SEMESTER – III			
PRACTICAL –III **TECHNIQUES IN AGRICULTURAL, ENVIRONMENTAL, INDUSTRIAL AND PHARMACEUTICALMICROBIOLOGY**			
Code: 17PMICR3	**Hrs/week: 6**	**Hrs/Sem: 90**	**Credits: 3**

OBJECTIVES:

To impart advanced level practical training in Agriculture and Industrial Microbiology.

1. Isolation of *Rhizobium* from root nodules of leguminous plants.
2. Isolation of *Azotobacter* from soil.
3. Isolation of antibiotic producing microbes from soil.
4. Testing antagonistic activity of soil microorganisms
5. Assessment of VAM colonization
6. Estimation of soil mineral contents a) pH b) nitrate c) nitrite d) sulphate e) phosphate.
7. Isolation of air borne bioparticles.
8. Isolation of coliforms from sewage.
9. Effect of high salt concentration on microbial growth.
10. Determination of biological oxygen demand
11. Determination of chemical oxygen demand
12. Production of citric acid by *Aspergillus niger.*
13. Bio ethanol production
14. Amylase production
15. Protease production
16. Immobilization of yeast cells using sodium alginate Bioassay of chloremphenicol by plate assay method or turbidiometric Assaay method
17. Sterility testing by *Bacillus stearothermophilus*
18. Determination of antimicrobial activity of a chemical compound (Phenol,Resorcinol,Thymol,Formaldehyde) to that of phenol under standardized experimental conditions.

REFERENCE BOOKS:

1. Gunasekaran. P. (1996). Laboratory Manual in Microbiology. New Age International Ltd., Publishers, New Delhi.
2. Dubey, R.C.andMaheswari,D.K. (2002).Practical Microbiology, 1st Edition Chand and Company Ltd., India.
3. Aneja K.R.(1993). Experiments in Microbiology,Plant Pathology and Tissue Culture. WishwaPrakashan.NewDelhi.India.
4. Benson. (2002). Microbiological Applications – Laboratory Manual in General Microbiology. International Edition, McGraw Hill Higher Education.
5.Jayaraman, J. (1985). Laboratory Manual in Biochemistry. Wiley Eastern Ltd., New Delhi.
6. Plummer. D.T. (1998). An Introduction to Practical Biochemistry. Tata McGraw Hill, New Delhi.

SEMESTER – IV			
PRACTICAL –IV **TECHNIQUES IN MICROBIAL GENETICS, MOLECULAR BIOLOGY, FOOD MICROBIOLOGY AND GENETIC ENGINEERING**			
CODE: 17PMICR4	**Hrs/week: 4**	**Hrs/Sem: 90**	**Credits: 2**

OBJECTIVES

To impart advanced level practical training in Microbial Genetics, Molecular Biology, Food Microbiology and Genetic Engineering.

1. Molecular Biology: Isolation & Quantification of DNA from microorganisms.
2. Isolation of plasmid DNA
3. Agarose gel electrophoresis of DNA
4. Isolation of antibiotic resistant mutants by gradient plate technique
5. Mutagenesis: spontaneous mutation and isolation of UV induced mutants of *E.coli.*
6. Isolation of autotrophic mutants by Replica plating technique.
7. Ampicillin selection of auxotrophs
8. Microbial examination of milk i) Methylene blue reductase test ii)Resazurin test
9. Microbiological analysis of foods i) Vegetables ii) Meat iii) Fish
10. Isolation and identification of *Salmonella* in processed foods.
11. Enumeration of microorganism from bread
12. Portability test of water – MPN.
13. Wine production from grapes.
14. Mushroom cultivation.
15. Isolation of RNA from microorganisms.
16. Quantification of RNA by Orcinol method.
17. Quantification of DNA by DPA method.

REFERENCE BOOKS:

1. Cappuccino. J.G., and Sherman. N. (1996). Microbiology – A Laboratory Manual. Benjamin Cummins. New York.
2. Kannan.N. (1996). Laboratory Manual in General Microbiology. Palani Paramount Publication, Palani.
3. Gunasekaran.P.(19960. Laboratory Manual in Microbiology. New Age International Ltd., Publishers, New Delhi.
4. Sundararaj, T. (2005), Microbiology – Laboratory Manual (1st Edition). Publn. Sundararaj.T, Chennai.
5. Palanivelu. P. Analytical Biochemistry and Separation Techniques.
6. Rajan.S.,Selvi Christy. R (2012).Experimental procedure in Life sciences. Book House.
7. Aneja.K.R., Experiments in Microbiology, Plant pathology and Biotechnology. Fourth Revised Edition. New Age International Publishers.

SEMESTER –II	
SELF STUDY COURSE(COMPULSORY) – QUALITY ASSURANCE TECHNIQUES IN SEA FOOD PROCESSING INDUSTRY	
Code : 17PMISS1	**Credits: +2**

OBJECTIVES

To impart advanced level information about the Quality control in the laboratory.

UNIT-I:

Quality assurance in sea food industry- Hazard analysis critical control point (HAACP) and Good Manufacturing practices (GMP) .

UNIT-II:

Standard sanitary operating procedures (SSOP) and Sanitary Control Procedures (SCP)

UNIT-III:

Microbial hazards detection and identification - *Listeria monocytogenes, Salmonella* and *Vibrio Cholerae.*

UNIT-IV:

Enumeration of surface, air and water microbes.

UNIT-V

National standard for sea foods and seafood industries

REFERENCES:

1) Quality control of fish and fishery products –compiled and edited by Dr.G.Jeyasekaran. Dr (Mrs.) R.JeyaShakila, Dr.P.Velayutham.

2) Fish Processing Plant-Guidelines for the application of HACCP program –prepared by Food Protection Services, BC centre for disease control-Revised January 2011.

SEMESTER- III			
CORE – VII AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY			
Code:17PMIC31	**HRS/WEEK: 6**	**HRS/SEM: 90**	**CREDITS: 5**

OBJECTIVES

1. To inculcate the knowledge on interaction between microbes and environment.
2. To impart advanced information in Agricultural Microbiology.

UNIT I :

Based on oxygen requirement, nutrition, temperature, habitat (soil, water & air). Physio-chemical properties of soil -Rhizosphere and rhizoplane organisms. Mineralization and immobilization. Biogeochemical cycling: Carbon cycling

UNIT II :

Microbial analysis of drinking water: Tests for coliforms (presumptive, confirmed andcompleted tests). Purification of water: Sedimentation, Filtration (slow and rapid sand filters) and Disinfection. Aeromicrobiology – Phylloplane microflora (morphological, physiological characters: nutrition, radiation, relative hymidity and temperature) – Air Pollution – aerosol, droplet nuclei and infectious dust. Examination of air microflora.

UNIT III :

Nature of sewage and its composition. Physical, chemical and biological properties of sewage (BOD, COD etc). Sewage systems and types. Sewage Treatment: Single Dwelling Unit, municipal sewage treatment – primary, secondary and tertiary treatments (Trickling filters, activated sludge process, Oxidation lagoons and Imhoff tank).

UNIT – IV

Biological Nitrogen fixation- The range of nitrogen fixing organisms- mechanism of nitrogen fixation (biochemistry of nitrogenase) - genetics of nitrogen-fixation - Rhizobium-Legume Association - N2 fixation by non-leguminous plants.

UNIT – V

Microbial products and plant health: PGPR (plant growth promoting rhizobacteria) - significance of mycorrhizae - Role of biofertilizers and biopesticides- Biofertilizers-(*Rhizobium, Azospirillum, Azotobacter, Cyanobacteria, Phosphobacteria and Azolla*)-Inoculants, mass production and method of application and its Quality Control (BIS specification).

REFERENCE BOOKS:

1. Shiva Aithal, C. (2010). Mordern approaches in Soil,Agricultural and Environmental Microbiology. Himalaya Publishers, New Delhi.
2. Atlas,R.M., and Bartha.M. (2003). Microbial Ecology –Fundamentals and applications. Benjamin – Cummings, Mento Park, California.
3. Martin Alexander (1983).Introduction to Soil Microbiology, Wiley eastern Ltd., NewDelhi.
4. SubbaRao,N.S.(1997). Biofertilizers in Agriculture and Forestry III Ed,Oxford and IBH Publishing Co, Pvt. Ltd, NewDelhi.

5. SubbaRao,N.S.(1995). Soil Microorganisms and Plant growth. Ed,Oxford and IBH Publishing Co, Pvt. Ltd, NewDelhi
6. Wheeler, B.E. (1976). An introduction to Plant disease. ELBS and John Wiley and sons, Ltd.
7. Rangaswamy.g., and Bagyaraj.D.J. (1996). Agricultural Microbiology. Prentice-Hall of India Pvt Ltd., New Delhi.
8. Dirk, J. Elasas, V., Trevors,.T., and Wellington, E.M.H. (1997). Modern Soil Mirobiology. Marcel Dekker INC, New York, HongKong.
9. Dubey R.C. (2001).A Text Book of Biotechnology. S Chand & Co. New Delhi.
10. Gupta,S.K.(2014).Approaches and trends in plant disease management. Scientific publishers.Jodhpur,India.
11. Jammaluddin et al (2013). Microbes and sustainable plant productivity. Scientific Publishers Jodhpur,India,G.
12. Purohit, S.S.Kothari,P.R.andMathur (1993). Basic and Agrcultural Biotechnology, Agrobotanical Publishers (India).Bikaner.

SEMESTER –III			
CORE VIII RESEARCH METHODOLOGY			
Code : 17PMIC32	**HRS/WEEK: 6**	**HRS/SEM: 90**	**CREDITS: 5**

OBJECTIVES

To impart advance level information in the subject on Research methodology, Biosafety, Bioethics, Patenting and IPR.

UNIT – I : Microscopy, pH and buffer

General laboratory procedures and maintenance of research equipments-microscopy-general principles-confocal microscope, SEM and TEM –pH basic principles and construction of pH meter- pH electrodes- Principles and application of buffers –Mechanism of buffer action and preparation of common buffers –Citrate, acetate, tris and phosphate-Application of buffers-pH measurements of soil and water.

UNIT – II : Isolation, Fractionation and Separation

Isolation, Fractionation and Separation of cellular constituents – Isolation of chloroplasts, mitochondria, nucleic acids and enzymes – homogenization –Manual, mechanical and sonication –centrifugation-centrifuges and their uses- Micro centrifuge, high speed refrigerated centrifuges, ultra centrifuges, differential and density gradient centrifugation – Chromatography –paper, thin layer-separation of amino acids and sugars-Gas liquid chromatography, HPLC and PCR –principle and applications.

UNIT – III :

Electrophoresis –principles, factors affecting electrophoretic mobility – support medium –Agarose and polyacrylamide gels- Electrophoresis of proteins and nucleic acids-Spectroscopic techniques –UV –visible, MALDI-TOF, LC-MS and AAS-principles, Instrumentation and applications-Estimation of cellular constituents- Sugars, amino acids and proteins –Flame photometer and Bomb calorimeter- principle and applications.

UNIT – IV : Research and Project writing methods

Research-definition, objectives, types and importance-Research methods in biological sciences- Research process- Literature survey – sources –scientific databases- Research report writing – Parts of Thesis and Dissertation –Title, certificate, declaration, acknowledgements, contents, List of tables, figures, plates & abbreviations, Introduction, Review of literature, Materials and methods-Results – Presentation of data – Tables, figures, map, graphs, photographs – Discussion – Summary, Bibliography/ References and Appendix.

UNIT – V : Article Publication

Presentation in seminars and conferences – Writing scientific paper – Organization of scientific paper – Importance of title – abstract –key words, Introduction, materials and methods, results, Discussion. Acknowledgements and References – Publication in research journals – Standards of Research journals- Peer – review – impact factor – citation index – Preparation of manuscript – Proof correction – proof correction marks- method of correcting proof- Writing chapters in books – Preparation of Research proposal and funding agencies – Research fellowships.

REFERENCE BOOKS:

1. Vijayalakshmi.G. andC.Sivapragasam (2008). Research Methods (Tips and Techniques). MJP Publishers, Chennai.
2. Gurumani.N. (2006). Research Methodology for Biological Sciences. MJP Publishers, Chennai.
3. Ramamurthi and Geetha Bali (2007). Bioethics and Biosafety.APH Publishing, New Delhi.
4. Biszley, R.E.(1991). Patenting animals in Europe, Biotechnology. 9:6 192- 622
5. Crespi, R.S. (1991). Biotechnology and Intellectual property. Part- I, Patenting In Biotechnology, TIP TECH 9:117-121.
6. Ehrlich, P.R., and Wilson, E.O.(1991). Biodiversity Studies – Science and. Policy. Science 253: 758- 762.
7. Eisenberg, R.S. (1992). Genes, Patents and product Development. Science, 257: 903-906.
8. Gill. K.S. (1991). Implications of intellectual property rights for Agricultural Sector in India. Crop Improve. 18: 81-87.
9. IDRC Report (1991). A patent on life: Ownership of Plant and Animal Research. IDRC, Ottawa, Canada.pp 40.
10. Marx. J.L. (Editor) (1989). A Revolution in Biotechnology. Cambridge Univ. Press. Cambridge.

SEMESTER - III			
CORE –IX INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY			
Code: 17PMIC33	**HRS/WEEK: 6**	**HRS/SEM: 90**	**CREDITS: 5**

OBJECTIVES:

1. To inculcate the knowledge of Industrial and Pharmaceutical Microbiology
2. To impart the students with the knowledge of various processes involved in Pharmaceutical industry.

UNIT-I

Isolation, preservation and improvement of industrially important microorganisms; Raw materials and media design for fermentation processes; Sterilization; Development of inoculums for industrial fermentations; Types of fermentation: Batch, continous, dual or multiple, surface, submerged, aerobic and anaerobic

UNIT-II

Fermenter- Design and types, Instrumentation and control-aeration and agitation.Recovery and purification of fermentation products.Enzymes and cell immobilization,production of recombinant proteins having therapeutic and diagnostic applications: Insulin,Interferon,Somatotropin,Single cell protein.

UNIT-III

Biology of industrial microorganisms.*Streptomyces*, Yeasts (*Saccharomyces, Hansenula)Spirulina* and *Penicillium*. Mushroom cultivation. Biosensors and Biochips.Biofuels from microbial sources.

UNIT-IV

Alcohols (Ethanol and Butanol); Beverages (Beer and Wine); Aminoacids (Glutamic acid and Lysine); Organic acids(Citric acid and acetic acid); Vaccines (Plant – *Agrobacterium tumefaciens*, Animal – Leptospirosis, Microbes - DPT)

UNIT-V

Antibiotics (Penicillin,Cepalosporin and Streptomycin); Vitamins (Riboflavin and cyanocobalamin); Production of enzymes (Protease,Amylase and Lipase); Biopolymers (Xanthan gum and PHB);Biopreservatives (Nisin); Production of Hormones (Testosterone and Androstenedione)

REFERENCE BOOKS:

1. WulfCrueger (2000).A Text Book of IndustrialMicrobiologyII.Ed. Panima Publishing Corporation,NewDelhi..

2. Peter F.Stanbury., Whittaker, A. and Hali,S.J.(1997).Principles of Fermentation Technology,
II Ed., Pergamon Press.
3. A.H.Patel, Industrial Microbiology (1996).Macmillan India Limited.
4. Reed.G.(Editor),Industrial Microbiology, CBS Publishers
5. Prescott &Dunn(1997). Industrial Microbiology.CBS publishers and Distributors.
6. Casida,L.E.(1986).Industrial Microbiology. Eastern Limited, NewYork.
7.Michael J.Waites, Neil L.Morgan, John S.Rockey and GrayHigton(2001). Industrial Microbiology An Introduction, Replika press Pvt.NewDelhi.
8. S. S. Purohit, H.N. Kakrani, A.K. Saluja, Pharmaceutical Biotechnology (2006). Student edition, Jodhpur.
9. U. Satyanarayana, Biotechnology (2013). Books and Allied (P) Ltd, Kolkata.

SEMESTER – III	
RESEARCH PROJECT	
CODE: 17PMIP31	**CREDITS: 5**

OBJECTIVES

1. To impart advanced level information for doing a Research Project Individually and to visit to Hi-Tech Industries / Institutes
2. To develop self confidence through paper presentation and skill based training at workshops and get acquainted to subject interviews.

RESEARCH PROJECT

To plan and design statistically, retrieve relevant literature, organize and process the data, photograph relevant observations, evaluate by statistical programme, present the project in any State/ Regional / National conference/ Seminar during the second year of the course and submit during the final semester examinations. The work has to be conducted in the Department / Collaborative organization / Institute under the guidance of the Project Supervisor. Inter- disciplinary collaborations from External Departments / Institutions can also be organized for essential areas of the Project if necessary. The method of valuation of the project report submitted by the candidate is outlined under the course project and viva-voce.

The project report should be submitted to the Head of the Course Department "One week prior" to the commencement of the practical examination in the Fourth Semester. Each student has to submit 3 copies of his / her project report for evaluation.

INDUSTRIAL VISIT

An educational tour to leading industrial institutes should be conducted as an eye opener and to basically understand the advanced technological know how which is a must. This exposure and orientation to Advanced Instruments / Gadgetries / On-line Process / By-product Recoveries / Involved Strategies and Implications would alleviate the level of scientific knowledge by all standards. A report pertaining to the visit of scientific learning shall be submitted for evaluation. On-Duty leave should be granted to the teachers accompanying the students. The industrial visit shall include Food, Dairy, Pharmaceutical, Biotechnological, Agricultural, Beverage and Fermentation, Enzyme Production, Solid and Liquid Waste Management, processing plants and research based organizations (Fundamental and Advanced Centers of Eminence)

PRESENTATION OF SCIENTIFIC FINDINGS

Each student will have to present their scientific findings of individual work (or) collaborative work in any State / Regional / National International Seminar or Symposia. Alternatively, they can attend any workshops conducted by the State / National Organizations of Scientific Recognition. Abstracts / Papers presented along with certificates will have to be

produced during examination. Scientific papers published in Journals / Proceedings during his / her Master Programme will be given special weightage.

GENERAL VIVA - VOCE

The examiners shall conduct a General Viva-Voce pertaining to the core course papers as an overall component.

SEMESTER – III			
PRACTICAL –III **TECHNIQUES IN AGRICULTURAL, ENVIRONMENTAL, INDUSTRIAL AND PHARMACEUTICALMICROBIOLOGY**			
Code: 15PMICR3	**Hrs/week: 6**	**Hrs/Sem: 90**	**Credits: 3**

OBJECTIVES:

To impart advanced level practical training in Agriculture and Industrial Microbiology.

1. Isolation of *Rhizobium* from root nodules of leguminous plants.
2. Isolation of *Azotobacter* from soil.
3. Isolation of antibiotic producing microbes from soil.
4. Testing antagonistic activity of soil microorganisms
5. Assessment of VAM colonization
6. Estimation of soil mineral contents a) pH b) nitrate c) nitrite d) sulphate e) phosphate.
7. Isolation of air borne bioparticles.
8. Isolation of coliforms from sewage.
9. Effect of high salt concentration on microbial growth.
10. Determination of biological oxygen demand
11. Determination of chemical oxygen demand
12. Production of citric acid by *Aspergillus niger.*
13. Bio ethanol production
14. Amylase production
15. Protease production
16. Immobilization of yeast cells using sodium alginateBioassay of chloremphenicol by plate assay method or turbidiometericAssaay method
17. Sterility testing by *Bacillus stearothermophilus*
18. Determination of antimicrobial activity of a chemical compound (Phenol,Resorcinol,Thymol,Formaldehyde) to that of phenol under standardized experimental conditions.

REFERENCE BOOKS:

1. Gunasekaran. P. (1996). Laboratory Manual in Microbiology. New Age International Ltd., Publishers, New Delhi.

2. Dubey, R.C.andMaheswari,D.K. (2002).Practical Microbiology, 1st Edition Chand and Company Ltd., India.

3. Aneja K.R.(1993). Experiments in Microbiology,Plant Pathology and Tissue Culture. WishwaPrakashan.NewDelhi.India.

4. Benson. (2002). Microbiological Applications – Laboratory Manual in General Microbiology. International Edition, McGraw Hill Higher Education.

5.Jayaraman, J. (1985). Laboratory Manual in Biochemistry. Wiley Eastern Ltd., New Delhi.

6. Plummer. D.T. (1998). An Introduction to Practical Biochemistry. Tata McGraw Hill, New Delhi.

SEMESTER- III	
SELF STUDY COURSE (OPTIONAL) -PROBIOTICS	
CODE:17UMISS2	CREDITS: +2

Objective:

1) To impart current knowledge of probiotics, prebiotics and functional dairy foods for the health benefits .

UNIT:1

Probiotics: Introduction and history of Probiotics, Probiotic microorganisms.

UNIT:II

Characteristics of Probiotics for selection: Tolerance to additives,stability during storage, stability maintenance of probiotic microorganisms.

UNIT:III

Role of probiotics in health and disease: prevention and treatment of gasterointestinal bacterial infection treatment of chronic urinary tract infection, antitumor and cholesterol level

UNIT:IV

Mechanism of probiotics: production of antimicrobial substances, modulation of immune system, alteration of intestinal bacterial metabolite action

UNIT:V

. Prebiotics: concept, definition,criteria, types and sources of prebiotics, prebiotics and gut microflora- Prebiotics and health benefits: mineral absorption,immune response, cancer prevention, elderly health and infant health, prebiotics in foods.

REFERENCES:

1.Salminen. S and Wright , A. V. 1998. Lactic Acid Bacteria, Marcel Dekker

2 Glenn R. G. Marcel R. 2008. Handbook of Prebiotics CRC press

3 Lee Y K, Salminen S 2009. Handbook of Probiotics and Prebiotics . A John Willey and Sons Inc. Publication

4 Sandholm T. M. Saarela M. 2003. Functional Dairy Products CRC Woodhead Publishing Ltd

SEMESTER IV			
Core X : Marine Biology			
Code: 17PBCC41	**Hrs /Week : 6**	**Hrs / Sem: 90**	**Credits : 5**

Objectives

- To make the students realize the potentiality of marine environment
- To understand the marine ecosystem threats and conservation

Unit I Marine Environment – Zonation and Biota

Sea as a biological environment.Classification of marine environment.– Plankton – classification (size, life, habitat) and adaptations. Inter-tidal, rocky, sandy and muddy shores –features of the flora, fauna and adaptations. Role of marine micro-organisms (bacteria and fungi) in nutrient cycles(nitrate, phosphate and sulphate)

Unit II Characteristics of Sea Water

Physical properties: waves, tides, currents- types, causes , and their impact on marine organisms.Illumination,temperature,pressure,. Chemical properties: nutrients, (major, minor, and trace elements), salinity, pH, density, dissolved gases (oxygen, carbon-di-oxide).

Unit III Marine Ecosystems

Estuaries, salt marshes, mangroves. Coral reef -– ecology and types, species interaction, adaptations and importance. Threats and conservation of coastal ecosystems (coral reef and mangroves)

Unit I V Marine Pollution

Sources,effects and control measures of heavy metal,,radioactive, oil, and thermal pollutions.Algal blooms-sources and effects. Microbial indicators of pollution. Role of microbes in pollution abatement.

Unit V Wealth of the sea

Living resources: Fishery products- fish meal and fish oil. Natural pearls: formation, ornamental and medicinal importance. Non-living resources: mineral wealth (manganese nodules, beach placers, glauconite and garnet). Bioactive compounds from marine organisms (bacteria, fungi, macro algae and sponges).Phycocolloids; agar-agar and algin.

Books for Reference

1.Tait, R.V. and Dipper F.A (1998) Elements of marine ecology.-4thed. British Library Cataloguing in Publication Data.

2. Gross, G., 1993.Oceanography: A view of the Earth. Sixth edition. Prentice Hall Inc., NewJersey.

3. McCormick, J.M. and J.V.Thiruvathaakal, 1976. Elements of Oceanography. W.B.

Saunders Company, Philadelphia.
4 .Nybakken, J.W. 1997. Marine Biology – An Ecological Approach. Addison Weslay Longman, Inc. California, 477pp.
5. Olivia J.Fernando 1999.Sea water-Properties and dynamics, Dhanesh Publications, Ponnagam,Thanjavur
6. Russel 1970. Marine Ecology, Academic Press- London and New York
7. Nelson and Smith 1973, Oil pollution and Marine Ecology-Plenum press
8. Benjamin- Cummings, Menlo Park, California.Vijaya Ramesh, K. (2004). Environmental Microbiology.MJP Publishers Chennai.
9.MoshrafuddinAhamed and Basumatary. S.K.(2006). Applied Microbiology. MJP Publishers Chennai
10.Daws, C.J.1981. Marine Botany John Wiley and Sons, New York.

PRACTICALS

Hrs / Week : 2

1.Determination of acidity
2 Determination of salinity
3 Determination of alkalinity
4 Determination of total hardness
5. Determination of nitrite
6. Determination of phosphate
7 .Biochemical test for micro-organisms-IMViC
8. Collection and identification of marine plankton (any three phyto and zooplanktons)
9.Identification and remarks of the following
i.Plankton net
ii Inter-tidal organisms
a.Rocky shore :Sea anemone, *Chiton*
b.Muddyshore:*Uca, Cerithidia*
c.Sandy shore: *Arenicola, Murex*
ii.Food fishes*: Cybium,Sardinella*
iiiSea weeds: *Gracilaria,Sargassum*,
. 10. Submission: Record Note Book

SEMESTER – IV			
CORE –XI MICROBIAL GENETICS & MOLECULAR BIOLOGY			
Code: 17PMIC41	**Hrs/ Week: 6**	**Hrs/ Sem: 90**	**Credit: 5**

OBJECTIVES

To make the students knowledgeable in the field of Microbial Genetics and Molecular Biology.

UNIT I

Historical aspects and current concepts of Molecular Biology - Experimental evidence for Nucleic acids as genetic information carriers - DNA features: Superhelicity, linking number, topological properties – Melting of DNA - DNA replication: General principles, modes of replication, proof reading – Enzymology of DNA replication.

UNIT II

Relationships between replication and cell cycle- Inhibitors of DNA replication (Blocking precursor synthesis, nucleotide polymerization and altering DNA structure),- DNA damage and repair – Types of DNA damage (Dimeration, oxidative damage, alkylation pyrimidine dimers) – Repair pathways : Methyl directed very short patch repair, nucleotide excision repair, base excision repair, recombinational repair and SOS repair.

UNIT III

Transcription in Prokaryotes - General principles, basic apparatus, types of RNA polymerases, steps in initiation, elongation and termination, inhibitors of RNA synthesis – Polycistronic and monocistronic RNAs – Control of transcription by RNA polymerases, promoter regions, sigma factors – Controlled termination: Attenuation and anti – termination – Protein synthesis: Steps, details of initiation elongation and termination, role of various factors, inhibitors – Signal hypothesis.

Regulation of gene expression: Operation concept, catabolite repression, instability of bacterial RNA, negative regulation *(E.coli,* lac operon), Positive regulation (*E.coli*ara operon) – Regulation by attenuation (trp operon). Maturation and processing of RNA: Methylation, trimming of rRNA - Capping, Polyadenylation and splicing of mRNA – Cutting and modification of tRNA.

UNIT IV

Gene as a unit of mutation and recombination – Mutants and mutation, mutagens, revertants, spontaneous mutation, mutant isolation, mutagenesis and it's types, suppression – Plasmids: Types, detection, transfer, replication and properties. Transposable elements – Nomenclature, classes, IS elements, Transposons – Composite structure and complex transposon structure, mechanism of transposition.

UNIT V

Gene transfer mechanisms: Transformation modes, transformation, natural and artificial competence, DNA uptake, molecular mechanisms of transformation in *Bacillus*sp and *E.coli* recombination and genetic mapping, Bacterial conjugation – F plasmid, structure and function, origin of conjugation (Hfr and F+) Interrupted and uninterrupted mating, time map and recombination map, conjugation in *E.coli*, colicins and col factors.

Transduction – Generalized and Specialized – Lambda phage and P1 Mechanism of gene transfer through lambda and P1 Phages – HFT and LFT lysate – Co transduction – Transduction mapping.

Reference Books:

1. Freifelder D. (1991). Molecular Biology. Narosa Publishing House
2. Jeyanthi, G.P (2008) Molecular Biology. MJP Publisher, Chennai.
3. Veer BalaRastogi (2008) Fundamentals of Molecular Biology. Ane Books India.
4. Raja Pandian. K., Shanthi. S (2011). Molecular Biology and Microbial Genetics. PBS Book Enterprises.
5. Avinash ., KakoliUpadhyay (2005). MolBio - Fundamentals of Molecular Biology . Himalaya Publishing House.
6. Satyanarayana. U (2013). Biotechnnology – Books and Allied (P) Ltd.
7. Mohan P. Arora., Gurdarshan., Sandhu. S (2004). Genetics. Fifth Edition. Himalaya Publishing House.
8. Sambamurty.A.V.S.S (2011). Molecular Biology. Narosa Publishing House.

SEMESTER – IV			
CORE – XII FOOD MICROBIOLOGY			
CODE:17PMIC42	**HRS/WEEK: 6**	**HRS/SEM: 90**	**CREDIT: 5**

OBJECTIVES:

To impart advanced level information in the subject on Food Microbiology.

UNIT – I

Food as a substrate for microorganisms – Microorganisms in food materials – Molds, yeasts and bacteria –General characteristics, classification and importance – Principles of food preservation, asepsis, removal of microorganisms (Anaerobic condition, high temperature, low temperature, drying) – Factors influencing microbial growth in food – Extrinsic and intrinsic factors (Nutrient content, pH, Redox potential, Relative humidity, temperature, gaseous atmosphere). Chemical preservatives – Food additives – Canning – Processing by heat treatment.

UNIT – II

Food borne infections and intoxications: bacterial and nonbacterial - Examples of infective and toxic types – *Bacillus, Clostridium, Escherichia, Staphylococcus*, Toxigenic algae and Fungi, Mycotoxicosis and Viral toxins – Food borne outbreaks – Laboratory testing procedures – Preventive measures.

UNIT – III

Types of fermentation: Solid substrate (Fermentation and medium), submerged fermentation (process of production, factors influencing submerged cultures) – Food fermentation: Bread, Shoyu, Tempeh, Fermented dairy products (buttermilk, cream, yoghurt, kefir, koumiss, acidophilus milk) - Experimental and industrial production methods – spoilage and defects of fermented dairy products.

UNIT IV

Methods of food preservation – Aseptic handling, pasteurization of milk, refrigeration and freezing, dehydration, chemicals – organic acids, nitrates, nitrites, sulphur di oxide and sulphites. Radiation - UV, Smoking.

UNIT – V

Microbiological examination of foods – Estimation and examination of specific microorganisms, quality and safety assurance in food and dairy industry. Good manufacturing practice, hazard analysis and critical control point (HACCP) concept. BIS Laboratory services.

REFERENCES BOOKS:

1. Adams, M.R. and Moss, M.O. (1995). Food Microbiology. The Royal Society of chemistry, Cambridge.
2. Frazier, W.C. and Westhoff, D.C. (2008) Food Microbiology.(4^{th} edition).Tata McGraw Hill Publishing Co. Ltd., New Delhi.
3. Jay, J.M. (1987), Modern Food Microbiology. CBS Publishers and Distributors, New Delhi.

4. Atlas, R.M. (1989), Microbiology – Fundamentals and Applications, Macmillian Publishing Company.
5. Banwart, G.J. (1989). Basic Food Microbiology. Chapman & Hall New York.
6. Board, R.C. (1983), A modern Introduction to food Microbiology Blackwell Scientific Publication, Oxford.
7. S.N. Tripathy (2006). Food Biotechnology, Dominant Publishers and Distributors, New Delhi.
8. Robinson.R.K. (1990). Dairy Microbiology. Elsevier Applied Sciences, London.
9. Vijaya Ramesh, K., (2007) Food Microbiology, MJP Publishers, Chennai.

SEMESTER –IV			
ELECTIVE -III- GENETIC ENGINEERING			
CODE: 17PMIE41	**HRS/WEEK: 6**	**HRS/SEM: 90**	**CREDITS: 4**

OBJECTIVES

To impart advanced level information in the subject of Genetic Engineering.

UNIT - I

Gene cloning and vectors: Biology of vectors – Plasmids, bacteriophages, single stranded DNA vectors, cosmids, phasmids, specialized vectors – Plant viral vectors and other plasmid vectors –Animal viral vectors – Biology of host – *Escherichia coli , Saccharomyces cerevisiae* Cloning strategies: Cloning of genomic DNA, cDNA cloning and screening strategies.

UNIT II

Enzymology of genetic engineering: Restriction enzymes – Types - Nomenclature – Recognition sequences – Cleavage patterns. Other enzymes used in Genetic engineering – DNA Ligase, Nuclease, Alkaline phosphatase, Kinase, Reverse transcriptase.

UNIT-III

Recombinant techniques: Blotting techniques – Southern, Northern and Western Blotting – Transformation of *E.coli*- PCR –Probe construction- RFLP – AFLP – RAPD – SSCP and SNP- Construction of cDNA library – Molecular mapping of genome – Genetic and physical maps.

UNIT- IV

Synthesis of commercial products by Recombinant microorganisms :Antibiotics, Biopolymers. Genetic engineering of bio-degradative pathways – Manipulation by Transfer of plasmids – by Gene Alteration.

UNIT – V

Cloning in plants and animals – Transgenic plant (FlavrSavr Tomato) – Transgenic animal (Dolly) – GEM (Super bug) - Biotechnology and ethics – Biotechnology in Agriculture and Environment – Ethical aspects of genetic testing – Biowarfare.

REFERENCE BOOKS

1. Bernard Glick; Jack J. Pasternak; Molecular Biotechnology: 2001 ASM press Washington 2ndEdn.
2. Brown, T.A. (1999). Gene Cloning. (3rd Edition). Chapman and Hall Publications, USA.
3. Burrel, M.M. (1993). Enzymes of Molecular Biology, Humana press.
4. Chirikjian, J.G. (1995). Biotechnology- Theory and Techniques. Vol.II, Jones and Burtlett Publishers.
5. Gerhardt, P., Murray, R.G., Wood, W.A., and Kreig, N.R. (1994). Methods for General and Molecular Bacteriology. ASM Press, Washington D.C.
6. Glick, B.R. and Pasternak, J. J. (1998) Molecular Biotechnology- principles and Applications of Recombinant DNA. ASM Press, Washington D.C.

7. Cafferty. Mc. J., Hoogenboom, H.R. and Chiswell, D.J. (1996) Antibody Engineering- A Practical Approach, Oxford University Press,
8. Lewin, B. (2000). Genes VII, Oxford University Press, Oxford.
9. Murray Moo Young (1992), Plant Biotechnology. Pergamon Press.
10. Radledge, C. and Kristiansen, B. (2001). Basic Biotechnology. (2^{nd} Edition). Cambridge University Press.
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12. MukheshPasupuleti (2006). Molecular biotechnology. MJP Publishers, Chennai.
13. Dubey.R.C. (1996). A text of Biotechnology. S. Chand and Co Ltd. New Delhi.
14. Das. H.K. (2005). Text Book of Biotechnology. Wiley Dreamtech India (P) Ltd., New Delhi.
15. Rigby. P.W.J.Ed. (1987). Genetic Engineering. 6^{th}Acadamic press, London.
16. Wiseman. A. (1983). Principles of Biotechnology. Chapman and Hall, New York.
17. Sathyanarayana.U. (2005). Biotechnology, Books and Allied (P).,Kolkatta.
18. Desmond.S.T., Nicholl. (1994). An Introduction to Genetic Engineering Cambridge Press.

SEMESTER – IV			
PRACTICAL –IV TECHNIQUES IN MICROBIAL GENETICS, MOLECULAR BIOLOGY, FOOD MICROBIOLOGY AND GENETIC ENGINEERING			
CODE: 17PMICR4	**Hrs/week: 4**	**Hrs/Sem: 90**	**Credits: 2**

OBJECTIVES

To impart advanced level practical training in Microbial Genetics, Molecular Biology, Food Microbiology and Genetic Engineering.

1. Molecular Biology: Isolation & Quantification of DNA from microorganisms.
2. Isolation of plasmid DNA
3. Agarose gel electrophoresis of DNA
4. Isolation of antibiotic resistant mutants by gradient plate technique
5. Mutagenesis: spontaneous mutation and isolation of UV induced mutants of *E.coli.*
6. Isolation of autotrophic mutants by Replica plating technique.
7. Ampicillin selection of auxotrophs
8. Microbial examination of milk i) Methylene blue reductase test ii)Resazurin test
9. Microbiological analysis of foods i) Vegetables ii) Meat iii) Fish
10. Isolation and identification of *Salmonella* in processed foods.
11. Enumeration of microorganism from bread
12. Portability test of water – MPN.
13. Wine production from grapes.
14. Mushroom cultivation.
15. Isolation of RNA from microorganisms.
16. Quantification of RNA by Orcinol method.
17. Quantification of DNA by DPA method.

REFERENCE BOOKS:

1. Cappuccino. J.G., and Sherman. N. (1996). Microbiology – A Laboratory Manual. Benjamin Cummins. New York.
2. Kannan.N. (1996). Laboratory Manual in General Microbiology. Palani Paramount Publication, Palani.
3. Gunasekaran.P.(19960. Laboratory Manual in Microbiology. New Age International Ltd., Publishers, New Delhi.
4. Sundararaj, T. (2005), Microbiology – Laboratory Manual (1st Edition). Publn. Sundararaj.T, Chennai.
5. Palanivelu. P. Analytical Biochemistry and Separation Techniques.
6. Rajan.S.,Selvi Christy. R (2012).Experimental procedure in Life sciences. Anjanaa Book House.

7. Aneja.K.R., Experiments in Microbiology, Plant pathology and Biotechnology. Fourth Revised Edition. New Age International Publishers.

SEMESTER – I			
Core Practical I - Laboratory in Fundamentals of Microbiology, Microbial Diversity and Classification			
Code: 19PMICR1	**Hrs/ Week: 6**	**Hrs/ Sem: 90**	**Credits: 3**

Vision:

To be recognized as a centre for excellence in Microbiology that provide an atmosphere to acquire skills in identifying the link between biological and human resources and transform it to enhance the quality of life

Mission:

To enhance the students with a broad-based knowledge in concepts and principles of fundamentals of microbiology and microbial diversity.

Course Outcome :

CO.No	Upon completion of this course, students will be able to	PSO addressed	C L
CO-1	develop bio-safety procedures in microbiology.	2	Re
CO-2	develop basic skill in aseptic techniques	2	Un
CO-3	perform various staining techniques.	3	Un
CO-4	cultivate bacteria with different cultivation techniques.	2	An
CO-5	acquainted with various sterilization techniques.	2, 4	Un
CO-6	understand various specialized techniques such as pasteurization.	2, 4	Un
CO-7	isolate and characterize bacteria by steak plate method.	2, 4 5	Un
CO-8	understand the enumeration technique for water,air and soil samples.	2, 4, 5	An

Practicals:

1. Laboratory Precautions ,Washing and cleaning of glass wares ,Biological safety cabinets
2. Hay mount to show different types of microbes
3. Hanging drop technique
4. Staining techniques - Gram's staining, Acid fast staining, Spore staining, Capsule staining
5. Preparation of culture media for micro organisms.
6. Techniques for pure culture of microorganisms by Serial dilution technique and determination of bacterial numbers.
   i) Pour plate method.
   ii) Streak plate method.
   iii) Spread plate method.
7. Enumeration of bacteria – Water and soil samples
8. Microbial sampling of air
9. Cultivation of anaerobic microorganisms – Pyrogallol method.
10. a) Cultural characteristics of microorganisms.
    b) Generic identification of unknown bacterial cultures.
    c) Generic identification of an unknown fungi.
    d) Isolation of yeast from grapes.
11. Growth curve (Turbidity method)
12. Cultivation and morphology of molds – Lacto phenol cotton blue staining
13. Fungal slide culture – technique

Books for Reference:

1. Cappuccino & Sherman, 2011. *Microbiology A laboratory manual,.* IX Edition. Pearson Publication
2. Kannan.N. 1995. *Laboratory Manual in General Microbiology*. Palani Paramount Publication, Palani.
3. Gunasekaran. P. 1996. *Laboratory Manual in Microbiology*. New Age International Ltd., Publishers, New Delhi.
4. Rajan.S.,Selvi Christy. R , 2012. *Experimental procedure in Life sciences.* Anjanaa Book House.
5. Aneja.K.R., 2007. *Experiments in Microbiology, Plant pathology and Biotechnology.* Fourth Revised Edition. New Age International Publishers.

SEMESTER I			
Core Practical - II- Laboratory in Biochemistry and Microbial Physiology			
Code : 19PMICR2	**Hrs/Week : 6**	**Hrs/Sem: 90**	**Credits : 3**

Vision:

To make the students imbibe the technical knowledge in the field of Biochemistry and Microbial physiology.

Mission:

To provide the students knowledge with various laboratory oriented techniques with advanced level informations.

Course Outcome:

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO - 1	know how to verify beer's law	2	K n
CO - 2	know how to estimate lowry's method	2	K n
CO - 3	recall about how to separate amino acid by paper chromatography	1	R n
CO- 4	know how to separate amino acid by thin layer chromatography.	3	K n
CO- 5	relate the procedures and principle of carbohydrate fermentation, imvic, triple sugar ion test.	1	Re
CO- 6	recall how to perform catalase and urease test.	2,3	Re
CO- 7	conclude the procedure for lactophenol cotton blue staining and turbidity method.	4,6	An
CO- 8	explain the fungal slide culture preparation and to examine dry weight of bacteria.	1,3	Ev

SEMESTER I			
Core Practical - II- Laboratory in Biochemistry and Microbial Physiology			
Code : 19PMICR2	**Hrs/Week : 6**	**Hrs/Sem : 90**	**Credits : 3**

1. Principles of colorimetry -Verification of Beer's law.
2. Estimation of proteins by Lowry's method.
3. Estimation of carbohydrates by Anthrone's method.
4. Separation of amino acid by paper chromatography.
5. Separation of amino acid by thin layer chromatography.
6. Extra cellular enzymatic activities of microorganisms (Utilization of gelatin, casein, starch, lipid)
7. Carbohydrate fermentation (Glucose, Lactose, Sucrose)
8. Triple sugar iron test
9. IMViC test series
10. H_2S test
11. Urease test
12. Catalase test
13. Growth curve (Turbidity method)
14. Examination of dry weight of bacteria

Books for Reference:

1. Cappuccino & Sherman, 2011. *Microbiology A laboratory manual,.* 9th Edition.Pearson Publication
2. Gunasekaran. P. 1996. *Laboratory Manual in Microbiology*. New Age International Ltd., Publishers, New Delhi.
3. Jayaraman, J. 1985. *Laboratory Manual in Biochemistry*. Wiley Eastern Ltd., New Delhi. Aneja.K.R., 2007. *Experiments in Microbiology, Plant pathology and Biotechnology.* Fourth Revised Edition. New Age International Publishers.
4. Kannan.N. 1995.*Laboratory Manual in General Microbiology*. Palani Paramount Publication, Palani.
5. Rajan.S.,Selvi Christy. R 2012.*Experimental procedure in Life sciences*. Anjanaa Book House.
6. Sundararaj, T. 2005. *Microbiology – Laboratory Manual.* (First Edition) Publn.

SEMESTER II			
Core Practical III- Laboratory in Immunology and Medical Microbiology			
Code : 19PMICR3	**Hrs/Week : 6**	**Hrs/Sem : 90**	**Credits : 3**

Vision:

To impart advanced practical knowledge in Immunology and Medical Microbiology.

Mission :

To perform highly specific advanced methodologies for the study of human immune system towards the pathogens.

Course Outcome:

CO No	Upon completion of this course, students will be able to	PSO addressed	CL
CO- 1	demonstrate various immuno diffusion test.	5	Re
CO - 2	develop their ability to perform qualitative and quantitative assay of widal test.	6	Re
CO -3	improve their ability to perform rpr test for syphilis.	6	Un
CO- 4	analyze how to perform latex agglutination and blood grouping techniques.	4,6	An
CO - 5	examine various types of bacterial pathogens like *staphylococcus aureus, escherichia coli klebsiella pneumonia.*	4	Un
CO- 6	demonstrate antibiotic susceptibility test.	5	Ap
CO -7	test urine samples.	4	Cr
CO - 8	examine stool sample .	4	An

SEMESTER II			
Core Practical III- Laboratory in Immunology and Medical Microbiology			
Code : 19PMICR3	**Hrs/Week : 6**	**Hrs/Sem : 90**	**Credits : 3**

1. Precipitation reaction based on immunodiffusion test
    a. ODD, b. Single Radial Immunodiffusion
2. WIDAL test – qualitative & quantitative assay.
3. RPR test for syphilis
4. Agglutination reaction with reference to blood grouping & RH typing.
5. Examination of Blood cells a) Total count b) Differential count
6. Latex agglutination test (ASO)
7. Blood smear identification of leucocytes by Giemsa stain
8. Biochemical identification of bacterial pathogens.
   Following tests to be performed – TSI, Indole, MR, VP, Citrate, Urease, Catalase test for
   a. *Staphylococcus aureus, Streptococcus* sp*.,*
   b. *Escherichia coli, Proteus vulgaris*
9. Isolation of normal flora of the skin and throat
10. Urine culture and its microbiological analysis (*E.coli)*
11. Isolation of enteric pathogen from stool – (*Vibrio*) .
12. Antibiotic sensitivity test – Kirby Bauer method.
13. Determination of minimal inhibitory concentration.
14. Isolation & identification of pathogens from wound and pus.

Books for Reference:

1. Practical microbiology R.C. Dubey & Maheswari, S. Chand&Co.Ltd., New Delhi, 2002.
2. Kanika L. Mukherjee, 2010. *Medical Laboratory Technology – Procedure manual for routine diagnostic tests* – McGraw – Hill Publishing Co., Ltd., New Delhi. Vol.I-III.
3. R.C. Dubey & Maheswari, 2007. *Practical Microbiology*. S.Chand & Co.Ltd., New Delhi
4. Kannan. N. 1996. *Laboratory Manual in General Microbiology*. Palani Paramount Publication, Palani.
5. Cappuccino & Sherman, 2011. *Microbiology A laboratory manual,.* IX Edition. Pearson Publication

SEMESTER – II			
Core Practical -IV-Laboratory in Microbial Genetics, Molecular Biology and Marine Microbiology			
Code : 19PMICR4	**Hrs/Week : 6**	**Hrs/Sem : 90**	**Credits : 3**

Vision

To impart advanced level practical training in Microbial Genetics, Molecular Biology and Marine microbiology.

Mission

To make the students skilled in the field of Microbial Genetics, Molecular Biology and Marine microbiology.

Course Outcome:

CO No	Upon completion of this course, students will be able to	PSO addressed	CL
CO -1	examine isolation of antibiotic resistant mutants.	5	An
CO- 2	examine isolation of spontaneous and induced mutants.	3	An
CO -3	assess the isolation of autotrophic mutants.	3	Ev
CO- 4	distinguish between transformation, conjugation and transduction.	2	An
CO -5	determine the marine water characteristics like total hardness, nitrite and phosphate.	1,4,5	Kn,Ev
CO -6	determine the salinity of marine water.	2,3,4,5	Kn, Ap
CO -7	determine the acidity, alkalinity of marine water.	1,4,5	Kn, Ap, Ev
CO- 8	acquire the knowledge to identify the marine micro organisms.	1,3,4	Kn,An,Ap

SEMESTER –II			
Core Practical -IV-Laboratory in Microbial Genetics, Molecular Biology and Marine Microbiology			
Code : 19PMICR4	**Hrs/Week: 6**	**Hrs/Sem: 90**	**Credits: 3**

1. Isolation of antibiotic resistant mutants by gradient plate technique.
2. Isolation of Spontaneous mutants.
3. Isolation of UV induced mutants.
4. Isolation of autotrophic mutants by Replica plating technique.
5. Bacterial Transformation - Demonstration.
6. Bacterial Conjugation - Demonstration.
7. Bacterial Transduction – Demonstration.
8. Isolation and enumeration of marine microbes (Bacteria, Fungi, Actinomycetes) from marine water.
9. Determination of acidity
10. Determination of salinity of sea water.
11. Determination of alkalinity of sea water.
12. Determination of total hardness of sea water.
13. Determination of nitrite of sea water.
14. Determination of phosphate of sea water.
15. Biochemical test for marine micro-organisms-IMViC

Books for Reference:

1. James G. Cappuccino and Natalie Sherman 2012 - *Microbiology* – A Laboratory Manual. Seventh Edition–Pearson Education, Inc.
2. Gunasekaran.P 2007. *Laboratory Manual in Microbiology.* New Age International (P) Ltd., Publishers, New Delhi.
3. Rajan.S.,Selvi Christy. R 2012.*Experimental procedure in Life sciences*. Anjanaa Book House, Chennai
4. Aneja.K.R. 2003. *Experiments in Microbiology, Plant pathology and Biotechnology.* 4th Revised Edition. New Age International Publishers.
5. Janarthanan. S. and Vincent.S 2007. *Practical Biotechnology*: Methods and Protocols. Universities press (India) private limited, Hyderabad.
6. Jyoti Saxena, MamtaBaunthiyal, Indu Ravi 2012. *Laboratory manual for Microbiology, Biochemistry and Molecular Biology*. Scientific Publishers, India.
7. Benson. 2002. Microbiological Applications – Laboratory Manual in General Microbiology. International Edition, McGraw Hill Higher Education.
8. Cappuccino.J.G.,and Sherman.N.1996. *Microbiology–A Laboratory Manual.* Benjamin Cummins. New York.

SEMESTER –III			
Core – XII Research Methodology			
Course Code : 21PMIC34	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 4**

Objectives:

1. To impart advanced level information in the subject of Research methodology.
2. To show various biological techniques used in research, and study about research project, paper presentation and article publication.

Course Outcome:

CO No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	Analyse the laboratory equipment's	2	An
CO-2	Evaluate the rights granted by IPR	6	Ev
CO-3	determine the process involved in centrifugation and chromatography techniques	6	Ev
CO-4	Examine electrophoresis techniques	6	An
CO-5	Apply research methods in biological science.	1	Ap
CO-6	Estimate project writing method and to estimate Data's used in projects.	1	Ev
CO-7	Identify the journals to publish articles	1	AP
CO-8	Design article to present on seminar and the conference	5	Cr

SEMESTER –III			
Core – XII Research Methodology			
Course Code : 21PMIC34	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 4**

Unit – I: Isolation, Fractionation and Separation

Isolation, Fractionation and Separation of cellular constituents – Isolation of chloroplasts, mitochondria and nucleic acids – homogenization –Manual, mechanical and sonication –centrifugation-centrifuges and their uses- Micro centrifuge, high speed refrigerated centrifuges, ultra centrifuges, differential and density gradient centrifugation – Chromatography –paper, thin layer-separation of amino acids and sugars-Gas liquid chromatography, HPLC and HPTLC.

Unit – II: Separation and estimation of macromolecules and other compounds

Electrophoresis –principles, factors affecting electrophoretic mobility – Agarose Gel Electrophoresis, PAGE, SDS-PAGE and Starch gel electrophoresis. Spectroscopic techniques – principles, mechanism and applications of UV –visible, Flame photometer and AAS - Estimation of cellular constituents- Sugars, amino acids and proteins.

Unit – III: Research and Project writing methods, Article publication

Research-definition, objectives, types and importance - Research methods in biological sciences - Research process- Literature survey – sources –scientific databases- Research report writing – Parts of Thesis and Dissertation – Presentation in seminars and conferences – Writing scientific paper – Organization of scientific paper – Importance of title – Publication in research journals – Standards of Research journals- Peer – review – impact factor – citation index – Preparation of manuscript – Proof correction – proof correction marks- method of correcting proof- Writing chapters in books – Preparation of Research proposal and funding agencies – Research fellowships.

Unit – IV: Biostatistics

Basic definitions and applications of biostatistics – Population, Sample, Data, variable, sampling. Data Collection and presentation – Types of data - methods of collection of primary and secondary data - methods of data presentation – Graphical presentation. Measures of central tendency: Mean, Median, Mode. Correlation – Positive and Negative correlation and calculation of Karl Pearson's coefficient of correlation. Regression – Linear regression and multiple linear regression - regression equation. ANOVA, one way and two way classification.

Unit – V:IPR

Introduction to Intellectual property rights, copyright, related rights, trademarks, geographical indication, industrial design, patents and protection of new varieties of plants.

Textbooks:

1. Veerakumari L. *Bioinstrumentation*. Chennai: MJP Publishers. 2006.
2. Gurumani N. *Scientific thesis writing and Paper presentation*. Chennai: MJP Publishers. 2010.

Books for Reference:

1. Dr. Simmi Kharb. *Scientific Writing and Project management in Biotechnology*. NewDelhi: University Science Press. 2009.
2. 4 Gurumani. N. *Research Methodology for Biological Sciences*. Chennai: MJP Publishers. 2006.
3. Vijayalakshmi Ponnuraj. G. and C. Sivapragasam. *Research Methods (Tips and Techniques)*. Chennai: MJP Publishers. 2008.

SEMESTER –IV			
Core XV – Applied Microbiology			
Course Code: 21PMIC43	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits:4**

Objectives:

1) To create the ability to be multi-skilled in the field of applied microbiology with good technical and instrumentation knowledge on various concepts. And providing standard education and enabling the students to become entrepreneurs and socially responsible.

2) To aware the basic knowledge about the applied microbiology and developing young students with active and creative minds in the field of applied microbiology.

Course Outcomes:

C O No	Upon completion of this course, students will be able to	PSO's Addressed	CL
CO-1	Acquire basic knowledge on applied microbiology	4	Un
CO -2	Explain the basics of composting technology	4	Un
CO-3	Appreciate the production of biogas technology	4	An
CO-4	Grasp the fundamental knowledge about mushroom cultivation	4	Un
CO-5	Acquire basic knowledge about *spirullina* production	2	Ap
CO-6	Gets knowledge about biodegradation.	4,2	Un
CO-7	Acquire detail knowledge about bioremediation.	2,4	Ap
CO-8	Acquire the detail knowledge on bioaccumulation and bioleaching.	4,5	Un,Ap

SEMESTER –IV			
Core XV – Applied Microbiology			
Course Code: 21PMIC43	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits:4**

Unit-I: Biofuel technology

Introduction – anaerobic digestion – microbes involved – factors influencing methane production – stages of methane generation – waste used in methanogenesis – various bioreactors used for methane generation – advantages and disadvantages.

Unit-II: Composting technology

Historical background - Composting – methods – factors influencing - waste availability – enrichments of compost and crop productivity.

Vermiculture technologies: History – species – life cycles – methods – different types of waste suitable for vermicomposting. Utilization of vermicompost for crop production.

Unit-III: Mushroom cultivation technology

Oyster, paddy, milky, button and King mushroom cultivation technology, post harvest technology.

Unit- IV: Biofertilizer and Biopesticides

Biofertilizers - *Rhizobium, Azotobacter, Cyanobacteria, Spirulina, VAM* and *Azolla* – cultivated methods, post harvest technology and single cell protein formulation.

Biopesticides – *Bacillus thuringiensis*, *Pseudomonas fluroscence*, *Trichoderma viridae, Bavaria bassiana*, Nuclear Polyhedrosis virus.

Unit-V: Biodegradation

Biodegradation of xenbiotics, cellulose, Lignin - Biodeterioration of wood, Leather ; Bioremediation – Degradation of DDT; Biomagnification, Bioaccumulation of heavy metals; Bio leaching of iron, gold and uranium, Cleanup oil spills – *Pseudomonas putida*

Books for Reference:

1. Kumar , H.D., *A textbook on Biotechnology* , New Delhi: East- west press Pvt Ltd., 2nd Edition , 1991.
2. Chatwal, G.R., *Textbook of Biotechnology*, New Delhi: Anmol Publications Pvt. Ltd., 1995.
3. Jarsa , O.P., *Environmental Biochemistry*, New Delhi, India: Sarup& Sons, Ist Edition., 2002 .
4. Prescott, L.M., Harley, J.P. and Helin,. *Microbiology*, New York: McGraw Hill, D.A. 5th Edition, 2008.

5. Raina M. Maier, Ian A. Pepper and Charles Gerba. *Environmental Microbiology*. Academic Press. 2nd edition. 2009.

6. Vonshak, A. *Spirulinaplantensis – physiology, cell biology and biotechnology*. London: Taylor and frencis, 2004.

7. Kawl, T.N. Introduction to mushroom science, New Delhi: Oxford and IBM co., Pvt. Ltd., 1999.

8. Philip G. Miles, Shu- ting chang, *Mushroom biology*, Singapore: World scientific, 1997.

9. Bahl, N . *Hand book on mushroom*. New Delhi: Oxford and IBH publishing Co.,Pvt Ltd., 1988.

7. Tripati. G. *Vermiresources technology*, New Delhi: Discovering Publication House, 1st Ed., 2003.

8. Gaur, A.C., Microbial *technology for composting of Agricultural Residues by Improved Methods,* New Delhi: ICAR, 1st Print, 1999.

9. SubbaRao, N.S., *Soil Microbiology*, New Delhi: Oxford IBH publishing Co. Pvt. Ltd., 4th Ed, 1999.

10. Chawla O.P. *Advances in Biogas Technology,* New Delhi: ICAR, 1986.

11. Martin Alexander. *Introduction to soil Microbiology*, New Delhi: Wiley eastern Ltd., 1976.

12. LE Cassida J.R . Industrial Microbiology. New Delhi: New Age International (P) Ltd., 2005.

SEMESTER – I			
Core Practical I - Laboratory in Fundamentals of Microbiology, Microbial Diversity and Classification			
Course Code: 21PMICR1	**Hrs/ Week: 6**	**Hrs/ Sem: 90**	**Credits: 3**

Objectives:

To be recognized as a centre for excellence in Microbiology that provide an atmosphere to acquire skills in identifying the link between biological and human resources and transform it to enhance the quality of life

To enhance the students with a broad-based knowledge in concepts and principles of fundamentals of microbiology and microbial diversity.

Course Outcome :

CO. No	Upon completion of this course, students will be able to	PSO addressed	C L
CO-1	develop bio-safety procedures in microbiology.	2	Re
CO-2	develop basic skill in aseptic techniques	2	Un
CO-3	perform various staining techniques.	3	Un
CO-4	cultivate bacteria with different cultivation techniques.	2	An
CO-5	acquainted with various sterilization techniques.	2, 4	Un
CO-6	understand various specialized techniques such as pasteurization.	2, 4	Un
CO-7	isolate and characterize bacteria by steak plate method.	2, 4 5	Un
CO-8	understand the enumeration technique for water,air and soil samples.	2, 4, 5	An

Practicals:

1. Laboratory Precautions ,Washing and cleaning of glass wares ,Biological safety cabinets
2. Hay mount to show different types of microbes
3. Hanging drop technique
4. Staining techniques - Gram's staining, Acid fast staining, Spore staining, Capsule staining
5. Preparation of culture media for micro organisms.
6. Techniques for pure culture of microorganisms by Serial dilution technique and determination of bacterial numbers.
   i) Pour plate method.
   ii) Streak plate method.
   iii) Spread plate method.
7. Enumeration of bacteria – Water and soil samples
8. Microbial sampling of air
9. Cultivation of anaerobic microorganisms – Pyrogallol method.
10. a) Cultural characteristics of microorganisms.
    b) Generic identification of unknown bacterial cultures.
    c) Generic identification of an unknown fungi.
    d) Isolation of yeast from grapes.
11. Growth curve (Turbidity method)
12. Cultivation and morphology of molds – Lacto phenol cotton blue staining
13. Fungal slide culture – technique

Books for Reference:

1. Cappuccino & Sherman, *Microbiology A laboratory manual,*. IX Edition. Pearson Publication. 2011.
2. Kannan.N. *Laboratory Manual in General Microbiology*. Palani : Palani Paramount Publication. 1995.
3. Gunasekaran. P. *Laboratory Manual in Microbiology*. New Delhi: New Age International Ltd., Publishers. 1996.
4. Rajan.S.,Selvi Christy. R ,. *Experimental procedure in Life sciences.* Anjanaa Book House. 2012
5. Aneja.K.R., *Experiments in Microbiology, Plant pathology and Biotechnology.* Fourth Revised Edition. New Age International Publishers. 2007.

SEMESTER I			
Core Practical - II- Laboratory in Biochemistry and Microbial Physiology			
Course Code : 21PMICR2	**Hrs/Week : 6**	**Hrs/Sem: 90**	**Credits : 3**

Objectives:

To make the students imbibe the technical knowledge in the field of Biochemistry and Microbial physiology.

To provide the students knowledge with various laboratory oriented techniques with advanced level informations.

Course Outcome:

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO - 1	know how to verify beer's law	2	K n
CO - 2	know how to estimate lowry's method	2	K n
CO - 3	recall about how to separate amino acid by paper chromatography	1	R n
CO- 4	know how to separate amino acid by thin layer chromatography.	3	K n
CO- 5	relate the procedures and principle of carbohydrate fermentation, imvic, triple sugar ion test.	1	Re
CO- 6	recall how to perform catalase and urease test.	2,3	Re
CO- 7	conclude the procedure for lactophenol cotton blue staining and turbidity method.	4,6	An
CO- 8	explain the fungal slide culture preparation and to examine dry weight of bacteria.	1,3	Ev

SEMESTER I			
Core Practical - II- Laboratory in Biochemistry and Microbial Physiology			
Course Code : 21PMICR2	**Hrs/Week : 6**	**Hrs/Sem : 90**	**Credits : 3**

1. Principles of colorimetry -Verification of Beer's law.
2. Estimation of proteins by Lowry's method.
3. Estimation of carbohydrates by Anthrone's method.
4. Separation of amino acid by paper chromatography.
5. Separation of amino acid by thin layer chromatography.
6. Extra cellular enzymatic activities of microorganisms (Utilization of gelatin, casein, starch, lipid)
7. Carbohydrate fermentation (Glucose, Lactose, Sucrose)
8. Triple sugar iron test
9. IMViC test series
10. H_2S test
11. Urease test
12. Catalase test
13. Growth curve (Turbidity method)
14. Examination of dry weight of bacteria

Books for Reference:

1. Cappuccino & Sherman, *Microbiology A laboratory manual,*. 9th Edition.Pearson Publication. 2011.
2. Gunasekaran. P.. *Laboratory Manual in Microbiology*. New Age International Ltd., Publishers, New Delhi. 1996
3. Jayaraman, J. *Laboratory Manual in Biochemistry*. New Delhi: Wiley Eastern Ltd.,. 1985.
4. Aneja.K.R., *Experiments in Microbiology, Plant pathology and Biotechnology.* Fourth Revised Edition. New Age International Publishers. 2007.
5. Kannan.N. *Laboratory Manual in General Microbiology*. Palani: Palani Paramount Publication, 1995.
6. Rajan.S.,Selvi Christy. R *Experimental procedure in Life sciences*. Anjanaa Book House. 2012.

SEMESTER II			
Core Practical III- Laboratory in Immunology and Medical Microbiology			
Course Code : 21PMICR3	**Hrs/Week : 6**	**Hrs/Sem : 90**	**Credits : 3**

Objectives:

To impart advanced practical knowledge in Immunology and Medical Microbiology.

To perform highly specific advanced methodologies for the study of human immune system towards the pathogens.

Course Outcome:

CO No	Upon completion of this course, students will be able to	PSO addressed	CL
CO- 1	demonstrate various immuno diffusion test.	5	Re
CO - 2	develop their ability to perform qualitative and quantitative assay of widal test.	6	Re
CO -3	improve their ability to perform rpr test for syphilis.	6	Un
CO- 4	analyze how to perform latex agglutination and blood grouping techniques.	4,6	An
CO - 5	examine various types of bacterial pathogens like *staphylococcus aureus, escherichia coli klebsiella pneumonia.*	4	Un
CO- 6	demonstrate antibiotic susceptibility test.	5	Ap
CO -7	test urine samples.	4	Cr
CO - 8	examine stool sample .	4	An

SEMESTER II			
Core Practical III- Laboratory in Immunology and Medical Microbiology			
Course Code : 21PMICR3	**Hrs/Week : 6**	**Hrs/Sem : 90**	**Credits : 3**

1. Precipitation reaction based on immunodiffusion test
   a. ODD, b. Single Radial Immunodiffusion
2. WIDAL test – qualitative & quantitative assay.
3. RPR test for syphilis
4. Agglutination reaction with reference to blood grouping & RH typing.
5. Examination of Blood cells a) Total count b) Differential count
6. Latex agglutination test (ASO)
7. Blood smear identification of leucocytes by Giemsa stain
8. Biochemical identification of bacterial pathogens.
   Following tests to be performed – TSI, Indole, MR, VP, Citrate, Urease, Catalase test for
   a. Staphylococcus aureus, Streptococcus sp.,
   b. Escherichia coli, Proteus vulgaris
9. Isolation of normal flora of the skin and throat
10. Urine culture and its microbiological analysis (*E.coli)*
11. Isolation of enteric pathogen from stool – (*Vibrio*) .
12. Antibiotic sensitivity test – Kirby Bauer method.
13. Determination of minimal inhibitory concentration.
14. Isolation & identification of pathogens from wound and pus.

Books for Reference:

1. R.C. Dubey & Maheswari, *Practical microbiology*. New Delhi, S. Chand & Co.Ltd., 2002.
2. Kanika L. Mukherjee,. *Medical Laboratory Technology – Procedure manual for routine diagnostic tests* – McGraw – Hill Publishing Co., Ltd., New Delhi. Vol.I-III. 2010
3. R.C. Dubey & Maheswari, *Practical Microbiology*. New Delhi: S.Chand & Co.Ltd., 2007.
4. Kannan. N. *Laboratory Manual in General Microbiology*. Palani : Palani Paramount Publication,. 1996.
5. Cappuccino & Sherman, *Microbiology A laboratory manual,*. IX Edition. Pearson Publication. 2011.

SEMESTER – II			
Core Practical -IV-Laboratory in Microbial Genetics, Molecular Biology and Marine Microbiology			
Course Code : 21PMICR4	**Hrs/Week : 6**	**Hrs/Sem : 90**	**Credits : 3**

Objectives:

To impart advanced level practical training in Microbial Genetics, Molecular Biology and Marine microbiology.

To make the students skilled in the field of Microbial Genetics, Molecular Biology and Marine microbiology.

Course Outcome:

CO No	Upon completion of this course, students will be able to	PSO addressed	CL
CO -1	examine isolation of antibiotic resistant mutants.	5	An
CO- 2	examine isolation of spontaneous and induced mutants.	3	An
CO -3	assess the isolation of autotrophic mutants.	3	Ev
CO- 4	distinguish between transformation, conjugation and transduction.	2	An
CO -5	determine the marine water characteristics like total hardness, nitrite and phosphate.	1,4,5	Kn,Ev
CO -6	determine the salinity of marine water.	2,3,4,5	Kn, Ap
CO -7	determine the acidity, alkalinity of marine water.	1,4,5	Kn, Ap, Ev
CO- 8	acquire the knowledge to identify the marine micro organisms.	1,3,4	Kn,An,Ap

SEMESTER –II			
Core Practical -IV-Laboratory in Microbial Genetics, Molecular Biology and Marine Microbiology			
Course Code : 21PMICR4	**Hrs/Week: 6**	**Hrs/Sem: 90**	**Credits: 3**

1. Isolation of antibiotic resistant mutants by gradient plate technique.
2. Isolation of Spontaneous mutants.
3. Isolation of UV induced mutants.
4. Isolation of autotrophic mutants by Replica plating technique.
5. Bacterial Transformation - Demonstration.
6. Bacterial Conjugation - Demonstration.
7. Bacterial Transduction – Demonstration.
8. Isolation and enumeration of marine microbes (Bacteria, Fungi, Actinomycetes) from marine water.
9. Determination of acidity.
10. Determination of salinity of sea water.
11. Determination of alkalinity of sea water.
12. Determination of total hardness of sea water.
13. Determination of nitrite of sea water.
14. Determination of phosphate of sea water.
15. Biochemical test for marine micro-organisms - IMViC

Books for Reference:

1. James G. Cappuccino and Natalie Sherman - *Microbiology* – A Laboratory Manual. Seventh Edition–Pearson Education, Inc. 2012
2. Gunasekaran.P. *Laboratory Manual in Microbiology.* New Delhi: New Age International (P) Ltd., Publishers,. 2007
3. Rajan.S.,Selvi Christy. R .*Experimental procedure in Life sciences*. Chennai: Anjanaa Book House, 2012
4. Aneja.K.R.. *Experiments in Microbiology, Plant pathology and Biotechnology.* 4th Revised Edition. New Age International Publishers. 2003
5. Janarthanan. S. and Vincent.S. *Practical Biotechnology*: Hyderabad : Methods and Protocols. Universities press (India) private limited,. 2007.
6. Jyoti Saxena, Mamta Baunthiyal, Indu Ravi. *Laboratory manual for Microbiology, Biochemistry and Molecular Biology*. India: Scientific Publishers, 2012.
7. Benson. Microbiological Applications – Laboratory Manual in General Microbiology. International Edition, McGraw Hill Higher Education. 2002.
8. Cappuccino.J.G.,and Sherman.N.. *Microbiology–A Laboratory Manual.* New York: Benjamin Cummins.. 1996

SEMESTER – III			
Core Practical - V – Laboratory in Industrial and Pharmaceutical Microbiology, Genetic Engineering			
Course Code: 21PMICR5	**Hrs/week: 6**	**Hrs/Sem: 90**	**Credits: 3**

Objectives:

1. To impart advanced level practical training in Industrial, Pharmaceutical and Genetic Engineering.
2. To make the students skilled in the field of Industrial, Pharmaceutical and Genetic Engineering.

Course Outcome:

CO.No	Upon completion of this course, students will be able to	PSO addressed	CL
CO 1	Relate the procedures and principle of pharmaceutical products test	1	Re
CO 2	Conclude the procedure for isolation of hydrocarbon, plastic degrading micro organisms	4,6	An
CO 3	Outline kirby-bauer disc diffusion technique, minimum inhibitory concentration.	4	Un
CO 4	Recall how to perform enzyme immobilization in sodium, calcium alginate gel	2,3	Re
CO 5	Examine isolation of spontaneous and induced mutants	3	An
CO 6	Evaluate polymerase chain reaction	2	Ev
CO 7	Assess the isolation of autotrophic mutants	3	Ev
CO 8	Distinguish between transformation, conjugation and transduction	2	An

SEMESTER – III			
Core Practical - V – Laboratory in Industrial and Pharmaceutical Microbiology, Genetic Engineering			
Course Code: 21PMICR5	**Hrs/week: 6**	**Hrs/Sem: 90**	**Credits: 3**

1. Production and characterization of citric acid using *Aspergillus niger*.
2. Laboratory scale cultivation of Mushroom.
3. Ethanol production using *Saccharomyces cerevisiae*.
4. Sterility test for pharmaceutical products (any two product)
5. Assay of amylase from bacteria.
6. Cell immobilization in calcium alginate gel.
7. Isolation of antibiotic producing microorganisms.
8. Screening of antibiotic producing microorganisms.
9. Isolation of chromosomal DNA.
10. Isolation of Plasmid DNA.
11. SDS PAGE
12. Western blotting -Demonstration.
13. Southern blotting -Demonstration.
14. Restriction digestion -Demonstration.
15. Polymerase Chain Reaction -Demonstration.

Books for Reference:

1. James G. Cappuccino and Natalie Sherman - *Microbiology – A Laboratory Manual*. Pearson Education,Inc. 7th Edition 2012
2. Gunasekaran.P *Laboratory Manual in Microbiology.* New Delhi: New Age International(P) Ltd Publishers, 2007.
3. Rajan S & Selvi Christy R *Experimental procedure in Life sciences*. Chennai: Anjanaa Book House, 2012.
4. Aneja.K.R. *Experiments in Microbiology, Plant pathology and Biotechnology.* New Age International Publishers. 4th Revised Edition. 2003.
5. Janarthanan. S. and Vincent.S. *Practical Biotechnology: Methods and Protocols.* Hyderabad: Universities press (India) private limited. 2007.
6. JyotiSaxena, MamtaBaunthiyal, Indu Ravi. *Laboratory manual forMicrobiology, Biochemistry and Molecular Biology*. India: Scientific Publishers. 2012.
7. John Vennison S. *Laboratory manual for Genetic engineering.* Delhi: PHI Learning Pvt Ltd, 2009.

SEMESTER- IV			
Core Practical -VII – Laboratory in Environmental Microbiology, Soil and Agricultural Microbiology			
Course Code : 21PMICR7	**Hrs/week: 6**	**Hrs/Sem:90**	**Credits: 3**

Objectives:

1) To impart skill on isolation of various microbes from Environment, soil and plant.

2) To enhance advanced level laboratory training in Soil and Agricultural Microbiology and Environmental microbiology.

Course Outcome:

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO -1	test for isolation of various soil microbes	5	An
CO- 2	infer quantitative assay of microbes from air borne.	5	Ap
CO -3	interpret the preparation of bio fertilizer and its assay	4	Un
CO -4	experiment with isolation of microbes from various agro samples.	2	Un
CO- 5	interpret staining of VAM	5	Un
CO -6	analyse antagonism between microorganisms	2	An
CO -7	demonstrate the isolation of phosphate solubilizing bacteria and fungi	5	Un
CO- 8	identify nitrogen fixing bacteria	5	Ap

SEMESTER- IV			
Core Practical -VII – Laboratory in Environmental Microbiology, Soil and Agricultural Microbiology			
Course Code : 21PMICR7	**Hrs/week: 6**	**Hrs/Sem:90**	**Credits: 3**

1. Testing antagonistic activity of soil microorganisms.
2. Estimation of soil mineral contents a) pH b) nitrate c) nitrite d) sulphate e) phosphate.
3. Effect of high salt concentration on microbial growth.
4. Quantitative assay of microbes in Rhizosphere and phyllosphere.
5. Isolation of air borne bio-particles.
6. Determination of biological oxygen demand.
7. Determination of chemical oxygen demand.
8. Determination of Soil pH and temperature.
9. Isolation of Phosphate solubilizing bacteria & fungi
10. MPN Technique.
11. Isolation of *Rhizobium sp* from root nodules of leguminous plants.
12. Isolation of *Azotobacter sp* from soil.
13. Isolation of *Azospirillum sp* from soil.
14. Identification of Cyanobacteria from soil. (*Anabaena* and *Nostoc*).
15. Assay of bio fertilizer (Seed treatment, Seedling treatment, Soil inoculation, Measurement of root and shoot system.

Books for Reference:

1. Jyoti Saxena, Mamta Baunthiyal, Indu Ravi. *Laboratory manual for Microbiology, Biochemistry and Molecular Biology*. India: Scientific Publishers, 2012.
2. Gunasekaran. P. *Laboratory Manual in Microbiology*. New Delhi: New Age International Ltd., Publishers, 1 st edition. 2005.
3. Dubey, R.C. and Maheswari,D.K. *Practical Microbiology*. India: Chand and Company Ltd., 2 ndedition. 2002.
4. Aneja K.R. *Experiments in Microbiology, Plant Pathology and Biotechnology.* New Delhi: New Age International Publishers, 4th edition. 1993.
5. Harold J. Benson, Alfred E. Brown - *Benson's Microbiologicalapplications: Laboratory manual in General Microbiology.* International Edition, McGraw Hill Higher Education. 2006.
6. Plummer. D.T. *An Introduction to Practical Biochemistry*. NewDelhi: Tata McGraw Hill, 1998.

SEMESTER -III			
Core Practical VI - Laboratory in Food and Dairy Microbiology, Research Methodology			
Course Code: 21PMICR6	**Hrs/Week:6**	**Hrs/Sem:90**	**Credits:4**

Objectives:

To impart advanced level practical training in food, dairy Microbiology and Research Methodology and to make the students skilled in the field of food, dairy Microbiology and Research Methodology.

Course Outcome:

CO NO	Upon completion of this course, students will be able to	PSO Addressed	CL
CO -1	interpret the viable count of bacteria	1	Ev
CO -2	assess the quantitative analysis of milk	3	Un
CO- 3	outline the microbial examination of milk test	4	Un
CO- 4	examine isolation of detection and determination of coliforms, faecal coliforms and E.*coli* in food & beverages.	5	An
CO- 5	Examine isolation of detection & confirmation of *Salmonella ,Shigella*,V*ibrio* species in food.	3	An
CO -6	Assess the isolation of microbial examination of canned foods.	3	Un
CO -7	Evaluate agarose gel electrophoresis of DNA	3	Ev
CO -8	Evaluate P^H meter, spectrophotometer	3	Ev

SEMESTER-III			
Core Practical VI - Laboratory in Food and Dairy Microbiology, Research Methodology			
Course Code: 21PMICR6	**Hrs/Week:6**	**Hrs/Sem:90**	**Credits:4**

1. Viable count of bacteria in milk.
2. Phosphatase test.
3. Microbial examination of milk by Methylene blue test
4. Microbial examination of milk by Resazurin test
5. Quantitative analysis of Milk by standard plate count method.
6. Detection of mastitis and isolation of microorganisms through the infected milk.
7. Isolation of lipolytic organism from butter.
8. Detection and determination of coliforms in food &beverages.
9. Detection and determination of faecal coliforms in food &beverages.
10. Detection and determination of *E.coli* in food &beverages.
11. Detection & confirmation of *Salmonella* species in food.
12. Detection & confirmation of *Shigella* species in food.
13. Detection & confirmation of pathogenic *Vibrio* in food.
14. Estimation of molds & yeast from fruit juice.
15. Microbial examination of canned foods.
16. Preparation of buffer and determination of pH using pH meter.
17. Verification of Beer-Lambert's Law using Spectrophotometer.
18. Agarose gel electrophoresis of DNA.
19. PCR-Demonstration.
20. Visit to food and dairy industry.

Books for Reference:

1. J.G. Cappuccino and N.Sherman. *Microbiology* – A lab manual. NewYork: Benjamin Cummins. 1996.
2. Kannan, N. *Laboratory Manual in General Microbiology*. Palani: Palani Paramount Publication, 1996.
3. Jayaraman, J. *Laboratory Manual in Biochemistry.* New Delhi: Wiley Eastern Ltd., 1985.
4. Plummer, D.T. *An Introduction to Practical Biochemistry.* New Delhi: Tata McGraw-Hill.. 1998.
5. Harley Precott. *Laboratory Exercises in Microbiology* The MacGraw Hill companies. 5 thedition. 2002.