M.Sc. Microbiology

Syllabus

(with effect from June 2015)

DEPARTMENT OF BIOLOGY
The Gandhigram Rural Institute – Deemed University
Gandhigram – 624 302 Tamil Nadu

M. Sc., MICROBIOLOGY PROGRAMME

SCHEME OF EXAMINATION

FIRST SEMESTER									
	Course code	**Course Title**	**C**	**L**	**P**	**E**	**CFA**	**ESE**	**Total**
CORE COURSES	15MIBP0101	Fundamentals of Microbiology	4	4	-	3	40	60	
	15MIBP0102	Microbial Diversity	4	4	-	3	40	60	100
	15MIBP0103	Microbial Metabolism	4	4	-	3	40	60	100
	15MIBP0104	Biochemistry	4	4	-	3	40	60	100
	15MIBP0105	Fundamentals of Microbiology –Practicals	2	-	4	3	60	40	100
	15MIBP0106	Microbial Metabolism and Biochemistry – Practicals	2	-	4	3	60	40	100
CNCC	15GTPP0001	Gandhi in Everyday Life	-	2	-	-	50	-	50
	15MIBP01F1	Field Visit		-	2	-	50	-	**50**
		Total Credits	**20**						

SECOND SEMESTER									
	Course code	**Course Title**	**C**	**L**	**P**	**E**	**CFA**	**ESE**	**Total**
CORE COURSES	15MIBP0207	Food Microbiology	4	4	-	3	40	60	100
	15MIBP0208	Agricultural Microbiology	4	4	-	3	40	60	100
	15MIBP0209	Biostatistics	4	4	-	3	40	60	100
	15MIBP0210	Food Microbiology – Practicals	2	-	4	3	60	40	100
	15MIBP0211	Agricultural Microbiology -Practicals	2	-	4	3	60	40	100
NME	-	Non Major Elective	4	4	-	3	40	60	100
CNCC	15MIBP02F2	Extension/Field visit/Internship	-	-	2	-	50	-	50
	15ENGP00C1	Communication and Soft Skills	-	2	-	-	50	--	50
		Total credits	**20**						

THIRD SEMESTER									
	Course code	**Course Title**	**C**	**L**	**P**	**E**	**CFA**	**ESE**	**Total**
CORE COURSES	15MIBP0312	Instrumentation Techniques and Research Methods	4	4	-	3	40	60	100
	15MIBP0313	Immunology and Medical Microbiology	4	4	-	3	40	60	100
	15MIBP0314	Molecular Biology	4	4	-	3	40	60	100
	15MIBP0315	Instrumentation Techniques -Practicals	2	-	4	3	60	40	100
	15MIBP0316	Seminar	2	2	-	-	50	-	50
MC	15MIBP03MX	Modular Course -1	2	2	-	-	50	-	50
ME	15MIBP03EX	Major elective*	4	4	-	3	40	60	100
VPP	15EXNP03V1	Village Placement Programme	-	-	2	-	50	-	50
		Total credits	**22**						

FOURTH SEMESTER									
	Course code	**Course Title**	**C**	**L**	**P**	**E**	**CFA**	**ESE**	**Total**
CORE COURSES	15MIBP0417	Industrial Microbiology	4	4	-	3	40	60	100
	15MIBP0418	Biotechnology and Genetic Engineering	4	4	-	3	40	60	100
	15MIBP0419	Environmental Microbiology	4	4	-	3	40	60	100
	15MIBP0420	Dissertation	6	12	-	-	75	75*+ 50**	200
MC	15MIBP04MY	Modular Course -2	2	2	-	-	50	-	50
		Total Credits	**20**						
Overall credits 86									

*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) 15MIBP 03MX / 04XY**
15MIBP03E1 Bioconversion of Organic Material	Advanced Molecular Techniques
15MIBP03E2 Microbial Genetics	Rural Biotechnology
15MIBP03E5 Mushroom Biotechnology	Bioinformatics
--	Microbial Production of Recombinant Molecules
--	Plant Tissue Culture Techniques

15MIBP0101 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:

Unit I: Be impressed on the milestones of Microbiology and its present status

Unit II: Identify key components and their functions in both prokaryotes and eukaryotes.

Unit III and IV: Be able to understand in depth the techniques used in Microbiology

Unit V: Have an insight to the interactions and characteristics of microorganisms.

Unit – I : History and Microscopy

Historical and recent developments - Spontaneous generation, germ theory of disease and development of medical microbiology, microbial genetics, physiology, virology, plant pathology, soil microbiology, industrial microbiology and molecular biology. Microscopy: Simple, Compound, Dark field, Phase contrast, Fluorescence and Electron microscopy.

Unit – II : Prokaryotic and Eukaryotic Cell

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

Sterilization: Dry Heat, Moist Heat, Filtration, Tyndallization, Pasteurization, Radiation, Antimicrobial Chemicals- classification - mode of action - antibiotic resistance - tests for antibiosis.

Unit – IV: Microbiological Techniques II

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. 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 Interactions- neutralism, mutualisms, commensalisms, competition, amensalisms, parasitism, predation, antagonism, syntrophism and symbiotic associations. Plant-microbes ineractions – Ectomycorrhizae and Endomycorrhizae-Root and stem nodules, rhizosphere and phyllosphere.

Text Books

1. Madigan, M.T., Martinko,J.M., Stahl,DA and Clark, D.P.2011.Brock Biology of Microorganisms 13th Ed. Benjamin Cummings, N.Y.
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. 2002. 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. pp: 86 – 117.
6. Lansing M. Prescott, John P. Harley and Donald A. Klein. 1999. Microbiology. IV Ed. WCB/McGraw Hill Company. pp: 1- 95; 135- 147.
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.

15MIBP0102 **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:

Unit I : The students will be able to understand the classification of prokaryotes and eukaryotes

Unit II : 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

UnitIII: 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

UnitIV: The students will be able to understand the basic principles and methods of classification of fungi and an in-depth knowledge on *Aspergillus* sp*., Candida* sp*., Mucor* sp and *Agaricus* sp.

UnitV: 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

General principles of classification, Evolution of methods in classification - International codes of nomenclature - Taxonomic approaches and Phylogeny, Bacterial diversity (metagenomics)

Unit – II : Virology

Classification and nomenclature 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

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.

Unit – IV : Mycology

Fungi: 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.

Unit – V : Protozology

Protozoa: 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.

References

1. Lansing M. Prescott, John P. Harley and Donald A. Klein. 1999. Microbiology. IV Ed. WCB/McGraw Hill Company. pp: 335 to 553.
2. S. Biwasis and Amita Biswas. 1998. An Introduction to Viruses. Vikaas Publishing House Pvt. Ltd. Pp: 1- 17; 209 – 224.
3. John G. Holt. 1994. Bergey's Manual of Determinative Bacteriology. Lippincott Williams and Wilkins. Pp: 351-352; 597-724.
4. Chatterjee, K. D. 1981. Parasitology. Chatterjee Medical Publishers. Pp: 1-106.
5. Dubey H. C. 1978. A Textbook of Fungi, Bacteria and Viruses. Vikaas Publishing House Ltd. Ltd. Pp: 1-341.

15MIBP0103 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:

Unit I: How fundamental chemical principles and reactions are utilized in biochemical processes.

Unit II: To understand the principles and mechanism of aerobic and anaerobic respiration in microorganisms.

Unit III: Be impressed on the special fermentation by specific microbes.

Unit IV: Be able to understand in depth the principles and mechanism of photosynthesis.

Unit V: Understand the fundamentals of bioluminescence.

UNIT –I : Metabolism

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 : Aerobic and anaerobic respiration

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.

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

Bioluminescent bacteria and its importance-Biochemistry-Luciferin-Luciferase along with the lux operon (genes) involved- Quorum sensing

Text Books

1. Hans G.Schlegel. 1995. General Microbiology, VII Ed., Cambridge University Press, Cambridge.
2. Roger Y. Stanier., John L.Ingraham., Mark L.Wheelis., Page R.Painter., 1987. General Microbiology, V Ed., Macmillan Press Ltd., London.
3. Salle, A.J. 1992. Fundamental Principles of Bacteriology, VII Ed., McGraw Hill Publishing Co. Ltd., New York.
4. Gottschalk, G. 1986. Bacterial Metabolism. II Ed. Heidelberg Springer.

References

1. Pelczar, Jr., Michael, E. C. S. Chan and Noel Kreig. (2000). Microbiology. V Ed.Tata McGraw Hill Book Company.
2. Lansing M. Prescott, John P. Harley and Donald A. Klein. 1999. Microbiology. IV Ed. WCB/McGraw Hill Company.

15MIBP0104 **BIOCHEMISTRY** **Credits - 4**

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:

Unit I : The students will learn the classification and structural properties of protein, carbohydrates and lipids.

Unit II : The students will become knowledgeable on classification of enzymes and are able to understand the characteristics of enzyme reactions.

Unit III: The students will be able to understand the structure and the biological activities of Nucleic acid and Vitamins.

Unit IV: The students will be able to understand on metabolic pathways and their biochemical importance.

Unit V : The students will be able to understand on lipid metabolism and knowledge on amino acid & urea metabolism.

UNIT – 1

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. J.L. Jain 2003 Fundamental of Biochemistry S. Chand of company Ltd, New Delhi.
2. G.S. Sandhu 2002 Text book of biochemistry 18th Edn. Campus books International, New Delhi.
3. 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. David L. Nelson and Michael M. Cox. 2003 Lehninger principles of Biochemistry, 3rd Edn. Mac Millan Worth publishers, New Yolk.
2. Ericc E.Conn, Paul K. Stumpf, George Bruening and Roy H. Doi 199+5. Outlines of Biochemistry. John Wiley of sons, New York.

15MIBP0105 FUNDAMENTALS OF MICROBIOLOGY – PRACTICALS Credits-2

Objectives:

- 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.
   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.

   b) Water Analysis for Total Bacterial Population by Standard Plate Count Method.

8. Isolation and Enumeration of selected Microorganisms such as Bacteria, Actinomycetes, Yeast, Pycomycets, Ascomycets and Basidomycets.

9. Isolation of Protozoa from soil.

10. Isolation of VAM spores from soil.

11. Isolation of yeast from grapes.

12. Demonstration of spore germination (Fungi)

13. Identification of an unknown bacteria.

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.

15MIBP0106 MICROBIAL METABOLISM AND BIOCHEMISTRY Credits-2
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:

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

EXPERIMENTS:

1. Determination of growth curve of bacteria by turbidometry, cell dry weight and 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 of an organism
    a. Determination of TDT of an organism
6. Genus identification of unknown bacterial cultures.
7. Genus Identification of an unknown fungi and measurement of fungal growth by biomass method.
8. a) Test for antimicrobial property (Kirby-Bauer method) by disc diffusion method.
   b) Determination of MIC of an antibiotic.
9. a) Demonstration of carbohydrate fermentation (glucose, sucrose and lactose)
10. b) TSI test.
11. IMVIC test of enteric bacteria
    a. Indole production test.
    b. Methyl red & Voges Proskaüer test
    c. Citric acid production test.
12. a) Catalase activity for H_2O_2 production.

13. b) Oxidase activity of a given bacterial sample.
    a. Demonstration of Urease production.
    b. Gelatin hydrolysis by bacteria.
    c. Nitrate Reductase activity.
14. Studies on starch, casein and lipid hydrolysis.
15. Estimation of IAA production by micro-organism.
16. Fermentative production of amylase by *Bacillus* species.
17. Estimation of carbohydrates, aminoacids and proteins and lipids.

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.

CNCC - COMPULSORY NON CREDIT COURSE

15GTPP0001 **GANDHI IN EVERYDAY LIFE**

(2 Hours per week)

Objectives:

1. To understand and appreciate the principles and practices of Gandhi and their relevance in the contemporary times.
2. To develop noble character and attitude to enable the students to cope up with the challenges of daily life.

Learning Outcomes:

To enable students to:

- To study in-depth the life and message of Gandhi.
- To understand the Gandhian way of Management.
- To practice the Gandhian model of conflict reduction.
- To lead a humane life on Gandhian lines.
- To become a Gandhian constructive worker.

Unit.I. **Understanding Gandhi:** Child hood days, Student days, influence of Books and Individuals, Religion, Family, and Social factors. Gandhi as rebel, acquaintance with vegetarianism, as lawyer, encountering and transforming humiliation: in India, in south Africa- train incident, Coach incident, on path way, at court, attack by protesters. Gandhi as political leader and reformer.

Unit.II. **Management**: Gandhi's experiments in managing family- Eleven vows, non-possession and sacrifice begin at home – Managing Ashram - community living, service and financial ethics – Managing Social movements- Transvaal March and Salt Satyagraha and nonattachment to position (Nishkama Seva).

Unit.III. **Conflict Reduction**: Pursuance of truth and nonviolence ends and means, openness, transparence, love and kindness in handling relationship, nonviolent communication, practicing nonviolence in social and political issues (Satyagraha), conflict resolution practices, art of forgiveness and reconciliation and shanti sena.

Unit.IV. **Humanism**: Trust in goodness of human nature, respect for individual and pluralistic nature of society, dignity of differences, equal regard for all religions (Sarvadharma Samabhava), castes, races, colours, languages etc., simple and ethical life, swadeshi and unity of humankind.

Unit.V. **Constructive programmes** and contemporary issues: Concept of Sarvodaya, poverty, terrorism, environmental degradation, problems in sharing common resources, health systems and education, science and technology and centralization of power and governance.

References:

M.K. Gandhi, (2012) *An Autobiography or The Story of My Experiments with Truth*, Navajivan Publishing House, Ahmedabad.

---. (2003) *Satyagraha in South Africa*, Navajivan Publishing House, Ahmedabad.

---. (1945) *Constructive Programme: Its Meaning and Place*, Navajivan Publishing House, Ahmedabad.

---. (2003) *Key to Health*, Navajivan Publishing House, Ahmedabad

---. (1949) *Diet and Diet Reform*, Navajivan Publishing House, Ahmedabad.

---. *Basic Education*, Navajivan Publishing House, Ahmedabad.

---. (2004) *Village Industries*, Navajivan Publishing House, Ahmedabad.

---. (1997) *Hind Swaraj*, Navajivan Publishing House, Ahmedabad.

---. (2004) *Trusteeship*, Navajivan Publishing House, Ahmedabad.

---. (2001) *India of my Dreams*, Navajivan Publishing House, Ahmedabad.

K.S.Bharathi (1995)Thought of Gandhi and Vinoba, *Shanti Sena*, Sarva Seva Sangh Prakashan, Varanasi.

V.P.Varma, (1999)*Political Philosophy of Mahatma Gandhi and Sarvodaya*,Lakshmi Narain Agarwal, Agra.

Louis Fisher (2010) *Gandhi: His Life and Message*.

B.R. Nanda. (2011)*Mahatma Gandhi: A Biography*, Allied Publishers Private Ltd., New Delhi.

N.K. Bose. (2008) *Studies in Gandhism*, Navajivan Publishing House, Ahmedabad.

Gopinath Dhawan, (2006)*The Political Philosophy of Mahatma Gandhi*, Navajivan Publishing House, Ahmedabad.

N. Radhakrishnan, (2006) *Gandhi's Constructive Programmes: An Antidote to Globalized Economic Planning?,* Gandhigram Rural Institute, 2006.

Films.

Richard Attenborough, **Gandhi.**

Syam Benegal**, The Making of Mahatma.**

Anupam P. Kher, **Mine Gandhi Ko Nahin Mara**.

Peter Ackerman and Jack Duvall, **A Force More Powerful.**

15MIBP0207 **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 food-borne outbreaks.

Learning Outcomes:

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

Unit I : Be impressed on the role of microorganisms in food (beneficial as well as harmful) and the factors influencing their growth.

Unit II : Identify key problems and prospects in processing and preservation of perishable food products and understand the microbial hazards involved

Unit III: Be able to understand in depth the techniques/process used in microbial products using fermentation technology

Unit IV: Be able to comprehend the different aspects of food preservation.

Unit V : Students able to understand the quality assurance of foods especially HACCP.

Unit I : Microbiology of Foods

Microbial flora of fresh foods, grains, fruits, vegetables, milk, meat, eggs and fish and their infestation by bacteria, fungi & viruses. Intrinsic and Extrinsic factors influencing the growth and survival of microorganisms in foods.

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 grains, vegetables and fruits, 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

Methods of food preservation, Aseptic handling, pasteurization of milk, refrigeration and freezing, dehydration, osmotic pressure, chemicals- organic acids, nitrates, nitrites & cresols; Radiation – UV light, - irradiation. Advanced 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

Text Books

1. Sivasankar, B. 2010. Food processing and preservation, PHL Learning Pvt. Ltd., New Delhi.

2.Tucker, G.S.2008 Food Biodeterioration and Preservation Blackwell Publishers, UK.

3. Jay, J.M.2000 Modern Food Microbiology 6th Ed. Aspen Publication, USA.

4. Joshi V. K and Ashok Pandey. 1999. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. (VOL II).

5. Adams, M. R. and Moss, M.O. 1995. Food Microbiology, IV Edition McGraw Hill, New York.

6. Frazier, W.C. 1978. Food Microbiology III Edition, McGraw Hill

7. Brain J. Wood. Microbiology of Fermented Foods. Volume I and II Elsevier Applied Science Publication

References

1. Carl, A.B and Tortorello, M.L. 2014. Microbiology, 2nd Ed. Academic Press, London.

2. Britz, T.J. and Robinson, R.K.2008 Advanced Dairy Science and Technology Blackwell publ.,U.K.

3. Hobbs,B.C.and Roberts,D. 1993.Food Poisoning and Food Hygiene, Edward Arnold (A Division of Hodder and Sloughton), London.

4. Salle, AJ. 1992. Fundamental Principles of Bacteriology, VII Ed., McGraw Hill, Publishing Co. Ltd., New York. pp: 710-793.

5. Robinson, R.K. 1990. Dairy Microbiology, Elsevier Applied Sciences, London

6. Banwart, GJ. Basic Food Microbiology, CBS Publishers and Distributors.

7. James Jay. Modern Food Microbiology.

8. Jenner, E.W. Microbiology of Food, Ganard Press.

15MIBP0208 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

Unit I and

II : Understand the role of microbes in the different cycles and their role in agriculture

Unit III: Understand biological nitrogen fixation in symbiotic and non symbiotic associations with plants.

Unit IV: To know the value, production, application and crop response of biofertilizers and biopesticides.

Unit V: To have an indepth knowledge on biopesticides and their role in pest control.

Unit – I : Soil Microbiology

Composition of Lithosphere, Soil Microbes, 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

Phosphrous, sulphur, iron and other elements - Chemistry, cycles, mineralization and immobilization and oxidation/reduction

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

Ammonia assimilation in Nitrogen-Fixing legume nodules-Hydrogen Metabolism, action of Hydrogenase - factors controlling the Legume - *Rhizobium* symbiosis

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, fungal, bacterial, viral, mycoplasma, Nematode 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.
6. Newton, W.E and Orme, Johnson, W.H.1980. Nitrogen fixation vol II: Symbiotic Associations and Cyanaobacteria. University park Press Baltimore, USA.
7. Wheeler, B. E. 1976. An Introduction to Plant Disease. ELBS and John Wiley and Sons, Ltd.

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.

15MIBP0209 **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.

15MIBP0210 FOOD MICROBIOLOGY – PRACTICALS Credits-2

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. Microbial spoilage - identification of spoilage causing microbes.
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 alchohol percentage of wine.
5. Role of yeasts in bread making.
6. Production and testing of antimicrobial activity in food samples and evaluate antibiotics in foods.
7. Detection and control of microbes causing food spoilage.
8. Identification of lactic acid bacteria / *Aspergillus flavus* from food sources.
9. Isolations and identification of *Salmonella* in processed foods.

10. Enumeration of anaerobic bacteria from food samples.
11. Detection of aflatoxin in agricultural products.
12. Preparation of certain traditional fermented products.
13. Cheese, curd and yoghurt production demonstration.
14. Detection and assay of bacteriocin by probiotic lactic acid bacteria.
15. Value added products from fruits and vegetables – Extraction of Biocolour from Beetroot, Ready to serve beverage from papaya, Clarified Banana RTS beverage. Extraction of anthocyanin from skin of grapes (Using Spray Drier) and evaluate shelf life
16. Extraction of pigment from microorganism to be used in industries.
17. Growth of *Lactobacillus* sp using a lab scale fermentor.
18. Visit to Indian Institute of Crop Processing Technology Tanjore and a milk processing unit.

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.

15MIBP0211 AGRICULTURAL MICROBIOLOGY–PRACTICALS Credits-2

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.

CNCC - COMPULSORY NON CREDIT COURSE

15ENGP00C1 COMMUNICATION AND SOFT SKILLS
(2 Hours per week)

CONTENTS

15MIBP0312 INSTRUMENTATION TECHNIQUES AND RESEARCH METHODS

Credits – 4

Objectives:

To enable the students:

- 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 Outcomes:

The Course will provide an overview of would 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 sample
- Understand how to isolate cellular constituents
- Realize the need of centrifuges and their uses in research
- Understand how to separate amino acids and sugars using paper & thin layer chromatography
- Realize the principle and applications of gas liquid chromatography, HPLC and PCR.
- Understand the principles and applications of electrophoresis
- Realize the importance of UV-Visible, MALDI-TOF, LC-MS &AAS
- 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
- Realize the need of publication and know the important terms such impact factor & citation index
- Describe the methods of writing scientific paper and parts 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 what are the research fellowships available for research

Unit I: Microscopy, pH and Buffer

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

Unit II: Isolation, Fractionation and Separation

Isolation, fractionation and separation of cellular constituents- Isolation of chloroplasts, mitochondria, nucleic acids and enzymes- Homogenization- Manual, mechanical and sonication- Centrifugation- Centrifuges and their uses- Micro centrifuge, high speed refrigerated centrifuges, ultra centrifuges, differential and density gradient centrifugation- Chromatography- Paper, thin

layer, Ion-exchange, column, affinity - separation of amino acids and sugars- Gas liquid chromatography, HPLC.

Unit III: Electrophoresis, Colorimetry and Calorimeter

Electrophoresis- Principles, factors affecting electrophoretic mobility- Support medium-Agarose and polyacrylamide gels- Electrophoresis of proteins and nuclic acids- Spectroscopic techniques-UV-Visible and FTIR - Flame photometer and Bomb calorimeter- Principle and applications.

Unit IV: Research and Project writing Methods

Research- Definition, objectives, types and importance- Research methods in Biological Sciences- Research process- Literature survey- sources- scientific databases- Research report writing- Parts of Thesis and Dissertation-Title, certificate, declaration, acknowledgements, contents- List of tables, figures, plates &abbreviations, Introduction, Review of literature, Materials and methods- Results- Presentation of data-Tables, figures, 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. N. Gurumani 2010 Research Methodology for Biological Sciences. MJP Publishers, Chennai.
2. Biju Dharmapalan, 2012. Scientific Research Methodology. Narosa Publising House, New Delhi.
3. David T. Plummer 1988. An introduction to practical biochemistry, Tata Mc Graw Hill pub. Co. Ltd, New Delhi.
4. J. Jeyaraman 1981. Laboratory Manual in Biochemistry. New Age International publishers, New Delhi.

Reference Books

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

15MIBP0313 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:

Unit I: Understand the role of pathogen in causing infectious disease on humans, natural barriers to infection, innate and acquired immune responses to infection and inflammation

Unit II: Understand the antigen antibody reactions and principles of hypersensitivity.

Unit III: Understand vaccine, immunohematology and tumor immunology.

Unit IV: Compare and contrast different bacterial diseases, including the properties of different types of pathogens, and the mechanisms of pathogenesis.

Unit V: 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. Greenwood D, Richard C.B.and.Peutherer S.J.. 2000. Medical Microbiology. Churchill Livingstone.
2. Roitt, I.M.. 1998. Essential Immunology, Blackwell Scientific Publishers.
3. Ananthanarayanan. R. and C.K. Jayaram Panicker.1997. Textbook of Microbiology Orient Longman.

Reference

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: 585-620.
2. Michael. J. Pelczar, JR, E.C.S. Chan, Noel R. Krieg. 2000. Microbiology. TATA McGraw Hill. pp: 673-763.
3. Lansing. Prescott, John. P. Harley and Donald. A. Klein 1999. Microbiology. WCB McGraw – Hill Company. pp: 605-676.
4. Kuby, J. 1994. Immunology 2nd Ed., W.H. Freeman and Company, New York.
5. Davis, BD., Dulbecco, R., Eisen, H.N and Ginsberg. 1980. Microbiology, Immunology and Molecular Genetics, 3rd Edt., Harper and Row, Philadelphia.

15MIBP0314 **MOLECULAR BIOLOGY** **Credits -4**

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:

Unit I : The students are be able to understand in-depth knowledge on Molecular Biology
Unit II : The students are be able to know various types of Mutagenesis
UnitIII : The students are be able to understand in detailed mechanisms of DNA Replication
Unit IV: The students are be able to understand the overall concepts of Transcription
Unit V: 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. Gene transfer mechanism- bacterial transformation, conjugation and transduction. Structure of DNA - primary, secondary and different forms (A, B, C Z).

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.

Unit-III : DNA Replication

Basic rule. The Geometry of DNA replication – Semiconservative 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 damage – repair mechanism – DSOS function

Unit – IV : Transcription

Basic factors of RNA Synthesis. RNA ploymerases – I, II and III. Mechanisms – RNA Chain Initiation, elongation and termination. Classes of RNA Molecules – Messenger, ribosomal and transfer RNA. RNA splicing mechanisms – 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 dictionary. Mechanism of protein synthesis and post translational modifications. Regulation of gene expression in prokaryotes – the operon model. Lactose, galactose and tryptophan operon. Feed back inhibition and Allosteric enzymes.

Text Books

1. David Freifelder, 1996, Molecular Biology, 4th Reprint., Narosa Publishing House, New Delhi, India.

Reference

1. B. Lewin 2000, Genes VII Oxford University Press.
2. H.D. Kumar, 1993, Molecular Biology & Biotechnology, Vikas publishing house Pvt. Ltd., New Delhi.
3. R.F. Weaver and P.W. Hedrick 1992, Genetics Wh.C. Brown publishers, Dubuque.
4. E.J. Gardener *et al.,*. 1991 Principles of Genetics (8th Ed.,) John Wiley & Sons, New York.
5. David Freifelder, 1986, Molecular Biology 2nd ed., Jones and Barflett publishers, Inc. Boston.
6. S.C. Rastogi, V.N. Sharma, Biology & Biotechnology, Vikas Publishing House Pvt. Ltd., New Delhi.

15MIBP0315 INSTRUMENTATION TECHNIQUES -PRACTICALS Credits – 2

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 Outcomes:

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. Differential and density gradient centrifugation.
3. Separation of amino acids and sugars using paper chromatography (2D)
4. Separation of amino acids and sugars using thin layer chromatography
5. Separation of pigments by column chromatography
6. Separation of proteins based on molecular weight using PAGE
7. Isolation and separation of plasmids and nucleic acids using agarose gel electrophoresis.
8. Verification of Beer- Lambert's law using spectrophotometer.
9. Estimation of sodium, potassium, calcium and magnesium using Flame photometer
10. Estimation of calorific value of feed/ fire wood samples.

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.

15MIBP0417 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:

Unit I : The students will be able to know historical aspects of industrial microbiology and fermentation techniques

Unit II : The students will be able to understand screening methods for Industrial microbes

Unit III : The students will be able to understand Biology of Industrial Microorganisms

Unit IV : The students will be able to know the Industrial production of various products

Unit V: The students will be able to understand the rules and regulation of industrial microbiology

Unit – I : History and Fermentor

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
6. Casida, L.E. 1986. Industrial Microbiology, Eastern Limited, New York.

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.

15MIBP0418 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, Fermentation techniques & Biosensors, Environment &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

Learning outcomes:

Unit I : The students are be able to understand in-depth knowledge on the history and concepts and scope in bio-technology

Unit-II : The students are be able to gain knowledge on biotransformation & production of useful compounds and uses of biosensors

Unit-III : The students are able to know the alternate energy sources and generation of energy from biomass energy

Unit-IV : The students are be able to understand the concepts and methods in Genetic Engineering

Unit-V : The students are be able to acquire knowledge on applications of genetic engineering

Unit – I : Concepts and Scope in bio-technology

Plant cell and tissue culture – Culture techniques – Protoplast technique – Anther and pollen culture. Animal tissue culture- culture techniques – Animal bio reactors. Gene banks and Germ plasm storage. Immobilization of microbial cells / enzymes – Adsorption, entrapping, ionic bonding, cross linking, encapsulation and microencapsulation. Application of immobilized enzymes.

Unit-II : Fermentation and Biosensors

Biotransformation and production of useful compounds – Glycerol, acetons, Alkene oxide, Ploy hydroxy butyrate, Xanthangum and Microbial Leaching. Biosensors – definition, outline design and types – Biosensors nutrients – glucose and acetic acid sensors. Sensor for cell population – Fuel cell type electrode, potentiostatic, piezoelectric membrane – Dye-coupled electrode membrane filter – Oxygen electrode system and 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 : Environment and 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. Bioremediation – microbial degradation of xenobiotics.

Unit – IV : Genetic Engineering

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, cosmid, shuttle and YAC vectors. Gene cloning strategy – Isolation of foreign DNA and recombinant DNA construct – Transformation – Screening and Storage. Expression of cloned genes in prokaryotic and eukaryotic systems – minicell, maxicell, Fused and unfused gene expression.

Unit-V : Applications of Genetic engineering

GMOS – Transgenic plants – Bt Cotton - Development of crops for disease resistance, Salt tolerances, drought tolerance, herbicide tolerance and nutritional quality. Transgenic animals and its applications. Genetically modified Microorganisms and its applications. 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., 2001. A text book of Biotechnology 1st Edition. S.Chand &Company Ltd., New Delhi.
2. Chhatoval G.R., 1995. Text book of Biotechnology, 1st Edi, Anmol Publications Pvt. Ltd., New Delhi.
3. 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.

Reference Books

1. Dubey, R.C. 2001. A Text Book of Biotechnology .S. Chand & Company Ltd., Ramnagar, 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.

15MIBP0419 ENVIRONMENTAL MICROBIOLOGY Credits – 4

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:

Unit I : Understand on soil characteristics and biogeochemical cycling

Unit II : Know the microbial analysis of drinking water and aeromicrobiology

Unit III : Know on the different aspects of waste management and sewage Treatment systems

Unit IV : Acquire knowledge on bioremediation and microbial leaching

Unit V : 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. Atlas, R.M. and Bartha, R. 1992. Microbial Ecology: Fundamentals and Applications.III Ed., Benjamin Cummings, Redwood City.CA.

3. Pelczar.M.J. and Reid 1986 " Microbiology". V Ed., Tata McGraw Hill Co., New Delhi.

References

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. Raina M. Maier, Ian L. Pepper and Charles P. Gerba. 2000. Environmental Microbiology. Academic Press. New York. pp: 394-399;491-538.

4. Patel, A.H. 1996. Industrial Microbiology, Macmillan India Ltd., New Delhi.

5. Subba Rao, N. S. 1995. Soil Microbiology. IV Ed. Oxford & IBH Publishing Co. Pvt. Ltd.New Delhi. pp: 11-49; 292-301.

6. Subba Rao, N.S. 1995. Biofertilizers in Agriculture and Forestory.3rd Ed., Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi.

7. Salle, A.J. 1992. Fundamental Principles of Bacteriology, VII Ed., McGraw Hill Publishing Co. Ltd., New York. pp: 649-709;794-843.

8. Kumar, H.D. 1991. Biotechnology, II Ed., East – West Press Private Ltd., New Delhi.

9. Pelczar.M.J. and Reid 1986 " Microbiology". V Ed., Tata McGraw Hill Co., New Delhi.pp:593-617.

10. Brock, T.D, Smith, D.W. and Madigan M.T 1984, Biology of Microorganisms. IV Ed., Prentice Hall Int. Inc., London.

11. Campbell, R. 1983. Microbial Ecology, II Ed., Blackwell Scientific Publishers, London.

12. Alexander, M. 1971. Microbial ecology, John Wiley & Sons Inc., New York.

15MIBP03E1 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

Unit I : Understand the soil environment

Unit II : Understand the basics of microbiology of cellulose, hemicellulose and lignin

Unit III : Have clear idea about microbial degradation of pesticides

Unit IV: Know the principles and methods behind in Methane generation

Unit V: 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.

15MIBP03E2 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:

Unit I. Students understand the genes and mechanisms of mutation
Unit II. Students should know the different gene transfer mechanisms
Unit III. Students should about know Plasmids and its applications
Unit IV. Students should acquire knowledge on Bacteriophage
Unit V. 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.

15MIBP03E3 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:

Unit I: Students understand the importance of mushrooms
Unit II: Students know the characteristics of mushrooms
Unit III: Acquire knowledge on mushroom production technologies
Unit IV: Students know the applications of mushroom biotechnology
Unit V: 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 organic 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.

MODULAR COURSE

15MIBP 03MX / 04XY 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 Outcome:

Unit-I : The student are be able to understand in-depth knowledge on electrophoretic techniques
Unit-II : The student are be able to realize molecular sequencing techniques
Unit-III: The student are be able to know the principle and applications of PCR techniques
Unit-IV: The student are be able to be familiar with Chromatographic and Spectrophometric techniques
Unit-V : 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:

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

MODULAR COURSE

15MIBP 03MX / 04XY 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:

Unit-I : The students are able to understand in-depth understanding on biogas technology and its use in domestic, farming and industrial sector.
Unit-II : The student are be able to understand composting technology and its applications
Unit-III: The student are be able to know the cultivation and uses of mushrooms
Unit-IV: The student are be able to know the cultivation and uses spirulina
Unit-V : 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. Vonshak, A. 2004. Spirulina platensis- Physiology, cell biology and biotechnology. Taylor and Francis, London.
2. Kaul, T.N. 1999. Introduction to mushroom science, Oxford & IBH Co., Pvt. Ltd., New Delhi.
3. Philip G. Miles, Shu-Ting Chang, 1997. Mushroom biology, World Scientific, Singapore.
4. Bahl, N. 1988. Handbook on mushrooms. Oxford & IBH Publishing Co., Pvt. Ltd., New Delhi.
5. Tripati, G. 2003. Vermiresources technology, 1st Ed., Discovery Publication House, New Delhi.
6. Gaur, A.C., 1999. Microbial technology for Composting of Agricultural Residues by Improved Methods, 1st print, ICAR, New Delhi.
7. Subba Rao, N.S., 1999. Soil Microbiology, 4th Ed., Oxford IBH Publishing Co. Pvt. Ltd., New Delhi.
8. Chawla O.P. 1986. Advances in Biogas Technology, ICAR, New Delhi.
9. Martin Alexander 1976. Introduction to Soil Microbiology, Wiley eastern Ltd., New Delhi.
10. Anita Saxena, 2003. Aquarium management. Daya Pub. House, New Delhi.
11. Srivastava, C.B.L, 2002. Aquarium fish keeping. Kitab Mahal, Allhabad.

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.

MODULAR COURSE

15MIBP 03MX / 04XY **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:

Unit I : Students understand whole genome analysis methods
Unit II: Students know the computational tools used for sequence analysis tools
Unit III: Students know the use of internet in data analysis
Unit IV: Students acquire knowledge on DNA microarray techniques
Unit V: 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.

MODULAR COURSE

15MIBP 03MX / 04X 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:

Unit I: Students understand the application of Recombinant molecules in different fields

Unit II: Students know the designing of different vectors and their uses

Unit III: Students understand the expression of genes

Unit IV: Acquire knowledge on purification of expressed proteins

Unit V: 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.

MODULAR COURSE

15MIBP 03MX / 04 MY PLANT TISSUE CULTURE TECHNOLOGY Credits - 2

Objectives:
To enable the students:

- To understand the basic principles and methodologies of plant tissue culture
- To understand the different standard protocol for the production of viable clones
- To learn the knowledge on various methods of TC and secondary metabolites production.

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 media, sterilization, totipotency, cell induction, organogenesis
- Able to apply the techniques to develop a standard protocol for PTC
- Have comprehensive knowledge on GM technology, biosafety relations and germplasm storage

Unit I
Basic concepts of PTC
Plant tissue culture (PTC): History, concept of totipotency, sterilization, media types, preparation; Culture of plant materials; Brief account on callus induction and organogenesis; Hormonal regulations in *in vitro* morphogenesis.

Unit II
Techniques and applications of PTC
Basic techniques in plant tissue culture; Methods of plant cell, tissue and organ culture; Cell suspension culture, somatic embryogenesis, protoplast culture; Application of plant tissue culture in agriculture, horticulture and forestry.

Unit III
Micropropagation and haploid production
Micropropagation: Methods and application, androgenesis and gynogenesis for haploid production, protoplast culture and somatic hybridization, somaclonal variation and conservation of germplasm.

Unit IV
Secondary metabolite production and GM technology
Production of secondary metabolites from the culture cells; Production of synthetic seeds; GM crop, edible vaccines; GM technology and biosafety regulations.

Unit V
Industrial visit/ demonstration
1. Demo on various types of media preparation
2. Demo on various types of plant tissue culture
3. Demo on various stages of plant tissue culture
4. Visit to research institute/ commercial plant tissue culture industries

Reference Books

1. Kesavachandran, R. and Peter, K.V. 2008. Plant Biotechnology: Methods in Tissue cultute and gene transfer. University Press Ltd. Hyderabad.
2. Bhojwani , S.S. and Razdan , M.K. 1996. Plant Tissue Culture : Theory and Practice (revised edition). Elsevier Science Publishers, New York, USA
3. Jain, S.M.Sopory, S.K. and Veilleux, R.E.1996. In Vitro Haploid Production in HigherPlants, Vols. 1-5, Fundamental Aspects and Methods. Kluwer Academic Publishers,Dordrecht, The Netherlands
4. Vasil, I.K. and Thorpe, T.A.1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, The Netherlands.
5. Bhaojwani, S.S. 1990 , Plant Tissue Culture: Applications and Limitations Elsevier Science Publishers , New York , USA
6. Kartha, K.K. 1985. Cryopreservation of Plant Cells and Organs. CRC Press, Boca Raton, Florida, USA.