DEPARTMENT OF MICROBIOLOGY

FACULTY OF ARTS, SCIENCES AND HUMANITIES

PG PROGRAM – M. Sc. Microbiology

(2019 – 2020 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										
19MBP101	Fundamentals of Microbiology and Classification	I	a	4	0	0	4	40	60	100
19MBP102	Microbial Physiology and Metabolism	II	a	4	0	0	4	40	60	100
19MBP103	Molecular genetics	II	b	4	0	0	4	40	60	100
19MBP104	Bioinstrumentation	VI	b	3	1	0	4	40	60	100
19MBP105A	Marine microbiology	I	a	4	0	0	4	40	60	100
19MBP105B	Computer applications and Bioinformatics	VII	c,d							
19MBP105C	Biochemistry	II	A							
19MBP111	Basic Practical – I	VI	b, e	0	0	4	2	40	60	100
19MBP112	Basic Practical – II	VI	b, e	0	0	4	2	40	60	100
Journal Paper Analysis & Presentation		IV	c,e	2	0	0	-	-	-	-
Semester total				**21**	**1**	**8**	**24**	**280**	**420**	**700**
SEMESTER–II										
19MBP201	Virology	I	a, b	3	1	0	4	40	60	100
19MBP202	Medical Bacteriology	I	a, c	4	0	0	4	40	60	100
19MBP203	Biostatistics and Research Methodology	VI	c,d,g	4	0	0	4	40	60	100
19MBP204	Environmental and agricultural microbiology	I	a,i	4	0	0	4	40	60	100
19MBP205A	Cell biology	I	a,c	4	0	0	4	40	60	100
19MBP205B	Quality assurance and quality control	I	a,d,e							
19MBP205C	Bioprocess engineering	IV	a,e							
19MBP211	Advanced Practical – III	I	b,e,f	0	0	4	2	40	60	100
19MBP212	Advanced Practical – IV	I	b,e,f	0	0	4	2	40	60	100
Journal Paper Analysis & Presentation		IV	c,e	2	0	0	-	-	-	-
Semester total				**21**	**1**	**8**	**24**	**280**	**420**	**700**

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-III										
19MBP301	Advanced Immunology	II	b,d	4	0	0	4	40	60	100
19MBP302	Food Microbiology	IV	a,c	4	0	0	4	40	60	100
19MBP303	Medical Mycology and Parasitology	I	a,e,f	4	0	0	4	40	60	100
19MBP304	Microbial Technology and Intellectual Property Rights	V	b,d	4	0	0	4	40	60	100
19MBP305A	Biofertilizer and Biomanure Technology	I	a,i	4	0	0	4	40	60	100
19MBP305B	Laboratory animal care	V	b,d,f							
19MBP305C	Bio nanotechnology	IV	a,d,g							
19MBP311	Application Oriented Practical – V	I	b,h	0	0	4	2	40	60	100
19MBP312	Application Oriented Practical – VI	I	b,j	0	0	4	2	40	60	100
Journal Paper Analysis & Presentation		IV	c,d,e	2	0	0	-	-	-	-
Semester total				**22**	**0**	**8**	**24**	**280**	**420**	**700**

Course code	Name of the course	Hrs / Week	Marks			Exam Hrs	Credit (s)
			CIA	ESE	Total		
SEMESTER – IV							
19MBP491	Project and Viva Voce	-	80	120	200	-	15
Semester total		**-**	**80**	**120**	**200**	**-**	**15**
		90	**920**	**1380**	**2300**		**87**

Elective courses*

Elective – 1 (I9MBP105)		Elective – 2 (I9MBP205)		Elective – 3 (I9MBP305)	
Course code	**Name of the course (Theory)**	**Course Code**	**Name of the course (Theory)**	**Course Code**	**Name of the course (Theory)**
19MBP105A	Marine Microbiology	**I9MBP205A**	Cell biology	**I9MBP305A**	Biofertilizer and Biomanure Technology
19MBP105B	Computer Applications and Bioinformatics	**I9MBP205B**	Quality assurance and quality control	**I9MBP305B**	Laboratory animal care
19MBP105C	Biochemistry	**I9MBP205C**	Bioprocess engineering	**I9MBP305C**	Bio nanotechnology

*Red colour : Entrepreneurship course / Green colour : Employability courses/ Blue colour : Skill development courses

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. Student able to gain the good knowledge of the development process and the planning process involved in the microbial products and enhance the entrepreneurship.

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 – based reasoning.

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 in microbiology

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, biodegradation etc.

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

19MBP101 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

- 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 - 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 Chlamydomonas, 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 - Growth and Growth factors

Culture methods: Auxenic and synchronous, aerobic and anaerobic, culture media and nutritional types, growth curve, generation time and growth kinetics. Factors influencing microbial growth. Physical and chemical methods in control of 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, New Delhi.
2. Modi, H. A. (1996). *Elementary Microbiology*. Vol.2, AKTA Prakashan Nadiad, 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, New Delhi.
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., & 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, New Delhi.

Semester – I

19MBP102 MICROBIAL PHYSIOLOGY AND METABOLISM 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 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 - 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 & Biochemistry of Prokaryotes*. (2nded.). Oxford University Press, NY.
11. Voet, D., and Voet J.G., (2003). *Biochemistry*. John Wiley and Sons, NewYork. .
12. Satyanarayana, U. and Chakrapani, U. 2013. Biochemistry, Fourth Edition Book and Allied Pvt. Ltd., Kolkata.
13. Nelson, D.L. and Cox, M.M. 2012. Lehingers's Principles of Biochemistry, Sixth Edition, Mac Millan worth Publishers, New Delhi.
14. Donald Voet and Judith G. Voet, 2011. Biochemistry. Third Edition, John Wiley and Sons, Inc. New York.

WEBLINKS

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

Semester –I

19MBP103 MOLECULAR GENETICS 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 course presents methods and experimental tools used in modern molecular genetics with emphasis on prokaryotes and eukaryotes.
- The theoretical grounds of methods and their applications in research will be discussed.
- The course also deals with the genome structure, stability, organization, and its expression.
- To provide molecular mechanisms underlying mutations, detection of mutations and DNA damage and repair mechanisms
- The course includes among others model systems, genetics behind complex diseases, identification of disease genes and different types of mutations.
- It helps the students to explore genetic engineering techniques.

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 genetics.
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 novel medicines.
3. A thorough understanding of the process of translation and operons along with recombination of DNA.
4. An in-depth study of mutagenesis and genetic analysis with gene mapping.
5. Have a conceptual knowledge about DNA as a genetic material, enzymology, and replication strategies.
6. Full understanding of all aspects of all-important techniques used for the study of biomolecules.

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

19MBP104 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

- 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 spectrophotometer, spectrofluorimeter, atomic spectroscopy, double beam 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**,** 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), LCMS, LCMS/MS, MS-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), Isoelectricfocusing, 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 radioactive laboratory.

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*. (7th ed.). Cambridge university press,NY.
4. Boyer, R. (2000). *Modern Experimental Biochemistry*. (3rd ed.). Addison Wesley Longman, New Delhi.
5. Chatwal, G.R., and Anand, S.K., (2003). *Instrumental Methods of Chemical Analysis*. (5th ed.). 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

19MBP105A **MARINE MICROBIOLOGY** **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 provide students with basic knowledge on the biology and ecology of marine microorganisms, and their ecological role.
- To know the basic biology of marine microorganisms and their activities
- To impart modern techniques for the characterization and study of marine microorganisms and microbial communities.
- To understanding the ecological role of marine microorganisms and marine microbial communities.
- To know the main techniques of modern use necessary for the characterization and study of marine microbes.
- To understand basic biological processes that occur in and between organisms in nature.

COURSE OUTCOME (CO'S)

1. Capable of describing and explaining both biological interaction processes and their importance to ecosystems.
2. To acquire knowledge of the most common research methods used to develop our knowledge of biological processes.
3. learn to work independently in collecting and analysing scientific data, both in the field and in the laboratory.
4. Understand the architecture of marine ecosystem and its essential role
5. Specify the biological significance of biomolecules in metabolism
6. To understand computer applications and Bioinformatics

UNIT I - Marine microorganisms

Introduction of coastal, shallow and deep sea. Marine microorganisms- important and their significance. Marine micro and macro organisms-Collection, enumeration, identification based on morphological, physiological and biochemical characteristics and preservation. International and national collection centres.

.

UNIT-II- Extremophiles and Marine bio-diversity

Thermopiles, basophiles, halophiles, psychrophiles, alkalinophiles, oligotroph, toxitolerant, xerotolerant, endolith – Extremophiles and their environment. Coral reefs, Sea grass, Mangroves, Hydrothermal vents and water currents.

UNIT III- Marine food pathogens and microbial toxin

Marine food pathogenic microorganisms, distribution, indicator organism's prevention and control. Microbiology of processed -finfish and shellfish products. Microbial diseases- diagnosis and control. Introduction, microbial toxin, algal blooms, types. Harmful effect- Human health, Economic impact and Environmental impact, Potential remedies.

UNIT IV – Xenobiotics and Marine nutrient cycles

Microbiology of degradation of xenobiotic environment: Ecological considerations, decay behavior, degradative plasmids, hydrocarbons, oil pollution, surfactants, pesticides, plastics and heavy metals. Factors affecting bioremediation – role of microbes in the marine nutrient cycles.

UNIT V – Marine Microbes bioproducts

Microalgae and seaweeds – Food products- Human food and animal feed, Biomedical Products- Antimicrobial, antioxidant, antiviral and anticancer activity. Aquaculture products - Edible and ornamental fish live feed and pellet feed. Salt tolerant microbes – Probiotics. Agriculture products - Biofertilizer, biopesticide and biostimulants Industrial Application- Biodiesel and bioethanol production. Biopigment products - Phytoplanktons, Bioluminescence**.**

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 of Microorganisms 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. (5th 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 engineering Treatment, Disposal and Reuse*. Metcaff and Eddy. Inc., Tata Mc Grew Hill, New Delhi.
10. Rheinheimer, G., 1980 Aquatic Microbiology-an Ecological Approach. Blackwell Scientific Publications
11. Kirchman, L Microbial Ecology of the Oceans 2000 John Wiley and Sons. Hans G. Truper et. al 1991.

Semester - I

19MBP105B COMPUTER APPLICATIONS AND BIOINFORMATICS 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.
- To describe the history, scope and importance of Bioinformatics and role of internet in Bioinformatics
- Provide an overview of the application areas of bioinformatics, with a focus on the topics that will be taught in the course
- To get introduced to the basic concepts of Bioinformatics and its significance in Biological data analysis
- Classify different types of Biological Databases

COURSE OUTCOME (CO'S)

1. The students will have an understanding about the information on the search engines and various software tools involved in bioinformatics.
2. Additional knowledge on different operating systems would enable the candidate to work with versatility.
3. Provides computational skill on search engines and various software tools involved in bioinformatics
4. It will impart computational based techniques which includes genomics and proteomics in Bioinformatics.
5. Retrieve information from available databases and use them for microbial identifications and drug designing
6. Gain ability to modify gene and protein structures in simulated systems

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

I9MBP105C **BIOCHEMISTRY** **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 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 - 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-covalent interactions. 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 of proteins. 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 & Pyrimidines nucleotides, RNA, & DNA base pairing schemes, types of RNA: mRNA, rRNA, tRNA, amino acylt RNA synthetase, 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, (9thed.).* 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.
8. Stryer, L. 2010. *Biochemistry*, Seventh Edition, W.H. Freeman and Company, New York.
9. Donald Voet and Judith G. Voet, 2011. *Biochemistry*. Third Edition, John Wiley and Sons, Inc. New York.
10. Nelson, D.L. and Cox, M.M. 2012. *Lehingers's Principles of Biochemistry*, Sixth Edition, Mac Millan worth Publishers, New Delhi
11. Satyanarayana, U. and Chakrapani, U. 2013. *Biochemistry*, Fourth Edition Book and Allied Pvt. Ltd., Kolkata.

Semester – I

19MBP111 BASIC PRACTICAL– 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.

EXPERIMENTS

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 – 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 – Turbidity methods
8. Biochemical characterization
   a) Indole Test
   b) Methyl RedTest
   c) Voges ProskauerTest
   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

19MBP112 **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

- To acquire skill on the different molecular mechanism of gene transfer, mutations and separation of nucleic acids.
- 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 platetechnique
2. Induced Mutagenesis-chemical and physical -UV
3. Replica plating technique.
4. Transformation in Bacteria
5. Bacterial Conjugation
6. Induction of Lac operon
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. Protein Purification using microfiltration.
11. Analysis of amino acid by Paper chromatography
12. Analysis of amino acid by Thin layer chromatography
13. Purification of proteins by column chromatography
14. 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.). Nirali Prakashan, Pune.

Semester – I

JOURNAL PAPER ANALYSIS AND PRESENTATION **2H**

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

Semester – II

19MBP201 VIROLOGY 4H –4C

Instruction Hours / week: L: 3 T: 1 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 - 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 their immunization.

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*. (2nd ed.). New Central Book Agency (P) Ltd, Calcutta.
4. Dubey, R.C., and Maheswari, D.K., (2004). *A Text book of Microbiology*. (1st ed.). S. Chand and Company Ltd, NewDelhi.
5. Pelczar, Jr. M.J., Chan, E.C.S., and Kreig, K.R., (2003). *Microbiology.* (5th ed.). Tata McGraw-Hill Publishing Company, New Delhi.
6. Acheson, N.H. (2006). *Fundamentals of Molecular Virology*. Wiley publication.
7. Cann, A.J. (2005). *Principles of Molecular Virology*, Academic Press.
8. Dimmock, N.J., Easton, A.J., and Leppard, K.N., (2007). *Introduction to Modern Virology*, (6th ed.). 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 Society Microbiology.
10. Jawetz, E., Melnic, J.L, and Adelberg, E.A., (2001). *Review of Medical Microbiology*. (22nd ed.). Lange Medical Publishers,NY.
11. Levy, J. A., Fraenkel-Conrat, H., and Owens, O. S., (1994).*Virology*. (3rd ed.). Benjamin Cummings.
12. Knipe D.M., Howley P.M., and Griffin D.E., (2006). *Fields Virology*. (5th ed). Vols - I,II. Lippincott, Williams &Wilkins.
13. Prescott, M., Harley, J.P., and Klein, D.A., (2007). *Microbiology*. (7th ed.). McGraw-Hill Inc. New York.
14. White, D. O., and Fenner, F.J., (1994). *Medical Virology*, (4th ed.). 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

19MBP202 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 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- 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 Commensal. 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.Brook,G.F., J., Butel, S., Stephen, A., and Morse, A., (2003). *Medical Microbiology*, (22nd ed.). McGrawHill.
4. Chakraborty, P. (2003). *A Text book of Microbiology*. (2nd ed.). New Central Book Agency (P) Ltd., Calcutta.
5. Dismukes, W.E., Pappas, P.G., and Sobel, D., (2003). *Clinical Mycology*. Oxford University Press, UK.
6. Jawetz, E., Melnic, J.L., and Adelberg, E.A., (2001). *Review of Medical Microbiology*. (22nd ed.). Lange Medical Publishers.NY.

Semester - II

19MBP203 BIOSTATISTICS AND RESEARCH METHODOLOGY 4H –4C

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

End Semester Exam: 3Hours

COURSE OBJECTIVES

This course enables the students to learn

- 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.
- Analytical techniques to generate results
- Comparison of different groups.
- To know the significant among the groups.

COURSE OUTCOMES

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

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 and this course will support the employment in various bioscience sector.
5. The analytics of data, probability, and hypothesis testing of samples
6. The essential role of statistics in present, future use and applications of Biology

UNIT I - Introduction of Biostatistics and Correlation

Introduction to Biostatistics, Basic Measures - Central Tendency and Dispersion, Variables in Bioscience, Correlation – Meaning and definition - Scatter diagram –Karl Pearson's Correlation Coefficient. Rank Correlation. Regression: Regression in two variables – Properties of Regression, uses of Regression

UNIT II - Test of Significance

Sampling parameters: Difference between sample and Population, Censoring, difference between parametric and non-parametric statistics. Sampling Distributions, Standard Error, Testing of Hypothesis, Level of Significance and Degree of Freedom, Confidence Interval;, Small sample test based on t-test, Large Sample Test based on Normal Distribution - Z- test and F test.

UNIT III Analysis of Variance

Distribution-free test - Chi-square test; Basic Introduction to Multivariate statistics, etc. 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.

UNIT V - Sampling Design

Research Designs – Features of good research designs. Sampling Design: Meaning – Concepts – Steps in sampling – Criteria for good sample design. Scaling measurements - Types of scale, Types of sampling – random sampling and non- random sampling. Sampling Errors.

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, New Delhi.

Semester - II

19MBP204 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.
- 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 and Bioremediation

Microbial contaminants of air, sources of contamination, microbial indicators of air pollution. Enumeration of bacteria in air. Air samplers and sampling techniques. Air sanitation. Bioremediation of air pollutants. Bioleaching – recovery of metal from ores – oxidation of minerals – testing for biodegradability.

UNIT III – Microbes in agriculture

Importance of microbes in agriculture, Current agriculture problems. Bacterial diseases of agricultural crops -pathogens, symptoms and control measures with reference to paddy, cotton, maize, tomato, citrus, mango and potato. Plant protection –phenolics – phytoalexins and related compounds. Bioinsecticides – bacterial and fungal brief note.

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- Biofertilizers and Biocontrol

Application of biofertilizers and biomanures – A combination of biofertilizer and manure applications with reference to soil, seed and leaf sprays. Plant growth promoting microorganisms- Myzorrhizae, Rhizobia, Azosprillum, Azotobacter, Azolla, Frankia, Blue green algae, Phosphate- solubilizers fluorescent *Pseudomonas.* Laboratory and field application; Cost-benefit analysis of biofertilizer and biomanure production. Biocontrol and its application: Biofungicides, bionematicides and Biopesticides.

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*. (2nd ed.). Prentice Hall, New Delhi.
5. Rao, N.S. (1995). *Soil Microorganisms and plant Growth*. Oxford and IBH Publishing Co., New Delhi.
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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.
18. Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. 2000. Twelth Edition, Biology Microorganisms, Prentice Hall, New Jerry. 5.
19. Mark Wheelis, 2010. Principles of Modern Microbiology, Jones & Bartlett India Pvt. Ltd., New Delhi

Semester - II

19MBP205A **CELL BIOLOGY** **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.
- 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
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 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.

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

19MBP205B QUALITY ASSURANCE AND QUALITY CONTROL 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 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 – Roles and responsibility

An introduction to industrial microbiology. Definition of quality assurance- roles and responsibilities of quality assurance 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. Antibiotics and antimicrobial drug resistance and search for new antimicrobial agents.

UNIT III- Sterilization

Types and methods of sterilization, sterility testing and assessment of microbial contamination.

UNIT IV – Disinfection and antibiotics

Disinfection – types and methods. Disinfection agen ts- properties and mode of action (Phenol, isopropyl alcohol and ethanol), international disinfectant testing protocols.

UNIT V - Quality control

Quality assurance and Quality control – pharmacopoeias, quality checking, routine examination and validation of industry. Quality parameter to asses' Natural products, Nutraceutical product, Pharmaceutical products, SOP, SSOP, HACCP, ISO & European Standard, FCO, CIB.

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*. (4th ed). Blackwell ScientificPublications.
5. FCO, 1985
6. Brock-Madigan M.T. (2006). *Biology of Microorganisms.* (11th ed.). Pearson- Prentice Hall, USA.
7. Gunasekaran, P. (1996). *Laboratory Manual in Microbiology*. (1st ed.). New Age International Pvt. Ltd, NewDelhi.
8. Beckett, H., and Stenlake, J. B., (2003). *Practical Pharmaceutical Chemistry, Part I and Part II*, (4th ed.). Continuum International PublishingGroup.
9. Jeffery, G. H., Basset, J., Mendham, J., and Denny, R.C., (Rev. by) (1989). *Vogels Text Book of Quantitative Chemical Analysis*, (5th ed.).,Bath press,UK.

Semester – II
4H – 4C

19MBP205C 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.
- 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 - 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 – Microbial Products and Downstream process

Enzymes- Introduction, Enzyme Kinetics, Immobilized Enzyme system, large scale production, medical and industrial application. Down streaming process of microbial products (Peptides, Biopolymers, surfactants, Enzymes) - separation, extraction and purification, drying, crystallization centrifugation, filtration, freeze-drying, spray drying.

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*. (2nd ed.). A.S.M. Press, Washington,D.C.
2. Hugo, W.B., and Russell, A.D., (1998). *Pharmaceutical Microbiology*. (6th ed.). 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

19MBP211 **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 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 gelelectrophoresis
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 nodule -*Rhizobium*
7. Isolation of phosphate solublisers, ammonifiers and denitrifers
8. Study of Mycorrhizae, Cyanobacteria and *Azolla*
9. Determination of Dissolved oxygen ofwater
10. Determination of BOD (Biochemical Oxygen Demand) ofwater
11. Determination of COD (Chemical Oxygen Demand) of water
12. Estimation of Protein by Lowry's Method.

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*, (3rded.). Twenty First Century Publication,Madurai.

Semester - II

19MBP212 **ADVANCED PRACTICAL–IV** **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

- 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 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, 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 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

19MBP301 **ADVANCED IMMUNOLOGY** **4H – 4C**

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

End Semester Exam: 9 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. Immunoelectrophoresis, Complement fixation test, Immunofluorescence, ELISA, RIA, Immuno electron microscopy. Forensic serology, Immunohaematology – ABO, RH incompatibility.

SUGGESTED READINGS

TEXT BOOKS

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

REFERENCES

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

19MBP302 **FOOD 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

Microorganisms in Foods and methods for detection: Fresh meat, Processed meat and poultry, Culture, Microscopic, and Sampling Method for detecting microbes, Physical, Chemical methods, Whole animal assays, Immunological methods.

UNIT – V

Applications of Food Microbiology: Beneficial Uses of Microorganisms in Food, Intestinal Beneficial Bacteria-Concept of Prebiotics and Probiotics, Genetically modified foods. Biosensors in food.

SUGGESTED READINGS

TEXT BOOKS

1. Banwart, G.J. (2004). *Basic Food Microbiology*. (2nd ed.). CBS Publishers and Distributors New Delhi.
2. Casida, L.E. Jr., (2003). *Industrial Microbiology*. New Age International Publishers, New Delhi.
3. Doyle, M.P., Beuchat, R.L., and Montuille, T.J., (2001). *Food Microbiology – Fundamentals and Frontiers*. ASM press.
4. Frazier, W.C., and Westhoff, D.C., (1995). *Food Microbiology*. Tata McGraw-Hill Publishing Company Limited, New Delhi.
5. Adams, M.R. and Moss, M.O. 2008. Food Microbiology, RSC Publishing, Cambridge, UK.
6. Blackburn C. de W. 2006, Food spoilage microorganisms, Woodhead Publishing, Cambridge, UK
7. Ray. B. 2000. Fundamental Food Microbiology. 2nd Edition. CRC Press. New York. USA.Press, New York.

REFERENCES

1. Atlas, R.N., and Bartha, R., (2000). *Microbial Ecology - Fundamental and Applications*. (3rd ed.). 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.

Semester - III

MEDICAL MYCOLOGY AND PARASITOLOGY

19MBP303 **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, Balantidium coli.*

UNIT – V

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

SUGGESTED READINGS

TEXT BOOKS

1. Ananthanarayanan, R., and Panicker, C.K.J., (2009). *Text Book of Microbiology*. (8th ed.). Orient Longman. New Delhi.
2. Chakraborty, P. (2003). *A Text book of Microbiology*. (2nd ed.). 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 ed.). Chatterjee Medical Publishers, Calcutta.

REFERENCES

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

Semester - III

19MBP304 **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

- Microbial technology is concerned with the industrial processing of materials by microorganisms to provide desirable products or serve other useful purposes.
- This paper emphasizes the application of biological systems to the manufacturing and service industries or the use of biological processes within the framework of technical operations and industrial production.
- It creates awareness on the Intellectual property rights and patenting of biotechnological processes.
- This course will provide technical skill majorly deals with DNA.
- Recent developments in IPR laws in India
- To know the types of IPR.

COURSE OUTCOME (CO'S)

Upon the completion the course Students able

1. To learn the basic tools in recombinant technology
2. To understand the various concepts of cloning vectors
3. To learn the cloning strategies
4. To familiarize with the principles of bioethical concepts
5. To understand the IPR issues in patents in biotechnology innovations
6. To apply their knowledge in new product development

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 - lamda, 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. biolabeling of genes and proteins.

UNIT – III

Transgenic 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

Discrepancies in biotechnology / chemical patenting. IPR – historical perspective – recent developments in IPR laws in India, IPR and the rights of farmers in developing countries. Types of IPR- Governing bodies-National and International.

UNIT – V

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. Writing a patent document.

SUGGESTED READINGS

TEXT BOOKS

1. Sathyanarayana, U. (2005). *Biotechnology*. (1st ed.). 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., Gilman, M., and Wikowski, J., (2001). *Recombinant DNA*. (2nd ed.)., 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 ed.). Blackwell Publishing, USA.
2. Glick, B.K., and Pasternak, J.J., (2003). *Molecular Biotechnology. Principles and Applications of Recombinant DNA*. (3rd ed.). ASM Press, Washington.
3. Old, R.M., and Primrose, S.B., (2003). *Principles of Gene Manipulation*. (6th ed.). Blackwell Scientific Publication, London.
4. Primrose, S.B. (2001). *Molecular Biotechnology*. (2nd ed.). Blackwell Scientific Publishers, Oxford Press, London.
5. Winnacker, E.L. (2003). *From Genes to Clones: Introduction to Gene Technology*. (1st ed.). VCH. Weinhein, Germany.
6. Slater, A., and Scott, N., (2003). *Plant Biotechnology - The Genetic Manipulations of plants*. (2nd ed.)., Oxford University Press, New York.

19MBP305A	BIOFERTILIZER AND BIOMANURE TECHNOLOGY	Semester - III 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 – Nitrogen fixers, Phosphate solubilizers and Potassium mobilizers. Free living forms – Azatobacter, Azospirillum; Symbiotic forms – Rhizobium; Legume Association; *Pseudomonas*; Non-legume association.

UNIT – III

Mycorrhizal association –Ecto and Endo mycorrhizae, 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. Quality control parameters, ISI-FCO norms.

SUGGESTED READINGS

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 Ed.). 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 Ed.). Tata Mc Graw-Hill. New York.

REFERENCES

1. Burns, R.C., and Hardy, R.W.F., (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 Smith, S.E., (1983). *Mycorrhizal Symbiosis*. Academic Press, London.
4. Kumar, H.D. (1990). *Introductory Phycology*. Affiliated East-West Press Ltd., Madras.
5. Marks, G.C., and Koslowski, T.T., (1973). *Ectomycorrhizae*, Academic Press, London.
6. Rao, N.S., Venkataraman, G.S., and Kannaiyan, S., (1983). *Biological N2 fixation*, ICAR Publications, New Delhi.
7. Sandera, F.E., Mosse, B., and Tinke, P.B., (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 Fredrick, T., (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, L., and Becton, J.D., (1985). *Soil fertility and fertilizers*. Macmillan Publishing Co., New York.

Semester - III

LABORATORY ANIMAL CARE

19MBP305B **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

General introduction - responsibilities of institution and chief investigators, Aspects of rabbit behavior relevant to housing, Rabbit Group housing in pens, advantages and disadvantages, Pens, design of pens environment, Rabbit care management – Regrouping, catching and identification in pens and cages, Rabbit care management – food, water, health and breeding in pens and cages, Cage design and environment, Environment enrichment for rabbits in pens and cages, Ethical guidelines for use of animals in research.

UNIT – II

Introduction-behavior, anatomic and physiological features of mice in lab, Husbandry-Housing, nutrition and breeding requirements and management of lab mice, occupational health and zoonotic diseases, treatment of disease in mice, regulatory agencies and complain associates with management of lab mice, Restraining and sample collection methods from lab mice, Physical, examination of mice for disease conditions, anesthesia and analgesia -mice, Euthanasia in veterinary care.

UNIT – III

Introduction to anatomical and physiological features of laboratory rat, major color groups and varieties of rats, regulatory management housing of laboratory rats-equipment, feed formulation, ailments & disease management of laboratory rats, disease management and ailments of laboratory rats , restraining and sample collection in lab rats, anesthesia and analgesia of lab rats, breeding of laboratory rats.

UNIT – IV

Introduction – history and classification of guinea pigs, varieties and characteristics of guinea pigs used in labs, characteristics and behaviors of the guinea pig used in labs, housing, nutrition and feeding of guinea pigs, care and handling of guinea pigs in lab, zoonoses of guinea pigs, reproduction and breeding managements in guinea pigs –gnotobiotic animals.

UNIT – V

Various routes of inoculation in mice & rats, various routes of inoculation in mice & rats, handling and routes of inoculation in rabbits, guinea pigs, laboratory use of animals –role in microbiology, antibody production in animals, disposal of animal house wastes, safety measures in animal house.

SUGGESTED READINGS

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 ed.)., eds. Richard Fish, Peggy Danneman, Marilyn Brown, and Alicia Karas. Academic Press, (2008.
3. *The Mouse in Biomedical Research*, second ed.)., 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*, (2^{nd} ed.). American College of Laboratory Animal Medicine. eds. Suckow, weisbroth and Franklin. Elsevier, (2006).
5. *Handbook on Genetically Standardized Mice.* (6^{th} ed.). Ed. Joanne Currer, The Jackson Laboratory, Bar Harbor, Maine, (2009).
6. *Laboratory Animal Medicine*, (2^{nd} ed.). American College of Laboratory Animal Medicine, eds. Fox, Anderson, Lowe, Quimby. Academic Press, (2002).
7. Percy, D.H., and Barthold, S.W., (2007). *Pathology of Laboratory* Rodents and Rabbits, (3^{rd} ed.). Blackwell Publishing Company.

REFERENCES

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

Semester - III

BIO NANOTECHNOLOGY

19MBP305C **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: Bio nanomachines – 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 bio nanotechnology 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 – bio molecular sensing – self application – machine phase bio nanotechnology.

UNIT – V

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

SUGGESTED READINGS

TEXT BOOKS

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

REFERENCES

1. Goosell, D.S. (2004). *Bionanotechnology: Lessons from nature.* John Wiley & Sons Inc. publication.
2. Goodsell, D.S. (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 Crothers, D., (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.* (4^{th} ed.). Wiley, New York.

19MBP311 **APPLICATION ORIENTED PRACTICAL – V** **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 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.
   - β -HCG test
4. ELISA- thyroid hormone analysis
5. Ouchterlony's Double Immunodiffusion test (ODD)
6. Counter immunoelectrophoresis (CIE)

SUGGESTED READINGS

REFERENCES

1. Baron, E.O., and Finegold, S., (1990). *Bailey and Scott's Diagnostic Microbiology*. (8th ed.). CV Mosby Company, St Louis.
2. Benson, H.J. (1998). *Microbiological Application - Laboratory Manual in General Microbiology*. (7th ed.). WCB McGraw – Hill, New York.
3. Talwar, G.P., and Gupta, S.K., (1993). *A Handbook of Practical and Clinical Immunology*, (2nd ed.). Vol. 2, CBS Publishers and Distributors, New Delhi.
4. Kindt, T.J., Osborne, B.A., and Goldsby, R.A., (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. Wise, D.J., and Carter, G.R., (2002). *Immunology: a comprehensive review*. Wiley-Blackwell.
7. Janeway, C.A., and Travers, P., (1997), *Immunobiology: The immune system in health and disease*, (3rd ed.). New York, Garland Publishing.
8. Kuby, J. (1997). *Immunology*, (3rd ed.). 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 ed.). Harcourt Brace and Co., Asia PTE Ltd.

19MBP312 **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

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 – Amylase and protease.
2. Production of sauerkraut ,yoghurt, wine
3. Enumeration of Microorganisms from Food samples
4. Detection and enumeration of Microorganisms present in lab surfaces.
5. Analysis oand resazurin
6. Detection of coliforms from water - MPN test
7. Isolation of plant pathogens – Bacteria and fungi
8. Citric Acid production
9. Mushroom Cultivation
10. Immobilization technique (Sodium alginate method).

SUGGESTED READINGS

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 Arora, D.R., (2007). *Practical Microbiology*. (1st ed.). CBS Publishers and Distributors, Bangalore.
4. Cappucino, G.J., and Sherman, N., (2001). *Microbiology A Laboratory Manual*. (6th ed.). Benjamin Cummings, New York.
5. Demain, A.L., and Davies, J.E., (1999). *Manual of Industrial Microbiology and Biotechnology* (2nd ed.). 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 Denmark, P.N., (1984). *Microbes in Actions: A lab Manual of Microbiology*. D. B. Taraporwalla and Sons.
8. Jay, J.M., Loessner, M.J., Golden, D.A., (2005). *Modern Food Microbiology*. Springer Science, USA.
9. Davies, J.E., and Demain, A.L., (2009). *Manual of Industrial Microbiology and Biotechnology* ASM Publisher, USA.
10. Baltz, R.H., Davies, J.E., and Demain, A.L., (2010). *Manual of Industrial Microbiology and Biotechnology.* (3rd ed.). ASM Publisher, USA.

JOURNAL PAPER ANALYSIS AND PRESENTATION 2H

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

19MBP491 **PROJECT VIVA VOCE** **15C**

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