultivation-technology-milky-mushroom
3. https://www.iihr.res.in/cultivation-technology-reishi-mushroom
4. https://agricoop.nic.in/sites/default/files/ICAR_8.pdf
5. https://www.researchgate.net/publication/339616804

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	1	3	3	9	1	1	3	21
CO2	3	9	1	1	3	3	3	23
CO3	3	3	9	3	1	1	9	29
CO4	1	1	9	3	1	3	1	19
CO5	9	3	3	1	3	9	1	29
Total	17	19	25	17	9	17	17	121

Low-1 Medium-3 High-9

OPEN ELECTIVE COURSE II – LAB COURSE IN VERMICULTURE

(For Students Admitted from 2024-25)

Semester: IV **Hours / Week: 2**
Subject Code:IBOE4MB1P **Credit: 2**

Course Objectives:

1. To understand the core concepts of vermiculture and vermicomposting and then involved in the entrepreneurship to promote agriculture.
2. To apply vermiculture in vermicomposting, soil fertility, and bioremediation

processes.

List of Experiments:

1. Introduction to vermiculture
2. Earthworms and types (ecological strategies)
3. Collection of local Earthworm sample
4. Compost using endemic & exotic varieties of earthworms
5. Compost using Paper, Cardboard and Vegetable wastes
6. Aerobic & Anaerobic composting
7. Preparations of Vermiwash
8. Life cycle of earthworms and related issues
9. Effect of Vermicompost and vermiwash in the growth of *Trigonella foenum - graecum* (Fenugreek) seeds
10. Field trip to Vermicomposting site

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Identify the earthworms and classify the local earthworms composting and their collection

CO 2: Apply the vermiwash and vermicompost in fields and utilize the wastes and paper as substrates

CO 3: Discuss the methods involved in the preparation of vermiwash

CO 4: Explore the knowledge on Vermicomposting and gain entrepreneur ideas through field trip

CO 5: Formulate to cultivate an vermiculture

Text Books:

1. Clive A. Edwards Norman Q. Arancon Rhonda Sherman, *Vermiculture Technology Earthworms, Organic Wastes, and Environmental Management,* CRC Press, 2011.
2. Mukesh K Meghvansi; Ajit Varma, Biology of Composts, Publisher: Cham Springer International Publishing, 2020.

Reference Books:

1. Katheem K.S, Mahamad H.I, Shlrene Quaik, Sultan Ahmed Ismail., *Prospects of Organic Waste Management and the Significance of Earthworms,* Springer international publishing Switzerland, 2016
2. Sultan Ahmed Ismail, *The Earthworm Book***,** Edition 2, reprint, Other India Press, 2005.
3. Katheem Kiyasudeen S; Mahamad Hakimi Ibrahim; Shlrene Quaik; Sultan Ahmed Ismail, *Prospects of Organic Waste Management and the Significance of Earthworms,* Publisher: Springer International Publishing : Imprint : Springer, 2016.

Journals:

1. Turkish journal of agriculture – food science and technology
2. Advances in Agriculture
3. International journal of agronomy

E -Resources:

1. http://www.macollege.in/app/webroot/uploads/department_materials/doc_224.pdf
2. https://agricoop.nic.in/sites/default/files/Vermicompost%20Production%20Unit.pdf

3. Learning/Moocs/Solid_Waste/W4/Manual_On_Farm_Vermicomposting_Vermiculture.pdf
4. https://nptel.ac.in/courses/126/105/126105014/
5. https://api.taylorfrancis.com/content/books/mono/download?identifierName=doi&identifierValue=10.1201/b10453&type=googlepdf

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	1	3	9	1	3	1	21
CO2	3	1	9	3	3	9	3	31
CO3	1	3	3	9	3	1	1	21
CO4	9	1	3	1	9	3	1	27
CO5	1	3	9	3	9	1	9	35
Total	17	9	27	25	25	17	15	135

Low-1 Medium-3 High-9

EXTRA CREDIT – LIFE SCIENCE FOR COMPETITIVE EXAMINATIONS

(For Students Admitted From 2024-25)

Semester: VI **Hours / Week: -**
Subject Code:IBMBX6 **Credit: 2**

Course Objectives:

1. To acquire an overall knowledge on the morphology and functions of the structures with the prokaryotes and eukaryotes.
2. To make the students knowledgeable on the various techniques involved. To give an overview on microbial ecology-microbial habitats, their interactions and plant-microbe relationship

Unit I

Prokaryotic and Eukaryotic cells – Structure and Ultrastructure, Structure and function of organelles – Chloroplast, Mitochondria, Vacuoles, Endoplasmic Reticulum, Golgi Apparatus, Ribosomes & Lysosomes, Nucleus, Nucleolus, Chromatin and Nucleosome. Mitosis and Meiosis

Unit II

Structure and synthesis of DNA – Structure of mRNA, t-RNA & r-RNA; Structure of proteins - Primary, Secondary, Tertiary and Quaternary; General properties of Enzymes and Amino acids

Unit III

Concept of heredity and variation – Mendel's law of inheritance, monohybrid cross, dihybrid cross, test cross – chromosomal basis of inheritance, incomplete dominance, epistasis, mutation- types

Unit IV

Ecosystem – Concept, structure, function, producers, consumers and decomposers of ecosystem, energy flow, food web and food chain, ecological pyramids; Types of ecosystem. Pollution: air, water and land. Global warming.

Unit V

Definition and scope of biotechnology – Restriction enzymes, plasmid – types, Cloning vectors pBR322, methods of gene transfer. Application of genetic engineering in the field of agriculture (herbicide and pest resistance plants) & medicine (production of recombinant vaccines)

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Define the microbes and list the microbe's cell organelles
CO 2: Make use of the genetic material
CO 3: Appreciate the overall concept of heredity
CO 4: Report the genetic material
CO 5: Create a genetic modify application for Biotechnology

Text Books:

1. Dubey, R.C. and Maheswari, D.K. *A Textbook of Microbiology*, S.Chand and Company Ltd., New Delhi, 2013.
2. Ananthanarayan. R. and Paniker C.K. *Text Book of Microbiology*, Orient Longman, 11th Edition, 2020.

Reference Books:

1. Pelczar, Chan & Kreig, *Microbiology,* Tata McGraw Hill, New Delhi., 5th Edition, 2012.
2. Willey, Joanne M. *Prescott's Microbiology,* McGraw-Hill Education 10th Edition, 2017.
3. Kumaraswamy. K., *Environmental Studies,* UGC syllabus, Periyar EVR College, Tiruchirappalli, 2013.

Journals:

1. Journal of biological chemistry
2. Journal of the American chemical society
3. Cold spring harbor perspectives in biology

E -Resources:

1. https://nios.ac.in/media/documents/srsec314newE/PDFBIO.EL29.pdf
2. https://ncert.nic.in/textbook/pdf/lebo112.pdf
3. https://nptel.ac.in/courses/102/103/102103015/#
4. https://nptel.ac.in/courses/102/103/102103013/
5. http://www.cmsc.ac.in/zoo8.pdf

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	1	3	1	3	9	9	29
CO2	9	3	1	3	3	9	3	31
CO3	3	1	3	1	9	3	9	29
CO4	1	3	1	9	3	3	3	23
CO5	3	9	3	3	1	1	3	23
Total	19	17	11	17	19	25	27	135

Low-1 Medium-3 High-9

GENERAL INTEREST COURSE I – ENVIRONMENTAL SCIENCE

(For Students Admitted from 2024-25**)**

Semester: II **Hours / week: 2**
Subject Code: IBES2 **Credits: 2**

Course Objectives:

1. To become familiar with current research in environmental science.
2. To learn the basic principles of ecosystems, marine diversity and environmental pollution & its prevention.

Unit I **(6 hours)**

The concept of Environmental studies – Introduction, Definition, Scope and importance Natural Resources **–** Forest, Marine, Water and Land Resources, Food resources; changes caused by agriculture and overgrazing; effects of fertilizer and pesticide Energy resources **–** use of alternate energy resources; Role of individual in conservation of natural resources. On ground activity: Plant and maintain a sapling

Unit II **(6 hours)**

Ecosystems – Concept **–** Structure and function of an ecosystem, producers, consumers and decomposers, Energy flow; food chains; food webs and ecological pyramids.

Unit III **(6 hours)**

Land and Marine Biodiversity and its conservation - Introduction**,** Definition, biodiversity- Land and marine, threats to biodiversity: habitat loss, poaching of wildlife, endangered and endemic species of India, In- situ and Ex- situ conservation of biodiversity, Wildlife Protection Act, Forest Conservation Act
Field trip: Gulf of Mannar National Park

Unit IV **(6 hours)**

Environmental Pollution and its prevention – Definition, causes, effects and control measures of air, water, soil pollution. Climate change, global warming, acid rain, ozone layer depletion. Environment protection act **–** Air and Water (Prevention and Control of Pollution) Act, Solid waste management On ground activity: Coastal clean up

Unit V **(6 hours)**

Role of research institutes in sustainable livelihood – population growth; variation among nations; population explosion; Family welfare programme Role of CMFRI, CSMCRI, ICAR, KVK in development of sustainable food resources

Course Outcomes:

After successful the completion of the course, the students will be able to
CO1: Define environmental studies and list the concept of Environmental studies
CO2: Apply on natural ecosystem
CO3: Analyze the role of research institutes in sustainable livelihood
CO4: Evaluate the control measures of air, water and soil pollution
CO5: Construct the concept, structure and ecological pyramids of ecosystem

Text Books:

1. Erach Bharucha, *Environmental studies for undergraduate courses,* University Grant commission, New Delhi, 2021

2. Kumaraswamy K., *Environmental Studies,* Jazym Publications, 2013.

References Books:

1. Arumugam N. and Kumaresan B., *Environmental Studies*, Saras publications, 2012.
2. Dr. Biswarup Mukherjee., *Fundamentals of Environmental Biology,* Silver line Publications, 2008
3. Dr. D. K. Asthana & Dr. Meera Asthana, *A Text Book of Environmental Studies*, S Chand & Co Ltd, Revise Edition, 2006.

Journals:

1. Journal of Environmental Studies and Sciences
2. Journal of environmental sciences
3. Nature climate change

E- Resources:

1. https://nptel.ac.in/courses/127/105/127105018/
2. https://nios.ac.in/online-course-material/sr-secondary-courses/enviornmental-science-(333).aspx
3. https://rajneeshrajoria.weebly.com/uploads/4/9/0/6/49069889/environmental_science_birm301.pdf
4. https://nios.ac.in/media/documents/srsec314newE/PDFBIO.EL24.pdf
5. https://nios.ac.in/media/documents/srsec314newE/PDFBIO.EL25.pdf

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	1	1	3	9	9137	3	29
CO2	1	3	3	9	1	3	9	29
CO3	3	1	9	3	9	1	3	29
CO4	3	1	3	9	1	3	1	21
CO5	1	9	3	1	3	1	3	21
Total	11	15	19	25	23	17	19	129

Low-1 Medium-3 High-9

VALUE ADDED PROGRAMME
(For Students Admitted from June 2023-24)
PROGRAMME STRUCTURE

S.No.	Programme Name	Subject code	Title	Total Contact hours	Credits	ESE
1.	Value Added Programme in Biofertilizers Production	**GCBF21P**	Lab Course in Biofertilizers Production	**50**	**5**	**100**
2.	Value Added Programme in Aquaculture	**ICAQ21P**	Lab Course in Aquaculture	**50**	**5**	**100**
3.	Value Added Programme in Medicinal and Edible Mushroom Cultivation	**ICMC21P**	Lab Course in Medicinal and Edible Mushroom Cultivation	**50**	**5**	**100**
4.	Value Added Programme in Medical Laboratory Technology	**ICML2P**	Lab Course in Medical Laboratory Technology	**50**	**5**	**100**

PREAMBLE

- **Value Added Programme in Biofertilizers Production-** paper I (Microbes in fertilizer and biomanure application) is removed; only lab paper - Lab course in Biofertilizer production is sustained
- **Value Added Programme in Aquaculture** - paper I (Aquaculture) theory paper is removed; only lab paper (Lab course in ornamental fish Culture)is sustained
- **Value Added Programme in Medicinal and Edible Mushroom Cultivation**, paper I (Edible and medicinal mushroom cultivation) is removed; only lab paper (Lab Course in Mushroom Cultivation) is sustained.
- **Value Added Programme in Medical Laboratory Technology**, Paper I theory, (Fundamentals of Medical Lab Technology), is removed only lab paper, (Lab course in Medical Lab Technology), is sustained.
- Total contact hours are changed from 30+50 to 50 and credits 5 are added with ESE mark 100.
- These changes over value added programme can be included in I Series revised syllabus (2023-24).

VALUE ADDED PROGRAMME IN BIOFERTILIZERS PRODUCTION
Department of Microbiology

LAB COURSE IN BIOFERTILIZERS PRODUCTION
(For Students Admitted from 2023-24**)**

Subject Code:GCBF21P **Total Hours: 50**
Course Objectives: **Credit: 5**

1. To know the importance of biofertilizers and biopesticides
2. To make the students know about various techniques involved in biofertilizers

List of Experiments:

1. Laboratory rules and safety measures
2. Equipments needed for Biofertilizer Production
3. Sterilization techniques
4. Media preparation, plating, streaking and staining techniques
5. Observation of cross section of root nodules
6. Isolation of *Rhizobium*
7. Isolation of *Phosphobacteria*
8. Isolation of *Azospirillum*
9. Isolation of *Spirullina* / *Blue Green Algae*
10. Isolation of *Azolla*
11. Isolation of *VAM*
12. Mass production of *Rhizobium, Azolla - Blue Green Algae*
13. Preparation of carrier material
14. Preparation of Inoculum
15. Storage of biofertilizers
16. Principles of marketing and marketing potentials

Text books:

1. Mahendra Rai., *Handbook of Microbial Biofertilizer*, First Edition, 2006.
2. Natarajan Amaresan; Prittesh Patel; Dhruti Amin, *Practical Handbook on Agricultural Microbiology*, Publisher: New York, NY : Springer US : Imprint: Humana, 1st Edition, 2022.

Reference Books:

1. Aneja K.R., *Experiments in Microbiology, Plant Pathology and Biotechnology,* Revised Fourth edition, New Age International Publishers, 2007.
2. Kannan N., *Laboratory Manual in General Microbiology,* Panima Publishers, 2002.
3. Bibhuti Bhusan Mishra; Suraja Kumar Nayak; Swati Mohapatra; Deviprasad Samantaray**,** *Environmental and agricultural microbiology : applications for sustainability,* Publisher: Hoboken, NJ : John Wiley & Sons ; Beverly, MA : Scivener Publishing, 1st Edition, 2021.

Journals:

1. Journal of Food and Environment
2. Journal of Food Measurement and Characterization
3. Journal of Food and Dairy Technology

E- Resources:

1. https://www.kstate.edu/fungi/Greeting/Publications_files/2006%20Handbook. pdf
2. https://www.researchgate.net/publication/323185331_Role_of_Biofertilizers_in_Agriculture
3. http://www.hillagric.ac.in/edu/coa/agronomy/lect/agron-3610/Lecture-12-BINM-Biofertilizers.pdf
4. https://www.fnca.mext.go.jp/bf/bfm/pdf/Biofertilizer_Manual.pdf
5. http://www.vedamsbooks.com/no48706/handbook-organic-farming-biofertilizers-ac-gaur

VALUE ADDED PROGRAMME IN AQUACULTURE
Department of Microbiology

LAB COURSE IN AQUACULTURE
(For Students Admitted from 2023-24**)**

Subject Code: ICAQ21P **Total Hours: 50**
Credit: 5

Course Objectives:

1. To impart basic practical skills in different aspects of biology.
2. To gain knowledge on theory and practice on Aquatic Microbiology.

List of Experiments:

1. Visit to marine ornamental fish aquarium and hatchery unit
2. Describing nutritional requirements of fish and common aquarium fishes
3. Setting up of aquarium
4. Fish feeds – live (Artemia, Rotifer and copepods) and artificial feeds (Pellet food)
5. Breeding of live breeding fish and egg layers – Zebra fish, Guppies fish, Mollies fish and Betta Splenders (Bubble nest)
6. Breeding of Marine ornamental fish culture – Clown fish
7. Water quality analysis and management in aquarium
8. Visit to coastal area aquaculture, seaweed cultivation (Integrated fish farming)

Text Books:

1. Brian Andrews, *Ornamental Fish Farming: Miscellaneous Fish Farming Techniques,* Book Baby, 2013.
2. Pillay T. V. R., Kutty M. N., *Aquaculture: Principles and Practices,* Wiley, 2005.

Reference Books:

1. Hertrampf J.W., Piedad-Pascual F., *Handbook on Ingredients for Aquaculture Feeds,* Springer Science & Business Media, 2003.
2. Claude E. Boyd, Tucker C.S., *Pond Aquaculture Water Quality Management,* Springer Science & Business Media, 2012.
3. S. Vinodh, M. Kannan, P. Ranchana, *Practical manual on fish Nutrition and Feed Technology,* 2017.

Journals:

1. Journal of fisheries & livestock production
2. Journal of fisheries sciences

3. Journal of applied aquaculture

E -Resources:

1. 1.https://nfdb.gov.in/PDF/Fish%20&%20Fisheries%20of%20India/3.
2. http://oms.bdu.ac.in/ec/admin/contents
3. https://books.google.com/books
4. https://www.foxmetro.org
5. https://core.ac.uk/download/pdf/10864244.pdf

VALUE ADDED PROGRAMME IN MEDICINAL AND EDIBLE MUSHROOM CULTIVATION

Department of Microbiology

LAB COURSE IN MEDICINAL AND EDIBLE MUSHROOM CULTIVATION

(For Students Admitted From 2023-24)

Subject Code: ICMC21P **Total Hours: 50**

Credits:5

Course Objectives:

1. To make the students more knowledge on mushroom cultivation
2. To motivate students to prepare value added food products and marketing strategies.

List of Experiments:

1. Key to differentiate edible and poisonous mushrooms
2. Nutritional values & global status of mushroom
3. Preparation of nucleus culture
4. Mother spawn production and multiplication of spawn
5. Cultivation techniques of Oyster mushroom
6. Cultivation techniques of Milky mushroom
7. Cultivation techniques of Reishi mushroom
8. Harvesting and post-harvest handling techniques
9. Constraints in production – adverse environmental factors, pests and pathogens
10. Industrial cum study tour to mushroom cultivation farms
11. Preparation of value-added food products from mushroom
12. Principles of marketing and marketing potentials

Text Books:

1. Shu–ting, Chang and Philip.G Miles, *Mushrooms: Cultivation, Nutritional value, Medicinal Effect and Environmental Impact,* CRC press, Washington, 2004.
2. EIRI, *Handbook of Mushroom Cultivation, Processing and Packaging,* Engineers India Research Institute, 2016.

Reference Books:

1. Suman,B.C. and Sharma V.P., *Mushroom cultivation in India,* Eastern Book Corporation, 2021.
2. Suman B.C. and Sharma V.P., *Mushroom Cultivation, Processing and Uses,* Agrobios. 2011.
3. Pathak Yadav Gour, *Mushroom Production and Processing Technology,* Agrobios, India, 2010.

Journals:

1. Journal of fungi
2. The International Journal of Medicinal Mushrooms
3. Journal of fungal biology

E-Resources:

1. https://agricoop.nic.in/sites/default/files/ICAR_8.pdf
2. https://agrimoon.com/mushroom-culture-horticulture-icar-pdf-book/
3. https://www.researchgate.net/publication/330599403
4. https://books.google.co.in/books?id=CGH9DwAAQBAJ&lpg=PP12&ots=HEnbD7OL4r&dq=mushroom
5. https://books.google.co.in/books?id=6AJx99OGTKEC&lpg

VALUE ADDED PROGRAMME IN MEDICAL LABORATORY TECHNOLOGY

Department of Microbiology

LAB COURSE IN MEDICAL LABORATORY TECHNOLOGY

(For Students Admitted from 2023-24)

Subject Code: ICML2P **Total Hours : 50**

Credit: 5

Course Objectives:

1. To develop students understanding of medical microbiology with hands on experience in the isolation of the bacteria from different sources
2. To establish the knowledge about microbial pathogenicity, biofilm formation and their antibiotics resistance pattern.

List of Experiments:

1. Medical Laboratory Technician Code – personal safety measures – Care in the Laboratory
2. Common Causes of Accidents in laboratory
3. Blood Sample collection, Separation and Transportation
4. Blood grouping– A, B, O, AB, H
5. Bleeding Time and Clotting Time
6. Total WBC and Total RBC
7. Differential Cell count
8. Estimation of Hemoglobin
9. Estimation of Blood Sugar, Urine Sugar, Urine Albumin and Deposits
10. Estimation of Bile Salt and Bile pigment (BSBP)
11. Erythrocytes Sedimentation Rate (E.S.R)
12. Agglutination test (ASO, CRP, RF)
13. Widal slide agglutination and tube dilution
14. Thyroid Profile - ELISA
15. Microscopic Examination of Sputum for Acid Fast Staining
16. Microscopic Examination of Malarial Parasites (Pf & Pv)
17. Microscopic Examination of Stool for Ova and Cyst
18. Rapid Lab Diagnosis: Blood - HIV, HBAgs,HCV
19. Urine - Urine Pregnancy Test (UPT)
20. Biomedical Waste Management

21. Field visit of Hospital

Course Outcomes:

After successful completion of the course, students will be able to

CO 1: Discuss the basics of clinical laboratory and highlight the importance about various techniques

CO 2: Explain and justify the common accidents and their causes in the laboratory

CO 3: Group the students and find their blood groups by their own

CO 4: Recommend various diagnostic methods to find the basic blood analytics

CO 5: Develop lab for Rapid Lab Diagnosis methods like ELISA HIV, HBAgs,HCV

Text Books:

1. Sant M. *Textbook of medical Laboratory Technology*. CBS Publishers & Distributors Pvt Ltd, 2020.

2. Robert Bailey W, Patricia M Tile, *Bailey & Scott's diagnostic microbiology*, St. Louis Elsevier. 14th Edition, 2017.

Reference Books:

1. Patrick R Murray, Ken S Rosenthal, Michael A Pfaller, *Medical Microbiology*, Edinburgh: Elsevier, 2021.

2. Daniel Amsterdam, *Antibiotics in Laboratory Medicine.* Philadelphia: Wolters Kluwer. 6th Edition, 2015

3. Ranjan Kumar De, *Diagnostic Microbiology, (For DMLT Students),* Jaypee Brothers publishing, New Delhi, 2007.

Journals:

1. Biomedical and Pharmacology Journal
2. Indian Journal of Community Medicine
3. Archives of Pathology and Laboratory Medicine

E Resources:

1. https://www.digimat.in/nptel/courses/medical/pathology/PA11.html
2. https://nios.ac.in/online-course-material/vocational-courses/dmlt.aspx
3. https://ndma.gov.in/index.php/Resources/awareness/hospital-safety
5. http://applyonline.itmuniversity.org/Images/biochemistry/BSc_MLT.pdf
6. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2760796

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	1	3	3	1	3	3	23
CO2	3	1	1	3	1	9	3	21
CO3	1	3	9	3	3	1	9	29
CO4	3	9	1	9	1	3	3	29
CO5	1	3	3	1	3	9	1	21
Total	17	17	17	19	9	25	19	123

Low-1 Medium-3 High-9