DEPARTMENT OF MICROBIOLOGY

FACULTY OF ARTS, SCIENCES AND HUMANITIES

PG PROGRAM – M. Sc. Microbiology

(2018 – 2019 Batch & onwards)

Course code	Name of the course	Objectives and out comes		Instruction hours / week			Credit (s)	Marks		
		PEOs	POs	L	T	P		CIA	ESE	Total
SEMESTER-I										
18MBP101	Fundamentals of Microbiology and Classification	I	a	4	0	0	4	40	60	100
18MBP102	Microbial Physiology and Metabolism	II	a	4	0	0	4	40	60	100
18MBP103	Molecular genetics	II	a	4	0	0	4	40	60	100
18MBP104	Bioinstrumentation	VI	b	3	1	0	4	40	60	100
18MBP105A	Marine microbiology	I	a	4	0	0	4	40	60	100
18MBP105B	Computer applications and Bioinformatics	VII	d							
18MBP105C	Biochemistry	II	a							
18MBP111	Basic Practical – I	VI	b	0	0	4	2	40	60	100
18MBP112	Basic Practical – II	VI	b	0	0	4	2	40	60	100
Journal Paper Analysis & Presentation		IV	a	2	0	0	-	-	-	-
Semester total				**21**	**1**	**8**	**24**	**280**	**420**	**700**
SEMESTER–II										
18MBP201	Virology	I	a	3	1	0	4	40	60	100
18MBP202	Medical Bacteriology	I	a	4	0	0	4	40	60	100
18MBP203	Biostatistics and Research Methodology	VI	c	4	0	0	4	40	60	100
18MBP204	Environmental and agricultural microbiology	I	a	4	0	0	4	40	60	100
18MBP205A	Cell biology	I	a	4	0	0	4	40	60	100
18MBP205B	Quality assurance and quality control	I	a							
18MBP205C	Bioprocessengineering	IV	a							
18MBP211	Advanced Practical – III	I	b	0	0	4	2	40	60	100
18MBP212	Advanced Practical – IV	I	b	0	0	4	2	40	60	100
Journal Paper Analysis & Presentation		IV	a	2	0	0	-	-	-	-
Semester total				**21**	**1**	**8**	**24**	**280**	**420**	**700**

Elective courses*

Elective – 1 (I8MBP105)		Elective – 2 (I8MBP205)		Elective – 3 (I8MBP305)	
Course code	**Name of the course (Theory)**	**Course Code**	**Name of the course (Theory)**	**Course Code**	**Name of the course (Theory)**
18MBP105A	Marine Microbiology	**I8MBP205A**	Cell biology	**I8MBP305A**	Biofertilizer and Biomanure Technology
18MBP105B	Computer Applications and Bioinformatics	**I8MBP205B**	Quality assurance and quality control	**I8MBP305B**	Laboratory animal care
18MBP105C	Biochemistry	**I8MBP205C**	Bioprocess engineering	**I8MBP305C**	Bionanotechnology

Postgraduate Programme – M.Sc Microbiology

Programme Outcomes

Programme Outcomes of PG Microbiology: Students of all postgraduate microbiology degree Programmes at the time of graduation will be able to

a. Science Observation: Microbiology majors able to discuss science and scientific methodology as a way of knowing. Microbiology majors will make observations, develop hypotheses and design and execute experiments using appropriate methods. They will be able to explain how the nature of science is applied to everyday problems.

b. Laboratory Skills: Microbiology students will master the following laboratory skills: aseptic pure culture techniques, preparation of and viewing samples for microscopy, use appropriate methods to identify microorganisms, estimate the number of microorganisms in a sample and use common lab equipment. They will be able to practice safe microbiology using appropriate protective and emergency procedures.

c. Data analysis skills: Microbiology majors will be able to systematically collect, record and analyze data, identify sources of error, interpret the result and reach logical conclusions. They will be able to appropriately format data into tables, graphs and charts for presentation and publication.

d. Critical Thinking Skills: Microbiology majors will be able to (1) differentiate between fact and opinion, (2) recognize and evaluate author bias and rhetoric, (3) develop inferential skill, (4) recognize logical fallacies and faulty reasoning and (5) make decisions and judgments by drawing logical conclusions using sound quantitative and statistically – basedreasoning.

e. Problem Solving Skills: Microbiology majors will be competent problem-solvers. They should be able to assess the elements of a problem and develop and test a solution based on logic and the best possible information. Microbiology students should be able to analyze and interpret results from a variety of microbiological methods and apply these methods to analogous situations. They will use mathematical and graphing skills and reasoning to solve problems inmicrobiology

Programme Specific Outcomes (PSOs)

f. Upon master graduation, Microbiology majors will mastered a set of advanced skills, which would be useful to function effectively as professionals and to their continued development and learning within the field of Microbiology.

g. Our candidates will be able to explain why microorganisms are ubiquitous in nature, inhabiting a multitude of habitats and occupying a wide range of ecological habitats.

h. Able to cite examples of the vital role of microorganisms in biotechnology, fermentation, medicine and other industries important to human well being.

i. Able to demonstrate that microorganisms have an indispensible role in the environment, including elemental cycles, biodegradationetc.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Programme Educational Objectives of PG Microbiology: The major objectives of the postgraduate course is

PEO-I: To provide detailed knowledge of Microbiology (bacteriology, virology, parasitology and mycology) and their application fields (Medical, Agricultural and Marine Microbiology). To understand the beneficial and harmful role of microorganisms in the environment and in the industries.

PEO-II: To understand the fundamentals of physiological reactions including metabolic pathways and biochemical reactions in microorganisms. To understand the fundamental concepts of immunology, biochemistry, biotechnology and genetics etc.

PEO-III: To develop human resource and entrepreneurs in Microbiology with the ability to independently start their own ventures or small biotech units in the field of biotechnology.

PEO-IV: Understand modern microbiology - practices and approaches with an emphasis in technology application in pharmaceutical, medical, industrial, environmental and agricultural areas.

PEO-V: Gain experience with standard molecular tools and approaches utilized: manipulate genes, gene products and organisms. Become familiar with handling of Laboratory animals for the research purpose. Interpret differences in data distributions via visual displays.

PEO-VI: Become familiar with public policy, biosafety, bioinformatics and intellectual property rights issues related to microbiologyapplications.

POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**
PEO I	X					X	X	X	
PEO II	X	X							X
PEO III			X	X	X	X			
PEO IV	X					X	X	X	X
PEO V		X	X	X					
PEO VI				X	X	X			

Semester –I

18MBP101 FUNDAMENTALS OF MICROBIOLOGY AND CLASSIFICATION 4H –4C

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

End Semester Exam: 3 Hours

COURE OBJECTIVES

- To encourage candidate on the study of microbial techniques for well exploitation of
- microbes.To differentiate the microorganisms.
- This course enables the students to identify any microorganisms.

COURSE OUTCOME (CO'S)

After studying this paper student could be able to:

1. Define the science of microbiology and describe some of the general methods used in the studyof Microorganisms.
2. Discuss the fundamental similarities and differences between microorganisms based on their phenetic and phylogeneticrelationships.
3. Explain the taxonomy and classification of bacteria, fungi, algae, virus andprotozoa.

UNIT I - Scope of Microbiology and classification system

History and scope 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 and Staining methods

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 and Differential staining methods.

UNIT III - Classification of microorganisms

Systematics of bacteria - Bergey's manual and its importance.Actinobacteria.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 – *Entamoebahistolytica*, *Giardia*, *Trichomonas*, *Plasmodium*.

UNIT IV - Growth and Growth factors

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 - Molecular taxonomy and microbial cell application

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

SUGGESTED READINGS

1. Dubey, R.C., and Maheswari, D.K., (2010). *A Text book of Microbiology*. (3rd Ed), S. Chand and Company, NewDelhi.
2. Modi, H. A. (1996). *Elementary Microbiology*. Vol.2, AKTA PrakashanNadiad,Gujarat
3. Powar, C.B., and Daginawala, H.F., (2008). *General Microbiology*. Vol: 2. Himalaya Publishing House.
4. Singh, R.P. (2007). *General Microbiology*. Kalyani Publishers, NewDelhi.

5. Christopher, J.W., Linda, S., and Joanne, W., (2016).*Prescott's Microbiology*. (10th Ed), McGraw-Hill Education, UnitedStates.
6. Noel, R.K., Wolfgang, L., William, B.W., Brian, P.H., Bruce, J.P., James, T.S., Naomi, W., and Daniel, B., (2011). *Bergey's Manual of Systematic Bacteriology: Volume 4*, Springer Science & Business Media,Germany.
7. Frobisher, H., Hinsdil, R.D., Crabtree, K.T., and Goodhert, D.R., (2005). *Fundamentals of Microbiology*, Saunder and Company,London.
8. Tortora, G.J., Funke, B.R., and Case, C.L., (2010). *Microbiology: An Introduction*. (10thed.). Pearson Education,Singapore.
9. Stanier, R.Y., Ingraham, J.L., Wheelis, M.L., and Painter, P.R., (2008). *General Microbiology*.
(5thed.). Macmillan Press Ltd, London.
10. Salle, A.J. (2007). *Fundamental Principles of Bacteriology*. (7th ed.).,Envins Press, New York.
11. Alcomo, I.E., (2006). *Fundamentals of Microbiology*. (8thed.). Jones and Bartlett Publishers, Sudbury,Massachusetts.
12. Talaro, K.P., and Talaro, A., (2006). *Foundations in Microbiology*. (6thed.). McGraw-Hill College,Dimensi.
13. Pelczar Jr. M.J., Chan, E.C.S., and Kreig, N.R., (2004). *Microbiology*. (5thed.). Tata McGraw-Hill Publishing Company, NewDelhi.

Semester – I

18MBP102 MICROBIAL PHYSIOLOGYANDMETABOLISM 4H–4C

Instruction Hours / week :L: 4 T: 0P: 0 **Marks:** Internal: **40** External: **60** Total:**100**
End Semester Exam: 3Hours

COURSE OBJECTIVES

- To gain the knowledge with the various inner and outer structures of prokaryotes and eukaryotes in detail.
- 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 microbialgrowth.

COURSE OUTCOME (CO'S)

1. The students will be able to understand and predict the various metabolic reactions inmicrobial cell.
2. This will make them to predict the intermediate products which can be employed in industrial productionprocesses.

UNIT I - Prokaryotic cell structure

Prokaryotic cell structure and organization - cell wall, plasma membrane, cytoplasmic matrix, inclusion bodies, ribosome, nucleiod, capsule, slime layers, S layers, pili, 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 – Bacterial spores

Structure of bacterial endospore, endospore formation in *Bacillus* spp. Exospore formation in *Streptomyces*. Sporulation in fungi: *Aspergillus*sp., *Penicillium*sp. Spore cycle, factors affecting spore formation. Growth and nutritional requirements, control of microrganisms. Biofilm and biosurfactant production in bacteria

UNIT III – Metabolic pathway

Glycolysis, EMP, HMP and ED pathway, TCA cycle, Glyoxylate cycle.Aerobic respiration and anaerobic respiration.Electron transport chain in prokaryotes and eukaryotes; Substrate level and oxidative phosphorylation – ATP generation.

UNIT IV - Fatty acids, nucleotides and toxins

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

UNIT V - Photosynthetic bacteria & Bioluminescence

Aerobic and anaerobic fermentation and its types.Photosynthetic bacteria – Oxygenic (Cyanobacteria) and anoxygenic (Purple/green sulfur and non-sulfur bacteria).Bacterial photosynthetic pigments.Methanogenesis – assimilation of carbondioxide. Bioluminescence and Quorum sensing – mechanism, importance and applications.

SUGGESTED READINGS

1. Nelson, D., and Cox, M.M., (2009). *Principles of Biochemistry*. W.H. Freeman and Company, New York.
2. Joanne, M.W., Linda, S., and Christopher, J.W., (2008). *Prescott, Harley, and Klein's Microbiology*. (7th Ed). McGraw-Hill Higher Education, UnitedStates.
3. Berg, J.M., Tymoczko, J.L., Stryer, L., and Clarke, N.D., (2001). *Biochemistry*. (5thed.). WH Freeman &Co.
4. Doelle, H.W. (2005). *Bacterial Metabolism*. Elsevier India Pvt. Ltd., NewDelhi.
5. Moat, A,G., and Foster J.W., (2003). *Microbial Physiology*. John Wiley and Sons, NewYork.
6. Caldwell, D.R. (2008). *Microbial Physiology and Metabolism*. (2nded.). Wm C Brown Publishers, England.
7. Rose, A.H. (2008). *Chemical Microbiology – An Introduction to Microbial Physiology*. (International Ed.). Plenum PublishingCorporation.
8. Atlas, R.M., (1997). *Principles of Microbiology*. (2nded.). Wm. C. Brown Publishers, Lowa,US
9. Madigan, M.T., Martinko, J.M., and Parker, J., (2003). *Brock Biology of Microorganisms*. (10thed.). Prentice Hall, NewJersey.
10. White, D. (2003). *Physiology and Biochemistry of Prokaryotes*. (2nded.). Oxford University Press, NY.
11. Voet, D., and Voet J.G., (2003). *Biochemistry*. John Wiley and Sons, NewYork.

WEBLINKS

1.https://bio.libretexts.org/TextMaps/Microbiology/Book%3A_Microbiology

Semester –I

18MBP103 **MOLECULARGENETICS** **4H –4C**

Instruction Hours / Week: L: 4 T: 0P:0 **Marks:** Internal: **40** External: **60** Total:**100**
End Semester Exam: 3 Hours

COURSE OBJECTIVES

- The emergence of Molecular Genetics has revolutionized large areas of modern biological and
- biochemical research work
- It has had a huge impact on the biotechnology industry.
- Molecular genetics is concerned with the development of biochemical and genetic techniques for handling the complex nucleic acids that constitute genetic material.

COURSE OUTCOME (CO'S)

1. This course allows the candidate to recollect the basics of Molecular Genetics and apply a cognitive thinking on the application oriented sectors of MolecularBiology.
2. Students would be able to practically apply this knowledge in different sectors with possibilities ranging from the treatment of human diseases to the development of novelmedicines.

UNIT I – DNA structure and replication

Genetics and its types – History; Mendelian principles – nucleic acid as genetic material Experimental evidence. Structure of DNA – chemical and physical structure of DNA – circular and super helical DNA - different forms of DNA. DNA replication – enzymology of DNA replication – different modes, models and types of DNA replication – Eukaryotic DNA replication.

UNIT II – Gene regulation

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 – III - Genetic recombination

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

UNIT – IV – Mutation and repair mechanism

Mutagen, mutagenesis and mutation.Luria Delbruck experiment and its significance.Molecular basis of mutation.Spontaneous and induced mutations. Different types of mutation, mutant detection, mutant selection and carcinogenicity testing. DNA damage – types of damage (deamination, oxidative damage, alkylation, Pyrimidine dimers) – DNA repair mechanism (base excision, nucleotide excision, recombination repair, SOS repair).

UNIT V - Yeast genetics

Life cycle, metabolism, genome and extra chromosomal element.Genetic nomenclature in yeast.Tetrad analysis, Petite mutants (mutant isolation and complementation).Genetic mapping in yeast, *Neurospora*and *Drosophila*.

SUGGESTED READINGS

1. Malacinski, G.M. (2008). *Freifelder's Essentials of Molecular Biology*. Narosa Publishing House, New Delhi.
2. Verma,P.S.,andAgarwal,V.K.,(2008).*CellBiology,Genetics,MolecularBiologyandEvolution.* S. Chand & Company Ltd, New Delhi
3. Gardner, E.J., Simmons, M.J., and Snustad, D.P., (2008). *Principles of Genetics*. (8th ed.). John Wiley and Sons,NY.
4. Guthrie, C., and Fink, G., (2002). *Guide to Yeast Genetics and Molecular Cell Biology*. Elsevier Publication,USA.
5. Klug, W.S., Cummings, M.R. Spencer, C.A., and Palladino, M.A., (2009). *Essentials of Genetics*. (7th ed.). Prentice Hall, NewJersey.
6. Maloy,S.R.,CronanJr,J.E.,andFreifelder,D.,(2001).*MicrobialGenetics*.Narosa Publishing House. NewDelhi.
7. Weaver, R.F. (2002). *Molecular Biology*. (2nd ed.). McGraw-Hill, NewYork.
8. Alberts. (2008). *Molecular Biology of The Cell*, (5th ed.). Garland Science, Taylor and Francis group, LIC, an InforrmaScience.
9. Griffiths *et al.*, (2002). *Modern genetic analysis*, (2nd ed.).Freeman.
10. Hartl and Jones, (1998). *Genetics-Principles and Analysis*, (4th ed.). Jones &Bartlett.
11. Krebs, E,J., S.T.Kilpatrick and E.S.Goldstein, (2008). *Lewin's Genes X*, (10th ed.). Jones and Bartlett publishers,Canada.
12. Nelson, D., and Cox, M.M., (2008). *Lehninger's Principles of Biochemistry*, (5th ed.).McMillan.
13. Tamarin, R.H. (2001). *Principles of Genetics*. (7th ed.). Wm. C. Brown Publishers.England
14. Turner, P., McLennan, A., Bates, A., and White, M., (2005). *Molecular Biology*. (3rd ed.). Taylor and Francis group.
15. Watson, J.D., Baker, T., Bell, S., Gann, A., Levine, M., and Losick, R., (2008). *Molecular Biology of Genes*. (6th ed.). PearsonEducation.

WEBLINK

1. http://www.biologydiscussion.com/bacteria/genetic-recombination-of-bacteria-with-diagram/47074
2. http://www2.csudh.edu/nsturm/CHEMXL153/RegulationofGeneExpression.htm
3. https://www.youtube.com/watch?v=8_f-8ISZ164.

Semester -I

18MBP104 **BIOINSTRUMENTATION** **4H – 4C**

Instruction Hours / week:L: 3 T: 1P: 0 **Marks:** Internal: **40** External: **60** Total:**100**
End Semester Exam: 3 Hours

COURSE OBJECTIVES

- This course highlights the basic laboratory skills that are essential for beginning-level employment in clinical, pharmaceutical, microbiology, biochemistry and biotechnology laboratories.
- Upon successful completion of this course, students are expected to be able to explain bioinstrumentation techniques, design and application.

COURSE OUTCOME (CO'S)

1. The students upon course completion will be able to know all the basic principles, technology and applications of various instruments in lifescience.

UNIT I - Spectroscopy

Properties of electromagnetic radiations. Instrumentation and applications of – UV-Visible spectrophotometer, spectrofluorimeter, atomic spectroscopy, FTIR, NMR spectroscopy and flow cytometer.

UNIT II - Centrifugation

Principle and types of centrifuges.Principles and applications of analytical and preparative centrifuges.Relative molecular mass determination and sedimentation coefficient.Sub-cellular Fractionation of cellular components.Density gradient and ultra-centrifugation.

UNIT III - Chromatography

Principle, instrumentation and applications of ion exchange, affinity, gel filtration, Low pressure liquid chromatography (LPLC) and high performance liquid chromatography (HPLC) and fast protein liquid chromatography (FPLC), gas liquid chromatography-mass spectroscopy (GC-MS), LCMS, LCMS/MS, LCMS – QQQ, MALDI – TOF.

UNIT IV - Electrophoresis

Principle, instrumentation and applications of agarose gel electrophoresis, native PAGE, sodium dodecyl sulphate - polyacrylamide gel electrophoresis (SDS-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 radioactive decay, units of radio activity, detection and measurement of radio activity. Principle, instrumentation and applications of Geiger-Muller counter, solid and liquid scintillation counter and autoradiography. Biosafety methods in radioactivelaboratory.

SUGGESTED READINGS

1. John Enderle., (2006). *Bioinstrumentation*. (2006). Morgan and Claypool Publishers,NJ.
2. Richard Normann. (1988). *Principles of bioinstrumentation*. WileyPublishers,US.
3. Keith Wilson and John Walker. (2010). *Principle and Techniques of Biochemistry and molecular biology*. (7^{th}ed.). Cambridge university press,NY.

4. Boyer, R. (2000). *Modern Experimental Biochemistry*. (3rded.). Addison Wesley Longman, New Delhi.
5. Chatwal, G.R., and Anand, S.K., (2003). *Instrumental Methods of Chemical Analysis*. (5thed.). Himalaya Publishing House,Mumbai
6. Friedfelder,D.(2001).*PhysicalBiochemistry:Applicationstobiochemistryandmolecularbiology.* Oxford Publishers, New York.
7. Sharma, B.K. (2007). *Instrumental Methods of Chemical Analysis*, Krishna Prakashan Media (P) Ltd, India.
8. Wilson, K., and Walker, J., (2010). *Principlesand Techniques of Biochemistry and MolecularBiology,* (7th Low Price ed.). Cambridge University Press,India.

WEBLINK

1.https://www.coleparmer.com/tech-article/basics-of-centrifugation.

Semester -I

18MBP105A **MARINEMICROBIOLOGY** **4H – 4C**

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

End Semester Exam: 3 Hours

COURE OBJECTIVES

- This course has been intended to provide knowledge about the origin and maintenance of microbial diversity and its role in the structure and function of marine ecosystems.

COURE OUTCOME

1. Students undertaking this course shall get an idea about isolation, Identification and preservationof the marine microbes and its application in variousfields.

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 – Xenobiotics and Marine Bioproducts

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. Marine Bioproducts.

UNIT IV – Biopigment and Marine micro and macro organisms

Brief account of photosynthetic and accessory pigments.Phytoplanktons and Zooplanktons, Red tides, Zones, Bioluminescence and Biopigment, Marine micro and macro organisms, Coral reefs, Mangrooves, Hydrothermal vents and water currents.

UNIT V - Marine exploration

Bar coding of marine organisms: Genome sequencing and physical mapping of genome. Marine exploration, Aquaculture-inland and freshwater, Isolation of marine bioactive compounds-separation, purification and identification techniques, cryopreservation.

SUGGESTED READINGS

1. Colin Munn. (2011). *Marine Microbiology: Ecology & Applications*. (2nd ed.). Black Well Publishers.
2. David Sigee. (2005). *Freshwater Microbiology: Biodiversity and Dynamic Interactions ofMicroorganisms in the Aquatic Environment*. (1st ed.). Black wellPublishers.
3. Joanne, M.W., Linda, S., and Christopher, J.W., (2008). *Prescott, Harley, and Klein's Microbiology*. (7th Ed). McGraw-Hill Higher Education, UnitedStates.
4. Se-Kwon Kim. (2013). *Bioactive compounds and biotechnological applications*. CLSPublishers

5. Dube, H.C. (1994). *A text book of fungi, bacteria and viruses*. Vikas Publishing House, New Delhi.
6. Dale, J.W. (1994). *Molecular genetics of Bacteria*. John Wiley andStones.

7. Pelczar, M., JR., Chan, E.C.S., and Noel, R. K., (2006). *Microbiology*. Tata McGraw, Hill. Co. (5^{th}ed.). NewDelhi.
8. Presscott, L.N., Harley, J.P. and Klein, D.A., (1999). *Microbiology*. W.C. BrownPublishers.

9. Stanier, R.Y., Ingharam, J.L., Wheelis, M.L., and Painter, P.R., (1986). *General Waste water engineeringTreatment, Disposal and Reuse*. Metcaff and Eddy. Inc., Tata Mc Grew Hill, New Delhi.

Semester - I

18MBP105B COMPUTER APPLICATIONSANDBIOINFORMATICS 4H – 4C

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To detail the importance of computer in field of life sciences.
- To obtain good understanding about the interpretation of biological data
- base.To uptake knowledge in latest tools and technology.

COURSE OUTCOME (CO'S)

1. The students will have an understanding about the information on the search engines and various software tools involved inbioinformatics.
2. Additional knowledge on different operating systems would enable the candidate to work with versatility.

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.

SUGGESTED READINGS

1. Rashidi, H., and Buehler, L.K., (2005). *Bioinformatics Basics: Applications in Biological Science and Medicine*. CRC Press/Taylor & FrancisGroup.
2. Krawetz, S.A., David, D., Womble, S.A., Krawetz, D.D., Womble, D., (2003). *Introduction to Bioinformatics: A theoretical and Practical approach*. Humana Press, USA.
3. Bergeron, B.(2002). *Bioinformatics Computing*. Prentice Hall Publishres.

4. MountD. W. (2001). *Bioinformatics. Sequence and Genome Analysis*, Cold Spring Harbor LaboratoryPress.
5. Higginns, D., and Taylor, W., (2000). *Bioinformatics. Sequence, Structure and databanks – A Practical Approach*, Oxford UniversityPress.
6. Baxevanis, A.D., and Francis Ouellette, B.F., (2001) *Bioinformatics – A Practical Guide to the Analysis of Genes and Proteins*, Wiley –Interscience.
7. Gibson, G., and Muse, S.V., (2002). *APrimer of Genome Science, Sinauer Associates*, Inc. Publishers.
8. Misener, S., and Krawetz, S.A., (2000). *Methods in Molecular Biology – Bioinformatics. Methods and Protocols*, HumanaPress.
9. Attwood, T.K., and Parry-Smith, D. J., (2001). *Introduction to Bioinformatics*, Pearson Education Asia.
10. Claverie, J.M., and Notredame, C., (2003). *Bioinformatics for Dummies***,** Wiley Publishing,Inc

Semester - I

I8MBP105C BIOCHEMISTRY 4H –4C

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

End Semester Exam: 3 Hours

COURSE OBJECTIVE

- Students get an idea about the biomolecules, structure, function and biologicalactivity.

COURSE OUTCOME

1. To obtain good understanding about the structures, Role and function ofbiomolecules.

UNIT I - Concepts of Biochemistry

Concepts of Biochemistry- Structure and Properties of water, Buffers**;** Oxidation-Reduction reactions, important functional groups in biochemistry, general types of reactions in biochemistry. Non-covalentinteractions.

Cellular basis of life, molecular composition of cells, elements and compounds of life Biochemical functions of cell organelles.

UNIT II - Carbohydrates

Carbohydrates: Introduction, Sources, Classification. Reactions of carbohydrates, Isomerism of carbohydrates, Fischer projections, Haworth structures. Structure and functions of sugars, homo and heteropolysaccharides, glycoconjugates: Lipids-Introduction, sources, Nomenclature, Classification.

Carbohydrate Metabolism-Introduction, Aerobic and anaerobic pathways: Glycolysis and its regulation, Gluconeogenesis and its regulation.TCA cycle - Regulation, Glyoxylate cycle, amphibolic&anaplerotic reactions. Electron Transport chain, Oxidative phosphorylation, & production of ATP, Inhibitors of ETC and ATP synthesis, balance sheet of glucose oxidation.

UNIT III - Amino Acids and Proteins

Amino Acids and Proteins- Introduction, Classification optical isomerism, chemical properties, Acid-base properties- Levels of protein structure (Ramachandran plot. Denaturation of proteins. Proteins- protein content of various type of cells, biological role of proteins; primary, secondary, tertiary, quaternary structure of proteins.Classification ofproteins.

Amino Acid Metabolism- Overview of amino acid metabolism, fate of NH_4^+ and carbon skeleton.Urea cycle and regulation.Biodegradation of amino acids – deamination, transamination, decarboxylation, urea cycle including its regulation.

UNIT IV - Lipids

Lipids-Introduction, sources, Nomenclature, Classification.Properties & Functions. Steroids: Structure of steroid nucleus, biological role of cholesterol, fat soluble vitamins.

Lipid Metabolism- Biodegradation of fatty acids, beta – oxidations of saturated & unsaturated fatty acids. Ketone bodies, production during starving and diabetes Biosynthesis of fatty acids – Acetyl-CoA carboxylase reaction, Fatty acid synthase complex, biosynthesis of palmitate, energetics, Regulation of fatty acid biosynthesis. Biosynthesis of triacylglycerols, Biosynthesis of cholesterol, regulation.Prostaglandins and thromboxanes.

UNIT V- Nucleic Acids

Nucleic Acids-Purines &Pyrimidinesnucleotides, RNA, & DNA base pairing schemes, types of RNA: mRNA, rRNA, tRNA, aminoacyltRNAsynthetase, Secondary structure of DNA, Watson and Crick model. Denaturation of DNA keto-enoltautomerism and consequences.

Nucleic Acid Metabolism- Denovo and salvage pathways for purine synthesis.Recycling of Purine and Pyrimidine nucleotides by salvage pathways.Lesch-Nyhan syndrome & Gout.

SUGGESTED READINGS

1. Ambika, S. (2004). *Fundamentals of Biochemistry for Medical Students*, CITChennai.
2. Deb, C. (2011). *Fundamentals of Biochemistry*, (9^{th}ed.). New Central Book Agency, Calcutta.
3. Jain, J.L., Jain, S., and Jain, N., (2005). *Fundamentals of Biochemistry*, S. Chand and Company Ltd, NewDelhi.
4. Wood, E.J., and Pickering, W.R., (1982). *Introducing biochemistry*. ELBS/JohnMuray.
5. Lehninger, A.L. (1982). *Principles of biochemistry*, Worth Publishers, Inc. New York.
6. Conn, E.E., and Stumpf, P.K., (1976). *Outlines of biochemistry*. Wiley Eastern, New Delhi.
7. Stryerm, L. (1995). *Biochemistry* W.H. Freeman Press, San Francisco, USA.

Semester – I

18MBP111 BASIC PRACTICAL– I 4H –2C

Instruction Hours / week: L: 0 T:0P: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.

COURSE OUTCOME

1. A student undertaking this course will be able to skillfully isolate and identify the microorganisms using different techniques which is the needed skill in medical laboratories and researchsectors.

EXPERIMENTS

1. Micrometry
2. Measurement of pH
3. Staining techniques: Simple, Gram, Negative andEndospore
4. Motility determination - Hanging drop and SIMinoculation
5. Cultivation of anaerobic microorganisms – Wrights tube – McIntosh anaerobic jar - roll tube methods.
6. Lactophenol cotton blue mounting of fungi - *Aspergillus*sp, *Mucor*sp, *Rhizopus*sp, *Fusarium*sp, *Penicillium*sp
7. Measurement of microbial growth – Viable count – Direct count – Turbiditymethods
8. Biochemical characterization
   a) IndoleTest
   b) Methyl RedTest
   c) VogesProskauerTest
   d) Citrate utilizationTest
   e) TSITest
   f) CatalaseTest
   g) OxidaseTest
   h) UreaseTest
   i) NitrateTest
   j) Carbohydrate fermentationTest
   k) Amino acid utilizationTest
   l) Hydrolysis of polymers- Starch, Lipid, Casein,Gelatin.

SUGGESTED READINGS

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

Semester – I

18MBP112 **BASIC PRACTICAL– II** **4H –2C**

Instruction Hours / week:L: 0 T: 0P: 4 **Marks:** Internal: **40** External: **60** Total:**100**
End Semester Exam: 9 Hours

COURSE OBJECTIVES

The contents of this course would enable the student

- To acquire practical knowledge on the different molecular mechanism of gene transfer, mutations and separation of nucleicacids.
- To understand the molecular mechanism of compound separation and isolation using chromatographytechniques.

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 basedlaboratories.

EXPERIMENTS

1. Spontaneous Mutation – gradient platetechnique
2. Induced Mutagenesis-chemical and physical -UV
3. Replica plating technique.
4. Transformation in Bacteria
5. Bacterial Conjugation
6. Induction of Lacoperon
7. Measurement of growth-one step growth curve using a T evenphage
8. Titration of phages(T4)
9. Nuclear staining for nucleic acid identification.
10. Spectrophotometric estimation of protein –BSA
11. Protein Purification using microfiltration.
12. Analysis of amino acid by Paperchromatography
13. Analysis of amino acid by Thin layerchromatography
14. Purification of proteins by column chromatography
15. Analysis of amino acid by HPLC –Demonstration

SUGGESTED READINGS

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

JOURNAL PAPER ANALYSISANDPRESENTATION 2H

Instruction Hours / week:L: 2 T: 0 P: 0

Semester – II

18MBP201 **VIROLOGY** **4H –4C**

Instruction Hours / week:L: 3 T: 1P: 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 likeagents:
- Viral structure, classification and evolution, their ways to infect and exploit cells of virus reproduction, the disease theycause,
- the techniques to isolate and culture them and their potential uses in research andtherapy.

COURSE OUTCOME (CO'S)

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 duringreactivation.
3. Describe the growth behavior differences between normal cells and cells transformed by oncogenic DNA and RNAviruses.
4. Integrate experimental strategies learned in the context of viral systems into the design of experiments involving othersystems.

UNIT I - Viral classification and properties

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

UNIT II – Animal DNA viruses

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 RNA viruses

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

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- Infections and Immunization

Nosocomial infections, Viral vaccines-Interferons - Antiviral drugs - strategies to develop AIDS vaccines - Rabies vaccines preparation (animal and cell culture) and theirimmunization.

SUGGESTED READINGS

1. Ananthanarayanan, R., and Panicker, C.K.J., (2005). *Text book of Microbiology*. (7th ed.). Orient Longman, NewDelhi.
2. Carter, J., and Saunders, V., (2007). *Virology: Principles and Applications*. (1st ed).Wiley.

3. Chakraborty, P. (2003). *A Text book of Microbiology*. (2nded.). New Central Book Agency (P) Ltd, Calcutta.
4. Dubey, R.C., and Maheswari, D.K., (2004). *A Text book of Microbiology*. (1sted.). S. Chand and Company Ltd, NewDelhi.
5. Pelczar, Jr. M.J., Chan, E.C.S., and Kreig, K.R., (2003). *Microbiology.* (5thed.). Tata McGraw-Hill Publishing Company, NewDelhi.
6. Acheson, N.H. (2006). *Fundamentals of Molecular Virology*. Wileypublication.
7. Cann, A.J. (2005). *Principles of Molecular Virology*, AcademicPress.
8. Dimmock, N.J., Easton, A.J., and Leppard, K.N., (2007). *Introduction to Modern Virology*, (6thed.). Blackwell Scientific Publications, Oxford,UK.
9. Flint, S.J., Racaniello, V.R., Enquist, L.W., Rancaniello, V. R., and Skalka, A. M., (2003). *Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses*. American SocietyMicrobiology.
10. Jawetz, E., Melnic, J.L, and Adelberg, E.A., (2001). *Review of Medical Microbiology*. (22nded.). Lange Medical Publishers,NY.
11. Levy, J. A., Fraenkel-Conrat, H., and Owens, O. S., (1994).*Virology*. (3rded.). BenjaminCummings.
12. Knipe D.M., Howley P.M., and Griffin D.E., (2006). *Fields Virology*. (5thed). Vols - I,II. Lippincott, Williams &Wilkins.
13. Prescott, M., Harley, J.P., and Klein, D.A., (2007). *Microbiology*. (7thed.). McGraw-Hill Inc. New York.
14. White, D. O., and Fenner, F.J., (1994). *Medical Virology*, (4thed.). Academic Press, NewYork.

WEBLINK

1. https://www.medicalnewstoday.com/articles/181418.php

2.https://www.medicinenet.com/swine_flu/article.htm#swine_flu_h1n1_and_h3n2_influenza_virus_facts

Semester -II

18MBP202 MEDICAL BACTERIOLOGY 4H – 4C

Instruction Hours / week:L: 4 T: 0P: 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 infectiousdiseases.
- The infectious disease cycle of the pathogens enables to solve the epidemics.
- The territory covered by infections and the immune response expands each year;
- we focus on pathogenic mechanisms in order to foster a student's ability to solve problems in their future clinical career.

COURSE OUTCOME

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.

UNIT I- Isolation and identification of pathogens

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

Infections – types – methods – infectious disease cycle. Definitions of Epidemics, Endemics Pandemics and investigation of epidemics and control.Definition of pathogens, Saprophytes and Copmmensals.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. 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., *Leptospira*sp; *Neisseria* sp. and *Haemophilus*sp.

UNIT – V – Infection and Therapy

Nosocomial infection – Urinary tract infection, Respiratory tract infection, Sexually transmitted disease – Immunoprophylaxis – Antimicrobial chemotheraphy, Antibiotics, second line drugs.Vaccines.

SUGGESTED READINGS

1. Ananthanarayanan, R., and Panicker, C.K.J., (2005). *Text Book of Microbiology* (7th ed.). Orient Longman, NewDelhi.
2. Salle, A.J. (2008). *Fundamentals principles of bacteriology*. T.M.H. Ed.). McGrawHill.
3. Carl Fraenkel. (2012). *Text book of bacteriology*. Printing company publishers, NewYork.

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

Semester - II

18MBP203 BIOSTATISTICS ANDRESEARCHMETHODOLOGY 4H –4C

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

End Semester Exam: 3Hours

COURSE OBJECTIVE

- This course has been intended to provide the learner insights into helpful areas of Statistics which plays an essential role in present, future use and applications ofBiology.
- Students get an idea about collection, interpretation and presentation of statisticaldata.

COURSE OUTCOMES(CO'S)

On successful completion of this course the learners will be able to

1. apply basic statistical concepts commonly used in health and medicalsciences
2. use basic analytical techniques to generateresults
3. interpret results of commonly used statistical analyses in writtensummaries
4. demonstrate statistical reasoning skills correctly andcontextually

UNIT I -Scope of Biostatistics

Definitions-Scopeof Biostatistics- Variables in biology, collection, classification and tabulation of data- Graphical and diagrammaticrepresentation.

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

UNIT II - Correlation

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

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

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

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

SUGGESTED READINGS

1. Jerrold H. Zar. (2003). *Biostatistical Analysis.* (4th ed.). Pearson Education (P) Ltd, New Delhi.
2. Kothari. C.R. (2004). *Research Methodology – Methods and Techniques.* (2nd ed.). New Age International Pvt. Ltd, NewDelhi.

Semester - II

18MBP204 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: 3Hours

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.

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 inenvironmental management.
2. Students able to know detailed idea about biofertilizer production and plantdisease.

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

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.Genetically Modified organisms and crops.

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.Biopesticides and its application.

SUGGESTED READINGS

1. Saxena., and Sanjai., (2015). *Applied Microbiology*. Springer,Germany.
2. Denise., G.A., Sarah, S., and Deborah, A., (2015). *Nester's Microbiology*. McGraw-Hill Education
3. SubbaRao, N.S. (1999). *Biofertilizers in Agriculture and Agroforestry*. Oxford and IBH, NewDelhi.
4. Rangaswami, G., and Bhagyaraj, D.J., (2001). *Agricultural Microbiology*. (2nded.). Prentice Hall, New Delhi.
5. Rao, N.S. (1995). *Soil Microorganisms and plant Growth*. Oxford and IBH Publishing Co., New Delhi.
6. Pelzar, M.J., and Reid, M., (2003). *Microbiology*. (5thed.). Tata McGraw-Hill, NewYork.
7. Reinheimer, G. (1991). *Aquatic Microbiology*. (4thed.). John Wiley and Sons, NewYork.

8. Deniel, J.C. (1996). *Environmental aspects of microbiology*, British Sun Publication,Chennai.
9. Abbasi, S.A. (1998). *Environmental pollution and its control*. Cogent International publishers, Pondicherry.
10. Sen, K., and Ashbolt, N.J., (2010). *Environmental Microbiology: Current Technology and Water Applications.*
11. Josdand, S.N. (1995). *Environmental Biotechnology*. Himalaya Publishing House,Bombay.
12. Maier, R.M., Pepper, I,L., and Gerba, C.P., (2009). *Environmental Microbiology.* (2nd ed.). Elsevier Publisher.
13. Metcalf, R.L., and Luckmann, W.H., (1994). *Introduction to insect pest management.* (3rd ed). John Willey and Sons,Inc.
14. Atlas, R.M., and Bartha, M., (2000). *Microbial Ecology - Fundamental and Applications*. (3rde d.). Redwood City CA. Benjamin/Cumming Science Publishing Co., NewDelhi.
15. Maier, R.M., Pepper, I.L., and Gerba, C.P., (2000). *Environmental Microbiology*. (1st ed.). Academic Press, NewYork.
16. Mitchell, R. (1992). *Introduction to Environmental Microbiology*; Prentice Hall. Inc. Englewood Clifs- NewJersey.
17. Motsara, M.R., Bhattacharyya, P., and Srivastava, B., (1995). *Biofertilizer- Technology, Marketing and Usage. Fertilizer Development and Consultant Organization*, NewDelhi.

Semester - II

18MBP205A **CELLBIOLOGY** **4H -4C**

Instruction Hours / week :L: 4 T: 0P: 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.
- To introduce the concept of cellsignaling.

COURSE OUTCOME (CO'S)

1. Students upon completion of this paper will have clear knowledge on various cellular functions such as transportation andsignaling.
2. And also will enable them to enter into cellular research for theirfuture.

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

Plasma membrane - structure and functions. Transportation – types and methods. Role of microtubules andmicrofilaments.

UNIT III - Cell organelles

Endoplasmic reticulum, Golgi complex, Mitochondria, Chloroplast, Ribosomes, Lysosomes, Peroxisomes, Nucleus andVacuoles.

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.

SUGGESTED READINGS

1. Najman, S. (2012). *Current Frontiers and Perspectives in CellBiology*.
2. Twesigye, C. K. *Cell Biology andGenetics*.
3. Cooper, G.M., and Hausman, R. E., (2007). *The Cell: A Molecular Approach*. (4th ed.). Sinauer Associates, IncorporatedPublications
4. Ge Yang. (2011). *Engineering Molecular Cell Biology*. Garland SciencePublishers.
5. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., and Walter, P., (2002). *Molecular Biology of the Cell*. (4th ed.). Garland SciencePublications.
6. Albert, B., Bray, D., Lewis, J., Raff, M., Roberts, K., and Watson, V., (1989). *Molecular Biology of the Cell*, Garland Publishing Inc,London.
7. Sadava, D.E. (1993). *Cell biology: Organelle structure and functions*. (1st ed.). Jones and Bartlett Publishers, USA.
8. Karp, G. (1984). *Cell biology*, (2nd ed.). McGraw-Hill Publications,USA.
9. Gupta, M.L., and Jangir, M.L., (2001). *Cell Biology: Fundamentals and Applications*, (1st ed.). Agrobios, Jodhpur,India.
10. Verma, P.S., and Agarwal, V.K., (2005). *Cell Biology*, (24th ed.)., S. Chand and Company Limited,India.

Semester - II

18MBP205B QUALITY ASSURANCE ANDQUALITYCONTROL 4H –4C

Instruction Hours / week:L: 4 T: 0P: 0 **Marks:** Internal: **40** External: **60** Total:**100**
End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To inculcate the quality standards and the quality control practice followed in theindustry.
- To bring awareness aboutbiosafety.

COURSE OUTCOME (CO'S)

1. Set up and Assess Food Quality AssurancePlans.
2. Create and Critically Evaluate quality specifications for raw materials, and associated final product and appropriatepackaging.
3. Design and critically evaluate appropriate testing and recording procedures for raw materials and associated Final product. Design, and evaluate processing documentation including Standard Operatingprocedures.

UNIT – I – Roles and responsibility

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, Sanitizers – QA compounds, 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.SOP, SSOP, HACCP, ISO and European Standard.

UNIT IV – Disinfection and antibiotics

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 control

Quality assurance and Quality control – pharmacopoeias, quality checking, routine examination and validation of industry. International disinfectant testing protocols, assessment of biocide effectiveness. SOP, SSOP, HACCP, ISO& European Standard.

SUGGESTED READINGS

1. Rowland, M., and Tozer, T.N., (1995). *Clinical Pharmacokinetics: Concepts and Applications*. Williams & Wilkinspublishers.
2. Tozer, T.M., and Rowland, M., (2006). *Introduction to Pharmacokinetics and Pharmacodynamics: The Quantitative Basis of Drug Therapy*. Lippincott Williams & Wilkins Publishers.
3. Pandit, N.K. (2007). *Introduction to the Pharmaceutical Sciences*. Lippincott Williams & WilkinsPublishers.
4. Hugo, W. B., and Russel, A.D., (2006). *Pharmaceutical Microbiology.* (4thed). Blackwell ScientificPublications.

5. Brock-Madigan M.T. (2006). *Biology of Microorganisms.* (11th ed.). Pearson- Prentice Hall, USA.
6. Gunasekaran, P. (1996). *Laboratory Manual in Microbiology*. (1st ed.). New Age International Pvt. Ltd, NewDelhi.
7. Beckett, H., and Stenlake, J. B., (2003). *Practical Pharmaceutical Chemistry, Part I and Part II*, (4th ed.). Continuum International PublishingGroup.
8. Jeffery, G. H., Basset, J., Mendham, J., and Denny, R.C., (Rev. by) (1989). *Vogels Text Book of Quantitative Chemical Analysis*, (5th ed.).,Bathpress,UK.

Semester – II
4H – 4C

18MBP205C BIOPROCESS ENGINEERING

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.

COURSE OUTCOME

1.This course will enable the students to design the various microbial fermentation products and their production, purification for various applications.

UNIT I - Fermenter

Design of a basic fermenter, bioreactor configuration, design features, computer control of fermentation process, measurement and control of process.Types of Bioreactors and its functions.

UNIT II - Physical factors and scale-up

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 - Cultures in the fermenter

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 forproductivity.

UNIT IV - Down streaming process

Down streamingprocess of microbial products (Peptides, Biopolymers, surfactants, Enzymes) - separation, extraction and purification, drying andcrystallization.

UNIT V - Strain improvement & Preservation

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.

SUGGESTED READINGS

1. Demain, A.L., and Davies, J.E., (1999). *Manual of Industrial Microbiology and Biotechnology*. (2nded.). A.S.M. Press, Washington,D.C.
2. Hugo, W.B., and Russell, A.D., (1998). *Pharmaceutical Microbiology*. (6thed.). Publisher Blackwell Science Ltd.
3. Mansi, E.M.T., and Bryce, C.F.A., (2002). *Fermentation Microbiology and Biotechnology*. Taylor and Francis, NewYork.
4. Patel, A.H. (2003). *Industrial Microbiology*. Macmillan India Ltd. NewDelhi.

5. Reed, G. (2002). *Presscott and Dunn's Industrial Microbiology*. (5th ed.). CBS Publishers, NewDelhi.
6. Shuler, M.L., and Kargi, F., (2005). *Bioprocess Engineering Basic Concepts*. Pearson Education, New Delhi.
7. Stanbury, P.T., and Whitaker, A., (2005). *Principles of Fermentation Technology*, Pergamon Press. NY.
8. Waites, M. J. (2007). *Industrial Microbiology*. Blackwell Publishing Company.UK.

WEBLINKS

1. Http://www.biologydiscussion.com/industrial-microbiology-2/fermentor-bioreactor-history-design- and-its-construction/55756

18MBP211 **ADVANCED PRACTICAL – III** **4H – 2C**

Instruction Hours / Week:L: 0 T: 0P: 4 **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 AgriculturalMicrobiology.

COURSE OUTCOME (CO'S)

1. This practical course renders a candidate the knowledge of advanced techniques involved in Microbial Biotechnology and AgriculturalMicrobiology.
2. Candidates would be able to understand and perform molecular techniques which forms anintegral part of coreMicrobiology.

EXPERIMENTS

1. Isolation of plasmid DNA fromBacteria
2. Isolation of chromosomal DNA fromBacteria
3. Determination of molecular weight by SDS Polyacrylamide gelelectrophoresis
4. Isolation of microbes fromsoil
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 anddenitrifers
8. Study of Mycorrhizae, Cynobacteria andAzolla
9. Determination of Dissolved oxygen ofwater
10. Determination of BOD (Biochemical Oxygen Demand) ofwater
11. Determination of COD (Chemical Oxygen Demand) ofwater

REFERENCES

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

Semester - II

18MBP212 **ADVANCED PRACTICAL–IV** **4H –2C**

Instruction Hours / week:L: 0 T: 0P:4 **Marks:** Internal: **40** External: **60** Total:**100**
End Semester Exam: 9 Hours

COURSE OBJECTIVES

A student undertaking this course will learn

- To acquirepractical 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.

COURSE OUTCOME

1. This course provides the current medical aspects on the clinical diagnosis of infection providing the combined treatment of bacteriology andvirology.

EXPERIMENTS

1. Laboratory diagnosis of pyogenic infections – tuberculosis – enteric fever –diarrhea – UTI – anaerobic infections
2. Isolation and identification of *Candidaalbicans*
3. Antibiotic sensitivity test discpreparation
4. Antibiotic sensitivity test – Kirby - Bauer, Stroke'smethod
5. MIC determination by Broth dilution technique, filter paper discassay
6. Wet mount preparation of parasites- Saline,iodine
7. Identification of parasites-formal ether concentration, floatationmethods
8. Morphological examination of fungi intissues
9. Cultivation of viruses-Egginoculation
10. Isolation of coli phage from sewage using membrane filtertechnique.
11. Examination of plant diseases: Wilt of potato, Citrus canker, Rice dwarfvirus

SUGGESTED READINGS

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

Semester - II

JOURNAL PAPER ANALYSIS AND PRESENTATION 2H

Instruction Hours / week:L: 2 T: 0 P: 0