M.Sc., MICROBIOLOGY

SYLLABUS
(with effect from July 2018)

Department of Biology
The Gandhigram Rural Institute (Deemed to be University)
Gandhigram – 624 302
Dindigul District
Tamil Nadu
India

M. Sc., MICROBIOLOGY PROGRAMME
SCHEME OF EXAMINATION

FIRST SEMESTER									
	Course code	**Course Title**	**C**	**L**	**P**	**E**	**CFA**	**ESE**	**Total**
CORE COURSES	18MIBP0101	Fundamentals of Microbiology@	4	4	-	3	40	60	100
	18MIBP0102	Microbial Diversity@	4	4	-	3	40	60	100
	18MIBP0103	Microbial Metabolism@	4	4	-	3	40	60	100
	18MIBP0104	Molecular Biology#	4	4	-	3	40	60	100
	18MIBP0105	Biochemistry#	3	3	-	3	40	60	50
	18MIBP0106	Fundamentals of Microbiology –Practicals	1	-	3	3	60	40	100
	18MIBP0107	Microbial Metabolism and Biochemistry – Practicals	1	-	3	3	60	40	100
CNCC	18GTPP0001	Gandhi in Everyday Life	-	2	-	-	50	-	50
		Total Credits	**21**						

SECOND SEMESTER									
	Course code	**Course Title**	**C**	**L**	**P**	**E**	**CFA**	**ESE**	**Total**
CORE COURSES	18MIBP0208	Food Microbiology@	4	4	-	3	40	60	100
	18MIBP0209	Agricultural Microbiology	4	4	-	3	40	60	100
	18MIBP0210	Applied Environmental Microbiology#	3	3	-	3	40	60	100
	18MIBP0211	Biostatistics	4	4	-	3	40	60	100
	18MIBP0212	Food Microbiology – Practicals	1	-	3	3	60	40	100
	18MIBP0213	Agricultural Microbiology –Practicals	1	-	3	3	60	40	100
	18MIBP0214	Summer Internship	2	-	-	-	50	-	50
NME	-	Non Major Elective	4	4	-	3	40	60	100
CNCC	18ENGP00C1	Communication and Soft Skills	-	2	-	-	50	-	50
		Total credits	**23**						

THIRD SEMESTER									
	Course code	**Course Title**	**C**	**L**	**P**	**E**	**CFA**	**ESE**	**Total**
CORE COURSES	18MIBP0315	Instrumentation Techniques and Research Methods@	4	4	-	3	40	60	100
	18MIBP0316	Immunology and Medical Microbiology@	4	4	-	3	40	60	100
	18MIBP0317	Industrial Microbiology #	4	4	-	3	40	60	100
	18MIBP0318	Instrumentation Techniques -Practicals	1	-	3	3	60	40	100
	18MIBP0319	Immunology and Medical Microbiology - Practicals	1	-	3	3	60	40	100
	18MIBP0320	Seminar	2	2	-	-	50	-	50
	18MIBP03F1	Extension/Field visit /Industrial Visits	-	-	-	-	50	-	50
ME	18MIBP03EX	Major elective*	4	4	-	3	40	60	100
MC	18MIBP03MX	Modular Course	2	2	-	-	50	-	50
VPP	18EXNP03V1	Village Placement Programme	-	-	-	-	50	-	50
		Total credits	**22**						

FOURTH SEMESTER									
	Course code	**Course Title**	**C**	**L**	**P**	**E**	**CFA**	**ESE**	**Total**
	18MIBP0421	Biotechnology and Genetic Engineering@	4	4	-	3	40	60	100
CORE COURSES	18MIBP0422	Seminar	2	2	-	-	50	-	50
	18MIBP0423	Dissertation	6	12	-	-	75	75*+ 50**	200
	18MIBP04F2	Extension/Field visit /Industrial Visits	-	-	-	-	50	-	50
MC	18MIBP04MY	Modular Course	2	2	-	-	50	-	50
		Total Credits	**14**						
Overall credits 80									

# Courses may be offered under MOOC/NPTEL based on availability online and the syllabus will be modified as per MOOC/NPTEL with equal credits	**@ A portion of the Course may offered under MOOC/NPTEL based on availability online**
*Evaluation by External Examiner	**Evaluation by External and Internal Examiners
L-Lecture Hours	C-Credits
P-Practical Hours	CNCC-Compulsory Non Credit Course
E-Exam Hours	MC- Modular course
CFA-In-semester continuous assessment	ME – Major Elective
ESE-End Semester Assessment	VPP – Village Placement Programme

List of Major Elective Courses (4 credits)	List of Modular Courses (2 Credits)	Non Major Elective Course offered to other Departments (4 credits)
18MIBP03E1 Bioconversion of Organic Material	18MIBP03M1 Advanced Molecular Techniques	18BIOP02N1 Food Microbiology
18MIBP03E2 Microbial Genetics	18MIBP03M2 Bioinformatics	18BIOP02N2 Agricultural Microbiology
18MIBP03E3 Mushroom Biotechnology	18MIBP04M1 Rural Biotechnology	18BIOP02N3 Immunology and Medical Microbiology
Any other Major Elective Courses under MOOC / NPTEL available online with equal credits	18MIBP04M2 Microbial Production of Recombinant Molecules	18BIOP02N4 Industrial Microbiology
	18MIBP04M3 **G**enetic Engineering and Applications	

Possible Online Courses to be introduced in I to IV Semesters through NPTEL / MOOC modes based on its availability		
1. Molecular Biology	5. Industrial Biotechnology	9. Bio-electrochemistry
2. Applied Environmental Microbiology	6. Experimental Biotechnology	10. Bioreactors
3. Fundamentals of Biotechnology	7. Genetic Engineering and Applications	--
4. Biochemistry	8. Biomathematics	--

18MIBP0101 FUNDAMENTALS OF MICROBIOLOGY Credits-4

Objectives:

- To enhance the students knowledge on the historical aspects and development of microbiology
- To acquire an overall knowledge on the morphology and functions of the structures with the prokaryotes and eukaryotes.
- To make the students knowledgeable on the various techniques involved.
- To give an overview on microbial ecology-microbial habitats, their interactions and plant-microbe relationship

Learning outcomes:

By the end of this course students will be able to:

- Be impressed on the milestones of Microbiology and its present status
- Identify key components and their functions in both prokaryotes and eukaryotes.
- Be able to understand in depth the techniques used in Microbiology
- Have an insight to the interactions and characteristics of microorganisms.

Unit – I : History and Microscopy *(Source NPTEL course)*

Historical and recent developments -Scope of microbiology- Spontaneous generation and germ theory of disease - Major contribution of scientists– Leeuwenhoek, Edward Jenner, and Alexander - Fleming, Joseph Lister, Robert Koch and Louis Pasteur- Modern Microbiology - Landmark achievements in 20th century – Brief view on bacterial classification according to Berge's manual of Determinative bacteriology - Microscopy: Simple, Compound, Dark field, Phase contrast, Fluorescence and Electron microscopy.

Unit – II : Prokaryotic and Eukaryotic Cell *(Source NPTEL course)*

Ultra structure of Prokaryotic and Eukaryotic cell- The Prokaryotic Cell: Size, shape and arrangement of bacterial cells; structure of cell wall, and structures external (glycocalyx, flagella, pili, etc.,) and internal (plasma membrane, cytoplasm, inclusion bodies, etc.,) to the cell wall. The Eukaryotic Cell: Cilia, flagella, cytoskeleton, cytomembrane systems, mitochondria and chloroplast Comparison of Prokaryotic and Eukaryotic cell.

Unit – III : Microbiological Techniques I

Microbial control – Physical methods - Heat, (Low & High temperatures), Filtration, high pressure, Osmotic pressure, Radiation, and Desiccation. Chemical methods – chemical agents, types and mode of action- Evaluation and monitoring of sterilization procedures- Use dilution tests ,Disc-Diffusion method – Decimal reduction time (D Value).

Unit – IV: Microbiological Techniques II ***(Source NPTEL course)***

Cultural techniques: pure culture techniques, types of media - media preparation - preservation of cultures - aerobic and anaerobic culture techniques - growth of bacteria: batch and synchronous culture - factors influencing growth - growth curve-Microbial nutrient -macro nutrients, micro nutrients, growth factors and sources of nutrients- Methods to study microbial morphology - wet mount and hanging drop method. Staining techniques - Gram's, acid fast, spore and capsule staining.

Unit – V: Microbial Ecology

Microbial habitat- An overview, the niche, aquatic habitats (marine and fresh water)-soil habitats-subsurface and atmospheric- Microbial classification-metabolically based on nutritional pattern(source of energy and source of carbon)- Microbial Interactions- neutralism, mutualisms, commensalisms, competition, amensalisms, parasitism, predation, antagonism, syntrophism and symbiotic associations. Plant-microbes interactions – Ectomycorrhizae and Endomycorrhizae-Root and stem nodules, rhizosphere and phyllosphere.

Text Books

1. Jeffery C. Pommerville (2016). Alcamo's Fundamentals of Microbiology (Third Edition). Jones and Bartlett Learning. LLC, Burlington, MA 01803.
2. Tortora, G.J, Funke B.R. and Case,C.L..2010. Microbiology: An introduction 10th Ed, Benjamin Cummings, N.Y.
3. Wiley, J.M., Sherwood, L.M. and Wodverton, C.J. 2009. Prescott's principle of Microbiology, Mc Graw Hill, New York.
4. Dubey, R.C and Maheswari, D.K 2005. A text book of Microbiology, Revised Edt., S.Chand Publishers, New Delhi.
5. Pelczar, Jr., Michael, Chan E. C. S. and Kreig Noel. 2000. Microbiology. 5th Ed. Tata McGraw Hill Book Company.

References

1. Stanier, Y. Roger, John L. Ingrahm, Mark L. Wheelis and Page R. Painter. 2003. General Microbiology. V Ed. MacMillan Press Ltd. New Jersey. pp: 621-626; 655-670.
2. Sundararajan, S. 2003. Microorganisms. I Ed. Anmol Publications Pvt. Ltd. New Delhi..
3. Hans G. Schlegel. 2012(Reprint). General Microbiology. VII Ed. Cambridge University Press. UK..
4. Salle, A. J. 2001. Fundamental and Principles of Bacteriology. 7th Ed. Tata McGraw Hill Publishing Co. Ltd.
5. John L. Ingrahm and Catherine Ingrahm.. 2000. Introduction to Microbiology. II Ed. Brooks/Cole, Thompson Learning division. USA.
6. Lansing M. Prescott, John P. Harley and Donald A. Klein. 2002. Microbiology. V Ed. WCB/McGraw Hill Company.
7. Brock, T. D., Smith, D. W and Madigene, M. T. 1997. Biology of Microorganisms: Milestones in Microbiology. Prentice-Hall International Inc. London.

8. Talaro, K and Talaro, A. 1996. Foundations in Microbiology, 2en Ed., Wm. C. Brown publishers, Toronto.
9. Heritage, J. Evans E.G.V. and Killington, R.A. (1996). Introductory Microbiology. Cambridge University Press.

Web resources:

1. http://www.microbiologyonline.org.uk/links.html
2. http://www.bac.wise.edi/microtextbook/index.php
3. http://www.microbeworld.org.uk
4. http://www.staff.ncl.ac.uk/n.y.morris/lectures/class2007.html

18MIBP0102 **MICROBIAL DIVERSITY** **Credits – 4**

Objectives:

- To make the students to understand the different aspects to the classification of Prokaryotes and Eukaryotes.
- To make the students knowledgeable on the diversity of microbes.
- To in-depth an on knowledge on the different groups and species of microbes

Learning outcomes:
By the end of this course the students will learn the following outcomes:

- The students will be able to understand the classification of prokaryotes and eukaryotes
- The students will be able to understand the basic principles and methods of classification of viruses and an in-depth knowledge on T_4, λ, M_{13} and HIV
- The students will be able to understand the basic principles and methods of classification of bacteria and an in-depth knowledge on *E. coli, Rhizobium* sp., *Rhodomicrobium* sp., *Methanobacteria* sp*., and* Cyanobacteria
- The students will be able to understand the basic principles and methods of classification of algae and fungi and an in-depth knowledge on *Aspergillus* sp*., Candida* sp*., Mucor* sp., and *Agaricus* sp*.,* green algae ,diatoms, euglenoids, brown rhodophyta and pyrrophyta
- The students will be able to understand the basic principles and methods of classification of protozoa and an in-depth knowledge on *Entamoeba histolytica and Plasmodium vivax.*

Unit – I : General Classification *(Source NPTEL course)*

General principles of classification of microorganisms – Haekel's three kingtom concept –Whittaker's five kingdom concept – three domain concept of Carl Woese. Evolutionary methods in classification - International codes of nomenclature - Taxonomic approaches and Phylogeny – Brief outline on metagenomics.

Unit – II : Virology

Classification and salient features of viruses. Nature and properties in relation to classification. Structure and in-depth study of T_4, λ, M_{13} and HIV. Brief outline on virions and Prions.

Unit – III : Bacteriology

Classification and salient features of bacteria according to Bergey's manual of determinative bacteriology, cyanobacteria, proclorons and cyanells. Bacteria and Actinomycetes, Rickettsias, Chlamydiae and mycoplasma according to Bergey's Manual of Determinative Bacteriology (IX Ed.). In-depth study of *E. coli, Rhizobium* sp., *Rhodomicrobium* sp., Methane oxidizing bacteria *Methanobacteria* sp*.,* Cyanobacteria. Economic importance of bacteria.

Unit – IV : Phycology and Mycology

Classification and salient features of algae – nutrition, thallus characteristics and reproduction. Characteristics of green algae, diatoms, euglenoids, brown Rhodophyta, pyrrophyta. Economic importance of algae. Principles and outline classification of fungi: *Myxomycetes, Ascomycetes*, *Basidiomycetes, Deuteromycetes, Zygomycetes, Acrasiomycetes* and *Oomycetes.* In-depth study of *Aspergillus* sp.*, Candida* sp.*, Mucor* sp and *Agaricus* sp. Economic importance of fungi.

Unit – V : Protozology

Principles and outline classification of protozoa: Sarcodina, Mastigophora, Ciliata and Sporozoa. Structure and in-depth study of *Entamoeba histolytica and Plasmodium vivax.*

Text Books

1. Pelczar, Jr., Michael, E. C. S. Chan and Noel Kreig. (2000). Microbiology. V Ed. Tata McGraw Hill Book Company.
2. Alexopoulos, C.J. and Mims, C.W. (1979). Introductory Mycology, John Wiley, New York.
3. Lansing M. Prescott, John P. Harley and Donald A. Klein. 2002. Microbiology. V Ed. WCB/McGraw Hill Company. pp: 335 to 553.
4. John G. Holt. 1994. Bergey's Manual of Determinative Bacteriology. Lippincott Williams and Wilkins. Pp: 351-352; 597-724.
5. Dubey H. C. 1978. A Textbook of Fungi, Bacteria and Viruses. Vikaas Publishing House Ltd. Ltd. Pp: 1-341.

References

1. Jeffery C. Pommerville (2016). Alcamo's Fundamentals of Microbiology (Third Edition). Jones and Bartlett Learning. LLC, Burlington, MA 01803.
2. HansG. Schlegel. 2012. General Microbiology. VII Ed. Cambridge University Press. UK.
3. S. Biwasis and Amita Biswas. 1998. An Introduction to Viruses. Vikaas Publishing House Pvt. Ltd. Pp: 1- 17; 209 – 224.
4. Chatterjee, K. D. 1981. Parasitology. Chatterjee Medical Publishers. Pp: 1-106.
5. Brock, T. D., Smith, D. W and Madigene, M. T. 1997. Biology of Microorganisms: Milestones in Microbiology. Prentice-Hall International Inc. London.

Web resources:

a. http://www.microbiologyonline.org.uk/links.html
b. http://www.bac.wise.edi/microtextbook/index.php
c. http://www.microbeworld.org.uk
d. http://www.staff.ncl.ac.uk/n.y.morris/lectures/class2007.html

18MIBP0103 **MICROBIAL METABOLISM** **Credits-4**

Objectives: Students will be able to learn how to make microbes differentiate based on the metabolism and describe how microbes do catabolism to get energy and metabolism to build structure.

Learning Outcomes:

Upon completion of this course, students should be able to recognize:

- How fundamental chemical principles and reactions are utilized in biochemical processes.
- To understand the principles and mechanism of aerobic and anaerobic respiration in microorganisms.
- Be impressed on the special fermentation by specific microbes.
- Be able to understand in depth the principles and mechanism of photosynthesis.
- Understand the fundamentals of bioluminescence and quorum sensing

UNIT –I : Metabolism *(source NPTEL course)*

Definition, terminology - types - specific functions and general pattern of metabolism – Anabolism versus Catabolism – Metabolic pathways – Linear, irreversible and branched metabolic pathways – Mechanisms of enzyme reaction – the role of ATP, reducing power and precursor metabolites in metabolism. Biochemical mechanisms of generating ATP – the components of electron transport chains – NAD, NADP, FAD, FMN, Coenyme-Q, Cytochromes, Ferredoxin and Iron - Sulphur protein. Mechanism of ETC – aerobic respiratory system of *E. coli* – Oxidative phosphorylation – chemiosmotic hypothesis and conformational change hypothesis.

Unit-II : Respiration and bioenergetics

Aerobic respiration – glycolysis – Pentose Phosphate pathway - TCA cycle, Electron transport under anaerobic conditions – nitrate respiration, sulphate respiration, sulphur respiration, carbonate respiration, fumarate respiration and iron respiration -Gluconeogenesis and Calvin–Benson cycle. Basic aspects of bioenergetics – entropy –enthalpy – electron carriers – artificial electron donors – inhibitors – uncouplers – energy bond – phosphorylation.

Unit – III: Special fermentations

Outline mechanisms and ATP regeneration by fermentation – Alcoholic fermentation by yeasts and bacteria ethanol formation. Lactic acid fermentation homofermentation/heterofermentation, lactate fermentation- propionic acid fermentation – formic acid fermentation – butyric acid – butanol fermentation – Homo acetate fermentation.

Unit – IV : Bacterial photosynthesis

Aerobic and anaerobic phototropic bacteria – purple sulphur bacteria, non-sulphur purple bacteria, green sulphur bacteria and cyanobacteria – Pigments of the photosynthetic apparatus – bacteriochlorophylls, carotenoids and bacteriorhodopsin – Localization of the pigments – regulation of pigment. Metabolism of phototropic bacteria – CO_2 fixation, hydrogen donors, dark metabolism, photoproduction of hydrogen, Nitrogen fixation and nif genes. Distribution of the phototropic bacteria – the elementary processes of photosynthesis – anoxygenic photosynthesis – oxygenic photosynthesis – photosynthesis in halobacteria.

Unit- V: Bioluminescence and Quorum sensing *(through NPTEL Course)*

Bioluminescent bacteria and its importance-Biochemistry – Luciferin - Luciferase along with the lux operon (genes). Quorum sensing – Introduction, Types of Autoinducers, Acyl Homoserine Lactone Molecules, Synthesis of Autoinducers, Peptide Pheromones- Autoinducers In Gram-Positive Bacteria, Bioluminescence as a Phenotype of Quorum Sensing- The Lux System.Other Phenotypes in Quorum Sensing Systems.

Text Books

1. Hans G.Schlegel. 2002. General Microbiology, VII Ed., Cambridge University Press, Cambridge.
2. Pelczar, Jr., Michael, E. C. S. Chan and Noel Kreig. (2000). Microbiology. V Ed.Tata McGraw Hill Book Company.
3. Roger Y. Stanier., John L.Ingraham., Mark L.Wheelis., Page R.Painter., 1987. General Microbiology, V Ed., Macmillan Press Ltd., London.
4. Salle, A.J. 1992. Fundamental Principles of Bacteriology, VII Ed., McGraw Hill Publishing Co. Ltd., New York.
5. Gottschalk, G. 1986. Bacterial Metabolism. II Ed. Heidelberg Springer.

References

1. David L. Nelson and Michael M. Cox(2017). Lehninger Principles of Biochemistry, 7th edition, W.H. Freeman and Company, New York
2. Charu Gera and S. Srivastava(2006). Quorum- sensing: The phenomenon of microbial communication, Current science. 90: 666-676.
3. Jeremy M Berg, John L Toymoczko and Lubert Stryer Stryer (2006). Biochemistry VI Edition. W.H. Freeman and Company, New York
4. Albert G. Moat, John W. Foster and Michael P. Spector (2002) Microbial Physiology, 4th Edn. Wiley Liss.
5. Lansing M. Prescott, John P. Harley and Donald A. Klein (2002). Microbiology. V Ed. WCB/McGraw Hill Company.
6. Fuqua W C, Winans S C and Greenberg E P (1994). Quorum sensing in bacteria: the LuxR-LuxI family of cell density-responsive transcriptional regulators, Journal of bacteriology. 176(2): 269–275.

Web resources:

a. http://www.microbiologyonline.org.uk/links.html
b. http://www.bac.wise.edi/microtextbook/index.php
c. http://www.microbeworld.org.uk
d. http://www.staff.ncl.ac.uk/n.y.morris/lectures/class2007.html

18MIBP0104 **MOLECULAR BIOLOGY** **Credits -4**

(May also offered under MOOC / NPTEL with Syllabus available online)

Objectives:

- To impart information on the historical developments in Molecular Biology
- An in-depth study on structure and organization of chromosome, replication process, transcription process, translation process and mutagenesis.
- To expose the students on the basic understanding of various techniques used in molecular studies.

Learning outcomes:

- The students are be able to understand in-depth knowledge on Molecular Biology
- The students are be able to know various types of Mutagenesis
- The students are be able to understand in detailed mechanisms of DNA Replication
- The students are be able to understand the overall concepts of Transcription
- The students are be able to understand in detailed mechanisms Translation

Unit-I : Introduction to Molecular Biology

Introduction and historical development - Central dogma of Molecular biology. The Logic of molecular biology – the efficient argument, examination of models and strong inference. Molecules of life – DNA world – RNA world and protein world. Prokaryotic and Eukaryotic Chromosome organization. Genes – definition, types and functional organization. Structure of DNA - primary, secondary and different forms (A, B & Z). Gene transfer mechanism- bacterial transformation, conjugation and transduction.

Unit- II: Mutagenesis

Mutation – Types – Molecular and biochemical basis of mutation. Mutagenesis – Spontaneous and induced – Base – analog, physical agents, chemical mutagens, intercalating substances and mutator genes. Reversion – definition – Types – Mechanisms – application (Ames test). Mutants – Types and Uses – bacterial mutants, plant mutants and animal mutants.

Unit-III : DNA Replication

Basic rule. The Geometry of DNA replication – Semi conservative replication of double – stranded DNA and Circular DNA molecules. Enzymology – DNA Polymerases I and III, DNA ligase and DNA gyrase. Events in the replication fork – Continuous and discontinuous. Plasmid and φ174 DNA replication- DNA damages – DNA repair mechanism – photoreactivation, excision repair, recombinant repair and DSOS function.

Unit – IV : Transcription

Basic factors of RNA Synthesis - RNA ploymerases – I, II and III - Transcription Mechanisms in prokaryotes and eukaryotes – chain Initiation, elongation and termination. Significance of pribnow box, TATA box, CAAT box and enhancers in transcription initiation. Rho dependent and Rho independent termination of transcription. Classes of RNA Molecules – Messenger, ribosomal and transfer RNA. Post –transcriptional modification - RNA splicing –

role of lysozyme – Spliceosomes, Group I and Group II introns Self-splicing. Capping and tailing of 5' and 3' termini of Eukaryotic mRNA molecules.

Unit – V : Translation

Genetic code – Definition, deciphering of codons – Universality of the code – Wobble hypothesis and codon degeneracy - codon dictionary. Mechanism of protein synthesis - importance of Initiation(IF), elongation(EF) and releasing factors(RF) - post translational modifications – protein splicing and folding – role of molecular chaperones. Regulation of gene expression in prokaryotes – the operon model. Lactose, galactose and tryptophan operon. Feed back inhibition and Allosteric enzymes.

Text Books

1. Lansing M. Prescott, John P. Harley and Donald A. Klein(2002). Microbiology. Mc Graw Hill companies.
2. B. Lewin 2000, Genes VII Oxford University Press.
3. David Freifelder, 1996, Molecular Biology, 4th Reprint., Narosa Publishing House, New Delhi, India.
4. H.D. Kumar, 1993, Molecular Biology & Biotechnology, Vikas publishing house Pvt. Ltd., New Delhi.
5. S.C. Rastogi, V.N. Sharma, Biology & Biotechnology, Vikas Publishing House Pvt. Ltd., New Delhi.

References

1. R.F. Weaver and P.W. Hedrick 1992, Genetics Wh.C. Brown publishers, Dubuque.
2. E.J. Gardener *et al.,*. 1991 Principles of Genetics (8th Ed.,) John Wiley & Sons, New York.
3. Buchanan, Gruissum and Jones, (2000). Biochemistry and Molecular Biology of Plant; ASPP, USA.
4. David Rawn(2012). Biochemistry. Panima Publishers.
5. Richard Calendar (2005). The Bacteriophages, 2nd Edition, Oxford University Press.
6. J.E. Krebs, E.S. Goldstein, and S.T. Kilpatrick(2012). LEWINS Gene XI. Jones and Barttlett Publishers.
7. Alberts et al., Molecular Biology of the Cell, Garland Publications, (2012).

*(NPTEL) - National Programme on Technology Enhanced Learning.

Web resources

1. www.cellbio.com/education.html
2. https://www.loc.gov/rr/scitech/selected- interval/molecular.html
3. global.oup.com/uk/orc/biosciences/molbio/
4. https://www.loc.gov/rr/scitech/selected-internet/molecular.html

18MIBP0105 BIOCHEMISTRY Credits – 3

(May also offered under MOOC / NPTEL with Syllabus available online)

Objectives:

- To make the students knowledgeable on the various biological molecules and their importance
- To study the classification and structural properties of various biological molecules
- To acquire an overall knowledge on enzymes and their kinetics
- To provide knowledge on metabolic pathways and their biochemical importance

Learning outcomes:

- The students will learn the classification and structural properties of protein, carbohydrates and lipids.
- The students will become knowledgeable on classification of enzymes and are able to understand the characteristics of enzyme reactions.
- The students will be able to understand the structure and the biological activities of Nucleic acid and Vitamins.
- The students will be able to understand on metabolic pathways and their biochemical importance.
- The students will be able to understand on lipid metabolism and knowledge on amino acid & urea metabolism.

UNIT – I

Classification of protein – Based on source, shape, composition and solubility – carbohydrates – Monosaccharides, oligosaccharides and polysaccharides – Lipids – simple, compound and derived. Structure – protein – primary, secondary, Tertiary and quaternary – Carbohydrates and lipids – Properties – physical and chemical properties of protein, carbohydrate and lipids.

Unit – II

Enzymes : Classification – Based on substrate acted upon by the enzyme, Type of reaction catalysed, substrate acted upon and type of reaction catalysed, substance that is synthesized, chemical composition of the enzyme substance hydrolysed and the group involved and over–all chemical reaction taken into consideration – six major classes of enzymes – oxidoreductases, Transferases, Hydrolases, Lyases, Isomerases and Ligases – Characteristics of enzymatic reaction (enzyme concentration, substrate concentration and michaelis – menten equation). Enzyme specificity and enzyme inhibitors.

Unit – III

Nucleic acid structures – biological activities of Nucleic acids – synthesis – salvage and de novo pathway – Degradation – Regulation of nucleic acid metabolism – Replication of DNA – DNA polymerase in prokaryotes and eukaryotes – vitamins – Fat soluble and water soluble – structure, physiological role and disorders.

Unit – IV

Introduction to metabolism – Catabolism and anabolism – Metabolic pathways – Carbohydrate metabolism – Glycolysis or EMP pathway, Pentose – Phosphate pathway, Krebs cycle (TCA

cycle) Electron transport chain and oxidative phosphorylation – Biochemical importance and regulation.

Unit – V

Lipid metabolism – Digestion and absorption of fatty acids – Oxidation and synthesis- Synthesis of triglycerides – Essential and Non-essential fatty acids – Amino acids- Essential and Non-essential – urea synthesis.

Text books

1. David L. Nelson and Michael M. Cox(2017). Lehninger Principles of Biochemistry, 7th edition, W.H. Freeman and Company, New York
2. Donald Voet, Judith G. Voet, Charlotte W. Pratt (2016). Fundamentals of Biochemistry Fifth Edition. John Wiley & Sons Inc, New York.
3. J.L. Jain 2003 Fundamental of Biochemistry S. Chand of company Ltd, New Delhi.
4. G.S. Sandhu 2002 Text book of biochemistry 18th Edn. Campus books International, New Delhi.
5. A.C. Deb. 2000 Fundamentals of Biochemistry New Central book Agency, Ltd, Calcutta. J.H. Well 1997. General biochemistry. 6th Edn. New Age International (P) Ltd pub; New Delhi.

Reference Books

1. D.Papachristodoulou, A. Snape, W.H. Elliott and D. C. Elliott(2014). Biochemistry and Molecular Biology. 5th Edn. Oxford University Press
2. Jeremy M Berg, John L Toymoczko and Lubert Stryer Stryer (2006). Biochemistry VI Edition. W.H. Freeman and Company, New York
3. Lansing M. Prescott, John P. Harley and Donald A. Klein(2002). Microbiology. Mc Graw Hill companies.
4. Buchanan, Gruissum and Jones, (2000). Biochemistry and Molecular Biology of Plant; ASPP, USA.
5. David Rawn(2012). Biochemistry. Panima Publishers.

Web resources:

- Onlinelearning.hms.harvad.edu/biochemistry
- Aldrin.tripod.com/biochemistry
- https://study.com/biochemistry-class-online.html
- Canterbury.libguides.com/bchm/websites

18MIBP0106 FUNDAMENTALS OF MICROBIOLOGY – PRACTICALS Credit-1

Objective:

- To enhance the student's knowledge and impress upon them the important aspects of microorganisms
- To provide practical knowledge and skill in the isolation and handling of microorganisms
- To understand the working procedure and principles of microscopes.
- To know pure culture techniques and methods of culturing preservation and maintenance of microorganisms
- To gain skill in isolation of microorganisms from various samples.

Learning outcomes:

By the end of this course students will be able to:

- Identify standard methods for the isolation, identification and culturing of microorganisms.
- Comprehend the ubiquitous nature of microorganisms and identify the different groups of microorganisms from different habitats and their applications
- Carry out experiments to evaluate microbial quality of food products and water

EXPERIMENTS:

1. a) Safety measures and rules of conduct to be followed in a microbiological laboratory.
   b) Cleaning of Glasswares
   c) Handling and Care of Microbiological Instruments.

2. a) Microscopic Examination of Living Organisms – Demonstration of Motility (Hanging drop method).
   b) Sample preparation and characterization of microorganisms using Scanning Electron Microscope (SEM).
   c) Measurement of Microorganisms using Micrometry.

3. Staining Techniques – Gram's staining, Acid-fast staining, Endospore Staining and Capsule staining.

4. Basic Laboratory and Culture techniques
   a) Preparation of Culture Media for Microorganisms. Preparation and sterilization.

   b) Demonstration of Techniques for Pure Culture of Micro-organisms by Serial Dilution Techniques and determination of Bacterial numbers.
      i) Streak Plate method.
      ii) Pour Plate method
      iii) Spread Plate method

iv) Isolation of Anaerobic Bacteria
v) Isolation and maintainance of pure cultures.
vi) Determination of bacterial numbers

5. Isolation of Bacteriophage from Sewage.

6. Milk Analysis – Total Aerobic count and Methylene Blue Reductase Test

7. a)Standard Qualitative Analysis of Water
   i) Presumptive Test for Coliform Group of Bacteria.
   ii) Confirmed Test of Coliform Bacteria.
   iii) Completed Test for Coliform Bacteria.

8. Water Analysis for Total Bacterial Population by Standard Plate Count Method
9. Enumeration of Microorganisms from soil using serial dilution technique.
10. Enumeration of Microorganisms from Air using Air sampler
11. Isolation of VAM spores from soil

References

1. James. G. Cappucino. And Natabe Sherman, 2004. Microbiology – A Laboratory Manual, VI Ed., (I Indian Reprint). Pearson Education (Singapore) Pvt. Ltd., India.
2. Dubey, R.C and Maheswari, D.K. 2002. Practical Microbiology, I Ed., Chand and Company Ltd., India.
3. Aneja. K.R, 2002. Experiments in Microbiology plant pathology tissue culture and mushroom production technology, III Ed. New Age International publishers (P) Ltd, New Delhi.
4. Breed and Buchanan. Bergey's Manual of Systematic Bacteriology. 2nd Edition, (Volumes. 1 – 5) (2001 – 2003).

18MIBP0107 MICROBIAL METABOLISM AND BIOCHEMISTRY Credit - 1
PRACTICALS

Objectives: Students will be able to depict the flow of carbon during catabolism by a representative prokaryote. Students will be able to measure microbial growth and make microbes accountable.

Learning Outcomes

Upon successful completion of this course, students will be able to:

- Understand how microbial growth is measured and analyze bacterial growth curves.
- Analyze the biochemical characteristics of bacteria
- Identify unknown species of bacteria and fungi.
- Estimate various biological molecules

EXPERIMENTS:

1. Determination of growth curve of bacteria by viable count method. Calculation of Generation Time.
2. Bacterial population count by turbidity determination method.
3. Direct cell/spore counting by Haemocytometer.
4. Effect of environmental factors on growth of bacteria.
    a. Effect of Temperature, pH, Osmotic pressure, UV light & heavy metals on the growth of bacteria.
5. Determination of TDP and TDT of an organism
6. Genus identification of unknown bacterial strains using the Bergey's Manuals:
   IMVIC test of enteric bacteria
    a. Indole production test.
    b. Methyl red & Voges Proskaüer test
    c. Citric acid production test.
7. a) Catalase activity for H_2O_2 production. b) Oxidase activity of a given bacterial sample
8. a) Urease production test.
   b) Gelatin hydrolysis by bacteria.
   c) Nitrate Reductase activity.
   d) TSI test.
   e) Carbohydrate fermentation (glucose, sucrose and lactose)
9. Test for antimicrobial property (Kirby-Bauer method) by disc diffusion method Determination of MIC of an antibiotic.
10. Studies on starch, casein and lipid hydrolysis.
11. Genus Identification of an unknown fungi and measurement of fungal growth by biomass method.
12. Estimation of IAA production by micro-organisms.
13. Fermentative production of amylase by *Bacillus* species.
14. Estimation of carbohydrates(Anthrone method), aminoacids and proteins (Folin Lowry's) and lipids(Bligh and Dyer's method, Van Handel's method).

References

1. James. G. Cappucino. And Natabe Sherman, 2004. Microbiology – A Laboratory Manual, VI Ed., (I Indian Reprint) Pearson Education (Singapore) Pvt.. Ltd., India
2. Dubey, R.C and Maheswari, D.K. 2002. Practical Microbiology, I Ed., Chand and Company Ltd., India.
3. Aneja. K.R, 2002. Experiments in Microbiology plant pathology tissue culture and mushroom production technology, III Ed. New Age International publishers (P) Ltd, New Delhi.
4. Breed and Buchanan. Bergey's Manual of Systematic Bacteriology. 2nd Edition, (Volumes. 1 – 5) (2001 – 2003).

18MIBP0208 **FOOD MICROBIOLOGY** **Credit -4**

Objectives:

- To impart information on the scope and development of food microbiology
- To understand fermentation technologies in the food processing industry.
- To create awareness among the students about the food quality analysis and the role of government organizations involved in food quality control.
- To give an overview on food spoilage organisms- Food borne diseases- to understand infection process and foodborne outbreaks.

Learning Outcomes:

By the end of this course students will be able to:

- Be impressed on the role of microorganisms in food (beneficial as well as harmful) and the factors influencing their growth.
- Identify key problems and prospects in processing and preservation of perishable food products and understand the microbial hazards involved
- Be able to understand in depth the techniques/process used in microbial products using fermentation technology
- Be able to comprehend the different aspects of food preservation.
- Students able to understand the quality assurance of foods especially HACCP.

Unit I : Microbiology of Foods

History of microorganism in food. Primary sources of microorganisms found in food. Intrinsic and Extrinsic parameters of food that affect microbial growth.

Unit II : Food poisoning and Food-borne diseases

Food intoxication and Food infection – Food hygiene and sanitation (utensils and cross contamination). Food poisoning mycotoxins and bacterial toxins. Microbial contamination of foods – spoilage of food by microbes in meat, poultry, sea food, grains, vegetables, fruits and canned food. Microbial spoilage of milk and food, types of spoilage organisms

Unit III : Microbial fermentations

Bread making, Alcoholic Beverages viz., wine, beer and whisky. Some fermented food preparations, Sauerkraut preparations and natural Vinegar. Fermented foods – preparation of Yogurt, Manufacture of cheese. Fermented soybean products, microorganisms as food single cell protein yeast, algae and fungal biomass production. Fermented milk and dairy products.

Unit IV : Food processing and preservation (*Source NPTEL cou**rse***)

Methods of food preservation, Aseptic handling, pasteurization of milk, refrigeration and freezing, high temperature, dehydration, osmotic pressure, chemicals- organic acids, nitrates, nitrites & cresols; Radiation – UV light, - irradiation. Food preservation with modified atmosphere. Advanced and conventional microbiological method for examination of foods.

Unit V : Quality and safety assurance

Quality and safety assurance in food and dairy industry Good manufacturing practice, hazard analysis and critical control point (HACCP) concept. BIS Laboratory services. Microbial criteria/ standards for various products.

Text Books

1. Carl, A.B and Tortorello, M.L. 2014. Microbiology, 2nd Ed. Academic Press, London.
2. Sivasankar, B. 2010. Food processing and preservation, PHL Learning Pvt. Ltd., New Delhi.
3. Tucker, G.S.2008 Food Biodeterioration and Preservation Blackwell Publishers, UK.
4. Jay, J.M.2000 Modern Food Microbiology 6th Ed. Aspen Publication, USA.
5. Joshi V. K and Ashok Pandey. 1999. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. (VOL II).

References

1. Britz, T.J. and Robinson, R.K.2008 Advanced Dairy Science and Technology Blackwell publ.,U.K.
2. Hobbs,B.C.and Roberts,D. 1993.Food Poisoning and Food Hygiene, Edward Arnold (A Division of Hodder and Sloughton), London.
3. Salle, AJ. 1992. Fundamental Principles of Bacteriology, VII Ed., McGraw Hill, Publishing Co. Ltd., New York. pp: 710-793.
4. Robinson, R.K. 1990. Dairy Microbiology, Elsevier Applied Sciences, London
5. Banwart, GJ. Basic Food Microbiology, CBS Publishers and Distributors.

Web Resources:

1. http://www.microbes.info
2. http://www.fsis.usda.gov/
3. http://www.cdc.gov.
4. http://www.microbes.info/ resource/food microbiology
5. http://www.binewsonline.com/1/what is food microbiology.html

18MIBP0209 AGRICULTURAL MICROBIOLOGY Credits-4

Objectives:

- To impart in-depth information on soil and agriculture
- To make the students understand the role of microbes in agriculture
- To give an overview on plant microbe interaction. To understand infection process and control measures
- To know the importance of biofertilizers and biopesticides
- To make the students to know about various techniques involved in biofertilizers and biopesticides production

Learning outcomes:

By the end of this course students will be able to

- Understand the role of microbes in the different cycles and their role in agriculture
- Understand biological nitrogen fixation in symbiotic and non symbiotic associations with plants.
- To know the value, production, application and crop response of biofertilizers and biopesticides.
- To have an in depth knowledge on biopesticides and their role in pest control.

Unit – I : Soil Microbiology

Composition of Lithosphere, Soil physical, chemical and biological interaction. Factors influencing soil microbial population. The soil environment-Distribution and abundance, generic groups and nutrition of bacteria, actinomycetes, fungi, algae, protozoa and viruses.

Unit – II: Microbial transformations of minerals

Bio geo chemical cycles- Carbon, Nitrogen, Phosphrous, Sulphur, iron and other elements microbial transformation-Mineralization-Aminisation-Ammonification-Factors affecting microbial transformation-Organisms involved in the process of microbial transformation

Unit – III : Biological Nitrogen fixation-Legume-Rhizobium symbiosis

Biological Nitrogen fixation – symbiotic - root nodulation, non symbiotic, associative organisms, nitrogenase, hydrogenase, nif gene, nod gene- Biochemistry of nitrogen fixation-Factors influencing nitrogen fixation (Edapic factor, Climatic factor and biotic factor)-Estimation of nitrogen fixation-Ammonia assimilation-Nitrate assimilation-Importance of nitrogen fixation

Unit- IV: Non Leguminous associations and biofertilizer production

*Azotobacte*r sp and Azospirillum sp and their functions - Cyanobacteria (BGA) and their associations in Nitrogen fixation. Phospahte solubilizing microbes. Mycorhizae and plant growth promoting rhizobacteria (PGPR). Role of biofertilizers. Quality control (BIS specification), marketing, Evaluation of field performance and economics of production. Role of biofertilizer in integrated nutrient management. Regulation and standards, Marketing and Monitoring field performance.

Unit – V : Plant pathogenic microorganisms

Algal, bacterial, fungal, mycoplasma, Nematode and viral, diseases and symptoms. Mode of entry of pathogens and factors affecting disease incidence - Plant disease resistance and various control measures. Phenolic compounds. Interaction of plant pathogens with host. Definition and History of Biopesticides – Viral (NPV, CPV & GV), bacterial (*Bacillus thuringiensis, B.popillae & Pseudomonas* sp.), Fungal (*Entomophthora musca, Beaveria* sp*., Metarrhizium* sp*. & Verticillium* sp.),Protozoan (*Mattesia* sp*., Nosema* sp*., Octospora muscaedomesticae & Lambornella* sp.).

Text Books

1. Gupta, S.K.2014 Approaches and trends in plant disease management. Scientific publishers, Jodhpur, India.
2. Jamaluddin *et al* 2013 Microbes and sustainable plant productivity. Scintific Publishers Jodhpur, India. G
3. Subba Rao, N. S. 1997. Biofertilizers in Agriculture and Forestry, III Ed., Oxford & IBH Publishing Co.Pvt.Ltd.,New Delhi.
4. Subba Rao, N. S. 1995. Soil microorganisms and plant growth. Oxford & IBH Publishing Co.Pvt.Ltd. New Delhi.
5. Martin Alexander 1983. Introduction to Soil Microbiology, Wiley eastern Ltd., New Delhi.

References

1. Gaur, A.C., 1999. Microbial technology for Composting of Agricultural Residues by Improved Methods, 1st print, ICAR, New Delhi.
2. Glick, B.R. AND Pasternak, J.J 1994. Molecular Biotechnology, ASM Press, Washington DC.
3. Purohit, S. S., Kothari, P. R. and Mathur 1993. Basic and Agricultural Biotechnology, Agrobotanical Publishers (India). Bikaner.
4. Newton, W.E and Orme, Johnson, W.H.1980. Nitrogen fixation vol II: Symbiotic Associations and Cyanaobacteria. University park Press Baltimore, USA.
5 . Wheeler, B. E. 1976. An Introduction to Plant Disease. ELBS and John Wiley and Sons, Ltd.

Web resources:

1.https:/microbewiki.keyon.edu/index.php/agricultural-microbiology
2. mic.microbiologyresearch.org/
3.https://www.microbe,net/resources/microbiology-web-resources
4.microbiologyonline.org

18MIBP0210 APPLIED ENVIRONMENTAL MICROBIOLOGY Credits – 3

Objectives: This course aims to provide the student with an understanding of the current views of microbial association in various environments; to evaluate the continuing roles played by microbes in the environment, and to consider the non-pathogenic roles of microbes in the human body

Learning Outcomes:

- On the completion of the course students should be able to:
- Understand on soil characteristics and biogeochemical cycling
- Know the microbial analysis of drinking water and aeromicrobiology
- Know on the different aspects of waste management and sewage Treatment systems
- Acquire knowledge on bioremediation and microbial leaching
- Know the biosafety and environmental monitoring regulations

Unit I : Soil characteristics & Biogeochemical cycling

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

Unit- II : Microbial analysis of drinking water & Aeromicrobiology

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

Unit- III : Waste management & Sewage Treatment

Waste management - Utilization of solid and liquid waste pollutants for production of Single-Cell protein. Nature of sewage and its composition. Physical, chemical and biological properties of sewage (BOD, COD etc). Sewage systems and types. Sewage Treatment: Single Dwelling Unit, municipal sewage treatment - primary, secondary and tertiary treatments (Trickling filters, activated sludge process, Oxidation lagoons and Imhoff tank).

Unit- IV : Bioremediation & Microbial leaching

Polluted heterogeneous environment. Indicator organisms for pollution and abatement of pollution. Bioremediation – Types and uses - Microbes and Environmental clean up - Genetically Engineered microbes for Bioremediation. Microbial leaching: In situ & Ex situ methods -copper and uranium mining.

Unit- V : Biosafety & Environmental monitoring

Environmental regulations - Biohazards - Types of hazardous emission - Biosafety measures - Biomonitority of waste water toxics - Monitoring of Genetically Engineered Microbes in the Environment.

Text Books

1. Raina M. Maier, Ian L. Pepper and Charles P. Gerba. 2000. Environmental Microbiology. Academic Press. New York.
2. Patel, A.H. 1996. Industrial Microbiology, Macmillan India Ltd., New Delhi
3. Subba Rao, N. S. 1995. Soil Microbiology. IV Ed. Oxford & IBH Publishing Co. Pvt. Ltd.New Delhi. pp: 11-49; 292-301.
4. Salle, A.J. 1992. Fundamental Principles of Bacteriology, VII Ed., McGraw Hill Publishing Co. Ltd., New York. pp: 649-709;794-843.
5. Atlas, R.M. and Bartha, R. 1992. Microbial Ecology: Fundamentals and Applications.III Ed., Benjamin Cummings, Redwood City.CA.

Reference Books

1. Mara. D and Horan. N 2003. The Handbook of Water and Waste Water Microbiology. Academic. Press, California.
2. Clescri, L.S., Greenberk, A.E. and Eaton, A.D.1998. Standard Methods for Examination of Water and Waste Water, 20th Edition, American Public Health Association.
3. Subba Rao, N.S. 1995. Biofertilizers in Agriculture and Forestory.3rd Ed., Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi.
4. Kumar, H.D. 1991. Biotechnology, II Ed., East – West Press Private Ltd., New Delhi.
5. Pelczar.M.J. and Reid 1986 " Microbiology". V Ed., Tata McGraw Hill Co., New Delhi.pp:593-617.
6. Brock, T.D, Smith, D.W. and Madigan M.T 1984, Biology of Microorganisms. IV Ed., Prentice Hall Int. Inc., London.

Web resources:

1. https://www.microbe.net/resources/microbiology-web-resources

2.https;//www.microbes.info/resources/3/environmental-microbiology

3.https://blogs.ntu.edu.sg/library-resources/resource-guide-formicrobiology

4.https://www.asm.org/division/w/web-sites.htm

Alternate syllabus available online

18MIBP0210 APPLIED ENVIRONMENTAL MICROBIOLOGY Credits – 3

(Under NPTEL / MOOC Online mode)

Objectives: This course aims to provide the student with an understanding of the current views of microbial association in various environments; to evaluate the continuing roles played by microbes in the environment, and to consider the non-pathogenic roles of microbes in the human body

Learning Outcomes:

- On the completion of the course students should be able to:
- Understand on Microbes and their environmental niches
- Know the Microbial energetics and diversity
- Know on the different aspects of Microbial ecosystems
- Acquire knowledge on Investigations in environmental microbiology
- Know the Drinking water and solid waste microbiology

Unit–I: Introduction:

Cell elements and composition Cell and its composition - cytoplasmic membrane - Prokaryotic cell division - Microbes and their environmental niches - Historical roots of microbiology - Nucleic acids and amino acids DNA structure, replication, and manipulation Protein and its structure Regulation - Microbial nutrition - Microscopy: Light microscopy, 3D Imaging, AFM, Confocal scanning laser microscopy.

Unit–II: Microbial energetics and diversity:

Stoichiometry and bioenergetics - Oxidation-reduction - NAD, energy-rich compounds and energy storage - Mathematics of microbial growth - Glycolysis Respiration Citric-acid cycle Catabolic Alternatives Phototrophy, Chemolithotrophy, anaerobic respiration (Nitrate and Sulfate reduction; Acetogenesis; Methanogenesis; Metal, Chlorate, and organic electron acceptors) -Microbial metabolism and functional diversity of bacteria Prokaryotic diversity Classical taxonomy - Origin of life Tree of life - Major catabolic pathways Catalysis and enzymes - Energy conservation Sugars and polysaccharides, amino acids, nucleotides, lipids.

Unit-III: Microbial ecosystems:

Population, guilds, and communities Environments and microenvironments - Microbial growth on surfaces Environmental effects on microbial growth - Environmental genomics and microbial ecology - genetic exchange - Environmental genomics Microbial ecology - Horizontal and vertical gene transfer: Replication, Transformation Transduction. Microbial symbiosis and virus, Mutation and its rate ,Genetic recombination, Population dynamics ,Virus ,Viroid, Prion, Application of environmental microbes.

Unit-IV: Investigations in environmental microbiology:

Sampling, detection, isolation, taxonomic and functional annotation and quantification; introductory bioinformatics and data analysis - Microbial sampling Culture based and culture

independent tools: Molecular biology tools: Cloning, amplification, sequencing, Case study. Bioremediation and wastewater microbiology, Bioremediation and examples, Acid mine drainage, Enhanced metal recovery, Wastewater microbiology.

Unit-V: Drinking water microbiology & Public health:

Drinking water microbiome and treatment, Microbial instability, Water borne microbial diseases. Solid waste microbiology and antimicrobial resistance, Landfills, Leachate, Anaerobic degradation phases, Antimicrobial resistance. Epidemiology and biosensors, Public health, Epidemics, Biosensors, Wearable biosensors. Built microbiology, exposomes and bioinformatics, Exposure routes, Microbes living around us, Exposomes, Basic bioinformatics, Bioinformatics tools available online.

Text Books

1. Raina M. Maier, Ian L. Pepper and Charles P. Gerba. 2000. Environmental Microbiology. Academic Press. New York.
2. Patel, A.H. 1996. Industrial Microbiology, Macmillan India Ltd., New Delhi
3. Subba Rao, N. S. 1995. Soil Microbiology. IV Ed. Oxford & IBH Publishing Co. Pvt. Ltd.New Delhi. pp: 11-49; 292-301.
4. Salle, A.J. 1992. Fundamental Principles of Bacteriology, VII Ed., McGraw Hill Publishing Co. Ltd., New York. pp: 649-709;794-843.
5. Atlas, R.M. and Bartha, R. 1992. Microbial Ecology: Fundamentals and Applications.III Ed., Benjamin Cummings, Redwood City.CA.

Reference Books

1. Mara. D and Horan. N 2003. The Handbook of Water and Waste Water Microbiology. Academic. Press, California.
2. Clescri, L.S., Greenberk, A.E. and Eaton, A.D.1998. Standard Methods for Examination of Water and Waste Water, 20th Edition, American Public Health Association.
3. Subba Rao, N.S. 1995. Biofertilizers in Agriculture and Forestory.3rd Ed., Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi.
4. Kumar, H.D. 1991. Biotechnology, II Ed., East – West Press Private Ltd., New Delhi.
5. Pelczar.M.J. and Reid 1986 " Microbiology". V Ed., Tata McGraw Hill Co., New Delhi.pp:593-617.
6. Brock, T.D, Smith, D.W. and Madigan M.T 1984, Biology of Microorganisms. IV Ed., Prentice Hall Int. Inc., London.

Web resources:

1. https://www.microbe.net/resources/microbiology-web-resources

2.https;//www.microbes.info/resources/3/environmental-microbiology

3.https://blogs.ntu.edu.sg/library-resources/resource-guide-formicrobiology

4.https://www.asm.org/division/w/web-sites.htm

18MIBP0211 **BIOSTATISTICS** **Credits - 4**

Objectives:

- Students will be able to make informed decisions based on data and apply statistical tools and techniques in their research works

Learning Outcomes:

Upon completion of the course, the students will be able to:

- be familiar with statistics and its applications in biology
- solve problems quantitatively using appropriate statistical measures
- create and interpret visual representations of quantitative information
- understand and critically assess data collection and its representation
- understand various rates, ratios and odds ratio

Unit–1: Introduction to Bio-Statistics - Development of Biostatistics and its applications - Sources of biological data - Secondary and Primary sources - Classification and tabulation of data - frequency distribution -Diagrammatic and Graphical representation of statistical data

Unit–2: Sampling and Theoretical Distributions - Sampling – meaning, advantages, concept of parameter and statistics, sample size, sampling error, sampling frame, Types of samples – Probability and non-Probability samples – purposive sampling, Reliability of samples. Introduction of probability and its applications – Theoretical Distributions – Binomial, Poisson and Normal distributions; Properties, uses and applications.

Unit–3: Descriptive Statistics - Measures of central tendency - Measures of Dispersion: Measures – Mean, Median, Mode Range, and standard deviation, absolute and relative measures of dispersion.

Unit- 4: Correlation and Regression Analysis - Theory of correlation and regression. Definition, uses, types and correlation, Regression Lines – Properties of regression coefficients.

Unit–5: Biological Measures and Hypothesis Testing: Rates, incidence, prevalence, mortality rate, case fatality; Measurement of risk, odds ratio and Bio-assay and dose responses
Test of attributes, small and large sample tests - Analysis of variance – one-way and two-way classification.

References

1. Vijayalakshmi G. & Sivapragasam C., Research Methods: Tips and Techniques, Chennai : MJP Publishers, 2009.
2. Gurumani N., An Introduction to Biostatistics, Chennai: MJP Publishers, 2004.
3. Sampath kumar V.S., Bio-Statistics, Manonmaniam Sundaranar University publication, Tirunelveli, 1997.
4. Arora P.N. Malhan P.K. Biostatistics, Delhi : Himalaya PublishingHouse, 1996.
5. Verma B.L, Shukla G.D and Srivastava.R.N., Biostatistics – Perspectives in Health Care, Research and Practice, CBS Publishers & Distributors, New Delhi, 1993
6. Gupta C.B. An introduction to statistical methods New Delhi; VikasPublishers, 1992.
7. Gupta, S.P. Statistical Methods, New Delhi: Sultan Chand, 1992
8. Daroga Singh, Chaundjari F.S. Theory and Analysis of Sample survey, New Delhi; Wiley Eastern Ltd., 1986.

Web resources

1.nu.libguides.com/biostatistics
2.https://newonline courses.sciences.psu.edu/

18MIBP0212 **FOOD MICROBIOLOGY – PRACTICALS** **Credit -1**

Objectives:

- To provide practical knowledge and skills in production as well as evaluate the microbial quality of the food product.
- To give students confidence in modern technical capabilities to analyse food for specific microorganisms
- To encourage development of skills in co-operative learning in small groups to design methods for microbial food analysis as a team and communicate the decisions of the design to peers.
- To extend students knowledge on traditional fermented products to industrial fermentation products in the applied area of food microbiology.

Learning Outcomes:

By the end of this course students will be able to:

- Identify standard methods for the isolation and identification of microorganisms in food sample.
- Be impressed on the application of rapid microbial techniques for the microbial analysis of food.
- Be able to comprehend observations, evaluate the data obtained and report accurately on the findings.
- Be able to understand the microbial principles relating to the production of fermented foods.

EXPERIMENTS:

1. Microbiological analysis of food products - microscopic count and standard plate count.
2. Testing the microbiological quality of milk (Standard plate count, Presumptive test for Coliforms, Methylene Blue Reductase test & Phosphatase activity)
3. Isolation and identification of microorganisms from food samples and detect the food spoilage organisms
4. Bioethanol production from sugarcane molasses and wine production from grapes. Evaluation of anti oxidant potential of wine. Determination of colour intensity, reducing sugar and alcohol percentage of wine.
5. Role of yeast in fermented food -bread and some traditional fermented foods
6. Enumeration of anaerobic bacteria from food samples.
7. Detection of aflatoxin from fungi-Qualitative and quantitative analysis
8. Detection and assay of bacteriocin by probiotic lactic acid bacteria.
9. Enumeration of microbial load in fruit pulp, carbonated beverages and ice creams
10. Extraction of pigment phycocyanin from *Spirulina* to be used in industries.
11. Production of extracellular enzymes Protease by submerged fermentation and Cellulase by solid state fermentation
12. Determination of invertase activity
13. Isolation and identification of microorganisms from canned foods
14. Production, antimicrobial effect and nutritional value of Probiotics
15. Production and estimation of SCP from agricultural wastes

References

1. Spencer, JFT and De spencer, ALR. 2001. Food Microbiology protocols, Humama press, Totowa, New Jersey.
2. Dubey, R.C and Maheswari, D.K. 2002. Practical Microbiology, 1st Ed., Chand and Company Ltd., India.
3. Precott, H. 2002. Laboratory excercises in Microbiology. 5th Edition. The Mac Graw – Hill Companies.
4. K. R. Aneja. 1993. Experiments in Microbiology, Plant Pathology and Tissue Culture. Wishwa Prakashan.. New Delhi. India.

18MIBP0213 AGRICULTURAL MICROBIOLOGY–PRACTICALS Credit -1

Objectives:

- To provide practical knowledge in the isolation and characterization of microbes important in agriculture.
- To understand the plant-pathogen interaction
- To be able to isolate organisms that have potential as biofertilizers

Learning outcomes:

- Be able to understand the importance of microbes in agriculture
- Be able to know the methods of isolation, identification and mass production of Biofertilizers
- Be able to know the methods to identify plant pathogens
- Be able to gain expertise in Acetylene reduction assay and radiotracer techniques.

EXPERIMENTS:

1. Demonstration of Winogardsky coloumn.
2. Isolation of beneficial microbes from the soil: *Rhizobium* sp., *Azotobacter* sp., *Azospirillum* sp.,VAM, Cyanobacteria, Phosphobacter etc.
3. Authentication of rhizobia by biochemical and by plant infection test (tubes and Leonard jar experiment).
4. Study the growth response of crops due to biofertilizer application.
5. Compost making - testing the quality of compost made, fortification of compost by inoculating beneficial microbes and rock phosphate.
6. Study on plant pathogens, collection, identification and submission.
7. Cultivation of *Azolla*.
8. Acetylene reduction assay to evaluate nitrogenase activity.
9. Visit to an institution to study use of radiotracer techniques used for plant studies.

References

1. Dubey, R.C and Maheswari, D.K. 2002. Practical Microbiology, 1st Ed., Chand and Company Ltd., India.
2. K. R. Aneja. 1993. Experiments in Microbiology, Plant Pathology and Tissue Culture. Wishwa Prakashan.. New Delhi. India.
3. Sadasivam, S and Manikam, A. 1992. Biochemical methods for agricultural sciences. Wiley Eastern Ltd., New Delhi.

18MIBP0315 INSTRUMENTATION TECHNIQUES AND RESEARCH METHODS

Credits – 4

Objectives:

- To understand the working principles, construction and applications of the instruments used in the studies related to various disciplines of biological sciences.
- To appreciate the importance, concept of research and learn the art of thesis & paper writing and publication.

Learning Outcome:

The Course will provide an overview to know the general laboratory procedures and maintenance of research equipments, Instrumentation of equipments, concept of research and preparation of research proposal & funding agencies

- Understand general laboratory procedures and maintenance of research equipments, microscopy, pH meter and preparation of different buffers
- Describe the pH measurement in soil and water samples\
- Understand how to isolate cellular constituents
- Realise the need of centrifuges and their uses in research
- Understand how to separate amino acids and sugars using paper & thin layer chromatography
- Realise the principle and applications of gas liquid chromatography, HPLC and
- Learn the principles and applications of electrophoresis
- Realise the importance of UV-Visible.
- Understand how to estimate sugars, amino acids and sugars using spectroscopic techniques
- Describe the principle of flame photometer and bomb calorimeter
- Understand the objectives, types and importance of research
- Understand how to present research papers in seminars and conferences
- Realise the need of publication and know the importance of impact factor & citation index
- Describe the methods of writing scientific paper and components of research paper
- Understand how to prepare manuscript & methods of correcting proof
- Able to know how to prepare research proposals, identification of funding agencies and availability of research fellowships

Unit I: Microscopy, pH and Buffer

General Laboratory procedures and maintenance of research equipments- Microscopy- General principles-Confocal Microscope, SEM -EDAX and TEM (source NPTEL)- pH basic principles and construction of pH meter- pH electrodes- Principles and application of buffers- Mechanism of buffer action and preparation of common buffers- Citrate, acetate, tris and phosphate- Application of buffers- pH measurements of soil and water.

Unit II: Isolation, Fractionation and Separation

Isolation, fractionation and separation of cellular constituents- Isolation of chloroplasts, mitochondria, nucleic acids and enzymes- Homogenization- Manual, mechanical and sonication- Centrifugation techniques- Basic principles, Different types of Centrifuges, Analytical and preparative ultracentrifugation methods (source NPTEL)- Chromatography- Paper, thin layer, Ion-exchange, column, affinity - separation of amino acids and sugars- Gas liquid chromatography, HPLC.

Unit III: Electrophoresis, Colorimetry and Calorimeter

Electrophoresis- General Principles Horizontal & Vertical gel electrophoresis, Iso electric focusing, 2D, pulse field and immune electrophoresis (NPTEL), Electrophoresis of proteins and nuclic acids- Spectroscopic techniques- UV-Visible and FT-IR - Flame photometer, Bomb calorimeter, AAS, mass Spectra and NMR- Principle and applications.

Unit IV: Research and Project writing Methods

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

Unit V: Article Publication

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

Text Books

1. Biju Dharmapalan 2012 Scientific Research Methodology. Narosa Publising House, New Delhi.
2. N. Gurumani 2010 Research Methodology for Biological Sciences. MJP Publishers, Chennai.
3. S. Palanichamy and M. Shunmugavelu 2009. Research methods in biological sciences. Palani paramount publications, Palani
4. Rodney Boyer 2001 Modern Experimental Biochemistry. III Ed. Addison Wesley Longman Pte. Ltd, Indian Branch, Delhi, India.
5. Sahu, P.K. 2013. Research Methodology: A Guide for Researchers in Agricultural Science, Social Science and other related fields. Springer, New Delhi.

References

1. K. Kannan 2003 Hand book of Laboratory culture media, reagents, stains and buffers Panima publishing corporation, New Delhi.
2. Keith Wilson and John Walker 2002 Practical biochemistry – Principles and techniques. Fifth edn. Cambridge Univ. Press.
3. P. Asokan 2002. Analytical biochemistry – Biochemical techniques. First dition – Chinnaa publications, Melvisharam, Vellore

Course url

1. http://nptel.ac.in/syllabus.php?subject Id= 102107028.
2. http://b-ok.xyz/book/674611/288bc3
3. http://www.researchgate.net/publication/317181728- Lecture Notes on Laboratory Instrumentation and Techniques.
4. iiscs.wssu.edu/drupal/node/4673
5. http://www.studocu.com/en/search/research methodology?languages=language_en&type =document

*(NPTEL) -National Programme on Technology Enhanced Learning.

18MIBP0316 IMMUNOLOGY AND MEDICAL MICROBIOLOGY Credits-4

Objectives:

- The objective of this course is students will learn about the structural features of the components of the immune system as well as their functions and responsiveness.
- The student will able to learn the basic concepts of medical microbiology and microbial pathogenesis: study of microbes, antimicrobial agents, epidemiology, and virulence factors associated with the pathogen.

Learning Outcomes:

At the end of this course students will be able to:

- Understand the role of pathogen in causing infectious disease on humans, natural barriers to infection, innate and acquired immune responses to infection and inflammation
- Understand the antigen antibody reactions and principles of hypersensitivity.
- Understand vaccine, immunohematology and tumor immunology.
- Compare and contrast different bacterial diseases, including the properties of different types of pathogens, and the mechanisms of pathogenesis.
- Comprehend viral-human interaction, in-depth knowledge on different viral and fungal diseases.

Unit- I : Introduction to Immunology

History and scope of Immunology. Microflora of normal human body, Host parasite relationships, microbial infection, virulence and host resistance. Lymphoid organ systems - Ontogeny & physiology of immune system. Immunity - Definition and types, acquired, passive and active, physiology of immune response - Humoral immunity and cell mediated immunity. Mechanism of immune regulation - tolerance.

Unit- II : Antigen and Immunoglobulins

Antigen: types - properties and functions; Immunoglobulin: Types structure, function. Antigen - antibody reaction*, Invitro* methods: Agglutination - precipitation, complement fixation, Immunoflurescense, ELISA, RIA. *Invitro* method - Immune complex tissue demonstration. Theories of antibody production. Hypersensitivity reactions - Antibody mediated - Type I anaphylaxis - Type II Antibody dependent cell cytotoxicity - Type III Immune complex reactions - the respective disease and immune response - Lymphokines, cytokines - Type IV hypersensitivity reactions.

Unit-III : Immunohaematology, Tumor immunology & Vaccines

Immunohaematology of blood groups, forensic serology - ABO and Rh incompatibility. Transplantation. HLA tissue typing – major histocompatibility complex - immunological tolerance - Immune suppression. Tumor immunology - Tumor antigens - Immunotherapy of malignancy - Autoimmune disease. Principles underlying the preparation of live, attenuated vaccines and recombinant vaccine (Hepatitis B). Monoclonal antibody - production and application

Unit- IV : Bacterial diseases

Development of medical bacteriology as scientific discipline: contributions made by eminent scientists. Classification of medically important microorganisms; Classification of pathogenic bacteria. *Staphylococcus,s, Neisseria; Corynebacterium, Clostridium*, *Vibrio*, *Yersinia, Haemophilus, Mycobacterium*, Spirochetes, Bordetella, Rickettsiae, *Chlamydia*.

Unit-V : Viral and Fungal diseases

General properties of viruses Host interactions: Pox viruses; Herpes virus, Hepatitis viruses Picorna viruses, Orthomyxo viruses and Human Immuno deficiency viruses (HIV) Fungal diseases of man, Epidemiology. Dermatophytes, dimorphic fungi, opportunistic fungal pathogens. Description and classification of pathogenic fungi and their laboratory diagnosis, treatment. Superficial mycoses, subcutaneous mycoses, systemic mycoses.

Text books

1. Kuby Immunology; Oven, (2013). Punt, Stranford, 7th Edn. W. H. Freeman
2. Michael. J. Pelczar, JR, E.C.S. Chan, Noel R. Krieg. 2000. Microbiology. TATA McGraw Hill. pp: 673-763.
3. Greenwood D, Richard C.B.and.Peutherer S.J.. 2000. Medical Microbiology. Churchill Livingstone.
4. Roitt, I.M.. 1998. Essential Immunology, Blackwell Scientific Publishers.
5. Ananthanarayanan. R. and C.K. Jayaram Panicker.1997. Textbook of Microbiology Orient Longman.

Reference

1. Antibodies– A Laboratory Manual; E. D. Harlow, David Lane, 2nd Edn. CSHL Press (2014).
2. Understanding Immunology (Cell and Molecular Biology in Action). (2006).; Peterwood, Pearson Education Ltd
3. Microbiology; Prescott, Harley and Klein, McGraw-Hill (2003).
4. Molecular Toxicology; Nick Plant, Garland Science (2003).
5. Stanier, Y. Roger, John L. Ingrahm, Mark L. Wheelis and Page R. Painter. 2003. General Microbiology. V Ed. MacMillan Press Ltd. New Jersey. pp: 585-620.
6. Lansing. Prescott, John. P. Harley and Donald. A. Klein 1999. Microbiology. WCB McGraw – Hill Company. pp: 605-676.
7. Kuby, J. 1994. Immunology 2nd Ed., W.H. Freeman and Company, New York.

Web resources:

1. https://www.microbe.net/resources/microbiology/web-resources/
2. https://www.omicsonline.org/medicalmicrobiology-diagnosis.php
3. guides.emich/immunology
4. http://oew.mit.edu/courses/.../hst-176-cellular-and-molecular.immunology-fall-2005

18MIBP0317 INDUSTRIAL MICROBIOLOGY Credits-4

Objectives:

- An in-depth study on industries
- To make the students knowledgeable on production of various industrial products.
- To make the students to know various techniques used in industries.

Learning outcomes:

By the end of this course:

- The students will be able to know historical aspects of industrial microbiology and fermentation techniques
- The students will be able to understand screening methods for Industrial microbes
- The students will be able to understand Biology of Industrial Microorganisms
- The students will be able to know the Industrial production of various products
- The students will be able to understand the rules and regulation of industrial microbiology

Unit – I : History and Fermentor *(source NPTEL)*

Introduction, Historical background, Fermentor - principle, types - design - mode of operation - instrumentation and control - sterilization of fermentor - aseptic inoculation method. Fermentation process- upstream and downstream process.

Unit – II : Screening methods for Industrial microbes

Detection and assay of fermentation products - Classification of fermentation types - Genetic control of fermentation - Strain selection and improvement - mutation and recombinant DNA technique for strain development.

Unit – III : Biology of Industrial Microorganisms

Streptomyces, *Saccharomyces*, *Spirulina* and *Penicillium*; Large scale cultivation of Industrially important microbes, Fermentation media - Desired qualities - media formulation strategies - carbon, nitrogen, vitamin and mineral sources, role of buffers, precursors, inhibitors, inducers and antifoams.

Unit – IV : Industrial production

Product recovery and purification. Vitamins - Riboflavin, cyanocobalamin. Enzymes (protease, amylase). antibiotics (penicillin, streptomycin). Microbiological assay of vitamins and antibiotics. Antigens, antibodies, interferons, vaccine, insulin, toxin, toxoid.

Unit – V : Rules and regulation

Newer Approaches to Industrial waste and sewage treatment and disposal. Institutional Biosafety Committee.

Text Books

1. Srivastva, M.L. 2008. Fermentation Technology, Narosa Publ. House, New Delhi.
2. Michael J. Waites, Neil L.Morgan, John S. Rockey and Gray Higton. 2001. Industrial Microbiology An Introduction, Replika Press Pvt Ltd. New Delhi.
3. Wulf Crueger and Anneliese Crueger. 2000. A textbook of Industrial Microbiology II Ed. Panima Publishing Corporation, New Delhi.
4. Prescott and Dunn's. 1997. Industrial Microbiology. CBS publishers and Distributors.
5. Patel A.H. 1996. Industrial Microbiology, Macmillan India Limited

References

1. Stanbury, P.F., Whittaker, A. and Hali, S.J. 1995. Principles of Fermentation Technology, II Ed., Pergamon Press.
2. V. K. Joshi and Ashok Pandey. 1999. Biotechnology: Food Fermentation-Microbiology, Biochemistry and Technology.
3. Casida, L.E. 1986. Industrial Microbiology, Eastern Limited, New York.

Web resources:

1.www.rmit.edu.au/courses/034150
2.microbiologyonline.org
3.https://www.omicsonlineorg/.../industrial-microbiology-journals-articles-ppt-list.php
4.www.nature.com/nrmicro/series/applied and industrial

18MIBP0318 INSTRUMENTATION TECHNIQUES - PRACTICALS Credit - 1

Objectives:

- To know the preparation of buffers and determination of pH.
- To separate amino acids and sugars using chromatography and electrophoresis
- To estimate proteins, sugars, nucleic acids, chlorophyll, sodium, potassium, calcium and magnesium using different equipments.

Learning Outcome:

By the end of this course students will be able to:

- Know the preparation of buffers and determination of pH.
- Separate amino acids and sugars using chromatography and electrophoresis
- Estimate proteins, sugars, nucleic acids, chlorophyll, sodium, potassium, calcium and magnesium using different equipments.

EXPERIMENTS:

1. Preparation of buffers and determination of pH using pH meter
2. Separation of amino acids and sugars using paper chromatography (2D)
3. Separation of amino acids and sugars using thin layer chromatography
4. Separation of pigments by column chromatography
5. Separation of proteins using vertical gel electrophoresis.
6. Verification of Beer- Lambert's law using spectrophotometer.
7. Estimation of Protein using Spectrophotometer
8. Estimation of sodium, potassium, calcium and magnesium using Flame photometer
9. Estimation of calorific value of biodiesel/ food/ biomass
10. Demonstration of Biological samples using SEM –EDAX
11. Demonstration of ASS, FT-IR, Mass Spectra and NMR

References

1. Rodney Boyer, 2001. Modern Experimental Biochemistry. III Ed. Addison Wesley Longman Pte. Ltd, Indian Branch, Delhi, India.
2. J.Jeyaraman 1981. Laboratory Manual in Biochemistry. New Age International publishers, New Delhi.

18MIBP0319 IMMUNOLOGY AND MEDICAL MICROBIOLOGY-PRACTICALS

Credit -1

1. Selection, collection, and transport of specimens, blood samples, sera for microbiological and immunological examinations
2. Isolation and enumeration of Anaerobic bacteria from wound specimen.
3. Isolation and identification of Human pathogenic fungi and other opportunistic organisms.
4. Fixation of Smears for microscopy by different methods
5. Different staining techniques
   a) Ziehl –Neelsen method for AFB
   b) Leishman's staining
   c) Albert's staining
   d) Giemsa's staining
   e) Special staining methods to demonstrate granules, capsules and spores
6. ABO Blood grouping and Rh typing
7. Agglutination tests
   a) WIDAL
   b) VDRL Test (RPR).
   c) RA
   d) ASO(Anti streptolysin 'O' Test).
   e) HBs Ag Test
   f) CRP
8. Precipitation Tests
   a) Immuno - diffusion test
   b) Immuno electrophoresis
9. Demonstration of ELISA (HIV & HBs Ag)
10. Visit to Diagnostic Labs and Hospitals

References

1. Horold J Benson (1998). Microbiological Applications - Laboratory Manual in General Microbiology. Seventh International edition, Mc Grew-Hill, Boston.
2. Cappuccino, J. and Sherman, N. (2002) Microbiology: A Laboratory Manual, 6th Edn. Pearson Education Publication, New Delhi.
3. Collee, J.C., Duguid, J.P., Fraser, A.C. and Marimon, B.P. (1996) Mackie and McCartney. Practical Medical Microbiology, 14th Edn. Churchill Livingstone, London.
4. Turgeon, M.L., 1990. Immunology and serology in laboratory medicine, St.Louis, C.V. Mosby Co.
5. Talwar G.P and Gupta S.K(1992). A hand book of practical and clinical immunology. CBS Publication, New Delhi, India
6. E. D. Harlow, David Lane (2014). Antibodies– A Laboratory Manual;, 2nd Edn. CSHL Press

18MIBP0318 BIOTECHNOLOGY AND GENETIC ENGINEERING Credits - 4

Objectives:

- To impart information on the historical aspects development of Biotechnology and Genetic Engineering
- To provide knowledge and in-depth study on plant & animal tissue culture techniques, Biosensors, Bio-energy, Concepts & Scope in Genetic Engineering and Applications of Genetic engineering
- To expose the students on the basic understanding of various techniques used in Biotechnology and Genetic Engineering in plant, animal and microbial system.

Learning outcomes:

- The students are be able to understand in-depth knowledge on the history and concepts and scope in bio-technology
- The students are be able to gain knowledge on biotransformation & production of useful compounds and uses of biosensors
- The students are able to know the alternate energy sources and generation of energy from biomass energy
- The students are be able to understand the concepts and methods in Genetic Engineering
- The students are be able to acquire knowledge on applications of genetic engineering in plant, animal and microbial system.

Unit – I : Concepts and Scope in bio-technology

Historical development - Plant cell and tissue culture techniques – Culture medium - Culture techniques — Anther and pollen culture. Animal tissue cultures techniques - primary culture, cell strains and cell lines – culture medias - Small scale and large scale culture techniques – Animal bioreactors. Protoplast culture technique and its applications. Germplasm and cryopreservation. Immobilization of microbial cells / enzymes – Adsorption, entrapping, ionic bonding, cross linking, encapsulation and microencapsulation. Application of immobilized microbial cells & enzymes.

Unit-II : Biotransformation and Biosensors *(Source NPTEL course)*

Biotransformation and production of useful compounds – Glycerol, butanol, acetone, alkene oxide, Poly hydroxy butyrate and valerate(PHBV), Xanthangum and Microbial Leaching. Biosensors – definition and outline design- types of electrode systems – Oxygen electrode system, Fuel cell type electrode, Potentiostatic, Piezoelectric membrane and Dye-coupled electrode membrane filter systems –Biosensors for nutrients (glucose sensors). Sensor for cell population (Lactate sensor) - Biosensor for products (alcohol sensor, formic acid sensor and methane sensor) - Biosensor for environmental control (BOD sensor, Ammonia sensor, Nitrite sensor and Sulfite Ion sensor).

Unit-III : Biomass and Bio-energy

Energy sources – nuclear energy, fossil fuel energy and non-fossil and non-nuclear energy. Biomass energy – Composition of biomass-wastes as sources of renewable source of energy – Composition wastes – sources of wastes (Industrial, agricultural, forestry, municipal sources). Biomass conversion – non-biological process, direct combustion (Pyrolysis, Gasification, liquefaction); biological process (enzymatic digestion, anaerotic digestion, aerobic digestion). Bioenergy products – ethanol, biogas and Hydrogen.

Unit – IV : Genetic Engineering *(Source NPTEL course)*

Definition and outline strategy: Enzymology – Restrict enzymes, DNA ligases, reverse transcriptase, klenow fragment, Alkaline phosphatase, Polynucleotide kinase, terminal transferase, Dnase and Rnase. Cloning vehicles- Plasmids – pBR 322 & pUC; phage vector, cosmid vector, shuttle vector, expression vector and YAC vector. Gene cloning strategy – Isolation of foreign DNA and recombinant DNA construct – Transformation – Screening and selection. Expression of cloned genes in prokaryotic and eukaryotic systems – minicell, maxicell, Fused and unfused gene expressions.

Unit-V : Applications of Genetic engineering *(Source NPTEL course)*

GMOS – transgenic plants – role of *Agrobacterium* - development of transgenic crops for disease resistance, salt tolerances, drought tolerance, herbicide tolerance and nutritional quality – Brief outline on Bt Cotton & golden rice. Transgenic animals - development of Transgenic animals for disease resistance, improved milk content and expression of antibodies. Brief outline on transgenic mice and Cattle. Genetically modified Microorganisms (GMOs) and its applications for antibiotic production, expressing hGH, interferon and human insulin (Humulin). Brief outline on Superbug bacteria. Rules and regulation in biotechnology – biosafety, bioethics, hazards of environmental engineering and intellectual property rights (IPR) and protection (IIP).

Text Books

1. Dubey R.C., 2014.Advanced Biotechnology 1st Edition. S.Chand&Company Ltd., New Delhi.
2. S.B. Primrose, R.M. Twyman, and R.W. Old (2012).Principles of Gene Manipulations; 6th Edn. Blackwell Science.
3. Chhatoval G.R., 1995. Text book of Biotechnology, 1st Ed, Anmol Publications Pvt. Ltd., New Delhi.
4. Kumar H.D., 1991. A text book on Biotechnology 2nd Ed, East-west Press Private Ltd., New Delhi. Pg.1-250; 411-472; 534-555.
5. Glick, B.R. and Pasternak, J.J 1994. Molecular Biotechnology, ASM Press, Washington DC.

Reference Books

1. Dubey R.C., 2001. A text book of Biotechnology 1st Edition. S.Chand&Company Ltd., New Delhi.
2. Glick, B.R. and Pasternak, J.J 1994. Molecular Biotechnology, ASM Press, Washington DC.
3. Kumar, H.D. 1993. Molecular Biology & Biotechnology, Vikas Publishing House Pvt., Ltd., New Delhi.
4. Kumar, H.D. 1991 Biotechnology, 2nd Ed., East – West Press Private Ltd., New Delhi.
5. Trevan, M.D, Boffey, S., Goulding, K.H. and Stanbury, P. 1990. Biotechnology- The basic Principles. Tata McGraw Hill, New Delhi.
6. Demain, A.L., Solomon, N.A. 1986. "Manual of Industrial Microbiology and Biotechnology", ASM Press, Washington.
7. Robert F. Weaver, 2012Molecular Biology; McGraw Hill
8. Keith Wilson and John Walker 2010 Principles and Techniques of Biochemistry and Molecular Biology; 7th Edn.
9. T. A. Brown 2006 Gene Cloning and DNA analysis- An Introduction;, 5th Edition, Wiley Blackwell Publishing

Web resources

1.https://www.edx.org/learn/biotechnology
2.https://biog.feedspot.com/genetics-blogs/
3.learn.genetics.utah.edu/
4.http://bmc biotechnol.biomedcentral.com

18MIBP03E1 Elective-1 BIOCONVERSION OF ORGANIC MATERIAL

Credits-4

Objectives:

- An in-depth study on soil and components of soil
- To make the students knowledgeable on degradation of organic material by various microorganisms.
- To make the students to understand the role of microbes in improving soil fertility

Learning outcomes:

By the end of this course students will be able to

- Understand the soil environment
- Understand the basics of microbiology of cellulose, hemicellulose and lignin
- Have clear idea about microbial degradation of pesticides
- Know the principles and methods behind in Methane generation
- Learn the methods and applications of Composting

Unit-I : Introduction to Soil environment

Composition, Soil types, Soil profile, Physical and Chemical properties of soil – Organic material decomposition – Litter composition – microflora – factors influencing decomposition – process of decomposition – Simple end products Humus and Humic acid – 'C' assimilation – Carbon dioxide evolution – C:N ratio.

Unit-II : Microbiology of cellulose, hemicellulose and lignin

Chemical composition – factors governing decomposition – Micro flora – aerobic, anaerobic, Mesophilic and thermophilic groups – process of decomposition with biochemistry.

Unit-III : Microbial degradation of pesticides

Classification of pesticides – Insecticides, herbicides and fungicides – Microbial metabolism on pesticides – Classification with examples – degradation reactions – epoxidation, nitroreduction, b-oxidation, oxidative alkylation, hydroreduction, decorboxylation etc., - Microbial breakdown of herbicide (2,4D) and fungicide (Carbendazim).

Unit-IV: Methane generation

Introduction and history – anaerobic digestion – microbes involved – factors influencing methane production – Stages of CH_4 generation – Wastes used in methanogenesis – various bioreactors used for methane generation – Advantages and disadvantages.

Unit – V: Composting

Composting – Historical background – waste availability – factors influencing – methods-enrichment – Compost and crop productivity- biomaturity of compost.Vermiculture Technologies: History – species – life cycles – methods – different types of waste suitable for vermicomposting – factors influences and quality. Utilization of vermicompost for crop production.

Text Books

1. Tripati, G. 2003. Vermiresources technology, 1st Ed., Discovery Publication House, New Delhi.
2. Gaur, A.C., 1999. Microbial technology for Composting of Agricultural Residues by Improved Methods, 1st print, ICAR, New Delhi.
3. Subba Rao, N.S., 1999. Soil Microbiology, 4th Ed., Oxford IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Chawla O.P. 1986. Advances in Biogas Technology, ICAR, New Delhi.
5. Martin Alexander 1976. Introduction to Soil Microbiology, Wiley eastern Ltd., New Delhi.

References

1. Kumar, H.D., 1991. A Textbook on Biotechnology, II Edition, East-west Press Pvt. Ltd., New Delhi.
2. Chatwal, G.R., 1995. Textbook of Biotechnology, Anmol Publications Pvt. Ltd., New Delhi.
3. Jasra, O.P., 2002. Environmental Biochemistry, I Ed., Sarup & Sons, New Delhi, India.

Web resources:

1.www.mdpi.com/journal/fermentation/special-issues/bioconversion-processes

2. https://www.omicsonline.org/.../recycling-of-organic-wastes-for-sustainable-soil health

3.microbiologyonline.org

4.https://www.asm.org/division/w/web-sites.htm

18MIBP03E2 Elective –2 MICROBIAL GENETICS Credits – 4

Objectives:

- An in-depth study on genetics of microorganisms
- To understand the importance of gene transfer mechanisms and design of vaccine

Learning outcomes:

- Students understand the genes and mechanisms of mutation
- Students should know the different gene transfer mechanisms
- Students should about know Plasmids and its applications
- Students should acquire knowledge on Bacteriophage
- Students should know about the designing of vaccines

Unit-I : Introduction to Microbial Genetics

Gene as unit of mutation and recombination. Molecular nature of mutations; mutagens. Spontaneous mutations – origin.

Unit-II : Gene transfer mechanisms

Transformation, transduction, conjugation and transfection. Mechanisms and applications. Genetic analysis of microbes. Bacteria and yeast.

Unit-III : Biology of Plasmids

Plasmids, F-factors description and their uses in genetic analysis. Colicins and col factors. Plasmids as vectors for gene cloning. Replication of selected plasmids : compatibility. Transposons and their uses in genetic analysis.

Unit–IV : Genetics of Bacteriophage

Bacteriophages, Lytic phages – T7 and T4 . Lysogenic phages I and Pl. M13 and f x 174 Life cycle, and their uses in microbial genetics.

Unit-V : Microbial genetics and design of vaccines

Historical perspectives-Vaccine development-evaluation and standardization-progress and challenges in modern vaccinology. Recent advances in vaccine development- impact of vaccine development-computer prediction of T-cell epitopes- identification of B- and T-cell epitopes through structural characterization and peptide technology.

Text books

1. Myron M. Levine, Graeme C. Woodrow, James B. Kaper and Gary S. Cobon. 1997. New Generation Vaccines. II Ed. Marcel Dekker, Inc. New York.
2. Stanley R. Maloy, John. E. Cronan, Jr. and David Freifielder. 1994. Microbial Genetics. II Ed. Jones & Bartlett Publishers. London.

Reference

1. Pelczar, Jr., Michael, E. C. S. Chan and Noel Kreig. 2000. Microbiology. 5th Ed. Tata McGraw Hill Book Company. pp: 227-260.
2. Lansing M. Prescott, John P. Harley and Donald A. Klein. 1999. Microbiology. 4th Ed. WCB/McGraw Hill Company. pp: 255 to 309.
3. S. Biwasis and Amita Biswas. 1998. An Introduction to Viruses. Vikaas Publishing House Pvt. Ltd. pp: 175-208.
4. Glick, B.R. AND Pasternak, J.J 1994. Molecular Biotechnology, ASM Press, Washington DC. pp: 207-232.

Web resources:
1.webresources.articles411.com/tag/genome-bacterial/
2.microbiologyonline.org
3.https://www.sciencedirect.com/topics/biochemistry-genetics...biology/microbial-genetics

18MIBP03E3 Elective-3 MUSHROOM BIOTECHNOLOGY Credits - 4

Objectives:

- An in-depth study on Mushroom Biotechnology
- To make the students more knowledge on mushroom cultivation

Learning outcomes:

- Students understand the importance of mushrooms
- Students know the characteristics of mushrooms
- Acquire knowledge on mushroom production technologies
- Students know the applications of mushroom biotechnology
- Students know the cultivation methods of different mushrooms

Unit I : Introduction to mushroom biology

Mushroom past and present, characteristics, importance of mushrooms – as food, tonics and medicines.

Unit II: Basics of fungi as background for mushroom biology

Fungal characteristics, history of mycology, habitat, morphology, nutrition and reproduction of fungi.

Unit III: General principles of production of mushrooms and mushroom products

Contributing fields – microbiology, mycology and environmental engineering; phases of mushroom technology – pure culture, spawn, preparation of compost, mushroom development, management and marketing.

Unit IV: Mushroom biotechnology

Applications: Bioconversion of organics wastes into protein, fodder, soil conditioner and fertilizer, bioremediation, nutraceuticals, nutriceuticals, pharmaceuticals and medicinal properties.

Unit V: Prospects of tropical mushroom cultivation technology

Oyster mushroom technology, paddy mushroom technology, milky mushroom and button mushroom technology, post harvest technology. Mushroom farming and prospects.

References

1. Kaul, T.N. 1999. Introduction to mushroom science, Oxford & IBH Co., Pvt. Ltd., New Delhi.
2. Philip G. Miles, Shu-Ting Chang, 1997. Mushroom biology, World Scientific, Singapore.
3. Bahl, N. 1988. Handbook on mushrooms. Oxford & IBH Publishing Co., Pvt. Ltd., New Delhi.

Web resources:

1.www.Scmsfungi.org/?page-id=311
2.http://blogs.cornell.edu/mushrooms/
3.https://www.elsevier.com/books/mushroom-biotechnology/petre/978-0-12-802794-3

MODULAR COURSE

18MIBP 03M1 ADVANCED MOLECULAR TECHNIQUES Credits -2

Objectives:

- To impart knowledge on advanced biological and molecular techniques
- To provide hands on exposure to various advanced Instruments used for biological and molecular studies

Learning Outcomes:

- The student are be able to understand in-depth knowledge on electrophoretic techniques
- The student are be able to realize molecular sequencing techniques
- The student are be able to know the principle and applications of PCR techniques
- The student are be able to be familiar with Chromatographic and Spectrophometric techniques
- The student are be able to distinguish Genome sequencing and Physical mapping of genome analysis

Unit-I: Electrophoresis

Principle and application: paper electrophoresis, agarose gel electrophoresis, polyacrylamide gel electrophoresis (Native PAGE and SDS- PAGE) and Immunoelctrophoresis.

Unit-II: Molecular Sequencing

Amino acid sequencing and analysis -MALDI-TOF, DNA sequencing –Enzymatic & chemical methods and new generation sequencing. Blotting techniques – Southern, northern, western and Dot blots. Microarray techniques – oligonucleiotide array and cDNA array and its applications.

Unit-III: PCR techniques

Principle and applications- types of PCR - enzymology- primer types-methods. PCR amplification for Detection of mutation, monitoring cancer therapy, detect bacterial & viral infections, sex determination of prenatal cells, linkage analysis in sperm cells and studies on molecular evolution.

Unit-IV: Chromatographic and Spectrophometric techniques

Principle and applications of Gas Chromatography (GC), High Performance Liquid Chromatography (HPLC). Principle and applications of Atomic Absorbance Spectra (AAS), Infra –red (IR) Spectra and LC-MS technique.

Unit-V: Genome sequencing and Physical mapping of genome analysis

Restriction fragment Length Polymorphism (RFLP) technique, Random Amplified polymorphic DNA (RAPD) technique and 16 S rRNA sequencing. Methods and applications of Chromosome walking &Chromosome jumping.

Text Books:

1. Glick, B.R. and Pasternak, J.J 1994. Molecular Biotechnology, ASM Press, Washington DC.
2. James .D.Watson, Michael Gilman, Jan Wit Koeski and Mark Zuller, 2001. Recombinant DNA. IInd Ed. Scientific American Book, New York.
3. B. Lewin 2000. Genes VII Oxford University Press.
4. E.J. Gardener *et al.,*. 1991. Principles of Genetics (8^{th} Ed.,) John Wiley & Sons, New York.

Reference Books:

1. S. Palanichamy and M. Shunmugavelu 2009. Research methods in biological sciences. Palani paramount publications, Palani.
2. K. Kannan 2003 Hand book of Laboratory culture media, reagents, stains and buffers Panima publishing corporation, New Delhi.
3. Keith Wilson and John Walker 2002 practical biochemistry – Principles and techniques. Fifth edn. Cambridge Univ. Press.
4. P. Asokan 2002. Analytical biochemistry – Biochemical techniques. First edition – Chinnaa publications, Melvisharam, Vellore
5. Rodney Boyer, 2001. Modern Experimental Biochemistry. III Ed. Addison Wesley Longman Pte. Ltd, Indian Branch, Delhi, India.

Web resources

1. www.cellbio.com/education.html
2. https://www.loc.gov/rr/scitech/selected- interval/molecular.html
3. global.oup.com/uk/orc/biosciences/molbio
4. https://www.loc.gov/rr/scitech/selected-internet/molecular.html

MODULAR COURSE

18MIBP03M2 **BIOINFORMATICS** **Credits - 2**

Objectives:

- An- in depth study on Bioinformatics, microbial genomics and proteomics
- To make the students to understand genome analysis, sequence analysis and protein analysis
- To make the students to know the tools used in Bioinformatics

Learning outcomes:

- Students understand whole genome analysis methods
- Students know the computational tools used for sequence analysis tools
- Students know the use of internet in data analysis
- Students acquire knowledge on DNA microarray techniques
- Students know the different methods of protein analysis

Unit –I : Whole genome analysis: Preparation of ordered cosmid libraries, bacterial artificial chromosome libraries, shotgun libraries and sequencing.

Unit–II : Sequence analysis: Computational methods, homology algorithms (BLAST) for proteins and nucleic acids. PROSITE, PEAM, and Profile Scan.

Unit–III : Databases Analysis: Use of internet, public domain databases for nucleic acid and protein sequences (EMBL, GenBank); database for protein structures (PDB).

Unit-IV : DNA microarray and general Analysis: DNA microarray printing or oligonucleotides and PCR products on glass slides, nitrocellulose paper. Whole genome analysis for global patterns of gene expressions using fluorescent labeled DNA or end labeled RNA probes. Analysis of single nucleotide polymorphisms using DNA chips.

Unit-V : Protein analysis and Proteomics : Sequence analysis of individual protein spots by mass spectroscopy. Protein microarray. Advantages and disadvantages of DNA and protein microarrays. Introduction to docking.

References

1. Read, TD., Nelson, KE., Fraser, CH. 2004. Microbial Genomics. Humana Press Inc., USA.
2. Rashidi, H.H. and Buchler, L.K. 2002 Bioinformatics Basics :Applications in Biological Science and Medicines, CRC Press, London
3. Stephen P. Hont and Rick Liveey (OUP) 2000. Functional Genomics, A practical Approach.
3. Perysju, Jr. abd Peruski 1997. The Internet and the New Biology: Tools for Genomic and molecular Research.
4. Mark Schena (OUP). DNA Microarrays, A practical approach.

Web resources:

1.https://www.bioinformatics.org
2.bioinformaticsonline.com
3. www.ii.uib.no/~inge/list.html

MODULAR COURSE

18MIBP 04M1 RURAL BIOTECHNOLOGY Credits -2

Objectives:

- To impart knowledge on various biotechnological commercial processes and it usefulness
- To provide hands on exposure to various biotechnological commercial processes such as biogas production, composting methods, mushroom production, *Spirulina* cultivation and ornamental fish cultures.

Learning Outcomes:

- The students are able to understand in-depth understanding on biogas technology and its use in domestic, farming and industrial sector.
- The student are be able to understand composting technology and its applications
- The student are be able to know the cultivation and uses of mushrooms
- The student are be able to know the cultivation and uses *Spirulina*
- The student are be able to understand the concepts of Ornamental Fish culture

Unit-I: Biogas technology

Introduction and history – anaerobic digestion – microbes involved – factors influencing methane production – Stages of methane generation – Wastes used in methanogenesis – various bioreactors used for methane generation – Advantages and disadvantages.Visit to biogas production units with field demonstration.

Unit-II: Composting technology

Historical background – waste availability – factors influencing – methods- biomaturity-enrichment of Compost and crop productivity. Vermiculture Technologies: History – species – life cycles – methods – different types of waste suitable for vermicomposting. Utilization of vermicompost for crop production. Visit to vermicompost industries with field demonstration.

Unit-III: Mushroom technology

Bioconversion of organic wastes into protein - Oyster mushroom technology, paddy mushroom technology, milky mushroom and button mushroom technology, post harvest technology. Mushroom farming and prospects. Visit to mushroom farms with field demonstration.

Unit -IV*: Spirulina* cultivation technology

Biology of *Spirulina* - cultivation methods, post harvest technology and single cell protein formulation. Visit to *Spirulina* industries with field demonstration.

Unit -V: Ornamental Fish culture

Present status and importance – popular varieties – artificial and live feeds – breeding techniques of egg layers – gold fish, angel fish, fighter and barbs – live bearers – guppy, molly, platy and sword tail – economics. Visit to ornamental fish farms with field demonstration.

Text Books:

1) Tripati, G. 2003. Vermiresources technology, 1st Ed., Discovery Publication House, New Delhi.
2) Anita Saxena, 2003. Aquarium management. Daya Pub. House, New Delhi.
3) Kaul, T.N. 1999. Introduction to mushroom science, Oxford & IBH Co., Pvt. Ltd.,
4) New Delhi.
5) Kumar, H.D., 1991. A Textbook on Biotechnology, II Edition, East-west Press Pvt. Ltd., New Delhi.
6) Chawla O.P. 1986. Advances in Biogas Technology, ICAR, New Delhi.

References

1. Srivastava, C.B.L, 2002. Aquarium fish keeping. Kitab Mahal, Allhabad.
2. Gaur, A.C., 1999. Microbial technology for Composting of Agricultural Residues by Improved Methods, 1st print, ICAR, New Delhi.
3. Subba Rao, N.S., 1999. Soil Microbiology, 4th Ed., Oxford IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Philip G. Miles, Shu-Ting Chang, 1997. Mushroom biology, World Scientific, Singapore.
5. Chatwal, G.R., 1995. Textbook of Biotechnology, Anmol Publications Pvt. Ltd., New Delhi
6. Bahl, N. 1988. Handbook on mushrooms. Oxford & IBH Publishing Co., Pvt. Ltd., New Delhi.

MODULAR COURSE

18MIBP04M2 MICROBIAL PRODUCTION OF RECOMBINANT MOLECULES

Credits - 2

- **Objectives:**

- An in-depth study on recombination
- To make the students to understand the importance of recombinant molecules

Learning outcomes:

- Students understand the application of Recombinant molecules in different fields
- Students know the designing of different vectors and their uses
- Students understand the expression of genes
- Acquire knowledge on purification of expressed proteins
- Students understand the experiments using various model microorganisms

Unit–I : Requirement of recombinant molecules

Pharmaceutical, health, agricultural and industrial sectors

Unit–II: Design of vectors and uses

Selection of suitable promoter sequences, ribosome binding sites, transcription terminator, fusion protein tags, purification tags, protease cleavage sites and enzymes.

Unit-III: Gene Expression

Over expression conditions, production of inclusion bodies, solubilization of insoluble proteins.

Unit–IV: Purification of expressed proteins

Determination of purity and activity of over expressed proteins.

Unit–V: Experiments using model systems

E.coli, Yeast, *Baculovirus*, *Agrobacterium tumefaciens*.

References

1. D.M. Glover and B.D. Hames (OUP), 1996. DNA cloning, A Practical Approach, 4th Volume.

2. S.J. Higgins and B.D. Hames (OUP), Protein Expression, A Practical Approach.

Web resources:

1.https://blog.feedspot.com/genetics-blogs/
2..learn.genetics.utah.edu/

MODULAR COURSE

18MIBP04M3 GENETIC ENGINEERING AND APPLICATIONS Credits - 2
(Under NPTEL / MOOC Online mode)

Objectives:

To enable the students:

- To understand the basic principles of genetic engineering
- To understand the different protocol for molecular cloning strategies
- To learn the knowledge on various applications of genetic engineering

Learning Outcomes:
This course will impart a thorough knowledge on research oriented learning which will develop analytical problem solving approach. On completion of this course, the students will be able to:

- Understand various vectors and enzymes used in genetic engineering
- Acquire knowledge on various methods employed in genetic engineering
- Have comprehensive knowledge on wider applications of genetic engineering

Unit – I:

Role of genes within cells, genetic code, genetic elements that control gene expression, Method of creating recombinant DNA molecules, Types, biology and salient features of vectors in recombinant DNA technology–I: Plasmids, Phages, Cosmids, Fosmids, Phagemids, and Artificial chromosomes, Safety guidelines for recombinant DNA research, Control of spills and mechanism of implementation of biosafety guidelines.

Unit – II:

Enzymes in genetic engineering: Restriction nucleases: exo & endo nucleases, Enzymes in modification- Polynucleotide phosphorylase, DNase and their mechanism of action, Enzymes in modification- Methylases and phosphatases and their mechanism of action, Enzymes in modification- Polynucleotide kinase, Ligases, RNase and their mechanism of action.

Unit – III:

Methods of nucleic acid detection, Polymerase chain reaction (PCR) and its applications, Variations in PCR and their applications, Methods of nucleic acid hybridization, Probe and target sequences, Nucleic acid mutagenesis in vivo and in vitro.Isolation and purification of nucleic acid (genomic/plasmid DNA and RNA), Quantification and storage of nucleic acids, Construction of cDNA library, Construction of Genomic library, Screening and preservation of DNA libraries, DNA Sequencing and cloning strategies.

Unit –IV:

Gene transfer techniques: biological methods, Gene transfer techniques: chemical methods, Gene transfer techniques: physical or mechanical methods, *Agrobacterium*- mediated gene transfer in plants, Chloroplast transformation. Transgenic science in plant improvement, Biopharming - plants as bioreactors, Transgenic science for animal improvement**,** Biopharming-Animals as bioreactor for recombinant protein, Gene mapping in plants and animals, Marker-assisted selection for plant breeding and livestock improvement.

Unit – V:

Microbial biotechnology: Genetic manipulation, Engineering microbes for the production of antibiotics and enzymes, Engineering microbes for the production of insulin, growth hormones, monoclonal antibodies, Engineering microbes for clearing oil spills.Gene therapy: Introduction and Methods, Gene targeting and silencing, Gene therapy in the treatment of diseases, Challenges and future of gene therapy.

Web resources:

1.https://www.edx.org/learn/biotechnology
2.https://blog.feedspot.com/genetics-blogs/
3.learn.genetics.utah.edu/
4.http://bmcbiotechnol.biomedcentral.com