Department of Microbiology and Biotechnology

UNIQUE FEATURES OF SYLLABI

- The students fascinated by Microbiology & Biotechnology 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 & Biotechnology
- 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 these fields, to involve the students in research, industrial, environmental and agricultural area
- 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 their needs of different professional skills such as medical lab technicians, academicians, research, food analyst, quality controller, forensic and agricultural professionals
- These programmes 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 entrepreneurs in the field of Microbiology& Biotechnology
- It is a good base degree course for the purpose of higher research studies. They can avail wide employment opportunities and employability in the field of research and development sectors

DEPARTMENT OF MICROBIOLOGY AND BIOTECHNOLOGY

(For Students Admitted from June 2025-26)

Vision:

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

Mission:

- To enlighten microbiologist & biotechnologist 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

M.Sc., MICROBIOLOGY

(Two Year Regular Programme)

(For Students Admitted from June 2025-26)

Programme Educational Objectives (PEO):

PEO1: Graduates will acquire advanced theoretical and practical knowledge in microbiology and its applied fields.

PEO2: Graduates will develop the ability to design, conduct, and analyze microbiological research independently or in teams.

PEO3: Graduates will be equipped for successful careers in industry, academia, clinical labs, or pursue higher education.

Programme Outcomes (PO):

In completion of post graduate degree programme, the students will be enabled 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

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 technology

PREAMBLE

- Core I - General Microbiology Unit IV The topic Mycorrhizae is included. Unit V more examples of Protozoans were added
- Core II - Biomolecules and Microbial Physiology Unit I: Unbolded the title Proteins
- DSE Ia - Algal Technology Unit I: Included the topic Bacilloriophyta
- Core V - Food Microbiology Unit IV &V : the topics FSSAI , SCP were added
- Core VII - Recombinant DNA Technology Unit I: Thermostable DNA polymerases and their types were included
- Unit V: mRNA vaccines was included in the place of sickle cell anemia. The topic Cancer was changes as HPV
- Core VIII - Lab Course in Environmental, Agricultural Microbiology, Food Microbiology Ex: 7 Viral diseases were included
- DSE II b. - Nanobiotechnology Unit I: Nanostructure dimension 0D and Tangling bone were Included Unit III: Raman Effect was included
- Core IX - Medical Microbiology Unit IV: The order was changed like Cutaneous, Subcutaneous, Systemic and Opportunistic mycoses, also Aspergillosis, Elephantiasis was included
- Core X - Immunology and Immunodiagnostics Unit V: Included the topic “Edible vaccines”
- Core XI - Basics of Research Methodology Unit I: The following topics were included, Copyrights, Salami slicing .Unit II: h index, g index Vidwan database were also included

M.Sc., MICROBIOLOGY
(Two Year Regular Programme)
(For Students Admitted from June 2025-26)

MSc MICROBIOLOGY 2025-26
PROGRAMME STRUCTURE

Semester	Subject code	Course	Subject Title	Hours / Week	Credit	@ SD | ENT | EMP	$ REG | NAT | GLO	CIA Marks	ESE Marks	Total Marks
I	JMMBC11	Core I	General Microbiology	6	5	SD | ENT || EMP	**REG | NAT | GLO**	25	75	100
	JMMBC12	Core II	Biomolecules and Microbial Physiology	6	5	SD | ENT || EMP	**REG | NAT | GLO**	25	75	100
	JMMBC13	Core III	Molecular Biology and Microbial Genetics	6	6	SD | ENT || EMP	**REG | NAT | GLO**	25	75	100
	JMMBC14P	Core IV (Practical)	Lab course in General Microbiology, Biomolecules and Microbial Physiology, Molecular Biology and Microbial Genetics	6	4	SD | ENT || EMP	**REG | NAT | GLO**	25	75	100
	JMMBE1A/ JMMBE1B	DSE I	a. Algal Technology/ b. Enzymology	6	5	SD | ENT || EMP	**REG | NAT | GLO**	25	75	100
	JMMBX1/ JMMBX1O	Extra Credit-I	Life Science for Competitive Examination/Online Course*	-	2	SD | ENT | EMP	**REG | NAT | GLO**	-	100	100

	Total			**30**	**25+2**			**125**	**375+100**	**500+100**
	JMMBC21	Core V	Food Microbiology *Integrated courses- Principles of Downstream process in Bioprocess	6	5	SD | ENT | EMP	**REG | NAT | GLO**	25	75	100
II	JMMBC22	Core VI	Environmental and Agricultural Microbiology	6	5	SD | ENT | EMP	**REG | NAT | GLO**	25	75	100
	JMMBC23	Core VII	Recombinant DNA Technology	6	5	SD | ENT | EMP	**REG | NAT | GLO**	25	75	100
	JMMBC24P	Core VIII	Lab Course in Environmental and Agricultural Microbiology, Food	6	5	SD | ENT | EMP	**REG | NAT | GLO**	25	75	100
	JMMBE2A/ JMMBE2B	DSE II	a. Genomics and Proteomics/ b. Nanobiotechnology *Integrated courses- Biomedical Nanotechnology	6	5	SD | ENT | EMP	**REG | NAT | GLO**	25	75	100
	JMMBX2/ JMMBX2O	Extra Credit-II	Biofertilizers Production/Online Course*	-	2	SD | ENT | EMP	**REG | NAT | GLO**	-	100	100
	Total			**30**	**25+2**			**125**	**375 +100**	**500 +100**
III	JMMBC31	Core IX	Medical Microbiology	6	5	SD | ENT | EMP	**REG | NAT | GLO**	25	75	100
	JMMBC32	Core X	Immunology & Immunodiagnostics	6	5	SD | ENT | EMP	**REG | NAT | GLO**	25	75	100

	JMMBC33	Core XI	Basics of Research Methodology	6	5	SD | ENT | EMP	**REG | NAT | GLO**	25	75	100
	JMMBC34P	Core XII	Lab Course in Medical Microbiology, Immunology & Immunodiagnostics	6	5	SD | ENT | EMP	**REG | NAT | GLO**	25	75	100
	JMMBE3A/ JMMBE3B	DSE III	a. Bioethics, Biosafety and IPR/ Bioinformatics	6	5	SD | ENT | EMP	**REG | NAT | GLO**	25	75	100
	JMMBX3/ JMMBX3O	Extra Credit-III	Employability Skills/ Online Course*	-	2	SD | ENT | EMP	**REG | NAT | GLO**	100	-	100
Total				**30**	**25+2**			**125+ 100**	**375**	**500+ 100**
IV	JMMBC41	Core XIII	Entrepreneurship in Microbiology	6	5	SD | ENT | EMP	**REG | NAT | GLO**	25	75	100
	JMMBC42DW	Core XIV	Dissertation	24	10	SD | ENT | EMP	**REG | NAT | GLO**	100	100	200
	JMMBX4/ JMMBX4O	Compulsory Extra Credit-IV	Information Technology for Biologists/ Online Course*		2	SD | ENT | EMP	**REG | NAT | GLO**	-	100	100
Total				**30**	**15+2**	**30**	**15+2**			**125**
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.

CORE I - GENERAL MICROBIOLOGY

(For Students Admitted from 2025-26)

Semester: I **Hours/week: 6**

Subject Code: JMMBC11 **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, Mycorrhizae.

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, Giardia, Plasmodium* – general characteristics

and reproduction.

Unit VI

Questions related to the above units, from various competitive examinations to be solved. (To be discussed during the Skill Development Course hour).

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 2025-26)

Semester: I **Hours/Week: 6**

Subject Code: JMMBC12 **Credit: 5**

Course Objectives:

1. To learn the chemical structure, properties and biological functions of carbohydrates, lipids, proteins and nucleic acids
2. To understand microbial catabolism and anabolism, including energy production and biosynthesis.

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.

Unit VI

Questions related to the above units, from various competitive examinations to be solved. (To be discussed during the Skill Development Course hour).

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 2025-26)

Semester: I **Hours/Week: 6**
Subject Code: JMMBC13 **Credit: 6**

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.

Unit VI
Questions related to the above units, from various competitive examinations to be solved. (To be discussed during the Skill Development Course hour).

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. Bruce Alberts, Alexander D. Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, *Molecular Cell Biology*, W. W. Norton & Company, 6th Edition, 2014.
2. Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Anthony Bretscher, HiddePloegh, Kelsey Martin, Michael Yaffe, Angelika Amon, Angelika, *Molecular Cell Biology*, 9th Edition,W.H. Freeman, USA., 2021.

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 2025-26)

Semester: I **Hours/week: 6**
Subject Code: JMMBC14P **Credit: 4**

Course Objectives:

1. To develop proficiency in basic microbiological laboratory techniques
2. To learn methods of culturing, isolating, and maintaining microbial cultures.

List of Experiments:

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: Understand and apply aseptic techniques for handling microorganisms safely.

CO 2: List out the laboratory safety measures and illustrate the preparation of buffers and molar solution

CO 3: Apply the knowledge of Chromatography and Electrophoretic method in the field of molecular biology

CO4: Perform to test antibiotic sensitivity

CO 5: Validate the biomolecules like protein, amino acid by advanced molecular techniques

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 2025-26)

Semester: I **Hours/Week: 6**
Subject Code: JMMBE1A **Credit: 5**

Course Objectives:
1. To learn about various types of algae and their biological significance.
2. To understand the growth requirements and culture techniques for microalgae and macroalgae.

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, Bacilloriophyta, 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; SCP, 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.

Unit VI

Questions related to the above units, from various competitive examinations to be solved. (To be discussed during the Skill Development Course hour).

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. Dr. A. K. Kushwaha and Dr. M.K.Shukla, *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 2025-26)

Semester: I **Hours/week: 6**
Subject Code: JMMBE1B **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

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.

Unit VI

Questions related to the above units, from various competitive examinations to be solved. (To be discussed during the Skill Development Course hour).

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

Text Books:

1. Palanivelu P., *Enzymes, Ribozymes and DNAzymes,* MKU Coop. Press Ltd., Madurai, Twentyfirst Century Publications, 2nd 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 2025-26)

Semester: I **Hours per Week: -**

Subject Code: JMMBX1 **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, 12th 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, 8th 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%20 Biotechnology%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	9	257

Low-1 Medium-3 High-9

CORE V: FOOD MICROBIOLOGY
(For Students Admitted from 2025-26)

Semester: II **Hours/Week: 6**
Subject Code: JMMBC21 **Credit: 5**

Course Objectives:

1. To understand the role of microorganisms in food production, spoilage, and preservation.
2. To learn and apply national and international food safety standards and guidelines

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), FSSAI, 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.

Unit VI

Questions related to the above units, from various competitive examinations to be solved. (To be discussed during the Skill Development Course hour).

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 2025-26)

Semester: II **Hours/week: 6**
Subject Code: JMMBC22 **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.

Unit VI

Questions related to the above units, from various competitive examinations to be solved. (To be discussed during the Skill Development Course hour).

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: Classify biogeochemical 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, *Prescott's Principles of Microbiology.* Boston: McGraw- Hill, Second Edition, 2020.

Reference Books:

1. John L. Havlin, Samuel L. Tisdale, Werner L. Nelson and James D. Beaton, *Soil Fertility and Fertilizers*, Pearson Education India, New Delhi, India, 8th Edition, 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**		**Total**
CO1	9	9	9	3	1	9	9	49
CO2	9	9	9	9	1	9		55
CO3	9	9	9	9	1	9		55
CO4	9	9	9	9	3	9	9	57
CO5	9	9	9	9	1	9		55
Total	45	45	45	39	7	45		271

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

CORE VII - RECOMBINANT DNA TECHNOLOGY
(For Students Admitted from 2025-26)

Semester: II **Hours/week: 6**
Subject Code: JMMBC23 **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 types, 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, mRNA vaccines & HPV cancer; Clinical trials – Phases in Clinical trials, Bioethics – Ethical issues in clinical trials.

Unit VI

Questions related to the above units, from various competitive examinations to be solved. (To be discussed during the Skill Development Course hour).

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**		**Total**
CO1	9	3	9	9	9	9		57
CO2	9	9	9	9	3	9	9	57
CO3	9	9	9	9	9	9		63
CO4	9	9	9	9	9	9		63
CO5	9	9	9	9	1	9	9	55
Total	45	39	45	45	31	45		295

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

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

(For Students Admitted from 2025-26)

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

Subject Code: JMMBC24P **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:

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 solubilizing bacteria

6. Isolation of *Cyanobacteria*
7. Examination of plant diseases

Bacterial Disease	**Fungal Disease**	**Viral diseases**
Blight of rice	Tikka leaf spot of ground nut	Papaya Ring Spot
Citrus canker,	Blast of rice	Tobacco Mosaic Disease
Brown rot of potato	Red rot of sugarcane	Banana Bunchy Top Disease

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=one page&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		49
CO2	9	9	9	3	3	9		51
CO3	9	9	9	3	1	9		49
CO4	9	9	9	3	3	9		51
CO5	9	9	9	3	1	9		49
Total	45	45	45	15	9	45		249

Low-1 Medium-3 High-9

Discipline Specific Elective II: a. GENOMICS AND PROTEOMICS
(For Students Admitted from 2025-26)

Semester:II **Hours/week: 6**
Subject Code: JMMBE2A **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.

Unit VI

Questions related to the above units, from various competitive examinations to be solved. (To be discussed during the Skill Development Course hour).

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 2025-26)

Semester: II **Hours/week: 6**
Subject Code: JMMBE2B **Credit: 5**

Course Objectives:
1. To understand the synthesis, characterization, and functionalization of nanomaterials.
2. To explore the various applications of nanotechnology.

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.

Unit VI

Questions related to the above units, from various competitive examinations to be solved. (To be discussed during the Skill Development Course hour).

Course Outcomes:

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

CO 1: Define Nanobiotechnology and explain 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.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- BIOFERTILIZERS PRODUCTION

(For Students Admitted from 2025-26)

Semester: II **Hours/week: -**
Subject Code: JMMBX2 **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/978156022705
2. https://www.taylorfrancis.com/books/mono/10.1201/9780367805500/microbesbiofertil izers 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&prints ec=frontcover&q=inpublisher:%22Elsevier+Science%22&tbm=bks&sa=X&ved=2ah UKEwjlkajTusf1AhVKwTgGHTrrDHEQmxMoAHoECBgQAg&sxsrf=AOaemvKPO PTQagJgrujzQt5mtkcOU6nErg: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 2025-26)

Semester: III **Hours/week: 6**
Subject Code: JMMBC31 **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, Taenia.
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.

Unit VI

Questions related to the above units, from various competitive examinations to be solved. (To be discussed during the Skill Development Course hour).

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. Rajan S., *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 2025-26)

Semester: III **Hours/week: 6**
Subject Code: JMMBC32 **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.

Unit VI
Questions related to the above units, from various competitive examinations to be solved. (To be discussed during the Skill Development Course hour).

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**		**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 2025-26)

Semester: III **Hours/week: 6**
Subject Code: JMMBC33 **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.

Unit VI

Questions related to the above units, from various competitive examinations to be solved. (To be discussed during the Skill Development Course hour).

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**		**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 2025-26)

Semester: III **Hours/week: 6**
Subject Code: JMMBC34P **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:

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: 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 and 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 2025-26)

Semester: III **Hours/week: 6**
Subject Code: JMMBE3A **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.

Unit VI

Questions related to the above units, from various competitive examinations to be solved. (To be discussed during the Skill Development Course hour).

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		Total

CO1	9	9	9	9	9	9		63
CO2	9	9	9	9	9	9		63
CO3	9	9	9	3	3	9		51
CO4	9	9	9	1	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 2025-26)

Semester: III **Hours/week: 6**
Subject Code: JMMBE3B **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.

Unit VI

Questions related to the above units, from various competitive examinations to be solved. (To be discussed during the Skill Development Course hour).

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. Cynthia L., Greene, *Entrepreneurship, Ideas in Action*, Hardcover Fifth edition2012.
2. Venkataraman G.S, *Algal Biofertilizers and Rice Cultivation***,** Today and Tomorrow's Printers and Publishers, New Delhi, 1972.

Reference Books:

1. Thompson L. M. and T. Fredrick, *Soils and Soil Fertility*, Tata Mc Graw–Hill Publishing Co, New Delhi, 1979.
2. Rao N.S., *Biofertilizers in Agriculture*, Oxford and IBH Publishing Co. Pvt. Ltd., Bombay, 1980.
3. Rao N.S., G.S. Venkataraman and Kannaiyan, *Biological N2 fixation*, ICAR Publications, New Delhi, 1983.
4. Tilak K.V.B.R, *Bacterial Biofertilizers*, IARI Publications, New Delhi, 1990.
5. Subba Rao N.S, *Biofertilizer in agriculture and forestry*, Oxford and IBH, New york,1995.

E- Resources:

1. https://github.com/mdozmorov/Bioinformatics_notes
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=31BI+Y%2FJyQo+vtlwaZoj+g%3D%3D
3. https://www.cs.cmu.edu/~ckingsf/bioinfo-lectures/
4. https://ocw.mit.edu/courses/6-092-bioinformatics-and-proteomics-january-iap-2005/pages/lecture-notes/

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 – ENTREPRENEURSHIP IN MICROBIOLOGY
(For Students Admitted from 2025-26)

Semester: IV **Hours / Week: 6**
Sub code: JMMBC41 **Credit: 5**

Course Objectives:
1. To introduce the fundamentals of entrepreneurship with a focus on microbiology-based innovations.
2. To foster innovative thinking for addressing real-world problems using microbial technologies.

Unit I **(18 Hours)**
Evolution of the concept of entrepreneur: Entrepreneurship: Definitions–concept of Entrepreneurship, development – need – role of resource, talent and spirit – process of Entrepreneurship to socio–economic gains.

Unit II **(18 Hours)**
Institution And Schemes of Government of India: Schemes and programmes, Department of science and technology schemes, Nationalized banks – other financial institutions, etc – SIDBI – NSIC – NABARD – IDBI – IFCI.

Unit III **(18 Hours)**
Skills For Entrepreneurs: communication skills, problem solving skills; Business plan development; Market need – market research, SWOT analysis, Business competition. Financial plan – obtain financing for your business, insure your business, Marketing – mix–product, distribution, price, promotion, set marketing goals.

Unit IV **(18 Hours)**
Microbial fertilizer production: Biofertilizers (rhizobial inoculants, mass production and method of application), Isolation and purification of Cyanobacteria. Mass multiplication of cyanobacterial bioinoculants – Trough or Tank method, Pit method, Field method; methods of application of cyanobacterial inoculum. Biofertilizers – Storage, shelf life, quality control and marketing.

Unit V **(18 Hours)**

Biopesticides: (viral, bacterial and fungal biopesticides); Biopolymers – Polyhydroxybutyrate (PHB), xantham gum

Microbial products – SCP (bacterial and algal), Mushroom production

Compost – Vermicomposting (agricultural, domestic and industrial waste)

Unit VI

Questions related to the above units, from various competitive examinations to be solved. (To be discussed during the Skill Development Course hour).

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

Text books :

1. Cynthia L., Greene, *Entrepreneurship, Ideas in Action*, South Western Educational Publishing, Fifth edition, 2012.
2. Venkataraman G.S., *Algal Biofertilizers and Rice Cultivation*, Today and Tomorrow's Printers and Publishers, New Delhi, 1972.

Reference Books:

1. Thompson L. M. and T. Fredrick, *Soils and Soil Fertility*, Tata Mc Graw–Hill Publishing Co, New Delhi,1979.
2. Rao N.S., *Biofertilizers in Agriculture*, Oxford and IBH Publishing Co. Pvt. Ltd., Bombay, 1980.
3. Rao N.S., G.S. Venkataraman and Kannaiyan, *Biological N_2 fixation*, ICAR Publications, New Delhi, 1983.
4. Tilak K.V.B.R, *Bacterial Biofertilizers*, IARI Publications, New Delhi, 1990.
5. Subba Rao N.S, *Biofertilizer in agriculture and forestry*, Oxford and IBH, New york,1995.

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/978156022705

2. https://www.taylorfrancis.com/books/mono/10.1201/9780367805500/microbesbiofertil izers 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	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 – DESSERTATION
(For Students Admitted from 2025-26)

Semester: IV **Hours/week: 24**
Subject Code: JMMBC42DW **Credit: 10**

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**		**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 2025-26)

Semester: IV **Hours/week: -**
Subject Code: JMMBX4 **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 2025-26)

Programme Educational Objectives (PEO):

PEO1: Core Competence: Graduates will develop a strong foundation in microbiology, including microbial physiology, genetics, immunology, and applied microbiology, enabling them to pursue advanced studies or careers in life sciences.

PEO2: Professionalism and Ethics: Graduates will demonstrate ethical conduct, professional responsibility, and a commitment to scientific integrity in academic, industrial, or clinical settings.

PEO3: Research and Innovation:
Graduates will engage in research and innovation by applying microbiological techniques to solve real-world problems in healthcare, agriculture, food safety, and the environment.

Programme Outcomes (PO):

On completion of the degree programme, the students will be enabled with:

PO1: Knowledge and Understanding: Apply comprehensive knowledge of microbiology and allied subjects to understand the structure, function, diversity, and evolution of microorganisms.

PO2: Laboratory Skills: Perform microbiological experiments using standard lab techniques, including aseptic handling, culturing, staining, and biochemical testing.

PO3: Scientific Temper and Inquiry: Demonstrate analytical and critical thinking skills to interpret scientific data, design experiments, and solve microbiological problems.

PO4 : Ethics and Responsibility: Recognize and follow ethical practices in handling microorganisms, data reporting, and use of biological materials.

PO5 : Teamwork and Leadership: Work effectively as a member or leader in teams, contributing to collaborative scientific investigations or projects.

PO6 : Technological Proficiency: Use modern tools, databases, bioinformatics resources, and instrumentation relevant to microbiology and life sciences.

PO7: Environment and Sustainability: Understand the role of microorganisms in environmental processes and contribute to sustainability initiatives.

Programme Specific Outcomes:

The graduate will be able to

PSO 1: Gain both theoretical and practical knowledge in the fields of microbiology

PSO 2: Inoculate the knowledge of the 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-enabled 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 I (Fundamentals of Microbiology),** Unit IV and V were merged into a single Unit; Sterilization and media preparation was introduced as Unit III; In Text books Microbiology by Pelczar was added
- **Core II (Lab course in Microbiology),** Ex: 5 Calculations in preparation of solution was included; Ex: 7 Cultural characters of bacteria was changed to Cultural characteristics of Bacteria and Fungi; Ex: 10 Wet mount preparation of protozoa was given as a separate experiment
- **Core III (Microbial Physiology),** Unit II: Extremophiles term was included before the titles Thermophiles, and the term Barophiles was introduced; Unit IV: Title was changed to Microbial Photosynthesis; CO3 & CO4 was interchanged
- **Core IV (Lab Course in Microbial Physiology),** Isolation and enumeration of soil microflora by Winogradsky method was added.
- **Core V (Molecular Biology),** Gene editing was included in Unit 5 before the topic Crispr Cas9
- **Core VII (Microbial Genetics),** Unit V: The topic SCP was included before Food; Unit III, the topics were changed in this order, Transformation, Conjugation and Transduction
- **Core VIII (Medical Microbiology & Biotherapeutics),** Medical Microbiology title was replaced as Medical Microbiology & Biotherapeutics; Dermatophytosis was removed, Mycosis and mycetoma were included
- **Core IX (Environmental and Agricultural Microbiology),** Unit V: Plant diseases - Bacteria and Fungi was included
- **Core X (Immunology),** Unit II: Immune response topic was included before the topic Antigen; Unit V: PCR was removed and topics RIA, Immunofluorescence were included
- **Core XI (Lab Course in Environmental & Agricultural Microbiology and Immunology),** Ex: 6 Bacterial assessment of water – MPN was changed to Water quality assessment of Microorganisms; Ex: 15 the term agglutination was removed
- **Core XII (Food Microbiology),** Unit I: The topic water activity(a_w) was included; Unit II: Natural preservatives, and Chemical preservatives was added; Unit III: Fish, egg was removed and replaced with the topic seafoods and poultry products
- **Core XIII (Industrial Microbiology),** Unit V: SCP was included

Skill Enhancement Courses

- **All the SEC papers were introduced as practical subjects**
- SEC I (Lab Course in Microbial Biochemistry); SEC II (Basics in Bioinformatics Practicals); SEC III (Lab course in Biofertilizers Production); SEC IV (Lab course in Medical lab Technology); SEC V (Lab course in Aquaculture); SEC VI (Scientific writings for Life Science Research Practicals)

Ability Enhancement Compulsory Course

- **AECC II (Introductory Virology),** in Unit III - CaMv was changed to CaMV; Gemini Virus topic was included. In the Lambda phage the λ symbol was inserted; In Unit V, Hepatitis was changed to HBV
- **AECC III (Bioethics, Biosafety, IPR and Bioentrepreneurship),** This course was newly introduced which was replaced instead of Intellectual Property rights, which includes Bioethics and Biosafety; Bioentrepreneurship was included as Unit V, by removing the unit II Ethics in human cloning
- **AECC IV (Bioinstrumentation and Biostatistics),** Bioinstrumentation and biostatistics papers are combined; Basic software to analyse large data was added

Multidisciplinary

- **MD III (a. Marine Microbiology),** Unit II: IMTECH was placed before MTCC; Unit III: The topics Biomagnification and Bioaugmentation were included; Unit IV: The term Seaweeds was changed to Macroalgae
- **MD III (b. Biotechnological techniques),** Title was changed to Techniques in Biotechnology ; Unit V - The order was changed as sheep, mice and Fish
- **MD IV (a. Computational Drug Designing),** This paper was newly introduced
- **MD IV (b. Bionanotechnology),** Unit I: Nanostructure dimensions 0 D was included; Unit II: Nanopore sequencing was included; Unit IV: The topic Raman effect was included, UV was changed to UV VIS Spectroscopy

Value Added Course

- **VAC II (Environmental Science and SDGs),** General interest course was changed to Value Added Course; EVS syllabus was reframed; The title was changed as Environmental Science and SDGs; Unit I was framed exclusively for SDG goals and related summits

BSc MICROBIOLOGY
(2025-26)
Programme Structure

Sem	Part	Subject Code	Course	Subject Title	Hours / Week	Credit	@ SD | ENT | EMP	$ REG | NAT | GLO	CIA	ESE	Total Marks
	I	JBLT11	LanguageI	இக்கால இலக்கியமும் சிற்றிலக்கியமும்	5	3	SD | ENT | EMP	REG | GLO	25	75	100

I		JBLA11		Basic Arabic I				REG | NAT | GLO			
		JBLHB11/ JBLHA11		General Hindi I (Basic)/ Hindi Grammar &Translation (Advanced)				REG | NAT | GLO			
	II	JBLEB12 / JBLEA12	LanguageII	Part II – English for Everyday Communication (Basic) & Literature and Language for Life (Advanced)	5	3	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	III	JBMBC11 / JBBTC11	Core I	Fundamentals of Microbiology	6	6	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	III	JBMBC12 P / JBBTC12 P	Core II	Lab Course in Fundamentals of Microbiology	6	5	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	III	JBMBA13 / JBBTA13	AECC I	Biochemistry	4	4	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	IV	JBMBS14 P / JBBTS14P	SEC I	Lab Course in Microbial Biochemistry	2	1	SD | ENT | EMP	REG | NAT | GLO	-	50	50
				Library/Browsing	1	-	SD	REG | NAT | GLO	-	-	-
				Remedial/Games	1	-	SD	REG | NAT | GLO	-	-	-
		TOTAL			**30**	**22**			**125**	**425**	**550**
II	I	JBLT21	Language I	காப்பிய இலக்கியமும் புதினமும்	5	3	SD | ENT | EMP	REG | GLO	25	75	100
		JBLA21		Basic Arabic II			SD | ENT | EMP	REG | NAT | GLO			
		JBLHB21/ JBLHA21		General Hindi II (Basic) / Hindi Prose, Poem & Story (Advanced)			SD | ENT | EMP	REG | NAT | GLO			
	II	JBLEB22 / JBLEA22	Languages II	Part II – English for Academic and Social Interaction (Basic)	5	3	SD | ENT | EMP	REG | NAT | GLO	25	75	100

				& Critical Reading and Reflective Writing (Advanced)							
	III	JBMBC21	Core III	Microbial Physiology	5	5	SD | EMP	REG | NAT | GLO	25	75	100
	III	JBMBC22P	Core IV	Lab Course in Microbial Physiology	5	4	SD | EMP	REG | NAT | GLO	25	75	100
	III	JBMBA23	AECC II	Introduction to Virology	4	4	SD | EMP	REG | NAT | GLO	25	75	100
	IV	JBMBS24P / JBBTS24P	SEC II	Basics in Bioinformatics Practicals	2	1	SD | EMP	REG | NAT | GLO	-	50	50
`	IV	JBUI2V	CVAC I	Understanding India	2	2	ENT | EMP	REG | NAT | GLO	-	50	50
				Library/Browsing	1				-	-	-
				Remedial/Games	1				-	-	-
	V	JBMBX2/JBMBX2O	Extra Credit I	Cell Biology/*Online Course	-	2				100	100
				TOTAL	**30**	**22 + 2**			**125**	**475+ 100**	**600+ 100**
III	I	JBLT31	Language I	இடைக்கால இலக்கியமும் இதழியலும்	5	3	SD | ENT | EMP	REG | NAT | GLO	25	75	100
		JBLA31		Classical Arabic Prose			SD | ENT | EMP	REG | NAT | GLO			
		JBLHB31/ JBLHA31		General Hindi III (Basic)/ Hindi Literature & Letter writing(Advanced)			SD | ENT | EMP	REG | NAT | GLO			
	II	JBLEB32 / JBLEA32	Language II	Part II – Workplace English: Foundations of English Communication Skills (Basic) & English for the Corporate World (Advanced)	5	3	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	III	JBMBC31 / JBBTC31	Core V	Molecular Biology	4	4	SD | EMP	REG | NAT | GLO	25	75	100
	III	JBMBC32P / JBBTC32	Core VI	Lab Course in Molecular Biology	4	3	SD || EMP	REG | NAT | GLO	25	75	100

		P									
	III	JBMBA33 / JBBTA33	AECC III	Bioethics, Biosafety, Intellectual Property Rights and Bioentrepreneurship	4	4	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	IV	JBMBS34 P / JBBTS34P	SEC III	Lab course in Biofertilizers Production	2	1	SD | ENT | EMP	REG | NAT | GLO	-	50	50
	IV	JBMD31 MBP/JBM D31BTP	MD I	Lab Course in Mushroom Cultivation	2	1	SD | ENT | EMP	REG | NAT | GLO	-	50	50
	IV	JBES3V	CVAC II	Environmental Studies for Sustainable Development	2	2	SD | ENT | EMP	REG | NAT | GLO	-	50	50
	V	JBXTN3	Extension	NSS / CSS	2	2	SD | ENT | EMP	REG | NAT | GLO	100	-	100
	V	JBMBX3/J BMBX3O	Extra Credit II	Developmental Biology/ *Online Course	-	2	SD | EMP	REG | NAT | GLO	-	100	100
	TOTAL				**30**	**23 +2**			**225**	**525+ 100**	**750+ 100**
IV		JBLT41	LanguageI	பண்டைய இலக்கியமும் நாட்டுப்புறப் பாடல்களும்	5	3	SD | ENT | EMP	REG | GLO	25	75	100
		JBLA41		Hadeeth			SD | ENT | EMP	REG | NAT | GLO			
		JBLHB41/ JBLHA41		General Hindi IV (Basic) / Computer and Hindi (Advanced)			SD | ENT | EMP	REG | NAT | GLO			
		JBLEB42 / JBLEA42	LanguageII	Part II – Professional Communication Skills (Basic) & Strategic Communication for Global Careers (Advanced)	5	3	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	I	JBMBC41	Core VII	Microbial Genetics	5	5	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	II	JBMBC42 / JBBTC42	Core VIII	Medical Microbiology and Biotherapeutics	4	4	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	III	JBMBA43 /	AECC IV	Bioinstrumentation and Biostatistics	4	4	SD | ENT | EMP	REG | NAT | GLO	25	75	100

		JBBTA43									
	III	JBMD41MBP/ JBMD41BTP	MD II	Lab Course in Vermiculture	3	2	SD | ENT | EMP	REG | NAT | GLO	-	50	50
	III	JBMBS44P / JBBTS44P	SEC IV	Lab course in Medical lab Technology	2	1	SD | ENT | EMP	REG | NAT | GLO	-	50	50
	IV	JBDT4V	CVAC III	Digital and technology solution	2	2	SD | ENT | EMP	REG | NAT | GLO	-	50	50
	IV	JBMBX4/JBMBX4O	Extra Credit III	Microbes in Human Welfare /*Online Course	-	2			-	100	100
	V	**TOTAL**			**30**	**24+2**	**125**			**525+100**	**650+100**
V	III	JBMBC51	Core IX	Environmental and Agricultural Microbiology	6	6	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	III	JBMBC52	Core X	Immunology	6	6	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	III	JBMBC53P	Core XI	Lab Course in Environmental, Agricultural Microbiology and Immunology	6	4	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	IV	JBMD51MBA/JBMD51MBB / JBMD52BTB	MD III	a. Marine Microbiology b. Biotechnological Techniques	4	3	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	IV	JBMD52MBA/JBMD52BTA / JBMD52MBB/JBMD52BTB	MD IV	a. Computational Drug Designing b. Bionanotechnology	4	3	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	IV	JBMBS55P/ JBBTS55P	SEC V	Lab course in Aquaculture	2	1	SD | ENT | EMP	REG | NAT | GLO	-	50	50
		JBHW5V	CVAC IV	Health and wellness	2	2	SD | ENT | EMP	REG | NAT | GLO	-	50	50
	V	JBESX5	Extra Credit IV	Employability Skills	-	2	SD | ENT | EMP	REG | NAT | GLO	100	-	100

		TOTAL			**30**	**25 + 2**			**225**	**475**	**600+ 100**
VI	III	JBMBC61	Core XII	Food Microbiology	6	6	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	III	JBMBC62	Core XIII	Industrial Microbiology	6	6	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	III	JBMBC63P	Core XIV	Lab Course in Microbial Genetics, Food, Industrial and Medical Microbiology	6	4	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	III	JBMBC64PW	Core XV	Project	5	4	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	IV	JBMD65MB/JBMD65BT	MD V	Public Health and Hygiene	4	3	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	IV	JBMBS66P/JBBTS66P	SEC VI	Scientific writings for Life Science Research Practicals	2	1	SD | ENT | EMP	REG | NAT | GLO	-	50	50
	V	JBMBX6/ JBMBX6O	Extra Credit V	Life science for competitive examination / *Online Course	-	2	EMP	NAT	-	100	100
				Library / Browsing	1	-			-	-	-
	TOTAL				**30**	**24 + 2**			**125**	**425+ 100**	**550+ 100**
	Grand Total				**180**	**140 +10**			**950**	**2850 +500**	**3700 + 500**

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 June 2025-26)

Semester: I **Hours / Week: 6**
Subject Code: JBMBC11 **Credit: 6**

Course Objectives:

1. To gain foundational knowledge of microbiology, including microbial classification, microscopy techniques, and methods of sterilization and control.

2. To understand the structure, function, metabolism, growth, and reproduction of prokaryotic and eukaryotic microorganisms, with emphasis on fungi (mycology) and algae (phycology).

Unit I **(18 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 **(18 hours)**

Microscopy – Simple and Compound Microscopy, Bright field, Dark field, Phase contrast, Fluorescence and Electron Microscope (SEM & TEM). Introduction to Bergy's Manual, Archaea, Bacteria, Eukarya, and Actinomycetes.

Unit III **(18 hours)**

Sterilization – Physical methods of sterilization – Dry & moist heat, Filtration: Chemical methods of sterilization, Sterilizing gases, Preparation of microbiological media, Types of Media.

Unit IV **(18 hours)**

Prokaryotes and Eukaryotes – Anatomy of Prokaryotes and Eukaryotes, Ultrastructure and function of the Capsule, Slime layer, Cell wall, Cytoplasmic membrane, Cilia, Flagella, Pili, Endospore, Genetic material and Plasmid. Difference between Prokaryotic and Eukaryotic cells. Mycoplasma.

Unit V **(18 hours)**

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

Phycology – General characteristics of Algae, Habitat, Morphology, Pigments and reproduction, Biological and economic importance of Algae (*Cyanobacteria* - *Spirulina*). Introduction on Lichens, Cultivation of fresh water and marine algae.

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
CO 3: Elaborate the structure and functions of Prokaryotes
CO 4: Interpret the cultural characteristics of microorganisms
CO 5: Update 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.
3. Pelczar, Chan & Kreig, *Microbiology*, Tata McGraw Hill, New Delhi., 5th Edition, 2012.

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 June 2025-26)

Semester: I **Hours/ Week:6**
Subject Code: JBMBC12P **Credit:5**

Course Objectives:

1. To develop practical skills in the isolation, handling, and safe manipulation of microorganisms.

2. To understand and apply pure culture techniques, along with methods for culturing, preserving, and maintaining microbial strains.

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. Calculations in media preparations
6. Preparation of media for the culture of microorganisms:

a. Liquid (Nutrient Broth)
b. Solid (Stab and slant)

7. Pure culture methods:
    a. Pour plate
    b. Spread plate
    c. Streak plate – simple, zigzag, T streak, quadrant and radiant.
8. Cultural characteristics of Bacteria and Fungi.
9. Enumeration of Bacteria &Fungi by serial dilution technique
10. 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

11. Wet mount preparation of protozoa
12. Bacterial motility – Hanging drop method
13. Observation of permanent slides to study the structural characteristic of Microalgae and fungi
    a. *Cyanobacteria – Oscillatoria, Nostoc,Anabaena*
    b. 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 the aseptic and pure culture techniques, preparation and viewing of sample under the microscope
CO 4: Explain and compare the cultural characteristics of algae and fungi
CO5: Experiment with 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 ENHANCED COURSE I - LAB COURSE IN MICROBIAL BIOCHEMISTRY
(For Students Admitted from 2025-2026)

Semester: I **Hours / Week: 2**
Subject Code: JBMBS14P **Credit: 1**

Course Objectives:

1. To understand and apply basic laboratory safety procedures, along with the preparation of buffer solutions and accurate pH measurement.
2. To perform qualitative analyses of biomolecules, including carbohydrates, proteins, amino acids, lipids, and phytochemicals, to understand their biochemical properties and significance.

List of Experiments:

1. Rules and Procedures of General Safety
2. Buffer solution preparation and pH measurement
3. Qualitative analysis of carbohydrates
4. Tests for proteins
5. Tests on amino acids
6. Qualitative tests for lipids
7. Phytochemical/Bioactive compounds analysis

Text Books:

1. Albert L. Lehninger, David L. Nelson and Michael M. Cox. Lehninger, *Principles of Biochemistry*, 2nd edition, Wiley publisher. 2010.
2. Deb A.C., *Fundamentals of Biochemistry*, 10th edition, New Central Book Agency (p) ltd, London. 2011.

References:

1. Keith Wilson and John Walker, Principles and Techniques of Practical Biochemistry, 4th edition, Cambridge University press, Britain. 1995.
2. Shawn O' Farrell and Ryan T Ranallo, Experiments in Biochemistry: A Hands-on Approach-A manual for the undergraduate laboratory, Thomson Learning, Inc., Australia. 2000.
3. Strolv B.A., Makavora V.C., Laboratory manual in Biochemistry. MIR Publisher, Moscow. 1989. Oser BL Hawks. Physiological Chemistry, TATA Mc Graw Hill. 1965.

Journals:

1. Journal of Science & Technology
2. International Journal of Advanced Research
3. International Journal of Applied Microbiology and Biotechnology

E-Resources:

1. Onlinelearning.hms.harvad.edu/biochemistry
2. Aldrin.tripod.com/biochemistry
3. https://study.com/biochemistry-class-online.html
4. Canterbury.libguides.com/bchm/websites

Course Outcomes

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

CO 1: Demonstrate proper adherence to general laboratory safety rules and procedures.
CO2: Prepare buffer solutions and accurately measure pH for biochemical experiments.
CO3: Perform qualitative tests to identify carbohydrates and proteins.

CO4: Conduct biochemical tests for amino acids and lipids.
CO5: Carry out phytochemical analysis to detect bioactive compounds in plant/fungal/bacterial extract.

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

CORE III – MICROBIAL PHYSIOLOGY

(For Students Admitted from June 2025-26)

Semester: II **Hours / Week: 5**
Subject Code: JBMBC21 **Credit: 5**
Course Objectives:

1. To develop prime understanding on microbial physiology, including diverse metabolic pathways in bacteria and their roles in survival and propagation.
2. To build foundational knowledge that supports advanced learning, particularly in areas such as microbial pathogenicity and biotechnology.

Unit I **(15 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 **(15 hours)**

Microbial Physiology - Structure, Function and physiology of organisms living in extreme environments – Extremophiles, Thermopiles, Hyperthermophile, Barophiles, Halophiles, Psychrophiles and Methanogens

Unit III **(15 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 **(15 hours)**

Microbial Photosynthesis – 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 **(15 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: Explain the transport mechanisms in microbes
CO 4: Classify the photosynthetic pathways
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 T.M., Bender K.S., Buckley D.H., Satterly W.M., Stahl D.A., *Brock biology of microorganisms.* Hoboken Nj, Pearson Education. 2021.

Reference Books:

1. Sokatch, J.R., *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 June 2025-26)

Semester: II **Hours/ Week: 5**
Subject Code: JBMBC22P **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 – Hemocytometer
3. Determination of microbial growth curve - Turbidity method
4. Isolation and enumeration of soil microflora from Winogradsky method
5. Isolation of Cellulolytic bacteria from compost
6. Carbohydrate fermentation tests
7. Nitrate Reduction test
8. Starch hydrolysis
9. Gelatin hydrolysis
10. Lipid hydrolysis
11. Casein hydrolysis
12. Oxidase test
13. Catalase test
14. Coagulase test
15. IMViC test
16. TSI test
17. 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, Hemocytometer 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, Matthew Sattley.W., 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. Prescott L.M., Harley J.P. and Klein. D.A., *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

ABILITY ENHANCEMENT COMPULSORY COURSE II – INTRODUCTION TO VIROLOGY

(For Students Admitted from June 2025-26)

Semester: II **Hours /Week: 4**
Subject Code: JBMBA23 **Credit:4**

Course Objectives:

1. To provide foundational knowledge of viruses, including their structure, classification, replication, quantification, and amplification methods.
2. To understand the diversity and biology of viruses infecting bacteria, plants, animals, and humans, with emphasis on their transmission and impact on health and ecosystems.

Unit I **(12 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 **(12 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 **(12 hours)**

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

Unit IV **(12 hours)**

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

Unit V **(12 hours)**

Human Viruses – Morphology, Symptoms, Laboratory diagnosis, Prevention and treatment of Herpes, HIV, Hepatitis (HBV), 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 of virus
CO 2: Illustrate knowledge of 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 into the facts of the 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 & Stephen 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

SKILL ENHANCEMENT COURSE II – BASICS OF BIOINFORMATICS PRACTICALS

(For Students Admitted from 2025-2026)

Semester: II **Hours / Week: 2**
Subject Code: JBMBS24P **Credits: 1**

Course Objectives:

1. To introduce students to key bioinformatics tools and databases for retrieving, analyzing, and interpreting nucleotide and protein sequences.
2. To equip students with practical skills in gene prediction, protein structure modeling, and functional annotation using current computational tools and software.

List of experiments:

1. Introduction to bioinformatics databases (any three): NCBI/PDB/DDBJ, Uniprot, PDB
2. Sequence retrieval using BLAST
3. Sequence alignment & phylogenetic analysis using ClustalW & PHYLIP
4. Picking out a given gene from genomes using Genscan or other softwares (promoter region identification, repeat in genome, ORF prediction). Gene finding tools (Glimmer, GENSCAN), Primer designing.
5. Protein structure prediction: primary structure analysis, secondary structure prediction using PSIPRED, homology-modeling using Swiss model.
6. Molecular visualization using PyMOL, Chimera, and Jmol. , Protein structure model evaluation (PROCHECK).
7. Functional feature prediction and annotation of genes using GO and KEGG Pathway Analysis

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*, 5th Edition, Oxford Publication, 2019.
2. Lesk M.A., *Introduction to Bioinformatics*, Oxford Publication, 3rd International Student Edition, 2008.
3. Jonesand N.C. and Pevzner P.A., *An Introduction to Bioinformatics Algorithms*, Ane Books, New Delhi, 2005.

Reference Books:

1. Christina Marshall, *Bioinformatics and functional genomics.* Forest Hills, NY: Callisto, 2019.
2. Rastogi S.C., Mendiratta N. and Rastogi P., *Bioinformatics: methods and applications, genomics, proteomics and drug discovery*, 2nd ed. Prentice Hall Publication, India, 2007.
3. Primrose and Twyman, *Principles of Genome Analysis & Genomics*, Blackwell, 2003.

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
3. https://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering
4. http://amrita.vlab.co.in/index.php?sub=3&brch=273
5. 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 I – CELL BIOLOGY
(For Students Admitted from 2025-2026)

Semester: II **Hours / Week: -**
Subject Code: JBMBX2 **Credit:2**

Course Objectives:

1. To provide students with a solid understanding of the fundamental concepts and structures of cell biology.
2. To enhance knowledge of cell communication and cell cycle regulation.

Unit I
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
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
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

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

Unit V

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, New York, 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 V – MOLECULAR BIOLOGY

(For Students Admitted from 2025-26)

Semester: III **Hours / Week: 4**
Subject Code: JBMBC31 **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, Gene editing; 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 2025-2026)

Semester: III **Hours / Week: 4**
Subject Code: JBMBC32P **Credit: 3**

Course Objectives:

1. To equip students with practical skills in nucleic acid and protein isolation, quantification, and analysis using modern biochemical techniques.
2. To develop proficiency in molecular biology methods including electrophoresis, chromatography, and recombinant DNA techniques for microbial samples.

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 bacteria

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 III – BIOETHICS, BIOSAFETY, INTELLECTUAL PROPERTY RIGHTS AND BIOENTREPRENEURSHIP

(For Students Admitted from 2025-2026)

Semester: III **Hours /week: 4**
Subject Code: JBMBA33 **Credits: 4**

Course Objectives:

1. Demonstrate an understanding of ethical principles, biosafety guidelines, and regulatory frameworks governing biological research and applications.
2. Apply knowledge of intellectual property rights and entrepreneurial strategies to translate biotechnological innovations into viable business ventures.

Unit I **(12 hours)**

Bioethics: Introduction and principles of Bioethics; Necessity 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, Ethical issues against the molecular technologies - environmental release of genetically modified microorganisms., different paradigms of Bioethics National & International.

Unit II **(12 hours)**

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

Unit III **(12 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 IV **(12 hours)**

Intellectual Property Right (IPR): 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.

Unit V **(12 hours)**

Bioentrepreneurship: Selection of a product, line, design and development processes, economics on material and energy requirement, stock the product and release the same for making etc. The basic regulations of excise: Demand for a given product, the feasibility of its production under given constraints of raw material, energy input, financial situations export potential etc. Innovation & Start-ups.

Course Outcomes:

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

CO1: Understand and apply core principles of bioethics and biosafety in biological research and biotechnology practise.

CO2: Analyze various types of intellectual property rights and their significance in protecting biotechnological innovations.

CO3: Evaluate national and international biosafety regulations and ethical considerations in the development and use of biotechnology.

CO4: Demonstrate knowledge of entrepreneurship in biotechnology, including business planning, funding, and commercialization of biological products.

CO5: Critically assess real-world case studies involving bioethics, IPR disputes, and successful entrepreneurial ventures.

Text Books:

1. Cornish, W. R. Intellectual property: Patents, Copyright, Trademarks, and Allied rights. Sweet & Maxwell, 1999.

2. Sibi. G., *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. Sateesh, M. K., *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	3	9	9	9	61
CO2	9	9	9	9	9	9	9	63
CO3	9	9	9	3	3	9	9	51
CO4	9	3	9	1	9	9	9	49
CO5	9	9	9	3	1	9	9	49
Total	45	95	45	22	31	45	45	273

Low-1 Medium-3 High-9

SKILL ENHANCEMENT COURSE III- LAB COURSE IN BIOFERTILIZERS PRODUCTION

(For Students Admitted From 2025-26)

Semester: III **Hours / Week: 2**
Subject Code: JBMBS34 **Credit: 1**

Course Objectives:

1. To provide students with hands-on training in the isolation, cultivation, and production of microbial biofertilizers.

2. To develop understanding of sterilization, inoculum preparation, storage, and marketing strategies essential for sustainable biofertilizer technology.

List of Experiments:

Laboratory rules and safety measures

1. Isolation of *Rhizobium*
2. Isolation of *Phosphobacteria*
3. Isolation of *Azospirillum*
4. Isolation of *Spirullina* / *Blue Green Algae*
5. Isolation of *VAM*
6. Mass production of *Rhizobium*, *Azolla - Blue Green Algae*
7. Preparation of carrier material
8. Preparation of Inoculum
9. Storage of biofertilizers
10. 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. Pakpour and Horgan., *General Microbiology Lab Manual*, California State University East Bay: Published, 2024.
2. Aneja K.R., *Experiments in Microbiology, Plant Pathology and Biotechnology*, Revised Fourth edition, New Age International Publishers, 2007.
3. Kannan N., *Laboratory Manual in General Microbiology*, Panima Publishers, 2002.
4. 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_Agricultu re
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

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

MULTIDISCIPLINARY I – LAB COURSE IN MUSHROOM CULTIVATION

(For Students Admitted From 2025-26)

Semester: III **Hours / Week: 2**
Subject Code: JBMD31MBP **Credit: 1**

Course Objectives:

1. To equip students with practical knowledge and skills in the identification, cultivation, and post-harvest handling of edible mushrooms.
2. To develop an understanding of spawn production, pest and disease management, and marketing strategies for sustainable mushroom farming.

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
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:

The mushroom cultivation lab provides hands-on training for students to

CO 1: Identify the differences between edible and poisonous mushrooms.

CO 2: Learn how to prepare and multiply mushroom spawn.

CO 3: Gain hands-on experience in growing Oyster, Milky, and Button mushrooms.

CO 4: Manage post-harvest handling, storage, and packaging to maintain mushroom quality and extend shelf life.

CO 5: Evaluate production constraints and implement effective marketing strategies for successful mushroom entrepreneurship.

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. Ram, R. C., *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

EXTRA CREDIT II– DEVELOPMENTAL BIOLOGY

(For Students Admitted from 2025-26)

Semester: III **Hours / Week: -**

Subject Code: JBMBX3 **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, superovulation; 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 superovulation

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 VII – MICROBIAL GENETICS

(For Students Admitted from 2025-26)

Semester: IV **Hours /Week: 5**
Subject Code: JBMBC41 **Credit:5**

Course Objectives:

1. To provide a foundational understanding of gene organization, mutation, and DNA repair mechanisms in

prokaryotic and eukaryotic organisms.
2. To develop knowledge of genetic elements, gene transfer methods, and the molecular basis of recombination and transposition in microbes.

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 – Transformation – competent cells – mechanism; Conjugation – F^+, F^- mating, Hfr mating, F' conjugation; 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: Categorize 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. Tina M Henkin; Joseph Edward Peters, Snyder & Champness. *Molecular genetics of bacteria*, Washington, 5th Edition, 2020.
2. Jeremy W. Dale, *Molecular genetics of Bacteria*, Wiley Blackwall, 5th Edition, 2016.

Journals:
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

CORE VIII – MEDICAL MICROBIOLOGY AND BIOTHERAPEUTICS

(For Students Admitted from 2025-26)

Semester: IV **Hours / Week: 4**
Subject Code: JBMBC42 **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 and Fungal diseases – Tuberculosis, Plague, Anthrax, Meningitis, Typhoid,

Tetanus – infection, infection establishment, pathogenesis, symptoms, diagnosis, treatment; Mycoses – – Mycosis, Mycetoma, Histoplasmosis, Cryptococcosis, Aspergillosis Pathogenesis, Diagnosis, and treatment

Unit III **(12 hours)**

Protozoan and Viral diseases – Amoebiasis, Giardiasis, Malaria – infection, infection establishment, pathogenesis, symptoms, diagnosis, treatment; Hepatitis, Dengue, Rabies, Pox Virus, Rubella, Ebola, Zika, SARSCoV Causative agents– pathogenesis, symptoms, transmission, diagnosis, prevention and treatment

Unit IV **(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. India's first Indigenous antibiotic – Nafithromycin for resistant infections

Unit V **(12 hours)**

Biotherapeutics: Biotherapeutics agents – Bacteria, Viruses, Fungi, and associated toxins; Probiotics, monoclonal antibodies, recombinant protein, Gene therapy, cell therapies and vaccines; biotherapeutic drugs- live biotherapeutic product, Fecal microbiota transplant- Ferring's Rebyota and Seres' Vowst. Advantages of biotherapeutics, challenges in biotherapeutics.

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: categorize 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, 1st Edition, 2019.

Reference Books:

1. Patrick R Murray, Michael A. Pfaller, Ken S. Rosenthal**,** *Medical microbiology,* 9th Edition, 2021.
2. Neeran Jasim, *Medical Mycology*, Saarbrucken LAP LAMBERT Academic Publishing, 2018.
3. Dey, T.K., *Medical Parasitology*, La Vergne: New Central Agency, 2020.

Journals:

1. International Journal of Medical Microbiology
2. Journal of Clinical Microbiology

3. Clinical Microbiology and Infection
4. Biotherapeutics and its applications in Microbiology

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 IV – BIOINSTRUMENTATION AND BIOSTATISTICS

(For Students Admitted from 2025-26)

Semester: IV **Hours / week: 4**
Subject Code: JBMBA43 **Credit: 4**

Course Objectives:

1. To provide knowledge & understanding of various advanced instruments, radioisotopes and their applications.
2. To gain knowledge of various spectroscopy, electrophoresis and its operation.

Unit I **(12 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 Hemocytometer.

Unit II **(12 hours)**

Chromatography and Spectrophotometry – 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. Principle and applications of spectrophotometer – visible, ultraviolet and infrared; Atomic Absorption Spectroscopy. Colorimetry, turbidometry, FTIR.

Unit III **(12 hours)**

Separation Techniques – Centrifugation – Basic principles of sedimentation, RCF and sedimentation coefficient; types of centrifuges, sonicator and sonication. Filters – Seitz, HEPA, Membrane; Lyophilizer.

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).

Unit IV **(12 hours)**

Biostatistics – Definition, Statistical methods, Biological measurements, Kinds of biological data (Primary & secondary data), Data Collection methods **–** 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), Function of statistics and limitation of statistics, Application of statics in health.

Unit V **(12 hours)**

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

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

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: Develop the practical skills for applying statistical tools in research

Text Books:

1. David J. Holme, Hazel Peck, *Analytical Biochemistry and Separation Techniques*, Publisher: New York, NY, U.S.A, 1st Edition, 2020.
2. Brown D.R., *Chromatography***,** Publishing House, New Delhi, 2005.
3. 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. Sanderson J.B., *Understanding light microbiology*, Hoboken NJ: John Wiley & Sons Ltd. 1st Edition, 2019**.**
2. Bhatia S.C**.,** *Bioinstrumentation*, Shree Publishers & Distributors: New Delhi, 2015.
3. Murphy D.B., Davidson M.W., *Fundamentals of Light Microscopy and Electronic Imaging*, Wiley-Blackwell, 2012.

4. 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.

Journals:

1. Medical Instrumentation
2. International Journal of Biological Instrumentation.
3. Journal of Biomedical Instrumentation and Applications
4. Brain research bulletin

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://homogenizers.net
5. https://books.google.com/books?hl=en&lr=&id=7tJMDwAAQBAJ&oi=fnd&pg
6. http://www.bnemid.byethost14.com/BIOSTATICS%202.pdf

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

MULTI DISCIPLINARY II – LAB COURSE IN VERMICULTURE

(For Students Admitted From 2025-26)

Semester: IV **Hours /Week: 3**
Subject Code: JBMD41MBP **Credit: 2**

Course Objectives:

1. To understand the concepts of 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 foetida*
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 entrepreneurial 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. International 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

Low-1 Medium-3 High-9

SKILL ENHANCEMENT COURSE IV – LAB COURSE IN MEDICAL LAB TECHNOLOGY

(For Students Admitted from 2025-26)

Semester: IV **Hours / Week: 2**
Subject Code: JBMBS44P **Credit: 1**

Course Objectives:

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

List of Experiments:

1. Medical Laboratory Technician code of conduct
2. Blood Sample collection, Separation and Transportation
3. Blood grouping – A, B, O, AB, H
4. Bleeding Time and Clotting Time
5. Total WBC and Total RBC
6. Differential Cell count
7. Estimation of Hemoglobin
8. Estimation of Blood Sugar, Urine Sugar, Urine Albumin and Deposits
9. Estimation of Bile Salt and Bile pigment (BSBP)
10. Erythrocytes Sedimentation Rate (E.S.R)
11. Agglutination test (ASO, CRP, RF)
12. Widal slide agglutination
13. Microscopic Examination of Malarial Parasites (Pf & Pv)
14. Urine - Urine Pregnancy Test (UPT)
15. Field visit to 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 such as Widal, Pregnancy test etc.

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
4. http://applyonline.itmuniversity.org/Images/biochemistry/BSc_MLT.pdf
5. 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 2025-26)

Semester: IV **Hours / week: -**

Subject Code: JBMBX4 **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; wastewater 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, Faruk Bozoglu, T., *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 2025-26)

Semester: V **Hours /Week: 6**
Subject Code: JBMBC51 **Credit: 6**

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 microorganisms; 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 microflora, Outline of Airborne diseases (Bacterial, Fungal and Viral); Air sanitation; Effect of Air pollution for Plants and Humans.

Unit II **(18 hours)**

Wastewater (sewage and industrial effluents) treatments – Primary, Secondary (Trickling Filter, Activated Sludge) and Tertiary treatments; Anaerobic treatment of industrial effluents; Hydrolysis, Fermentation and Methanogenesis. Conventional methods of wastewater 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), Phytoremediation

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.

Plant tissue culture: Gene transfer techniques –Ti plasmid, Ri plasmid

Plant diseases: Bacterial, Fungi

Course Outcomes:

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

CO1: Identify the types of microorganisms and explain their 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 phycologist

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 2025-26)

Semester: V **Hours / Week: 6**

Subject Code: JBMBC52 **Credit: 6**

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)**

Immune response, 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, RIA, Immunofluorescence

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, AGRICULTURAL MICROBIOLOGY AND IMMUNOLOGY

(For Students Admitted from 2025-26)

Semester: V **Hours / Week: 6**
Subject Code: JBMBC53P **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* and *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. Water quality assessment of Microorganisms
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 faecal bacteria from water
12. Immunodiffusion – Simple, Double and Radial
13. Immunoelectrophoresis
14. Australian latex antigen test
15. Agglutination Test for Blood grouping
16. Demonstration of ELISA, HIV

Course Outcomes:

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

CO 1: Observe the environmental microbes and discuss 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. Journal of the Science of food and agriculture
3. The journal of agricultural science

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

MULTIDISCIPLINARY III – a**. MARINE MICROBIOLOGY**
(For Students Admitted from 2025-26)

Semester: V **Hours / Week: 4**
Subject Code: JBMD51MBA **Credit: 3**

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 (IMTECH, MTCC, ATCC, 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 microorganisms, Bioleaching and Biodeterioration of natural and synthetic materials; Biomagnification and Bioaugmentation

Unit IV **(12 hours)**

Macroalgae, Mangroves and their importance – Macroalgae; types – green, red, brown algae; Economical importance of Macroalgae, Macroalgae as a source of polysaccharides, Macroalgae 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 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
CO 4: 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, 2nd 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,, 4th Edition, 2013.

Journals:

1. Journal of marine microbiology
2. Frontiers in marine science
3. Journal of Environmental microbiology

E –References:

1. https://www.microbiologyresearch.org/content/marine-microbiology
2. https://www.researchgate.net/publication/355037287_Text_Book_on_Marine_Microbiology
3. https://ocean.si.edu/milestones-marine-microbiology

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

MULTIDISCIPLINARY COURSE III: b. BIOTECHNOLOGICAL TECHNIQUES
(For Students Admitted from 2025-26)

Semester: V **Hours / Week: 4**
Subject Code: JBMD51MBB **Credit: 3**

Course Objectives:
1. To understand microbes for the development of various products.
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 nanostructures, 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 **–** Sheep, Mice, and Fish; 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: Determine 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. Journal of biotechnology and bioengineering
2. Journal of Biotechnology
3. Biotechnology Journal

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

MULTI DICIPLINARY IV – a. COMPUTATIONAL DRUG DESIGNING

(For Students Admitted from 2025-26)

Semester: V **Hours / Week: 4**

Subject Code: JBMD52MBA **Credit:3**

Course Objectives:

1. To learn about the different sources of drug discovery and the challenges in the pharmaceutical industry.
2. To learn how drugs interact with receptors and macromolecules at the molecular level

Unit I **(12 hours)**

Drug Design: Introduction to Computer Aided Drug Design (CADD) History, different technique sand applications Quantitative Structure Activity Relationships: Basics History and development of QSAR: Physicochemical parameters and methods to calculate physicochemical parameters: Hammett equation and electronic parameters (sigma), lipophilicity effects and parameters (log P, disubstituent constant), steric effects (Taft steric and MR parameters)

Unit II **(12 hours)**

Quantitative Structure-Activity Relationships: Quantitative Structure-Activity Relationships: Applications Hansch analysis, Free Wilson analysis and relationship between them, Advantages and disadvantages; Deriving 2D-QSAR equations 3D-QSARapproaches and contour map analysis Statistical methods used in QSAR analysis and importance of statistical parameters

Unit III **(12 hours)**

Molecular Modeling and Docking: Molecular Modeling and Docking - Molecular and Quantum Mechanics in drug design, Energy Minimization Methods: comparison between global minimum conformation and bioactive conformation and Molecular docking and drug receptor interactions: Rigid docking, flexible docking and extra-precision docking.

Unit IV **(12 hours)**

Molecular Properties and Drug Design: Molecular Properties and Drug Design: a) Prediction and analysis of ADMET properties of new molecules and their importance in drug design. b) De novo drug design: Receptor/enzyme-interaction and its analysis, Receptor/enzyme cavity size prediction,

predicting the functional components of cavities, Fragment-based drug design. c) Homology modelling and generation of 3D-structure of protein.

Unit V **(12 hours)**

Virtual Screening: Pharmacophore Mapping and Virtual Screening Concept of pharmacophore, pharmacophore mapping, identification of Pharmacophore features and Pharmacophore modeling; Conformational search used in pharmacophore mapping In Silico Drug Design and Virtual Screening Techniques Similarity based methods and Pharmacophore based screening, structure based In-silico virtual screening protocols.

Course Outcomes:

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

CO1: Explain the various stages of drug discovery
CO2: Learn the concept of cause and drug resistance
CO3: Describe physicochemical Properties and the techniques involved in QSAR
CO4: Learn introduction to Bioinformatics and Cheminformatics
CO5: Explain the various techniques in Virtual Screening

Text Books:

1. Voit E., *A First Course in Systems Biology*, Garland Science, 1st edition, 2012.
2. Robert M. Stroud and Janet.F. Moore, *Computational and structural approaches to drug discovery*, RCS Publishers, 2006

Reference books:

1. Young. D. C., *Computational Drug Design - A Guide for Computational and Medicinal Chemist*, John Wiley & Sons, Inc., Hoboken, New Jersey, 2009.
2. Hinchliffe, *Molecular Modelling for Beginners*, John Wiley & Sons Ltd, England, 2008.
3. Martin Y.C., *Introduction to Quantitative Drug Design*, CRC Press, Taylor & Francis group, 2000.
4. Smith and Williams, *Principles of Drug Design*, CRC Press, Taylor & Francis, 2010.

Journals:

1. Journal of Computer-Aided Molecular Design
2. Computer-aided drug design
3. Chemical Biology & Drug Design

E-Resources:

1. https://pharmacyconcepts.in/wp-content/uploads/2022/06/Drug-Design.pdf
2. https://www.researchgate.net/publication/41554841_Systems_Biology_A_Textbook
3. https://www.coursera.org/learn/drug-discovery
3. https://www.coursera.org/learn/drug-development
4. https://www.vbspu.ac.in/e-content/Alok-Dash/drug%20design.pdf

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

MULTI DISCIPLINE III: b. BIONANOTECHNOLOGY

(For Students Admitted from 2025-26)

Semester: V **Hours /Week: 4**

Subject Code: JBMD52MBB **Credit: 3**

Course Objectives:

1. To understand the essential features of biology and nanotechnology that are converging to create a 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 nanobiotechnology

Unit I **(12 hours)**

Nanostructure and biomaterial – Bionanotechnology – Definition, History of bionanotechnology – Richard Feynman and his contributions; Classification of Nanostructures – 0D, 1D, 2D and 3D, Nanomaterial in biotechnology - nanoparticles, quantum dots, nanotubes and nanowires etc.

Unit II **(12 hours)**

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

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 VIS Spectroscopy, Raman effect, FT-IR, XRD, SEM, TEM, Atomic Force Microscopy.

Unit V **(12 hours)**

Nanomedicine – Developing of nanodrug and carriers – liposomes, dendrimers, 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. Christof M. Niemeyer, Chad A. Mirkin, *Nanobiotechnology: Concepts, Applications and Perspectives*, Wiley VCH, 2004.
2. Chad A. Mirkin and Christof M. Niemeyer, *Nanobiotechnology - II more concepts and applications*, Wiley VCH., 2007.

Reference Books:
1. Anil Kumar Anal, *Bionanotechnology: Principles and applications*, CRC Press, Taylor and Francis group, 2018.
2. Sherron Sparks; Safari, *Nanotechnology*, Publisher: CRC Press, 1st Edition, 2017.
3. David E. Reisner, Joseph D. Bronzino, *Bionanotechnology: Global Prospects*. CRC Press, 2008.

Journals:
1. Journal of Nanotechnology
2. Nanobiotechnology Reports
3. Nanomedicine: Nanotechnology, Biology and Medicine

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 AQUACULTURE

(For Students Admitted from 2025-26)

Semester: V **Hours / Week: 2**

Subject Code: JBMBS55P **Credit: 1**

Course Objectives:

1. To provide students with hands-on experience and technical knowledge in the breeding, nutrition, and health management of freshwater and marine ornamental fishes.
2. To equip students with skills in aquarium setup, water quality monitoring, and integrated aquaculture practices including seaweed cultivation and value-added product extraction.

List of Experiments:

1. Field visit to the 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
   ii. Live (Artemia, Rotifer) and
   iii. 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 – Clownfish
7. Isolation of bacteria from fishes (Scales, gut, gills)
8. Water quality analysis and management in the aquarium by MPN method
9. Visit coastal area aquaculture, seaweed cultivation (Integrated fish farming)
10. Analysis of physico-chemical parameters affecting the 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: Set up and maintain aquariums for freshwater and marine ornamental fish.

CO2: Prepare and provide proper fish feed, including live and artificial types.

CO3: Breed and care for different ornamental fish like guppies, mollies, and clownfish.

CO4: Test and manage water quality to keep fish healthy.

CO5: Develop entrepreneurial skills through fish health management, value-added products like carrageenan, and integrated aquaculture practices.

Textbooks:

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

Reference Books:

1. Ronald W Hardy, *Fish Nutrition*. Elsevier, 2021.
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 Aquaculture & Marine Biology
2. Journal of Aquaculture, Marine Biology & Ecology
3. Journal of Phycology

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

CORE XII – FOOD MICROBIOLOGY

(For Students Admitted from 2025-26)

Semester: VI **Hours / Week: 6**
Subject Code: JBMBC61 **Credit: 6**

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; Water activity (a_w)

Unit II **(18 hours)**

Food Preservation – Principles of food preservation; Asepsis, Removal, Anaerobic conditions. Natural preservatives and Chemical preservatives; 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, Seafoods and Poultry products, 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)**

Foodborne 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.FSSAI regulations for packaging and food labeling.

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. Lelieveld H.L.M., *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. Arun K. Bhunia, *Foodborne microbial pathogens: Mechanisms and pathogenesis*, Springer, 2008.
4. Thomas J. Montville, Karl R. Matthews, Kalmia E. Kniel, *Food Microbiology: An Introduction*, American Society for Microbiology, 2012.

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 2025-26)

Semester: VI **Hours / Week: 6**
Subject Code: JBMBC62 **Credits: 6**

Course Objectives:

1. To apply the microbiology concepts toward the exploitation of microbial population for industrial and human benefits.
2. To develop the microbial strains for large-scale production and product recovery.

Unit I **(18 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 **(18 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 **(18 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 **(18 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 **(18 hours)**

Microbial Production of Industrial Products – Citric acid, Acetic acid (vinegar), Ethanol, Penicillin, Cyanocobolamine, SCP, 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 economically 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: NewYork: John Wiley & Sons, Incorporated, 2020.

Journals:

1. Journal of Food and Industrial Microbiology
2. Journal of industrial microbiology and biotechnology
3. Journal of industrial microbiology

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 MICROBIAL GENETICS, FOOD, INDUSTRIAL AND MEDICAL MICROBIOLOGY

(For Students Admitted from 2025-26)

Semester: VI **Hours/ Week: 6**
Subject Code: JBMBC63P **Credit: 4**

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. Isolation of antibiotic-resistant mutant by gradient plate method
2. Isolation of antibiotic resistance mutant by replica plating
3. Study the effect of chemical (HNO_2) and physical (UV) mutagens on bacterial cells
4. Study the survival curve of bacteria after exposure to ultraviolet (UV) light.
5. Isolation of Plasmid DNA from *E. coli*.
6. Study different conformations of plasmid DNA through Agarose gel electrophoresis.
7. Demonstration of Bacterial Conjugation.
8. Demonstration of bacterial transformation and transduction.
9. Enumeration of microorganisms from food products (egg, milk, meat and fish)
10. Determination of the quality of milk sample by Dye Reduction Test and Phosphatase test
11. Isolation and identification of *Salmonella*, *E. coli*, *Listeria*, *Proteus*, *Shigella* and *Vibrio* spp.

12. Portability analysis of drinking water by MPN method
13. Sauerkraut production
14. Production of yoghurt
15. Screening of enzyme-producing microorganisms (protease, amylase and cellulase)
16. Immobilization of yeast using sodium alginate
17. Alcohol fermentation by yeast
18. Isolation of normal flora of skin, nose, throat
19. Isolation and identification of *E. coli* from the urine sample
20. Isolation and Identification of *Staphylococcus aureus* from pus sample
21. Determination of the effectiveness of certain antibiotics (Antibiotic Sensitivity Test)
22. 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 the industrial food
CO 4: Evaluate the industrial microbiology
CO 5: Formulate the new food product and fermentation methods

Text Books:

1. Tortora G.J., Funke B.R., and Case CL. *Microbiology: An Introduction*. 9th Edition. Pearson Education., 2008.
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. Jawetz, Melnick and Adelberg's, *Medical Microbiology*, 26th edition, McGraw Hill Publication, 2013.
3. ThomasJ., Matthews,Karl; Kniel, Kalmia E., *Food Microbiology: An Introduction*, American Society, 2017.
4. Sambrook J.F., Russell D.W., *Molecular Cloning: a Laboratory Manual.*, 3rd edition, Cold Spring Harbor, N.Y. Cold Spring Harbor Laboratory Press, 2001.

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. Struhl K., Seidman J.G., Moore D.D., Kingston R.E., Brent R., Ausubel F.M., Smith J.A., hort , *Protocols in Molecular Biology: A Compendium of Methods from Current Protocols in Molecular Biology*, John Wiley & Sons Inc., New York, United States, 2002.
4. Doyle M. P. and Beuchat L. R., *Food Microbiology- Fundamentals*, Frontiers, ASM Press, 2007.

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 2025-26)

Semester: VI **Hours /Week: 5**
Subject Code: JBMBC64PW **Credit: 4**

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.

Individual Student Projects under the DBT Star Scheme:

To enhance the research aptitude and practical skills of undergraduate students, individual research projects are mandated under the DBT Star College Scheme. These projects are designed to encourage independent inquiry, scientific thinking, and hands-on research experience.

Evaluation Criteria:

Project Review Presentation: Each student is required to present the progress and outcomes of their project during scheduled review meetings during CIA. The presentation will be evaluated for a maximum of 20 marks, based on clarity, content, methodology, and presentation skills.

Attendance: Consistent participation and attendance are essential for project continuity and learning. Therefore, 5 marks will be allocated based on attendance, following the same computation method used for other theory/practical courses.

Course outcomes:
After successful completion of the course, students will be able to
CO 1: Critically observe emerging research trends and implement innovative ideas to enhance scientific inquiry
CO 2: Engage in hands-on research experiences within the domains of microbiology or life sciences to build practical expertise
CO 3: Design interdisciplinary research projects to address scientific problems effectively
CO 4: Formulate experimental solutions with a perspective of future research implications
CO 5: Develop hypotheses based on experimental outcomes and refine them through systematic analysis and interpretation

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

MULTIDISCIPLINARY COURSE V – PUBLIC HEALTH AND HYGIENE

(For Students Admitted from 2025-26)

Semester: VI **Hours /Week: 4**
Subject Code: JBMD65MB **Credit: 3**

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 the 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 the 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 hygiene and outline the attained knowledge in personal health
CO 2: Reveal the environmental condition in human health
CO 3: Impact of public hygiene on environmental pollution
CO 4: Interpret the issues related to environment affecting health and sustainable development
CO 5: Sympathize the public action against a 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. 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 hygiene

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: SCIENTIFIC WRITINGS FOR LIFE SCIENCE RESEARCH PRACTICALS

(For Students Admitted From 2025-26)

Semester: VI **Hours / Week: 2**
Subject Code: JBMBS66P **Credit: 1**

Course Objectives:

1. To equip students with the skills necessary to write and present scientific content effectively in the field of life sciences
2. To develop the ability to critically analyze, organize, and communicate experimental data through proper documentation and research reporting

Unit I **(6 hours)**

Introduction to Scientific Writing: Importance of scientific writing in life sciences, Types of scientific documents: lab reports, research papers, reviews, proposals, Ethics in scientific writing: plagiarism, data integrity, and authorship, Structure of a scientific paper (IMRAD format: Introduction, Methods, Results & Discussion).

Unit II **(6 hours)**

Writing Research Reports and Lab Notebooks: Maintaining a research/lab notebook: best practices, Writing materials and methods clearly and reproducibly, Describing observations and experimental results, Using tables, graphs, and images effectively, Summarizing findings for internal or academic reports.

Unit III **(6 hours)**

Literature Review and Referencing: Finding and reading scientific literature (using PubMed, Google Scholar), Writing a literature review: purpose and structure, Paraphrasing and summarizing scientific texts,

Citation styles (APA, MLA, Vancouver, etc.), Using reference management tools (e.g., Zotero, Mendeley).

Unit IV **(6 hours)**

Research Communication and Abstract Writing: Writing scientific abstracts and summaries, Preparing posters and slide presentations, Communicating results to scientific and general audiences, Writing cover letters, biosketches, and research proposals, Presentation of research projects – Do's and Don'ts.

Unit V **(6 hours)**

Manuscript Preparation and Publication Process: Planning and organizing a manuscript, Choosing the right journal for submission, Peer-review process: how to respond to reviewers, Common errors in scientific writing and how to avoid them, Open access and ethical considerations in publication

Course Outcomes:

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

CO1: Understand the structure and purpose of different types of scientific documents used in life science research

CO2: Maintain accurate lab records and write clear, detailed experimental reports

CO3: Perform literature reviews and use proper citation styles to avoid plagiarism

CO4: Prepare and present scientific abstracts, posters, and research proposals effectively

CO5: Draft and revise manuscripts for publication, understanding the peer-review and publication process

Text Books:

1. Angelika H. Hofmann, *Scientific Writing and Communication*, Oxford Univ Pr, USA; 2nd edition, 2014.
2. Angelika H. Hofmann, *Writing in the Biological Sciences: A Comprehensive Resource for Scientific Communication*, Oxford Univ Pr, USA, 2nd edition, 2015.

Reference Books:

1. Michael Alley, *The Craft of Scientific Writing*, Springer, 4th edition, 2018.
2. Jan A. Pechenik, A *Short Guide to Writing about Biology*, Pearson, 8th edition, 2012.
3. Robert A. Day and Barbara Gastel, *How to Write and Publish a Scientific Paper*, Cambridge University Press, 7th edition, 2012.
4. Robert A. Day and Nancy Sakaduski, *Scientific English: A Guide for Scientists and Other Professionals*, Greenwood Press, 3rd edition, 2011.

Journals:

1. American Society for Biochemistry and Molecular Biology
2. Public Library of Science
3. Nature Methods – Author & Writing Resources

E -Resources:

1. https://www.ncbi.nlm.nih.gov/pmc/
2. https://researcheracademy.elsevier.com
3. https://www.springer.com/gp/authors-editors/author-academy

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

EXTRA CREDIT V – LIFE SCIENCE FOR COMPETITIVE EXAMINATIONS

(For Students Admitted From 2025-26)

Semester: VI **Hours / Week: -**
Subject Code: JBMBX6 **Credit: 2**

Course Objectives:

1. To acquire an overall knowledge of 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 of 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 – the 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: Understand what microbes are and list their cell parts (organelles)
CO 2: Use genetic material like DNA and RNA in basic experiments or studies
CO 3: Understand the ecosystem and causes of pollution
CO 4: Identify and explain the role of genetic material in living things
CO 5: Design a simple application using genetic modification in 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 Cell Biology
2. Journal of Molecular Biology
3. Journal of Microbiology and Biotechnology

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

B.Sc., BIOTECHNOLOGY
(Three Year Regular Programme)
(For Students Admitted from June 2025-26)

Programme Educational Objectives (PEO):

PEO1: Graduates will pursue successful careers in biotechnology and allied fields by applying theoretical knowledge and practical skills in research, industry ans education.

PEO2: Graduates will contribute to scientific research, innovation, and development in areas like genetic engineering, molecular biology, microbiology and bioinformatics to address societal and industrial challenges.

PEO3: Graduates will demonstrate professional ethics, environmental responsibility, and a commitment to social well being while working in healthcare, agriculture, environmental or industrial biotechnology sectors.

Programme Outcomes (PO):

On completion of the degree programme, the students will be enabled with:

PO1: Disciplinary Knowledge: Apply fundamental knowledge of biology, chemistry, and biotechnology to understand life processes and solve problems in the field.

PO2: Laboratory Skills: Perform laboratory techniques in molecular biology, microbiology, genetic engineering with accuracy, safety, and good documentation practices.

PO3: Critical Thinking and Problem Solving: Analyze scientific data, interpret results, and develop logical conclusions using biotechnological principles to address real world biological problems

PO4 : Research aptitude: Demonstrate basic research skills including literature review, hypothesis formulation, experimental design and data analysis

PO5 : Communication skills: Communicate scientific ideas, research findings amd technical information effectively through oral presentations, reports and publications

PO6 : Environment and sustainability: Apply biotechnology knowledge to promote sustainable solutions in agriculture, health and environmental conservation

PO7: Life long learning: Recognize the importance of self directed and life long learning to stay updated with emerging trends in biotechnology and related fields

Programme Specific Outcomes:

The graduate will be able to

PSO 1: Apply knowledge of cell biology, biochemistry, and microbiology to solve biotechnology problems.

PSO 2: Acquire information on the basis of biotechnology for comprehensive and compact base which enables them to understand the emerging concepts in life sciences.

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

PSO 4: Acquire information on various domains of advanced biotechnology and their applications and research.

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

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

PSO 7: Acquire expertise in key areas such as Patent drafting and application, Artificial intelligence in diagnostic medicine, Bio-entrepreneurship, Computer aided Drug Design, Biomass and Bioenergy which will help to meet the necessities of Indian and International Biotech industries.

BSc BIOTECHNOLOGY
2025-26

PROGRAMME STRUCTURE

Sem	Part	Subject Code	Course	Subject title	Hours / Week	Credit	@ SD | ENT | EMP	$ REG | NAT | GLO	CIA	ESE	Total Marks
I	I	JBLT11	LanguageI	இக்கால இலக்கியமும் சிற்றிலக்கியமும்	5	3	SD | ENT | EMP	REG | GLO	25	75	100
		JBLA11		Basic Arabic I			SD | ENT | EMP	REG | NAT | GLO			
		JBLHB11/ JBLHA11		General Hindi I (Basic)/ Hindi Grammar &Translation (Advanced)			SD | ENT | EMP	REG | NAT | GLO			
	II	JBLEB12 / JBLEA12	LanguageII	Part II – English for Everyday Communication	5	3	SD | ENT |	REG | NAT |	25	75	100

				(Basic) & Literature and Language for Life (Advanced)			EMP	GLO			
	III	JBBTC11 / JBMBC11	Core I	Fundamentals of Microbiology	6	6	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	III	JBBTC12P / JBMBC12P	Core II	Lab Course in Fundamentals of Microbiology	6	5	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	III	JBBTA13 / JBMBA13	AECC I	Biochemistry	4	4	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	IV	JBBTS14P / JBMBS14P	SEC I	Lab Course in Microbial Biochemistry	2	1	SD | ENT | EMP	REG | NAT | GLO	-	50	50
				Library/Browsing	1	-			-	-	-
				Remedial/Games	1	-			-	-	-
		TOTAL			**30**	**22**			**125**	**425**	**550**
II	I	JBLT21	Language I	காப்பிய இலக்கியமும் புதினமும்	5	3	SD | ENT | EMP	REG | GLO	25	75	100
		JBLA21		Basic Arabic II			SD | ENT | EMP	REG | NAT | GLO			
		JBLHB21/ JBLHA21		General Hindi II (Basic) / Hindi Prose, Poem & Story (Advanced)			SD | ENT | EMP	REG | NAT | GLO			
	II	JBLEB22 / JBLEA22	Languages II	Part II – English for Academic and Social Interaction (Basic) & Critical Reading and Reflective Writing (Advanced)	5	3	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	III	JBBTC21	Core III	Basics of Genetics	5	5	SD | EMP	REG | NAT | GLO	25	75	100
	III	JBBTC22P	Core IV	Lab Course in Basics of Genetics	5	4	SD | EMP	REG | NAT | GLO	25	75	100
	III	JBBTA23	AECC II	Cell Biology	4	4	SD | EMP	REG | NAT | GLO	25	75	100
	IV	JBBTS24P /	SEC II	Basics of Bioinformatics	2	1	SD |	REG |	-	50	50

		JBMBS24P		Practicals			EMP	NAT | GLO			
	IV	JBUI2V	CVAC I	Understanding India	2	2	ENT | EMP	NAT	-	50	50
				Library/Browsing	1				-	-	-
				Remedial/Games	1				-	-	-
	V	JBBTX2/JBBTX2O	Extra Credit I	Food and Nutrition/*Online Course	-	2	ENT | EMP	REG | NAT | GLO		100	100
				TOTAL	**30**	**22 + 2**			**125**	**475+ 100**	**600 + 100**
III	I	JBLT31	LanguageI	இடைக்கால இலக்கியமும் இதழியலும்	5	3	SD | ENT | EMP	REG | GLO	25	75	100
		JBLA31		Classical Arabic Prose			SD | ENT | EMP	REG | NAT | GLO			
		JBLHB31/ JBLHA31		General Hindi III (Basic)/ Hindi Literature & Letter writing(Advanced)			SD | ENT | EMP	REG | NAT | GLO			
	II	JBLEB32 / JBLEA32	Language II	Part II – Workplace English: Foundations of English Communication Skills (Basic) & English for the Corporate World (Advanced)	5	3	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	III	JBBTC31 / JBMBC31	Core V	Molecular Biology	4	4	SD | EMP	REG | NAT | GLO	25	75	100
	III	JBBTC32P / JBMBC32P	Core VI	Lab Course in Molecular Biology	4	3	SD | EMP	REG | NAT | GLO	25	75	100
	III	JBBTA33 / JBMBA33	AECC III	Bioethics, Biosafety, Intellectual Property Rights and Bioentrepreneurship	4	4	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	IV	JBBTS34P / JBMBS34P	SEC III	Lab course in Biofertilizers Production	2	1	SD | ENT | EMP	REG | NAT | GLO	-	50	50
	IV	JBMD31BTP / JBMD31MBP	MD I	Lab Course in Mushroom Cultivation	2	1	SD | ENT | EMP	REG | NAT | GLO	-	50	50

	IV	JBES3V	CVAC II	Environmental Studies for Sustainable Development	2	2	SD | ENT | EMP	REG | NAT | GLO	-	50	50
	V	JBXTN3	Extension	NSS / CSS	2	2			100	-	100
	V	JBBTX3 / JBBTX3O / JBMBX3/JBMBX3O	Extra Credit II	Developmental Biology/ *Online Course	-	2	SD | EMP	REG | NAT | GLO	-	100	100
	TOTAL				**30**	**23 +2**			**225**	**525+100**	**750+100**
IV		JBLT41	LanguageI	பண்டைய இலக்கியமும் நாட்டுப்புறப் பாடல்களும்	5	3	SD | ENT | EMP	REG | GLO	25	75	100
		JBLA41		Hadeeth			SD | ENT | EMP	REG | NAT | GLO			
		JBLHB41/ JBLHA41		General Hindi IV (Basic) / Computer and Hindi (Advanced)			SD | ENT | EMP	REG | NAT | GLO			
		JBLEB42 / JBLEA42	LanguageII	Part II – Professional Communication Skills (Basic) & Strategic Communication for Global Careers (Advanced)	5	3	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	I	JBBTC41	Core VII	Bioprocess Technology	5	5	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	II	JBBTC42 / JBMBC42	Core VIII	Medical Microbiology and Biotherapeutics	4	4	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	III	JBBTA43 / JBMBA43	AECC IV	Bioinstrumentation and Biostatistics	4	4	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	III	JBMD41BTP / JBMD41MBP	MD II	Lab Course in Vermiculture	3	2	SD | ENT | EMP	REG | NAT | GLO	-	50	50
	III	JBBTS44P / JBMBS44P	SEC IV	Lab course in Medical lab Technology	2	1	SD | ENT | EMP	REG | NAT | GLO	-	50	50

	IV	JBDT4V	CVAC III	Digital and technology solution	2	2	SD | ENT | EMP	REG | NAT | GLO	-	50	50
	IV	JBBTX4/JBBTX4O / JBMBX4/JBMBX4O	Extra Credit III	Microbes in Human Welfare /*Online Course	-	2	SD | ENT | EMP	REG | NAT | GLO	-	100	100
	V	**TOTAL**			**30**	**24+2**			**125**	**525+100**	**650+100**
V	III	JBBTC51	Core IX	Plant and Animal Biotechnology	6	6	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	III	JBBTC52	Core X	Immunotechnology	6	6	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	III	JBBTC53P	Core XI	Lab Course in Plant and Animal Biotechnology	6	4	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	IV	JBMD51BTA /JBMD51BTB/JBMD51MBB	MD III	a. Environmental and Marine Biotechnology b. Biotechnological Techniques	4	3	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	IV	JBMD52BTA /JBMD52MBA/JBMD52BTB/JBMD52MBB	MD IV	c. Computational Drug Designing d. Bionanotechnology	4	3	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	IV	JBBTS55P/JBMBS55P	SEC V	Lab course in Aquaculture	2	1	SD | ENT | EMP	REG | NAT | GLO	-	50	50
		JBHW5V	CVAC IV	Health and wellness	2	2	SD | ENT | EMP	REG | NAT | GLO	-	50	50
	V	JBESX5	Extra Credit IV	Employability Skills	-	2	SD | ENT | EMP	REG | NAT | GLO	100	-	100
		TOTAL			**30**	**25 + 2**			**225**	**475**	**600 + 100**
	III	JBBTC61	Core XII	Nutritional Biotechnology	6	6	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	III	JBBTC62	Core XIII	Genomics and Proteomics	6	6	SD | ENT |	REG | NAT |	25	75	100

VI							EMP	GLO			
	III	JBBTC63P	Core XIV	Lab Course in Nutritional Biotechnology, Genomics and Proteomics	6	4	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	III	JBBTC64PW	Core XV	Project	5	4	SD | ENT | EMP	REG | NAT | GLO	25	75	100
	IV	JBMD65BT/JBMD65MB	MD V	Public Health and Hygiene	4	3	ENT | EMP	REG | NAT | GLO	25	75	100
	IV	JBBTS66P/JBMBS66P	SEC VI	Scientific writings for Life Science Research Practicals	2	1	SD | ENT | EMP	REG | NAT | GLO	-	50	50
	V	JBBTX6/ JBBTX6O/JBMBX6/ JBMBX6O	Extra Credit V	Life science for competitive examination / *Online Course	-	2	EMP	NAT	-	100	100
				Library / Browsing	1	-			-	-	-
	TOTAL				**30**	**24 + 2**			**125**	**425+ 100**	**550 + 100**
	Grand Total				**180**	**140 +10**			**950**	**2850 +500**	**3700 + 500**

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 2025-26)

Semester: I **Hours /Week: 6**
Subject Code: JBBTC11 **Credit: 6**

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 prokaryotes and eukaryotes.

Unit I **(18 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 **(18 hours)**

Microscopy: Simple and Compound Microscopy, Bright field, Dark field, Phase contrast, Fluorescence and Electron Microscope (SEM & TEM). Classification of Bacteria according to Bergy's Manual. Bacteria, Archea and Actinomycetes.

Unit III **(18 hours)**

Sterilization: Physical methods of Sterilization - Dry & moist heat, Filtration: Chemical methods of Sterilization; Sterilizing gases: Preparation of Microbiological media: Types of Media

Unit IV **(18 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 V **(18 hours)**

Mycology: General characteristics and Morphology of fungi, Habitat, and Morphology, Reproduction and Fruiting bodies, types of spores produced. Biological and economic importance of fungi

Phycology: General characteristics of algae, Habitat, Morphology, Pigments and Reproduction. Biological and economic importance of algae. Brief introduction on lichens, Cultivation of fresh water and marine algae

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 economic 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. Michael J.Pelczar Jr., E.C.S.Chain, Noel R.Krieg, Microbiology 6th Edition, East West Press Private Limited, 2025
3. 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 2025-26)

Semester: I **Hours/ Week: 6**
Subject Code: JBBTC12P **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. Calculations in media preparation
6. Preparation of media for the culture of microorganisms:
a. Liquid (Nutrient Broth)
b. Solid (Stab and slant)
7. Pure culture methods:
   a. Pour plate
   b. Spread plate
   c. Streak plate – simple, zigzag, T streak, quadrant and radiant.
8. Cultural characteristics of Bacteria and Fungi.
9. Enumeration of Bacteria &Fungi by serial dilution technique
10. 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
11. Wet mount preparation of protozoa
12. Bacterial motility – Hanging drop method
13. Observation of permanent slides to study the structural characteristic of Microalgae – *Cyanobacteria - Oscillatoria, Nostoc, Anabaena*
Fungi – *Aspergillus, Penicillium, Rhizopus, Yeast*

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 the aseptic 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

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	**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 - LAB COURSE IN MICROBIAL BIOCHEMISTRY
(For Students Admitted from 2025-2026)

Semester: I **Hours / Week: 2**
Subject Code: JBBTS14P **Credit: 1**

Course Objectives:
1. To understand and apply basic laboratory safety procedures, along with the preparation of buffer solutions and accurate pH measurement.
2. To perform qualitative analyses of biomolecules, including carbohydrates, proteins, amino acids, lipids, and phytochemicals, to understand their biochemical properties and significance.

List of Experiments:
1. Rules and Procedures of General Safety
2. Buffer solution preparation and pH measurement
3. Qualitative analysis of carbohydrates
4. Tests for proteins

5. Tests on amino acids
6. Qualitative tests for lipids
7. Phytochemical/Bioactive compounds analysis

Text Books:

1. Albert L. Lehninger, David L. Nelson and Michael M. Cox. Lehninger, *Principles of Biochemistry*, 2nd edition, Wiley publisher. 2010.
2. Deb A.C., *Fundamentals of Biochemistry*, 10th edition, New Central Book Agency (p) ltd, London. 2011.

References:

1. Keith Wilson and John Walker, Principles and Techniques of Practical Biochemistry, 4th edition, Cambridge University press, Britain. 1995.
2. Shawn O' Farrell and Ryan T Ranallo, Experiments in Biochemistry: A Hands-on Approach-A manual for the undergraduate laboratory, Thomson Learning, Inc., Australia. 2000.
3. Strolv B.A., Makavora V.C., Laboratory manual in Biochemistry. MIR Publisher, Moscow. 1989. Oser BL Hawks. Physiological Chemistry, TATA Mc Graw Hill. 1965.

Journals:

1. Journal of Science & Technology
2. International Journal of Advanced Research
3. International Journal of Applied Microbiology and Biotechnology

E-Resources:

1. Onlinelearning.hms.harvad.edu/biochemistry
2. Aldrin.tripod.com/biochemistry
3. https://study.com/biochemistry-class-online.html
4. Canterbury.libguides.com/bchm/websites

Course Outcomes

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

CO 1: Demonstrate proper adherence to general laboratory safety rules and procedures.
CO2: Prepare buffer solutions and accurately measure pH for biochemical experiments.
CO3: Perform qualitative tests to identify carbohydrates and proteins.
CO4: Conduct biochemical tests for amino acids and lipids.
CO5: Carry out phytochemical analysis to detect bioactive compounds in plant/fungal/bacterial extract.

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

CORE III – BASICS OF GENETICS

(For Students Admitted from 2025-26)

Semester: II **Hours / Week: 5**
Subject Code: JBBTC21 **Credit: 5**

Course Objectives:

1. To develop clear understanding of various aspects of genetics such as allelic interactions, genome organization and sex linkage
2. To enable students to better understand courses taught later such as molecular biology.

Unit I **(15 hours)**

Introduction To Genetics: Historical developments in the field of genetics. Mendelian genetics: Mendel's experimental design, monohybrid, di-hybrid crosses, Law of segregation & Principle of independent assortment; test cross and back cross, chromosomal theory of inheritance.

Unit II **(15 hours)**

Allelic Interactions: Concept of dominance, recessive, incomplete dominance, co-dominance, semi-dominance, pleiotropy, multiple allele, pseudo-allele, essential and lethal genes, penetrance and expressivity.

Unit III **(15 hours)**

Chromosome And Genomic Organization: Structure and characteristics of bacterial and eukaryotic chromosomes, chromosome morphology, concept of euchromatin and heterochromatin. Packaging of DNA molecules into chromosomes, chromosome banding pattern, karyotype, giant chromosomes, one gene, one polypeptide hypothesis.

Unit IV **(15 hours)**

Sex Determination And Sex Linkage: Mechanisms of sex determination, sex differentiation, Barr bodies, dosage compensation, genetic balance theory, sex influenced dominance, sex limited gene expression, sex linked inheritance. Genetic linkage, crossing over and chromosome mapping: Linkage and Recombination of genes in a chromosome crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Crossing over at four strand stage, Multiple crossing-over Genetic mapping.

Unit V **(15 hours)**

Extra Chromosomal Inheritance: Rules of extranuclear inheritance, maternal effects, maternal inheritance, cytoplasmic inheritance, organelle heredity, genomic imprinting. Evolution and population genetics: Inbreeding and outbreeding, Hardy Weinberg law (prediction, derivation),

allelic and genotype frequencies, changes in allelic frequencies, systems of mating, evolutionary genetics, natural selection.

Text Books:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. Principles of Genetics. VIII Edition John Wiley & Sons, 2006
2. Snustad, D.P., Simmons, M.J. Principles of Genetics. V Edition. John Wiley and Sons Inc., 2009.

Reference Books:

1. Klug, W.S., Cummings, M.R., Spencer, C.A. Concepts of Genetics. IX Edition. Benjamin Cummings., 2009
2. Russell, P. J. Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
3. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis, W. H. Freeman & Co., 2009.

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 BASICS OF GENETICS

(For Students Admitted from 2025-26)

Semester: II **Hours/ Week: 5**
Subject Code : JBBTC22P **Credits: 4**

Course Objectives:
1. To understand mitosis, meiosis and Mendelian Inheritance
2. To understand pedigree charts and genotyping

List of Experiments:
1. Permanent and temporary mount of mitosis.
2. Permanent and temporary mount of meiosis.
3. Mendelian deviations in dihybrid crosses
4. Demonstration of - Barr Body translocation.
5. Karyotyping with the help of photographs
6. Pedigree charts of some common characters like blood group, color blindness and PTC tasting.
7. Study of polyploidy in onion root tip by colchicine treatment.
8. Staining-based karyotyping analysis of cancer cells
9. Genotyping

Course Outcomes:
After successful completion of this course, the students will be able to
CO1: To understand the cell cycle
CO2: To understand karyotyping
CO3: To understand Mendelian inheritance
CO4: To understand pedigree charts
CO5: To understand genotyping

Text Books:
1. G. Koliantz and D.B. Szymanski. Genetics A Laboratory Manual, 2nd edition Spi Lab Edition, 2009.
2. Klug W.S., Cummings M.R., Spencer C.A., Palladino M.A., *Concepts of Genetics*, 12th edition, New York, NY: Pearson; 2019.

Reference Books:
1. Thomas L Mertens and Robert L. Hammersmith. *Genetics Laboratory Investigations*, 13th edition, 2006.
2. Strachan and Read. *Human Molecular Genetics*.4th Edition. Garland Science, 2010.
3. Cantor and Smith. *Genomics*, , John Wiley and Sons, Inc, 2002.
4. Brown. T.A., *Genomes*, 2nd edition, Oxford: Wiley-Liss; 2002.

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
6. http://learn.genetics.utah.edu/

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

ABILITY ENHANCEMENT COMPULSORY COURSE II – CELL BIOLOGY

(For Students Admitted from 2025-2026)

Semester: II **Hours / Week: 4**
Subject Code: JBBTA23 **Credit: 4**

Course Objectives:

1. To educate students about the fundamental concepts in eukaryotic cell biology.
2. To develop 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 the cell
CO 2: Explain the complete information on the Plasma membrane
CO 3: Reflect critically on the knowledge of 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, New York, 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.
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

SKILL ENHANCEMENT COURSE II – BASICS OF BIOINFORMATICS PRACTICALS

(For Students Admitted from 2025-2026)

Semester: II **Hours / Week: 2**
Subject Code: JBBTS24P **Credits : 1**

Course Objectives:

1. To introduce students to key bioinformatics tools and databases for retrieving, analyzing, and interpreting nucleotide and protein sequences.
2. To equip students with practical skills in gene prediction, protein structure modeling, and functional annotation using current computational tools and software.

List of experiments:

1. Introduction to bioinformatics databases (any three): NCBI/PDB/DDBJ, Uniprot, PDB
2. Sequence retrieval using BLAST
3. Sequence alignment & phylogenetic analysis using ClustalW & PHYLIP
4. Picking out a given gene from genomes using Genscan or other softwares (promoter region identification, repeat in genome, ORF prediction). Gene finding tools (Glimmer, GENSCAN), Primer designing.
5. Protein structure prediction: primary structure analysis, secondary structure prediction using PSIPRED, homology-modeling using Swiss model.
6. Molecular visualization using PyMOL, Chimera, and Jmol. , Protein structure model evaluation (PROCHECK).
7. Functional feature prediction and annotation of genes using GO and KEGG Pathway Analysis

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*, 5th Edition, Oxford Publication, 2019.
2. Lesk M.A., *Introduction to Bioinformatics*, Oxford Publication, 3rd International Student Edition, 2008.
3. Jonesand N.C. and Pevzner P.A., *An Introduction to Bioinformatics Algorithms*, Ane Books, New Delhi, 2005.

Reference Books:

1. Christina Marshall, *Bioinformatics and functional genomics*. Forest Hills, NY: Callisto, 2019.
2. Rastogi S.C., Mendiratta N. and Rastogi P., *Bioinformatics: methods and applications, genomics, proteomics and drug discovery*, 2nd ed. Prentice Hall Publication, India, 2007.
3. Primrose and Twyman, *Principles of Genome Analysis & Genomics*, Blackwell, 2003.

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
3. https://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering
4. http://amrita.vlab.co.in/index.php?sub=3&brch=273
5. 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 II – FOOD AND NUTRITION

(For Students Admitted from 2025-26)

Semester: III **Hours / Week: -**

Subject Code: JBBTX2 **Credit: 2**

Course Objectives:

1. To gain basic knowledge on macro and micronutrients and different types of food and their nutritional contribution.
2. To gain practical knowledge on market surveys and locally available food stuffs from each food group.

Unit-I

Introduction to Food and Nutrition Science: Definitions - food, food science, food additive, fermented food, food fortification, functional food, nutrition, health, nutrients, nutritional status, optimal nutrition, nutrition security.

Unit-II

Macro Nutrients: Carbohydrates - Introduction, classification, functions, dietary sources, and daily requirement. Proteins - Introduction, classification, functions, dietary sources, and daily requirement. Lipids - Introduction, classification, functions, dietary sources, and daily requirement.

Unit-III

Micro Nutrients: Fat Soluble Vitamins (A, D, E and K), Water Soluble Vitamins (Thiamin, Riboflavin, Niacin, Folate, Vitamin B12 and Vitamin C), Minerals (Calcium, Iron, Zinc, and Iodine)

UNIT - IV

Dietary Reference Intakes: Estimated average requirements, Recommended Dietary allowances, adequate intakes, Tolerable upper intake levels.

UNIT - V

Food, Nutrition and Health: Over Nutrition, Under Nutrition, Malnutrition, Balanced Diet, BMI

Course Outcomes:

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

CO1: Discuss various aspect of nutrition
CO2: Show and teach the macronutrients
CO 3: Discover the importance of various micronutrients
CO 4: Explain the dietary reference intakes
CO 5: Elaborate on nutrition and health

Text Books:

1. Srilakshmi B., *Nutrition Science*, 6th Multicolour Edition, New Age International (P) Ltd, 2017.
2. Roday S., *Food Science and Nutrition*, 2nd Edition, Oxford University Press, 2012.

Reference Books:

1. Mann J. and Truswell S., *Essentials of Human Nutrition*, 5th Edition, Oxford University Press, 2017.
2. Srilakshmi B., *Dietetics*, 7th Multicolour Edition, New Age International (P) Ltd., 2014.

3. Gopalan C , Rama Sastri B.V. and Balasubramanian S.C., *Nutritive value of Indian Foods*, Indian Council of Medical Research, 2016.

Journals:

1. Journal of Nutrition
2. American Journal of Clinical Nutrition
3. Journal of the Academy of Nutrition and Dietetics

E-RESOURCES:

1. http://www.nutrition.gov
2. http://www.usda.gov
3. http://egyankosh.ac.in
4. http://ecourses.icar.gov.in

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 2025-26)

Semester: III **Hours / Week: 4**
Subject Code: JBBTC31 **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 polyadenylation, 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. Gene editing; 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, New York, 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 2025-26)

Semester: III **Hours / Week: 4**
Subject Code: JBBTC32P **Credit: 3**

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 bacteria
3. Isolation of DNA from plant cell
4. Isolation of DNA from animal tissue
5. Separation of DNA by Agarose Gel Electrophoresis
6. Isolation of RNA by Trizol method
7. Estimation of RNA by Orcinol method
8. Estimation of Protein by Lowry's and Bradford method
9. Separation of amino acids and microbial pigments by TLC and Paper Chromatography
10. Separation of Protein by SDS-PAGE
11. Mitosis in onion root tip
12. Meiosis in flower bud.

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 *bacteria* and plant
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 III – BIOETHICS, BIOSAFETY,

INTELLECTUAL PROPERTY RIGHTS AND BIOENTREPRENEURSHIP

(For Students Admitted from 2025-2026)

Semester: III **Hours /week: 4**

Subject Code: JBMBA33 **Credits: 4**

Course Objectives:

1. Demonstrate an understanding of ethical principles, biosafety guidelines, and regulatory frameworks governing biological research and applications.
2. Apply knowledge of intellectual property rights and entrepreneurial strategies to translate biotechnological innovations into viable business ventures.

Unit I **(12 hours)**

Bioethics: Introduction and principles of Bioethics; Necessity 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, Ethical issues against the molecular technologies - environmental release of genetically modified microorganisms., different paradigms of Bioethics National & International.

Unit II **(12 hours)**

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

Unit III **(12 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 IV **(12 hours)**

Intellectual Property Right (IPR): 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.

Unit V **(12 hours)**

Bioentrepreneurship: Selection of a product, line, design and development processes, economics on material and energy requirement, stock the product and release the same for making etc. The basic regulations of excise: Demand for a given product, the feasibility of its production under given constraints of raw material, energy input, financial situations export potential etc. Innovation & Start-ups.

Course Outcomes:

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

CO1: Understand and apply core principles of bioethics and biosafety in biological research and biotechnology practise.
CO2: Analyze various types of intellectual property rights and their significance in protecting biotechnological innovations.
CO3: Evaluate national and international biosafety regulations and ethical considerations in the development and use of biotechnology.
CO4: Demonstrate knowledge of entrepreneurship in biotechnology, including business planning, funding, and commercialization of biological products.
CO5: Critically assess real-world case studies involving bioethics, IPR disputes, and successful entrepreneurial ventures.

Text Books:

1. Cornish, W. R. Intellectual property: Patents, Copyright, Trademarks, and Allied rights. Sweet & Maxwell, 1999.
2. Sibi. G., *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. Sateesh, M. K., *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	3	9	9	9	61
CO2	9	9	9	9	9	9	9	63
CO3	9	9	9	3	3	9	9	51
CO4	9	3	9	1	9	9	9	49
CO5	9	9	9	3	1	9	9	49
Total	45	95	45	22	31	45	45	273

Low-1 Medium-3 High-9

SKILL ENHANCEMENT COURSE III- LAB COURSE IN BIOFERTILIZERS PRODUCTION

(For Students Admitted From 2025-26)

Semester: III **Hours / Week: 2**

Subject Code:JBBTS34P **Credit: 1**

Course Objectives:

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

Textbooks:

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. Pakpour and Horgan., General Microbiology Lab Manual, California State University East Bay: Published, 2024.
2. Aneja K.R., *Experiments in Microbiology, Plant Pathology and Biotechnology*, Revised Fourth edition, New Age International Publishers, 2007.
3. Kannan N., *Laboratory Manual in General Microbiology*, Panima Publishers, 2002.

4. 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

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

MULTI DISCIPLINARY I - LAB COURSE IN MUSHROOM CULTIVATION

(For Students Admitted From 2025-26)

Semester: III **Hours / Week: 2**
Subject Code: JBMD31BTP **Credit: 1**

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

EXTRA CREDIT II – DEVELOPMENTAL BIOLOGY

(For Students Admitted from 2025-26)

Semester: III **Hours / Week: -**
Subject Code: JBBTX3 **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 VII - BIOPROCESS TECHNOLOGY

(For Students Admitted from 2024-25)

Semester: IV **Hours / Week: 5**

Subject Code: JBBTC41 **Credit: 5**

Course Objectives:

1. To give students a broad understanding and experience of technological processes.
2. To update students' knowledge of new developments in industrial biology relevance.

Unit I **(15 hours)**

Introduction To Industrial Bioprocess: The isolation, preservation and improvement of industrially important micro-organisms Screening methods, Storage at reduced temperature, Storage in a dehydrated form, The selection of induced mutants, use of auxotrophs, resistant mutants, revertant mutants, Modification of the permeability, use of recombination systems, protoplast fusion techniques

Unit II **(15 hours)**

Bioreactor Types And Operation Control: Fermentation systems – Batch culture, Continuous culture, Fed-batch culture, Kinetics of growth and product formation, Design of a fermenter – components of a bioreactor, various types of bioreactors for microbial, animal, plant cell culture – fluidized bed reactor, bubble column, air lift fermenter, packed bed, trickle bed etc. Aseptic operation and containment. Medium formulation, scale-up of fermentation processes.

Unit III **(15 hours)**

Downstream Processing: Downstream Processes in fermentation and bioprocess technology; Solid and liquid separation – Flocculation and Flotation, filtration and centrifugation. Cell disruption by solid and liquid shear, ultrasonication, enzyme action and mechanical disruption. Product recovery and purification principle – Precipitation, Crystallization, Liquid-Liquid extraction, Distillation, Evaporation, Chromatographic separation, Adsorption and concentration, Membrane filtration, Lyophilization, spraying, drying and packing.

Unit IV **(15 hours)**

Production Of Primary And Secondary Metabolites: A brief outline of processes for the production of some commercially important organic acids (e.g. citric acid, lactic acid, acetic acid etc.,); amino acids (glutamic acid, phenyalanine, aspartic acid etc.,) and alcohols (ethanol, butanol etc.,) Study of production processes for various classes of secondary metabolites.

Unit V **(15 hours)**

Applications: Introduction to genetic engineering, Production of recombinant proteins having therapeutic and diagnostic applications (insulin, human growth hormone & interferon), Production of recombinant vaccines (hepatitis B vaccine, cholera vaccine & vaccinia vector vaccine),

production of monoclonal antibodies, Food processing, Sweeteners, Food wastes, Rapid diagnostics, Bioremediation.

Course Outcomes:

Students will be able to acquire knowledge on

CO1: The facts, concepts, principles and theories relevant to the broad area of industrial biotechnology.

CO2: The upstream and downstream processes used for industrial production of various metabolites.

CO3: Current themes and/or insights, at/or informed by, the forefront of the Biotechnology Industry and its related disciplines.

CO4: The techniques applicable to the area of industrial biotechnology.

CO5: Processes which facilitate the critical evaluation of research, scholarship and methodologies within the area of biotechnology.

Text Books:

1. Wulf Cruger and Anneliese Crueger, *Biotechnology: A Textbook of Industrial Microbiology*, 2nd edition, Panima Publishing Corporation, 2004.
2. Casida Jr, L.E., *Industrial Microbiology*, 1st edition, New Age International (P) Ltd, 2007.

Reference Books:

1. Christoph Wittmann, James C. Liao, *Industrial Biotechnology: Products and Processes*, Wiley-VCH Verlag GmbH & Co. KGaA, 2017.
2. Presscott, Dunn, *Industrial Microbiology*, 1st edition, Agrobios (India), CBS Publication, 2004.
3. Glazer, A.N., and Nikaido, H., *Microbial Biotechnology*, W.H. Freeman & Company, NewYork, 1995.

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	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 VIII – MEDICAL MICROBIOLOGY AND BIOTHERAPEUTICS

(For Students Admitted from 2025-26)

Semester: IV **Hours / Week: 4**

Subject Code: JBBTC42 **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 and Fungal diseases: Tuberculosis, Plague, Anthrax, Meningitis, Typhoid, Tetanus – infection, infection establishment, pathogenesis, symptoms, diagnosis, treatment; Mycoses – Mycosis, Mycetoma, Histoplasmosis, Cryptococcosis, Aspergillosis - Pathogenesis, Diagnosis, and treatment

Unit III **(12 hours)**

Protozoan and Viral diseases: Amoebiasis, Giardiasis, Malaria – infection, infection establishment, pathogenesis, symptoms, diagnosis, treatment; Hepatitis, Dengue, Rabies, Pox Virus, Rubella, Ebola, Zika, SARS CoV Causative agents – pathogenesis, symptoms, transmission, diagnosis, prevention and treatment

Unit IV **(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. India's first indigenous antibiotic – Nafithromycin for resistant infections

Unit V **(12 hours)**

Biotherapeutics: Biotherapeutics agents – Bacteria, Viruses, Fungi, and associated toxin;

Probiotics, monoclonal antibodies, recombinant protein, Gene therapy, cell therapies and vaccines; biotherapeutic drugs- live biotherapeutic product, Fecal microbiota transplant- Ferring's Rebyota and Seres' Vowst. Advantages of biotherapeutics, challenges in biotherapeutics.

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. Dey, T.K., *Medical Parasitology*, La Vergne: New Central Agency, 2020.

Journal:
1. International Journal of Medical Microbiology
2. Journal of Clinical Microbiology
3. Clinical Microbiology and Infection
4. Biotherapeutics and its applications in Microbiology

E-Resources:
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 IV – BIOINSTRUMENTATION AND BIOSTATISTICS

(For Students Admitted from 2025-26)

Semester: IV **Hours / week: 4**
Subject Code: JBBTA43 **Credit: 4**

Course Objectives:

1. To provide knowledge & understanding of various advance instrument, radioisotopes and their applications. To gains knowledge of various spectroscopy, electrophoresis and its operation.
2. To emphasis the students for the application of biological databases to solve the problem in real research.

Unit I **(12 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 Hemocytometer.

Unit I **(12 hours)**

Chromatography and Spectrophotometry: 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. Principle and applications of spectrophotometer – visible, ultraviolet and infrared; Atomic Absorption Spectroscopy. Colorimetry, turbidometry, FTIR.

Unit III **(12 hours)**

Separation Techniques: Centrifugation – Basic principles of sedimentation, RCF and sedimentation coefficient; types of centrifuges, sonicator and sonication. Filters – Seitz, HEPA, Membrane; Lyophilizer.

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).

Unit IV **(12 hours)**

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

Unit V **(12 hours)**

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

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

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 bio instrumentation
CO 4: Defend the techniques which are involved in the research
CO5: Develop the practical skills for applying statistical tools in research

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.
3. 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. 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
4. 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.

Journals:

1. Medical Instrumentation
2. International Journal of Biological Instrumentation.
3. Journal of Biomedical Instrumentation and Applications
4. Brain research bulletin

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
6. https://books.google.com/books?hl=en&lr=&id=7tJMDwAAQBAJ&oi=fnd&pg

7. http://www.bnemid.byethost14.com/BIOSTATICS%202.pdf

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

MULTI DISCIPLINARY II - LAB COURSE IN VERMICULTURE

(For Students Admitted From 2025-26)

Semester: IV **Hours /Week: 2**
Subject Code: JBMD41BTP **Credit: 1**

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 fetid*
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

Low-1 Medium-3 High-9

SKILL ENHANCEMENT COURSE IV - LAB COURSE IN MEDICAL LAB TECHNOLOGY

(For Students Admitted from 2025-26)

Semester: IV **Hours / Week: 2**

Subject Code: JBBTS44P **Credit: 1**

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
2. Blood Sample collection, Separation and Transportation
3. Blood grouping– A, B, O, AB, H
4. Bleeding Time and Clotting Time
5. Total WBC and Total RBC
6. Differential Cell count
7. Estimation of Hemoglobin
8. Estimation of Blood Sugar, Urine Sugar, Urine Albumin and Deposits
9. Estimation of Bile Salt and Bile pigment (BSBP)
10. Erythrocytes Sedimentation Rate (E.S.R)
11. Agglutination test (ASO, CRP, RF)
12. Widal slide agglutination
13. Microscopic Examination of Malarial Parasites (Pf & Pv)
14. Urine - Urine Pregnancy Test (UPT)
15. Field visit to 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
4. http://applyonline.itmuniversity.org/Images/biochemistry/BSc_MLT.pdf
5. 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 2025-26)

Semester: IV **Hours / week: -**
Subject Code: JBBTX4 **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; wastewater 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 the technique for human welfare
CO 4: Determine the concepts of these techniques 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 - PLANT AND ANIMAL BIOTECHNOLOGY

(For Students Admitted from 2025-26)

Semester: V **Hours / week: 6**
Subject Code: JBBTC51 **Credit: 6**

Course Objectives:

1. Provide training in the science behind plant biotechnology
2. Familiarize the students with fundamentals of different culturing and propagation techniques of animals

Unit I **(18 hours)**

Introduction to Plant Tissue Culture: Introduction Importance and history of in vitro culture, nutritional requirements, media components (MS and White's media; Basal and supplemented animal cell culture media for normal and cancer cells), sterilization techniques, culture lab architecture.

Unit II **(18 hours)**

Micropropagation: Micropropagation and haploid production Micropropagation, axillary bud, shoot-tip and meristem culture, callus culture. Haploid production and their applications. Somaclonal variations and applications.

Unit III **(18 hours)**

Protoplast culture: Protoplast culture and cybrids Principles of protoplast isolation and applications. Testing of viability of isolated protoplasts. Various steps in the regeneration of protoplasts. Introduction of somatic hybridization, various methods for fusing protoplasts, chemical and electrical, cybrids- definition and application.

Unit IV **(18 hours)**

Animal Tissue Culture: Animal Cell culture Introduction of animal cell culture substrate, culture media, preservation and maintenance of cell lines, Transgenic animals. Test tube baby, In vitro fertilization and embryo transfer.

Unit V **(18hours)**

Applications: Applied plant and animal Biotechnology Growth factors promoting the proliferation of animal cells (EGF, FGF, PDGF, IL-1, IL-2, NGF, and erythropoietin). Production of monoclonal antibodies. Bioreactors for large-scale culture of animal cells. Transgenic plants for abiotic Transgenic plants for abiotic and biotic stress tolerance (virus, herbicide, salt) delay in fruit ripening, fortified crops, plants as therapeutic factories. Cytoplasmic male sterility, somatic embryos and artificial seeds, elite germplasm screening by molecular biology tools.

Course Outcomes:

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

CO1: Learn about the basic principles of plant and animal biotechnology

CO2: Learn about the techniques and tools used in plant and animal research

CO3: Gain practical skills in plant tissue culture and animal cell culture

CO4: Apply knowledge to real-world challenges in agriculture, veterinary medicine, conservation, and biomedical research

CO5: Design strategies to increase plant yield and fruit/seed quality

Text Books:

1. Razdan, M.K., *An Introduction to Plant Tissue Culture*, Oxford and IBH Publishing, 2020.
2. Caldenty K.M.O. and Barz W.H., *Plant Biotechnology and Transgenic Plants*, CRC Press, 1st edition, 2002.
3. Clynes M., *Animal Cell Culture Techniques*, Springer Verlag, 1998.
4. Butler M. and DawsonM. , *Cell Culture Lab Fax*, Bios scientific Publications Ltd,1992.

Reference Books:

1. Dodds J.H., and Roberts L.K., *Experiments in Plant Tissue Culture*, Cambridge University Press, 1985.
2. Fu T-J., Singh G., and Curtis W.R. , *Plant Cell & Tissue Culture for the production of Food Ingredients*, Kluwer Academic/Plenum Press, 1999.
3. Davey M.R., & Anthony P., *Plant Cell Culture: Essential Methods*, Wiley-Blackwell, 2010.
4. Slater A., Scott N. & Fowler M., *Plant Biotechnology: The Genetic Manipulation of Plants*, Oxford University Press, Oxford, 2003.
5. Moraes L., Augusto A. E. & Butler M., "Animal Cell Technology: from Biopharmaceuticals to Gene Therapy", Taylor & Francis, 2008.
6. Butler M., *Animal Cell Culture and Technology*, 2nd edition, Bios Scientific, Oxford, 2004.

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	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 X- IMMUNOTECHNOLOGY

(For Students Admitted from 2025-26)

Semester: V **Hours / week: 6**
Subject Code: JBBTC52 **Credit: 6**

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 defence system of the body.

Unit I **(18 hours)**

Introduction to Immunology: Introduction and History; Properties of the immune response, active and passive immunization; Innate and acquired immunity; humoral and cell-mediated immunity; Cells & Tissues of Immune System.

Unit II **(18 hours)**

Antigen And Antibody: Antigen and immunogen; antigenicity vs immunogenicity; Different characteristics of antigens, mitogens, Hapten, Immunogen, Adjuvants; Molecular structure of antibody; antigen-antibody interaction; Hybridoma technology.

Unit III **(18 hours)**

Molecular Immunology: MHC molecule- types, structure and functions; MHC self-restriction, antigen processing and presentation, inflammation pathway and compliment pathways.

Unit IV **(18 hours)**

Clinical Immunology: Immune system and human health; Microbial immunology, autoimmunity, hypersensitivity, transplantation immunology; Cancer immunity

Unit V **(18hours)**

Immunological Techniques: Precipitation, agglutination, Immuno diffusion, Immunoelectrophoresis, ELISA, RIA, western blot, immunoprecipitation. Fluorescence-activated cell sorter.

Course Outcomes:

CO1: To develop and extend the knowledge of cellular and molecular components of the human immune system.
CO2: Understanding the mechanisms involved in immune system development and responsiveness.
CO3: To allow you to gain laboratory skills by using methods to recognize, isolate and culture leukocytes and study their functions and to use antibodies for quantification in laboratory practical classes
CO4: To allow you to develop and practice a range of transferable skills during the practicals, including teamwork, software applications and data analysis.
CO5: To understand about how immunologists think and work.

Text Books:

1. Paul W.E., *Fundamentals of Immunology*, Raven Press, New York, 2012.
2. Goldsby R. A., Kindt T.J., OsborneB.A., Kuby- Immunology, 4th Edition, 2000.

References:

1. Ivan Riot, *Essentials of Immunology*, Blackwell Scientific Publications, Oxford, 6th Edition, 1988.
2. Harlow and David Lane, *Antibodies A Laboratory Manual*: Cold Spring Harbor Laboratory, 1988.

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 PLANT AND ANIMAL BIOTECHNOLOGY

(For Students Admitted from 2025-26)

Semester: V **Hours / Week: 6**
Subject Code: JBBTC53P **Credit: 4**

Course Objectives:

1. To learn how to collect, identify, and conserve plant and animal bioresource.
2. To study how to perform cell and tissue culture, and genetic transformation.

List of Experiments:

1. Sterilization techniques
2. Preparation of plant tissue culture media
3. Preparation and decontamination of explants
4. Inoculation of culture and incubation for callusing/ in vitro morphogenesis
5. Cell suspension culture
6. Preparation of animal cell culture media and sterilization
7. Separation and isolation of animal cells and their microscopic examination
8. DNA isolation from animal tissue
9. Qualitative and quantitative estimation of isolated DNA

Course Outcomes:

After successful completion of the course, students will be able to
CO 1: Learn about the basics of plant and animal biotechnology
CO 2: Learn about the techniques and tools used in plant and animal research
CO 3: Develop practical skills in plant tissue culture and animal cell culture
CO 4: Design strategies for genetic manipulation of plants and animals
CO 5: Apply knowledge to real-world challenges in agriculture, veterinary medicine, conservation, and biomedical research

Text Books:

1. Chawla H. S., *Introduction to plant biotechnology*, Enfield, N.H.: Science Publishers, c2000.

2. Satyanarayana U., "*Biotechnology*", Books and Allied (p) Ltd., 2008.
3. Ranga M., "Animal Biotechnology", Studam publishers, 2006.

Reference books:

1. Watson. J. S., Gillman. M., Witknowski. J. and Zoller. M., "Recombinant DNA", 2nd edition - Scientific American Books, NY, 1992.
2. Dodds J.H., and Roberts L.K., Experiments in Plant Tissue Culture, Cambridge University Press, 1985.
3. Butler M., *Animal Cell Culture and Technology*, 2nd edition, Bios Scientific, Oxford, 2004.

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	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

MULTI DISCIPLINARY III a - ENVIRONMENTAL AND MARINE BIOTECHNOLOGY

(For Students Admitted from 2025-26)

Semester: V **Hours / Week: 4**
Subject Code: JBMD51BTA **Credit: 3**

COURSE OBJECTIVES:

1. To learn the environment protection Act and Law related to marine and environmental biotechnology

2. To give basic idea on environmental sample analysis, Bioremediation, Biooxidation and microbial leaching

UNIT I **(12 hours)**

Introduction To Environmental Biotechnology: Water, Soil and Air: their sources and effects. Removal of Specific Pollutants: Sources of Heavy Metal Pollution, Microbial Systems for Heavy Metal Accumulation, Biosorption & Detoxification Mechanisms. Environment Protection Act: Environmental laws, Environmental policies, Environmental ethics.

UNIT II **(12 hours)**

Waste Water Management: Wastewater constituents, Analysis and selection of flow rates and loadings, Process Selection, Physical unit operations, Chemical unit operations, Fundamentals of biological treatment, Role of biotechnology in water purification systems

UNIT III **(12 hours)**

Bioremediation and Biodegradation: Bioremediation – Types of bioremediation, Bioremediation of Surface Soil and Sludges; Principles and applications of Bioaccumulation, Biomagnification, Biodegradation; Microbial Degradation of Hydrocarbons – Methane, alkanes; Biodegradation of pesticides. Bio corrosion, Bio leaching and Biofouling.

UNIT IV **(12 hours)**

Marine microorganisms: 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 (IMTECH, MTCC, ATCC, IMTECH, UTEX); Microbial nutrition – influence of environment factors on microbial growth, activity and distribution

Unit - V **(12 hours)**

Applications: Microalgal biotechnological applications in nutrition, health and environment. Biofuels and Biofertilizer: Biogas, Ethanol, Diesel and Hydrogen production by algae. Seaweed fertilizer and algae as Biofertilizer.

Course Outcomes:

CO1: Understand the concepts, types, and factors influencing natural bioremediation processes.
CO2: Analyze the applications, advantages, and limitations of various bioremediation technologies, including water sample analysis.
CO3: Apply molecular techniques utilized in wastewater management and bioremediation.
CO4: Evaluate the methods and challenges involved in the bioremediation of nuclear waste.
CO5: Design and propose sustainable bioremediation strategies for different environmental pollutants using advanced biotechnological tools.

Text Books:

1. Sivaramakrishnan S., Rajasekaran P. and Balasubramanian T., *Marine Biotechnology: Concepts and Applications*, PHI Learning Pvt. Ltd., New Delhi, 1st Edition, 2013.

2. Ajay Kumar, Environmental Biotechnology, APH Publishing Corporation, New Delhi, 1st Edition, 2014.

References:

1. SetlowJ. K, *Environmental Microbiology*, Wiley-Liss, 2nd Edition, 2011.
2. Pal S.R., Jha M.K., *Marine Biotechnology: Applications in Food, Pharmaceuticals and Environmental Remediation*, CRC Press, 1st Edition, 2017.
3. Rai B., and Singh D., *Environmental Biotechnology: Principles and Applications*, IK International Publishing House, 1st Edition, 2016.

Journals:

1. Annals of Applied Biology
2. Journal of bacteriology
3. New phycologist

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	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

MULTI DISCIPLINARY III: b. BIOTECHNOLOGICAL TECHNIQUES

(For Students Admitted from 2025-26)

Semester: V **Hours / Week: 4**
Subject Code: JBMD51BTB **Credit: 3**

Course Objectives:

1. To understand microbes for the development of various products.
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 nanostructures, 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 – Sheep, Mice, and Fish; 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

MULTI DICIPLINARY IV – a. COMPUTATIONAL DRUG DESIGNING

(For Students Admitted from 2025-26)

Semester: V **Hours / Week: 4**
Subject Code: JBMD52BTA **Credit: 3**

Course Objectives:
1. To learn about the different sources of drug discovery and the challenges in the pharmaceutical industry.
2. To learn how drugs interact with receptors and macromolecules at the molecular level

Unit I **(12 hours)**

Drug Design: Introduction to Computer Aided Drug Design (CADD) History, different technique sand applications Quantitative Structure Activity Relationships: Basics History and development of QSAR: Physicochemical parameters and methods to calculate physicochemical parameters: Hammett equation and electronic parameters (sigma), lipophilicity effects and parameters (log P,

disubstituent constant), steric effects (Taft steric and MR parameters)

Unit II **(12 hours)**

Quantitative Structure Activity Relationships: Quantitative Structure Activity Relationships: Applications Hansch analysis, Free Wilson analysis and relationship between them, Advantages and disadvantages; Deriving 2D-QSAR equations 3D-QSARapproaches and contour map analysis Statistical methods used in QSAR analysis and importance of statistical parameters

Unit III **(12 hours)**

Molecular Modeling and Docking: Molecular Modeling and Docking - Molecular and Quantum Mechanics in drug design, Energy Minimization Methods: comparison between global minimum conformation and bioactive conformation and Molecular docking and drug receptor interactions: Rigid docking, flexible docking and extra-precision docking.

Unit IV **(12 hours)**

Molecular Properties and Drug Design: Molecular Properties and Drug Design: a) Prediction and analysis of ADMET properties of new molecules and its importance in drug design. b) De novo drug design: Receptor/enzyme-interaction and its analysis, Receptor/enzyme cavity size prediction, predicting the functional components of cavities, Fragment based drug design. c) Homology modeling and generation of 3D-structure of protein.

Unit V **(12hours)**

Virtual Screening: Pharmacophore Mapping and Virtual Screening Concept of pharmacophore, pharmacophore mapping, identification of Pharmacophore features and Pharmacophore modeling; Conformational search used in pharmacophore mapping In Silico Drug Design and Virtual Screening Techniques Similarity based methods and Pharmacophore based screening, structure based In-silico virtual screening protocols.

Course Outcomes:

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

CO1: Explain the various stages of drug discovery
CO2: Learn the concept of cause and drug resistance
CO3: Describe physicochemical Properties and the techniques involved in QSAR
CO4: Learn introduction to Bioinformatics and Cheminformatics
CO5: Explain the various techniques in Virtual Screening

Text Books:

1. Voit E., *A First Course in Systems Biology*, Garland Science, 1st edition, 2012.
2. Robert M. Stroud and Janet.F. Moore, *Computational and structural approaches to drug discovery*, RCS Publishers, 2006

Reference books:

1. Young. D. C., *Computational Drug Design - A Guide for Computational and Medicinal Chemist*, John Wiley & Sons, Inc., Hoboken, New Jersey, 2009.
2. Hinchliffe, *Molecular Modelling for Beginners*, John Wiley & Sons Ltd, England, 2008.

3. Martin Y.C., *Introduction to Quantitative Drug Design*, CRC Press, Taylor & Francis group, 2000.
4. Smith and Williams, *Principles of Drug Design*, CRC Press, Taylor & Francis, 2010.

Journals:

1. Journal of Computer-Aided Molecular Design
2. Computer-aided drug design
3. Chemical Biology & Drug Design

E-Resources:

1. https://pharmacyconcepts.in/wp-content/uploads/2022/06/Drug-Design.pdf
2. https://www.researchgate.net/publication/41554841_Systems_Biology_A_Textbook
3. https://www.coursera.org/learn/drug-discovery
4. https://www.coursera.org/learn/drug-development
5. https://www.vbspu.ac.in/e-content/Alok-Dash/drug%20design.pdf

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

MULTI DISCIPLINE III: b. BIONANOTECHNOLOGY

(For Students Admitted from 2025-26)

Semester: V **Hours /Week: 4**
Subject Code: JBMD52BTB **Credit: 3**

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 nanobiotechnology

Unit I **(12 hours)**

Nanostructure and biomaterial – Bionanotechnology – Definition, History of bionanotechnology – Richard Feynman and his contributions; Classification of Nanostructures – 0D, 1D, 2D and 3D, Nanomaterial in biotechnology - nanoparticles, quantum dots, nanotubes and nanowires etc.

Unit II **(12 hours)**

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

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 VIS Spectroscopy, Raman effect, FT-IR, XRD, SEM, TEM, Atomic force Microscopy.

Unit V **(12 hours)**

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

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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. Christof M. Niemeyer, Chad A. Mirkin, *Nanobiotechnology: Concepts, Applications and Perspectives*, Wiley VCH, 2004.
2. Chad A. Mirkin and Christof M. Niemeyer, *Nanobiotechnology - II more concepts and applications*, Wiley VCH., 2007.

Reference Books:

1. Anil Kumar Anal, *Bionanotechnology: Principles and applications*, CRC Press, Taylor and Francis group, 2018.
2. Sherron Sparks; Safari, *Nanotechnology*, Publisher: CRC Press, 1st Edition, 2017.
3. David E. Reisner, Joseph D. Bronzino, *Bionanotechnology: Global Prospects*. CRC Press, 2008.

Journals:

1. Journal of Nanotechnology
2. Nanobiotechnology Reports
3. Nanomedicine: Nanotechnology, Biology and Medicine

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 AQUACULTURE

(For Students Admitted from 2025-26)

Semester: V **Hours / Week: 2**
Subject Code: JBBTS55P **Credit: 1**

Course Objectives:

1. To provide students with hands-on experience and technical knowledge in the breeding, nutrition, and health management of freshwater and marine ornamental fishes.
2. To equip students with skills in aquarium setup, water quality monitoring, and integrated aquaculture practices including seaweed cultivation and value-added product extraction.

List of Experiments:

1. Field visit to the 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 – Clownfish
7. Isolation of bacteria from fishes (Scales, gut, gills)
8. Water quality analysis and management in the aquarium by MPN method
9. Visit coastal area aquaculture, seaweed cultivation (Integrated fish farming)
10. Analysis of physico-chemical parameters affecting the 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: Set up and maintain aquariums for freshwater and marine ornamental fish.

CO2: Prepare and provide proper fish feed, including live and artificial types.

CO3: Breed and care for different ornamental fish like guppies, mollies, and clownfish.

CO4: Test and manage water quality to keep fish healthy.

CO5: Develop entrepreneurial skills through fish health management, value-added products like carrageenan, and integrated aquaculture practices.

Textbooks:

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

Reference Books:

1. Ronald W Hardy, *Fish Nutrition*. Elsevier, 2021.
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 Aquaculture & Marine Biology
2. Journal of Aquaculture, Marine Biology & Ecology
3. Journal of Phycology

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

CORE XII - NUTRITIONAL BIOTECHNOLOGY

(For Students Admitted from 2025-26)

Semester: VI **Hours / week: 6**
Subject Code: JBBTC61 **Credit: 6**

Course Objectives:

1. To explore the application of biotechnology in improving the nutritional quality and safety of food.
2. To understand the development and use of functional foods, nutraceuticals, and genetically modified organisms (GMOs) for enhancing human health.

Unit I **(18 hours)**

Introduction to Nutritional Biotechnology: Scope and significance of nutritional biotechnology, Role of biotechnology in improving nutritional quality, Overview of human nutrition: macronutrients and micronutrients, Nutrient deficiencies and global malnutrition, Genetically modified foods (Golden Rice, biofortified crops).

Unit II **(18 hours)**

Food Biochemistry and Metabolism1: Digestion and absorption of carbohydrates, proteins, and lipids, Micronutrient metabolism (vitamins and minerals), Enzymes in digestion and nutrient assimilation, Metabolic pathways and regulation (Glycolysis, TCA cycle, Beta-oxidation), Nutritional biomarkers and their applications

Unit III **(18 hours)**

Functional Foods and Nutraceuticals: Concept and classification of functional foods, Probiotics, prebiotics, synbiotics. Nutraceuticals: definition, types, sources (plant-based, marine-based, microbial), Bioavailability and bioaccessibility of nutraceuticals
Case studies: Omega-3 fatty acids, antioxidants, dietary fibers

Unit IV **(18 hours)**

Microbial and Genetic Applications in Nutrition: Role of microbes in food fermentation (yogurt, kefir, sauerkraut, etc.), Biotechnology in vitamin and amino acid production, Genetic engineering for nutrient enhancement (Iron, Zinc, Vitamin A), CRISPR and omics technologies in nutrition,Applications of metabolomics and nutrigenomics

Unit V **(18 hours)**

Food Safety, Regulations, and Quality Control: Food additives and preservatives: biotechnology perspective, Assessment of food safety: HACCP, FSSAI, Codex Alimentarius, GMO safety and regulatory frameworks, Labeling of nutraceuticals and fortified foods, Ethical issues and public perception of biotech foods

Course Outcomes:

CO1: Explain the role of biotechnology in enhancing the nutritional content and bioavailability of food components.

CO2: Analyze the metabolic functions of essential nutrients and the impact of nutrient deficiencies on human health.
CO3: Evaluate the use of probiotics, prebiotics, and nutraceuticals in promoting health and preventing disease.
CO4: Apply knowledge of genetic engineering and microbial biotechnology in the development of functional and fortified foods.
CO5: Assess food safety, regulatory standards, and ethical considerations related to the production and consumption of biotech-based food products.

Text Books:
1. Vinod K. Joshi and Ram S. Singh, *Food Biotechnology: Principles and Practices*, I.K. International Publishing House Pvt. Ltd., New Delhi, 2012.
2. Darshan Malik, Nandita Narayanasamy, PratyushaV.A. , Jayita Thakur, and Nimisha Sinha, *Nutritional Biochemistry*, Springer Nature Singapore, 1st edition, 2023.
3. Robert E.C. Wildman, *Handbook of Nutraceuticals and Functional Foods*, CRC Press, 3rd edition, 2017.

Reference Books:
1. John W. Brady, *Introductory Food Chemistry*, Comstock Publishing Associates, Cornell University Press, Ithaca, USA. 2013.
2. Virendra Kumar Pandey, *Textbook of Food Microbiology*, INSC International Publishers, 2021.
3. Mudambi R.S. and Rajagopal M.V., *Fundamentals of Foods, Nutrition and Diet Therapy*, Wiley Eastern Ltd, 2012.
4. Gibson G.R. and Roberfroid M.B., *Dietary Modulation of the Human Colonic Microbiota: Updating the Concept of Prebiotics*, Cambridge University Press, 2007.

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 XIII - GENOMICS AND PROTEOMICS

(For Students Admitted from 2025-26)

Semester: VI **Hours / week: 6**
Subject Code: JBBTC62 **Credit: 6**

Course Objectives:

1. To offer basic knowledge of genome sequencing methods and functional genomics
2. To provide introduction to proteomics and tools to analyze

Unit I **(18 hours)**

Introduction To Genomics: Genomes of prokaryotes and eukaryotes, the molecular structure of the gene; Human Genome Project- history, goals, findings, applications, HUGO, HapMap Project, Genomes of model organisms- Viral, bacterial, worm, fruit fly, plant.

Unit II **(18 hours)**

DNA Sequencing Methods: Maps-Linkage maps, Physical mapping methods-Banding patterns, Restriction maps, STS content; DNA sequencing- Sanger‘s dideoxy method, automated DNA sequencing method; High-throughput sequencing-Roche 454, Helicos, Illumina, SOLiD, Nanopore.

Unit III **(18 hours)**

Functional Genomics: Northern blotting, Subtractive hybridization, Differential Display Reverse Transcription, Representational Difference Analysis (RDA), Serial Analysis Gene Expression (SAGE), Microarray technology.

Unit IV **(18 hours)**

Introduction To Proteomics: Introduction to proteome- protein families, 1D and 2D PAGE, Isoelectric focusing, liquid chromatography-HPLC, Tandem LC; Protein Digestion Techniques; Mass Spectrometers- MALDI-TOF MS, ESI Tandem MS, Q-TOF and Fourier Transform Ion Cyclotron Resonance MS; Peptide Mass Fingerprinting.

Unit V **(18 hours)**

Applications of Proteomics: Proteome mining; Protein Expression Profiling; Identifying Protein–Protein Interactions-IP and Co-IP, Bait and reverse bait; Mapping Protein Modifications; Phospho and Glycoproteomics.

Course Outcomes:

At the end of the course students will be

CO1: Describe the basic structure and organization of the genome, and explore various genomic databases.
CO2: Apply different tools and techniques used in genome sequencing.
CO3: Explain the concepts of functional genomics and utilize relevant analytical tools.
CO4: Interpret the principles of proteomics and apply appropriate tools for proteomic analysis.
CO5: Demonstrate an understanding of the fundamentals of proteomics and its diverse applications.

Text Books:

1. Nachimuthu Saraswathy and Ponnusamy Ramalingam, *Concepts and Techniques in Genomics and Proteomics*, Biohealthcare Publishing (Oxford) Limited, 2011.

References:

1. Arthur M. Lesk Introduction to Genomics. 2nd Edition, Oxford University, 2012.
2. Press.Daniel C. Liebler, *Introduction to Proteomics: Tools for the New Biology*, Humana Press Inc. Totowa, NJ, 2002.

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_andgenomes-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	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 XIV - LAB COURSE IN NUTRITIONAL BIOTECHNOLOGY, GENOMICS AND PROTEOMICS

(For Students Admitted from 2025-26)

Semester: VI **Hours / week: 6**
Subject Code: JBBTC63P **Credit: 4**

Course Objectives:

1. To examine microbial contamination and spoilage of food, and evaluate preservation methods used to control microbial growth.
2. To analyze food-borne infections and intoxications, and assess the role of sanitation and hygiene in the food industry.

List of Experiments:

1. Proximate analysis of food samples (Determination of protein, Determination of carbohydrate, Determination of fat, Determination of moisture content, Determination of ash content, Determination of fiber content)
2. Determination of chemical constituents of foods.
3. Indirect and Direct Determination of the Casein Content of Milk
4. Microbial analysis of food
5. Food preservation techniques
6. Exploring Genome Databases
7. Retrieving Genome sequences from NCBI using SRA toolkit
8. Using different types of BLAST program
9. Genome annotation: DNA prediction methods
10. Protein-Protein Interaction Prediction

Course Outcomes:

After completion of the course students,

CO1: Demonstrate an understanding of the fundamental principles and techniques used in a food biotechnology laboratory.

CO2: Explain the significance of proximate analysis in evaluating the nutritional composition of food.

CO3: Analyze the chemical constituents of food using appropriate biochemical methods.

CO4: Apply various tools and techniques for genomic analysis in food biotechnology.

CO5: Utilize online bioinformatics tools to analyze and interpret proteomic data.

Text Books:

1. Neelima Garg, K.L., Garg and K.G., Mukerji, *Laboratory Manual of Food Microbiology*, Wiley Publications, 2020.
2. Andreas D. Baxevanis, Gary D. Bader & David S. Wishart**,** *Bioinformatics -4th edition*. Wiley publication, 2020.
3. Jean-Michel Claverie, & Cedric Notredame, *Bioinformatics for Dummies*, Wiley publication, 2006.

Reference Books:

1. Poonam Shakya, Shilpa Gajbhiye, Serlene Tomar,Ajay Rai and Anju Nayak., *A Practical Manual on Food Microbiology and Food safety*, Weser books, 2022.
2. Arthur M. Lesk, *Introduction to Genomics*, 2nd Edition, Oxford University, 2012. Press.Daniel C. Liebler, *Introduction to Proteomics: Tools for the New Biology*, Humana Press Inc. Totowa, NJ, 2002.

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

MULTI DISCIPLINARY V - PUBLIC HEALTH AND HYGIENE

(For Students Admitted from 2025-26)

Semester: VI **Hours /Week: 4**
Subject Code: JBMD65BT **Credit: 3**

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 hygiene

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 - SCIENTIFIC WRITINGS FOR LIFE SCIENCE RESEARCH PRACTICALS

(For Students Admitted From 2025-26)

Semester: VI **Hours / Week: 2**
Subject Code: JBBTS66P **Credit: 1**

Course Objectives:

1. To equip students with the skills necessary to write and present scientific content effectively in the field of life sciences
2. To develop the ability to critically analyze, organize, and communicate experimental data through proper documentation and research reporting

Unit I **(6 hours)**

Introduction to Scientific Writing: Importance of scientific writing in life sciences, Types of scientific documents: lab reports, research papers, reviews, proposals, Ethics in scientific writing:

plagiarism, data integrity, and authorship, Structure of a scientific paper (IMRAD format: Introduction, Methods, Results & Discussion).

Unit II **(6 hours)**

Writing Research Reports and Lab Notebooks: Maintaining a research/lab notebook: best practices, Writing materials and methods clearly and reproducibly, Describing observations and experimental results, Using tables, graphs, and images effectively, Summarizing findings for internal or academic reports.

Unit III **(6 hours)**

Literature Review and Referencing: Finding and reading scientific literature (using PubMed, Google Scholar), Writing a literature review: purpose and structure, Paraphrasing and summarizing scientific texts, Citation styles (APA, MLA, Vancouver, etc.), Using reference management tools (e.g., Zotero, Mendeley).

Unit IV **(6 hours)**

Research Communication and Abstract Writing: Writing scientific abstracts and summaries, Preparing posters and slide presentations, Communicating results to scientific and general audiences, Writing cover letters, biosketches, and research proposals, Presentation of research projects – Do's and Don'ts.

Unit V **(6 hours)**

Manuscript Preparation and Publication Process: Planning and organizing a manuscript, Choosing the right journal for submission, Peer-review process: how to respond to reviewers, Common errors in scientific writing and how to avoid them, Open access and ethical considerations in publication

Course Outcomes:

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

CO1: Understand the structure and purpose of different types of scientific documents used in life science research

CO2: Maintain accurate lab records and write clear, detailed experimental reports

CO3: Perform literature reviews and use proper citation styles to avoid plagiarism

CO4: Prepare and present scientific abstracts, posters, and research proposals effectively

CO5: Draft and revise manuscripts for publication, understanding the peer-review and publication process

Text Books:

1. Angelika H. Hofmann, *Scientific Writing and Communication*, Oxford Univ Pr, USA; 2nd edition, 2014.
2. Angelika H. Hofmann, *Writing in the Biological Sciences: A Comprehensive Resource for Scientific Communication*, Oxford Univ Pr, USA, 2nd edition, 2015.

Reference Books:

1. Michael Alley, *The Craft of Scientific Writing*, Springer, 4th edition, 2018.
2. Jan A. Pechenik, A *Short Guide to Writing about Biology*, Pearson, 8th edition, 2012.
3. Robert A. Day and Barbara Gastel, *How to Write and Publish a Scientific Paper*, Cambridge University Press, 7th edition, 2012.
4. Robert A. Day and Nancy Sakaduski, *Scientific English: A Guide for Scientists and Other Professionals*, Greenwood Press, 3rd edition, 2011.

Journals:

1. American Society for Biochemistry and Molecular Biology
2. Public Library of Science
3. Nature Methods – Author & Writing Resources

E -Resources:

1. https://www.ncbi.nlm.nih.gov/pmc/
2. https://researcheracademy.elsevier.com
3. https://www.springer.com/gp/authors-editors/author-academy

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

EXTRA CREDIT V - LIFE SCIENCE FOR COMPETITIVE EXAMINATIONS

(For Students Admitted From 2025-26)

Semester: VI **Hours / Week: -**
Subject Code: JBBTX6 **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

DIPLOMA IN MARINE ORNAMENTAL FISH CULTURE
(1 YEAR PROGRAMME)

Programme Specific Outcomes (PSOs):

Upon successful completion of this diploma program, the students will be able to:

1. **Identify and Classify** marine ornamental fish species with knowledge of their biological characteristics, habitat preferences, and trade relevance.
2. **Apply Breeding and Hatchery Techniques** for selected marine ornamental species such as clownfishes and damselfishes, including broodstock management, larviculture, and seed production.
3. **Operate and Maintain Marine Aquaria**, including setup, biological filtration, gadget integration, and water quality management tailored to marine ornamental species.
4. **Culture and Manage Live Feeds** such as microalgae, rotifers, Moina, and Artemia essential for feeding ornamental fish at various life stages.
5. **Plan and Manage Small-Scale Hatchery Units**, including economic planning, disease control, marketing strategies, and sustainable trade practices.

DIPLOMA IN MARINE ORNAMENTAL FISH CULTURE
(1 YEAR PROGRAMME)
Programme Structure

Sem	Subject code	Subject	Hours/Week	Credits	Internal	External	Total
I	JDMRF1	Principles of Aquaculture	6	6	25	75	100
	JDMRF2	Introduction to Marine Ornamental Fish Culture	6	6	25	75	100
	JDMRF3P	Practicals in Water Quality Analysis in Fish Culture	6	5	25	75	100
	JDMRF4	Fish Health and Disease Management	6	6	25	75	100
		Library	6	2	-	-	-
	Total		30	25	**100**	**300**	**400**

II	JDMRF5	Fish Feed Technology	6	6	25	75	100
	JDMRF6	Breeding, Seed production, Rearing and Marketing	6	6	25	75	100
	JDMRF7	Entrepreneurship Development	6	6	25	75	100
	JDMRF8P	Practicals in Ornamental Fish Culture	6	5	25	75	100
		Library	6	2	-	-	-
	Total		**30**	**25**	**100**	**300**	**400**

PRINCIPLES OF AQUACULTURE

(For Students Admitted From 2025-26)

Sub code : JDMRF1 **Hours / week : 6**

Credits: 6

Course Objectives:

1. To introduce students to the fundamental concepts, history, and scope of aquaculture and its comparison with traditional agriculture.
2. To provide knowledge about different aquaculture systems, pond management practices, species selection, and environmental factors influencing aquaculture productivity.

UNIT I

Basics of aquaculture, definition and scope. History of aquaculture: Present global and national scenario. Aquaculture vs Agriculture

UNIT II

Systems of aquaculture - pond culture, pen culture, cage culture, running water culture and zero water exchange system

UNIT III

Extensive, semi-intensive, intensive and super-intensive aquaculture in different types of water bodies viz., freshwater, brackish water inland saline and marine water

UNIT IV

Principles of organic aquaculture. Pre-stocking and post-stocking pond management. Carrying capacity of pond, factors influencing carrying capacity. Criteria for selection of candidate species for aquaculture

UNIT V

Major candidate species for aquaculture: freshwater, brackish-water and marine. Monoculture, polyculture and integrated culture systems. Water and soil quality about fish production. Physical, chemical and biological factors affecting productivity of ponds.

Course Outcomes:

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

1. Explain the basic principles and historical evolution of aquaculture globally and in India, and differentiate it from agriculture.
2. Describe various aquaculture systems such as pond, cage, pen, running water, and zero water exchange systems.
3. Classify aquaculture practices based on intensity (extensive to super-intensive) and understand their application in different aquatic environments.
4. Understand principles of organic aquaculture, pre- and post-stocking pond management, and carrying capacity determination.
5. Identify major candidate species for aquaculture and analyze environmental factors such as water and soil quality affecting fish production.

Textbooks:

1. Yadav, B.N., Fish and Fisheries 4th edition. Daya Publishing House, 2006.
2. Stickney, R.R., *Principles of Aquaculture*, John Wiley & Sons, New York, 1979.
3. Axelrod, H.R., *Breeding aquarium fishes*, TFH publications Inc.England, 1967.
4. Srivastava, C.B.L., Textbook *of fishery science and Indian Fisheries*, KutubMahal Publications, Allahabad, 1985.

References:

1. Thabrow De, W.V., Popular aquarium plants. Thornbill Press.UK., 1981.
2. Michael B. and Somsak Singholka F.A.O, *Manual on freshwater Prawn farming*, UNDP –FAO, Rome, 2002.
3. Midlen and Redding T.A. *Environmental Management for Aquaculture*, Kluwer Academic Publishers, London, 1998.
4. New, M.B., *Freshwater prawn farming*, CRC Publications, 2000.

5. Welcomme. R.L., *Inland Fisheries: Ecology and Management*, Fishing news Books. 2001.

Journals:

1. Aquaculture – Elsevier
2. Aquaculture Research – Wiley
3. Journal of the World Aquaculture Society
4. Indian Journal of Fisheries – ICAR
5. Journal of Applied Aquaculture – Taylor & Francis

E-Resources:

1. http://www.fao.org/fishery/aquaculture
2. https://nptel.ac.in/courses/126104005/
3. https://www.was.org
4. https://aquanic.org
5. http://eprints.cmfri.org.in

INTRODUCTION TO MARINE ORNAMENTAL FISH CULTURE

(For Students Admitted From 2025-26)

Sub code: JDMRF2 **Hours / week : 6**

Credits: 6

Course Objectives:

1. To provide students with foundational knowledge of marine ornamental fish species, their biological characteristics, and the technical requirements for breeding and rearing in captivity.
2. To equip learners with practical understanding of aquarium setup, live feed culture, broodstock development, and larval rearing techniques for selected marine ornamental fish species.

UNIT I

Introduction: Scope of marine ornamental fish culture, marine ornamental fish trade and its importance in general characteristics of selected families of marine ornamental fishes. Identification of the importance of marine ornamental fishes, conditioning of ornamental fishes, introduction to aquaculture, general aspects of broodstock development and breeding of marine ornamental fishes.

UNIT II

Biological aspects and Aquarium Technology: Biological aspects relevant to broodstock development, breeding and larval rearing marine ornamental fishes. Marine aquarium technology and water quality management in an aquarium, physical, chemical and biological filters, modern gadget setting up of aquarium, maintenance of aquarium.

UNIT III

Feeds for ornamental fishes: Types of feeds – artificial, natural and live feeds, importance of live feeds, culture of microalgae, culture of rotifers, culture of other live feeds, artificial feed formulation, feeding schedules.

UNIT IV

Broodstock development: General aspects of reproduction in fish, methods of broodstock development, broodstock feeds and their role sex reversal, breeding, spawning, fecundity and larval development.

UNIT V

Breeding techniques: Types of eggs, parental care, hatching of eggs, types of larvae, larval feeding techniques breeding, larviculture and seed production of selected clownfishes and damselfishes.

Course Outcomes:

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

CO 1: Explain the scope and significance of marine ornamental fish culture and identify key marine ornamental fish species and families.

CO 2: Describe aquarium technology, including filtration systems and water quality management specific to marine ornamental fish.

CO 3: Identify different types of feeds (natural, artificial, live), and demonstrate knowledge of live feed culture techniques (e.g., rotifers, microalgae).

CO 4: Understand reproductive biology and broodstock management strategies including sex reversal and broodstock nutrition.

CO 5: Apply breeding and larval rearing techniques to successfully produce seed of marine ornamental species like clownfishes and damselfishes.

Textbooks:

1. Sundararaj, V., Marine ornamental Fish Culture, Yegam Pathipagam. Chennai, 2006.
2. Palanichamy, K.P., A Guide to Fish and Prawn farm construction and management. Narmatha Publishers, Chennai, 1996.

References:

1. Charles Anthony, Jack A. Mathias., *Integrated Fish Farming*, CRC Press, 2020.
2. Emmens.C.W., *A step by step book about setting up a marine aquarium*, TFH Publications, Inc., One TFH Plaza, Neptune City, NJ 07753.1995.
3. Colette, W., M. Taylor, E. Green and T. Razak, *From Ocean to Aquarium: a global trade in marine ornamental species*, UNEP World conservation and monitoring centre (WCMC), 2003.
4. Claude E. Boyd, Tucker C.S., *Pond Aquaculture Water Quality Management*, Springer Science & Business Media, 2012.

Journals:

1. Frontiers in Marine Science
2. Journal of Applied Aquaculture
3. Journal of fisheries & livestock production

E-Resources:

1. https://www.frankbaensch.com/marine-aquarium-fish-culture
2. https://eprints.cmfri.org.in/8395/1/CMFRI%20SP%20101.pdf
3. https://www.foxmetro.org
4. https://core.ac.uk/download/pdf/10864244.pdf

FISH HEALTH AND DISEASE MANAGEMENT
(For Students Admitted From 2025-26)

Sub code: JDMRF4 **Hours / week: 6**
Credits: 6

Course Objectives:
1. To provide in-depth knowledge about common diseases affecting marine ornamental fish and their causative agents.
2. To develop practical skills in the diagnosis, treatment, and prevention of diseases in marine ornamental aquaculture systems.

UNIT I
Introduction to Fish Health: Importance of fish health in marine ornamental industry, Stress and immunity in ornamental fish, Overview of marine fish anatomy relevant to disease, Signs and symptoms of a healthy vs. diseased fish

UNIT II
Water Quality and Its Impact on Fish Health: Marine aquarium water parameters: salinity, pH, DO, ammonia, nitrite, nitrate, Nitrogen cycle and biological filtration, Stress indicators in marine ornamentals, Preventive water quality management.

UNIT III
Diseases of Marine Ornamental Fishes: Bacterial diseases - fin rot, ulcers, columnaris, Fungal diseases - Saprolegnia, secondary infections, Parasitic diseases - *Cryptocaryon irritans* (marine ich), *Amyloodinium, monogeneans,* Viral diseases - Lymphocystis, Iridovirus Case studies of common diseases in clownfish.

UNIT IV
Diagnosis and Treatment: Clinical signs and behavioural symptoms, Wet mount and microscopic examination, Sampling techniques for gills, skin, and faeces, Use of formalin, copper sulfate, freshwater dips, antibiotics, Role of probiotics and immunostimulants.

UNIT V
Biosecurity, Quarantine & Disease Prevention: Setting up and managing quarantine tanks, Disinfection protocols for tanks and equipment, Preventive nutrition and vaccination, Biosecurity in home and commercial marine aquaria, International regulations on ornamental fish health (OIE, CITES).

Course Outcomes:
After successful completion of this course, the student will be able to:
CO 1: Identify and classify common diseases of marine ornamental fishes.
CO 2: Perform disease diagnosis using clinical and microscopic techniques.
CO 3: Recommend appropriate treatment methods and preventive strategies.
CO 4: Understand the impact of water quality and stress on fish health.
CO 5: Implement biosecurity, quarantine, and management protocols for disease prevention.

Textbooks:
1. Pillay, T.V.R., & Kutty, M.N., *Aquaculture: Principles and Practices*, Wiley-Blackwell, 2005.

2. Swain, S.K., Dash, P., & Sahoo, P.K., *Ornamental Fish Breeding, Culture and Trade*, Narendra Publishing House, 2010.

Reference Books:

1. Noga, E.J., *Fish Disease: Diagnosis and Treatment*, Wiley-Blackwell, 2010.
2. Roberts, R.J., Fish Pathology, 4th Edition, Wiley-Blackwell, 2012.
3. Andrews, C., *The Manual of Fish Health*, Tetra Press, 1990.
4. Woo, P.T.K., *Fish Diseases and Disorders*, Vol. 1–3. CABI Publishing, 2011.

Journals:

1. Journal of Fish Diseases
2. Aquaculture Research
3. Diseases of Aquatic Organisms
4. Journal of the World Aquaculture Society

E-Resources:

1. FAO Fisheries and Aquaculture Department – http://www.fao.org/fishery/
2. World Aquaculture Society (WAS) – https://www.was.org
3. OIE Aquatic Animal Health Code – https://www.woah.org
4. Aquatic Animal Health Training (e-Learning) – https://www.open.edu/openlearncreate/
5. ReefBase – Coral Reef Fish Diseases – http://www.reefbase.org

PRACTICALS IN WATER QUALITY ANALYSIS IN FISH CULTURE

(For Students Admitted From 2025-26)

Sub Code: JDMRF3P **Hours / week: 6**
Credits: 5

Course Objective

1. To impart hands-on experience in testing and analyzing key water quality parameters critical to aquaculture.
2. To enable students to understand the role of each parameter in maintaining a healthy aquatic environment.

List of Experiments:

1. Estimation of water temperature
2. Determination of pH of water
3. Measurement of dissolved oxygen (DO)
4. Estimation of free carbon dioxide (CO_2)
5. Determination of total alkalinity
6. Estimation of total hardness (calcium and magnesium)
7. Estimation of ammonia (NH_3)
8. Estimation of nitrite (NO_2^-)
9. Estimation of nitrate (NO_3^-)
10. Measurement of salinity using a refractometer

Course Outcomes:
Upon successful completion of this practical course, students will be able to:
CO 1: Accurately test and record important water quality parameters.
CO 2: Understand the impact of each parameter on fish health and pond ecology.
CO 3: Analyze variations in water chemistry and recommend corrective actions.
CO 4: Use standard analytical instruments like DO meters, refractometers, pH meters.
CO 5: Apply water quality monitoring techniques in hatcheries and grow-out systems.

Textbook:
1. Santhosh, B. & Singh, N.P., *Guidelines for Water Quality Management for Fish Culture in Tripura*. ICAR., 2007.

Reference Books:
1. Boyd, C.E. & Tucker, C.S., *Water Quality and Pond Soil Analyses for Aquaculture*, Auburn University, 1992.
2. Bhatnagar, A. & Devi, P., *Water Quality Guidelines for the Management of Pond Fish Culture*, International Journal of Environmental Sciences, 2013.
3. Timmons, M. B., & Ebeling, J. M., *Recirculating Aquaculture*, 2nd edition, Ithaca, NY: Cayuga Aqua Ventures, 2010.

Journals:
1. Aquaculture Research
2. Journal of Aquaculture and Aquatic Sciences
3. Journal of Environmental Biology
4. Aquaculture Engineering

E-Resources:
1. FAO Aquaculture: http://www.fao.org/aquaculture
2. Open Aquatic Science Journal: https://benthamopen.com/TOASCJ
3. World Aquaculture Society: https://www.was.org
4. Aquaculture Network Information Center (AquaNIC): https://aquanic.org
5. NPTEL – Aquaculture Water Quality Lectures: https://nptel.ac.in/courses/126/104/126104005/

FISH FEED TECHNOLOGY

(For Students Admitted From 2025-26)

Sub code: JDMRF5 **Hours / week: 6**
Credits: 6

Course Objectives:

1. To provide foundational knowledge of nutritional requirements, feed ingredients, and formulation techniques used in aquaculture.
2. To develop practical skills in feed preparation, feeding strategies, and assessment of feed efficiency and nutritional pathology.

UNIT I

Nutritional requirement: Protein, carbohydrate and lipid requirement-amino acid, fatty acid and

non-protein sources vitamins and minerals-food additives, immunostimulants, growth promoters and preservatives.

UNIT II

Feed ingredients: Animal, plant and microbial origin, SCP, silages-nutritional factors, compound feed, pellets, scrambles and micro-encapsulated feed.

UNIT III

Fish feed Formulation and preparation: Feed formulation methods and square methods - On-farm feed manufacture -commercial feed formulation -Food storage.

UNIT IV

Nutritional physiology and pathology: Digestion and nutrient flow factors affecting digestibility-anti-nutritional factors and antimetabolites- microbial toxins- nutritional deficiency and symptoms. Fish Energetic Feeding practices-feeding methods and scheduling-ration, size, feed performance and economics.

UNIT V

Marketing Strategy From Fish Feeding : Define Your Market - Target Markets: Product Strategy - Product Types, Value Proposition : Pricing Strategy, Distribution Strategy, Promotion Strategy and Monitoring & Feedback

Course Outcomes:

Upon successful completion of this course, students will be able to:

CO 1: Explain the roles of macronutrients (protein, carbohydrates, lipids) and micronutrients (vitamins and minerals) in fish growth and health.

CO 2: Identify and classify feed ingredients from plant, animal, and microbial sources, including additives and immunostimulants.

CO 3: Apply feed formulation techniques such as square method and develop on-farm or commercial feed.

CO 4: Understand digestive physiology, nutritional deficiencies, and the impact of anti-nutritional factors and toxins.

CO 5: Design appropriate feeding practices based on feed type, ration size, scheduling, and economic considerations.

Textbooks:

1. Gupta, S.K., & Ramraj, V., *Textbook of Fish Nutrition***,** Narendra Publishing House, 2015.
2. Wilson, R.P., *Handbook on Nutrient Requirements of Finfish and Crustaceans,* CRC Press, 2000.

References:

1. Halver.J. and Hardy R.W., *Fish Nutrition*, Academic Press, London,3rd Edition, 2002.

2. Lovell.R.T., *Nutrition and feeding of fishes*, Chapman & Hall, New York, 1998.

3. Houlihan, D., Boujard, T. and Jobling, M., *Food intake in fish*, Blackwell Science Ltd, London, 2001.

Journals:

1. Aquaculture Nutrition (Wiley)
2. Fish Physiology and Biochemistry (Springer)
3. Journal of the World Aquaculture Society
4. Aquaculture (Elsevier)
5. Journal of Applied Aquaculture

E-Resources:

1. FAO Fisheries and Aquaculture Division – http://www.fao.org/fishery
2. AquaNIC (Aquaculture Network Information Center) – https://aquanic.org
3. NPTEL Course on Aquaculture Nutrition – https://nptel.ac.in/courses/126/104/126104005/
4. World Aquaculture Society (WAS) – https://www.was.org
5. Open Access Journal – MDPI Fishes – https://www.mdpi.com/journal/fishes

BREEDING, SEED PRODUCTION, REARING AND MARKETING

(For Students Admitted From 2025-26)

Sub code : JDMRF6 **Hours / week : 6**
Credits: 6

Course Objectives:

1. To provide students with comprehensive knowledge and hands-on skills in the breeding, seed production, rearing, and health management of marine ornamental fishes such as clownfish and damselfish.
2. To equip learners with practical insights into small-scale hatchery setup, fish packaging, transportation, marketing strategies, and the economic feasibility of ornamental fish culture.

UNIT I

Introduction- Breeding, Techniques for seed production of selected species of clown fishes and damselfishes; methods for rearing to marketable size

UNIT II

Disease Management - Health care protocols, Symptoms and treatment of common diseases of ornamental fishes, Prevention and control measures

UNIT III

Aquarium set up- Setting up of a small-scale backyard hatchery: Requirements for setting up of a small-scale backyard hatchery unit, its maintenance and management

UNIT IV

Packaging & Marketing strategies - Packing, Transportation and Marketing; Methods of packing

and transportation of ornamental fishes, marketing outlets

UNIT V

Economic Aspects - Economic aspects of setting up of a small-scale hatchery unit, recurring and non-recurring investments, profit

Course Outcomes:

Upon successful completion of this course, students will be able to:

CO 1: Understand breeding techniques and hatchery protocols for clownfish and damselfish, including larval rearing practices.

CO 2: Identify and manage common diseases of ornamental fish using appropriate preventive and treatment methods.

CO 3: Set up and manage a small-scale backyard hatchery for ornamental fish production.

CO 4: Apply efficient packaging and transportation techniques and identify suitable marketing strategies.

CO 5: Analyze the economic aspects of ornamental fish hatchery operation including cost estimation, investment planning, and profit calculation.

Textbooks:

1. Sundararaj, V., *Marine ornamental Fish Culture*, Yegam Pathipagam, Chennai, 2006.
2. Palanichamy, K.P., A Guide to Fish and Prawn farm construction and management, Narmatha Publishers, Chennai, 1996.
3. Hertrampf J.W., Piedad-Pascual F., *Handbook on Ingredients for Aquaculture Feeds*, Springer Science & Business Media, 2003.

References:

1. Martin A. Moe, Jr., *Marine Aquarium Handbook Beginner to Breeder*, Green Turtle Publications, P.O.Box 17925. Plantation, Florida 33318, 1995.
2. Frank.R.Hoff..Jr., *Conditioning, spawning and rearing of fish with emphasis on Marine clownfish*, Aquaculture Consultants Inc.. 33418 old Saint Joe Rd.Dade City, FL 33525, 1996.
3. Vinodh S., Kannan M., Ranchana P., *Practical manual on fish Nutrition and Feed Technology*, 2017.

Journals:

2. Frontiers in Marine Science
2. Journal of Applied Aquaculture
3. Journal of fisheries & livestock production
4. Journal of Fisheries Sciences

E-Resources:

1. https://www.frankbaensch.com/marine-aquarium-fish-culture
2. https://eprints.cmfri.org.in/8395/1/CMFRI%20SP%20101.pdf
3. https://www.foxmetro.org
4. https://core.ac.uk/download/pdf/10864244.pdf
5. https://mpeda.gov.in/?page_id=791

ENTREPRENEURSHIP DEVELOPMENT
(For Students Admitted From 2025-26)

Sub code: JDMRF7 **Hours / week: 6**
Credits:6

Course Objectives:
1. To provide students with foundational knowledge of entrepreneurship, types of entrepreneurs, and the process of starting a small business.
2. To familiarize students with the institutional support systems and incentive schemes available for small-scale enterprises in India.

UNIT I
Entrepreneur: Definition - Characteristics - Functions - Competencies - Entrepreneur vs Entrepreneurship - Role of Entrepreneur in Economic Development.

UNIT II
Types of Entrepreneurs: Innovative - Adaptive - Fabian - Drone; Entrepreneur vs Intrpreneur, Copreneur; Women entrepreneur - Types – Problems.

UNIT III
Starting a small Business: Steps; Project Report: Contents – Importance.

Unit IV
Institutional Support to Entrepreneurs: SIDCO - TCOs - DIC - TIIC - SIDBI - Commercial Banks.

Unit V
Incentives for Small Scale Business: Subsidy - Tax Concessions - Assistance – Export Assistance - Technical Assistance.

Course Outcomes:
Upon successful completion of this course, students will be able to:
CO 1: Define the concept of an entrepreneur and explain their characteristics, functions, and role in economic development.
CO 2: Distinguish between various types of entrepreneurs (innovative, adaptive, Fabian, drone) and analyze the role of women entrepreneurs and intrapreneurs.
CO 3: Outline the steps involved in starting a small business and prepare a basic project report with all essential components.
CO 4: Identify and evaluate the role of different institutions (SIDCO, DIC, TIIC, SIDBI, etc.) in supporting entrepreneurship.
CO 5: Understand the various government incentives and assistance schemes, including subsidies, tax concessions, and export/technical aid for small businesses.

Textbooks:
1. E. Gordan & K. Natarajan, Entrepreneurship Development, Himalaya Publishing House, 2017.

References:
1. Holt, *Entrepreneurship: New Venture Creation*, Prentice-Hall, 2018.
2. Badi R. V., & Badi A. V., *Entrepreneurship*, Vrinda Publication (p) Ltd, New Delhi, 2010.
3. Ramachandran K., *Entrepreneurship Development*, Tata McGraw Hill, New Delhi, 2017.
4. Dr. Radha, *Entrepreneurial Development*, Prasanna and Co, Chennai, 2019.

Journals:
1. *Journal of Entrepreneurship*
2. *Journal of Innovation and Entrepreneurship*
3. *Indian Journal of Entrepreneurship*

E-Resources:
1. https://nios.ac.in/media/documents/249_Enterpreneurship/English_pdf/249_Enterpreneurship_Lesson_17.pdf
2. https://www.iitmanagement.com/images/ENotes/ENotes%206th%20Sem%20ME/EDM%20(6th%20sem)/Chapter-I%20EDM.pdf

PRACTICALS IN ORNAMENTAL FISH CULTURE

(For Students Admitted From 2025-26)

Sub Code: JDMRF8P **Hours / week: 6**
Credits: 5

Course Objectives:
1. To provide hands-on training in the identification, breeding, larval rearing, and aquarium management techniques for selected marine ornamental fish species such as clownfishes and damselfishes.
2. To develop practical skills in live feed culture, broodstock maintenance, disease management, and marketable-size rearing of marine ornamental fish.

List of Experiments:
1. Identification of selected families and species of marine ornamental fishes
2. Broodstock, collection, conditioning, setting up of broodstock tanks, broodstock feeding, maintenance of broodstock tanks for selected clown fishes and damselfishes
3. Setting up of a marine aquarium, development of biological filter, setting up of other gadgets, introduction of fishes, feeding, maintenance
4. Stock and mass cultures of microalgae, preparation of culture medium, determination of cell count, growth phases of microalgae & reculturing schedules
5. Culture of rotifers, *Moina*
6. Artemia hatching techniques
7. Enrichment protocols for live feeds

8. Hatching the eggs
9. Methods of larviculture of selected species of clown fishes and damselfishes
10. Rearing of metamorphosed larvae to marketable size for selected species
11. Common diseases their treatment and precautions for healthy rearing.

Course Outcomes:

Upon successful completion of this practical course, students will be able to:

CO1: Identify important families and species of marine ornamental fishes and understand their broodstock handling and tank setup.

CO2: Demonstrate the ability to set up and maintain marine aquariums, including biological filtration systems and gadget integration.

CO3: Culture live feeds such as microalgae, rotifers, Moina, and hatch Artemia using standard enrichment and hatching protocols.

CO4: Perform larviculture and rearing techniques for selected species including hatching, larval feeding, and growth monitoring up to marketable size.

CO5: Detect common diseases in ornamental fish, apply treatments, and follow precautionary measures to maintain fish health during the rearing process.

Textbooks:

1. Sundararaj, V., *Marine ornamental Fish Culture*, Yegam Pathipagam, Chennai, 2006.
2. Palanichamy, K.P., *A Guide to Fish and Prawn farm construction and management*, Narmatha Publishers, Chennai, 1996.

Reference 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.
3. Santhanam, R. Sukumaran.N. and Natarajan, P., *A Manual of Fresh Water Aquaculture*, Oxford and IBH Publications, New Delhi, 1990.

Journals:

1. Frontiers in Marine Science
2. Journal of Applied Aquaculture

E- Resources:

1. https://www.frankbaensch.com/marine-aquarium-fish-culture
2. https://eprints.cmfri.org.in/8395/1/CMFRI%20SP%20101.pdf
3. https://eprints.cmfri.org.in/17141/1/Winter%20School_2023_Mariculture_Anikuttan%20K%20K.pdf
4. https://mpeda.gov.in/?page_id=791

VALUE ADDED PROGRAMME
(For Students Admitted from June 2025-2026)
PROGRAMME STRUCTURE

S. No	Programme Name	Subject code	Title	Total Contact Hours	Credits	ESE
1	Value Added programme in Biofertilizer Production	JCBF1P	Lab Course In Biofertilizer Production	50	5	100
2	Value Added programme in Medicinal And Edible Mushroom Cultivation	JCMC1P	Lab Course In Medicinal And Edible Mushroom Cultivation	50	5	100
3	Value Added programme in Medical Laboratory Technology	JCML1P	Lab Course In Medical Laboratory Technology	50	5	100

LAB COURSE IN BIOFERTILIZER PRODUCTION

(For Students Admitted from 2025-26**)**

Subject Code: JCBF1P **Total Hours: 50**
Credit: 5

Course Objectives:

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*Isolation of *Azospirillum*
8. Isolation of *Spirullina* / *Blue Green Algae*
9. Isolation of *Azolla*

10. Isolation of *VAM*
11. Mass production of *Rhizobium, Azolla - Blue Green Algae*
12. Preparation of carrier material
13. Preparation of Inoculum
14. Storage of biofertilizers
15. Principles of marketing and marketing potentials

Textbooks:

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: Scrivener 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

LAB COURSE IN MEDICINAL AND EDIBLE MUSHROOM CULTIVATION

(For Students Admitted From 2025-26)

Subject Code: JCMC1P **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

LAB COURSE IN MEDICAL LABORATORY TECHNOLOGY

(For Students Admitted from 2025-26)

Subject Code: JCML1P **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
4. http://applyonline.itmuniversity.org/Images/biochemistry/BSc_MLT.pdf
5. 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-Employability Skills

For PG Programme
Extra Credit-Employability Skills
(For Students Admitted from 2025-26)

Semester: III **Credit: 2**
Subject Code:JMMBX3

Course Objectives:

1. Get ready the students for job market with good communication skill
2. Appear for interviews and make presentations confidently

Unit I
Behaviour al Skill
Personal Strength Analysis-Perception Management-Social Etiquette.

Unit II
Communicati on Skill
Self-Introduction- Verbal Communication-Non-Verbal Communication-Campus to Work.

Unit III
I.T. Literacy
MS-Word-File Conversion & Reducing File Size-Web browsers & Search Engines-Email- Mobile Application-Online CV.

Unit IV
Entrepreneursh ip Skill
Need of becoming Entrepreneur-Ways to become a good Entrepreneur-Different Government Institutions/Schemes Promoting Entrepreneur-Day to day mechanism for maintaining an enterprise.

Unit V
Preparation to the World of Work
Career Plan-Basic Professional Skill-Career Pathways-Search and Apply for a Job.

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Identify a planned approach towards career
CO 2: Associate skills and interests with chosen career path
CO 3: Take part in group discussions
CO 4: Develop thinking ability
CO 5: Perceive personal interviews through mock interviews

Text Books:

1. Mclnotsh M Esther, Doug Graham & Deepthi Lamahewa. "Trainer Manual for Soft Skills:Applied for Entry Level Occupation".WUSC-ASSET Project, Srilanka, 2019.
2. Lata, Pushp, and Kumar, Sanjay. *Communication Skills*, 2nd Edition. India, Oxford University

Press, 2015.
3. Maluth, John Monyjok. *Basic Computer Knowledge. N.p.*, Independently Published, 2016.
4. *Khanka, S S. Entrepreneurial Development. S Chand and Company Limited, New Delhi, 2001.*
5. *Ann, Mary Bailey. Finding the Right Career Path*: Wetfeet Insider Guide. Wetfeet.Com Publisher, 2006.

Reference Books:

1. Rath, Tom, et al. *Strengths-Based Leadership: Great Leaders, Teams, and Why People Follow*. Philippines, Gallup Press, 2009.
2. Chaturvedi, P. D. *Business Communication: Concepts, Cases and Applications* (for Chaudhary Charan Singh University). N.p., Dorling Kindersley (India), 2011.
3. Morrison, Connie, and Wells, Dolores. *Computer Literacy BASICS*. United States, Cengage Learning, 2012.
4. *Promoting Entrepreneurship and Innovative SMEs in a Global Economy*. France, OECD Publishing, 2008.
5. Janson, Simone. *Wanted! The Job of Your Dreams – Better Career Choice Reorientation Job Application: Develop Your Skills Potential & Self-confidence, Discover Chances & Strategies, Achieve Goals*. Germany, Best of HR – Berufebilder.de®, 2021.

Journals:

1. International Journal on Procedia-Social Sciences and Behaviour
2. e-Journal of Business Education & Scholarship of Teaching
3. Journal of Further and Higher Education

E- Resources:

1. https://opentextbc.ca/organizationalbehavioropenstax/chapter/employee-abilities-and-skills/
2. https://courses.lumenlearning.com/wm-businesscommunicationmgrs/chapter/verbal- and- nonverbal-communication/
3. https://www.avantixlearning.ca/microsoft-word/reduce-file-size-large-word- documents- avoid-bloat-slowness-corruption-crashes/
4. https://support.microsoft.com/en-us/office/video-resumes-in-word-ce00832f-8388-4291- a417-0f70cd2e5914
5. https://gfgc.kar.nic.in/mccw-mysore/FileHandler/410-00295b1f-7b5c- 49b1-ae68-3debdd957e67.pdf
6. https://learnenglish.britishcouncil.org/skills/listening

Course Outcomes	Programme Outcomes							
	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	9	9	9	57
CO4	9	9	9	9	9	9	9	63

CO5	9	9	9	9	9	9	9	**63**
Total	**45**	**45**	**45**	**39**	**45**	**45**	**45**	**309**

Low-1 Medium-3 High-9

For UG Programme

Extra Credit- Employability Skills

(For Students Admitted from 2025-26)

Semester: V **Credit: 2**

Subject Code: JBESX5

Course Objectives:

1. To create awareness on the skills necessary for getting, keeping and being successful in a profession
2. To expose the students to leadership and team-building skills

Unit I

Introduction to Soft Skill.

Unit II

Self-management.

Unit III

Critical thinking development.

Unit IV

Reflective thinking and writing.

Unit V

Group work and Peer to peer interaction.

Course Outcomes:

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

CO 1: Recognize prioritizing tasks

CO 2: Construct personal strategies for independent learning

CO 3: Communicate clearly and precisely to interested audience in a range of different contexts **CO 4:** Consider and respect others' point of view in offering constructive feedback to others **CO 5:** Lead team while working for a task

Text Book:

1. Alfredo, Becky and Alison. *Soft Skills (Academic Guide and Teaching Materials).* Shoo fly publishing, Ukraine, 2015.

Reference Books:

1. Rao, Manchanahalli Satyaranayana. *Soft skills-enhancing employability: connecting campus with corporate*. IK International Pvt Ltd, 2010.

2. Verma, Shalini. *Enhancing employability@ soft skills*. Pearson Education India, 2012.

Journals:

1. International Journal of Trend In Scientific Research and Development
2. International Journal of Evaluation and Research in Education (IJERE)
3. International Journal on Industry and Higher Education

E-Resources:

1. https://www.exeter.ac.uk/ambassadors/HESTEM/resources/General/STEMNET%20Emplo yability%20skills%20guide.pdf
2. http://psydilab.univer.kharkov.ua/resources/ucheba/softskills/Chapter_1_Introduction.PDF

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
CO1	9	9	9	9	9	9	9	**63**
CO2	9	9	9	9	9	9	9	**63**
CO3	9	9	9	9	9	9	9	**63**
CO4	9	9	9	9	9	9	9	**63**
CO5	9	9	9	9	9	9	9	**63**
Total	**45**	**45**	**45**	**45**	**45**	**45**	**45**	**315**

Low-1 Medium-3 High-9

COMMON VALUE ADDED COURSE I- UNDERSTANDING INDIA
(For Students Admitted from 2025-2026)

Semester: II **Hours/week: 2**
Subject Code: JBUI2V **Credit: 2**

Course Objectives:
1. To provide learners with a comprehensive overview of India's diverse cultural, historical, social, political, and economic landscapes.
2. To develop a nuanced understanding of India's evolution as a nation, its internal complexities, and Indian Polity.

Unit I **(6 hours)**
History of India: India's freedom struggle: An introduction to Indian knowledge systems: Indian First War of Independence, Non-Cooperation Movement in Indian Independence, Quit India Movement, Civil Disobedience Movement

Unit II **(6 hours)**
Geography of India: India's Geographical overview with neighbours - India and its relationship with neighbouring countries -Types of diversities in India -Geographical diversities of India

Unit III **(6 hours)**
Communicating Culture: Oral narratives: Myths, tales and folklore- Introduction to the Tribal Cultures of India - Indian Oral narrative, myths, tales & folklore - Tribal cultures of India - Odisha's Special Development Councils

Unit IV **(6 hours)**
Indian Social Structure: Continuity and change of the Indian Social Structure: Caste, Community, Class and Gender - Continuity and change in social structure in India - Caste. Class and Gender in India - Indian Caste and Communities

Unit V **(6 hours)**
Understanding Indian Polity: The evolution of State in India: Nature and origin Interpreting India: Traditional, Modern and Contemporary Constitution as a living document - The evolution of Indian state - changing the Nature of Indian state - The traditional, modern and contemporary India - Constitution of India

Text Book:
1. Ramesh Dutta Dikshit, Political Geography: Politics of Place and Spatiality of Politics, Macmillan Education, 2020.

Reference Books:
1. Ramesh Dutta Dikshit, Political Geography: Politics of Place and Spatiality of Politics,
2. Macmillan Education,2020.
3. Bose D. M., S. N. Sen and B. V. Subbarayappa ed. (1971) A Concise History of Science

in India, Indian National Science Academy, New Delhi.
4. A. K. Ramanujan, "'A Flowering Tree': A Woman's Tale", Oral Tradition, 12/1 (1997): 226- 243.

E-Resources:

1. **https://doi.org/10.1177/0038022919680205**
2. **https://iksindia.org**

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

COMMON VALUE ADDED COURSE II– ENVIRONMENTAL STUDIES FOR SUSTAINABLE DEVELOPMENT

(For Students Admitted from 2025-26**)**

Semester: III **Hours / week: 2**
Subject Code: JBES3V **Credits: 2**

Course Objectives:

1. To introduce students to the principles of sustainable development, environmental conservation, and the global efforts supporting ecological balance and human well-being.
2. To develop awareness and practical understanding of biodiversity, pollution control, natural resource management, and the role of institutions in promoting sustainability.

Unit I **(6 hours)**

Sustainable Development Goals (SDGs) – Introduction, History, 17 SDGs, Agenda 21, Earth Summit, eight Millennium Development Goals (MDGs), UN Sustainable Development Summit, Paris Agreement on Climate Change.

On ground activity: Plant and maintain a sapling

Unit II **(6 hours)**

The concept of Environmental studies – Introduction, Definition, Scope and importance Natural Resources **–** Forest, Marine, Wet land, 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.

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 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 (Turtle Hatchery), Wildlife Protection Act, Forest Conservation Act. Birds Sanctuary in Ramanathapuram, Gulf of Mannar Bioreserve, Mangrove Forest and Ecotourism in Ramanathapuram district

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, and 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; Education for Women, Balanced Diet, Menstrual hygiene, Role of ICAR-CMFRI, CSIR-MARS, KVK, and UNICEF in the development of sustainable food resources.

Course Outcomes:

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

CO1: Understand the history, goals, and importance of the Sustainable Development Goals (SDGs) and related global initiatives

CO2: Recognize the value of natural resources and ecosystems

CO3: Learn why biodiversity matters, what harms it, and how to protect plants and animals, especially in places like the Gulf of Mannar.

CO4: Understand what causes pollution and how we can prevent it through laws and personal actions.

CO5: Know how research centers and organizations help people live better through food, health, and education programs.

TextBooks:

1. Erach Bharucha, *Environmental studies for undergraduate courses*, University Grant commission, New Delhi, 202
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://sdgs.un.org/goals
3. http://eprints.cmfri.org.in/14270/
4. https://nios.ac.in/online-course-material/sr-secondary-courses/enviornmental-science-(333).aspx
5. https://rajneeshrajoria.weebly.com/uploads/4/9/0/6/49069889/environmental_science_birm301.pdf
6. https://nios.ac.in/media/documents/srsec314newE/PDFBIO.EL24.pdf
7. 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

COMMON VALUE ADDED COURSE III – DIGITAL AND TECHNOLOGY SOLUTION

(For Students Admitted from 2025-26)

Semester: IV **Hours/week: 2**
Subject Code: JBDT4V **Credit: 2**

Course Objectives:

1. To introduce key concepts in operating systems, communication systems, digital tools, and emerging technologies.
2. To equip students with skills in e-commerce, cybersecurity, and innovative technologies for effective problem-solving and governance.

Unit I **(6 Hours)**

Operating Systems: Types and Functions. Problem Solving: Algorithms and Flowcharts. Communication Systems: Principles, Model & Transmission Media, Computer Networks & Internet:
Concepts & Applications, WWW, Web Browsers, Search Engines, Messaging, Email, Social Networking.

Unit II **(6 Hours)**

Computer Based Information System: Significance & Types. E-commerce & Digital Marketing:Basic Concepts, Benefits & Challenges. Digital India & e-Governance: Initiatives, Infrastructure,Services and Empowerment.

Unit III **(6 Hours)**

Digital Financial Tools: Unified Payment Interface, Aadhar Enabled Payment System, USSD, Credit/Debit Cards, e-Wallets, Internet Banking, NEFT/RTGS and IMPS, Online Bill Payments and PoS.Cyber Security: Threats, Significance, Challenges, Precautions, Safety Measures, & Tools, legal and ethical perspectives.

Unit IV **(6 Hours)**

Emerging Technologies & their applications: Overview of Cloud Computing, Big Data, Internet of Things, and Virtual Reality.

Unit V **(6 Hours)**

Emerging Technologies & their applications: Blockchain & Cryptocurrency, Robotics, Machine Learning & Artificial Intelligence, 3-D Printing. Digital Signatures

Text Books:

1. Pramod Kumar, Anuradha Tomar, R. Sharmila, "*Emerging Technologies in Computing - Theory, Practice, and Advances*", Chapman and Hall / CRC, 1st Edition, 2021
2. V. Rajaraman, "*Introduction to Information Technology*", PHI, 3rd Edition, 2018
3. E. Balagurusamy, *"Fundamentals of Computers"*, Tata Mc GrawHill, 2nd Edition, 2011
4. Behrouz A. Forouzan, "*Data Communications and Networking*", McGraw Hill, 4 Edition, 2007,

Reference Books:

1. Rajkumar Buvya, James Broberg, and Andrzej Gosciniski, "*Cloud Computing-Principals and Paradigms"*, Wiley, 2011
2. Stuart Russel and Peter Norvig, "*Artificial Intelligence - A Modern Approach"*, Pearson Education, 3rd Edition, 2010
3. Samuel Greengard, *"Internet of Things"*, The MIT Press, 2015
4. C.S.V. Murthy, "*E-Commerce Concept, Models & Strategies*", Himalaya Publishing House, 2015
5. Hurwith, Nugent Halper, Kaufman, "*Big Data for Dummies*", Wiley & Sons, 1st Edition, 2013

Course Outcomes:

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

CO1: Understand key digital concepts
CO2: Apply e-commerce and digital marketing concepts
CO3: Analyze digital financial tools and cyber security
CO4: Explain emerging technologies and their applications
CO5: Evaluate the impact of emerging technologies

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total

CO1	3	1	3	1	3	3	3	**17**
CO2	3	1	3	1	3	3	3	**17**
CO3	3	1	3	1	3	3	3	**17**
CO4	3	1	3	1	3	3	3	**17**
CO5	3	1	3	1	3	3	3	**17**
Total	**15**	**5**	**15**	**5**	**15**	**15**	**15**	**85**

Low-1 Medium-3 High-9

COMMON VALUE ADDED COURSE IV- HEALTH AND WELLNESS

(For Students Admitted from 2025-2026)

Semester:V **Hours/week: 2**
Subject Code: JBHW5V **Credit: 2**

Course Objectives:

1. To understand the importance of a healthy lifestyle and familiarize students on physical and mental health
2. To increase awareness of various diseases associated with lifestyle and enable understanding of stress management

Unit I **(6 hours)**

Introduction to health & wellness: Define, differentiate health and wellness, Importance of health and wellness education, Local, demographic, societal issues, factors affecting health and wellness.

Unit II **(6 hours)**

The Role of Essential Nutrients in a Balanced Diet: Diet and nutrition for health & wellness, Essential components of balanced diet for healthy living, Specific reference to the role of carbohydrates, proteins, fats, vitamins & minerals. Malnutrition.

Unit III **(6 hours)**

Unhealthy Eating Habits, and Lifestyle Factors on Body Systems: Processed foods, unhealthy eating habits, Body systems, common diseases, Sedentary lifestyle and its risk of disease, stress, anxiety, and depression.

Unit IV **(6 hours)**

Management of health and wellness: Healthy foods for prevention, progression of Cancer, Hypertension, Cardiovascular, Types of Physical Fitness and its Health benefits.

Unit V **(6 hours)**

Spirituality and mental health: Role of Yoga, asanas, meditation in maintaining health and wellness, Role of sleep in maintenance of physical, mental health.

Course Outcomes:

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

CO1: Explain the principles of physical, mental, and emotional well-being and their role in overall health.
CO2: Assess the impact of diet, physical activity, and lifestyle habits on health and disease prevention.
CO3: Identify stressors and implement effective coping mechanisms to enhance mental and emotional well-being.
CO4: Apply knowledge of health policies, disease prevention, and wellness programs to advocate for community health.
CO5: Explore alternative and complementary health practices, including mindfulness, fitness, and self-care techniques.

Text Books:

1. Raheena, S. *Health and Wellness: A Practical Approach*. CBS Publishers & Distributors, 2nd Edition.2019
2. Tariq, M. *Food and Health: The Interlinking of Nutrition and Wellness*. Springer, 1st Edition,2020.
3. Pood, V., & Gopinath, S.,*Foundations of Health and Wellness*. Wiley-Blackwell, 1st Edition,2021.

Reference Books:

1. Bouchard, C., Blair, S. N., & Haskell, W. L, *Physical Activity and Health*. Human Kinetics,2007
2. Attached, E., & Fernandez, M., *Mental Health Workbook*. Independently published,2021.
3. Lorick, N.*Mental Health Workbook for Women: Exercises to Transform Negative Thoughts and Improve Wellbeing*. Rockridge Press,2022
4. Nyambichu, C., & Lumiri, J. *Lifestyle Diseases: Lifestyle Disease Management*. Independently published,2018.

Journals:

1. Journal of Nutrition and Health Sciences
2. Health Promotion International
3. American Journal of Health Promotion

E-Resources:

1. https://www.who.int/health-topics
2. https://www.nimh.nih.gov/
3. https://pmc.ncbi.nlm.nih.gov/
4. https://pmc.ncbi.nlm.nih.gov/
5. https://portal.ct.gov/-/media/DMHAS/SkillBuilding/Dana/Health-and-Wellness-FULL-Revised.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	3	57
CO3	9	9	9	9	9	9	9	63
CO4	9	9	9	9	9	9	9	63
CO5	9	9	9	9	9	9	9	63
Total	**45**	**45**	**45**	**45**	**45**	**45**	**39**	**309**

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

Curriculum Development Cell (CDC) Recommendations

Resolution1:

Change in CIA pattern

- Two test to be conducted instead of three. Need based improvement test will be conducted for the passing minimum requirement
- one Quiz/Assignment/Seminar will be conducted instead of two for all the courses