TUMKUR UNIVERSITY

Undergraduate
B.Sc. Microbiology Syllabus

For
III & IV SEMESTERS

Under
Revised National Education Policy (RNEP)

Prepared by
BOS in Microbiology(UG)
Tumkur University

ACADEMIC YEAR 2025-2026

Tumkur University, Tumkur
B.Sc. in Microbiology
Effective from 2025-26

Semester	Type of Course Theory/ Practical	Course Code	Course Title	Instruction hour/ week	Total hours/ sem	Duration of Exam (Hrs)	Marks			Credits
							Formative	Summative	Total marks	
III	Theory	**MBDSC-T3**	Molecular Biology and Genetic Engineering	4	60	3	20	80	100	4
	Practical	**MBDSC-P3**	Molecular Biology and Genetic Engineering	4	30	3	10	40	50	2
	Elective 1 (Theory)	**MBOEC-01**	Fundamental Microbiology	3	45	3	20	80	100	3
IV	Theory	**MBDSC-T4**	Environmental and Agricultural Microbiology	4	60	3	20	80	100	4
	Practical	**MBDSC-P4**	Environmental and Agricultural Microbiology	4	30	3	10	40	50	2
	Elective 2 (Theory)	**MBOEC-02**	Applied Microbiology	3	45	3	20	80	100	3
	Practical	**MBSEC**	Microbial Quality Control in Industries	4	56	3	10	40	50	2

B.Sc., Microbiology Semester-III

Course code: MBDSCT-3

Course Title: Molecular Biology& Genetic Engineering-3 (Theory)

COURSE TITLE	**Molecular Biology & Genetic Engineering-3**
COURSE	DISCIPLINE SPECIFIC CORE, **THEORY**
COURSE CODE	**MBDSCT-3**
COURSE CREDITS	**04**
TOTAL CONTACT HOURS	**60**
DURATION OF EXAM	**3 Hrs**
FORMATIVE ASSESSMENT MARKS	**20**
SUMMATIVE ASSESSMENT MARKS	**80**
TOTAL MARKS	**100**

Course Learning Objectives:

The objectives of learning the course in molecular biology and genetic engineering is that students would be able to integrate the principles of enzymes and microbial metabolism to functioning of entire central dogma of molecular biology, which indeed is the molecular basis of creation of order in cell for its functioning. This course inculcate creative thinking capacity, wherein , after learning the course in molecular biology, the student will be able to confluence the concepts learned in molecular biology to microbiology to develop unprecedented technologies like genetic engineering and biotechnology to develop biosimilars and biologics to serve mankind.

Course Outcome:

The course provides fundamental insights about the interaction of various molecules in the cell. The course provides knowledge about the central dogma of molecular biology, which explains the flow of information from DNA to RNA to protein. The molecular biology course emphasizes on how, the coordinated interplay of large number of enzymes snd proteins would conserve the information in the cell, retrieve information from DNA into RNA and different RNA and proteins translate the retrieved information into work horse proteins. Apart from this the regulation of gene expressions to control metabolism is emphasized. The course also trains students on the much excited and integrated discipline of genetic engineering. The rewarding aspect of this course is that the students develop knowledge and skill in genetic engineering..

Unit	Molecular Biology& Genetic Engineering-3 (Theory)	60 Hr
Unit I	**Molecular basis of Life:** Central Dogma of Molecular biology, Nucleoside, nucleotide, Structure of DNA (Watson and Crick model). Organization of DNA in cells, DNA denaturation and renaturation. RNA structure and types-mRNA, t-RNA, and rRNA **DNA Replication:** Experimental proof for Semi-conservative replication, Direction of replication. **DNA replication-** Initiation, elongation and termination of DNA replication. Role of helicase, SSB, DNA polymerases, gyrase and ligase in replication. Rolling-circle and θ- model of replication. **Transcription**: Concept of gene, promoter concept (prokaryotic and Eukaryotic promoters)**,** Transcription in prokaryotes and eukaryotes.Stages of transcription – initiation, elongation, termination. Transcription factors. Structure of prokaryotic RNA polymerase. **Post-transcriptional modification of RNA**: RNA splicing and Processing, 5'-capping, mRNA splicing, polyadenylation, RNA editing.	**15 Hrs**
Unit II	**Genetic code:** salient features of genetic code. Rules governing the genetic code. Clover-leaf model of t-RNA, ribosome structure. **Translation in prokaryotes**: Concept, Structure and role of RNA polymerase. Translation–process: Initiation, elongation and termination of protein synthesis. **Translation in Eukaryotes** - Translation in eukaryotes. Translation–process: Initiation, elongation and termination of protein synthesis. Post-translational modification. Post-translational Modifications in prokaryotes and eukaryotics. Chaperon. Protein denaturation and factors affecting protein denaturation. Outline of protein folding linked to disease. **Regulation of gene Expression in prokaryotes:** Regulation of gene expression at transcriptional level. Operon concept, *lac* operon, *trp* operon.	**15 Hrs**
Unit III	**DNA isolation:** Methods of isolation of genomic DNA from virus, bacteria, and eukaryotic microorganisms. Isolation of plasmid DNA. Methods of Purification and detection of nucleic acids -DNA and RNA. Blotting techniques (Southern, Northern and Western blotting). Nucleic acid Separation Techniques: Agarose gel electrophoresis, PAGE. **Genetic engineering**: Definition, principles and concept of genetic engineering, mile stones in genetic engineering, prospects and problems of genetic engineering. **DNA modifying enzymes**: Restriction modification systems. Nomenclature and applications of restriction enzymes. DNA polymerases, methylases, Terminal	**15 Hrs**

	deoxynucleotidyl transferase, kinases, phosphatases and DNA ligases. **Vectors**: Characteristics features of cloning and expression vectors. Cloning vectors: Plasmid (p^{BR}), cosmid, Lambda (insertion and replacement) vectors, BAC, YAC. Phagemid, and M^{13} vector. Cloning and Expression vector: p^{UC}, BEV, p^{SV40}. **Cloning host**: *Escherichia coli* and *Saccharomyces cerevisiae* as cloning host and expression host cell.	
Unit IV	**Applications of Genetic engineering:** Restriction enzyme digestion of DNA, Use of linkers, adaptors, and homopolymer tailing. Gene cloning and expression in *E. coli*, Method of DNA/ gene amplification by PCR. **PCR**–Working Principle and applications. **DNA transfer methods**: Transformation (rDNA in *E,coli* host), microinjection, Electroporation, Ti plasmid, T-DNA and gene transfer in plants. **Screening and selection of recombinant host cells**: Insertional inactivation - antibiotic selection, Blue white selection. Selection of recombinants by Colony/ hybridization and Immunological techniques. **Gene Library**: Construction of Genomic library and gene (cDNA) library. Chromosome walking. Restriction mapping, RFLP and RAPD, **DNA fingerprinting technique** – Principle and applications, Merits and Demerits.	**15 Hrs**

Reference Books:

1. Karp,G.,Iwasa,J.,&Marshall,W.(2023).*Karp'sCellandMolecularBiology*(10thed.).Wiley.
2. Krebs, J. E., Goldstein, E. S., & Kilpatrick, S. T. (2021). *Lewin's Genes XIII* (13th ed.). Jones & Bartlett Learning.
3. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., &Losick, R. (2020). *Molecular Biology of the Gene* (8th ed.). Pearson.
4. Malacinski, G. M. (2018). *Freifelder's Essentials of Molecular Biology* (5th ed.). Jones & Bartlett Learning.
5. Berg, J. M., Tymoczko, J. L., Gatto, G. J., & Stryer, L. (2019). *Biochemistry* (9th ed.). W.H. Freeman.
6. Alberts, B., Johnson,A., Lewis, J.,Raff, M., Roberts, K.,& Walter, P. (2014). *Molecular Biology of the Cell* (6th ed.). Garland Science.
7. Tropp,B.E.(2012).*MolecularBiology:GenestoProteins*(4thed.).Jones&BartlettLearning.
8. Allison,E.A.(2015).*FundamentalMolecularBiology*(3rded.).Wiley.
9. Vidyavathi N and Chethan D.M (2007)*MolecularBiology* L.K International Publishing House Pvt.Ltd.

FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TEST)	**15**
ASSIGNMENT/ OPEN DISCUSSION	**5**
TOTAL	**20**

Course code: MBDSCP-3
Course Title: Molecular Biology& Genetic Engineering-3 (Practical)

COURSE TITLE	**PRACTICAL COURSE ON Molecular Biology & Genetic Engineering-3**
COURSE	DISCIPLINE SPECIFIC COURSE **PRACTICAL**
COURSE CODE	**MBDSCP-3**
COURSE CREDITS	**02**
CONTACT HOURS	**4 Hr/Week**
DURATION OF EXAM	**03Hrs**
FORMATIVE ASSESSMENT MARKS	**10**
SUMMATIVE ASSESSMENT MARKS	**40**
TOTAL MARKS	**50**

Course Outcome:

The practical course in Molecular Biology & Genetic Engineering provides basic skills in molecular biology and genetic engineering experimental techniques. Students will learn GLP, preparation reagents, buffers and handling basic equipments. Te students also learn the methods of quantitative estimations of isolated DNA/ RNA and protein.

List of the experiments,:

1. Good Laboratory Practices and Safety Measures of Biohazard materials
2. Study of micropipette operation and calibration
3. Standard operating procedure for molecular biology tools/equipments
4. Preparation of Buffers and Reagents
5. Isolation of Bacterial Genomic DNA
6. Isolation of Plasmid from *E.coli*
7. Detection of DNA by gel electrophoresis
8. Quantitative estimation of DNA by DPA method
9. Quantitative estimation of RNA by orcinol method
10. Analysis of Purity of DNA by spectrophotometric method
11. Extraction and estimation of protein from microbial/animal/plant source
12. Study of semi-conservative replication of DNA through micrographs/ schematic representations
13. Study of DNA finger printing technique through micrographs/schematic representations
14. Identifying Mutants by Replica plate technique
15. Study of Plasmids by Chart
    a) pBR322
    b) pUC18and19
    c) pSV40
    d) Bacteriophages

Reference Books:

1. Brown,T.A.(2023).Genetics:Amolecularapproach(4thed.).Cdn.StanclyPhonicsLtd.
2. Colwell,R.R.(2012).Microbialdiversity(2nded.).AcademicPress.
3. Davis, R. W., Bolstein, D., & Roth, J. R. (1980). A manual for genetic engineering. Cold Spring Harbor Laboratory.
4. De Robertis, E. D. P., & De Robertis, E. M. F. (2017). Cell and molecular biology (8th ed.). Lea &Febiger.
5. Karp,G.(2023).Cellbiology(10thed.).McGrawHill.
6. American Society for Microbiology. (2020). Recombinant DNA (3rd ed.). American Society for Microbiology.
7. Nicholl, D. S. T. (2020). An introduction to genetic engineering (4th ed.). Cambridge University Press.
8. Peters,P.(2015).Aguidetogeneticengineering(3rded.).WMCBrown.
9. Salle,A.J.(2019).Fundamentalprinciplesofbacteriology(10thed.).TataMcGrawHill.
10. Smith,J.(2018).Molecularbiology(6thed.).FaberandFaberPublications.
11. Stanier,R.Y.,&Ingraham,J.L.(2019).Generalmicrobiology(6thed.).PrenticeHallofIndia.
12. Watson,J.D.(2020).RecombinantDNA(4thed.).ScientificAmericanBooks.

FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
ASSIGNMENT/ REPORT	**5**
CONTINUOUS EVALUATION AND CLASS TEST	**5**
TOTAL	**10**

B.Sc., Microbiology Semester-III

Course code: MBOET-3

Course Title: Fundamental Microbiology -3 (Elective 1-Theory)

COURSE TITLE	Fundamental Microbiology-3 (Elective)
COURSE	ELECTIVE COURSE, **THEORY**
COURSE CODE	**MBOET-3 (Elective-1)**
COURSE CREDITS	**03**
TOTAL CONTACT HOURS	**45**
DURATION OF EXAM	**3 Hrs**
FORMATIVE ASSESSMENT MARKS	**20**
SUMMATIVE ASSESSMENT MARKS	**80**
TOTAL MARKS	**100**

Course outcomes: The course in endocrinology provides an insight into the endocrine system, the organs and cells of endocrine system that synthesize endocrine hormones. The course also provides an understanding about the histological structures of endocrine glands, types of endocrine hormones they secrete, process of transport and mechanism of action of hormone. The course provides good understandingabout the significance of hormones in health and disease.

CourseOutcomes(COs):

Attheendofthecoursestudentswillbeableto -

CO1:AcquireknowledgeofMicrobiology,historical backgroundofMicrobiology,wherethey learn about Contribution and discoveries of different scientist.

CO 2: Understand the concept of stains, staining techniques and working principle and applications of equipments.

CO 3: Understandknowledgeaboutthegeneralcharactersandtypesofclassificationof Microorganisms, Viz-Bacteria, Fungi, algae, protozoa and virus Comprehend evolutionary importance and economic significance of microorganisms

CO 4:Learnthemicroscopy,culturemedias,microbialnutritionandsterilizationtechniqueswhich are helpful for industrial applications.

Unit	Fundamental Microbiology -3 (Elective Theory)	45hrs/
Unit I	**History of microbiology**: Theory of abiogenisis and biogenisis. Scope and branches of Microbiology. Contributions of Antonie Von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Edward Jenner. Branches of microbiology. Scope and applications of microbiology in different areas. **Systems of classification**: Whittaker's five kingdom classification and Carl Woese's three domain classification. Classical and molecular characteristic usedin microbial taxonomy. **General characteristics of different groups: Acellular microorganisms**- Viruses, Viroids, Prions. **Cellular microorganisms**- Prokaryotes: Bacteria, Cyanobacteria, Archaebacteria.. Eukaryotes: Algae, Fungi and Protozoa; with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.	15hrs
Unit II	**Microbiological techniques:** **Microscopy:** Principle and Applications of Microscopes: Compound, Dark-field, Stereomicroscope, Fluorescent microscope, Electronmicroscope. **Stains and Staining techniques–** Principles of Stains and dyes. Preparation of smears and fixation. Simple staining (Positive and Negative). Differential staining. **Nutrition and Culturing of Microbes** – Nutritional requirements of microorganisms: Nutritional requirement- Water, Micronutrients, Macronutrients. Fastidious and Non Fastidious organisms, Culture media: components of media natural and synthetic media, chemically defined media, complex media, selective, differential, and enriched media. Conditions required for growth of the microorganisms. Preservation of pure cultures.	15hrs
Unit III	**Sterilization techniques** - Control of Microorganisms, Definitions of Sterilization, Disinfection, Antiseptic, Germicide, Microbiostasis, Antisepsis, Sanitization. Physical agents for control of microorganisms- Temperature, Dryheat, Moist heat, Radiations - U.V and Gamma rays. Chemical Agents for control of microorganisms: Mode of action, application - Phenol and Phenols and Halogen compounds and Heavy metals (Cu and Hg). **Instruments:** Working principles and applications of Instruments: Autoclave, Hotairoven, Laminar air flow, Centrifuge, pH meter, Incubator, Colorimeter.	15hrs

Recommended books:

1. Brock,T.D.,&Madigan,M.T.(2021).*BiologyofMicroorganisms*(15thed.).Pearson.
2. Gardner, E. J., Simmons, M. J., &Snustad, D. P. (2020). *Principles of Genetics* (9th ed.). Wiley-India.
3. Gottschalk,G.(2012).*BacterialMetabolism*(3rded.).SpringerVerlag.
4. Klug, W. S., Cummings, M. R., Spencer, C. A., &Palladino, M. A. (2019). *Concepts of Genetics* (12th ed.). Pearson.
5. Lansing, M., Prescott, J., Ohn, P., Harley, J. P., & Klein, D. A. (2019). *Microbiology* (10th ed.). McGraw Hill.
6. Madigan, M. T., &Martinko, J. M. (2021). *Brock Biology of Microorganisms* (16th ed.). Pearson.
7. Moat,A.G.,&Foster,J.W.(2019).*MicrobialPhysiology*(5thed.).JohnWiley&Sons.
8. Nelson, D. L., & Cox, M. M. (2021). *Lehninger Principles of Biochemistry* (8th ed.). W.H. Freeman.
9. Pierce, B. A. (2020). *Genetics: A Conceptual Approach* (7th ed.). Macmillan Higher Education.
10. Primrose, S. B., &Twyman, R. M. (2016). *Genomics: Applications in Human Biology* (4th ed.). Wiley-Blackwell.
11. Stanier,R.Y.,Ingraham,J.L.,Wheelis,M.L.,&Painter,P.R.(2019).*GeneralMicrobiology* (6thed.).Pearson.
12. Willey, J. M., Sherwood, L. M., &Woolverton, C. J. (2021). Prescott's Microbiology(11th ed.). McGraw Hill.
13. Caetano-Anollés, G. (2021). Evolutionary Genomics and Systems Biology (2nd ed.). John Wiley & Sons.
14. Bouarab,K.,Brisson,N.,&Daayf,F.(2010).MolecularPlant-MicrobeInteraction.CABI.
15. Daniel, W. W., & Cross, C. L. (2018). Biostatistics: A Foundation for Analysis in Health Sciences (11th ed.). John Wiley & Sons.
16. Edmondson, A., &Druce, D. (2021). Advanced BiologyStatistics (2nd ed.). Oxford University Press.
17. Fraser, C. M., Read, T. D., & Nelson, K. E. (2019). *Microbial Genomes* (2nd ed.). Humana Press.

FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TEST)	**15**
ASSIGNMENT/ OPEN DISCUSSION	**5**
TOTAL	**20**

B.Sc., Microbiology Semester-IV

Course code: MBDSCT-4

Course Title: Environmental & Agricultural Microbiology-4 (Theory)

COURSE TITLE	**Environmental &Agricultural Microbiology-4**
COURSE	DISCIPLINE SPECIFIC CORE, **THEORY**
COURSE CODE	**MBDSCT-4**
COURSE CREDITS	**04**
TOTAL CONTACT HOURS	**60**
DURATION OF EXAM	**3 Hrs**
FORMATIVE ASSESSMENT MARKS	**20**
SUMMATIVE ASSESSMENT MARKS	**80**
TOTAL MARKS	**100**

Course Learning Objectives:

The objective of the course in environmental and agricultural microbiology is to teach students the importance of sustainable environment and agricultural process. Students will learn the existence of microorganisms in air, water, soil, waste waters and their role. Microbes may also accumulate on aerosolic suspended particles, soils, waters, industrial effluents, which would lead to airborne, oil and water born diseases. Sustainable environment and agriculture is very important to existence of life.

Course Outcome:

The course provides fundamental insights into the existence of microorganisms in all type of habitats, they are found in air, water, soil, waste water, causing air-born allergy, hypersensitivity, and other contagious diseases to man. Microbes also cause disease in plants. On the other hand microorganisms are key to degrade environmental pollution and also detoxification of industrial effluents. The students also learn the concept of biofertilizer and biopesticides.

Unit	Environmental & Agricultural microbiology-4 (Theory)	60hrs
Unit I	**Microbiology of air:** Microbes and atmosphere: Atmospheric layers, air as habitat for microbes, air microflora of indoor and outdoor environment, space microbes, factors affecting air microflora, significance and management of airborne-microbes. Techniques of trapping airborne microorganisms: Gravity slide, Petri plate exposure, liquid impingements evedevice and filtration. Air borne diseases: allergens, pathogens, significance of microorganisms in air. Control of air borne microorganisms. **Microbiology of water - Sources of water:** surface and ground water and their microflora. Water as a habitat for microbes. Water pollution - sources, water borne diseases-viral (Jaundice), bacterial (Cholera,) and protozoan (amoebiasis), biological indicators of water pollution. Determination of sanitary quality of water: SPC tests for coliform and E.coli. MPN. IMViC tests, membrane filter technique. Water purification in municipal water supply.	15 hrs
Unit II	**Microbiology of waste water -** Source of waste water - domestic, agricultural and industrial, physical, chemical andmicrobiologicalcharacteristicsofwastewater. Wastewatertreatment: Single dwelling unit - Septic tank; municipal waste water treatment- Primary (Screening, coagulation and Sedimentation). Secondary **(**trickling filter, activated sludge process, Osmosis,oxidation pond), Tertiary (reverse Ion exchange method and dialysis), reclamation of waste water and solid waste, recycling.Wasteas Resource (organic compost): Biogas production and composting. **Bioremediation and Bioleaching**: Introduction, types, mechanism, scope and applications of Bioremediation. Factors affecting the microbes in heavy metal tolerance.Different microbial groups in bioremediation of environment pollution. Biodegradation of Petroleum (Hydrocarbons), pesticides (2,4-D and DDT), different microbial groups in bioremediation of environment. Role of Bio-surfactants in bioremediation of pollutants. **Bioleaching:** Scope, organisms involved, economic importance, mechanism of bioleaching of Cu and Fe **.**	15 hrs

Unit III	**Microbiology of soil** Introduction: Type, soil profile physical and chemical characters. Soil as habitat for microbes. Soil Microorganisms: Bacteria, fungi, actinomycetes, algae, protozoa and viruses. Role of Microbes in soil process: Biogeochemical cycles - Carbon, Nitrogen, Sulphur and Phosphorous. Biodegradation: Pectin. Cellulose and lignin. Rhizosphere Microorganisms: Rhizosphere and rhizoplane, Interactions among microorganisms-Neutralism, Mutualism, Commensalism. Antagonism and Parasitism. Plant-microbe interaction: Mycorrhizae**.** **Microorganisms in Agriculture - Bio-fertilizers:** Types (Bacterial, fungal, phosphate solubilizers, BGA, Plants- Azolla*)*. **Mechanism of Nitrogen fixation:** Phosphate solubilizing and Cellulolytic micro organisms, Mass production, mode of applications, advantages and limitations of bacterial inoculants *(Rhizobium, Azotobacter, Azospirullum* and Cyanobacteria).	**15hrs**
Unit IV	**Microbes as plant pathogens** A brief account of the causative agent. Symptoms and control of the following plant diseases: Fungal *(Puccinia, Plasmopara, Cercospora, Pyricularia)* Bacterial *(Xanlhomonas oryzae),* Mycoplasma - Sandal spike. Grassy shoot. Viruses (TMV. Tomato leaf curl). Brief account of post-harvest pathology and IntegratedPestManagement. **Bio-pesticides:** Types (Bacteria- *Bacillus thuringienes,* viral- NPV. *Fungal (Trichoderma,* modeofaction, factors influencing and target pests.	**15hrs**

Reference books:

1. Alexander,M.(2019).*Introductiontosoilmicrobiology*(6thed.).JohnWiley&Sons.
2. Atlas, R. M., &Bartha, R. (2021). *Microbial ecology: Fundamentals and applications* (4th ed.). Benjamin Cummings.
3. Brock,T.D.(2015).*Principlesofmicrobialecology*(3rded.).PrenticeHall.
4. Colwell,R.R.(2012).*Microbialdiversity*(2nded.).AcademicPress.
5. Grant,W.D.,&Long,P.E.(2018).*Environmentalmicrobiology*(2nded.).ThomsonLithoLtd.
6. Hurst,C.J.(2020).*Environmentalmicrobiology*(3rded.).ASMPress.
7. Mehrotra,R.S.(2017).*Plantpathology*(5thed.).TataMcGrawHill.
8. Pelczar,M.J.,Chan,E.C.S.,&Krieg,N.R.(2019).*Microbiology*(6thed.).McGrawHill.
9. Mitchell,R.(2018).*Introductiontoenvironmentalmicrobiology*(4thed.).PrenticeHall.
10. Powar, C. B., &Daginwala, H. F. (2015). *General microbiology* (Vol. 1, 4th ed.). Himalaya Publishing House.
11. Powar, C. B., &Daginwala, H. F. (2015). *General microbiology* (Vol. 2, 4th ed.). Himalaya Publishing House.
12. Prescott,L.M.,Harley,J.P.,&Klein,D.A.(2021).*Microbiology*(11thed.).McGrawHill.
13. Mitchell,R.(2020).*Environmentalmicrobiology*(4thed.).Wiley.
14. Rangaswamy,G.(2019).*DiseasesofcropplantsinIndia*(4thed.).PrenticeHallofIndia.
15. Rangaswamy, G., &Bagyaraj, D. J. (2017). *Agricultural microbiology* (3rd ed.). Prentice Hall of India.
16. Rao,M.N.,&Datta,A.K.(2018).*Wastewatertreatment*(3rded.).Oxford&IBH.
17. Rheinheimer,G.(2016).*Aquaticmicrobiology*(5thed.).JohnWiley&Sons.

18. Salle,A.J.(2019).*Fundamentalprinciplesofbacteriology*(10thed.).TataMcGrawHill.
19. Singh, D. P., &Dwivedi, S. K. (2018). *Environmental microbiology and biotechnology* (2nd ed.). New Age Industrial Publishers.
20. Stanier,R.Y.,&Ingraham,J.L.(2019).*Generalmicrobiology*(6thed.).PrenticeHallofIndia.
21. Stewart,W.D.P.(2017).*Nitrogenfixationinplants*(4thed.).TheAlhionePress.
22. SubbaRao,N.S.(2019).*Soilmicroorganismsandplantgrowth*(5thed.).Oxford&IBH.
23. SubbaRao,N.S.(2018).*Biofertilizersinagriculture*(3rded.).Oxford&IBH.

FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TEST)	**15**
ASSIGNMENT/ OPEN DISCUSSION	**5**
TOTAL	**20**

Course code: MBDSCP-4
Course Title: Environmental & Agricultural Microbiology-4 (Practicals)

COURSE TITLE	**PRACTICAL COURSE ON Environmental & Agricultural Microbiology-4**
COURSE	DISCIPLINE SPECIFIC COURSE**PRACTICAL**
COURSE CODE	**MBDSCP-4**
COURSE CREDITS	**02**
CONTACT HOURS	**4 Hr/Week**
DURATION OF EXAM	**03Hrs**
FORMATIVE ASSESSMENT MARKS	**10**
SUMMATIVE ASSESSMENT MARKS	**40**
TOTAL MARKS	**50**

Course Outcome:

The practical course in **Environmental & agricultural microbiology** provides skills in isolation, enumeration and identification of microorganisms from different habitats on different media. The student develop skills in understanding different media fo the isolation of specific microorganisms.

At the end of the course students will be able to –

1. Develop thorough knowledge of Experiments in Microbiology of Air, water and soil.
2. Become efficient in managerial skills in water microbiological analysis chemical and biological tests.
3. Able to employ analytical reasoning, problems solving, interpretation and documentation of laboratory experiments at a level suitable tosucceedatan entry-level position in Microbiology.
4. Get expertise in Biofertilizer and biopesticides production, techniques to detect plant pathogens from diseased plants.

List of the Experiments, each will have 04Hrs/Week -

1. Isolation of microorganisms from soil, air and water.
2. Isolation and enumeration of microorganisms from different water samples.
3. MPN tests and Membrane filtration techniques for Coliform and *E.coli* from potable water samples.
4. Estimation of TSS (Total Suspended Solids) and TDS (Total Dissolved Solids) in sewage samples.
5. Estimation of dissolved oxygen, BOD
6. Bioremediation of industrial wastes (Soiland Water) by using indigenous microbes.
7. Demonstration of water purification process: Flocculator, Clarifier, Sand filter, back wash chlorometer and chloroscope), sewage treatment plants - Trickling filter, Imhoff tank, Septic tank and sewage treatment
8. Isolation and enumeration of bacteria and fungi from Rhizosphere and Rhizoplane.
9. Study of Antagonism between soil microorganisms by plate method.
10. Isolation of *Rhizobium* using yeast extract Mannitol Agar and Isolation of *Azotobacterium* using Ashby's Mannitol Agar from soil.
11. Study of *Rhizobium* from Legume root nodules through gramstaining.
12. Mass of cultivation of *Rhizobium* Biofertilizer (liquid/solid) using carrier material.
13. Isolation of Actinomycetes from soil using different agar media.
14. Demonstration of air samplers – vertical cylinder spore trap. Rotarod samples, Hirst spore trap. Anderson samples liquid impingement method-Photographs/charts
15. Plant Pathology: Study of plant pathogens (Two diseases each from Bacteria, Fungi and Virus).
16. Study of fungi-*Cladosporium, Helminthosporium, Mucor, Curvularia, Alternaria, Geotrichum and Trichoderma.*

FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
ASSIGNMENT/ REPORT	**5**
CONTINUOUS EVALUATION AND CLASS TEST	**5**
TOTAL	**10**

B.Sc., Microbiology Semester-IV

Course code: MBOET-4 (Elective-2, Theory)

Course Title: Applied Microbiology course-4 (Elective-2, Theory)

COURSE TITLE	Applied Microbiology course-4
COURSE	ELECTIVE COURSE, **THEORY**
COURSE CODE	**MBOET-4 (Elective-2)**
COURSE CREDITS	**03**
TOTAL CONTACT HOURS	**45**
DURATION OF EXAM	**3 Hrs**
FORMATIVE ASSESSMENT MARKS	**20**
SUMMATIVE ASSESSMENT MARKS	**80**
TOTAL MARKS	**100**

Course outcomes: The course in Animal Behaviour provides an insight into the fundamental understanding of proximate and ultimate cause of animal behavior, the patterns of stereotyped and individual behavior and associated learning. in different habitats and circumstances.

After attending the coursestudentswillbeableto -

CO1: Overview various food and water borne diseases CO

2: Demonstrate entrepreneurial skills

CO3:Acquireknowledgeonmassproductions

CO4:AcquireknowledgeonCommunicablediseases

Unit	Applied Microbiology Course-4 (Elective-2, Theory)	45hrs/ sem
Unit I	**Microbes and Environment** Microbes of Air: Atmospheric layers and sources of microorganisms, air microflora of indoor and outdoor environment.Microbes of Water: Biological indicators of water pollution. Determination of sanitary Quality of water: SPC tests for coliform. MPN. IMViC reactions, membrane filters technique. Source of waste water - Domestic, agricultural and industrial, physical,chemical and microbiological characteristics of waste water. Microbes of Soil: Rhizosphere and rhizoplane, Interactions among microorganisms - Neutralism, Mutualism, Commensalism.Antagonism and Parasitism. Microbes of Food: Food as substrate for microbes and sources of contamination, Spoilage of food and milk - Gassy fermentation, Proteolysis. Lipolysis, Ropiness and canned foods, cereals, fruits, vegetables. Meat and fish.	**15hrs**
Unit II	**Microbial Entrepreneurship** Introduction and scope, Business development, product marketing, HRD, Biosafety and Bioethics. Outline of copy right and patent laws. Microbiological Industries – Mass production, mode of applications of Biofertilizers Plant (Azolla) bacteria (*Rhizobium*) and Bio pesticides – *Tricoderma*. Concept of Prebiotics, Probiotics and Synbiotics– Production of fermented foods sauerkraut and SCP. Production of Alcoholic and Beverages, Mushroom Cultivation and biogas production.	**15hrs**
Unit III	**Microbiomes and Human Health**: **Human Microbiome**: Normal microflora of skin, throat, intestine and Factors affecting microbial diversity and functions of microbiome - age, genetics, environment, diet, physiology, immunity of host **Types of Immunity**: Introduction to immunity. Natural (active and passive) and artificial (active and passive) with example Innate and acquired, Humoral and cell Mediated immunity. Outline of organs and cells of immune cells. **The pathogenesis, diagnosis and control measures of Bacterial Disease** – Cholera Botulism, Salmonellosis. **Fungal Disease**- Tinea, pedis (Athlete's foot), and Mycotoxins **Viral disease** - Dengue, AIDS, Corona, Jaundice **Protozoan diseases**: Malaria and amoebiasis. **Antibiotics** – Types, functions and antibiotic therapy. **Vaccines**: Types, properties, functions and schedules	**15hrs**

Reference Books:

1. Ananthanarayan, R., &Paniker, C. K. J. (2021). *Textbook of Microbiology* (12th ed.). Orient Longman.
2. Dubey, R. C., &Maheshwari, D. K. (2020). *A Textbook of Microbiology* (3rd ed.). S Chand &Co.
3. Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (2020). *Microbiology*(7th ed.). Tata McGraw Hill.
4. Prescott,L.M.,Harley,J.P.,&Klein,D.A.(2021).*Microbiology*(11thed.).McGrawHill.
5. Modi,H.A.(2018).*ElementaryMicrobiology*(Vol.I,2nded.).EktaPrakashan.
6. Sateesh,M.K.(2020).*BioethicsandBiosafety*(3rded.).IKInternationalPvtLtd.
7. Dubey,R.C.(2019).*ATextbookofBiotechnology*(5thed.).SChandPublications.
8. Singh,B.D.(2021).*ExpandingHorizonsinBiotechnology*(4thed.).KalyaniPublication.
9. Willey, J. M., Sherwood, L. M., &Woolverton, C. J. (2021). *Prescott, Harley, and Klein's Microbiology (12th ed.). McGraw Hill.*
10. *Madigan, M. T., &Martinko, J. M. (2021). Brock Biology of Microorganisms (16th ed.). Pearson.*
11. *Caetano-Anollés, G. (2021). Evolutionary Genomics and Systems Biology (2nd ed.). John Wiley & Sons.*
12. *Bouarab,K.,Brisson,N.,&Daayf,F.(2010).MolecularPlant-MicrobeInteraction.CABI.*
13. *Daniel, W. W., &Cross, C. L. (2018). Biostatistics: A Foundation for Analysis in Health Sciences (11th ed.). John Wiley & Sons.*
14. *Edmondson, A., &Druce, D. (2021). Advanced Biology Statistics (2nd ed.). Oxford University Press.*
15. *Fraser, C. M., Read, T. D., &Nelson, K. E. (2019). Microbial Genomes (2nd ed.). Humana Press.*

FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TEST)	**15**
ASSIGNMENT/ OPEN DISCUSSION	**5**
TOTAL	**20**

B.Sc., Microbiology

Course code: SEC -1

Course Title: Skill Enhancement in Microbiology (Theory/ practice)

COURSE TITLE	Microbial quality control in Industry
COURSE	Skill Enhancement, **THEORY/ PRACTICAL**
COURSE CODE	**MBSEC -1**
COURSE CREDITS	**02**
TOTAL CONTACT HOURS	**30**
DURATION OF EXAM	**2Hrs**
FORMATIVE ASSESSMENT MARKS	**10**
SUMMATIVE ASSESSMENT MARKS	**40**
TOTAL MARKS	**50**

Course Outcomes (COs):

At the end of the course, students will be able to -

CO1: Expertise skills of food sampling, handling and homogenization in food and pharma industry.

CO2: Develop knowledge of laboratory safety procedures and protocols and acquire skills in handling maintaining laboratory equipment and instruments.

CO3: Operate analytical equipment and instruments as per standard operating procedures (SOP).

CO4: Gain knowledge about major activities of the Microbial industry, regulations and compliance, environment, health and safety (EHS), good laboratory practices (GLP), and Good Manufacturing Practices (GMP) as per the industry standards.

List of the Experiments, each will have 04Hrs/Week:

1. SOP for Swab and food sampling, handling and homogenization in food industry.
2. Guidelines and procedure for GLP, GMP and GDP in quality control food and pharma industries.
3. SOP for cleaning,disposal,decontamination glassware and culture medias.
4. SOP sanitation,fumigation and sterility in Microbiology laboratory.
5. Monitoring and validation of autoclave process by chemical and biological indicators in quality control microbiology.
6. Media preparation and its importance in pharmaceutical and food industries.
7. Pure cultures maintenance techniques in quality control microbiology.
8. Growth Promotion Test(GPT)to verify the fertility of culture media.
9. Physical and chemical analysis of raw water used in food and pharma industries.
10. Enumeration of Total Viable Count (TVC), Total Yeast and Mould Count (TYMC).
11. Enumeration of specified pathogens from water by membrane filtration techniques in pharma industries.
12. Enumeration of Total Coliforms and *E. coli* form drinking, raw and DM water by membrane filtration techniques.
13. Environmental monitoring of Surface and personal hygiene swabs in industries.
14. Demonstration of BET and MLT sterility tests in pharma industries.
15. Visit to Pharma, Food and food processing, alcoholic beverage industries. Tour Report should be submitted.

Books recommended:

1. Baird, R. M., Hodges, N. A., &Denyer, S. P. (2021). *Handbook of Microbiological Quality Control in Pharmaceutical and Medical Devices* (2nd ed.). CRC Press.
2. Garg, N., Garg, K. L., &Mukerji, K. G. (2019). *Laboratory Manual of Food Microbiology* (2nd ed.). I K International Publishing House Pvt. Ltd.
3. Harrigan,W.F.(2013).*LaboratoryMethodsinFoodMicrobiology*(4thed.).AcademicPress.
4. Jay, J. M., Loessner, M. J., & Golden, D. A. (2021). *Modern Food Microbiology* (8th ed.). Springer.
5. Willey, J. M., Sherwood, L. M., &Woolverton, C. J. (2021). *Prescott, Harley, and Klein's Microbiology* (12th ed.). McGraw Hill.
6. Madigan, M. T., &Martinko, J. M. (2021). *Brock Biology of Microorganisms* (16th ed.). Pearson.
7. Caetano-Anollés, G. (2021). *Evolutionary Genomics and Systems Biology* (2nded.). John Wiley& Sons.
8. Bouarab,K.,Brisson,N.,&Daayf,F.(2010).*MolecularPlant-MicrobeInteraction*.CABI.
9. Daniel, W. W., & Cross, C. L. (2018). *Biostatistics: A Foundation for Analysis in Health Sciences* (11th ed.). John Wiley & Sons.
10. Edmondson, A., &Druce, D. (2021). *Advanced Biology Statistics* (2nd ed.). Oxford University Press.

FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
REPORT/ ASSIGNMENT	**5**
CONTINUOUS EVALUATION AND CLASS TEST	**5**
TOTAL	**10**

B.Sc,. Programme: 2025-26

GENERAL PATTERN OF THEORY QUESTION PAPER FOR DSC/EC

(80 marks for Semester End Examination with 3hrsduration)

Part-A

1. Question number 1-12 carries 2 marks each. 20marks
   Answer any 10 questions

Part-B

2. Question number 13-20 carries 05 Marks each.

Answer any 06 questions 30marks

Part-C

3. Question number 21-24 carries 10 Marks each.

4. Answer any 03 questions 30marks

Note: Equal weightage is given to all units.

TUMKUR UNIVERSITY
BSc III SEMESTER MICROBIOLOGY PRACTICAL EXAMINATION

MBDSCP-3: Molecular biology and Genetic engineering

Time: 3hrs **Max. Marks: 40**

1. Estimate the amount of **DNA** in the given sample **'A'** by Diphenylamine method.
   Or
   Estimate the **RNA** in the given sample '**A'** by Orcinol method. **12 marks**
2. Prepare Citrate/Phosphate buffer **'B'** having the pH…….. **4 marks**
3. Write the experimental Protocol for **'C' .** **4 marks**
   Isolation of plasmid DNA from bacteria / Isolation of genomic DNA from *E. coli* / Restriction digestion of DNA / In vitro DNA ligation/Purity of DNA by Absorbance method
4. Identify and write the comment on **D, E, F** and **G** **3X4=12 marks**
5. Practical Class record **4 marks**
6. Viva-voce **4 marks**

SCHEME OF EVALUATION

1. 'A' DNA/RNA :	Principle	3	
	Procedure	2	12 marks
	Performance	4	
	Graph	2	
	Result	1	

2. Citrate/Phosphate buffer 'B' 4 marks

Note: Different pH values should be provided for the students

3. Procedure 'C' 4 marks

4. Identify and comment on D,E, F and G

   Identification 1 3X4=12 marks
   Comment 2

   [pBR322, pUC 18&19, SV40, bacteriophage, λ phage, Gene cloning, replica plate technique]

5. Practical Class record 4 marks
6. Viva-voce 4 marks

TUMKUR UNIVERSITY
BSc IV SEMESTER MICROBIOLOGY PRACTICAL EXAMINATION
MBDSCP-4 Environmental and Agricultural Microbiology

Time: 3 hrs **Max. Marks: 40**

1. Determine BOD/Total dissolved solids (TDS) for the given sample 'A'**.** **12 marks**
2. Prepare temporary mount 'B' for the legume root nodules by Gram staining. **5 marks**
3. Temporary mount for the sample 'C' by tease mount **3 marks**
4. Identify and comment 'D', 'E' and 'F' **12 marks**
5. Practical class record **4 marks**
6. Viva voce **4 marks**

SCHEME OF EVALUATION

1.	'A' BOD/TDS:	Principle 3 Procedure 2 Performance 4 Calculation 2 Result 1	12 marks
2.	Tease mount 'B'	Performance 2 Principle 1 Procedure 1 Result 1	5 marks
3.	Tease mount 'C'	Performance 1 Result 1 Comment 1	3 marks
4.	Identify and Comment 'D', 'E' and 'F'	'Identification 1 Comment 2	3X4=12 marks
5.	Practical class record		4 marks
6.	Viva voce		4 marks