Semester – I

15MBP101 FUNDAMENTALS OF MICROBIOLOGY AND CLASSIFICATION

4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

COURE OBJECTIVES

- The course in designed to provide a basic understanding on the fundamental aspects of microbiology from historical development.
- To improve the proficiency and knowledge of the candidate on the study of microbial techniques for well exploitation of microorganisms.
- To comprehend the various methods for identification of unknown microorganisms
- This course enables the students to understand various physical and chemical means of sterilization and also learn various techniques for isolation of pure cultures.
- This course figures out them to know about culture collection and maintenance of microbial cultures.
- The beneficial and harmful manifestations of microorganisms especially of bacteria and their role in microbial mineralization and disease processes

COURSE OUTCOME (CO'S)

1. Understand the basic microbial structure and functions of various physiological groups of prokaryotes and eukaryotes.
2. Learn the theory and practical skills in microscopy handling and staining techniques know various culture media and their applications.
3. Study microbial nutritions- Autotrophy and heterotrophy modes of nutrition.
4. Identify the unknown organisms by using microbial tools.
5. Demonstrate electricity generation from the organic matter.
6. Understand the microbial transport systems and the modes and mechanisms of energy conservation in microbial metabolism – Autotrophy and heterotrophy

UNIT – I

History of Microbiology. Microbial evolution and Diversity – Taxonomic ranks - Classification system – Phenetic and Phylogenetic Haeckel's three–kingdom concept, Whittaker's Five-kingdom concept, Three-domain concept of Carl Woese.

UNIT – II

Microscopy –Simple, Compound, Dark-field, Phase contrast, Fluorescent and Electron microscopes. (SEM and TEM), Confocal microscopy – Principles and their applications. Stains and Staining techniques: Simple, Differential staining methods.

UNIT – III

Classification of bacteria - Bergey's manual and its importance. Classification of algae Clamydomonas, volvox, diatoms, red and brown algae. Classification of virus – DNA, RNA viruses. Classification and taxonomy of fungi – Alexopolous. Economical importance of Fungi. Classification of protozoa – *Entamoeba histolytica, Giardia, Trichomonas, Plasmodium.*

UNIT – IV

Sterilization and disinfection, culture methods: Auxenic and synchronous, aerobic and anaerobic, culture media and nutritional types, growth curve, generation time and growth kinetics. Factors influencing microbial growth. Preservation methods and quality control.

UNIT – V

Modern Microbiology: Molecular taxonomy, 16S/18S rRNAs and its importance in identification of microorganisms. Phylogenetic tree, Molecular tools in assessing microbial diversity, Metagenomics, prebiotics and probiotics and their applications, microbial fuel cells.

TEXT BOOKS

1. Dubey, R.C. and D.K. Maheswari, 2010. A Text book of Microbiology. 3rd Edition, S. Chand and Company, New Delhi.
2. Modi, H. A., 1996. Elementary Microbiology. Vol.2, AKTA Prakashan Nadiad. Gujarat
3. Powar, C.B. and H.F. Daginawala, 2008 .General Microbiology. Volume: II. Himalaya Publishing House.
4. Singh, R.P. 2007. General Microbiology. Kalyani Publishers, New Delhi.
5. Frobisher, H., Hinsdil, R.D., Crabtree, K.T. and Goodhert, D.R. 2005. Fundamentals of Microbiology, Saunder and Company, London.

REFERENCES

1. Holt, J.G., N.R. Krieg, P.H.A. Sneath, J.T. Staley and S.T. Williams, 2000. Bergey's Manual of Determinative Bacteriology. 9th Edition, Lippincott Williams and Wilkins Publishers. Baltimore.
2. Pelczar Jr. M.J., E.C.S. Chan and N.R. Kreig, 2004. Microbiology. 5th Edition. Tata McGraw-Hill Publishing Company. New Delhi.
3. Prescott, L.M., J.P.Harley and C.A.Klein, 2003. Microbiology, 5th Edition McGraw Hill Publishing Company Limited. New York.
4. Salle, A.J., 2007. Fundamental Principles of Bacteriology. 7th Edition, Envins Press, New York.
5. Tortora, G.J., Funke, B.R. and Case, C.L. 2010. Microbiology: An Introduction. 10th Edition. Pearson Education, Singapore.
6. Alcomo, I.E. 2006. Fundamentals of Microbiology. VIII Edition, Jones and Bartlett Publishers, Sudbury. Massachusetts.
7. Stanier, R.Y., J.L. Ingraham, M.L. Wheelis and P.R. Painter, 2008. General Microbiology. 5th Edition. Macmillan Press Ltd. London.
8. Talaro K. P. and Talaro A. 2006. Foundations in Microbiology. 6th Edition. McGraw-Hill College Dimensi.

Semester – I

15MBP102 MICROBIAL PHYSIOLOGY AND METABOLISM 4H–4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To gain the knowledge with the various inner and outer structures of prokaryotes and eukaryotes in detail.
- To provide information on sources of energy and its utilization by microorganisms. Microorganisms play important role in environment as producers, consumers and decomposers.
- To impart knowledge on metabolic function and biochemical reaction going on inside the microbial cell.
- To teach metabolic pathways, their regulation and engineering, and methods used in their elucidation.
- To teach students about cell cycle, growth and methods to determine microbial growth.
- Understand the microbial transport systems and the modes and mechanisms of energy conservation in microbial metabolism – Autotrophy and heterotrophy

COURSE OUTCOME (CO'S)

1. The students will be able to understand and predict the various metabolic reactions in microbial cell.
2. This will make them to predict the intermediate products which can be employed in industrial production processes.
3. The students will be able to know how bacterial and archaeal structure lead to function, how metabolic processes are regulated.
4. The course makes them to understand how microbes respond to environmental stressors, and how microbes can be manipulated to enhance their growth or the production of desired products.
5. Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement
6. The students will be able to understand how the organisms communicate to the population by using various mechanisms.

UNIT – I

Microbial Anatomy:- Prokaryotic cell structure and organization, cell membrane, plasma membrane, cytoplasmic matrix, inclusion bodies, ribosome, nucleiod, prokaryotic cell wall, capsule, slime layers, S layers, pili and fimbriae, flagella and motility. Eukaryotic cell structure and its organelles. Lichens and microalgae: Structural organization and their properties; mycoplasma, basic structure of viruses.

UNIT – II

Formation of specialized structures:- Endo and exospores, endospore formation in *Bacillus* sp. Exospore formation in *Streptomyces*: Sporulation in fungi: *Aspergillus* sp., *Penicillium* sp.: Biofilm and biosurfactants in bacteria. Spore cycle, factors affecting spore formation.

UNIT – III

EMP, HMP and ED pathway, TCA cycle, Glyoxylate cycle. Aerobic respiration and anaerobic respiration. Generation of energy - substrate level and oxidative phosphorylation – ATP generation. Lipid metabolism.

UNIT – IV

Biosynthesis of fatty acids, nucleotide, amino acids, proteins, phospholipids, Archaeal lipids. Cell wall biosynthesis of Gram positive and Gram negative bacteria. Toxins- characterization, mechanism of action. Cell membrane synthesis and synthesis of secondary metabolites.

UNIT – V

Photosynthesis – Oxygenic and anoxygenic – The prototrophic prokaryotes- purple photosynthetic bacteria, sulfur oxidizing and reducing bacteria – methanogenesis – assimilation of carbondioxide – photosynthetic pigments, bioluminescence. Quorum sensing cell signaling – mechanism and applications.

TEXT BOOKS

1. Berg, J.M, Tymoczko J.L, Stryer L and Clarke N.D., 2001. Biochemistry. 5th Edition. WH Freeman & Co.
2. Doelle, H.W., 2005. Bacterial Metabolism. Elsevier India Pvt. Ltd., New Delhi.
3. Moat, A,G., and Foster J.W., 2003. Microbial Physiology. John Wiley and Sons, New York.
4. Nelson, D., and Cox M.M, 2009. Principles of Biochemistry. W.H. Freeman and Company, New York.

REFERENCES

1. Atlas, R.M., 1997. Principles of Microbiology. 2nd Edition. Wm. C. Brown Publishers, Lowa, US
2. Caldwell, D.R., 2008. Microbial Physiology and Metabolism. Second edition, Wm C Brown Publishers, England.
3. Madigan, M.T., J.M. Martinko and J. Parker, 2003. Brock Biology of Microorganisms. 10th Edition. Prentice Hall. New Jersey.
4. Rose, A.H., 2008. Chemical Microbiology – An Introduction to Microbial Physiology. International Edition, Plenum Publishing Corporation.
5. White, D., 2003. Physiology and Biochemistry of Prokaryotes. 2nd Edition. Oxford University Press. NY.
6. Voet, D, and Voet J.G, 2003. Biochemistry. John Wiley and Sons, New York.

Semester – I

15MBP103 MOLECULAR GENETICS 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To gain the knowledge with the various inner and outer structures of prokaryotes and eukaryotes in detail.
- To provide information on sources of energy and its utilization by microorganisms. Microorganisms play important role in environment as producers, consumers and decomposers.
- To impart knowledge on metabolic function and biochemical reaction going on inside the microbial cell.
- To teach metabolic pathways, their regulation and engineering, and methods used in their elucidation.
- To teach students about cell cycle, growth and methods to determine microbial growth.
- Understand the microbial transport systems and the modes and mechanisms of energy conservation in microbial metabolism – Autotrophy and heterotrophy

COURSE OUTCOME (CO'S)

1.The students will be able to understand and predict the various metabolic reactions in microbial cell.
2.This will make them to predict the intermediate products which can be employed in industrial production processes.
3.The students will be able to know how bacterial and archaeal structure lead to function, how metabolic processes are regulated.
4.The course makes them to understand how microbes respond to environmental stressors, and how microbes can be manipulated to enhance their growth or the production of desired products.
5.Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement
6.The students will be able to understand how the organisms communicate to the population by using various mechanisms.

UNIT – I

Genetics – historical introduction – Mendelian principles – nucleic acid as genetic information carriers: Experimental evidence– The duplex DNA – chemical and physical structure of DNA – circular and superhelical DNA - different forms of DNA. DNA replication – enzymology of DNA replication- different modes, models and types of DNA replication- Eukaryotic DNA replication.

UNIT – II

Mutagen – mutation – mutagenesis - Luria Delbruck experiments and its significance –molecular basis of mutation–spontaneous and induced mutations - Different types of mutation - mutant detection - mutant

selection – carcinogenecity testing. DNA damage -types of damage (deamination, oxidative damage, alkylation, Pyrimidine dimers) - DNA repair mechanism (base excision, nucleotide excision, recombination repair, SOS repair).

UNIT – III

Genetic code - DNA transcription in prokaryotes and eukaryotes. Trancriptional control and modification system– RNA translation in prokaryotes and eukaryotes. Polypeptide synthesis (maturation and processing of RNA) - Translational modification - Regulation of gene expression – Operon model (Lac, Trp, Ara) - Regulation of gene expression in eukaryotes.

UNIT – IV

Genetic recombination in bacteria – conjugation, transformation, transduction. Linkage and genetic mapping. Phage genetics (Replication cycle) – Phage T4 mutants (detection and isolation) – Genetic recombination – Genetic map of T4 phage, Gene mapping.

UNIT – V

Yeast genetics - Life cycle - metabolism – Genomes - extra chromosomal element - genetic nomenclature - tetrad analysis. Petite mutants (mutant isolation and complementation) - Gene conversion and gene mapping in Yeast. Genetic mapping in *Neurospora*. Genetic mapping in *Drosophila*.

TEXT BOOKS

1. Malacinski, G. M, 2008. Freifelder's Essentials of Molecular Biology Molecular Biology. Narose Publishing House. New Delhi.
2. Verma, P. S. and Agarwal, V. K., 2008: Cell Biology, Genetics, Molecular Biology and Evolution. S. Chand & Company Ltd, New Delhi
3. Gardner, E.J., M.J. Simmons and D.P. Snustad, 2008. Principles of Genetics. 8th Edition. John Wiley and Sons, NY.
4. Guthrie, C., and G. Fink, 2002. Guide to Yeast Genetics and Molecular Cell Biology. Elsevier Publication, USA.
5. Klug, W.S. M.R. Cummings, C. A. Spencer and M. A. Palladino, 2009. Essentials of Genetics. 7th Edition. Prentice Hall, New Jersey.
6. Maloy, S.R., J.E. Cronan Jr and D. Freifelder, 2001. Microbial Genetics. Narosa Publishing House. New Delhi.
7. Weaver, R.F., 2002. Molecular Biology. 2nd Edition. McGraw-Hill, New York.

REFERENCES

1. Alberts, 2008. Molecular Biology of The Cell, 5th Edition, Garland Science, Taylor and Francis group, LIC, an Inforrma Science.
2. Griffiths et al, 2002. Modern genetic analysis, 2nd Edition, Freeman.
3. Hartl and Jones, 1998. Genetics-Principles and Analysis, 4th Edition, Jones & Bartlett.
4. Krebs, E,J., S.T.Kilpatrick and E.S.Goldstein, 2008. Lewin's Genes X, 10th Edition , Jones and Bartlett publishers Canada.
5. Nelson, D., and M.M.Cox , 2008. Lehninger's Principles of Biochemistry, 5th Edition, McMillan.
6. Tamarin, R.H., 2001. Principles of Genetics. 7th Edition. Wm. C. Brown Publishers. England

7. Turner, P., A. McLennan, A. Bates and M.White.2005. Molecular Biology.3rd Edition. Taylor and Francis group.
8. Watson, J.D., T. Baker, S. Bell, A. Gann, M. Levine and R. Losick, 2008. Molecular Biology of Genes. 6th Edition, Pearson Education.

Semester – I

15MBP104 BIOINSTRUMENTATION 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- Introduce the basic concept of qualitative and quantitative analysis of a given sample
- To Study various spectroscopic techniques and its instrumentation.
- To know the concept of separation science and its applications.
- To understand the basic laboratory skills that are essential for beginning-level employment in clinical, pharmaceutical, microbiology, biochemistry and biotechnology laboratories.
- To impart the concept of radiochemical analysis along with industrial analyzers
- To understand working of different laboratory equipment's used in microbiological laboratories

COURSE OUTCOME (CO'S)

1. This enables students to be able to explain bioinstrumentation techniques, design and application.
2. To know the concepts and operation of various lab instruments and related terms.
3. Acquire knowledge and lab skills to perform experiments in laboratory.
4. Connect the concepts of physics, chemistry and engineering principles in the instrumentation.
5. The students will be able to know all the basic principles, technology and applications of various instruments in life science.
6. Comprehend the techniques and the underlying principles in bioinstrumentation.

UNIT – I

Spectroscopy – properties of electromagnetic radiations, Instrumentation and applications of – UV Visible light spectroscopy, spectrofluorimeter, atomic spectroscopy, FTIR, NMR spectroscopy and MALDI –TOF. Flow cytometer.

UNIT – II

Centrifugation – principle, types of centrifuges, principles and applications of analytical and preparative centrifuge, density gradient and ultra centrifuge. Relative molecular mass determination and sedimentation coefficient. Sub-cellular Fractionation of cellular components.

UNIT – III

Chromatography - principle, instrumentation and applications of ion exchange chromatography, affinity, gel filtration and column chromatography. Low pressure liquid chromatography (LPLC) and high

performance liquid chromatography (HPLC) and fast protein liquid chromatography (FPLC), gas liquid chromatography mass spectroscopy (GC – MS).

UNIT – IV

Electrophoresis - principle, instrumentation and applications of agarose gel electrophoresis, sodium doecyl sulphate – polyacrylamide gel electrophoresis (SDS-PAGE), native PAGE, isoelectric focusing, immuno electrophoresis, pulse field gel electrophoresis, capillary electrophoresis, gel documentation – applications.

UNIT – V

Radioisotopic techniques – introduction, nature of radio activity, types and rate of radio active decay, units of radio activity, detection and measurement of radio activity. Principle, instrument and applications of Geiger-Muller counter, solid and liquid scintillation counter and autoradiography. Biosafety methods in radio active laboratory.

TEXT BOOKS

1. John Enderle Bioinstrumentation. 2006. Morgan and Claypool Publishers. NJ.
2. Richard Normann. 1988. Principles of bioinstrumentation. Wiley Publishers.US.
3. Keith Wilson and John Walker. 2010. Principle and Techniques of Biochemistry and molecular biology. 7th Edition. Cambridge university press. NY.

REFERENCES

1. Boyer, R., 2000. Modern Experimental Biochemistry. 3rd Edition. Addison Wesley Longman. New Delhi.
2. Chatwal, G.R. and Anand, S. K, 2003. Instrumental Methods of Chemical Analysis. 5th Edition, Himalaya Publishing House, Mumbai
3. Friedfelder, D., 2001. Physical Biochemistry: Applications to biochemistry and molecular biology. Oxford Publishers. New York.
4. Sharma, B.K., 2007. Instrumental Methods of Chemical Analysis, Krishna Prakashan Media (P) Ltd, India. .
5. Wilson, K and Walker, J, 2010. Principles and Techniques of Biochemistry and Molecular Biology, 7th Low Price Edition, Cambridge University Press, India.

Semester - I

15MBP105 ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To educate the students about concepts of designs of water distribution systems, sewer networks, working principles and design of various physical, chemical and biological treatment systems of water and wastewater.
- To study about the biofertilizers, plant disease and increasing soil fertility.
- To impart a skilled knowledge on Microbes and environment and ecological importance.
- The main goal is to know and understand the role of microbes in biogeochemical processes in different ecosystems. The students will learn the basic microbiological principles, the methods in microbial ecology and their theoretical and practical use.
- The knowledge can give the base for understanding processes and changes in the environment.
- The students can get some skills to recognise the ecological problems and critical evaluation of the human impacts on pollution, climate changes and as well as environmental protection.

COURSE OUTCOME (CO'S)

1. This course will provide the student insights into these invaluable areas of Environmental microbiology, which play a crucial role in determining its future use and applications in environmental management.
2. Students able to know detailed idea about biofertilizer production and plant disease.
3. Students able to become Entrepreneur after understanding this process and product development.
4. This course will determine microbial role in nutrient cycling
5. This course can able to determine water quality.
6. It will explain the degradation of natural organic compounds and selected pollutants in the environment.

UNIT – I

Aquatic environment - microbiology of water - water pollution and water borne pathogens. Bacteriological examination of water, indicator organism. Microbiology of sewage. Chemical and biochemical characteristic of sewage. methods of sewage treatment - physical screening, chemical, biological (sludge digestion; activated sludge, aerating filters, oxidation pond).

UNIT – II

Microbiology of air - Microbial contaminants of air, sources of contamination, microbial indicators of air pollution. Enumeration of bacteria in air. Air samplers and Sampling techniques. Air sanitation.

UNIT – III

Bioremediation – contaminated soil, aquifers, marine pollutants, air pollutants, stimulation of oil spills degradation. Bioremediation of air pollutants. Bioleaching – recovery of metal from ores – oxidation of minerals – testing for biodegradability.

UNIT – IV

Biological nitrogen fixation - symbiotic and non-symbiotic microorganisms, root nodule formation, nitrogen fixers, hydrogenase, Nitrogenase, *Nif* gene regulation. Biochemistry of nitrogen fixation, Rhizosphere- R: S ratio, Interaction of microbes with plants. Bioconversion of agricultural wastes.

UNIT – V

Biofertilizer - Application of biofertilizers and biomanures – A combination of biofertilizer and manure applications with reference to soil, seed and leaf sprays. Laboratory and field application; Cost-benefit analysis of biofertilizer and biomanure production.

TEXT BOOKS

1. Subba Rao, N.S., 1999. Biofertilizers in Agriculture and Agroforestry. Oxford and IBH, New Delhi.
2. Rangaswami, G. and D.J. Bhagyaraj, 2001. Agricultural Microbiology. 2nd Edition. Prentice Hall, New Delhi.
3. Rao, N.S., 1995. Soil Microorganisms and plant Growth. Oxford and IBH Publishing Co., New Delhi.
4. Pelzar, M.J. and M. Reid, 2003. Microbiology. 5th Edition. Tata Mc Graw-Hill. New York.
5. Reinheimer, G., 1991: Aquatic Microbiology. 4th Edition. John Wiley and Sons. New York.

REFERENCES

1. Joseph C. Deniel, 1996, Environmental aspects of microbiology, British Sun Publication, Chennai.
2. Abbasi, S.A. 1998. Environmental pollution and its control. Cogent International publishers, Pondicherry.
3. Keya Sen and Nicholas J. Ashbolt 2010. Environmental Microbiology: Current Technology and Water Applications.
4. Josdand, S.N., 1995. Environmental Biotechnology. Himalaya Publishing House, Bombay.
5. Maier, R.M., Pepper, I,L., Gerba, C.P. 2009. Environmental Microbiology IInd Edition Elsevier Publisher.
6. Metcalf, R.L. and Luckmann, W.H. 1994. Introduction to insect pest management 3rd edn. John Willey and Sons, Inc.
7. Atlas, R.M. and M. Bartha, 2000. Microbial Ecology - Fundamental and Applications. 3rdEdition. Redwood City CA. Benjamin/Cumming Science Publishing Co., New Delhi.
8. Maier, R.M., I.L. Pepper and C.P. Gerba, 2000. Environmental Microbiology.1st Edition. Academic Press. New York.

9. Mitchell, R., 1992. Introduction to Environmental Microbiology; Prentice Hall. Inc. Englewood Clifs-New Jersey.
10. Motsara, M.R., P. Bhattacharyya and B. Srivastava, 1995. Biofertilizer- Technology, Marketing and Usage. Fertilizer Development and Consultant Organization, New Delhi.

15MBP111 **BASIC PRACTICAL – I** **Semester – I**
4H – 2C

Instruction Hours / week: L: 0 T: 0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 9 Hours

COURSE OBJECTIVES

- This course is put forward with the objectives of equipping the candidates with practical knowledge on basic techniques involved in the isolation, characterization and identification of different types of microorganism.
- Know various Culture media and their applications and also understand various physical and chemical means of sterilization.
- Know General bacteriology and microbial techniques for isolation of pure cultures.
- Master aseptic techniques and be able to perform routine culture handling tasks safely and effectively.
- Comprehend the various methods for identification of unknown microorganisms.
- Understand the microbial transport systems and the modes and mechanisms of energy conservation in microbial metabolis

COURSE OUTCOME

1. A student able to skillfully isolate and identify the microorganisms using different microbiological techniques needed in laboratory.
2. To enhance the ability of the student skills in medical laboratories and research sectors.
3. Demonstrate practical skills in the use of tools, technologies and methods common to microbiology.
4. To apply the scientific method and hypothesis testing in the design and execution of experiments
5. To develope theoretical and practical skills in the design and execution of experiments.
6. Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement.

1. Micrometry
2. Measurement of pH
3. Staining techniques: Simple, Gram, Negative and Endospore
4. Motility determination - Hanging drop and SIM inoculation
5. Cultivation of anaerobic microorganisms – Wrights tube – Mc Intosh anaerobic jar - roll tube methods.
6. Permanent slide preparation
7. Lactophenol cotton blue mounting of fungi - *Aspergillus* sp, *Mucor* sp, *Rhizopus* sp, *Fusarium* sp, *Penicillium* sp
8. Measurement of microbial growth – Viable count – Direct count – Turbidity methods

9. Biochemical characterization
    a) Indole
    b) MR
    c) VP
    d) Citrate utilization tests
    e) TSI test
    f) Catalase
    g) Oxidase
    h) Urease
    i) Nitrate
    j) Hydrogen sulphide production test
    k) Litmus milk reduction test
    l) Carbohydrate fermentation tests
    m) Amino acid utilization
    n) Hydrolysis of polymers- Starch, Lipid, Casein, Gelatin.

REFERENCES

1. Aneeja, K.R., 2001. Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, 3rd Edition, New Age International (P) Limited Publishers, New Delhi.
2. Cappucino, J.G. and N. Sherman, 2001. Microbiology A Laboratory Manual, 6th Edition, Benjamin Cummings, New York.
3. Dubey, R.C. and D.K. Maheshwari, 2002. Practical Microbiology, 1st Edition, S. Chand and Company Ltd, New Delhi.
4. Gunasekaran, P., 1996. Lab Manual in Microbiology, 1st Edition, New Age International (P) Ltd, Publishers , New Delhi.

Semester – I

15MBP112 BASIC PRACTICAL – II 4H – 2C

Instruction Hours / week: L: 0 T: 0 P: 4 Marks: Internal: **40** External: **60** Total: **100**

COURSE OBJECTIVES

- To acquire skill on the different molecular mechanism of gene transfer, mutations and separation of nucleicacids.
- This course is put forward with the objectives of equipping the candidates with practical knowledge on basic techniques.
- To impart skills of isolation, characterization and identification of different types of microorganism.
- Know various Culture media and their applications and also understand various physical and chemical means of sterilization.
- To make students understand the principles of Genetics
- Students will learn the basic principles of inheritance at the molecular, cellular and organismal levels.

COURSE OUTCOME

1. A student undertaking this course will be learning the principles behind the molecular techniques which would enable him to work in competent molecular biology based laboratories.
2. Imparts knowledge on the different aspects of genetics and pedigree analysis.
3. Students will apply their knowledge of to selected examples of changes or losses in cell function.
4. Identify the organs and tissue systems of plants, and explain their respective function.
5. Impart knowledge on applications of microorganisms in various fields
6. Provides skill development on microbial products.

EXPERIMENTS

1. Spontaneous Mutation – gradient plate technique
2. Induced Mutagenesis-chemical and physical - UV
3. Replica plating technique.
4. Isolation of Mutants and Revertants
5. Transformation in Bacteria
6. Bacterial Conjugation
7. Induction of Lac operon
8. Measurement of growth-one step growth curve using a T even phage
9. Titration of phages (T4)
10. Nuclear staining for nucleic acid identification.
11. Spectrophotometric estimation of protein – BSA
12. Analysis of amino acid by Paper chromatography
13. Analysis of amino acid by Thin layer chromatography
14. Purification of metabolites by column chromatography

15. Analysis of amino acid by HPLC

REFERENCES

1. Arora, B. and D.R. Arora, 2007. Practical Microbiology, 1st Edition, CBS Publishers and Distributors, Bangalore.
2. Benson, H.J., 1998. Microbiological Application (Laboratory Manual in General Microbiology), 7th Edition, WCB.
3. Palanivelu, P., 2004. Analytical Biochemistry and Separation Techniques, 3rd Edition, Twenty First Century Publication, Madurai.
4. Chakraborthy, P. and N.K. Pal, 2008. Manual of Practical Microbiology and Parasitology, New Central Book Agency (P) Ltd, India.
5. Gaud, R.S. and G.D. Gupta, 1999. Practical Microbiology, 1st Edition, Nirali Prakashan, Pune.

Semester – II

15MBP201 **VIROLOGY** **5H – 5C**

Instruction Hours / week: L: 5 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- Virology, often considered a part of microbiology or of pathology, is the study of biological viruses and virus like agents.
- Viral structure, classification and evolution, their ways to infect and exploit cells of virus reproduction, the disease they cause.
- The techniques to isolate and culture them and their potential uses in research and therapy.
- To know how viruses are classified
- To understand the architecture of viruses
- To understand the interactions between viruses and the host immune system

COURSE OUTCOMES

1. Describe the structure and replication strategies of the viruses, the processes of entry into cells, control of gene transcription and where relevant translation and gene product stability, control of and mechanism of genome replication, virion assembly and egress from the cell.
2. Define the process of virus latency and describe in molecular terms control of the process and activation of viral genomes during reactivation.
3. Describe the growth behavior differences between normal cells and cells transformed by oncogenic DNA and RNA viruses.
4. Integrate experimental strategies learned in the context of viral systems into the design of experiments involving other systems.
5. Discern the replication strategies of representative viruses from the seven Baltimore classes
6. To understand the interactions between viruses and the host immune system

UNIT – I

Historical perspective of virology - Scope of virology -Viral classification and properties of viruses – Replication of viruses, cultivation of viruses (animal inoculation, Embroyanated egg and tissue culture) - properties of viroids and Prions.

UNIT – II

Animal viruses- DNA viruses - morphology, replication, pathogenesis and laboratory diagnosis of Pox virus, Adeno virus, Hepatitis viruses – type A,B and D. Herpes simplex viruses, oncogenic viruses- Papova virus,- oncogenes and Oncogenesis.

UNIT – III

Animal viruses - RNA viruses - morphology, replication, pathogenesis and laboratory diagnosis of Poliovirus. Rabies virus, Influenza virus, mumps virus, Measles virus and rubella virus, Retro virus - HIV virus. Dengue and Japanese Encephalitis, SARS, Swine Flu.

UNIT – IV

Plant viruses – RNA viruses – TMV, Cowpea mosaic virus, Bromomosaic viruses, Satellite viruses – Double stranded DNA viruses - CaMV – Single stranded DNA viruses – Gemini virus. Structure and replication of Bacteriophage (T4) – Filamentous phage (ΦX174).

UNIT – V

Common type of hospital infections – hospital waste disposal. Viral vaccines and interferons - Antiviral drugs - strategies to develop AIDS vaccines - Rabies vaccines preparation (animal and cell culture) and their immunization dosage.

TEXT BOOKS

1. Ananthanarayanan, R. and C.K.J. Panicker, 2005. Text book of Microbiology. 7th Edition. Orient Longman. New Delhi.
2. Carter J & Saunders V. 2007. Virology: Principles and Applications. 1stEd. Wiley.
3. Chakraborty, P., 2003. A Text book of Microbiology. 2nd Edition. New Central Book Agency (P) Ltd., Calcutta.
4. Dubey, R.C. and D.K. Maheswari, 2004. A Text book of Microbiology. 1st Edition, S. Chand and Company Ltd, New Delhi.
5. Pelczar, Jr. M.J., E.C.S. Chan and K. R. Kreig, 2003. Microbiology 5th Edition Tata McGraw-Hill Publishing Company. New Delhi.

REFERENCES

1. Acheson NH. 2006. Fundamentals of Molecular Virology. Wiley publication.
2. Cann, A.J, 2005. Principles of Molecular Virology, Academic Press.
3. Dimmock, N.J., A.J. Easton and K.N. Leppard, 2007. Introduction to Modern Virology, 6th Edition, Blackwell Scientific Publications, Oxford, UK.
4. Flint, S. J.,V. R. Racaniello, L. W. Enquist, V. R. Rancaniello, and A. M. Skalka.,2003.Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses. American Society Microbiology.
5. Jawetz, E., J.L. Melnic and E.A. Adelberg, 2001. Review of Medical Microbiology. 22nd Edition. Lange Medical Publishers, NY.
6. Jay A. Levy, Heinz Fraenkel-Conrat, and Oliver S. Owens., 1994.Virology. 3rd Edition Benjamin Cummings.
7. Knipe D.M., Howley P.M., Griffin D.E. 2006. Fields Virology. 5th Ed. Vols. I,II. Lippincott, Williams & Wilkins.
8. Prescott, M., J.P. Harley and D.A. Klein, 2007. Microbiology. 7th Edition, McGraw-Hill Inc. New York.
9. White, D. O., Fenner, F. J. 1994. Medical Virology, 4th edition, Academic Press, New York.

Semester - II

15MBP202 MEDICAL BACTERIOLOGY 5H – 5C

Instruction Hours / week: L: 5 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- Medical Bacteriology introduces basic principles and then applies clinical relevance of many etiological agents responsible for global infectious diseases.
- The infectious disease cycle of the pathogens enables to solve the epidemics.
- The territory covered by infections and the immune response
- We focus on pathogenic mechanisms in order to foster a student's ability to solve problems in their future clinical career and able to establish the medical laboratory.
- This course provides learning opportunities in the basic principles of medical microbiology and infectious disease
- It covers mechanisms of infectious disease transmission, principles of aseptic practice, and the role of the human body's normal microflora

COURSE OUTCOMES

1. Demonstrate an understanding at an advanced level of microbial virulence mechanisms and host response toinfection.
2. Application of molecular techniques to medical microbiology; biochemical and genetic mechanisms of antimicrobial agent activity, microbial susceptibility and resistance to antimicrobialagents.
3. Demonstrate an understanding of skin and respiratory tract infections (microbial causes, pathogenesis, transmission of infection, diagnosis, prevention and treatment) by being able to identify a unknown organisms in clinical samples, and describe the pathogenesis of important pathogens.
4. It also provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.
5. To understand the importance of pathogenic bacteria in human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue.
6. Recall the relationship of this infection to symptoms, relapse and the accompanying pathology.

UNIT – I

Laboratory precaution and guidelines – Aseptic collection – transportation – handling and examination of pathological specimens – methods of isolation, identification and interpretation of pathogenic organisms – antibiotic susceptibility testing..

UNIT – II

Infections – types – methods – infectious disease cycle. Definitions of Epidemics, Endemics Pandemics and investigation of epidemics and control. Definition of pathogens, Saprophytes and Commensals. Quality control in microbiology lab.

UNIT – III

Gram positive organisms: Morphology, cultural characteristics, antigenic property, pathogenecity, laboratory diagnosis and treatment. *Staphylococcus* sp., *Streptococcus* sp., *Bacillus* sp., *Corynebacterium* sp., *Clostridium sp.* and *Mycobacterium* sp.

UNIT – IV

Gram negative organisms*:* Morphology, cultural characteristics, antigenic property, pathogenecity, laboratory diagnosis and treatment. *E.coli*, *Klebsiella* sp., *Proteus* sp., *Pseudomonas* sp., *Vibrio* sp., *Salmonella* sp., *Shigella* sp., *Treponema* sp., *Neisseria* sp. and *Haemophilus* sp.

UNIT – V

Nosocomial infection – Urinary tract infection, Respiratory tract infection, Sexually transmitted disease – Immunoprophylaxis – Vaccines and antibiotics.- Phage typing and bacteriocin typing.

TEXT BOOKS

1. Ananthanarayanan, R. and C.K.J. Panicker, 2005. Text Book of Microbiology 7th Edition. Orient Longman, New Delhi.
2. A.J.Salle. Fundamentals principles of bacteriology. 2008. T.M.H. Edition. Mc Graw Hill.
3. Carl Fraenkel. Text book of bacteriology. 2012. Printing company publishers, New York.

REFERENCES

1. Brook,G.F., J. S. Butel, A. Stephen and Morse, 2003. Medical Microbiology, 22nd Edition. Mc Graw Hill.
2. Chakraborty, P., 2003. A Text book of Microbiology. 2nd Edition. New Central Book Agency (P) Ltd., Calcutta.
3. Dismukes, W.E., P.G. Pappas and D. Sobel, 2003. Clinical Mycology. Oxford University Press, UK.
4. Jawetz, E., J.L. Melnic and E.A. Adelberg, 2001. Review of Medical Microbiology. 22nd Edition. Lange Medical Publishers. NY.

Semester – II

14MBP203 MICROBIAL TECHNOLOGY AND INTELLECTUAL PROPERTY RIGHTS **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- Medical Bacteriology introduces basic principles and then applies clinical relevance of many etiological agents responsible for global infectious diseases.
- The infectious disease cycle of the pathogens enables to solve the epidemics.
- The territory covered by infections and the immune response
- We focus on pathogenic mechanisms in order to foster a student's ability to solve problems in their future clinical career and able to establish the medical laboratory.
- This course provides learning opportunities in the basic principles of medical microbiology and infectious disease
- It covers mechanisms of infectious disease transmission, principles of aseptic practice, and the role of the human body's normal microflora

COURSE OUTCOMES

1. Demonstrate an understanding at an advanced level of microbial virulence mechanisms and host response toinfection.
2. Application of molecular techniques to medical microbiology; biochemical and genetic mechanisms of antimicrobial agent activity, microbial susceptibility and resistance to antimicrobialagents.
3. Demonstrate an understanding of skin and respiratory tract infections (microbial causes, pathogenesis, transmission of infection, diagnosis, prevention and treatment) by being able to identify a unknown organisms in clinical samples, and describe the pathogenesis of important pathogens.
4. It also provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.
5. To understand the importance of pathogenic bacteria in human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue.
6. Recall the relationship of this infection to symptoms, relapse and the accompanying pathology.

UNIT – I

Introduction to microbial technology, restriction enzymes – nomenclature – types – and its properties, isolation of DNA, plasmids and RNA. Handling and quantification of nucleic acids, radiolabelling and non radiolabelling of nucleic acids, gel electrophoresis - Blotting techniques – Southern, Northern and Western blotting techniques.

UNIT – II

Cloning vectors: Plasmid as cloning vectors - pBR322, Bacteriophage - □, M13; Cosmid, phagemids. Yeast vector. Expression vectors. Prokaryotic hosts: *E.coli*, Eukaryotic hosts: Yeast cell. Gene cloning - basic steps, cloning construction of cDNA, selection and screening method of recombinants. Biolabelling of genes and proteins.

UNIT – III

Trrangenic plants: Methodology, development of herbicide resistance plants, delayed fruit ripening, Biocontrol agents - Insecticidal toxin of BT, cry gene and baculovirus. Trangenic animals. Methodology, development of transgenic mice – its application. DNA diagnostic in medical forensics. Biosafety and Bioethics.

UNIT – IV

Patenting – fundamental requirements – patenting multicellular organisms – patenting and fundamental research. Patenting of biological materials, Product patents, conditions for patenting, Patenting of liveforms, regulating recombinant technology, Food and food ingredients. Trade secrets. How do write a patent?.

UNIT – V

Discrepancies in biotechnology / chemical patenting. IPR – historical perspective – recent developments – IPR in India, IPR and the rights of farmers in developing countries.

TEXT BOOKS

1. Sathyanarayana, U., 2005. Biotechnology. 1st Edition. Books and Allied (P) Ltd., Kolkata, India.
2. Dubey, R.C., 2002. Text book of Biotechnology. S. Chand and Company Ltd., New Delhi.
3. Ramawat, K.G., 2003. Text book of Plant Biotechnology. S. Chand and Company Ltd. New Delhi.
4. Watson, J.D., M. Gilman and J. Wikowski, 2001. Recombinant DNA. 2nd Edition, Scientific American Books. W.H. Freeman and Co. NY.
5. Verma, A. and Podila, G.K. 2005. Biotechnological Applications of Microbes. I.K. International Publishing House. New Delhi.

REFERENCES

1. Brown, T.A., 2001. Gene Cloning and DNA analysis: An Introduction. 4th Edition. Blackwell Publishing, USA.
2. Glick, B.K. and J.J. Pasternak, 2003. Molecular Biotechnology. Principles and Applications of Recombinant DNA. 3rd Edition. ASM Press, Washington.
3. Old, R.M. and S.B. Primrose, 2003. Principles of Gene Manipulation. 6th Edition. Blackwell Scientific Publication. London.
4. Primrose, S.B., 2001. Molecular Biotechnology 2nd Edition. Blackwell Scientific Publishers, Oxford Press, London.
5. Winnacker, E.L., 2003. From Genes to Clones: Introduction to Gene Technology. 1st Edition, VCH. Weinhein. Germany.
6. Slater, A. and N. Scott, 2003. Plant Biotechnology - The Genetic Manipulations of plants. 2nd Edition, Oxford University Press. New York.

Semester - II

15MBP204A **MARINE MICROBIOLOGY** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

- To educate the students about concepts of designs of water distribution systems, sewer networks, working principles and design of various physical, chemical and biological treatment systems of water and wastewater.
- To study about the biofertilizers, plant disease and increasing soil fertility.
- To impart a skilled knowledge on Microbes and environment and ecological importance.
- The main goal is to know and understand the role of microbes in biogeochemical processes in different ecosystems. The students will learn the basic microbiological principles, the methods in microbial ecology and their theoretical and practical use.
- The knowledge can give the base for understanding processes and changes in the environment.
- The students can get some skills to recognise the ecological problems and critical evaluation of the human impacts on pollution, climate changes and as well as environmental protection.

COURSE OUTCOME (CO'S)

7. This course will provide the student insights into these invaluable areas of Environmental microbiology, which play a crucial role in determining its future use and applications in environmental management.
8. Students able to know detailed idea about biofertilizer production and plant disease.
9. Students able to become Entrepreneur after understanding this process and product development.
10. This course will determine microbial role in nutrient cycling
11. This course can able to determine water quality.
12. It will explain the degradation of natural organic compounds and selected pollutants in the environment.

UNIT – I

Marine microorganisms: collection, preservation, enumeration (total and viable counts), isolation of culture and identification based on morphological, physiological and biochemical characteristics. International and national collection centres.

UNIT – II

Extremophiles: Thermopiles, basophiles, halophiles, psychrophiles, acid – alkalinophiles, oligotroph, toxitolerant, xerotolerant, endolith – Extremophiles and their environment, biodiversity. Genomics of extremophiles, phylogeny of extremophiles, 16S RNA classification in mitochondrial DNA genome, RAPD, RFLP studies.

UNIT – III

Microbiology of degradation of xenobiotic environment: Ecological considerations, decay behaviour, degradative plasmids, hydrocarbons, oil pollution, surfactants, pesticides, Bioremediation:- Factors affecting bioremediation – role of microbes in the marine nutrient cycles – diseases of marine organisms and its impact on marine biodiversity.

UNIT – IV

Brief account of photosynthetic and accessory pigments: Chlorophyll – bacterial chlorophyll – carotenoids – rhodopsin, phycobilliprotein, carbohydrates, anabolism – autotrophy – photosynthesis – autotrophic generation of ATP, fixation of CO_2 – Calvin cycle– C_3 and C_4 pathway.

UNIT – V

Bar coding of marine organisms: Genome sequencing and physical mapping of genome. Composting of domestic, agricultural and industrial wastes, vermicomposting. SCP production; Mushroom cultivation.

TEXT BOOKS

1. Colin Munn. Marine Microbiology: Ecology & Applications. 2011. 2nd edition. Black Well Publishers.
2. David Sigee. 2005. Freshwater Microbiology: Biodiversity and Dynamic Interactions of Microorganisms in the Aquatic Environment. 1st Edition. Black well Publishers.
3. Se-Kwon Kim. 2013. Bioactive compounds and biotechnological applications. CLS Publishers

REFERENCES

1. Dube, H.C., 1994. A text book of fungi, bacteria and viruses. Vikas Publishing House, New Delhi.
2. Dale, J.W. 1994. Molecular genetics of Bacteria. John Wiley and Stones.
3. Pelczar, M. JR. E.C.s. and Chan and Noel, R. K. 2006. Microbiology. Tata McGraw, Hill. Co. 5th Edition, New Delhi.
4. Presscott, L.N., Harley, J.P. and Klein, D.A. 1999. Microbiology. W.C. Brown Publishers.
5. Stanier, R.Y., Ingharam J.L. Wheelis, M.L. Painter, P.R. 1986. General Waste water engineering Treatment, Disposal and Reuse. Metcaff and Eddy. Inc., Tata Mc Grew Hill, New Delhi.

Semester - II

15MBP204B COMPUTER APPLICATIONS AND BIOINFORMATICS 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- About collection, interpretation and presentation of statistical data
- The analytics of data, probability, and hypothesis testing of samples
- The essential role of statistics in present, future use and applications of Biology.
- To equip students with a basic understanding of the underlying principles of quantitative and qualitative research methods.
- Provide students with in-depth training on the conduct and management of research from inception to completion using a wide range of techniques
- The ethical and philosophical issues associated with research in education

COURSE OUTCOMES

1. Apply basic statistical concepts commonly used in health and medical sciences
2. Use basic analytical techniques to generate results
3. Interpret results of commonly used statistical analyses in written summaries.
4. Demonstrate statistical reasoning skills correctly and contextually.
5. Provide learning opportunities to critically evaluate research methodology and findings.
6. Enable students to be reflexive about their role and others' roles as researchers.

UNIT – I

Information networks-internet, web browsers, HTTP,HTML and URLs. EMBnet – NCBI, Virtual tourism. Introduction to Operating systems like Windows, UNIX & LINUX - Computer Viruses – Overview and prevention.

UNIT – II

Bioinformatics tools - Global Vs local alignment – Similarity searching –Pair wise alignment and multiple alignments – Biological Databases – Literature, Sequence and Structure – identification and retrieving data from databases.

UNIT – III

Protein information resources –primary sequence database, Composite protein sequence database, secondary database, and Composite protein structure database. Protein structure prediction - Proteomic tools at ExPASy server.

UNIT – IV

Protein structure comparison and classification – RNA structure analysis – Plasmid mapping and Primer designing– Structure visualization softwares – Phylogenetics – Tree types and construction methods.

UNIT – V

DNA sequencing –Specialized genomic resources. DNA microarray – principles and databases – Genomics and Proteomics – genes prediction, splices sites and regulatory regions – Drug designing and Commercial Bioinformatics.

TEXT BOOKS

1. Hooman Rashidi, Lukas K. Buehler, 2005. Bioinformatics Basics: Applications in Biological Science and Medicine. CRC Press/Taylor & Francis Group.
2. Stephen A. Krawetz, David D. Womble. Stephen A. Krawetz, David D. Womble. 2003. Introduction to Bioinformatics: A theoretical and Practical approach. Humana Press, USA.
3. Bryan Bergeron. 2002. Bioinformatics Computing. Prentice Hall Publishres.

REFERENCES

1. David W. Mount, 2001, Bioinformatics. Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press.
2. Higginns D and W. Taylor, 2000, Bioinformatics. Sequence, Structure and databanks – A Practical Approach, Oxford University Press.
3. Baxevanis A.D and B.F. Francis Ouellette, 2001, Bioinformatics – A Practical Guide to the Analysis of Genes and Proteins, Wiley – Interscience.
4. G. Gibson and S.V. Muse, 2002, A Primer of Genome Science, Sinauer Associates, Inc. Publishers.
5. S. Misener and S.A. Krawetz, 2000, Methods in Molecular Biology – Bioinformatics. Methods and Protocols, Humana Press.
6. Attwood T.K and D.J. Parry-Smith, 2001, Introduction to Bioinformatics, Pearson Education Asia.
7. Claverie J.M, C. Notredame, 2003, Bioinformatics for Dummies**,** Wiley Publishing, Inc

Semester - II

15MBP204C **BIONANOTECHNOLOGY** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVE

- This course has been intended to provide knowledge about the Bio nanomaterials synthesis and its advancement.
- To foundational knowledge of the Nanoscience and related fields.
- To make the students acquire an understanding the Nanoscience and Applications
- To help them understand in broad outline of Nanoscience and Nanotechnology.
- Understand the synthesis of nanomaterials and their application and the impact of nanomaterials on environment
- Apply their learned knowledge to develop Nanomaterial's.

COURSE OUTCOME (CO'S)

1. Students get an idea about application of nanotechnology in biology.
2. It provide analytical knowledge of trends and developments in the field of nanotechnology
3. Acquire knowledge in nanotechnology and how it will support the employment greatly.
4. Students able to construct hierarchy strategy in machine.
5. Able to describe self-application and machine phase biotechnology.
6. Students have an enhanced knowledge and understanding of chemical transformation and biomolecular sensing.

UNIT – I

Biotechnology to Bionanotechnology: Bionanomachines – Modern bionano materials – protein, nucleic acid, lipids used for carrying information – polysaccharides use in special structural roles – Present status of bionanotechnology.

UNIT – II

Molecular design for nanotechnology: Recombinant DNA technology – X-ray crystallography, NMR spectroscopy and electron microscopy, use in nanotechnology – Computer modeling to bionanomachines and computer assisted molecular design.

UNIT – III

Structural principles of Bionanotechnology: Natural bionanotechnology design for specific environment – Biomolecular structure as low materials – Hierarchical strategy in construction of nanomachines – protein folding – self organization – molecular recognition – flexibility.

UNIT – IV

Functional principles of Bionanotechnology: Information driven nano assembly – chemical transformation – biomolecular sensing – self application – machine phase bionanotechnology.

UNIT – V

Future of Bionanotechnology: Problems in bionanotechnology – Abide finger problem – Sticky finger problem – role of enzyme to solve these problems – Core studies – nomotuble synthesis, nanoscale assembler, nanozurveillance – ethical consideration – respect for life, potential dangers, fuel

TEXT BOOKS

1. David S. Goodsell. Bionanotechnology. 2004. Wiley-Blackwell.
2. Kenneth Gonsalves, Craig Halberstadt, Cato T. Laurencin, 2007. Biomedical Nanostructures. Wiley-Blackwell.
3. Cristina Sabliov, Hongda , Rickey Yada. 2015. Nanotechnology and Functional Foods. Wiley-Blackwell Publishers
4. Rakesh Kumar, Kamlapati Tiwari. A Textbook of Nanoscience. 2013. Publisher: S.K. Kataria & Sons.

REFERENCES

1. David S. Goosell, 2004. Bionanotechnology, Lessons from nature, John Wiley & Sons Inc. publication.
2. David S. Goodsell, 1996. Biomolecules and Nanotechnology, Ancient Scientist, 88, 230 – 237.
3. Blundell T. L. and Johnson L. N, 1976. Protein crystallography, New York.
4. Eisenberg. D and D. Crothers 1979. Physical Chemistry with Applications to the Life Sciences. Benjamin Cummings, Menlo Park, California.
5. Ausubel, F. M., Breut R. Kingston R. E., Moore, D. D., Siedman, J. G., Smith, J. A. and Struhl K, 1999. Short protocols in Molecular Biology, Fourth Edition. Wiley, New York.

Semester - II

15MBP204D MOLECULAR TAXONOMY AND PHYLOGENY 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVE

1.To learn the information on an organism's evolutionary relationships based on phylogeny.
2.To emphasize on molecular analysis of the microorganisms for species confirmation.
3.To know molecular techniques
4.To study DNA, RNA and Protein
5.To know biochemical taxonomy
6. To study gene molecular level.

COURSE OUTCOME

1.Students can gain the knowledge to construct phylogenetic tree, multiple sequence alignment.
2. Able to understand the various groups of microorganisms are genetically related
3. Able to trace their evolution.
4.Student can get employment in the biodiversity division.
5. Students able to know the species at genetic level.
6. Students able to understand the DNA, RNA and Protein level of conformation.

UNIT – I

Introduction to microbial taxonomy – morphological taxonomy, biochemical taxonomy, and molecular taxonomy. Numerical taxonomy – basic concepts of taxonomy. Positive and negative aspects of each taxonomical methods. Morphological phylogeny

UNIT- II

Molecular taxonomy –- G +C content, DNA – DNA hybridization, RFLP, RAPD, STRR & LTRR, REP – PCR, rRNA based DNA finger printing methods

UNIT – III

Microbial identification and taxonomy using 16SrRNA. 16S rRNA / Rdna fingerprinting - RT- PCR. DNA Isolation, amplification, Cloning, transformation, Blue-white screening.

UNIT – IV

Isolation of Plasmid, Dot blot /Southern blot using specific probes.16S rDNA sequencing by chain-termination method. GenBank –guidelines. NCBI, EMBL & DDBJ – retrieving sequences.

UNIT – V

Molecular phylogeny – tree terminology, phylogenetic trees – MEGA, Phylib, RAPDistance. Cladogram, additive trees and ultrametric trees, rooted, unrooted trees and tree shapes.

TEXT BOOKS

1. Dubey, R.C. and D.K. Maheswari, 2004. A Text book of Microbiology 1st Edition, S. Chand and Company Ltd.
2. Modi, H. A., 1995. Fundamentals of Microbiology. Vol.7. AKTA Prakashan Nadiad. Gujarat.
3. Powar, C.B. and H. F. Daginawala, 2003. General Microbiology. Volume: II, Himalaya Publishers, New Delhi.

REFERENCES

1. Roderic D. M. Page, Edward C. Holmes 1998. Molecular Evolution: A Phylogenetic Approach.Blackwell publishing, USA.
2. S. B. Primrose, 1998. Principles of Genome Analysis: A Guide to Mapping and Sequencing DNA from Different Organisms Microbial Genome Methods by Kenneth W. Adolph (Hardcover - Oct 28, 1996)
3. Genome Mapping and Sequencing by Ian Dunham (Hardcover - Sep 1, 2003).
4. Brendan Wren (Editor), Nick Dorrell 2002. Functional Microbial Genomics (Volume 33) (Methods in Microbiology), Academic Press, UK.
5. Sandy B. Primrose Richard M. Twyman 2005. Principles of Genome Analysis and Genomics, Blackwell Publishing, USA.

Semester - II

15MBP204E **BIOPROCESS ENGINEERING** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- This course encompasses the use of microorganisms in the manufacture of food or industrial products.
- The use of microorganisms for the production of food, either human or animal, the microorganisms used in bio processes may be natural isolates; laboratory selected mutants or genetically engineered organisms.
- To know the basics and concepts of various biotechnological related terms
- Elucidate the significance of transgenic plants as bioreactors for the production of enzymes.
- Address bioethical and biosafety issues related to plant transgenics
- Elucidate the molecular techniques involved in gene manipulation and rDNA technology

COURSE OUTCOME

1. This course will enable the students to design the various microbial fermentation products and their production, purification for various applications
2. To know the process protocol for the, synthesis and characterization of nanoparticles
3. Explain the gene transfer methods for the production of transgenic animals
4. Gain experimental knowledge to perform animal biotechnology related experiments
5. Explain the application of biotechnology in medical and its allied fields, gene therapy, genetic counseling
6. Address the bioethical issues & concerned linked to medical biotechnology

UNIT–I

Design of a basic fermenter, bioreactor configuration, design features, computer control of fermentation process, measurement and control of process. Reactors for specialized applications: Tube reactors, packed bed reactors, fluidized bed reactors, cyclone reactors, trickle flow reactors, their basic construction and types for distribution of gases.

UNIT – II

Transport phenomena in fermentation: Gas- liquid exchange and mass transfer, oxygen transfer, critical oxygen concentration, heat transfer, aeration/agitation, its importance. Sterilization of Bioreactors, nutrients, air supply, products and effluents, process variables and control, scale-up of bioreactors.

UNIT – III

Growth of cultures in the fermenter. Importance of media in fermentation, media formulation and modification . Kinetics of growth in batch culture, continuous culture with respect to substrate utilization, specific growth rate, steady state in a chemostat, fed-batch fermentation, yield of biomass, product, calculation for productivity. Storage of cultures for repeated fermentations, scaling up of process form shake flask to industrial fermentation.

UNIT – IV

Biomass separation by centrifugation, filtration, flocculation and other recent developments. Cell disintegration: Physical, chemical and enzymatic methods. Extraction: Solvent, two phase, liquid extraction, whole broth, aqueous multiphase extraction. Purification by different methods. Concentration by precipitation, ultra-filtration, reverse osmosis. Drying and crystallization.

UNIT – V

Isolation, selection and improvement of microbial cultures. Strain improvement for the selected organism: Use of recombinant DNA technology, protoplast fusion techniques for strain improvement. Improvement of characters other than products and its application in the industry. Preservation of cultures after strain improvement programme.

TEXT BOOKS

1. Demain, A. L. and J. E. Davies, 1999. Manual of Industrial Microbiology and Biotechnology. 2nd Edition, A.S.M. Press, Washington, D.C.
2. Hugo, W.B. and A.D. Russell, 1998. Pharmaceutical Microbiology. 6th Edition, Publisher Blackwell Science Ltd.
3. Mansi, E.M.T. and C.F.A. Bryce, 2002. Fermentation Microbiology and Biotechnology. Taylor and Francis, New York.
4. Patel, A.H., 2003. Industrial Microbiology. Macmillan India Ltd. New Delhi.

REFERENCES

1. Reed, G., 2002. Presscott and Dunn's Industrial Microbiology. 5th Edition. CBS Publishers, New Delhi.
2. Shuler, M.L. and F. Kargi, 2005. Bioprocess Engineering Basic Concepts. Pearson Education, New Delhi.
3. Stanbury, P.T. and A. Whitaker, 2005. Principles of Fermentation Technology, Pergamon Press, NY.
4. Waites, M. J., 2007. Industrial Microbiology. Blackwell Publishing Company. UK.

Semester - II

15OEP201 **HEALTH AND FITNESS** **3C**

Instruction Hours / week: L: 0 T: 0 P: 0 **Marks:** External: **100** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

1.To make an awareness of physically, socially and psychologically well being.
2. To know the Health awareness
3.To know the disease mechanism
4.To prevent the disease.
5. Healthy diet habit.
6.Normal exercise for body.

COURSE OUTCOME (CO'S)

1.Students get an idea about nutritional food, proper diet and routine exercise.
2.To make an awareness of physically, socially and psychologically well being.
3.To know the Health awareness
4.To know the disease mechanism
5.To prevent the disease
6. Students able to understand the importance of fitness in leading healthy life

UNIT - I

Definition of Health and wellness - Factors affecting health and wellness. Physiological, psychological and social health.

UNIT - II

Fitness - Definition, basic components of physically active life style in preventing obesity, osteoporosis, heart disease, and diabetes, Physical fitness tests - for flexibility, muscle endurance (any 3 tests for each) and cardio vascular endurance.

UNIT - III

Nutrition and exercise - energy requirement for, aerobic and anaerobic exercises, carbohydrate loading, water and dehydration, special foods. Importance of exercise in preventing life style diseases - Diabetes, CVD, hypertension, obesity and osteoporosis.

UNIT - IV

Sports nutrition - special foods - Nutrition and performance of athetles and players, dietary modifications and diet plan, sports supplementation.

UNIT - V

Special nutritional needs for monitaring, space, military and sea voyage.

TEXT BOOKS

1. Jerrold Greenberg . Comprehensive Stress Management. 2012. McGraw Hill Publishers.
2. Gwen Robbins, Debbie Powers, Sharon Burgess . A Wellness Way of Life. 2012. McGraw Hill Publishers.
3. Charles Corbin, Gregory Welk, William Corbin, Karen Welk. Concepts of Fitness And Wellness: A Comprehensive Lifestyle Approach.2012. McGraw Hill publishers.
4. Michael Teague, Sara Mackenzie, David Rosenthal. 2012. Your Health Today: Choices in a Changing Society. McGraw Hill Publishers.

REFERENCES

1. Nickolaos katsilambros. Clinical nutrition in practice. 2010. Wiley Black well publication. U.K.
2. Doyle, M.P., L. R. Beuchat and T. J. Montuille, 2001. Food Microbiology – Fundamentals and Frontiers. ASM Press, U.S.
3. Frazier, W.C. and D. C. Westhoff, 1995. Food Microbiology. Tata McGraw- Hill Publishing Company limited. New Delhi.
4. Gould, G.W., 1996. New Methods of Food Preservation. Blackie Academic and Professional, Madras.

Semester – II

15MBP211 ADVANCED PRACTICAL – III 5H – 3C

Instruction Hours / week: L: 0 T: 0 P: 5 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 9 Hours

COURSE OBJECTIVES

- To obtain outstanding practical skill in various techniques in Microbial Biotechnology and Agricultural Microbiology.
- The course provides the basics of microbiology to build a foundation for more advanced studies in microbiology and biotechnology
- In this course students will learn key methods of microbial production (e.g. fermentation, recombinant protein production and purification).
- Practice in research project planning, in different methods for biotechnology, and for conducting scientific research project.
- To develop an understanding of the major principles of and current issues in the several topical areas that collectively constitute Microbiology Techniques.
- It will distinguish the students to acquire practical skills on advanced laboratory analysis.

COURSE OUTCOME (CO'S)

1. This practical course renders a candidate the knowledge of advanced techniques involved in Microbial Biotechnology and Agricultural Microbiology.
2. Candidates would be able to understand and perform molecular techniques which forms an integral part of core Microbiology.
3. This practical course renders a candidate the knowledge of advanced techniques involved in microbial biotechnology.
4. He/she will be able to judge how microbes and enzymes could be applied in industry.
5. Candidates would be skilled enough to perform a molecular technique which forms an integral part of industrial microbiology.
6. Students can develop entrepreneur skills for applications in biotechnology based industries.

EXPERIMENTS

1. Isolation of plasmid DNA from Bacteria
2. Isolation of chromosomal DNA from Bacteria
3. Determination of molecular weight by SDS Polyacrylamide gel electrophoresis
4. Isolation of microbes from soil
5. Isolation of free-living N_2 fixation from soil - Azotobacter
6. Isolation of symbiotic nitrogen fixers from root odule - Rhizobium
7. Isolation of phosphate solublisers, ammonifiers and denitrifers
8. Study of Mycorrhizae, Cynobacteria and Azolla
9. Determination of Dissolved oxygen of water

10. Determination of BOD (Biochemical Oxygen Demand) of water
11. Determination of COD (Chemical Oxygen Demand) of water

REFERENCES

1. Aneja K.R., 2001. Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, 3rd Edition, New Age International (P) Limited Publishers, New Delhi
2. Cappucino, J.G. and N. Sherman, 2001. Microbiology A Laboratory Manual, 6th Edition, Benjamin Cummings, New York.
3. Chirikjan, J.G., E.C. Kisailus, B. King, R. Krasner and H. Mortensen, 1995.Biotechnology. Theory and Techniques, Vol II, Jones and Bartlett Publishers, London.
4. Palanivelu, P., 2004. Analytical Biochemistry and Separation Techniques, 3rd Edition, Twenty First Century Publication, Madurai.

Semester - II

15MBP212 ADVANCED PRACTICAL – IV 5H – 3C

Instruction Hours / week: L: 0 T: 0 P: 5 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 9 Hours

COURSE OBJECTIVES

- To acquire practical knowledge in numerous diagnostic tests and procedures used in the microbiology laboratory.
- To understand the importance of diagnostic procedures and gain skills related to the laboratory experiments.
- To learn the techniques pertaining to amplification of biological molecules
- To provide hands-on experience to determine microorganisms in clinical samples
- To understand the importance of diagnostic procedures and gain skills related to the laboratory experiments.
- It helps the students to study the advanced laboratory diagnosis procedures.

COURSE OUTCOME (CO'S)

1. This course provides the current medical aspects on the clinical diagnosis of infection providing the combined treatment of bacteriology and virology.
2. It will also provide opportunities for a student to develop diagnostic skills in microbiology, including the practical application and interpretation of laboratory tests for the diagnosis of infectious diseases.
3. It will also provide opportunities for a student to develop diagnostic skills in microbiology, including the practical application and interpretation of laboratory tests for the diagnosis of infectious diseases.
4. The significance of bacterial genetic variation (in drug resistance, pathogenesis or virulence and variation, diagnosis, and vaccination), and manipulation of cloned DNA.
5. To know the Virulence of bacteria, bacterial virulence factors and their regulation.
6. To understand drug resistance, drug-bacteria relationship, clinical implications, and prevention

EXPERIMENTS

1. Laboratory diagnosis of pyogenic infections – tuberculosis – enteric fever – diarrhea – UTI – anaerobic infections
2. Isolation and identification of *Candida albicans*
3. Antibiotic sensitivity test disc preparation
4. Antibiotic sensitivity test – Kirby - Bauer, Stroke's method
5. MIC determination by Broth dilution technique, filter paper disc assay
6. Wet mount preparation of parasites- Saline, iodine
7. Identification of parasites-formal ether concentration, floatation methods
8. Morphological examination of fungi in tissues

9. Cultivation of viruses-Egg inoculation
10. Isolation of coli phage from sewage using membrane filter technique.
11. Examination of plant diseases: Wilt of potato, Citrus canker, Rice dwarf virus

REFERENCES

1. Arora, B. and D.R. Arora, 2007. Practical Microbiology, 1st Edition, CBS Publishers and Distributors, Bangalore.
2. Cappucino, G.J., and N. Sherman, 2001. Microbiology A Laboratory Manual. 6th Edition. Benjamin Cummings, New York.
3. Ellenj O Baron and Sydneym Finegold, 1990. Bailey and Scott's Diagnostic Microbiology. 8th Edition, C V Mosby Company, St Louis.
4. Gaud, R.S. and G.D. Gupta, 1999. Practical Microbiology. 1st Edition. Nirali Prakashan, Pune.
5. Mukherjee, K.L. 2005. Medical Laboratory Technology, Vol. III, Tata McGraw-Hill Publishing Company Ltd, New Delhi.
6. Reddy, S. M. and S. R. Reddy, 2004. Microbiology A Laboratory Manual. 3rd Edition. Sri Padmavathi Publication, Hyderabad.
7. Sundararaj,T. Microbiology laboratory manual 2005. Aswathy Sundararaj Publishers. Chennai.
8. Vandepilte, J., J. Verhaegan, K. Engbaek, P. Rohner, P. Prot and C.C. Heuck, 2004. Basic Laboratory Procedures in Clinical Bacteriology. 2nd Edition, A.I.T.B.S Publishers and Distributors, Delhi.

Semester - III

15MBP301 **ADVANCED IMMUNOLOGY** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- Imparting advanced technological knowledge through a detailed study of topics such as immunodiagnosis, assessment of cell mediated immunity and current trends in immunology of diseases.
- The students will be able to identify the cellular and molecular basis of immune responsiveness.
- The students will be able to describe the roles of the immune system in both maintaining health and contributing to disease.
- The students will be able to describe immunological response and how it is triggered and regulated.
- The students will be able to demonstrate a capacity for problem-solving about immune responsiveness.
- Students will be able to transfer knowledge of immunology into clinical decision-making through case studies presented in class.

COURSE OUTCOME (CO'S)

1. To strengthen the technical skill on the immune system, their structure and classification, genetic control of antibody production, Types, structure of antigens and immunodiagnostics.
2. To obtain knowledge of through Molecular immunology, hypersensitive immune reaction and Latest trends in immunology.
3. Upon completion students will gain knowledge of immune system, cells involved along with complement system and autoimmunity.
4. Develop understanding about immune system, antigen antibody interactions.
5. Gain theoretical knowledge of various diseased conditions generated due to interplay of immune system components.
6. Introducing the employment aspect of immunology and to study various types of immune systems their classification structure and mechanism of immune activation.

UNIT – I

Immunity – types. Cells of the immune system - lymphoid cells, mononuclear cells, granulocytic cells and mast cells. T & B – cell maturation, activation and differentiation. Organs of the immune system - primary and secondary lymphoid organs – cutaneous / mucosal - associated lymphoid tissues

UNIT – II

Antigens - factor influence immunogenicity - Epitopes - Haptens - study of antigenicity. Immunoglobulins – structure – types and biological activities. Antigenic determinants. Monoclonal antibodies.

UNIT – III

Hypersensitive reactions – Type. Complement system - classical, alternative and lectin pathways, biological consequences. T - cell receptor. Cytokines – Structure, functions and receptors. Major Histocompatibility complex, classes, structure and its functions.

UNIT – IV

Autoimmune diseases: Antigen processing and presentation - Transplantation immunology - Transplantation antigens, HLA typing. Tumor immunology - treatment of tumors. Immune response to infectious disease.

UNIT – V

Antigen - Antibody reactions: Agglutination and precipitation. Complement fixation test, Immunofluorescence, ELISA, RIA, Immuno electron microscopy. Forensic serology, Immunohaematology – ABO, RH incompatibility.

TEXT BOOKS

1. Ananthanarayanan, R. and C.K.J. Panicker, 2004. Text Book of Microbiology - Orient Longman. New Delhi.
2. Coleman, R.M., M.F. Lombard and R.E. Sicard, 2000. Fundamental Immunology 4nd Edition. Wm. C. Publishers. London.
3. Fathima, D. and N. Arumugam, 2005. Immunology. Saras Publications, Nagercoil.

REFERENCES

1. Coleman, R.M., M.F. Lombard and R.E. Sicard, 2000. Fundamentals of Immunology 4th Edition. WMC Publications. London.
2. Goldsby, R.A., T.J. K. Barbara and A. Osborne, 2006. Kuby Immunology. 6th Edition. W.H. Freeman and Company, New York.
3. Hyde, R.M., 2000. NMS - Immunology. 4th Edition, Lippincott Williams and Wilkins, Baltimore.
4. Janeway, Jr. C.A., P.T. M. Walport and M. J. Shlomchick, 2001. Immunobiology - The Immune System in Health and Disease. 5th Edition. Churchill Livingstone - Garland Publishing Company, New York.
5. Pathaka, S. and U. Palan, 2005. Immunology – Essentials and Fundamentals. 2nd Edition. Capital Publishing Company, New Delhi.
6. Roitt, I.M., J.J Brostaff and D.K. Male, 2002. Immunology. 6th Edition. C.V. Mosby Publishers. St. Louis.
7. Delves, P., Martin, S., Burton, D. and Roitt, I. 2006. Roitt's Essential Immunology, Wiley-Blackwell, London

Semester - III

15MBP302 FOOD AND INDUSTRIAL MICROBIOLOGY 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To encompasses the employability use of microorganisms in the manufacture of food or industrial products.
- The aim of the course is to give the students broad theoretical and practical skills in food and industrial microbiology.
- This paper adds information about the role of microorganisms in many food, beverage and pharma industries both in production and spoilage processes.
- The students will be able to discuss the role of microorganisms in industry, as well as to carry out experiments to produce microbial metabolites.
- It will make the students to explore their practical skills in entrepreneurial activities.
- It will deliver the large-scale production of microbial products techniques in advanced level.

COURSE OUTCOME (CO'S)

1. Provides knowledge in the large-scale production of industrial product, providing the trends to cater the needs of industry.
2. This will help the students to enhance their employment knowledge on microbiology based commercial products.
3. The aim of the course is to give the students broad theoretical and practical skills in industrial microbiology.
4. To encode the importance of the role of microorganisms in food industries both in beneficial and harmful ways.
5. To obtain a good understanding of industrial microbiology and become qualified as microbiologist in food and other industries and candidate able to become entrepreneur after understanding this entire course.
6. Explain why microbiological quality control programmes are necessary in food production.

UNIT – I

Food and microorganisms – Important microorganisms in food – Fungi, Bacteria; Intrinsic and extrinsic parameters of food affecting microbial growth – sources of contamination of food. Food sanitation – indicators of food safety – Coliform bacteria.

UNIT – II

Food preservation – principles – factors affecting preservation – food preservation using temperature – low temperature food preservation – characteristics of psychrotrophs – high temperature food preservation – characteristics of thermophiles – preservation of foods by drying chemicals and radiation – limitations – commercial application.

UNIT – III

Food borne diseases - food poisoning - food borne infection and intoxication- Food control agencies - microbiological criteria for food, microbial quality control and food laws, Hazard Analysis Critical Control Point (HACCP).

UNIT – IV

History and chronological development of industrial microbiology. Industrially important strains – isolation and preservation. Inoculum development for various fermentation processes - strain development – mutation, recombinant DNA technology and protoplast fusion. Fermentation – submerged, solid state, batch and continuous.

UNIT – V

Fermentor design – scale-up process. Types of fermentors - Tower, cylindroconical, airlift and Components of CSTR. Downstream process – intracellular and extracellular product separation column chromatography, affinity. Production of beverages – beer, vitamins - vitamin B12, Riboflavin, antibiotics.

TEXT BOOKS

1. Banwart, G.J., 2004. Basic Food Microbiology. 2nd Edition. CBS Publishers and Distributors New Delhi.
2. Casida, L.E. Jr., 2003. Industrial Microbiology, New Age International Publishers, New Delhi.
3. Doyle, M.P., R. L. Beuchat and T. J. Montuille, 2001. Food Microbiology – Fundamentals and Frontiers. ASM press.
4. Frazier, W.C. and D.C. Westhoff, 1995. Food Microbiology. Tata McGraw-Hill Publishing Company Limited. New Delhi.
5. Patel, A.H., 2003. Industrial Microbiology, Macmillan India Ltd. New Delhi.
6. Shuler, M.L. and F. Kargi, 2005. Bioprocess Engineering Basic Concepts. Pearson Education, New Delhi.

REFERENCES

1. Atlas, R.N. and Bartha, 2000. Microbial Ecology - Fundamental and Applications.3rd Edition. Redwood City CA. Benjamin/Cumming Science Publishing Co., New Delhi.
2. Gould, G.W., 1996. New Methods of Food Preservation. Blackie Academic and Professional, Madras.
3. Jay, J.M., 2000. Modern Food Microbiology. CBS Publishers and Distributors. New Delhi.
4. Mansi,E.M.T.and C.F.A. Bryce, 2002.Fermentation Microbiology and Biotechnology. Taylor and Francis, New York.
5. Reed, G., (Editor) 2002. Presscott and Dunn's Industrial Microbiology. 5th Edition. CBS Publishers, New Delhi.
6. Stanbury, P.T. and A. Whittaker, 2005. Principles of Fermentation Technology. Pergamon Press, NY.
7. Waites, M.J. 2007. Industrial Microbiology, Blackwell Publishing. UK.

Semester - III

15MBP303 MEDICAL MYCOLOGY AND PARASITOLOGY 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- Medical Bacteriology introduces basic principles and then applies clinical relevance of many etiological agents responsible for infectious diseases.
- The infectious disease cycle of the pathogens enables to solve the epidemics.
- The territory covered by infections and the immune response
- We focus on pathogenic mechanisms in order to foster a student's ability to solve problems in their future clinical career and able to establish the medical laboratory.
- This course provides learning opportunities in the basic principles of medical microbiology and infectious disease
- It covers mechanisms of infectious disease transmission, principles of aseptic practice, and the role of the human body's normal microflora

COURSE OUTCOMES

1. Demonstrate an understanding at an advanced level of microbial virulence mechanisms and host response toinfection.
2. Application of molecular techniques to medical microbiology; biochemical and genetic mechanisms of antimicrobial agent activity, microbial susceptibility and resistance to antimicrobialagents.
3. Demonstrate an understanding of skin and respiratory tract infections (microbial causes, pathogenesis, transmission of infection, diagnosis, prevention and treatment) by being able to identify a unknown organisms in clinical samples, and describe the pathogenesis of important pathogens.
4. It also provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.
5. To understand the importance of pathogenic bacteria in human disease with respect to infections of. the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue
6. Recall the relationship of this infection to symptoms, relapse and the accompanying pathology.

UNIT – I

General Properties of Fungi - Isolation and identification of medically important fungi – diagnosis of fungal disease - routine mycological techniques - antifungal agents

UNIT – II

Superficial mycosis –Pityriasis versicolor, Tinea nigra, piedra. Cutaneous mycosis – Dermatophytes. Systemic mycosis –Opportunistic mycosis – Candidosis, Cryptococcosis, aspergillosis. Subcutaneous mycosis - Sporotrichosis, Chromoblastomycosis, Mycetoma

UNIT – III

Introduction to Parasitology - protozoa-amoebae – flagellates - Laboratory techniques in parasitology - Ova, cyst analysis direct and concentration methods. Blood smear examination - antiprotozoan therapy.

UNIT – IV

Protozoan infections - *Entamoeba histolytica, Plasmodium falciparum, Leishmania donovani - Giardia intestinalis Trichomonas vaginalis, Toxoplasma gondii, Pneumocystis carinii*

UNIT – V

Helminthic infections – *Taenia solium. Trematodes - Schistosoma haematobium,* Nematodes - *Trichuris trichiura - Ascaris lumbricoides, Ancylostoma duodenale, Wuchereria Bancrofti.*

TEXT BOOKS

1. Ananthanarayanan, R. and C.K.J. Panicker, 2009. Text Book of Microbiology. 8th Edition. Orient Longman. New Delhi.
2. Chakraborty, P., 2003. A Text book of Microbiology. 2nd Edition. New Central Book Agency (P) Ltd., Calcutta.
3. Chander, J., 2002. A Text book of Medical Mycology. Interprint Mehta Publishers, New Delhi.
4. Chatterjee, K.D., 1980. Parasitology in relation to medicine, 12th Edition, Chatterjee Medical Publishers, Calcutta.

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1. Chunin, J., 2000. Parasitology. New York Publishers, London.
2. Dismukes, W.E., P. G. Pappas and D. Sobel, 2003. Clinical Mycology. Oxford University Press. UK.
3. Jawetz, E., J.L. Melnic and E.A. Adelberg, 2001. Review of Medical Microbiology. 22nd Edition. Lange Medical Publishers. New York.
4. Mehrotra, R.S. and K. R. Aneja, 2007. Introduction to Mycology. New Age International Ltd. New Delhi.
5. Panjarathinam, R., 2007. Text book of Medical Parasitology, 2nd Edition. Orient Longman Publishers.
6. Parija, S.C., 2008. A Text book of Medical Parasitology. 3rd Edition. All India Publishers and Distributors, New Delhi.

Semester - III

15MBP304 BIOSTATISTICS AND RESEARCH METHODOLOGY 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- About collection, interpretation and presentation of statistical data
- The analytics of data, probability, and hypothesis testing of samples
- The essential role of statistics in present, future use and applications of Biology.
- To equip students with a basic understanding of the underlying principles of quantitative and qualitative research methods.
- Provide students with in-depth training on the conduct and management of research from inception to completion using a wide range of techniques
- The ethical and philosophical issues associated with research in education

COURSE OUTCOMES

7. Apply basic statistical concepts commonly used in health and medical sciences
8. Use basic analytical techniques to generate results
9. Interpret results of commonly used statistical analyses in written summaries.
10. Demonstrate statistical reasoning skills correctly and contextually.
11. Provide learning opportunities to critically evaluate research methodology and findings.
12. Enable students to be reflexive about their role and others' roles as researchers.

UNIT-I

Definitions-Scope of Biostatistics- Variables in biology, collection, classification and tabulation of data-Graphical and diagrammatic representation.

Measures of central tendency – Arithmetic mean, median and mode. Measures of dispersion-Range, standard deviation, Coefficient of variation.

UNIT – II

Correlation – Meaning and definition - Scatter diagram –Karl pearson's correlation coefficient. Rank correlation.

Regression: Regression in two variables – Regression coefficient problems – uses of regression.

UNIT – III

Test of significance: Tests based on Means only-Both Large sample and Small sample tests - Chi square test - goodness of fit. Analysis of variance – one way and two way classification. CRD, RBD Designs.

UNIT – IV

Research: Scope and significance – Types of Research – Research Process – Characteristics of good research – Problems in Research – Identifying research problems. Research Designs – Features of good designs.

UNIT – V

Sampling Design: Meaning – Concepts – Steps in sampling – Criteria for good sample design. Scaling measurements – Techniques – Types of scale.

REFERENCES

1 .Jerrold H.Zar, 2003. Biostatistical Analysis, Fourth Edition, Pearson Education (P) Ltd, New Delhi.
2. Kothari. C.R., 2004. Research Methodology – Methods and Techniques, Second edition, New Age International Pvt. Ltd, New Delhi.

Semester – III

15MBP305A GENOMICS AND PROTEOMICS 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

1.Offers advanced level training on gene sequencing, mapping,
2.Epression and proteomic techniques.
3.To know DNA replication
4.To know the Transcription
5.To know the protein translation
6.To know the techniques to study DNA, RNA, Protein

COURSE OUTCOME (CO'S)

1.Students able to understand the principle of gene sequencing, mapping, expression, experimental and analytical proteomics.
2. Candidate can perform advanced molecular techniques and can work in the different genomic laboratory.
3. Epression and proteomic techniques.
4.To know DNA replication
5.To know the Transcription
To know the techniques to study DNA, RNA, Protein

UNIT – I

Genome Sequencing: Gene, genomes, sequencing. Genomes - methodology, chain termination method, chemical degradation method, shotgun sequencing and assembly of contiguous DNA sequence. cDNA and genomic library construction.

UNIT – II

Genomic Mapping – Different types of genome maps and their uses, genetic and physical mapping techniques. Map resources. Practical uses of genome maps, Genetic markers -RFLP, Mini and micro satellite, STS and EST, SSCP, RAPD, AFLP, SNPs.

UNIT – III

Gene expressions and microarrays - gene structure and pseudo genes. Concepts of microarrays, spotter analysis, Normalization – total intensity, using regression techniques, ratio statistics. Clustering gene expression profiles - hierarchical, single -linkage, complete linkage, and average linkage. Tools for microarray analysis- MADAM, spot finder, SAGE Applications of microarrays - Bioinformatics challenges in micro array design and analysis.

UNIT – IV

Experimental proteomics - proteome analysis- 2-D gel electrophoresis: general strategy, immobilized pH gradients, sample preparation, isoelectric focusing, second dimension PAGE, staining, transfer of proteins from 2D gels, image acquisition and analysis of 2-D gels.

UNIT – V

Analytical proteomics: RP-HPLC, Mass spectrometry – ESI MS and MALDI techniques and applications. Characterization of protein complexes – protein-protein interactions, yeast two-hybrid system and protein micro arrays.

TEXT BOOKS

1. Charlie Hodgman, Chungui Lu, Sandra Kirk. An Advanced Textbook on Genomic and Proteomic Sciences. 2011. Garland Publishers.
2. Arthur M. Lesk. 2012. Introduction to Genomics. Oxford University Press, India.
3. Steven Haddock, 2011. Practical Computing for Biologists. CLR Publishers.
4. Jeremy W. Dale. 2010. From Genes to Genomes. Garland Publishers.

REFERENCES

1. Bourneand, P.E. and H. Weissig, 2003. Structural Bioinformatics. John Wiley & Sons (Asia), Singapore.
2. Brown, T.A., 2002. Genomes. John Wiley & Sons (Asia) Pvt. Ltd. Singapore.
3. Cantor, C.R. and C.L. Smith, 1999. Genomics: The Science and Technology behind the Human Genome Project, John Wiley and Sons (Asia) Pvt. Ltd. Singapore.
4. Dov Stekal, 2003. Microarray Bioinformatics, Cambridge University Press, Cambridge, UK.
5. Gibson and Muse, 2003. A Primer of Genome Science. Sinauer Associates Inc. Publishers, Sunderlands, New York.
6. Liebler, 2001. Introduction to Proteomics, Tools for the New Biology. Humana Press, New Jersey.
7. Pennington, S. and M.J. Dunn, 2001. Proteomics: From Sequence to Function. Bios Scientific Publishers Ltd. Oxford, U.K.
8. Primrose and Twyman, 2003. Principles of Genome Analysis. Blackwell Publishing, Oxford, UK.
9. Simpson, R.P., 2004. Proteins and Proteomics. A Laboratory Manual. Cold Spring Harbor Laboratory Press, NY.
10. Westermeier, R. and T. Naven, 2002. Proteomics in Practice. Wiley – VCH, Weinheim, Germany.

Semester – III

15MBP305B QUALITY ASSURANCE AND QUALITY CONTROL 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

- To inculcate the quality standards and the quality control practice followed in the industry.
- To bring awareness about biosafety and to enhance the entrepreneurship and employability.
- Knowledge of the principles and documentation of the quality system is a prerequisite for the course.
- Develop goal-oriented standards, policies, and procedures based on user-defined data quality requirements.
- Confirm that draft standards are acceptable to all users.
- Ensure that developed standards conform to the primary goals of the organization.

COURSE OUTCOME

1. Set up and Assess Food Quality Assurance Plans.
2. Create and Critically Evaluate quality specifications for raw materials, and associated final product and appropriate packaging.
3. Design and critically evaluate appropriate testing and recording procedures for raw materials and associated Final product.
4. Design, and evaluate processing documentation including Standard Operating procedures.
5. To realize the importance of significance of quality
6. Identify requirements of quality improvement programs

UNIT - I

An introduction to industrial microbiology. Definition of Quality assurance- roles and responsibilities of Quality assurance in industrial Microbiology. Roles and responsibilities of Quality control in industrial Microbiology.

UNIT - II

Antimicrobial agents – Definitions, properties, mode of action and applications. Antimicrobial agents for external usage - Chemical antimicrobial agents, synthetic antimicrobial agents, naturally antimicrobial agents.

UNIT - III

Sterilization – Types and methods of sterilization. Sterility testing and assessment of Microbial Contamination. Quality parameter to asses Natural products, Nutraceutical product, Pharmaceutical products.

UNIT - IV

Disinfection – Types and methods. Disinfection agents- properties and mode of action (Phenol, isopropyl alcohol and ethanol). Antibiotics and antimicrobial drug resistance, search for new antimicrobial agents.

UNIT - V

Quality assurance and Quality control – pharmacopeias, quality checking, routine examination and validation of industry. International disinfectant testing protocols, assessment of biocide effectiveness.

TEXT BOOKS

1. Malcolm Rowland, Thomas N. Tozer. 1995. Clinical Pharmacokinetics: Concepts and Applications. Williams & Wilkins publishers.
2. Thomas N. Tozer, Malcolm Rowland. 2006 Introduction to Pharmacokinetics and Pharmacodynamics: The Quantitative Basis of Drug Therapy. Lippincott Williams & Wilkins Publishers.
3. Nita K. Pandit. 2007. Introduction to the Pharmaceutical Sciences. Lippincott Williams & Wilkins Publishers.

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1. W.B.Hugo and A.D.Russel, 2006. Pharmaceutical Microbiology –4th Ed, Blackwell Scientific Publications.
2. Brock-Madigan M.T. 2006. Biology of Microorganisms –11th Edition. Pearson- Prentice Hall, USA.
3. Gunasekaran, P.1996. Laboratory Manual in Microbiology. 1st Edition, New Age International Pvt. Ltd, New Delhi.
4. Beckett, H. and J. B. Stenlake. 2003. Practical Pharmaceutical Chemistry, Part I and Part II, 4th Edition, Continuum International Publishing Group.
5. Jeffery, G. H., J. Basset, J. Mendham and R. C. Denny (Rev. by) 1989. Vogels Text Book of Quantitative Chemical Analysis, 5th Edition, Bathpress, UK

Semester - III

15MBP305C BIOFERTILIZER AND BIOMANURE TECHNOLOGY 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To study about the biofertilizers, plant disease and increasing soil fertility.
- To provide the knowledge on biomanure and biofertilizer and to become an entrepreneur in the field.
- To Provides detailed idea about biofertilizer production and plant disease.
- To provide the student knowledge about ecofriendly product which play a crucial role in determining its future use and applications in environmental management.
- The students will be able to make qualitative and quantitative description of the basic enzymatic phenomena and processes.
- To provide the student for entrepreneur.

COURSE OUTCOME (CO'S)

1. This course has been designed to provide the student knowledge about eco friendly product.
2. Product play a crucial role in determining its future use and applications in environmental management.
3. Provides detailed idea about biofertilizer production and plant disease.
4. To produce and impart training of ecofriendly agricultural inputs so as to nullify the ill effects of chemical fertilizers.
5. To demonstrate the know-how technology pertinent to microbiological and physico-chemical analyses of soil samples and their assessment.
6. Provides detailed entrepreneurial idea about biofertilizer production and plant disease.

UNIT – I

Fertilizer - importance and present status of types of fertilizers and application. Nitrogen; Carbon, phosphorus and sulphur cycles. Biogeocycles associated with microorganisms.

UNIT – II

Biofertilizers – Nostoc, Anabaena, Gloeocaps and Scytonema; Free living forms – Azatobacter, Azospirillum; Symbiotic forms – Rhizobium; Legume Association; *Pseudomonas*; Non-legume association.

UNIT – III

Mycorrhizal association - Vescicular arbuscular mycorrizal association (VAM) –Actimomycetes associations in biofertilizer.

UNIT – IV

Biomanures- Properties, production and applications; Composts – production and applications.Agro wastes – Poultry manure and saw-dust.

UNIT – V

Vermi composting– Properties, production and applications Types of compost pits and biodegradation. Application of biofertilizers and biomanures.

TEXT BOOKS

1.Subba Rao, N.S., 1999. Biofertilizers in Agriculture and Agroforestry. Oxford and IBH, New Delhi.

2. Rangaswami, G. and D.J. Bhagyaraj, 2001. Agricultural Microbiology. 2nd Edition. Prentice Hall, New Delhi.

3. Rao, N.S., 1995. Soil Microorganisms and plant Growth. Oxford and IBH Publishing Co., New Delhi.

4. Pelzar, M.J. and M. Reid, 2003. Microbiology. 5th Edition. Tata Mc Graw-Hill. New York.

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1. Burns, R.C. and R.W.F. Hardy, 1975. Nitrogen fixation in bacteria and higher plants. Springer – Verlag, Bertin.
2. Gallen and Chaplin, 1987. Introduction to Nitrogen fixation. Elsvier Publications.
3. Harley, J.L. and S.E. Smith, 1983. Mycorrhizal Symbiosis. Academic Press, London.
4. Kumar, H.D, 1990. Introductory Phycology. Affiliated East-West Press Ltd., Madras.
5. Marks, G.C. and T.T. Koslowski, 1973. Ectomycorrhizae, Academic Press, London.
6. Rao, N.S., G.S. Venkataraman and S. Kannaiyan, 1983. Biological N2 fixation, ICAR Publications, New Delhi.
7. Sandera, F.E., B. Mosse and P.B. Tinke, 1975. Endomycorrhizae, Academic Press, London.
8. Rao, N.S, 1980. Biofertilizers in Agriculture. Oxford & IBH Publishing Co., Pvt., Ltd., Bombay.
9. Thompson, L. M. and T. Fredrick, 1979. Soils and Soil Fertility. Tata Mc Graw-Hill Publishing Co., New Delhi.
10. Tilak, K.V.B.R, 1990. Bacterial Biofertilizers. IARI Publications, New Delhi.
11. Tirdale, S.L. Nelson, L. Werver and J.D. Becton, 1985. Soil fertility and fertilizers. Macmillan Publishing Co., New York.

Semester - III

15MBP305D **BIOCHEMISTRY** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To provide the knowledge on basics of biochemistry and its applications and to highlight the technical skill.
- To describe the classification and functions of lipids.
- To summarize the structure and classification of enzymes
- To state the Structure and types of DNA
- To analyse the functions and properties of phosphoglycerides
- To understand about storage and structural polysaccharides.

COURSEOUTCOME

1. Understand the structures of enzymes, proteins, carbohydrates and fats
2. Understand the functions of biomolecules
3. Analyze the process of metabolism
4. Understand of nucleic acids and their importance to combine and analyses information.
5. Explain the structure and mechanism of enzyme action
6. Summarize the DNA & RNA structure and base pairing schemes.

UNIT - I

Definition and scope of biochemistry, cellular basis of life, molecular composition of cells, elements and compounds of life Biochemical functions of cell organelles.

UNIT - II

Proteins- protein content of various type of cells, biological role of proteins; primary, secondary, tertiary, quaternary structure of proteins. Classification of proteins.

UNIT - III

Saccharides - Mono, oligo and polysaccharides; isomerism, chain and ring structure of carbohydrates, structure of starch, cellulose, glycogen and mucopolysaccarides.

UNIT - IV

Fatty acids- properties and nomenclature, essential and non-essential fatty acids. Classification of lipids and storage of lipids.

UNIT - V

DNA- Properties, structure, and importance. Prokaryotic and Eukaryotic cell differences. DNA as genetic material and genetic code

TEXT BOOKS

1. Ambika, S, 2004. Fundamentals of Biochemistry for Medical Students, CIT Chennai.
2. Deb C., 2011, Fundamentals of Biochemistry, 9th edition New Central Book Agency, Calcutta.
3. Jain, J.L, Sunjay Jain and Nitin Jain, 2005. Fundamentals of Biochemistry, S. Chand and Company Ltd, New Delhi.

RFERENCES

1. E.J. Wood and W.R. Pickering, 1982. Introducing biochemistry. ELBS/John Muray.
2. A.L., Lehninger, 1982. Principles of biochemistry, Worth Publishers, Inc. New York.
3. E.E. Conn and P.K. Stumpf. 1976. Outlines of biochemistry. Wiley Eastern, New Delhi.
4. L. Stryer.1995. Biochemistry W.H. Freeman Press, San Francisco, USA

Semester - III

15MBP305E **LABORATORY ANIMAL CARE** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- Aimed to provide training on various methods of handling.
- Concerning the care and use of laboratory animals.
- Laboratory animal care provides the proper handling and care for various species of animals used in research, testing, and in education.
- It extensively deals with the amended act on the Animal Welfare and the concept, availability, and use of research or testing methods that limit the use of animals or minimize animal distress.
- It extensively deals with the amended act on the Animal Welfare and the concept, availability, and use of research or testing methods that limit the use of animals or minimize animal distress.
- To study the preclinical studies.

COURSE OUTCOME (CO'S)

1. Laboratory animal care provides the proper handling and care for various species of animals used in research, testing, and in education.
2. It extensively deals with the amended act on the Animal Welfare and the concept, availability, and use of research or testing methods that limit the use of animals or minimize animal distress.
3. This course content will enhance the employment in drug testing field.
4. Validation for equipment, methods, cleaning and process
5. Students can develop their entrepreneurial skills in analysis of pens design and environment.
6. Ethical knowledge for use of animals in research.

UNIT – I
Modern methods of care, management breeding and maintenance of Laboratory animals – rabbit.

UNIT – II
Modern methods of care, management breeding and maintenance of Laboratory animals – mice.

UNIT – III
Modern methods of care, management breeding and maintenance of Laboratory animals – rat.

UNIT – IV
Modern methods of care, management breeding and maintenance of Laboratory animals– guinea pig. Specific pathogen free animal – gnotobiotic animal

UNIT – V
Handling – various routes of inoculation and bleeding. Laboratory use of animals in microbiology - antibody production. Disposal of animal house wastes and carcasses.

TEXT BOOKS

1. The IACUC Handbook, 2nd ed., eds. Silverman, Murthy, Suckow. CRC Press, 2006.
2. Anesthesia and Analgesia in Laboratory Animals. American College of Laboratory Animal Medicine, second edition, eds. Richard Fish, Peggy Danneman, Marilyn Brown, and Alicia Karas. Academic Press, 2008.
3. The Mouse in Biomedical Research, second edition, eds. James G. Fox, Muriel T. Davisson, Fred W. Quimby, Stephen W. Barthold, Christian E. Newcomer and Abigail L. Smith. Elsevier, 2007.
4. The Laboratory Rat, second edition, American College of Laboratory Animal Medicine. eds. Suckow, weisbroth and Franklin. Elsevier, 2006.
5. Handbook on Genetically Standardized Mice 6th Edition Ed. Joanne Currer, The Jackson Laboratory, Bar Harbor, Maine, 2009.
6. Laboratory Animal Medicine, 2nd Edition. American College of Laboratory Animal Medicine, eds. Fox, Anderson, Lowe, Quimby. Academic Press, 2002.
7. Percy, DH, Barthold, SW, 2007. Pathology of Laboratory Rodents and Rabbits, 3rd edition. . Blackwell Publishing Company.

REFERENCES

1. Nalinasundari, M.S. and R. Santhi, 2006. Entomology. MJP Publishers, Chennai.
2. Pelczar, Jr. M.J., E.C.S. Chan and N.R. Kreig, 1993. Microbiology McGraw-Hill Inc. New York.
3. Prescott, M., J.P. Harley and D.A. Klein, 1993. Microbiology, 2nd Edition. McGraw-Hill Inc. NY.
4. Roy, D.N. and A.W.A. Brown, 2003. Entomology – Medical and Veterinary. 1st Edition. Part – I, Biotech Books, New Delhi.
5. Warren, D. M., 2002. Small Animal Care and Management. 2nd Edition. Delmar – Thomson Learning, Columbia, NY.
6. Yadav, M., 2004. Applied Entomology. 1st Edition. Discovery Publishing House, New Delhi.

Semester - III

15MBP306 **CELL BIOLOGY** **4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** External: **100** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To study cell structure, functions of organelle and gain exposure on transportations through cell membrane and to focus on different receptors and model of signaling.
- Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.
- Students will understand how these cellular components are used to generate and utilize energy in cells.
- To gain the knowledge base in genetics, molecular biology and cell physiology.
- To engage the students in review of scientific literature in the areas of cell mediated biomedical studies.
- Conceptualize and describe protein structure, folding and sorting

COURSE OUTCOME

1. Students upon completion of this paper will have clear knowledge on various cellular functions such as transportation and signaling.
2. It will enable the students to enter into cellular function level research for their future.
3. Students will understand the cellular components underlying mitotic and meiotic cell division.
4. Students will apply their knowledge of cell biology to selected examples of changes or losses in cell function.
5. Students will get the knowledge of common and advanced laboratory practices in cell and molecular biology
6. Conceptual knowledge of properties, structure, function of enzymes, enzyme kinetics and their regulation, enzyme engineering, Application of enzymes in large scale industrial processes

UNIT – I

Cell- Definitions and properties, cell theory. Ultrastructure of eukaryotic cell - plant and animal. Bacterial cell wall structure and composition and their functions.

UNIT – II

Plasma membrane - structure and functions. Transportaion – types and methods. Role of microtubules and microfilaments.

UNIT – III

Cell organelles – Endoplasmic reticulum, Golgi complex, Mitochondria, Chloroplast, Ribosomes, Lysosomes, Peroxisomes, Nucleus and Vacuoles.

UNIT – IV

Mitosis – properties and significance, mitotic cell division and five phases of mitosis.

UNIT – V

Meiosis - properties and significance, Phases of meiosis and Cellular aging:

TEXT BOOKS

1. Stevo Najman. 2012. Current Frontiers and Perspectives in Cell Biology.
2. Twesigye, Charles K. Cell Biology and Genetics.
3. Geoffrey M. Cooper, Robert E. Hausman. 2007. The Cell: A Molecular Approach. 4th Edition: Sinauer Associates, Incorporated Publications
4. Ge Yang, 2011. Engineering Molecular Cell Biology. Garland Science Publishers.
5. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter 2002. Molecular Biology of the Cell. 4th Edition. Garland Science Publications.

REFERENCES

1. Albert, B., D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, 1989. Molecular Biology of the Cell, Garland Publishing Inc, London.
2. Sadava, D.E., 1993. Cell biology: Organelle structure and functions. 1st Edition, Jones and Bartlett Publishers. USA.
3. Karp, G., 1984. Cell biology, 2nd Edition, Mc Graw-Hill Publications. USA.
4. Gupta, M.L. and M.L. Jangir, 2001. Cell Biology: Fundamentals and Applications, 1st Edition, Agrobios, Jodhpur, India.
5. Verma, P.S. and V.K. Agarwal, 2005. Cell Biology, 24th Edition, S. Chand and Company Limited. India.

Semester – III

15MBP311 APPLICATION ORIENTED PRACTICAL – V 4H – 2C

Instruction Hours / week: L: 0 T: 0 P: 4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 9 Hours

COURSE OBJECTIVES

- The general objectives of the lab will be to introduce immunology and basic serological techniques.
- To develop the skill in health clinic
- To enhance knowledge in research.
- To give employment opportunities.
- Technical skill of immunology techniques.
- To understand disease mechanisms.

COURSE OUTCOME (CO'S)

1. This practical is to provide the student with a basic knowledge and technical skill of immunology and make them to understand the significance to human disease.
2. Upon completion students will gain knowledge of immune system, cells involved along with complement system and autoimmunity
3. Develop understanding about immune system, antigen antibody interactions.
4. Gain theoretical knowledge of various diseased conditions generated due to interplay of immune system components.
5. After course completion, students can apply the knowledge in further studies and higher education.
6. Introducing the science of immunology and to study various types of immune systems their classification structure and mechanism of immune activation.

EXPERIMENTS

1. Separation of serum / plasma

2. ABO Blood grouping - Rh typing and cross matching. Estimation of hemoglobin content of human blood.

3. Agglutination tests.
   - WIDAL - slide and tube test
   - RA test.
   - RPR test.
   - ASO test.
   - CRP test.
   - □-HCG test
4. ELISA- thyroid hormone analysis
5. Ouchterlony's Double Immunodiffusion test (ODD)
6. Counter immunoelectrophoresis (CIE)

REFERENCES

1. Ellenj O Baron and Sydneym Finegold, 1990. Bailey and Scott's Diagnostic Microbiology. 8th Edition, C V Mosby Company, St Louis.
2. Benson, H.J., 1998. Microbiological Application - Laboratory Manual in General Microbiology. 7th Edition. WCB McGraw – Hill, New York.
3. Talwar, G.P. and S.K. Gupta, 1993. A Handbook of Practical and Clinical Immunology, 2nd Edition. Vol. 2, CBS Publishers and Distributors, New Delhi.
4. Thomas J. Kindt, Barbara Anne Osborne, Richard A. Goldsby. 2007. Immunology. W.H.Freeman.
5. Coleman, R.M.,Lombard, M.F. and Sicard, R.E. 1992. Fundamental Immunology, 2nd ed, Dubuque, Iowa:Wm. C.Brown.
6. Darla J. Wise, Gordon R. Carter. 2002. Immunology: a comprehensive review. Wiley-Blackwell.
7. Janeway, C.A., and Travers, P. 1997, Immunobiology: The immune system in health and disease, 3rd Edition. New York, Garland Publishing.
8. Kuby, J. 1997, Immunology, 3rd Edition. New York, W.H. Freeman.
9. Male, D., Champion, B., Cooke, A. and Owen, M. 1991. Advanced immunology. Mosby publication, Baltimore.
10. Roitt, I., Brustoff, J. and Male, D. 1999. Immunology, 5th Edison. Harcourt Brace and Co. Asia PTE Ltd.

Semester - III

15MBP312 APPLICATION ORIENTED PRACTICAL – VI 4H – 2C

Instruction Hours / week: L: 0 T: 0 P: 4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 9 Hours

End Semester Exam: 9 Hours

COURSE OBJECTIVE

- This provides information on fermented food product production in food industries. To know the possible contamination of food products which may include bacteria and fungi.
- To develop the skill in Isolation of pathogen.
- To enhance knowledge in research.
- To give employment opportunities.
- Technical skill of industries techniques.
- To understand disease mechanisms.

COURSE OUTCOME (CO'S)

1. This practical adds a technical skill and good understanding of industrial microbiology
2. Students can develop the skills of an efficient microbiologist in food and beverage industries.
3. Provides necessary entrepreneurial information on the food, dairy Microbiology in safety and quality perspective.
4. It will help to study the importance in the prevention of contamination that might be caused by the microorganisms.
5. To Learn various methods for their isolation, detection and identification of microorganisms in food and employ in industries
6. Identify ways to control microorganisms in foods and thus know the principles involving various methods of food preservation

EXPERIMENTS

1. Production of enzymes – Solid state & Submerged fermentation – GUS assay – Amylase
2. Production of protease from submerged fermentation
3. Production of sauerkraut ,yoghurt, wine
4. Enumeration of Microorganisms from Food samples
5. Detection and enumeration of Microorganisms present in Utensils.
6. Analysis of Milk quality by MBRT
7. Detection of coliforms from water - MPN test
8. Isolation of plant pathogens – Bacteria and fungi
9. Citric acid production
10. Mushroom Cultivation
11. Immobilization technique (Sodium alginate method)
12. Bacterial endotoxin test (BET)

REFERENCES

1. Adams M. R. and Moss M. O. 2000 Food Microbiology. Royal Society of Chemistry. Cambridge, U.K.
2. Ahmed E.Y. and Carlstrom C. 2003. Food Microbiology: A Laboratory Manual, John Wiley and Sons, Inc. New Jeresy.
3. Arora, B. and D.R. Arora, 2007. Practical Microbiology, 1st Edition, CBS Publishers and Distributors, Bangalore.
4. Cappucino, G.J. and N. Sherman, 2001. Microbiology A Laboratory Manual. 6th Edition. Benjamin Cummings, New York.
5. Demain, A.L. and Davies, J.E. 1999. Manual of Industrial Microbiology and Biotechnology IInd Edition. ASM Press, Washington.
6. Garg, N., Garg, K.L. and Mukerji, K.G. 2010. Laboratory Manual of Food Microbiology. I.K. International Publishing House. New Delhi.
7. Harry, W., Seeley,Jr. and Paul Van Denmark, 1984. Microbes in Actions: A lab Manual of Microbiology. D. B. Taraporwalla and Sons.
8. James M. Jay, Martin J. Loessner, David A. Golden 2005. Modern Food Microbiology. Springer Science, USA.
9. Julian E Davies and Arnold L Demain 2009. Manual of Industrial Microbiology and Biotechnology ASM Publisher, USA.
10. Richard H Baltz, Julian E Davies and Arnold L Demain 2010. Manual of Industrial Microbiology and Biotechnology 3e ASM Publisher, USA.

Semester - IV

15MBP491 **PROJECT VIVA VOCE** **15C**

Instruction Hours / week: L: 0 T: 0 P: 0 **Marks:** Internal: **80** External: **120** Total: **200**

Semester - IV

15MBP401 ENTREPRENEURSHIP FOR MICROBIOLOGIST 4C

Instruction Hours / week: L: 0 T: 0 P: 0 **Marks:** External: **100** Total: **100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To study about the biofertilizers, plant disease and increasing soil fertility.
- To provide the knowledge on biomanure and biofertilizer and to become an entrepreneur in the field.
- To Provides detailed idea about biofertilizer production and plant disease.
- To provide the student knowledge about ecofriendly product which play a crucial role in determining its future use and applications in environmental management.
- The students will be able to make qualitative and quantitative description of the basic enzymatic phenomena and processes.
- To provide the student for entrepreneur.

COURSE OUTCOME (CO'S)

7. This course has been designed to provide the student knowledge about eco friendly product.
8. Product play a crucial role in determining its future use and applications in environmental management.
9. Provides detailed idea about biofertilizer production and plant disease.
10. To produce and impart training of ecofriendly agricultural inputs so as to nullify the ill effects of chemical fertilizers.
11. To demonstrate the know-how technology pertinent to microbiological and physico-chemical analyses of soil samples and their assessment.
12. Provides detailed entrepreneurial idea about biofertilizer production and plant disease.

UNIT - I

Entrepreneurship- Meaning, concept, Definition and Characteristics of an entrepreneur. Entrepreneurship as Process. Scope of Entrepreneurship in India.

UNIT - II

Motivation of Entrepreneur, Factors responsible For Emergence of Entrepreneurship, Type of Entrepreneur. Barriers to entrepreneurship. Scope of microbiologist as entrepreneur.

UNIT - III

Food and beverage –production of wine, beer, saukart, yogurt, cheese. Types and methods of food preservation. Food packaging-types and methods. Food standards and pharmacopeia.

UNIT - IV

Single cell protein (SCP)- production, processing and application of Spirullina, Azolla, Azospirillum, Rhizobium, Cynobacterium. Role of SCP, Mushroom cultivation- medicinal mushrooms.

UNIT - V

Coir pith degradation – preparation of bed, layering, culture inoculation, product harvesting. Vermicomposting – methods, types of worms, pit preparation, product isolation and separation, packaging.

TEXT BOOKS

1. Banwart, G.J., 2004. Basic Food Microbiology. 2nd Edition. CBS Publishers and Distributors New Delhi.
2. Casida, L.E. Jr., 2003. Industrial Microbiology, New Age International Publishers, New Delhi.
3. Doyle, M.P., R. L. Beuchat and T. J. Montuille, 2001. Food Microbiology – Fundamentals and Frontiers. ASM press.
4. Frazier, W.C. and D.C. Westhoff, 1995. Food Microbiology. Tata McGraw-Hill Publishing Company Limited. New Delhi.
6. Patel, A.H., 2003. Industrial Microbiology, Macmillan India Ltd. New Delhi.
7. Shuler, M.L. and F. Kargi, 2005. Bioprocess Engineering Basic Concepts. Pearson Education, New Delhi.
8. Mushroom Production Technology, 2000. 3rd Edition, New Age International (P) Limited Publishers, New Delhi

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1. Atlas, R.N. and Bartha, 2000. Microbial Ecology - Fundamental and Applications.3rd Edition. Redwood City CA. Benjamin/Cumming Science Publishing Co., New Delhi.
2. Gould, G.W., 1996. New Methods of Food Preservation. Blackie Academic and Professional, Madras.
3. Jay, J.M., 2000. Modern Food Microbiology. CBS Publishers and Distributors. New Delhi.
4. Mansi,E.M.T.and C.F.A. Bryce, 2002.Fermentation Microbiology and Biotechnology. Tayl and Francis, New York.
5. Reed, G., (Editor) 2002. Presscott and Dunn's Industrial Microbiology. 5th Edition. CBS Publishers, New Delhi.
6. Stanbury, P.T. and A. Whittaker, 2005. Principles of Fermentation Technology. Pergamo Press, NY.