

2020

M.Sc MICROBIOLOGY

Course Structure and Syllabus

(For the candidates admitted from the academic year 2020-2021 onwards)

CHOICE BASED CREDIT SYSTEM (CBCS)



THANTHAI HANS ROEVER COLLEGE (AUTONOMOUS)

(Nationally Re-Accredited by NAAC with B⁺⁺)

(Affiliated to Bharathidasan University, Tiruchirappalli)

ELAMBALUR, PERAMBALUR – 621 220



Thanthai Hans Roever College (Autonomous), Elambalur, Perambalur - 621 220

M.Sc., MICROBIOLOGY - Course Structure under CBCS

(For the candidates admitted from the academic year 2020-2021 onwards)

Semester	Course Code	Title of the Course	Ins. Hours/Weeks	Credit	Exam Hours	CIA (Max)	ESE (Max)	Total Marks
1	20PMB1CC1	Fundamentals of Biological Sciences	6	4	3	25	75	100
1	20PMB1CC2	General Microbiology	6	4	3	25	75	100
1	20PMB1CC3	Molecular Biology and Microbial Genetics	5	4	3	25	75	100
1	20PMB1CC4	General Biochemistry	5	4	3	25	75	100
1	20PMB1CP1	Fundamentals of Biological Sciences, General Microbiology, Molecular Biology and General Biochemistry (P)	8	4	3	40	60	100
Total			30	20				500
2	20PMB2CC5	Microbial Physiology	6	5	3	25	75	100
2	20PMB2CC6	Bioinformatics and Biostatistics	6	5	3	25	75	100
2	20PMB2EC1:1 20PMB2EC1:2 20PMB2EC1:3	Plant and Animal physiology Environmental and Agricultural Microbiology Molecular Taxonomy and Phylogeny	5	5	3	25	75	100
2	20PMB2EC2:1 20PMB2EC2:2 20PMB2EC2:3	Inheritance Biology Principles of Ecology Microbial Biotechnology	5	5	3	25	75	100
2	20PMB2CP2	Microbial Physiology & Bioinformatics (P)	8	4	3	40	60	100
Total			30	24				500
3	20PMB3CC7	Medical Microbiology	6	5	3	25	75	100
3	20PMB3CC8	Immunology	6	5	3	25	75	100
3	20PMB3EC3:1 20PMB3EC3:2 20PMB3EC3:3	Medical Laboratory Technology Food & Dairy Microbiology Marine Microbiology	5	5	3	25	75	100
3	20PMB3EC4:1 20PMB3EC4:2 20PMB3EC4:3	Quality control and IPR Biological Techniques Public Health and Hygiene	5	5	3	25	75	100
3	20PMB3CP3	Medical Microbiology and Immunology (P)	8	4	3	40	60	100
Total			30	24				500
4	20PMB4CC9	Bioprocess Technology	5	5	3	25	75	100
4	20PMB4CC10	Pharmaceutical Microbiology	5	5	3	25	75	100
4	20PMB4EC5:1 20PMB4EC5:2 20PMB4EC5:3	Genetic Engineering Food Processing Technology Microbial Nanotechnology	5	4	3	25	75	100
4	20PMB4CP4	Bioprocess Technology and Pharmaceutical Microbiology (P)	8	4	3	40	60	100
4	20PMB4PW	Project Work	7	4				100
Total			30	22				500
Grand Total			120	90				2000

List of Elective Courses

Elective	Course code	Title of the Course
Elective - 1	20PMB2EC1:1	Plant and Animal Physiology
	20PMB2EC1:2	Environmental and Agricultural Microbiology
	20PMB2EC1:3	Molecular Taxonomy and Phylogeny
Elective - 2	20PMB2EC2:1	Inheritance Biology
	20PMB2EC2:2	Principles of Ecology
	20PMB2EC2:3	Microbial Biotechnology
Elective - 3	20PMB2EC3:1	Medical Laboratory Technology
	20PMB2EC3:2	Food & Dairy Microbiology
	20PMB2EC3:3	Marine Microbiology
Elective - 4	20PMB2EC4:1	Quality control and IPR
	20PMB2EC4:2	Biological Techniques
	20PMB2EC4:3	Public Health and Hygiene
Elective - 5	20PMB2EC5:1	Genetic Engineering
	20PMB2EC5:2	Food Processing Technology
	20PMB2EC5:3	Microbial Nanotechnology

Note

Project	:	100
Dissertation	:	80 [2 reviewers – 20 + 20 = 40 marks, Report valuation = 40 marks]
Viva Voce	:	20

Core papers	:	10
Core practicals	:	04
Elective	:	05
Project	:	01

Particulars	Internal	External
1.Theory	25 Marks	75 Marks
2.Practical	40 Marks	60 Marks
3. Separate passing minimum is prescribed for internal and external		
a.	The passing minimum for CIA shall be 40% out of 25 marks (i.e. 10 marks)	
b.	The passing minimum for University Examinations shall be 40% out of 75 marks (i.e. 30 marks)	
c.	The passing minimum not less than 50% in the aggregate	

Question paper pattern for Theory Course

- 20 Questions compulsory - 20 x 01 = 20 Marks (4 from each unit)
- 5 Questions - 05 x 05 = 25 Marks (either or type, one from each unit)
- 3 Questions from 5 - 03 x 10 = 30 Marks (One question from each unit)
- Total = 75 Marks

Question paper pattern for Practical Course

- 1 Question compulsory - 15 x 01 = 15 Marks (Major Experiment)
- 2 Questions compulsory - 10 x 02 = 20 Marks (Minor Experiment)
- 5 Spotters - 03 x 05 = 15 Marks (Related to that semester Theory & Practical courses)
- Record Note - 05 x 01 = 05 Marks (According to maintaining the record note)
- Viva-voce - 05 x 01 = 05 Marks (Oral questions)
- Total - 60 Marks

CIA Components – Theory

- Best 2 tests out of 3 - 15 Marks
- Group Discussion / Seminar - 05 Marks
- Assignment - 05 Marks
- Total - 25 Marks

CIA Components – Practical

- Continuous Performance - 20 Marks
- Model Practical - 10 Marks
- Record - 05 Marks
- Viva - 05 Marks
- Total - 40 Marks

SEMESTER-I

Course Code: 20PMB1CC1
Instruction Hours: 5
Credits: 4

Exam Hours: 3
Internal Marks: 25
External Marks: 75

CORE COURSE 1–FUNDAMENTALS OF BIOLOGICAL SCIENCES

Objectives:

- To enable the students to understand the basic knowledge in Biological Sciences
- To understand the structure, classification, lifecycle and economic importance of algae and fungi
- To enlighten the students about the characteristics and classification of Plants, Vertebrates and Invertebrates

Course Outcomes:

- Students will get a fundamental knowledge on Algae and Fungi
- Imparting knowledge on economic importance and reproduction of plants
- Understand the morphology and taxonomy of plants
- Acquiring knowledge on characteristics and classifications of Invertebrates
- Obtaining knowledge on vertebrates and pest control

Unit I

Algae and Fungi: Thallophytes: Algae-General characteristics- Economic importance- Types of life cycle- Outline of various classifications. Fungi: General characteristics-Classifications and Economic importance

Unit II

Plant reproduction: General characteristics- Economic importance and outline of reproduction methods in Bryophytes, Pteridophytes and Gymnosperms.

Unit III

Plants: Basics of plant cell – Monocot and dicot - Classification of plant diversity –Classes of plant kingdom- Morphology: Inflorescence types -Racemose, cymose,and Mixed –Special types, Cyathium, Hypanthodium, Verticillaster and Thyrsus. Technical description of flower and floral diagram- Microsporangium and structure of Polygonum type embryo sac- Taxonomy: Systems of classification, (Artificial, Phylogenetic and Natural). Outline of Bentham and Hooker's classification.

Unit IV

Invertebrates: General characteristics and outline classification upto classes in Protozoa, Porifera, Coelenterata, Platyhelminthes and Ashelminthes; Economic importance of invertebrates. Classification of Chordata – Characteristic features - protochordata class – Pisces and Amphibia up to orders – General characters - a brief study on Star fish.

Unit V

Vertebrates and pests control: Salient features of Reptilia, Aves and Mammalia- Economic importance of Vertebrates. Bioluminescence. Insect pests of rice, sugarcane, coconut, cotton, vegetables, fruits and stored products (with an example of each). Principles of insect control: physical, mechanical, chemical, biological and integrated methods of pest control.

Text Book(s):

1. Ekambaranatha Iyar M and Ananthkrishnan TN. Manual of Zoology. Vol.I. part I and II, S. Visvanathan publication, Chennai.1994.
2. Ayyar EK and Ananthkrishnan. A Manual of Zoology, Vol. II(Chordata).1992.
3. Ekambaranatha Iyar M and Ananthkrishnan TN. Manual of Zoology Vol.II. S. Visvanathan publication, Chennai.1994.
4. Ranganathan TN.Chordata Zoology, Rainbow printers, Palayamkottai.1996.

- Ekambaranatha Ayyar. Outlines of Zoology. Vols. I and II S. Viswanathan (Printers and Publishers) Pvt. Ltd., Chennai.1993.
- Jordan EL and Verma PS. Invertebrate Zoology, 12th Edition, S. Chand and Co.1995.
- Krishnan NT. Economic Entomology, J.J. Publications, Madurai. 1993.

Reference Book(s):

- Mani MS. General Entomology, Oxford and IBH publishing Co., New Delhi.1982.
- Nayar K, Ananthkrishnan TN and David M. General and applied Entomology, Tata McGraw Hill Pub. Co., Ltd., New York. 1995.
- David BV. Pest Management and pesticides Indian Scenario, Namrutha Publications.1992.
- Kotpal RL. Invertebrata, Rastogi Publication, Meerut.2000.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	20PMB1CC1	Fundamentals of Biological Sciences					5	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓		✓	✓		
CO2	✓	✓	✓	✓		✓		✓	✓		
CO3	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓		✓	✓		
Number of Matches(✓) = 42 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-I

Course Code: 20PMB1CC2
Instruction Hours: 5
Credits: 4

Exam Hours: 3
Internal Marks: 25
External Marks: 75

CORE COURSE 2 – GENERAL MICROBIOLOGY

Objectives:

- To enable the students to understand the basic knowledge in Microbiology
- To impart the knowledge on microbial classification and taxonomy
- To acquire the students about cultivation methods of microbes

Course Outcomes:

- Receive a fundamental knowledge on morphology and functions of bacteria
- Understand the microbial classification and taxonomy
- Acquiring about the classification of fungi and viruses
- Obtaining knowledge on characteristics and classification of algae and protozoa
- Imparting ideas on cultivation methods of microbes

Unit I

Ultra structure and function: Bacteria: Morphological types; cell wall – cell walls of Gram negative, Gram positive, halophiles. L-forms and Archaeobacteria, Cell wall synthesis, cell membrane, capsule type's composition and function. Structure and function of flagella, fimbriae and pili, gas vesicles, chlorosomes, carboxysomes, magnetosomes and phycobilisomes. Reserve food materials polyhydroxybutyrate, polyphosphates, cyanophycin and sulphur inclusions. Nuclear material - bacterial chromosomes and bacterial plasmids.

Unit II

Microbial Classification: Microbial Taxonomy - Definition and systematics, Nomenclature and identification. Haeckel's three kingdom classification, Whittaker's five kingdom approach. Three domain classification; Taxon, species, strain, type culture; Major characteristics used in taxonomy – morphological, physiological, metabolic, serological and molecular. Phylogenetic relationships – Cladogram, Dendrogram; Classification and salient features of bacteria according to Bergey's Manual of Determinative Bacteriology (9th edition).

Unit III

Fungi and Viruses: Fungi: Classification of fungi based on Alexopoulos system. - characteristics of

Fungi – Filamentous, non-filamentous and dimorphic fungi -Morphology, structure and life cycle of *Aspergillus niger* and *Saccharomyces cerevisiae*. Parasitism, mutualism and symbiosis with plants and animals. Industrial uses of yeast and moulds. Viruses: ICTV system of classification, General properties,

Morphology and ultra-structure of virus - capsid and their arrangements, types of envelopes and their composition, viral genome (RNA, DNA); Viroids, Prions -structure and importance.

Unit IV

Algae and Protozoans : Classification of Algae based on Fritsch system – General characters of Bluegreen Algae (Cyanobacteria) Macroalgae - Biological and Economic importance of algae. Protozoa – structural characteristics, classification and reproduction.

Unit V

Cultivation methods of microbes: Isolation of different types of bacteria - Fungi – Actinomycetes - Cyanobacteria - Protozoa. Physical and Chemical requirements for growth; Pure culture methods. Anaerobic culture techniques. Preservation methods of microbes. Type culture collections. Physical and chemical methods of controlling microorganisms.

Text Book(s):

1. Alcamo E. Fundamentals of Microbiology. 6th Ed., Jones and Bartlett Publishers, New Delhi. 2001.
2. Dubey RC and Maheswari DK. A Text Book of Microbiology. S Chand, New Delhi. 2010.
3. Dube HC. Introduction to Fungi. Vikas publishing pvt. Ltd. New Delhi 2009.
4. Johri RM, Snehlatha, Sandhya Shrama. A Textbook of Algae. Wisdom Press, New Delhi. 2010.
5. Kanika Sharma. Textbook of Microbiology – Tools and Techniques. 1st edition, Ane Books Pvt. Ltd., New Delhi. 2011.
6. Pelczar TR, Chan ECS and Kreig NR .Microbiology. 5th Edition, Tata McGraw – Hill, New Delhi.2006.
7. Salle AJ. Fundamental principles of Bacteriology.7th edition, Tata McGraw- Hill publishing company Ltd, New Delhi. 2001.

Reference Book(s):

1. Alexopoulos CJ, Mims CW and Blackwell M. Introductory Mycology. Fifth edition John Wiley and Sons. Chichester. 2000.
2. Holt JS, Kreig NR, Sneath PHA and Williams ST. Bergey's Manual of Determinative Bacteriology (9th Edition), Williams and Wilkins, Baltimore. 1994.
3. Madigan MT, Martinko JM, Dunlap PV and Clark DP. Brock Biology of Microorganisms. 12th Ed. Pearson/ Prentice Hall. 2008.
4. Prescott LM, Harley JP and Klein DA. Microbiology. 7th edition, McGraw Hill, New York. 2008
5. Schlegel HG. General Microbiology, Cambridge University Press, UK. 2008.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	20PMB1CC2	General Microbiology					5	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓		✓	✓	✓	✓	✓		
CO3	✓			✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓		✓	
Number of Matches (✓) = 44 Relationship: High											

6.

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-I

Course Code: 20PMB1CC3
Instruction Hours: 5
Credits: 4

Exam Hours: 3
Internal Marks: 25
External Marks: 75

CORE COURSE 3 – MOLECULAR BIOLOGY AND MICROBIAL GENETICS

Objectives:

- To impart the updated knowledge on molecular biology and microbial genetics
- It endeavours to provide the required fundamental knowledge on eukaryotic and prokaryotic molecular mechanism
- To understand the process of gene expression, gene transfer and recombination

Course Outcomes:

- Acquiring the knowledge on DNA replication and repair mechanism
- Understanding the process of transcription and translation
- Imparting the concepts on the regulation of gene expression
- Attaining the knowledge on gene transfer and genetic recombination
- Got a comprehensive idea about the types of mutation

Unit I

Genetic material, DNA replication and repair: Identification of genetic material (Griffith, Avery and Hershey and Chase experiments). Organization of genetic material: Bacteria – Eukaryotes: nucleus and nucleosomes, lamp brush and giant chromosomes. DNA replication - Meselson – Stahl experiment, Molecular mechanisms of DNA Replication – bidirectional and rolling circle replication. Differences between prokaryotic and eukaryotic replication. Plasmids – types, structure and replication. Inhibitors of DNA replication - DNA repair – mechanism of excision repair, SOS repair and mismatch repair.

Unit II

Transcription and translation: Process of transcription – initiation, elongation – termination. Synthesis of mRNA in prokaryotes and eukaryotes. RNA splicing. Synthesis of rRNA and tRNA. RNA processing – capping and polyadenylation. Inhibitors of transcription. Genetic code, process of translation – initiation, elongation and termination. Signal sequences and protein transport. Inhibitors of translation.

Unit III

Regulation of gene expression : Organization of Genes in Prokaryotes and Eukaryotes - Introduction – Operon concept, lac, trp, arabinose operons, promoters and repressors. Regulation of gene expression – Transcriptional control – promoters, terminators, attenuators and anti terminators; Induction and repression; Translational control – ribosome binding, codon usage, antisense RNA; post-transcriptional gene silencing – RNAi.

Unit IV

Gene transfer and genetic recombination mechanisms: Transformation – competence cells, regulation, general process; Transduction – general and specialized; Conjugation – Discovery, mechanism of F⁺ v/s F⁻, Hfr+v/s F⁻, F' v/s F⁻, triparental mating, self transmissible and mobilizable plasmids, pili. Linkage and genetic maps – genetic mapping of T4 phage. Cvalue paradox. Hardy Weinberg Equilibrium.

Unit V

Mutation and transposable elements: Types and molecular basis of mutation– Agents of mutation - Importance of mutations in evolution of species. Discovery of insertion sequences, complex and compound transposons – T10, T5, and retroposon – Nomenclature- Insertion sequences – Mechanism – Transposons of *E. coli*, Bacteriophage and Yeast. Importance of transposable elements in horizontal transfer of genes and evolution.

Text Book(s):

1. Friedberg EC, Walker GC, Siede W. DNA repair and mutagenesis. ASM press. 2005.
2. James D Watson, Tania A Baker, Stephen P Bell and Alexander Gann. Molecular Biology of the Gene, 5th edition. 2008.
3. Malacinski GM and Freifelder D. Essentials of Molecular Biology, 3 edition, John and Bartlett Publish. 1998.
4. Maloy SR, Cronan Jr. JE, Freifelder D. Microbial genetics. Jones and Bartlett publishers. 1994.
5. Ajoy Paul. Text Book of Cell and Molecular Biology, Books and Allied (P)Ltd. Kolkata. 2007.
6. Gardner EJ, Simmons MJ, Snustad DP. Principles of Genetics. 8th edition John Wiley and sons. 2008.
7. George M Malacinski. Freifelder's Essentials of Molecular Biology. 4th edition. Narosa Publishing House. 2008.
8. Stanly R Maloy, John E Cronan and David Freifelder Jr. Microbial Genetics. Narosa publishing house, New Delhi. 2nd edition. 2006.
9. David Freifelder. Molecular Biology, Narosa publishing house, New Delhi. 2nd edition. 2008.
10. Channarayappa A. Cell Biology, Universities Press, (India) Pvt. Ltd, Hyderabad, India. 2010.
11. Channarayappa A. Molecular Biology, Universities Press, (India) Pvt. Ltd, Hyderabad, India. 2010

Reference Book(s):

1. Antony JF, Griffiths, Gilbert WM, Lewontin RC and Miller JH. Modern Genetic Analysis, Integrating Genes and Genomes, 2nd edition, WH. 2002.
2. Blackburn GM, Gait MJ. Nucleic acids in chemistry and biology. Oxford University press. 1996.
3. Lewin B. Genes VII. Oxford University press. 2000.
4. Singer M and Berg P. Genes and Genomes. University Science Books. 1991.
5. Watson JD, Hopkins NH, Roberts JW, Steitz JA, Weiner AM. Molecular biology of the gene, 4th edition, Benjamin/Cummings publishing company. 1998.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	20PMB1CC3	Molecular Biology and Microbial Genetics					5	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓		✓	✓	✓	✓		✓	
CO3	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO4	✓		✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓			✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 43 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-I

Course Code: 20PMB1CC4
Instruction Hours: 5
Credits: 4

Exam Hours: 3
Internal Marks: 25
External Marks: 75

CORE COURSE 4 – GENERAL BIOCHEMISTRY

Objectives:

- To provide basic understanding of Cell and its function
- To learn about the chemical nature of biological macromolecules
- To impart the knowledge on metabolism and mechanism of molecular recognition

Course Outcomes:

- Providing the knowledge on structure and functions of the cell
- Attaining the fundamental concepts of enzymes and its inhibition
- Understanding the types and biosynthesis of macromolecules
- Acquiring knowledge on bioenergetics
- Obtaining the basic concepts of metabolism

Unit I

Cell and its function : Composition of living matter. Biochemistry of bacterial, animal and plant cell. Specialized components of microorganisms and their structure and function.

Unit II

Enzymes : Enzymes as biocatalysts, enzyme classification, specificity, active site, unit activity, isozymes. Enzyme kinetics: Michaelis – Menton equation for simple enzymes. Enzyme inhibition.

Unit III

Types of macromolecules and their biosynthesis : Structural features and chemistry of macromolecules. Nucleic acid – properties, biosynthesis of purines and pyrimidines - Structure of DNA and RNA. Proteins – classification – aminoacids - primary-secondary-tertiary – quaternary and three dimensional structure of proteins. Carbohydrates -mono, di, oligo and polysaccharides. Lipids and biomolecules: Fatty acids, properties, -oxidation - biosynthesis of cholesterol.

Unit IV

Bioenergetics: Bioenergetics and strategy of metabolism - flow of energy through biosphere, strategy of energy production in the cell. Oxidation – reduction reactions, coupled reactions and group transfer. ATP production, structural features of biomembranes, transport, free energy and spontaneity of reaction, G , G° , G' and equilibrium. Basic concepts of acids, base, pH and buffers.

Unit V

Metabolism – basic Concepts: Cell metabolism - catabolic principles and break down of carbohydrates, lipids, proteins and nucleic acids - vitamins and their role as coenzymes.

Text Book(s):

1. Donald Voet and Judith G. Voet. Biochemistry – Second Edition. John Willey and Sons, Inc.1995.
2. Freifelder D. Molecular Biology, II Edition, Narosa Publishing House, New Delhi.1996.
3. Christopher K Mathews and Van Holde KE. Biochemistry. 2ndedition. The Benjamin/Cummings publishing company, Inc.1996.
4. Geofferey L and Zubay. Biochemsitry. Fourth Edition.Wm. C. Brown Publishers.1998.
5. Reginald H Garret and Charles M Grishm. Biochemistry (Second Edition) Saundars College Publishing.1998.

6. Thomas M Devlin. Textbook of Biochemistry with clinical correlations. 5th edition. A John Wiley and sons, Inc., publication, Newyork.2002.
7. Rafi MD. Textbook of Biochemistry for medical students, 2nd edition, Universities Press, (India) Pvt. Ltd, Hyderabad, India. 2014.

Reference Book(s):

1. David E Metzler and Carol M Metzler. Biochemistry -The chemical reactions of living cells- Voll1and2.2nd edition. Harcourt/Academic press, Newyork. 2001.
2. Lehninger, Albert L, David L Nelson and Michael M Cox. Lehninger Principles of Biochemistry. New York: Worth Publishers. 2000.
3. Jeremy M Berg, John L Tymoczko and Lubert stryer. Biochemistry.5th edition.W.H.Freeman and company, Newyork.2002.
4. Stryer L Berg JM and Tymoczko JL. Biochemistry. 5th edition. New York:W. H. Freeman. 2002.
5. Trudy McKee and James R McKee. Biochemistry-An Introduction.2nd edition.WCB McGraw-Hill,U.S.A. 1999.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	20PMB1CC4	General Biochemistry					5	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓		✓	✓	✓		✓	✓		
CO3	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓		✓	✓		✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 42 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-I

Course Code: 20PMB1CP1
Instruction Hours: 8
Credits: 4

Exam Hours: 3
Internal Marks: 40
External Marks: 60

CORE COURSE PRACTICAL 1 – FUNDAMENTALS OF BIOLOGICAL SCIENCES, GENERAL MICROBIOLOGY, MOLECULAR BIOLOGY AND MICROBIAL GENETICS & GENERAL BIOCHEMISTRY (P)

Objectives:

- To learn about the fundamental sections of the plants
- To isolate and identification of different microorganisms
- To learn basic biochemistry techniques and study the qualitative/quantitative analyses of macromolecules

Course Outcomes:

- Providing a practical exposure on fundamental studies on plants
- Imparting the knowledge on microbiological techniques and methods
- Understanding the process of molecular biology and microbial genetics
- Obtaining the knowledge on biochemical analysis
- Acquiring the knowledge on determining, analyzing and separation of samples

Fundamentals of Biological Sciences

1. Determination of photosynthetic pigment
2. Plant Tissue culture media preparation
3. Preparation, surface sterilization and inoculation of explant
4. Callus induction
5. Isolation of protoplast and culture
6. Isolation of plant genomic DNA by modified CTAB method and visualization of DNA by agarose gel electrophoresis.

General Microbiology

1. Preparation of media: Nutrient broth, Nutrient agar, plates, slants and soft agar
2. Micrometry - counting and measurements
3. Pure techniques - serial dilution - pour plate, spread plate, streak plate methods and stab culture techniques
4. Bacterial Staining methods - simple, Gram's, acid fast, flagella, capsule and spore.
5. Fungal Staining methods - Lacto-phenol cotton blue
6. Motility of bacteria
7. Enumeration of bacteria/ yeast cell; viable count (plate count), total count (Haemocytometer)

Molecular Biology and Microbial Genetics

1. Isolation of mutants by spontaneous mutation – Gradient plate technique
2. Isolation of auxotrophic and antibiotic resistant mutants by physical and chemical mutagens
3. Competent cell preparation and Bacterial transformation
4. Isolation of microbial genomic DNA
5. Isolation of plasmids from *E.coli* .
6. Restriction digestion and Ligation of DNA
7. Polymerase Chain Reaction
8. Blotting techniques (Southern, Northern, Western and Dot blottings)

General Biochemistry

1. Preparation of buffer (Tris, phosphate, acetate buffer)
2. Determination of (H⁺)ion concentration
3. Verification of Beer-Lambert's law using coloured solution
4. Preparation of standard graph for the following and estimating the concentration in a microbial sample i) glucose –anthrone method, ii) bovine serum albumin (Lowry's method) and iii) Nucleic acid – DNA (diphenylamine method), RNA (Orcinol method).
5. Separation of aminoacids by paper chromatography and identification of aminoacid.
6. Separation of proteins by PAGE, SDS – PAGE – Demonstration.

References:

1. James G Cappuccino and Natalie Sherman. Microbiology. 10th edition, The Benjamin/Cummings pub.co. California. 1996.
2. David R Brooke. Bergey's Manual of systematic bacteriology (Vol 1), Eastern Halz, Springer publication, US. 2007.
3. Gunasekaran P. Laboratory Manual in Microbiology, New Age International Pvt. Ltd. Publishers, New Delhi. 2008.
4. Kanika Sharma. Manual of Microbiology – Tools and Techniques. 2nd Edition, Ane Books Pvt. Ltd., New Delhi. 2009.
5. Keith Wilson and John Walker. Principles and Techniques of Practical Biochemistry. 4th edition. Cambridge University press, Britain. 1995.
6. Nizhny Novgorod. Laboratory manual on Biochemistry: Publishing House of Nizhny Novgorod State medical academy. 2008.
7. Rajan S and Selvi Christy R. Experiments in Microbiology. Anjana Books House, Chennai.2015.
8. Shawn O' Farrell and Ryan T Ranallo. Experiments in Biochemistry: A Hands on Approach-A manual for the undergraduate laboratory, Thomson Learning, Inc., Australia. 2000.
9. Wilson K and Walker J. Practical biochemistry, 5th edition, Cambridge University Press, London. 2000.
10. Mahatma Gandhi-Doerenkamp Centre (MGDC) for Alternatives to Use of Animals in Life Science Education. <http://www.mgdcaua.org/>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
I	20PMB1CP1	Core Course Practical 1 – Fundamentals of Biological Sciences, General Microbiology, Molecular Biology and Microbial Genetics & General Biochemistry (P)	8	4						
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2		✓	✓	✓	✓	✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓		✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓		✓	✓
Number of Matches (✓) = 44 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-II

Course Code: 20PMB2CC5
Instruction Hours: 6
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

CORE COURSE 5 – MICROBIAL PHYSIOLOGY

Objectives:

- To understand the growth, enzymology and physiological processes of microbes
- To learn about the metabolic pathways of microbes
- To enable the students to get knowledge about the spore structure and function

Course Outcomes:

- Understanding the basic concepts of cell structure and function
- Acquiring knowledge on bacterial growth, phases and measurement of growth curve
- Got a comprehensive idea about the microbial pigments and process of photosynthesis
- Understanding the metabolic pathways of microbes
- Attaining knowledge on microbial sporulation and morphogenesis

Unit I

Cell structure and function : Bacterial cell wall - Biosynthesis of peptidoglycan - outer membrane, teichoic acid – Exopolysaccharides; cytoplasmic membrane, pili, fimbriae, S-layer. Transport mechanisms – active, passive, facilitated diffusions – uni, sym, antiports. Electron carriers – artificial electron donors – inhibitors – uncouplers – energy bond – phosphorylation.

Unit II

Microbial growth: Bacterial growth - Phases of growth curve – measurement of growth – calculations of growth rate – generation time – synchronous growth – induction of synchronous growth, synchrony index – factors affecting growth – pH, temperature, substrate and osmotic condition. Survival at extreme environments – starvation – adaptative mechanisms in thermophilic, alkalophilic, osmophilic and psychrophilic.

Unit III

Microbial pigments and photosynthesis: Autotrophs - cyanobacteria - photosynthetic bacteria and green algae – heterotrophs – bacteria, fungi, myxotrophs. Brief account of photosynthetic and accessory pigments – chlorophyll – fluorescence, phosphorescence - bacteriochlorophyll – rhodopsin – carotenoids – phycobiliproteins.

Unit IV

Carbon assimilation: Carbohydrates – anabolism – autotrophy – oxygenic – anoxygenic photosynthesis – autotrophic generation of ATP; fixation of CO₂ – Calvin cycle (C₃) – C₄ pathways. Respiratory metabolism – Embden Mayer Hoff pathway – Entner Doudroff pathway – glyoxalate pathway – Krebs cycle – oxidative and substrate level phosphorylation – reverse TCA cycle – gluconeogenesis – Fermentation of carbohydrates – homo and heterolactic fermentations.

Unit V

Spore structure and function: Cell division – endospore – structure – properties – germination. Microbial sporulation and morphogenesis – Bacteria including cyanobacteria and actinobacteria, fungi and algae.

Text Book(s):

1. Lansing M. Prescott, John P. Harley and Donald A. Klein. Microbiology. 5th edition. McGraw-Hill Company, New York. 2003.
2. Moat AG, Foster JW and Spector MP. Microbial Physiology 4th edition. John Wiley and Sons, New York. 2002.
3. Pelczar Jr MJ, Chan ECS and Kreig NR. Microbiology, 5th edition. Mc. Graw Hill. Inc, New York. 2013.
4. Salle AJ. Fundamental principles of Bacteriology, 7th edition. Tata McGraw- Hill publishing company limited, New Delhi. 1996.

Reference Book(s):

1. Caldwell DR. Microbial Physiology and metabolism, Wm. C. Brown Publishers, USA 1995.
2. White D. The physiology and biochemistry of Prokaryotes, Oxford University Press, Oxford, New York. 1995.
3. Robert Poole K. Advances in Microbial Physiology, Volume 53, Elsevier Science and Technology. 2007.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	20PMB2CC5	Microbial Physiology					6	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓		✓	✓	✓	✓		✓	
CO3	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓		✓	✓	✓	✓	✓	
CO5	✓			✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 43 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-II

Course Code: 20PMB2CC6
Instruction Hours: 6
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

CORE COURSE 6 – BIOINFORMATICS AND BIOSATISTICS

Objectives:

- To gain insight about computer based technology for the study of biological molecules.
- To enable the students to get knowledge on molecular modeling and drug designing
- To equip statistical skills to solve biological problems.

Course Outcomes:

- Imparting knowledge on basics of computers and biological databases
- Understanding the types and applications of genomics and proteomics
- Acquiring knowledge on software, tools and interaction in molecular modeling
- Got a comprehensive idea about the process of drug designing
- Exposing the statistical concepts on analyzing and executing the results

Unit I

Biological databases : Basics of computers –types, servers, operating systems, UNIX, Linux.. Biological databases NCBI, EMBL, DDBJ - Finding scientific articles - Pubmed – sequencing genomes – pairwise sequence comparison - BLAST and FASTA. Multiple sequence alignments, Phylogenetic alignment - Phylip.

Unit II

Genomics and proteomics : Genomics and proteomics- types and application-Protein Data Bank, Swiss- prot – PIR, SCOP, CATH - secondary structure prediction – Chou Fassman, GOR method - predicting 3 D structure – protein modeling, abinitio - visualization tool RASMOL.

Unit III

Molecular Modelling: Macromolecular modeling- Software tools for modeling bio-molecules. Molecular electrostatic potentials, charge analyses. Protein conformations, folding and mutation through modeling-design of ligands for known macro molecular target sites. Drug-receptor interaction, classical SAR/QSAR studies and their implications to the 3-D modeler, 2-D and 3-D database searching.

Unit IV

Drug Designing: Advanced Drug Design Methods - Structure activity relationship, Pharmacokinetics, Pharmacophoric pattern, ADMET Properties, Quantitative Structure Activity Relationship (QSAR) - Docking-Rigid and Flexible – Structure based drug design - Finding new drug targets to treat disease-strategies for target identification and lead design- New targets for anticancer drugs.

Unit V

Biostatistics : Collection and presentation of data – Descriptive statistics - Measures of Central tendency – Mean, Median and Mode – Measures of dispersion – range, mean deviation, variance and standard deviation. Chi-square test – Hypothesis test - Student's t-test – Correlation and Regression – ANOVA.

Text Book(s):

1. Chavali LN. Bioinformatics and Bioprogramming in C, Universities Press, (India) Pvt. Ltd, Hyderabad, India. 2009.
2. Ruchi Singh and Richa Sharma. Bioinformatics: Basics, algorithms and applications, Universities Press, (India) Pvt. Ltd, Hyderabad, India. 2010.
3. MolecBryan Bergeron. Bioinformatics Computing First Indian Edition, Prentice Hall.2003.

4. Cynthia Gibas and Per Jambeck Developing Bioinformatics Computer Skills: First Edition Shroff Publishers and Distributors Pvt. Ltd (O'Reilly), Mumbai.2001.
5. Arora PN and Malhon PK Biostatistics Himalaya Publishing House, Mumbai (2008).
6. Pranabkumar Banerjee Introduction to Biostatistics, S.chand and company Ltd., (2007).

Reference Book(s):

1. Ewens WJ, Gregory Grant. Statistical Methods in Bioinformatics: An Introduction (Statistics for Biology and Health), Springer. 2013.
2. Rashidi HH and Buehler LK. Bioinformatics Basics: Applications in Biological Science and Medicine, Second Edition CRC Press, London. 2005.
3. Des Higgins and Willie Taylor Bioinformatics: Sequence, structure and databanks, Oxford University Press (2002).
4. Baxevanis AD and Ouellette BEF, Bioinformatics: A practical guide to the analysis of genes and proteins, First Edition Wiley Interscience – New York (2001)
5. Stanton A and Clantz, Primer of Biostatistics. The McGraw Hill Inc., New York (2005).

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	20PMB2CC6	Bioinformatics and Biosatistics					6	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓		✓	✓	✓		✓	✓		
CO3	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓		✓	✓		✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓		✓	✓	
Number of Matches(✓) = 41 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-II

Course Code: 20PMB2EC1:1
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ELECTIVE COURSE 1 – PLANT AND ANIMAL PHYSIOLOGY

Objectives:

- To facilitate the knowledge on photosynthesis and plant tissue culture
- To acquire the knowledge about the structure and functions of the system
- To understand about the functions of the body which adapts with internal and external environment

Course Outcomes:

- Attaining the knowledge on photorespiration and metabolic pathways
- Facilitates to understand about the plant tissue culture
- Imparting on anatomy and physiology of circulatory and respiratory system
- Acquiring the structure and functions of digestive system
- Understanding the process of excretory system

Unit I

Photorespiration: Photosynthesis - Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO₂ fixation-C₃, C₄ and CAM pathways- photorespiration – Citric acid cycle; plant mitochondrial electron transport and ATP synthesis. Plant growth hormones.

Unit II

Plant Tissue Culture: Micropropagation, haploids and their applications, somaclonal variations and applications, Endosperm culture- protoplast isolation, culture and regeneration, methods of fusing protoplasts, somatic hybridization.

Unit III

Circulatory and Respiratory system : Circulation: Structure of Heart and blood vessels, cardiac cycles, cardiac factors controlling blood pressure, electrocardiogram. Functions of heart. Respiration: Anatomy, and physiology of respiration, pulmonary surfactant, exchange of gases between lung and blood and between blood and tissues. Role of lung in acid-base balance.

Unit IV

Digestive system: Digestive system: Anatomy of the digestive system, Salivary, Gastric and Biliary Secretions- composition and functions. Intestinal hormones, movements in Gastro intestinal tract, Secretion, digestion and absorption in the small intestine. Absorption in the large intestine; Digestion and absorption of carbohydrates, lipids and proteins.

Unit V

Excretory system: Excretory system: Structure and functions of kidney. Urine- composition and formation. Renal regulation of acid-base balance. Muscle: Kinds of muscle, structure. Mechanism and theories of muscle contraction.

Text Book(s):

1. Biochemistry 29th edition Robert Harper's, McGraw Hill, 2012.
2. Phundan Singh, 2013. Principles of Plant Biotechnology. Kalyani Publishers, India.
3. Singh, 2014. Plant Biotechnology, 2nd Revised Edition, Kalyani Publishers, India.
4. Human Physiology: Vol I & II C.C. Chatterjee, 2016.
5. Functions of the Human body – Guyton A.C, 1974.
6. Human Physiology-Systemic & applied-Sahalya, 2009.
7. Human Nutrition and Dietetics – Swaminathan, Bangalore printing and Pulv. Co.Ltd, 1996.

Reference Book(s):

1. Biochemistry, 5th edition, Stryer W.H Freeman. Donald Voet, J.G. Voet, John

2. Wiley, J O H N W I V P & *Publisher* Kaye Pace, 2005.
3. Review of Medical Physiology – Ganong, Appleton and Lange, 2003

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	20PMB2EC1:1	Plant and Animal Physiology					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓		✓	✓	✓	✓	✓	✓		
CO3	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 45 Relationship: Very High											

4.

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-II

Course Code: 20PMB2EC1:2
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ELECTIVE COURSE 1 –ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

Objectives:

- To enable the students to get exposure on various aspects of environmental and agricultural microbiology
- To understand the role of microbes in soil and agricultural environment
- To impart the knowledge on soil, aquatic and air microorganisms

Course Outcomes:

- Facilitates to understand about the air microbiology and biogeochemical cycles
- Providing a knowledge on aquatic microbiology
- Got a basic idea about recycling of liquid and solid wastes
- Understanding the features of biofertilizers
- Attaining the fundamental knowledge on plant diseases and its control

Unit I

Air microbiology and Biogeochemical cycles : Aerobiology- Significance of air microflora - Microbial air pollution- sources, biological indicators and effects on plants and human beings. Enumeration of bacteria from air, Air sampling devices, Outline of Airborne diseases (Bacterial, Fungal and Viral), Air sanitation. Biogeochemical cycles -Nitrogen, Carbon, Phosphorous, Sulphur, Iron and their importance.

Unit II

Aquatic microbiology: Microbes in marine and fresh water environment – eutrophication – Water pollution – sources and nature of pollutants in water – sewage – treatment of liquid waste – primary, secondary and tertiary treatment – water borne diseases – Assessment of water quality – BOD and COD. Solid waste treatment – saccharification and pyrolysis.

Unit III

Recycling of Liquid and Solid wastes: Recycling of Liquid and Solid wastes-Composting-Biogas, Mushroom and SCP production from waste. Biodegradation of complex polymers (Cellulose, Hemicellulose, Lignin, Chitin and Pectin), Bioremediation (*In-situ*, *Ex-situ*, Intrinsic), Bioaugmentation and Biostimulation. Bioleaching (Copper and Uranium) -Xenobiotics degradation (Heavy metals). A brief note on panchakavya.

Unit IV

Soil Microbiology: Microbial association with plants - Phyllosphere, Rhizosphere, Mycorrhizae, nitrogen fixing organism – symbiosis, asymbiosis, associate symbiosis – phosphate solubilizers – application of biofertilizers in agriculture. Biology of nitrogen fixation – genes and regulations in *Rhizobium*.

Unit V

Plant diseases and its control: Bacterial, viral and fungal plant pathogens. Morphological, physiological changes with reference to disease establishment in plants – plant protection – phenolics – phytoalexins and related compounds. Disadvantages of chemical pesticides. Microbial pesticides- types, mechanisms, advantages and limitations.

Text Book(s):

1. Chatterji AK. Introduction to Environmental Biotechnology. 2005
2. Christon J Hurst, Manual of Environmental Microbiology.2nd edition. American Society for Microbiology, Washington. 2002.
3. Clescri LS, Greenberg AE and Eaton AD. Standard Methods for Examination of Water and Waste Water, 20th Edition, American Public Health Association. 1998.
4. Ec Eldowney S, Hardman DJ, Waite DJ, Waite S. Pollution: Ecology and Biotreatment – Longman Scientific Technical. 1993.
5. Gareth M. Evans and Judith C Furlong. Environmental Biotechnology-Theory and Application, John Wiley and sons Ltd. 2003.
6. Richard G Burus and Howard Slater. Experimental Microbial Ecology, Blackwell Scientific Publishers.1982.

Reference Book(s):

1. Atlas Ronald M, Bartha Richard. Microbial Ecology 2nd Edition Benjamin/Cummings Publishing Company, California. 1987.
2. Baker WC and Herson DS. Bioremediation – McGraw Hill Inc., New York.1994.
3. Dirk J. Elsas V, Trevors JT, Wellington EMH. Modern Soil Microbiology, Marcel Dekker INC, New York, Hong Kong. 1997.
4. Duncan Mara and Nigel Horen. The Handbook of water and waste water Microbiology. Academic press-An imprint of Elsevier. 2003
5. Gerhardt P, Murray RG, Wood WA and Kreig NR. Methods for General and Molecular Bacteriology, ASM Publications, Washington DC. 1994.
6. Mitchel R. Environmental Microbiology. Wiley – John Wiley and Sons. NewYork. 1992.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	20PMB2EC1:2	Environmental and Agricultural Microbiology					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓			✓	✓		✓	✓		
CO3	✓	✓		✓		✓	✓	✓	✓	✓	
CO4	✓	✓	✓		✓	✓		✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 40 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-II

Course Code: 20PMB2EC1:3
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ELECTIVE COURSE 1 –MOLECULAR TAXONOMY AND PHYLOGENY

Objectives:

- To gain knowledge about microbial taxonomy and molecular phylogeny
- To enable the students to get the knowledge on advanced fingerprinting techniques
- To understand the process of sequence analysis

Course Outcomes:

- Gaining knowledge on basic concepts of microbial taxonomy
- Attaining the knowledge on biochemical and molecular techniques
- Imparting knowledge on advanced fingerprinting techniques
- Facilitates to understand the process of sequence analysis
- Acquiring knowledge on molecular phylogeny

Unit I

Microbial Taxonomy: Introduction to microbial taxonomy – morphological, biochemical and molecular taxonomy. Basic concepts of numerical taxonomy. Positive and negative aspects of each taxonomical methods. Morphological phylogeny.

UNIT II

Biochemical and molecular taxonomy: Chemotaxonomy - fatty acid, protein finger printing, Isozyme typing, pigments and polyamines. Biochemical phylogeny. Molecular taxonomy - G +C content, DNA –DNA hybridization, Plasmid profiles, RFLP, RAPD, STRR and LTRR, REP –PCR, rRNA based DNA finger printing methods

Unit III

16S rRNA based finger printing: Types of rRNA - 23s rRNA, 16S rRNA and 5S rRNA. Isolation of DNA, amplification of 16S rDNA using PCR technique. Sequencing of 23s rRNA, 16S rRNA and 5S rRNA. Importance of 16S rRNA in identification of prokaryotes. Methods of 16S rRNA / rDNA fingerprinting.

UNIT IV

Sequence analysis: Submission of rDNA sequences in GenBank – Bankit and Sequin guidelines. NCBI, EMBL and DDBJ – retrieving sequences. RNA structure prediction, Restriction enzyme patterns. Ribosomal Database Project - Designing primers and probes. Sequence comparison, alignment and data base searching – ClustalW, FASTA and BLAST. DNA barcoding.

UNIT V

Molecular phylogeny: Introduction to Molecular phylogeny – tree terminology, software programs for making phylogenetic trees – MEGA, Phylip, RAPDistance. Cladogram, additive trees and ultrametric trees, rooted, unrooted trees and tree shapes.

Text Book(s):

1. Anna Tromontano. Introduction to Bioinformatics, CRC Press, Florida, USA. 2002.
2. Brendan Wren and Nick Dorrell. Functional Microbial Genomics (Volume 33) (Methods in Microbiology), Academic Press, UK. 2002.
3. Perry JJ, Staley JT and Lory S. Microbial Life. Sinauer Associates, Publishers, Sunderland, Massachusetts. 2002.

4. Higgins. Bioinformatics: Sequence structure and data banks: A practical approach, Blackwell Publishers, UK. 2005.
5. Sandy B Primrose and Richard M Twyman. Principles of Genome Analysis and Genomics, Blackwell Publishing, USA. 2005.

Reference Book(s):

1. Baxavanis and Oullette. Bioinformatics. A practical Guide to the Analysis of gene and proteins, 3rd edition. John Wiley and Sons, New York.2005.
2. Primrose SB. Principles of Genome Analysis: A guide to mapping and sequencing DNA from different organisms, 2nd edition, Oxford England, Cambridge, Mass., USA: Blackwell Science. 1998.
3. Roderic DM Page and Edward C Holmes. Molecular Evolution: A Phylogenetic Approach. Blackwell publishing, USA. 1998.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	20PMB2EC1:3	Molecular Taxonomy and Phylogeny					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓			✓	✓		
CO3					✓	✓	✓		✓	✓	
CO4	✓	✓		✓		✓		✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓		✓	
Number of Matches(✓) = 36 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-II

Course Code: 20PMB2EC2:1
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ELECTIVE COURSE 2 –INHERITANCE BIOLOGY

Objectives:

- To gain knowledge about basic Mendelian principles and gene mapping
- To impart knowledge on human and microbial genetics.
- To enable the students to know about mutation and recombination in genetics

Course Outcomes:

- Gaining knowledge on basic mendelian principles.
- Attaining fundamental methods in gene mapping.
- Imparting comprehensive knowledge on human genetics
- Understanding the process of microbial genetics
- Obtaining a good knowledge on mutation and recombination

Unit I

Mendelian Principles: Dominance, segregation, independent assortment- Extensions of Mendelian principles : Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

Unit II

Gene mapping methods : Concept of gene : Allele, multiple alleles, pseudoallele, complementation tests - Gene mapping methods : Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants.

Unit III

Human Genetics: Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping. Extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.

Unit IV

Microbial genetics : Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.

Unit V

Mutation and Recombination: Mutation : Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. Recombination : Homologous and non-homologous recombination including transposition.

Text Book(s):

1. Molecular Biology of the Cell, 5th Edition, Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P. Garland Science, USA 2008.
2. Molecular cell biology, 5th Edition. Lodish, H. Berk, A., Matsudaira, P., Kaiser, C. A., Krieger, M., Scott, M.P. Lawrence Z., Darnell, J. W. H. Freeman, USA 2003.
3. Cell and Molecular Biology, 3rd Edition. Rastogi, S.C. New age International Publishers, India 2012.

Reference Book(s):

1. Stanely R. Maloy, Jhon E Cornan Jr, David Freifelder. 1994. Microbial genetics. 2nd Edition. Jones and Bartlett publisher.
2. Uldis N. Streips and Ronald E. Yasbin. 2002. Modern Microbial Genetics. 2nd Edition. Wiley-Blackwell.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	20PMB2EC2:1	Inheritance Biology					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓		✓	✓		
CO2	✓	✓		✓	✓		✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓		✓		
Number of Matches(✓) = 43 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-II

Course Code: 20PMB2EC2:2
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ELECTIVE COURSE 2 –PRINCIPLES OF ECOLOGY

Objectives:

- To learn about fundamental concepts in environment
- To enable the students to get the knowledge on population and community ecology
- To understand the process of ecosystem and applied ecology

Course Outcomes:

- Gaining knowledge on basic concepts of the environment
- Attaining the knowledge on population ecology
- Understanding the types and mechanisms of community ecology
- Facilitates to understand the process of sequence analysis
- Acquiring knowledge on molecular phylogeny

Unit I

The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

Unit II

Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (*r* and *K* selection); concept of metapopulation – demes and dispersal, interdemec extinctions, age structured populations.

Unit III

Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological Succession- Types; mechanisms; changes involved in succession; concept of climax.

Unit IV

Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).

Unit V

Applied Ecology: Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.

Text Book(s):

1. Fundamentals of Ecology, Agarwal S.K . APH Publishing 2008.
2. Fundamentals of Ecology and Environment, Pranav Kumar and Usha Mina. Pathfinder Publication 2018.
3. Introduction to Population Ecology, 2nd Edition. Larry L. Rockwood Wiley-Blackwell Publication 2015

Reference Book(s):

1. Community Ecology Paperback, Gary G. Mittelbach Sinauer Associates, Oxford University Press. 2012
2. Introduction to Systems Ecology (Applied Ecology and Environmental Management Book 4) Sven Erik Jorgensen Kindle Edition 2013

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	20PMB2EC2:2	Principles of Ecology					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓		✓	✓		
CO2	✓	✓			✓	✓		✓	✓	✓	
CO3	✓	✓	✓	✓		✓		✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 41 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-II

Course Code: 20PMB2EC2:3
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ELECTIVE COURSE 2 –MICROBIAL BIOTECHNOLOGY

Objectives:

- To impart the potential applications of microbial and molecular biotechnology
- To enable the students to understand the basic knowledge in medicine, agriculture and various other current industrial processes.
- To acquire knowledge on animal biotechnology and IPR.

Course Outcomes:

- Receive a fundamental knowledge on therapeutic agents and vaccines
- Understand the microbial production of commercial products
- Acquiring about the of PGPR, biofertilizers and biocontrol agents
- Obtaining knowledge on Plant and algal biotechnology and bioremediation
- Imparting ideas on Animal biotechnology and IPR

Unit I

Microbial production of therapeutic agents and vaccines : History – Microbial vs molecular biotechnology and Commercialization –concerns and consequences - Pharmaceuticals - interferons and growth hormones, enzymes: DNase I and alginate lyase, Monoclonal antibodies – HIV therapeutic agents. Subunit vaccines: Herpes simplex virus, Foot and mouth disease virus, TB, Peptide vaccines – genetic immunization – vector vaccines.

Unit II

Microbial production of commercial products: Microbial production of restriction endonucleases: *PstI*, Dye: Indigo, Antibiotics: Synthesis of Novel antibiotics. Biopolymers: Xanthan gum and PHA. Microbial production of alcohol, lactic acid, streptomycin, L- glutamic acid, lipase and riboflavin.

Unit III

Production of PGPR, biofertilizers and biocontrol agents: Plant growth promoting bacteria (PGPR) – genetic engineering of nitrogenase gene cluster, hydrogenase and Nodulation. Mass cultivation of microbial biofertilizers: Cyanobacteria (*Spirulina*), *Azolla* and other nitrogen fixers (*Rhizobia*, *Azospirillum*, *Azotobacter* and VAM) Biocontrol of pathogens: Siderophores, antibiotics and enzymes. Release of genetically engineered organisms - Ice nucleation and anti-freeze proteins. Microbial herbicides. Microbial insecticides (*Pseudomonas* and *Bacillus thuringiensis*): - genetic engineering of Bt strains – Bt cotton – viral insecticides – entomopathogenic fungi.

Unit IV

Plant and algal biotechnology and bioremediation: Ti plasmid derived vector systems - Development of insect, virus and herbicide resistant plants, stress and senescence tolerant plants, modification of flower nutritional content, sweetening by genetic engineering. Plant as bioreactors. Production of food, colourant and fuel from microalgae.

Unit V

Animal biotechnology and IPR: Transgenic animals: methods of creating transgenic mice, cattle and sheep. Human gene therapy – *in vivo* and *ex vivo* gene therapy. Molecular diagnostics for genetic diseases. Biosafety and Bioethics. Intellectual Property Rights: Patents - copy right and neighboring rights, patents for invention, - Drafting and filing a patent application, exploitation of patented invention. Indian patent laws.

Text Book(s):

1. Winnacker EL. From Genes to Clones – Introduction to Gene Technology. First Indian reprint, PANIAMA publishing Co-operation, New Delhi. 2003.
2. Raledge C and Kristiansen B. Basic Biotechnology, 2nd edition, Cambridge University Press. 2001.
3. Balasubramanian D, Bryce CFA, Dharmalingam K, Green J, Jayaraman K. Concepts in Biotechnology University Press, India. 1996.
4. Borowitzka MA and Borowitzka LJ. Microalgal Biotechnology, Cambridge University Press. 1989.
5. Glazer AN, Nikaido H. Microbial Biotechnology – Fundamentals of Applied Microbiology WH Freeman and Company, New York. 1994.
6. Pnolella P. Introduction to Molecular Biology, WCB Mc Graw Hill, Boston Massachusetts. 1998.
7. Walsh G and Headon DR. Protein Biotechnology, John Wiley and Sons, New York. 1994.
8. Gerbardt P, Murray RG, Wood WA, Kreig NR. Methods for General and Molecular Bacteriology – American Society for Microbiology Washington D.C. 1994.

Reference Book(s):

1. Glick BR and Pasternak JJ. Molecular Biotechnology – Principles and Applications of Recombinant DNA. ASM Press, Washington DC. 2003.
2. Old RW and Primrose SB. Principles of Gene Manipulation - An Introduction to Genetic Engineering 5th Ed. Blackwell Scientific Publications, London. 1995.
3. Brown TA. Gene cloning and DNA analysis introduction. 4th Ed. Blackwell Science Ltd., London. 2001.
4. Watson JD, Gillman M, Iknowski J and Zollar M. Recombinant DNA. 2nd edition. Scientific American Books, WH freeman and Company, New York. 2001.
5. Alan T Bull. Microbial Diversity and Bioprospecting. ASM press. Washington, D.C. 2004.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	20PMB2EC2:3	Microbial Biotechnology					5	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓		✓		✓	✓	✓	
CO2	✓	✓	✓		✓	✓	✓				
CO3	✓	✓	✓		✓	✓		✓	✓	✓	
CO4	✓	✓		✓	✓	✓	✓			✓	
CO5	✓	✓	✓	✓	✓	✓		✓	✓		
Number of Matches(✓) = 36 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-II

Course Code: 20PMB2CP2
Instruction Hours: 8
Credits: 4

Exam Hours: 3
Internal Marks: 40
External Marks: 60

CORE COURSE PRACTICAL 2 – MICROBIAL PHYSIOLOGY & BIOINFORMATICS AND BIOSTATISTICS PRACTICAL (P)

Objectives:

- To know the basics of microbial growth and nutrition
- To understand the knowledge about metabolism including anabolism and catabolism
- To familiarize with sequence analysis and molecular modeling tools

Course Outcomes:

- Providing a practical exposure on fundamental studies on bacterial growth
- Imparting the knowledge on factors influencing microbial growth
- Understanding the principles fermentation test
- Obtaining the knowledge on sequence retrieval
- Acquiring the knowledge on visualization and structure prediction

Microbial Physiology

1. Bacterial growth curve – Turbidity method
2. Effect of temperature, pH and salinity on bacterial growth
3. Starch, casein, gelatin and lipid hydrolysis tests
4. Biochemical tests: IMViC, TSI, Urease, Catalase, Oxidase, Hydrogen sulphide, coagulase, nitrate reduction tests
5. Carbohydrate fermentation test
6. Morphological, Physiological and Biochemical tests for selected bacterial cultures.

Bioinformatics and Biostatistics

1. Retrieve sequence from NCBI, Genbank, GenPept
2. Sequence Analysis by Pairwise alignment and Multiple Sequence Alignment
3. Structural Databases - PDB, SCOP, CATH, Pfam
4. Secondary structure prediction – GOR, SOPMA
5. Binding site prediction – Prosite, Qsite finder
6. Structure Visualization tools- Rasmol, Cn3D, Modeler
7. Receptor-ligand interaction - Hex Software

References:

1. Atlas Ronald, M., Bartha, and Richard (1987). Microbial Ecology 2nd Edition. Benjamin/Cummings Publishing Company, California.
2. Dubey, R.C. and Maheshwari, D.K. (2002) Practical Microbiology, 1st Edn. S. Chand & Co. Ltd., New Delhi.
3. Rastogi S.C., Namita Mendiratta, Parag Rastogi. (2011) Bioinformatics – Concepts, Skills and Applications (Second Edition) CBS Publishers, New Delhi.
4. Harshawardhan, P. (2005) Bioinformatics principles and application. Tata Mc Graw Hill Publishers. New Delhi.
5. Mount, D.W. 2005. Bioinformatics Sequence and genome analysis (II edition) CBS Publishers. New Delhi

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	20PMB2CP2	Core Course Practical 2 – Microbial Physiology & Bioinformatics and Biostatistics Practical (P)					8	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓		✓	✓		✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 44 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-III

Course Code: 20PMB3CC7
Instruction Hours: 6
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

CORE COURSE 7 –MEDICAL MICROBIOLOGY

Objectives:

- To impart the updated knowledge on medical microbiology.
- It endeavors to provide the required fundamental knowledge on bacteriology, and mycology
- To understand the knowledge on virology and parasitology

Course Outcomes:

- Acquiring the knowledge on Medical Microbiology
- Understanding the process of Medical Bacteriology
- Imparting the concepts Medical Mycology
- Attaining the knowledge on Medical Virology
- Got a comprehensive idea about Parasitology and emergence of antibiotic resistant pathogens

UNIT I

Introduction to Medical Microbiology: Significance of Microbiology in Medicine, Classification of medically important microbes, Normal microbial flora of the human body: normal flora of skin, eye, throat, gastrointestinal tract and urogenital tract - Infections- Sources, types – opportunistic, nosocomial and community acquired infections - Mode of transmission, carriers and their types – investigation of epidemic diseases.

Unit II

Medical Bacteriology: Morphological, cultural and biochemical characteristics of and epidemiology, mechanism of bacterial pathogenesis, lab diagnosis, prophylaxis and control of medically important diseases caused by: Staphylococcus aureus, Group A Streptococci, Corynebacterium diphtheriae, Clostridium tetani, Bacillus anthracis, Leptospira interrogans, Treponema pallidum, Mycobacterium tuberculosis, Escherichia coli, Vibrio cholerae, Niesseriae, Haemophilus influenza, Helicobacter pylori, Pseudomonas and Salmonella. Brief note on Chlamydia, Rickettsia Mycoplasma, anaerobic bacterial infections, Atypical Mycobacterium, Zoonotic bacterial pathogens, Antibiotic susceptibility test: Kirby – Bauer disk diffusion method.

Unit III

Medical Mycology: Morphological and cultural characteristics of and epidemiology, mechanism of fungal pathogenesis, lab diagnosis and treatment of medically important diseases caused by: Superficial mycosis – Tinea versicolor. Cutaneous mycoses: Microsporum, Trichophyton, Epidermophyton. Subcutaneous mycoses: Sporotrichosis, Chromoblastomycosis, Zygomycosis. Systemic Mycoses – Histoplasma capsulatum, Blastomyces dermatitidis, Cryptococcus neoformans, Coccidioides immitis, Paracoccidioides brasiliensis. Opportunistic mycoses: Candidiasis, Cryptococcosis and Aspergillosis. Antifungal susceptibility testing.

Unit IV

Medical Virology: General properties of and epidemiology, pathogenesis, lab diagnosis and treatment of medically important viral diseases caused by: Influenza viruses, Measles, Mumps, Rubella, Chicken Pox, Hepatitis A,B,C, D and E, Poliomyelitis, HIV, Human Papilloma Virus, Rabies, Yellow fever, Dengue and Japanese Encephalitis viruses. Brief note on oncogenic viruses.

Unit V

Medical Parasitology and emergence of antibiotic resistant pathogens: Morphology of, and pathogenesis, laboratory diagnosis and treatment of medically important protozoan diseases caused by: *Entamoeba histolytica*, *Giardia lamblia*, *Trichomonas vaginalis*, *Plasmodium vivax*, *Leishmania donovani*, *Taenia solium*, *Ascaris lumbricoides*, *Ancylostoma duodenale* and *Wuchereria bancrofti*. Brief note on the emergence of MDR bacterial, fungal pathogens, extremely drug resistant (XDR) pathogens and superbugs.

Text Book(s):

1. Lenette E, Balows HA, Hausler WJ and Shadomy J. Manual of Clinical Microbiology. Bethesda, American Society of Microbiology. 1985.
2. Jawetz E, Melnick JC and Adelberg EA. Review of Medical Microbiology, Large Medical Publications, USA. 1998.
3. Jawetz, Melnick and Adelberg's Medical Microbiology, 22nd edition McGraw Hill Medical Publication division. 2001.
4. David Greenwood, Richard CB Slack and John Peutherer Medical Microbiology, 16th edition, Church Hill Living stone Publication. 2002.
5. David Greenwood. Mike Barer, Richard Slack and Will Irving. Medical Microbiology. A Guide to Microbial Infections: Pathogenesis, immunity, Laboratory investigation and Control, 18th edition, Churchill Livingstone. 2012.
6. Ananthanarayanan R and Jeyaram Panicker CK. Medical Microbiology, Orient Publications, New Delhi. 1990.
7. Ananthanarayanan R and Jeyaram Panicker CK. Textbook of Medical Parasitology. 5th Ed. Jay Pee brothers Medical publisher, Pvt Ltd., New Delhi. 2004.
8. Ananthanarayanan R and Jeyaram Panicker CK. Textbook of Microbiology. 9th Ed. University Press. 2013.
9. University Press. 2013.
10. Parija SC. Text book of Medical Parasitology, 1st Ed. All India publishers and Distributors Regd. 920. Poonamallee High Road, Madras. 2004.
11. Chakroborty P. A Text book of Microbiology. 2nd Ed. New Central Book Agency (P) Ltd., Calcutta. 2003.
12. Rajan S. Medical Microbiology, MJP Publishers Chennai. 2007.

Reference Book(s):

1. Monica Cheesbrough. District Laboratory Practice in Tropical Country. Part 1 and 2. Low price Ed., Cambridge University Press. 2003.
2. Chatterjee KD. Medical Parasitology, 7th edition. Chatterjee Medical publishers India. 2007.
3. John P. Harley Microbiology Lab Manual, 7th edition McGraw Hill Medical Publication division. 2007.
4. Prescott, Harley and Klein's. Microbiology, 7th edition McGraw Hill Medical Publication division. 2007.
5. Topley and Wilsons. Principles of Bacteriology, Virology and Immunology. Edward Arnold, London. 1995.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	20PMB3CC7	Medical Microbiology					6	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO3	✓	✓	✓	✓		✓	✓	✓	✓	✓	
CO4	✓			✓	✓	✓	✓	✓			
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 43 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-III

Course Code: 20PMB3CC8
Instruction Hours: 6
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

CORE COURSE 8 –IMMUNOLOGY

Objectives:

- To provide basic understanding of immunity, immune system, antigen, antigen - antibody reaction,
- To impart the knowledge on hyper sensitivity reaction and lymphocyte activation.
- To acquire the knowledge on immune deficiency disorders and transplantation

Course Outcomes:

- Providing the knowledge on structure and functions of immune system
- Attaining the fundamental concepts of Antigen –antibody reactions
- Understanding T and B cell activation
- Acquiring knowledge on MHC, Cytokines and Lymphokines
- Obtaining the basic concepts on applications of immunotechnology

Unit I

Immune system: History of Immunology, Types of immunity- innate and acquired. Humoral and cell mediated immunity. Central and peripheral lymphoid organs- Thymus, bone marrow, spleen, lymph nodes and other peripheral lymphoid tissues GALT. Haematopoiesis, Cells of the immune system- lymphocytes, mononuclear phagocytes- dendritic cells, granulocytes. NK cells and mast cells, cytokines.

Unit II

T and B cell, Antigen –antibody reactions : T and B-cell receptors, Antigen recognition- processing and presentation to Tcells. Interaction of T and B cells. Antigen and antibody – properties, types and functions. Antigen –antibody reactions - Precipitation, agglutination, complement fixation, RIA, ELISA, Western blotting and immunofluorescence.

Unit III

T and B cell activation : B cell receptor complex, B cell maturation, antibody diversity, understanding self – non self discrimination, TH cell subpopulation, organization of T cell receptor, cell mediated effectors responses. Complement system: Basics of complement protein - different pathways of complement activation – classical and alternative.

Unit IV

MHC, Cytokines and Lymphokines: Structure of MHC molecules- Human Leucocyte Antigen- Functions of MHC. Cytokine and lymphokines structure and their receptors. Hypersensitivity reaction and their types. Auto immune disorders, transplantation and cancer immunology.

Unit V

Immunotechnology and its applications: Production of polyclonal, monoclonal antibodies and phage display - techniques and applications. Immunization practices- active and passive immunization. Vaccines- killed and attenuated, recombinant vaccines, DNA and peptide vaccines. Applications of immunotechniques – Flow cytometry, Immunoelectron microscopy, Immunohistochemistry and Bioplex array.

Text Book(s):

1. Sudha Gangal and Shubhangi Sontakke. Textbook of Basic and clinical Immunology, Universities Press, (India) Pvt. Ltd, Hyderabad, India. 2013.
2. William E Paul. Fundamental Immunology. 7th revised edition, Raven press, New York. 2012.

3. Charlene Sand. A reference guide to immune disorder including hypersensitivity and auto immune disease, Webster's digital service, ebook. 2013.
4. Charles A Janeway, Paul Travers Jr. Mark Walport and Donald Capra J. Immunobiology – The immune system in health and disease. 4th edition, Current Biology Publications, London.1999.
5. Goldsby RA, Kindt TK, Osborne BA and Kuby J. Immunology, 5th Edition, W.H. Freeman and Company, New York. 2007.
6. Ivan Roitt, Jonathan Brostoff and David Male. Immunology, 8th edition, Elsevier science Ltd., New York. 2012.
7. Kuby J. Immunology, 7th edition, W.H. Freeman and company, New York. 2008.
8. Leslie Brent. A history of transplantation immunology, Academic press, London. 1996.
9. Nicole M. Valanzuela and Elaine F Reed. Antibodies in transplantation: the effects of HLA and non-HLA antibody binding and mechanism of injury. In: Transplantation immunology: Methods and protocols. (Eds: Andrea A. Zachary, Mary S. Leffell), Humana Press, New York. 2013.

Reference Book(s):

1. Patricks S and Larkin MJ. Immunological and molecular aspects of bacterial virulence. John wiley and sons, England. 1995.
2. Playfair JHL. Immunology at a glance, 6th edition, Blackwell Science, London. 1996.
3. Samuel Baron .Medical Microbiology, 4th edition, University of Texas medical branch at Galveston, Texas.1996.
4. Richard Hunt, Becker, Holger, Hlawatsch, Nadine, Julich, Sandra and Miethe Peter. Microbiology and Immunology Online. University of South Carolina. 2004.
5. Tak W Mak and Mary Saunders. The immune response basic and clinical practices. Elsevier Academic press, New York. 2012.
6. Tak W Mak and Mary Saunders. Primer to the Immune Response. 2nd edition from Tak Mak, Mary Saunders, Bradley Jett. New York. 2014.
7. Thomas J Kindt, Barbara A Osborne, and Richard A Golds. Immunology online, University of South Carolina. 2006.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	20PMB3CC8	Immunology					6	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO2	✓	✓		✓	✓			✓	✓		
CO3	✓	✓	✓	✓		✓	✓	✓	✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 42 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-III

Course Code: 20PMB3EC3:1
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ELECTIVE COURSE 3 – MEDICAL LABORATORY TECHNOLOGY

Objectives:

- To train the students to work as laboratory technicians and assists pathologist
- To encourage and prepare the graduates to improve their standard in medical sectors.
- To attain a good knowledge on clinical diagnosis

Course Outcomes:

- Understanding the basic concepts of laboratory
- Acquiring knowledge on Clinical pathology
- Got a comprehensive idea about Hematology
- Understanding Blood banking and Serology
- Attaining knowledge on Clinical Microbiology and Biochemistry

Unit I

Laboratory: Professional conduct, code of behaviour, staff health, safety and immunization, Reception, Labeling and Disposal of specimen and culture. Laboratory hazards and safety, First aid, Quality control in laboratory works.

Unit II

Clinical pathology: Urine analysis: Physical, chemical and microscopic examination, specific gravity, Test for albumin, acetone, bile salt and pigments, phosphate, urobilinogen, occult blood and urine deposits. Stool and Sputum analysis: Physical, chemical and microscopic examination (protozoa, helminthes). Examination of body fluids-CS, acidic and plural, hydatid fluids.

Unit III

Hematology: Anaemia - definition, types and investigation. Enumeration and investigation of RBCs, WBCs and Platelets. Blood coagulation and disorder, ESR determination.

Unit IV

Blood banking and Serology: Blood and Rh grouping, blood and plasma collection, screening and storage, safe transfusion of blood cross matching, Quality control, blood donation program, donor motivation and screening. Serology - WIDAL, RPR and ELISA tests.

Unit V

Clinical Microbiology and Biochemistry: Isolation and identification of microbes from clinical specimens - typhoid and bacillary dysentery, Antibiotic sensitivity test. Estimation of sugar from blood and urine. GCT. Estimation of Proteins and Cholesterol from blood.

Text Book(s):

1. Rafi MD. Textbook of Biochemistry for medical students, 2nd edition, Universities Press, (India) Pvt. Ltd, Hyderabad, India. 2014.
2. Ramnik Sood. Medical lab technology (methods and interpretations-sets of 2vols), Jaypee brothers. 2009. Kanai L Mukherjee. Medical laboratory technology (Procedure manual for routine diagnostic tests-Vol: 1), McGraw Hill Education India Pvt. Ltd. 2010.
3. Barbara H Estridge and Anna P Reynolds. Basic clinical laboratory techniques 5th edition, Cengage learning publisher. 2011

Reference Book(s):

1. Robert H Carman. Handbook of CMAI medical laboratory technology-3rd edition), Christian medical association of India. 2011.
2. Ramnik Sood. Concise book of medical laboratory technology (methods and interpretations-2nd edition). Jaypee brothers. 2014.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	20PMB3EC3:1	Medical Laboratory Technology					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO3	✓	✓	✓	✓		✓	✓	✓	✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 46 Relationship: Very High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-III

Course Code: 20PMB3EC3:2
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ELECTIVE COURSE 3 –FOOD AND DAIRY MICROBIOLOGY

Objectives:

- To gain insight about microbial illness in foods
- To enable the students to get knowledge on of microbial fermented foods.
- To provide the comprehensive idea about food preservation methods

Course Outcomes:

- Imparting knowledge on Food and microbes
- Understanding the Food fermentation
- Acquiring knowledge on Fermented food products
- Got a comprehensive idea about the process of Food preservation
- Exposing the concepts on Food borne diseases and control

Unit I

Food and microbes: Types of microorganisms in food – Bacteria, molds, yeast and protozoa. Source of contamination- Factors influencing microbial growth in food.

Unit II

Food fermentation: Food fermentations: methods of fermentations and organisms used -Cheese, bread, wine, beer. Fermented vegetables. Food and enzymes from microorganisms - single cell protein and mushrooms. Prebiotics, Probiotics and symbiotic. Advantages of probiotics.

Unit III

Fermented food products: Contamination, spoilage and preservation of cereals and cereals products, sugar and sugar products, vegetables, fruits, meat and meat products, Fish and other sea foods, egg and poultry, dairy and fermentative products (ice cream).

Unit IV

Food preservation method: Food preservations: principles- methods of preservations- Physical and chemical methods. Canning: classification of can, structure of cans, canning of food items, Thermal process time calculations for canned foods.

Unit V

Food borne diseases and control: Food borne diseases and food poisoning. General principles underlying food spoilage and contamination – Staphylococcus, Clostridium, Escherichia coli and Salmonella infections, Hepatitis, Amoebiosis and Mycotoxins. Spoilage in canned foods. Food sanitation and control measures, HACCP, GMP, GLP.

Text Book(s):

1. Adams MR, Moss MO and Peter McClure. Food Microbiology. The Royal Society of Chemistry, Cambridge. 2015.
2. Adrian Eley. Microbial food poisoning. Springer Science and Business Media, e-book. 1996.
3. Barrett DM, Somogyi L and Ramaswamy H. Processing fruits. CRC press, Boca raton, US. 2004.
4. Dogle MP. Food borne bacterial pathogens, Marcel Dekker, Inc New York- Basel. 1989.
5. Frazier and Westhoff, DC. Food Microbiology. 5th edition, TATA McGraw Hill Publishing Company Ltd., New Delhi. 2003.
6. Halasz A and Lasztity R. Use of yeast biomass in food production, CRC press, Boca raton, US. 2013.

7. Hui YH, Goddick LM, Hansen AS, Josephsen J, Wai-Kit-Nip, Stanfield, PS and Doldra, F. Hand book of food and beverage fermentation technology, CRC press, Boca raton, US.2008.
8. Reed G. Prescott's and Dunn's Industrial Microbiology. 4th edition. AVI publishing co Inc., West port. 2014.
9. Subbulakshmi G and Shoba A Udipi. Food processing and preservation – New Age Publisher, Chennai. 2009.
10. Swaminathan M. Advanced Text Book: Foods Nutrition, Bappco Publication, Jaipur. 2008.

Reference Book(s):

1. Jacobs MB, Gerstein MJ and Watter WG. Dictionary of Microbiology, Vanwostrant co.Inc, Princeceton, US. 1960.
2. Kaferstein F. Ten golden rules for safe food preparation. Magazine of the World Health Organization, Geneva. 1988.
3. Kiss I. Test in methods in food microbiology. Akademiai kiado, Budapest, Hungary. 1984.
4. Sofos J. Advances in microbial food safety. Center for Meat Safety and Quality, The College of Agricultural Sciences, Colorado State University, USA. 2013.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	20PMB3EC3:2	Food and Dairy Microbiology					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO2			✓	✓	✓	✓			✓	✓	
CO3	✓	✓		✓		✓	✓	✓			
CO4	✓	✓	✓			✓		✓	✓	✓	
CO5	✓	✓		✓	✓		✓	✓	✓		
Number of Matches(✓) = 35 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-III

Course Code: 20PMB3EC3:3
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ELECTIVE COURSE 3 –MARINE MICROBIOLOGY

Objectives:

- To facilitate the knowledge on microbial diversity, significance, dynamics of marine environment
- To acquire the knowledge about the marine microbial products
- To attain a basic idea about marine foods and extremophiles

Course Outcomes:

- Attaining the knowledge on Marine Microbial Habitats and Diversity
- Facilitates to understand about Cultivation of Marine microbes
- Imparting Marine extremophiles and Bioremediation
- Acquiring the idea about seafood
- Understanding the products of marine microbial products

Unit I

Marine Microbial Habitats and Diversity: Marine environment–properties of seawater , chemical and physical factors of marine environment-Ecology of coastal, shallow and deep sea microorganism - significance of marine microflora. Diversity of microorganism - Archaea, bacteria, actinobacteria, cyanobacteria, algae, fungi, viruses and protozoa in the mangroves and coral environments - Microbial endosymbionts – epiphytes - coral-microbial association, sponge-microbial association.

Unit II

Cultivation of Marine microbes and Nutrient cycling: Methods of studying marine microorganisms- sample collection- isolation and identification: Cultural, Morphological, physiological, biochemical and Molecular characteristics- Preservation methods of marine microbes. Role of microorganisms in carbon, nitrogen, phosphorous and sulphur cycles in the sea under different environments and mangroves.

Unit III

Marine extremophiles and Bioremediation: Survival at extreme environments – starvation – adaptive mechanisms in thermophilic, alkalophilic, osmophilic and barophilic, psychrophilic microorganisms – hyperthermophiles, halophiles and their importance. Microbial consortia and genetically engineered microbes in bioremediation of polluted marine sites - heavy metals and crude oil. Biofouling and their control.

Unit IV

Seafood microbiology: Pathogenic microorganisms, distribution, indicator organisms, prevention and control of water pollution, quality standards, International and National standards. Microbiology of processed finfish and shellfish products. Rapid diagnosis of contamination in seafoods and aquaculture products.

Unit V

Marine microbial products: Marine microbial products – Carrageenan, agar-agar, sea weed fertilizers-Astaxanthin, β carotene – enzyme – antibiotics – antitumour agents polysaccharide – biosurfactants and pigments. Preservation methods of sea foods. Quality control and regulations for microbial quality of fishes, shellfish and Marine living resources used for food and drugs.

Text Book(s):

1. Belkin S and Colwell RR. Ocean and health: Pathogens in the Marine Environment, Springer. 2005.
2. Bhakuni DS and Rawat DS. Bioactive marine natural products. Anamaya Publishers, New Delhi. 2005.
3. Prescott LM, Harley JP. Klein Microbiology, WCB, Mc Grow Hill Publications.1999.
4. Raina M. Maier, Ian L. Pepper, Charles, P. Gerba Environmental Microbiology,Academic press. 2006.
5. Shimshon Belkin and Rita R Colwell Ocean and Health: Pathogens in the marine environment. Springer. 2005.
6. Scheper T. Advances in Biochemical Engineering/Biotechnology-Marine Biotechnology I. Springer. 2005.
7. Hunter-Cevera J, Karl D and Buckley M. Marine Microbial Diversity: the key to Earth's habitability, American Academy of Microbiology. 2005.
8. James W. Nybakker Marine Biology, Benjamin Cummings. 2001.
9. Krichman DL. Microbial ecology of the oceans. Wiley – liss, New York. 2000.
10. Meller CB and Wheeler PA. Biological Oceanography, Wiley-Blackwell Publishers. 2012.
11. Mitchell R and Kirchman DL. Microbial Ecology of the Oceans, Wiley- Blackwell Publishers. 1982.

Reference Book(s):

1. Elay AR. Microbial food poisoning. Chapman and Hall, London. 1992.
2. Ford TE. Aquatic microbiology. An ecological approach. Blackwell scientific publications, London. 1993.
3. Munn C. Marine Microbiology: ecology and applications, Garland Science, Taylor and Francis group, NY. 2011.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	20PMB3EC3:3	Marine Microbiology					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO2			✓	✓	✓				✓	✓	
CO3	✓			✓		✓	✓	✓			
CO4	✓	✓	✓			✓		✓	✓	✓	
CO5	✓	✓		✓	✓		✓	✓	✓		
Number of Matches(✓) = 33 Relationship: Moderate											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-III

Course Code: 20PMB3EC4:1
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ELECTIVE COURSE 4 – QUALITY CONTROL & IPR

Objectives:

- To enable the students to get exposure on intellectual property rights, copyrights, trademarks and geographical limitation
- To understand the concepts of biotechnological inventions and their commercialization
- To impart the knowledge on GMP and biosafety

Course Outcomes:

- Facilitates to understand about bioethics
- Providing a knowledge on biosafety assessment
- Got a basic idea about biosafety assessment
- Understanding the features of quality control
- Attaining the fundamental knowledge on IPR

Unit I

Bioethics: Legality, Morality and Ethics, the principles of bioethics, autonomy, human rights, beneficence, privacy, justice and equality.

Unit II

Biosafety: Concept and issues, rational vs subjective, perceptions of risk and benefits of Biosafety. Biosafety concern levels – Individual, institution, society, region, country and world- Lab associated Infections.

Unit III

Biosafety Assessment (BSA): BSA of biotechnology and pharmaceutical products such as drugs, vaccines and biomolecules.

Unit IV

Quality Control: Quality control in food process technology- WHO Standards- Quality Control in Dairy product technology- Quality control in portable water.

Unit V

IPR: GATT and IPR, IPR in India, WTO Act, Convention on Biodiversity (CBD), patent cooperation treaty (PCT), forms of patents and patentability, process of patenting, Indian and international agencies involved in IPR and patenting, Global scenario of patents and India's position, patenting of biological material, GLP and GMP.

Text Book(s):

1. Frederic H Erbisich and Karim M Maredia. Intellectual Property Rights in Agricultural Biotechnology, CABI publisher. 2004.
2. John Bryant. Bioethics for scientist. John Wiley and son's publisher. 2002.
3. Sateesh MK. Bioethics and Biosafety, I. K. International Publishing House PVT. Ltd. 2010.
4. Dubey RC. A TextBook of Biotechnology, S. Chand and Company Ltd. 2008.

Reference Book(s):

1. Mittal D P. Indian patents law. Taxmann Allied Services (p) Ltd. 1999.
2. Christian lenk, Nils Hoppe and Roberto Andorno. Ethics and law of intellectual property: Current problems in politics, Science and technology, Ashgate publisher (p) ltd. 2007.
3. Felix Thiele, Richard E Ashcroft. Bioethics in a small World springer. 2005.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	20PMB3EC4:1	Quality Control & IPR					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO3	✓		✓			✓	✓	✓	✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 44 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-III

Course Code: 20PMB3EC4:2
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ELECTIVE COURSE 4 – BIOLOGICAL TECHNIQUES

Objectives:

- To gain knowledge about basic principles of biological techniques
- To enable the students to develop their research aptitude and career prospects
- To impart knowledge on advanced molecular techniques

Course Outcomes:

- Gaining knowledge on basic concepts of Microscopic techniques
- Attaining the knowledge on Analytical Techniques
- Imparting knowledge on Chromatographic Techniques:
- Facilitates to understand the Electrophoresis
- Acquiring knowledge on Molecular Techniques

Unit I

Microscopic techniques: Components of microscopes - Basic principles and methods of Bright field, Dark field, Phase contrast, Fluorescence, Polarization and confocal microscopes. Electron Microscopy – Principle, Techniques and applications of Transmission Electron microscope (TEM), Scanning Electron Microscope (SEM) and Atomic Force Microscope (AFM). Microtomy – Basic and Freezing microtome – specimen preparation.

Unit II

Analytical Techniques Spectroscopic methods: UV- Visible, Atomic Absorption Spectrophotometer, Atomic Emission Spectroscopy. Centrifugation – Principle, types and applications. Electroanalytical methods- Potentiometric, Conductimetric, Coulometric and Voltametric analyses. Biosensors. Principles of radioactivity, GM and LS counter.

Unit III

Chromatographic Techniques: Chromatography - Paper, Thin layer, Ion exchange, affinity and gel permeation - Principle, preparation of columns, adsorption and elution. GC, GC - MS and HPLC - principle and their applications.

Unit IV

Electrophoresis and its Applications: Electrophoresis – Principle and applications of Agarose and Pulse field gel electrophoresis, counter current and rocket immuno electrophoresis, SDS-PAGE and 2D gel electrophoresis.

Unit V

Molecular Techniques: Isolation and quantification of nucleic acid – DNA, RNA and Plasmids. Amplification of DNA - Polymerase chain reaction and Real time and reverse transcriptase PCR. Gene cloning techniques – Restriction digestion and phosphatase treatment of cloning vectors. Gene transfer mechanisms – chemical and electroporation. Method of detection of clones –colony hybridization, Blue - White selection and immunochemical detection.

Text Book(s):

1. Alan G. Marshall and Francis R. Verdun. Fourier Transforms in NMR, Optical and Mass Spectroscopy, Elsevier. 1990.
2. Cynthia Gibas and Per Jambek. Developing Bioinformatics computer skills, Shroff publishers and Distributors Pvt. Ltd., O' reilly, Madurai. 2001.

3. Demain AL and Davies JE. Manual of Industrial Microbiology and Biotechnology, ASM Press, US.1999.
4. Howard A Strobel and William R Heineman. Chemical Instrumentation: A Systematic Approach, 3rd edition., Wiley Interscience, New Jersey. 1989.
5. John G Webster. Bioinstrumentation. University of Wisconsin, John Wiley and Sons, Inc. US.2004.
6. Sambrook J, Fritsch EF and Maniatis T. Molecular Cloning: A Laboratory Manual. Cold Spring Harbor Laboratory Press, NY, Vol. 1, 2, 3. 3rd edition. 2001.
7. Surzeki S. Basic Techniques in Molecular Biology, Springer, US. 2000.
8. Webster G. Bioinstrumentation. University of Wisconsin, John Wiley and sons, US. 2004.
9. Willett JE. Gas Chromatography, John Wiley and Sons, US .1991.
10. Wittwer CT and Kusukawa N. Nucleic acid techniques. In: Tietz Textbook of Clinical Chemistry and Molecular Diagnostics, 4th edition (Eds, Burtis, C., Ashwood, E. and Bruns, D.) Elsevier, New York. 2005.
11. Wittwer CT and Kusukawa N. Nucleic Acid Techniques, In: Fundamentals of Molecular Diagnostics, (Eds; Bruns DE, Ashwood ER, Burtis CA), Saunders WB, Philadelphia. 2007.

Reference Book(s):

1. Westermeier R. Electrophoresis in practice – VCH – Federal Republic of Germany. 1993.
2. Wilson K and Walker. Practical Biochemistry Principles and Techniques, Cambridge University press, London. 1995.
3. Misener S and Krawetz SA. Bioinformatics Methods and Protocols. Humana Press, Totowa, New Jersey. 2000.
4. Rashidi HH and Buehler LK. Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London. 2002.
5. Sambrook J and Russell DW. Molecular cloning – A Laboratory Manual (3rd edition, Vol1, 2, 3) Cold spring Laboratory press, New York. 2001.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	20PMB3EC4:2	Biological Techniques					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓	✓	✓		✓	
CO2		✓	✓	✓	✓	✓		✓	✓	✓	
CO3	✓		✓				✓	✓	✓	✓	
CO4	✓	✓		✓	✓	✓		✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓		✓	✓	
Number of Matches(✓) = 39 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-III

Course Code: 20PMB3EC4:3
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ELECTIVE COURSE 4 – PUBLIC HEALTH AND HYGIENE

Objectives:

- To enlighten the students about the general knowledge on their health and hygiene
- To create general health awareness the hazardous impacts and remedy
- To impart a basic idea about health care organizations

Course Outcomes:

- Receive a fundamental knowledge on Public health and Hygiene
- Understand the Environment and Health hazards
- Acquiring about the Communicable diseases and their preventive and control measures
- Obtaining knowledge on Non-Communicable diseases and their preventive measures
- Imparting ideas on Health Education

Unit I

Scope of Public health and Hygiene: nutrition and health – classification of foods – Nutritional deficiency diseases- Vitamin deficiency diseases.

Unit II

Environment and Health hazards: Environmental degradation – Pollution – Air, Water, Land and Noise-associated health hazards.

Unit III

Communicable diseases and their preventive and control measures: Measles, Malaria, Hepatitis, Cholera, Filariasis, HIV /AIDS.

Unit IV

Non-Communicable diseases and their preventive measures: Genetic diseases, Cancer, Cardio vascular diseases, Chronic respiratory disease, Diabetes, Epilepsy,

Unit V

Health Education in India: WHO Programmes – Government and Voluntary Organizations and their health services – Precautions, First Aid and awareness on epidemic/sporadic diseases.

Text Book(s) :

1. Park and Park, 1995: Text Book of Preventive and Social Medicine – Banarsidas Bhanot Publ. Jodhpur – India.
2. Dubey, R.C and Maheswari, D.K. 2007 : Text Book of Microbiology- S.Chand & Co. Publ. New Delhi – India.

Reference Book(s) :

1. Verma, S. 1998 : Medical Zoology, Rastogi publ. – Meerut – India
2. Singh, H.S. and Rastogi, P. 2009 : Parasitology, Rastogi Publ. India.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	20PMB3EC4:3	Public Health and Hygiene					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓	✓		✓	
CO2		✓	✓	✓		✓		✓	✓	✓	
CO3	✓		✓				✓	✓		✓	
CO4		✓		✓	✓	✓		✓	✓		
CO5	✓	✓	✓		✓	✓	✓		✓	✓	
Number of Matches(✓) = 34 Relationship: Moderate											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-III

Course Code: 20PMB2CP3
Instruction Hours: 8
Credits: 4

Exam Hours: 3
Internal Marks: 40
External Marks: 60

CORE COURSE PRACTICAL 3 – MEDICAL MICROBIOLOGY AND IMMUNOLOGY (P)

Objectives:

- To know the basics of microbiological examinations of clinical specimens
- To familiarize with immunoserology and haematological analysis
- To obtain a fundamental knowledge on antibiogram

Course Outcomes:

- Providing a practical exposure on fundamental studies on medical microbiology
- Imparting the knowledge on collection and transport of clinical specimens
- Obtaining the knowledge on identification of bacterial and parasites.
- Acquiring the knowledge on examination of and fungus.
- Understanding the principles of antigen- antibody reactions.

Medical Microbiology

1. Collection, coding and transport of clinical specimens for microbiological examinations
2. Isolation and identification of upper respiratory tract bacterial pathogen – *Streptococcus pyogenes*
3. Isolation and identification of *Staphylococcus aureus* from clinical specimen
4. Isolation and identification of lower respiratory tract bacterial pathogen – *Pseudomonas aeruginosa*
5. Isolation and identification of gastrointestinal bacterial pathogens – *Salmonella*, *Shigella* and *Vibrio*
6. Isolation and identification of urinary tract pathogens – *E. coli* and *Klebsiella pneumoniae*
7. Isolation and identification of bacterial pathogen causing enteric fever – *Salmonella typhi*, *S. paratyphi A* and *B*
8. Isolation and identification of clinically important yeast and molds – *Candida albicans*, *Cryptococcus neoformans*, *Fusarium spp.* and *Aspergillus spp.*
9. Antibiotic susceptibility test – Disc diffusion method (Kirby –Bauer)
10. Determination of MIC of any one antibiotic against any one bacterial species.
11. Examination of blood smears for *Plasmodium spp.*
12. Examination of faeces for parasites, occult blood.
13. Urine analysis- physical examination of urine, urine sugar determination by Benedict's method, protein (albumin), Ketone bodies, Bile salt, Bile pigments.

Immunology

1. Collection of venous blood from human and separation, preservation and storage of serum/plasma
2. Identification and enumeration of RBC, WBC and total cell count.
3. Estimation of Haemoglobin content
4. Determination of ESR and PCV
5. Determination of blood glucose – FBG, PPG, GTT
6. Agglutination reactions - blood grouping, coomb's test, TPHA and WIDAL (slide and tube tests)

7. Immunoelectrophoresis – Counter-current immuno electrophoresis, rocket immuno-electrophoresis
8. Précipitation reaction – Agar gel diffusion, single radial immuno-diffusion, Ouchterlony's Double Immuno Diffusion technique.
9. Serum electrophoresis
10. Skin sensitivity test.
11. Label assays: Enzyme Linked Immunosorbent Assay (ELISA) (Hands on), Immunofluorescence (IF) (Hands on), Immunoperoxidase (PAP) staining, Immunohistochemistry (IH) (Demonstration)
12. Handling of Laboratory animals and raising antibodies.

References:

1. Monica Cheesbrough. District Laboratory Practice in Tropical Countries - Part I and II 2nd edition. Cambridge University Press, New Delhi. 2006.
2. Rajan S. Manual for Medical Laboratory Technology. Anajanaa Book House, Chennai. 2012.
3. Betty A Forbes, Daniel F Sahn and Alice S Weissfeld. Bailey and Scott's Diagnostic Microbiology, Mosby Elsevier. 12th edition. 2007.
4. Mackie and McCartney. Practical Medical Microbiology, South Asia Edition. 14th edition. 2006.
5. Rajan S and Selvi Christy R. Experimental Procedures in Life Sciences. Anajanaa Book House, Chennai. 2011.
6. Roitt IM. Essentials of Immunology. ELBS, Blackwell Scientific Publishers, London.1998.
7. Kuby J. Immunology 2nd Ed. W.H. Freeman and Co. New York. 1994.
8. Elgert CD. Immunology - Understanding of Immune System by Wiley - Liss, New York. 1996.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	20PMB3CP3	Core Course Practical 3 – Medical Microbiology and Immunology (P)					8	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓			✓		✓	✓	✓	
CO3	✓		✓	✓	✓	✓	✓		✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓		✓	✓	✓	✓	
Number of Matches(✓) = 43 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-IV

Course Code: 20PMB4CC9
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

CORE COURSE 9 - BIOPROCESS TECHNOLOGY

Objectives:

- To enable the students to understand the basic knowledge in industrial production of microbial products
- To impart the knowledge on microbial strain improvement
- To acquire the students about quality of food and products

Course Outcomes:

- Receive a fundamental knowledge on Industrially important microbes
- Understand the Fermenter – types and function
- Acquiring about the Fermentation process
- Obtaining knowledge on Food microbiology
- Imparting ideas on Legal protection and IPR

Unit I

Industrially important microbes and their improvement: Screening methods for industrial microbes – detection and assay of fermentation products– classification of fermentation types – strain selection and improvement. Mutation and recombinant DNA techniques for strain improvement. Preservation of cultures after strain improvement.

Unit II

Fermenter – types and function: Fermenters – Basic functions, design and components – asepsis and containment requirements – body construction and temperature control –aeration and agitation systems – sterilization of fermenter, air supply, and medium; aseptic inoculation methods – sampling methods, valve systems– a brief idea on monitoring and control devices and types of fermenters. Photobioreactors.

Unit III

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

Unit IV

Food microbiology: Microbiology of fermented milk – starter cultures, butter milk, cream, yoghurt, kafil, kumiss, acidophilus milk and cheese. Microbes as sources of food (Spirulina, Saccharomyces cereviceae, Rhizopus sp.). Food intoxications: Staphylococcus aureus, Clostridium botulinum and mycotoxins; Food infections: Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli, Salmonellosis, Shigellosis and Campylobacter jejuni – spoilage of canned foods – Detection of spoilage and characterization. Food sanitation in food manufacture and in the retail trade; Food control agencies and their regulations.

Unit V

Legal protection and IPR: GATT and IPR, forms of IPR, IPR in India, WTO, TRIPS Convention on

Biodiversity (CBD), Patent Co-operation Treaty (PCT), forms of patents and patentability, process of patenting, Indian and international agencies involved in IPR and patenting, Global scenario of patents and India's position, patenting of biological materials.

Text Book(s):

1. Adams MR and Moss MO. Food Microbiology. 1st edition. Reprinted, Published by New Age International (P) Limited. Publishers, New Delhi. 2005.
2. Agarwal AK and Pradeep Parihar. Industrial Microbiology. Published by Student Edition, Behind Nasrani Cinema, Chopasani Road, Jodhpur. 2006.
3. Banwart GJ. Basic Food Microbiology. 2nd edition, CBS Publishers and Distributors, New Delhi. 2004.
4. Casida LE Jr. Industrial Microbiology, 5th edition, Wiley Eastern Ltd., New Delhi. 1993.
5. Crueger W and Crueger A. Biotechnology: A Test Book of Industrial Microbiology, 2nd edition, Panima Publishing corporation, New Delhi. 2000.
6. Frazier WC and Westhoff DC. Food Microbiology 4th edition, Tata McGraw – Hill Publishing Company Limited – New Delhi. 1997.
7. Kalaichelvan PT and Arul Pandi. Bioprocess Technology, MJP Publishers, Chennai .2007.
8. Patel AH. Industrial Microbiology. Published by Macmillan India Ltd., New Delhi. 2005.

Reference Book(s):

1. Peppler HJ and Perlman D. Microbial Technology – Fermentation Technology. 2nd edition, Published by Academic Press (An imprint of Elsevier). Volume I and II. 2004.
2. Sivakumar PK, Joe MM and Sukesh K. An introduction to Industrial Microbiology. First edition, S. Chand and Company Ltd, New Delhi. 2010.
3. Stanbury PF, Whitaker A and Hall SJ. Principles of Fermentation Technology, 2nd edition, Aditya Book (p) Ltd., New Delhi. 1999.
4. Willey JM, Sherwood LM, and Woolverton CJ. Prescott's Microbiology. 9th edition. McGraw Hill Higher Education. 2013.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	20PMB4CC9	Bioprocess Technology					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓		✓		✓		✓	
CO3			✓	✓	✓		✓	✓	✓	✓	
CO4	✓	✓		✓	✓	✓	✓		✓	✓	
CO5	✓	✓	✓		✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 40 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-IV

Course Code: 20PMB4CC10
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

CORE COURSE 10 - PHARMACEUTICAL MICROBIOLOGY

Objectives:

- To impart the updated knowledge on pharmaceutical microbiology
- It endeavors to provide the required fundamental knowledge on secondary metabolites in pharmaceutical industry
- To understand the process of pharma products

Course Outcomes:

- Acquiring the knowledge on chemotherapeutic agents
- Understanding the process of Sterilization and disinfection
- Imparting the concepts on Spoilage and Preservation of Pharma Products
- Attaining the knowledge on Drug Discovery and Development
- Got a comprehensive idea about the Regulatory aspects in pharmaceuticals

Unit I

Introduction to chemotherapeutic agents: History and development of chemotherapeutic agent, Properties of antimicrobial agents, Types of chemotherapeutic agents – Synthetic, Semisynthetic, Natural. Antibiotics: Types of antibiotics with their mode of action; antibacterial, antifungal, antiviral, antiprotozoal.

Unit II

Sterilization and disinfection: Study of principle, procedure, merits, demerits and applications of Physical, chemical and mechanical method of sterilization. Evaluation of the efficiency of sterilization methods. Equipments employed in large scale sterilization. Sterility indicators. Classification and mode of action of disinfectants. Factors influencing disinfection, antiseptics and their evaluation. Evaluation of bactericidal & Bacteriostatic. Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP..

Unit III

Contamination, Spoilage and Preservation of Pharma Products: Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage. Preservation of pharmaceutical products using antimicrobial agents, methods of Preservative evaluation and testing.

Unit IV

Drug Discovery and Development: Microbial, Recombinant, Biochemical and Molecular level screening systems and their construction/ design strategies. Conventional Process; Bio-prospecting. Search of database/data mining for Drug designing; Preclinical and Clinical trials; Estimation of toxicity: LD50 and ED50; Rational Drug Design –Principle (Structure activity relationship -SAR) and Tools (applications of High through Put Screening, Combinatorial synthesis, Pharmaco-genomics).

Unit V

Regulatory aspects in pharmaceuticals: Introduction to pharmacopoeia; FDA regulation and IP, BP, USP; Reimbursement of drugs and biological; legislative perspectives; GMP in pharmaceuticals; Quality control through WHO; ICH process.

Text Book(s):

- 1.S. P. Vyas & V. K. Dixit. Pharmaceutical Biotechnology. (2003) CBS Publishers & Distributors, New Delhi.
- 2.Geoffrey Hanlon and Norman Hodges. Essential Microbiology for pharmacy and pharmaceutical science. (2013).Wiley Blackwell.
- 3.Krogsgaard L, Lilijefors T. and Madsen, U. Textbook of Drug Design and Discovery, (2004). Taylor and Francis, London.
4. Bhatia R and Ichhpujani RL. Quality Assurance in Microbiology. (1995). CBS Publishers, New Delhi.

Reference Book(s):

- 1.Hugo, WB and Russell, AD. Pharmaceutical Microbiology, (2003). Blackwell Science, Oxford, UK.
- 2.Gregory Gregoriadis. Drug Carriers in biology & Medicine. (2001). Academic Press New York.
- 3.Davis, B. D., Dulbecco, R, Eisen, H. N., Ginsberg, R. S. Microbiology. (1990). Harper and Row Publishers, Singapore.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	20PMB4CC10	Pharmaceutical Microbiology					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓		✓	✓	✓		✓	
CO3		✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓		✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 45 Relationship: Very High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-IV

Course Code: 20PMB4EC5:1
Instruction Hours: 5
Credits: 4

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ELECTIVE COURSE 5 – GENETIC ENGINEERING

Objectives:

- To provide basic understanding of genetic engineering
- To learn about the advanced tools, techniques and methods employed in genetic engineering
- To impart the knowledge on gene cloning and expression as well as in protein engineering strategies

Course Outcomes:

- Providing the knowledge on gene cloning strategies
- Attaining the fundamental concepts of Tools and methods in gene cloning
- Understanding Gene cloning vectors for prokaryotes and eukaryotes
- Acquiring knowledge on Techniques in genetic engineering
- Obtaining the basic concepts of Protein engineering and techniques

Unit I

Introduction to gene cloning strategies: Gene cloning: Steps - Isolation and purification of nucleic acids (genomic DNA, RNA and Plasmids) – Methods of handling and quantification of DNA and RNA.

Analyses of DNA/ RNA and proteins: Agarose Gel and SDS – PAGE - Blotting – types of blotting – Southern, Northern and Western Blotting. Chromosome walking.

Unit II

Tools and methods in gene cloning: Restriction endonucleases – nomenclature, classification and characteristics -DNA methylases – DNA polymerases - Ligases – Adapters, Linkers and Homopolymer tailing – Gene transfer techniques: electroporation, microinjection, protoplast fusion and microparticle bombardment – Screening for recombinants: Direct: Insertional inactivation, plaque phenotype and indirect methods: Immunochemical detection, nucleic acid hybridization, Dot and Colony Blotting. Methods of DNA cloning. Construction and applications of Genomic DNA and cDNA libraries.

Unit III

Gene cloning vectors for prokaryotes and eukaryotes: Cloning Vectors – properties - types of vectors – plasmids – host range and incompatibility – plasmids vectors for cloning in E. coli (pBR322 and derivatives, pUC vectors and pGEM3Z) - Vectors constructed based on bacteriophages (M13 and Lambda), cosmids, phasmids, phagemids and BACs - Eukaryotic vectors - Yeast vectors – animal and plant vectors – expression vectors: E. coli lac and T7 phage promoter based vectors - shuttle vectors - Expression of foreign genes in bacteria, animal, plant, algae and fungi – merits and demerits.

Unit IV

Techniques in genetic engineering: Characterization of cloned DNA: Restriction mapping - restriction fragment length polymorphism (RFLP) - Polymerase chain reaction (PCR) – Principles, types and their applications. DNA sequencing: Primer walking, Chemical method: Maxam and Gilbert method, Sanger's method: traditional (dideoxy) and automated sequencing methods. Pyrosequencing – DNA chips and microarray.

Unit V

Protein engineering and techniques: Site directed mutagenesis – methods - Design and construction of novel proteins and enzymes, Basic concepts in enzyme engineering, engineering for kinetic properties of enzymes. protein folding, protein sequencing, protein crystallization. Data analysis - Mass spectrometry based methods for protein identification, MALDI-TOF, 2D gel electrophoresis – Applications of protein engineering: Examples of engineered proteins.

Text Book(s):

1. Old RW and Primrose SB. Principles of gene manipulations – An introduction to genetic engineering, 5 ed. University of California Press, 1995.
2. Winnacker EL. From Genes to Clones. – Introduction to gene technology. Wiley-Blackwell. 1987.
3. Nicholl DST. An introduction to genetic engineering. Cambridge University Press.1994.
4. Brown TA. Gene Cloning. London; New York: Chapman and Hall.1995.
5. Pinler A. Genetic engineering of microorganisms. Protein Structure, Stability and Folding by Kenneth P. Murphy. Published by Humana Press Inc. 2001.
6. Jeffrey L, Cleland and Charles S Craik. Protein Engineering Principles and Practice Published by Wiley-Liss Inc. 1996.
7. Paul R Carey. Protein Engineering and Design, Published by AcademicPress Inc. 1996.
8. Glick BR. Molecular Biotechnology – Principles and applications of recombinant DNA. 3rd edition, ASM Press, Washington, DC. 2003.

Reference Book(s):

1. Old RW and Primrose SB. Principles of Gene Manipulation - An Introduction to Genetic Engineering. 5th edition. Blackwell Scientific Publications, London. 2003.
2. Winnacker EL. From Genes to Clones – Introduction to Gene Cloning, 1st edition. Indian reprint, Panima publishing Corporation, New Delhi. 2003.
3. Nicholl D. An introduction to genetic engineering. 3rd Cambridge University Press, Cambridge. 2008.
4. Brown TA. Gene Cloning and DNA analysis introduction. 4th Ed. Blackwell Science Ltd., London. 2001.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	20PMB4EC5:1	Genetic Engineering					5	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO2	✓		✓			✓	✓	✓		✓	
CO3		✓		✓	✓	✓			✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓		✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 40 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-IV

Course Code: 20PMB4EC5:2
Instruction Hours: 5
Credits: 4

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ELECTIVE COURSE 5 – FOOD PROCESSING TECHNOLOGY

Objectives:

- To understand the process in food processing
- To learn about the techniques in processing of food.
- To enable the students to get knowledge about the food storage

Course Outcomes:

- Understanding the basic concepts of food processing
- Acquiring knowledge on thermal processing of food
- Got a comprehensive idea about the irradiation of food
- Understanding the refrigeration and shelf life of food
- Attaining knowledge on food packaging

Unit I

Introduction to Food processing : Scope and importance; basic concepts about properties of foods: liquid, solid and gases; Equipment for raw material processing: Elementary concept of material handling in food industry, equipment and functioning of belt conveyor, screw conveyor, bucket elevator and pneumatic conveyor, size reduction, mixing and forming, separation and concentration of food components.

Unit II

Thermal processing: Degree of processing, selecting heat treatment, heat resistance of microorganisms, nature of heat transfer, protective effects of food constituents, types of thermal treatments.

Unit III

Ionizing radiations: Forms of radiant's energy; ionizing radiations, sources and properties; radiation units; radiation effects; limiting indirect effects; dose fixing factors; objectives in food irradiation; safety and quality of irradiated food.

Unit IV

Refrigeration : Refrigeration, cool storage and shelf life extension; cool storages with air circulation, humidity control and gas modifications (i.e. CA, MA & SA).

Unit V

Freezing : Changes during freezing, rate of freezing, choice for final temperature for frozen foods, freezing methods, freezing effects. Dehydration – Dehydration, water activity and food safety / quality; methods of dehydration. Packaging: Properties of packaging material, factors determining the packaging requirements of various foods and brief description of packaging of frozen products, dried products, fats and oils and thermally processed foods.

Text Book(s)

1. Sivasankar, B. 2002. Food Processing and Preservation. PHI, India
2. Hosahalli S. Ramaswamy & Michele Marcotte. 2005. Food Processing: Principles and Applications Hardcover, CRC Press.
3. Pyke, M. 1981. Food Science and Technology, 4th Edition. John Murray, London.
4. Desrosier, N.W. and Desrosier, J.N. 1987. The Technology of Food Preservation, CBS Publishers and Distributors, New Delhi.
5. Crosby, N.T. 1981. Food packaging Materials Applied Science Publishers, London.

Reference Book (s)

1. P.J.Fellows. 2009. Food Processing Technology: Principles and Practice. 3rd Edition Woodhead Publishing.
2. G. Subbulakshmi & Shobha A. Udipi, 2006. Food Processing and Preservation. New Age International Publishers, India.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	20PMB4EC5:2	Food Processing Technology					5	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO2	✓		✓			✓	✓	✓			
CO3		✓		✓	✓	✓			✓	✓	
CO4	✓	✓	✓	✓	✓		✓	✓	✓	✓	
CO5	✓	✓	✓		✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 38 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-IV

Course Code: 20PMB4EC5:3
Instruction Hours: 5
Credits: 4

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ELECTIVE COURSE 5 – MICROBIAL NANOTECHNOLOGY

Objectives:

- To gain insight about microbes and other eukaryotic systems in the synthesis of nanoparticles.
- To enable the students to get knowledge on synthesis and designing of nano particles
- To educate students about the potential applications of nano particles

Course Outcomes:

- Imparting knowledge on introduction to bionanotechnology
- Understanding the Synthesis of nanoparticles
- Acquiring knowledge on types of nanoparticles and methods of characterization
- Got a comprehensive idea about the applications of bionanotechnology
- Exposing the Merits and demerits of nanoparticles

Unit I

Introduction to bionanotechnology: Milestones in History – bionanotechnology – concept and future prospects – application in Life Sciences. Terminologies – nanotechnology, bionanotechnology, nanobiomaterials, biocompatibility, nanomedicine, nanowires, quantum Dots, nanocomposite, nanoparticles, nanosensors. Biotechnology to bionanotechnology, natural bionanomachines. Current status of bionanotechnology.

Unit II

Synthesis of nanoparticles: Molecular nanotechnology – nanomachines – collagen. Uses of nanoparticles– cancer therapy – manipulation of cell and biomolecules. Cytoskeleton and cell organelles. Types of nanoparticles production – physical, chemical and biological. Microbial synthesis (bacteria, fungi and yeast) of nanoparticles – mechanism of synthesis.

Unit III

Types of nanoparticles and methods of characterization: Nanoparticles – types, functions – Silver, Gold and Titanium. Physical and chemical properties of nanoparticles. Characterization of nanoparticles – UVVis spectroscopy, particle size analyzer, Electron Microscopy – HRTEM, SEM, AFM, EDS, XRD. Other tools and techniques required for bionanotechnology: rDNA technology, site directed mutagenesis, fusion proteins, X- Ray crystallography, NMR. Bioinformatics: molecular modeling, docking, computer assisted molecular design.

Unit IV

Applications of bionanotechnology: Drug and gene delivery – protein mediated and nanoparticle mediated. Uses of nanoparticles in MRI, DNA and Protein Microarrays. Nanotechnology in health sectors. Nanomedicines, Antibacterial activities of nanoparticles. Nanotechnology in agriculture. Toxicology in nanoparticles – Dosimetry.

Unit V

Merits and demerits of nanoparticles: Advantages of nanoparticles – drug targeting, protein detection, MRI, development of green chemistry – commercial viability of nanoparticles. Disadvantages – pollution and health risks associated with nanoparticles.

Text Book(s):

1. Parthasarathy BK. Introduction to Nanotechnology, Isha Publication. 2007.
2. Elisabeth Papazoglou and Aravind Parthasarathy. Bionanotechnology. Morgan and Claypool Publishers. 2007.
3. Bernd Rehm. Microbial Bionanotechnology: Biological Self-assembly Systems and Biopolymer-based Nanostructures. Horizon Scientific Press. 2006.
4. David E Reisner and Joseph D Bronzino. Bionanotechnology: Global Prospects. CRC Press. 2008.
5. Kamali Kannangara. Nanotechnology: Basic science and emerging technologies- Mick Wilson, Overseas Press. 2005.
6. Mark A Ratner and Bandyopadhyay AK. Nano Materials. Nanotechnology: A gentle introduction to the Next Big Idea, New Age Publishers. 2002.
7. Pradeep T. Nano Essentials understanding nanoscience and Nanotechnology. 1st edition. TMH publications. 2007.
8. Parag Diwan and Asish Bharadwaj. Nanomedicines, Pentagon Press. 2006.
9. Vladimir P Torchilin. Nanoparticles as Drug Carriers. Imperial College Press, North Eastern University, USA. 2006.
10. Rao CNR, Muller A, Cheetham AK, The Chemistry of Nanomaterials Synthesis, Properties and Applications. 2004.
11. Pradeep T, Nano: The Essentials Tata McGraw Hill, New Delhi. 2007.

Reference Book(s):

1. Niemeyer CM and Mirkin CA. Nanobiotechnology: Concepts, Applications and Perspectives, Wiley-VCH Verlag GmbH and Co., Weinheim. 2004.
2. Ehud Gazit. Plenty of Room for Biology at the Bottom: An Introduction to Bionanotechnology. Imperial College Press. 2006.
3. Mirkin CA and Niemeyer CM. Nanobiotechnology- II, More Concepts and Applications Wiley-VCH, Verlag GmbH and Co. 2007.
4. Claudio Nicolini. Nanobiotechnology and Nanobiosciences Pan Stanford Publishing Pte. Ltd. 2009.
5. David Goodsell S. Bionanotechnology, Lessons from Nature, Wiley-Liss, Inc. 2004.
6. Bhushan B. Handbook of Nanotechnology by, Springer, Heidelberg. 2004.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	20PMB4EC5:3	Microbial Nanotechnology					5	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO2	✓		✓	✓		✓			✓		
CO3	✓	✓	✓		✓		✓	✓		✓	
CO4	✓	✓		✓	✓	✓	✓		✓		
CO5	✓	✓			✓	✓		✓	✓	✓	
Number of Matches(✓) = 35 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-IV

Course Code: 20PMB4CP4
Instruction Hours: 8
Credits: 4

Exam Hours: 3
Internal Marks: 40
External Marks: 60

CORE COURSE PRACTICAL 4 – BIOPROCESS TECHNOLOGY AND PHARMACEUTICAL MICROBIOLOGY (P)

Objectives:

- To learn about the fundamentals of bioprocess technology
- To isolate and identification of industrial important microbes.
- To learn basics of pharmaceutical microbiology

Course Outcomes:

- Providing a practical exposure on screening of industrially important metabolite producing microbes
- Imparting the knowledge on microbiological techniques and methods on antibiotic production
- Understanding the process of fermentative production of enzymes
- Obtaining the knowledge on microbial examination of pharmaceutical products and disinfectant evaluation
- Acquiring the knowledge on environmental area monitoring

Bioprocess Technology

1. Isolation of industrially important microorganisms- antibiotic, enzyme producer
2. Isolation and enumeration of lactic acid bacteria from dairy products.
3. Production, quantification, extraction and characterization of the following: Alcohol – Wine
4. Organic acid – Citric acid – Solid state and submerged fermentation.
5. Extra cellular enzymes – Protease, amylase by submerged fermentation and Cellulase by solid state fermentation.
6. Immobilization of yeast cell by alginate beads
7. Isolation & identification microbes from spoiled canned food.
8. Production of fermented food - yogurt, butter milk, cheese, Kefir, Kumis
9. Production of SCP- Spirulina

Pharmaceutical microbiology

1. Microbial Examination of Non-Sterile Products
2. Sterility testing of pharmaceuticals.
3. Determination of D value, Z value for heat sterilization in pharmaceuticals.
4. Antimicrobial Effectiveness Testing
5. Evaluation of disinfectants.
6. Microbiological assay of antibiotics by cup plate method.
7. Bacterial Endotoxin test.
8. Antibiotic Potency Testing
9. Bioburden Estimation for Medical Devices
10. Environmental Monitoring- storage, production and packaging area.
11. Prediction of binding site of macromolecules using Prosite software.

References:

1. E Mans, E.M.T. and C.F.A. Bryce, Taylor and Francis, UK. 2002. Fermentation technology and Biotechnology.
2. Ghose, T.K and P.Ghose. 2003. Biotechnology in India. Springer Publishers, India.
3. Glazer, A.N and H. Nikaido. 1995. Microbial Biotechnology. W.H. Freeman and Co., New York.
4. Stanbury, P.F., A. Whitaker and S.J. Hall. 1995. Principles of fermentation Technology, Pergamon, UK.
5. Wolf. Cruzar and Annalise Cruzar. 2000. Biotechnology Text Book of Industrial Microbiology. Panima Publishing House, New Delhi.
6. Patel, A.H. 2001. Industrial Microbiology, Mac-Millan India Ltd.
7. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi.
8. G. Shyam Prasad, K. SriSailam. Pharmaceutical Microbiology: A Laboratory Manual. PharmaMed Press / BSP Books. 2019.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	20PMB4CP4	Core Course Practical 4 – Bioprocess Technology and Pharmaceutical Microbiology (P)					8	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓		✓	✓	✓	
CO2	✓		✓	✓		✓	✓	✓	✓		
CO3	✓	✓	✓	✓	✓	✓	✓	✓		✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5		✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches (✓) = 43 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-IV

Course Code: 20PMB4PW
Instruction Hours: 7
Credits: 4

Exam Hours: -
Internal Marks: -
External Marks: -

PROJECT WORK

Objectives:

The student can get the knowledge to prepare the document, to implement tools for the specific problem and learn the industrial need programs for their placement.

S.No.	Work Description	Maximum Marks
1	Dissertation	80
2	Viva voce	20
Total		100

Note:

PASSING MINIMUM – 50 MARKS

I Review –December last week

- Confirmation letter from the organization
- Project type & title
- Contact details of the organization.

II Review – January 3rd week

III Review – February 3rd week

IV Review – March 1st week

- Attending all the review is compulsory
- PPT and necessary Documentation should be brought for each Review
- Font size in documentation has to be 12, Times New Roman, Space 1.5
- Document should be neatly aligned and justified
- No change can be made in the review marks later
- Internal mark will be submitted at the same day of review to controller section.
