



Master of Microbiology Course Structure under CBCS

(For the candidates admitted from the academic year 2018-2019 onwards)



Semester	Course	Course Code	Title of the Course	Ins. Hours/ Weeks	Credit	Exam Hours	CIA (Max)	ESE (Max)	Total (Max)
I	Core Course – I (CC)	18PMB1CC1	General Microbiology	6	4	3	25	75	100
	Core Course – II (CC)	18PMB1CC2	Medical Bacteriology and Mycology	6	4	3	25	75	100
	Core Course – III (CC)	18PMB1CC3	Virology and Parasitology	5	4	3	25	75	100
	Core Course – IV (CC)	18PMB1CC4	Microbial Biochemistry	5	4	3	25	75	100
	Core Practical – I (CP)	18PMB1CP1	General Microbiology & Bacteriology and Mycology & Virology and Parasitology & Microbial Biochemistry (P)	8	4	3	40	60	100
				Total	30	20			
II	Core Course – V (CC)	18PMB2CC5	Microbial Physiology	6	5	3	25	75	100
	Core Course – VI (CC)	18PMB2CC6	Microbial Genetics and Molecular Biology	6	5	3	25	75	100
	Elective Course – I (EC)	18PMB2EC1:1	Statistical Tools for Biology	5	5	3	25	75	100
	Elective Course – II (EC)	18PMB2EC2:1	Bioinformatics and Drug Designing	5	5	3	25	75	100
	Core Practical – II (CP)	18PMB2CP2	Microbial Physiology & Genetics (P)	8	4	3	40	60	100
				Total	30	24			
III	Core Course – VII (CC)	18PMB3CC7	Immunotechnology	6	5	3	25	75	100
	Core Course – VIII (CC)	18PMB3CC8	Food Microbiology	6	5	3	25	75	100
	Elective Course – III (EC)	18PMB3EC3:1	IPR, Biosafety and Bioethics	5	5	3	25	75	100
	Elective Course – IV (EC)	18PMB3EC4:1	Environmental Toxicology and Management	5	5	3	25	75	100
	Core Practical – III (CP)	18PMB3CP3	Immunotechnology & Food Microbiology (P)	8	4	3	40	60	100
				Total	30	24			
IV	Core Course – IX (CC)	18PMB4CC9	Bioproducts Technology	5	5	3	25	75	100
	Core Course – X (CC)	18PMB4CC10	Environmental and Agricultural Microbiology	5	5	3	25	75	100
	Elective Course – V (EC)	18PMB4EC5:1	Marine Microbiology	5	4	3	25	75	100
	Core Practical – IV (CP)	18PMB4CP4	Bioproducts Technology & Environmental and Agricultural Microbiology (P)	8	4	3	40	60	100

Project work	18PMB4PW	Dissertation = 80 marks [2 reviewers – 20 + 20 = 40 marks Report valuation = 40 marks] Viva = 20 marks	7	4				100
		Total	30	22				500
Grand Total			120	90				2000

List of Elective Courses (For 2018 – 2019)

Elective	Semester	Course Code	Title of the Course
Elective-I	II	18PMB2EC1:1	Statistical Tools for Biology
	II	18PMB2EC1:2	Techniques in Microbiology
Elective-II	II	18PMB2EC2:1	Bioinformatics and Drug Designing
	II	18PMB2EC2:2	Microbial Nanotechnology
Elective-III	III	18PMB3EC3:1	IPR, Biosafety and Bioethics
	III	18PMB3EC3:2	General Biology
Elective-IV	III	18PMB3EC4:1	Environmental Toxicology and Management
	III	18PMB3EC4:2	Advanced Microbial Taxonomy
Elective-V	IV	18PMB4EC5:1	Marine Microbiology
	IV	18PMB4EC5:2	Clinical Laboratory Technology

Note:

Project : 100 Marks

Dissertation : 80 Marks

Viva Voice : 20 Marks

Core Papers - 10

Core Practical - 4

Elective Papers - 5

Project – 1

Note:

1. Theory Internal 25 marks External 75 marks

2. Practical Internal 40 marks External 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.

SEMESTER – I
CORE COURSE I - GENERAL MICROBIOLOGY

Course Code: 18PMB1CC1

Hours: 6

Credit: 4

Total Marks: 100

External Marks: 75

Internal Marks: 25

Objectives

- To know the early developments of microbiology
- Basic concepts of what microorganism is & its characteristics, nutritional details
- Importance of the taxonomic groups and various cellular organization
- The effect of sterilization & various antimicrobial agents on microbial inhibition

Unit I – History and Microbial Taxonomy

History of microbiology, Microbial classification - Definition and systematics, Nomenclatural rules and identification. Haeckel's three kingdom classification, Whittaker's five kingdom approach. Major characteristics used in taxonomy – Morphological and biochemical characterization of the organisms, techniques of genetical and molecular characterization of the organisms – GC%, sequencing, homology, conserved sequences and 16S rRNA analysis.

Unit II – Bacteria and Protozoa

Classification of bacteria according to Bergey's Manual. A note on fossil microorganisms. Morphological types; Reserve food materials – polyhydroxybutyrate, polyphosphates, cyanophycin and sulphur inclusions. Nuclear material – bacterial chromosomes and bacterial plasmids. Structure of Protozoa – classification – reproduction and characteristics of protozoa.

Unit III – Fungi and Algae

Fungi: Classification, cell wall – chemical composition and functions, membranes and their function; Fine structure of flagella and somatic nuclei. Structure and life cycle of fungi – Ascomycetes (Aspergillus), Deuteromycetes (Candida), Zygomycetes (Mucor), Basidiomycetes (Agaricus). Fungi and ecosystem: saprophytes, substrate groups. Algae: Structure of algal cells – classification – reproduction and characteristics of Algae/BGA.

Unit IV – Microbial nutrition

Microbial nutrition: Microbial nutrient requirements – macro-nutrients, micro-elements – growth factors - sources of nutrients – nutritional classification of bacteria - Phototroph, Chemotroph, Autotroph (lithotroph), Heterotroph (organotroph), Photoautotroph, Photoheterotroph, Chemoautotroph, Chemoheterotroph - Nutritional patterns of pathogens – Saprophytes – Auxotroph. Winogradsky column.

Unit V – Cultivation methods of microbes

Isolation and identification of different types of bacteria - Fungi – Actinomycetes - Cyanobacteria - Protozoa. Preservation methods of microbes. Type of culture collections. Physical and chemical sterilization.

Text Book:

1. Heritage, J. Evans E.G.V. and Killington, R.A. (1996). Introductory Microbiology. Cambridge University Press.

Reference Books:

1. Bernard D. Davis Renato Dulbecco. Herman N. Eisen.and Harold, S. Ginsberg. (1990). Microbiology (4th edition).J.B.Lippincott company, Newyork.
2. Alexopoulos CJ and C W. Mims. (1993). Introductory Mycology(3rd edition).Wiley Eastern Ltd, NewDelhi.
3. Elizabeth Moore-Landecker. (1996). Fundamentals of the fungi.(4th edition).Prentice Hall International, Inc, London.
4. Prescott LM, Harley JP and Klein DA (2006). Microbiology (7th edition) McGraw Hill, Newyork.
5. Schaechter M and Leaderberg J (2004). The Desk encyclopedia of Microbiology. Elseiver Academic press, California.

SEMESTER – I
CORE COURSE II - MEDICAL BACTERIOLOGY AND MYCOLOGY

Course Code: 18PMB1CC2
Hours: 6
Credit: 4

Total Marks: 100
External Marks: 75
Internal Marks: 25

Objectives

- To provide a comprehensive theoretical knowledge of bacteria and fungi
- To understand the basic techniques of bacterial and fungal culture
- To create awareness of bacterial and fungal diseases of human beings and causes and cures

Unit I – General pathogenesis

Microbial diseases - sources, route of transmission. Indigenous normal microbial flora. Pathogenesis - adhesion, invasion, host cell damage, release of pathogens. Microbial virulence and virulence factors - Signs and symptoms of microbial diseases. Immunity of microbial diseases.

Unit II – Bacterial diseases I

Morphology, classification, culture characters, pathogenicity, laboratory diagnosis, prophylaxis of following Gram-positive bacteria – *Bacillus anthracis*, *Clostridium*, *Pneumococcus*, *Corynebacterium*, Streptococcal infections, Staphylococcal infections. Gram-negative bacteria - Enterobacteriaceae – *Salmonella*, *Shigella*, *Klebsiella*, *Proteus*, *Yersinia* and *Escheichia*. *Vibrio*, *Pseudomonas*, *Neisseria*, *Haemophilus*, *Campylobacter*, *Bordetella*, *Brucella*.

Unit III – Bacterial diseases II

Morphology, classification, culture characters, pathogenicity, laboratory diagnosis, prophylaxis of following organisms: *Mycoplasma*, *Mycobacterium tuberculosis* and *Mycobacterium leprae*. *Spirochetes* – *Treponema*, *Borrelia* and *Leptospira*. Actinomycetes. *Rickettsiae* and *Chlamydiae*. Nosocomial infections and Zoonotic diseases

Unit IV – Fungal diseases

Superficial mycosis – Tinea, piedra. Cutaneous mycosis – Dermatophytosis. Subcutaneous mycosis - Sporotrichosis, Mycetoma, Rhinosporidiosis. Systemic mycosis – Histoplasmosis. Opportunistic mycosis - Candidiasis, Cryptococcosis and Aspergillosis. Ocular and dental histoplasmosis.

Unit V – Clinical manifestation, diagnosis and Treatment

General clinical manifestation and diagnostic methods for bacterial and fungal diseases. Treatment and prevention of microorganisms. Control of microbial infections.

Text Book:

1. Ananthanarayan R & CK Jayaram Paniker (2005). Text Book of Microbiology. 7th Edition, Orient Longman Private Limited

Reference Books:

1. David Greenwood, Richard CD, Slack, John Forrest Peutherer. (1992). Medical Microbiology. 14th edition. ELBS with Churchill Livingstone
2. Ronald M. Atlas. (1989) Microbiology. Fundamentals and Applications. II edition, Maxwell Macmillan international editions. Topley & Wilson's. (1990) Principles of Bacteriology, Virology and Immunity, VIII edition, Vol. III, Bacterial Diseases, Edward Arnold, London
3. Jagadish Chander. (1996). A Text Book of Medical Mycology. Interprint, New Delhi

SEMESTER – I
CORE COURSE III - VIROLOGY AND PARASITOLOGY

Course Code: 18PMB1CC3

Hours: 5

Credit: 4

Total Marks: 100

External Marks: 75

Internal Marks: 25

Objectives

- To provide a comprehensive theoretical knowledge of virus and protozoa
- To understand the basic techniques of viral and parasitic cultivation and identification

Unit I – Introduction of virology

History of viruses, nomenclature and classification of viruses; Structures and characteristics of virus - viral genome, their types and structures. Virus related agents (viroids, prions). Cultivation of viruses in embryonated eggs, experimental animals, and cell cultures. Serological methods – Haem-agglutination, complement fixation; immunofluorescence, ELISA (3 types) and radio-immunoassays. Assay of viruses – all methods. Antiviral agents. Controlling measure of viruses.

Unit II – Bacteriophage and Phytophaginae

Bacteriophage - structural organization - life cycle (lytic and lysogenic) - Brief details on M13, T4 and Lambda. Brief details on cyanophaginae. Classification of viruses on plants; Common virus diseases of plants - cotton and sugarcane. Type of plant viruses - TMV, Cauliflower Mosaic Virus and Potato Virus X.

Unit III – Zoophaginae

Classification. Characterization, Epidemiology, lifecycle, pathogenicity, diagnosis, prevention and treatment of RNA Viruses - Orthomyxo, Paramyxo, Rhabdo, HIV - Oncogenic viruses. DNA viruses - Pox, Herpes. Hepatitis viruses. Emerging viruses: Ebola virus - H1NI virus.

Unit IV – Infection of Parasites

History and classification of parasites – Laboratory techniques in Parasitology. Intestinal amoebae – *Entamoeba histolytica*, – Free living amoebae – *Naegleria fowleri*. Intestinal and genital flagellates - *Giardia*, *Trichomonas*. - Blood and tissue flagellates - *Leishmania donovani*, *Trypanosoma cruzi*. Hemosporina – Malarial Parasites. Coccidian - *Toxoplasma*, *Cryptosporidium*.

Unit V - Infection of helminthes

Infection of helminthes – *Taenia solium*, *T. saginata*, *Echinococcus granulosus*, *Fasciola hepatica*, *Paragonimus westermani* and Schistosomes. *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Trichuris*, *Enterobius* and *Wuchereria bancrofti*.

Text Book:

1. Jayaram Paniker CK. (2004). Text book of Medical Parasitology. 5th Edition, JAYPEE Brothers, Medical Publishers (P) Ltd., New Delhi

Reference Books:

1. Alan J.Cann (1997). Principles of Molecular virology. (2nd edition). Academic press, California.
2. Dimmock NJ, Primrose SB. (1994) Introduction to Modern Virology IV edi. Blackwell Scientific Publications, Oxford
3. Flint, S.J., Enquist, L.W., Krung, R. Racaniello, VR. and Skalka, A.M. (2000). Principles of Virology, Molecular Biology, pathogenesis and control, ASM Press, Washinton D.C.
4. Nicklin, J. Greame-Cook and Killington, R. (2003). Instant Notes in Microbiology. (2nd edition). Viva Books private limited, New Delhi.
5. Roger Hull (2002). Mathews' Plant Virology. (4th Edition). Academic press-A Harcourt Science and technology company, New York.
6. Karyakarte RP & AS Damle (2005). Medical Parasitology. Revised Edition. Published by Books And Allied (P) Ltd., Kolkata

SEMESTER – I
CORE COURSE IV – MICROBIAL BIOCHEMISTRY

Course Code: 18PMB1CC4

Hours: 5

Credit: 4

Total Marks: 100

External Marks: 75

Internal Marks: 25

Objectives

- Mainly to know the existence of biomolecules in nature and living things
- To understand biomolecules importance and their mode of action
- To know on cell metabolism, anabolism and catabolism

Unit I – Chemistry of life and special microbial molecules

Covalent, H-bonds, Van der Waals' interaction, Hydrophobic and hydrophilic interactions. Water as a biological solvent and its role in biological processes pH, Henderson-Hasselbalch equation, concept of buffer, strength of buffer, range of buffer, important biological buffers. Structure of Special Microbial Molecules: Peptidoglycan, bacteriorhodopsin, biphytanyl chains and lipids in archaeal cell membranes and their significance in adaptation in extreme conditions. Biosynthesis of purines and pyrimidines.

Unit II – Enzymes and Hormones

Enzyme definition – nomenclature, classification; Factors affecting enzyme activity- active site, co-enzyme, mechanism of enzyme action, enzyme pattern in diseases. Hormones: Classification; Mechanism of action; Role of biologically important hormones; Pituitary; Anterior; Posterior; Thyroid; Adrenal cortex, Adrenal medulla; GI hormones; Gonadal hormones.

Unit III – Proteins

Proteins: Structural features of amino acids, classification of amino acids, peptide linkage: partial double bond nature, determination of primary structure of polypeptide, structural classification of proteins, primary, secondary, tertiary, quaternary structures of proteins. Ramchandran plot.

Unit IV – Carbohydrates and Lipids

Carbohydrates: Monosaccharides, disaccharides, oligosaccharides and polysaccharides, concepts of epimer, isomer Lipids: Saturated and unsaturated fatty acids, Fatty acid oxidation. Biosynthesis of fatty acids, triacylglycerols and phospholipids.

Unit V – Metabolism

Cell metabolism, anabolism and catabolism. Catabolic principles and break down of carbohydrates, lipids, proteins and nucleic acids. Vitamins and their functions (co-enzyme).

Text Book:

1. Donald Voet and Judith G. Voet (1995). Biochemistry – Second Edition. John Wiley and Sons, Inc.

Reference Books:

1. Christopher K. Mathews and Van Holde, K.E. (1996). Biochemistry.(2nd edition).The Benjamin/Cummings publishing company, Inc.
2. David E. Metzler. And Carol M. Metzler. (2001). Biochemistry-The chemical reactions of living cells- Voll & 2. (2nd edition).Harcourt/Academic press, Newyork.
3. Jeremy M.Berg. John L. Tymoczko and Lubert stryer (2002). Biochemistry. (5th edi). W.H.Freeman and company, Newyork.
4. Reginald, H., Garret & Charles M. Grishm. (1998). Biochemistry (Second Edition) Saunders College Publishing.
5. Trudy McKee and James R.McKee. (1999). Biochemistry-An Introduction. (2nd edition).WCB McGraw- Hill,U.S.A.
6. Nelson D L, Cox M. M. Lehninger s Principle of Biochemistry. 4th ed. Freeman, 2004.

SEMESTER – I
CORE PRACTICAL I – GENERAL MICROBIOLOGY & BACTERIOLOGY AND
MYCOLOGY & MICROBIAL BIOCHEMISTRY & VIROLOGY AND PARASITOLOGY

Course Code: 18PMB1CP1
Hours: 8
Credit: 4

Total Marks: 100
External Marks: 60
Internal Marks: 40

Objectives

- To demonstrate safe practices in a microbiology laboratories
- To understand and explain causes of microbial infections
- To isolate and identification of different microorganisms
- To learn basic biochemistry tech. and study the qualitative/quantitative analyses of macromolecules

General Microbiology

1. Principles and methods of sterilization and Preparation of different types of media
2. Staining methods: Simple, Negative, acid fast, Gram staining, Spore, Capsule & MCG staining
3. Direct microscopic observations: Bacteria - cocci, rods & chains; Fungi - spores, mycelium & budding
4. Serial dilution techniques, Pure culture techniques and Membrane filtration technique
5. Measurement of size of microbes – micrometry
6. Motility determination – Hanging drop method and tube method
7. Enumeration of bacterial / yeast cells-viable count (Plate count) Total count (Haemocytometer)
8. Isolation and purification of cyanobacteria, actinomycetes, fungi and protozoans

Bacteriology and Mycology / Virology and Parasitology

1. Collection, transport and culture of clinical specimens - Sputum, pus, urine, faeces, blood and CSF
2. Isolation and identification of upper/ lower respiratory tract pathogen, gastrointestinal pathogens and urinary tract pathogens
3. Antibiotic susceptibility test - Kirby bauer technique
4. Isolation and identification of fungal pathogens from various samples
5. Direct microscopy – KOH and LCB preparations for skin scrapings for fungi
6. Germ tube, assimilation and fermentation tests for yeast
7. Isolation and characterization of bacteriophage - Cultivation methods - Egg inoculation techniques
8. Serological tests: Haemagglutination (HA) test and Haemagglutination inhibition (HI) tests
9. Diagnosis of HIV virus ELISA Method; HBV virus ELISA Method
10. Examination of cysts/ Ova in faeces - Direct Method - Simple flotation and Concentration methods (Formal ether Method, Zinc sulphate Methods and Saturated saline – technique)
11. Blood smear examination for malarial parasites - Thin smear by Leishman's stain

General Biochemistry

1. Preparation of Buffer - Tris, phosphate and acetate buffer
2. Acid-Base titration – pKa value determination – Determination of $[H^+]$ ion concentration
3. Preparation of standard graph for the following and estimating the concentration in a microbial sample - glucose – anthrone method; bovine serum albumin (Lowry's method); Nucleic acid – DNA (diphenylamine method), RNA (Orcinol method)
4. Separation of aminoacids by paper chromatography and identification of amino acid

Text Book:

1. Wilson, K. and Walker, J. (2000). Practical Biochemistry, 5th Edition, Cambridge University Press.

Reference Books:

1. John P. Harley Microbiology Lab Manual (2007) 7th edition McGraw Hill Medical Publication division
2. Collee, J.C., Duguid, J.P., Fraser, A.C. and Marimon, B.P. (1996) Mackie and McCartney Practical Medical Microbiology, 14th Edn. Churchill Livingstone, London
3. Cappuccino and James, G (1996) Microbiology a laboratory manual, Addison Wesley Publishing Company Inc. 4th edition, England, California.
4. David R. Brooke. Bergey's Manual of Systematic Bacteriology (Vol. I), Eastern Halz, Springer Publication.

SEMESTER – II
CORE COURSE V – MICROBIAL PHYSIOLOGY

Course Code: 18PMB2CC5

Hours: 6

Credit: 5

Total Marks: 100

External Marks: 75

Internal Marks: 25

Objectives

- The various transport systems available for different organisms for their nutritional uptake
- Giving a broader edge to the students about the process of Growth cycle, Morphogenesis, Endospore formation, Photosynthesis.
- The pathways for utilization of nutrients incorporated by the organism to gain their living,
- To know the microbial pigments and spores

Unit I - Cell structure and function

Biosynthesis of peptidoglycan; Outer membrane and plasma membrane. Cytoplasmic membrane, pili, fimbriae, S-layer. Transport mechanisms (4 types). Electron carries – artificial electron donors – inhibitors – uncouplers – energy bond – phosphorylation.

Unit II - Microbial 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. Extremophiles. Bioluminescence - mechanism – advantages.

Unit III – Energy and Regulation

Energy and Regulation: Energy and work-law of thermodynamics, spontaneity of reaction G , G° , G' and equilibrium. Role of ATP in metabolism- oxidation- reduction. Electron carriers- artificial electron donors, inhibitors, uncouplers, and energy bond. Significance and metabolic regulation

Unit IV - Carbon catabolism

Carbohydrates – anabolism – autotrophy – oxygenic – anoxygenic Photosynthesis – autotrophic generation of ATP; fixation of CO_2 – Calvin cycle – C3 – C4 pathways. Respiratory metabolism – Embden Mayer Hoff pathway – Enter Doudroff pathway – glyoxalate pathway – Krebs cycle – oxidative and substrate level phosphorylation – reverse TCA cycle – gluconeogenesis – Fermentation of carbohydrates – homo and heterolactic fermentations.

Unit V – Microbial pigments and spores

Pigments: Brief details of autotrophic and heterotrophic pigments. Brief account of chlorophyll – fluorescences, phosphoroscenses - bacteriochlorophyll – rhodopsin – carotenoids – phycobiliproteins; Brief account on Dormancy. Spores: Cell division – bacterial endospore. Microbial development, sporulation and morphogenesis. Hyphae vs yeast forms and their significance. Multicellular organization of selected microbes.

Text Book:

1. Caldwell, D.R. (1995). Microbial Physiology and metabolism, Wm. C. Brown Publishers, USA

Reference Books:

1. Lansing M. Prescott, John P. Harley and Donald A. Klein. (2003). Microbiology. (5th edition). McGraw-Hill company, Newyork.
2. Pelczar Jr, M.J. Chan, E.C.S. and Kreig, N.R. (1993). Microbiology, Mc. Graw Hill. Inc, New York.
3. White, D. (1995). The physiology and biochemistry of Prokaryotes, Oxford University Press, Oxford, New York.
4. Rabert Poole, K. (2007). Advances in Microbial Physiology, Volume 53 Elsevier Science & Technology.

SEMESTER – II
CORE COURSE VI – MICROBIAL GENETICS AND MOLECULAR BIOLOGY

Course Code: 18PMB2CC6
Hours: 6
Credit: 5

Total Marks: 100
External Marks: 75
Internal Marks: 25

Objectives

- To make a detailed study on the blue print of life and the information centers called genes
- To expose the mechanism and function of gene transfer methods
- To know about rDNA technology, mutagenesis and transposable elements

Unit I – Introduction

Premendelian genetic concepts – Preformationism, epigenesis, inheritance of acquired characters, traits, Germplasm theory. Hereditary and Environment, Genotype and Phenotype. Microbes as genetic tools for genetic studies. Identification of genetic material – Griffith experiment. DNA replication - Meselson – Stahl experiment.

Unit II - Gene

Organization of Gene - Operon concept, lac and trp 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 & modification – RNAi.

Unit III – Protein synthesis and Transfer mechanisms

Process of transcription. Synthesis of mRNA in prokaryotes and eukaryotes. Synthesis of rRNA and tRNA. cDNA library. RNA processing – capping and polyadenylation. Genetic code and process of translation. Signal sequences and protein transport. Brief details on Transformation (competence cells, regulation, general process), Transduction (general and specialized) and all Conjugation methods.

Unit IV – rDNA technology

Vectors - plasmids, cosmids, phages - Restriction enzymes - Principles and applications of recombinant DNA technology. Biosafety guidelines and measures – levels I, II, III and IV.

Unit V – Transposons and Mutagenesis

Discovery insertion sequences, complex and compound transposons – T10, T5, and retroposon –Insertion sequences – Mechanism – Transposons of E.coli, Bacteriophage and Yeast. Mutation and mutagenesis- Definition and types- Spontaneous mutation and induced mutation. DNA damage and repair mechanism.

Text Book:

1. Malacinski GM & Freifelder D (1998) Essentials of Molecular Biology, 3 edition, John and Bartlett Publis.

Reference Books:

1. Friedberg EC, Walker GC, Siede W. (2005). DNA repair and mutagenesis. ASM press James D. Watson, Tania A. Baker, Stephen P. Bell, and Alexander Gann (20080, Molecular Biology of the Gene, Fifth Edition.
2. Antony JF, Griffiths, Gilbert WM, Lewontin RC and Miller JH (2002). Modern Genetic Analysis, Integrating Genes and Genomes, 2nd edition, WH.
3. Maloy SR, Cronan Jr. JE, Freifelder D (1994). Microbial genetics. Jones and Bartlett publishers.
4. Singer M, Berg P. (1991). Genes and Genomes. University Science Books.
5. Watson JD, Hopkins NH, Roberts JW, Steitz JA, Weiner AM. (1998). Molecular biology of the gene, 4th edition, Benjamin/Cummings publishing company.

SEMESTER – II
CORE PRACTICAL II – MICROBIAL PHYSIOLOGY & MICROBIAL GENETICS AND
MOLECULAR BIOLOGY

Course Code: 18PMB2CP2

Hours: 8

Credit: 4

Total Marks: 100

External Marks: 60

Internal Marks: 40

Objectives

- To know the basics of metabolism including nutritional growth, anabolism and catabolism
- To appreciate the metabolic diversity existing in microbes
- To familiarize with morphologic criteria to differentiate the most common parasites
- To understand the principles and applications of microbial genetic methods

Microbial Physiology

1. Bacterial growth curve – Turbidity
2. Effect of various factors influence the growth of microbes – pH, T° and Nutrients
3. Biochemical tests – Indole, MR, VP, Citrate, TSI, Urease, Catalase, Oxidase, etc
4. Carbohydrate fermentation test

Genetics

1. Isolation of antibiotic resistant microbes
2. Induction of mutation by ultra-violet radiation and chemical mutagens – NTG, MNNG. Transformation (competent cell preparation) and Transduction using P1
3. Isolation of microbial genomic DNA and plasmid DNA from *E.coli* (mini preparation)
4. Demonstration: Bacterial conjugation – transfer of drug resistant factor (Plasmid)
5. Restriction digestion of DNA
6. DNA amplification - PCR analysis
7. Blotting techniques: Southern Blotting; RAPD and RFLP
8. Principle and separation of AG and SDS-PAGE

Text Book:

1. Dubey, R.C. and Maheshwari, D.K. (2002) Practical Microbiology, 1st Edn. S. Chand & Co. Ltd., New Delhi.

Reference Books:

1. Atlas Ronald, M., Bartha, and Richard (1987). Microbial Ecology 2nd Edition. Benjamin/Cummings Publishing Company, California.
2. Current protocols in molecular biology (2007), Vol. 1 & 2. John Wiley & Sons Inc.
3. Sambrook J and Russell DW (2001) Molecular cloning - A laboratory manual (3rd edition, Vol 1,2,3), Cold Spring Laboratory Press.
4. Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. 1994. Methods of General and Molecular Bacteriology, Ed.
5. Surzyeki S (2000). Basic Techniques in Molecular Biology. Springer.
6. Dharmalingam, K. 1986. Experiments with MI3 gene cloning and DNA sequencing, Published by Wasani for MacMillan India Limited.

SEMESTER – II
ELECTIVE COURSE I – STATISTICAL TOOLS FOR BIOLOGY

Course Code: 18PMB2EC1:1

Hours: 5

Credit: 5

Total Marks: 100

External Marks: 75

Internal Marks: 25

Objectives

- To imbibe statistical techniques applicable in biological sciences.
- To expose the essential ideas about designing and executing and interpreting statistical field experiments.

Unit I – Sampling Techniques

Complete enumeration Vs. Sampling – need and limitations of sampling design -Organization and Execution of Sample Surveys-Essential aspects of Sample Survey-Pilot Survey-Sources of Error in a survey. Sampling and Non-sampling errors. Probability and Non Probability Sampling Techniques.

Unit II – Test of significance for large samples

Test of Significance for Single Sample Proportion and Two Sample Proportions - Single Sample Mean and Two Sample Means - Single Sample Variance and Two Sample Variances - Simple Problems.

Unit III – Test of significance for small samples

Test of significance for means, variances, correlation coefficient, regression coefficient, based on t, Chi-square and F-distributions. And its applications – Simple problems.

Unit IV – Design of experiments

Fundamental principles of experimentation – Randomization, Replication and Local control techniques. Uniformity trials – Transformation of data and its uses. Analysis of variance- One way and Two way classification, missing plot technique, Analysis of CRD, RBD and LSD.

Unit V – Epidemiological Analysis

Definition and uses of vital statistics – Measures of mortality – C.D.R., S.D.R., A.S.D.R. – Central Mortality Rate – Force of Mortality – Measures of Fertility – C.B.R., G.F.R., A.S.F.R. and T.F.R.

Text Book:

1. Gupta, S.C. and Kapoor, V.K.: Fundamentals of Applied Statistics, Sultan Chand & Co., 11th ed., 2002 (Units I, IV and V).

Reference Books:

1. Gupta, S.C. and Kapoor, V.K.: “Fundamentals of Mathematical Statistics”, Sultan & Chand & Sons, New Delhi, 11th Ed, 2002. (Units II and III)
2. William G. Cochran.: Sampling Techniques, John Wiley Sons, 1999.
3. Das, M.N. and Giri, N.C.: Design and analysis of Experiments, New age International Publication 2nd ed, 1986.
4. Kendall, M. and Stuart, A.: “The advanced theory of Statistics” Vol. II, Charles Griffin, 1961.

SEMESTER – II
ELECTIVE COURSE I – TECHNIQUES IN MICROBIOLOGY

Course Code: 18PMB2EC1:2
Hours: 5
Credit: 5

Total Marks: 100
External Marks: 75
Internal Marks: 25

Objectives

Techniques in Microbiology deals with

- To study the principle and working procedure of different type of instruments in biological science
- To know the knowledge about the applications of instruments
- The methods available for the separation of biomolecules, 1^o and 2^o metabolites
- To study the advanced conventional and modern (molecular) microbiological instruments

Unit I – Microscopy and Centrifugation

Microscopy- Principles and applications, simple, compound, phase-contrast and fluorescent microscopes. Electron microscopy: SEM and TEM, Confocal laser scanning microscopy. Centrifugation Techniques: Principles, type of centrifuges, buoyant and density gradient centrifugation, ultracentrifuges.

Unit II – Spectroscopy

Spectroscopy: Electromagnetic spectrum, Beer Lambert's Law. Photometry, UV/VIS Spectrophotometry, Infrared spectroscopy, Atomic absorption spectroscopy (AAS), ESR and H and C NMR spectroscopy. Mass spectroscopy (LC-MS, GC-MS). Fluorescent spectroscopy, principle, instrumentation and application of MALDI-ToF.

Unit III - Chromatography

Chromatography: Introduction and types of chromatography, paper, thin layer, gas, partition, Gel permeation, ion-exchange, HP-TLC, HPLC, FPLC and affinity chromatography and instrumentation. Applications of Chromatographic techniques in Microbiology.

Unit IV – Electrophoresis and Blotting techniques

Electrophoresis and Blotting techniques - Paper and gel electrophoresis, PAGE (native and SDS), Agarose gel electrophoresis, PFGE, Blotting- Southern, Western and Northern blotting, Immunoblotting, Labelling and Detection methods - Nature and types of radiations, preparation of labelled biological samples. Detection and measurement of radioactivity, GM counter, Scintillation counter, Autoradiography, Flow cytometry. Safety measures in handling radioisotopes, RIA, non-radiolabelling.

Unit V – DNA sequencing methods

DNA sequencing methods: Major landmarks in DNA sequencing - Maxam-Gilbert sequencing, Chain-termination methods, Advanced methods and *de novo* sequencing, Shotgun sequencing, Next-generation methods, Massively Parallel Signature Sequencing (MPSS), Polony sequencing, 454 pyrosequencing, Illumina (Solexa) sequencing, SOLiD sequencing, Ion semiconductor sequencing, DNA nanoball sequencing, Heliscope single molecule sequencing, Single molecule real time (SMRT) sequencing.

Text Book:

1. Surzeki, S. (2000). Basic Techniques in Molecular Biology, Springer.

Reference Books:

1. Glick, B.R. and Pasternak, J.J. (1994). Molecular Biotechnology, ASM Press.
2. John G. Webster. (2004). Bioinstrumentation. University of Wisconsin, John Wiley & Sons, Inc.
3. Sambrook, J. and Ruseell, D.W. (2001) Manual of Molecular Cloning (3rd edition) Cold Spring Laboratory Press.
4. Westermeier, R (1993). Electroporesis in practice – VCH – Federal Republic of Germany.
5. Willett, J.E. (1991). Gas Chromatography, John Wiley & Sons.
6. Wilson, K. and Walker (1995). Practical Biochemistry Principles and Techniques, Cambridge University Press.

SEMESTER – II
ELECTIVE COURSE II – BIOINFORMATICS AND DRUG DESIGNING

Course Code: 18PMB2EC2:1
Hours: 5
Credit: 5

Total Marks: 100
External Marks: 75
Internal Marks: 25

Objectives

- To understand the biological databases and tools
- To know about the sequence alignment algorithms
- To understand about the structure prediction and visualization tools
- To know about the methods and applications of drug designing

Unit I – Biological Databases

Genbank - Nucleic acid and Protein Sequence Databases - Structural Databases -Literature Databases – Pubmed - Sequence Analysis – Pair wise sequence alignment – BLAST and FASTA – Gap Penalty - Alignment Algorithms: Needleman Wunsch Algorithm and Smith Waterman Algorithm - Multiple Sequence Alignment –Phylogenetic Analysis.

Unit II – Genomics

Sequencing Genomes – Sequence Assembly - Functional Genomics - Structural Genomics – Pharmacogenomics – Comparative genomics - Proteomics – Structural and Comparative proteomics - applications - Human Genome Project – Gene Prediction.

Unit III - Proteomics

Predicting Protein structure and function– Determination of structure - Secondary structure prediction – FSSP, PDB, SCOP and CATH - Chou-Fasman method –GOR method- Protein Modeling – Fold recognition – Ab initio prediction - Structure Visualization tools – Rasmol and Phymol.

Unit IV – Macromolecular Modeling

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 V – 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.

Text Book:

1. Rastogi S.C., Namita Mendiratta, Parag Rastogi. (2011) Bioinformatics – Concepts, Skills and Applications (Second Edition) CBS Publishers, New Delhi.
2. Attwood T K, D J Parry-Smith, “Introduction to Bioinformatics”, Pearson Education, 2005.

Reference Books:

1. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, New Delhi, 2003.
2. Alan Hinchliffe. 2003. Molecular Modelling for Beginners, John-Wiley and Sons New York.
3. Cohen, N. (Ed.).1996. Guide Book on Molecular Modeling in Drug Design, Academic Press, San Diego.
4. McCammon, J.A. and S.C. Harvey. 1987. Dynamics of Proteins and Nucleic Acids. Cambridge University Press.
5. Shanmughavel, P. 2006. Trends in Bioinformatics, Pointer Publishers, Jaipur, India.
6. Hansch, Corwin, Leo, Albert, Hockma, D.H. 1995. Exploring QSAR. American Chemical Society, Washington D.C.

SEMESTER – II
ELECTIVE COURSE II – MICROBIAL NANOTECHNOLOGY

Course Code: 18PMB2EC2:2
Hours: 5
Credit: 5

Total Marks: 100
External Marks: 75
Internal Marks: 25

Objectives

- To impart the knowledge of nano science and its application in biology
- To improve the knowledge about recombinant products with help of advanced techniques

Unit I - Introduction

History - bionanotechnology - concept and future prospects - application in life sciences. Terminologies - nanotechnology, bionanotechnology, nanomedicine, nanowires, quantum Dots, nanocomposite, nanoparticles.

Unit II - Molecular nanotechnology

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 of nanoparticles

Unit III - Nanoparticles

Nanoparticles - types, functions - Silver, Gold and Titanium. Physical and chemical properties of nanoparticles. Characterization of nanoparticles - UV-Vis spectroscopy, Electron Microscopy - HRTEM, SEM, AFM, EDS, XRD.

Unit IV - Applications

Applications of nanoparticles in biology: Drug delivery - protein mediated and nanoparticle mediated. Uses of nanoparticles in MRI, DNA and Protein Microarrays. Nanotechnology in health sectors. Toxicology in nanoparticles - Dosimetry.

Unit V – Significance of nanoparticles

Advantages of nanoparticles - drug targeting, protein detection, MRI, development of green chemistry - commercial viability of nanoparticles. Disadvantages - health risk associated with nanoparticles, inadequate knowledge on nanoparticles research.

Text Book:

1. Parthasarathy, B.K. (2007). Introduction to Nanotechnology, Isha Publication.

Reference Books:

1. Elisabeth Papazoglou and Aravind Parthasarathy (2007). Bionanotechnology. Morgan & Claypool Publishers.
2. Bernd Rehm (2006). Microbial Bionanotechnology: Biological Self-assembly Systems and Biopolymer-based Nanostructures. Horizon Scientific Press.
3. David E. Reisner, Joseph D. Bronzino (2008). Bionanotechnology: Global Prospects. CRC Press.
4. Ehud Gazit (2006). Plenty of Room for Biology at the Bottom: An Introduction to Bionanotechnology. Imperial College Press.

SEMESTER – III
CORE COURSE VII – IMMUNOTECHNOLOGY

Course Code: 18PMB3CC7

Hours: 6

Credit: 5

Total Marks: 100

External Marks: 75

Internal Marks: 25

Objectives

- To study in detail the components of the immune system
- To learn the immunological basis of infectious diseases, cancer and transplantation
- To learn the immunological testing's for disease diagnosis and treatment

Unit I - Introduction

Introduction to the field of Immunology: Historic perspective, Discovery of humoral and cellular immunity; Types of Immunity: Innate immunity - Acquired immunity: (specific) natural, artificial, active and passive immunity. Inflammatory response; Phagocytic system - mononuclear phagocytes, macrophages, neutrophils, Natural killer cells, mast cells, basophils, and eosinophils.

Unit II - Antigens and Antibodies

Antigens and Antibodies: Immunogenicity versus Antigenicity, Nature of antigens; Role of T helper cells in B cell activation; Antibody-structure and functions-subtypes; structural basis of Antibody diversity; Theories of Antibody formation. Complement pathway - Recent advances in the production of monoclonal antibodies and their applications.

Unit III - Organs, and tissues of immune system

Organs, and tissues of immune system: Primary and Secondary Lymphoid organs - Thymus and Bone marrow; Lymph node, spleen and tonsils, MALT, GALT; cells of the humoral Immunity (HI) and Cell mediated Immunity (CMI); Immune tolerance; Antigen presenting cells (APCs), T lymphocytes, B lymphocytes. MHC restriction – Tissue and HLA typing - Transplantation.

Unit IV – Immunological disorders

Immune system Disorders - Hypersensitivities -Type I to Type IV, Immunodeficiency diseases; Primary and secondary immune deficiencies, AIDS; Auto immune diseases-organ specific and systemic; Vaccines–definition, conventional vaccines and modern trends in development of vaccines, recombinant and DNA vaccines; current vaccines, safety, active and passive immunization.

Unit V – Immuno-techniques

Immuno-techniques and Immuno-diagnosis: Antigens and Antibody reactions *in vitro*; precipitation agglutination, complement fixation, ELISA, Western Blotting, Nano-pro-Immuno assay, Immunodiffusion, Immunoelectrophoresis, Immunofluorescence, Immuno-precipitation, Radioimmunoassay and Flow cytometry

Text Book:

1. I.Roitt. Essential Immunology. 10th ed. Blackwell Science, 2005

Reference Books:

1. Kuby Immunology- 6th edition. Publisher W. H. Freeman & Company
2. Janways Immunobiology. 7th edition. Publisher-Garland Science, 2007
3. Ivan M. Roit (1994) Essential Immunology – Blackwell Scientific Publications, Oxford
4. Eli Benjamini, Richard Coico, G. Sunshine. Immunology- A Short Course. 4th Ed. Wiley's Publication, 2000.

SEMESTER – III
CORE COURSE VIII – FOOD MICROBIOLOGY

Course Code: 18PMB3CC8
Hours: 6
Credit: 5

Total Marks: 100
External Marks: 75
Internal Marks: 25

Objectives

- Study about food preservation, spoilage and detection of pathogens using advanced techniques.
- To study about importance and benefit of microbes in food production and processing industry

Unit I - Introduction

Importance of food microbiology - Types of microorganisms in Food Spoilage source of contamination- Factors - Intrinsic and Extrinsic parameters – affecting / influencing microbial growth in food.

Unit II – Food Fermentation

Microbiology of Food fermentations: Milk, Fermentation, Fermented and Non-fermented Dairy Products. Food fermentations - Manufacture of fermented foods - Meat and fishery products, plant products- Sauerkraut and fermented breads, beverages. Microbial cells as food- SCP, mushroom cultivation. Source and applications of microbial enzymes, antioxidants, bio-surfactants, polysaccharides, flavors and colors. Probiotics and their advantages, genetically modified foods.

Unit III – Contamination and Spoilage

Contamination and spoilage of dairy and dairy products, cereals and cereals products, sugar and sugar products, vegetables and fruits, meat and meat products – fish and other sea foods, egg and poultry. Fermentative dairy products (ice cream, Yoghurt and Kefir). Food borne disease, intoxication and food poisoning – Staphylococcus, EPEC, Diarrhea, Clostridium, Escherichia coli and Salmonella infections.

Unit IV – Food Preservations

Food Preservations: Principles- Methods of Preservations-Physical and chemical methods.

Unit V – Food safety and Quality management

Food safety and Quality Management Systems: General principles of food safety risk management, Recent concerns on food safety - Food additives - Safe food alternatives (Organic foods), Good agricultural Practices (GAP), Food Indicators of water and food safety and quality-Microbiological criteria of foods and their Significance. Good manufacturing practices (GMP) and Good laboratory practices (GLP) - HACCP and personnel hygiene - ISO systems for food safety.

Text Book:

1. Frazier and Westhoff, DC. 1988. Food Microbiology. TATA McGraw Hill Publishing Company LTD., New Delhi

Reference Books:

1. Adams, M.R and Moss, MO. 1995. Food Microbiology. The Royal Society of Chemistry, Cambridge.
2. James M. Jay., Loessner, M. J., and Golden D. A., 2005, Modern Food Microbiology, Seventh edition.
3. Verma, L.K. and Joshi, V. K., 2000, Post Harvest Technology of Fruits and Vegetables, Tata McGraw Hill Publication.
4. Banwart GJ. 1989. Basic food microbiology, Chapman & Hall, New York.

SEMESTER – III
CORE PRACTICAL III – IMMUNOTECHNOLOGY & FOOD MICROBIOLOGY

Course Code: 18PMB3CP3

Hours: 8

Credit: 4

Total Marks: 100

External Marks: 60

Internal Marks: 40

Objectives

- To learn the advanced immunological techniques
- To learn the microbiological quality of foods

Immunotechnology

1. Collection of venous blood from human and separation and preservation of serum / plasma
2. Immunization of protocols and raising antibody
3. ABO Blood grouping – Rh typing and cross matching
4. Agglutination tests - WIDAL – slide and tube test, RA test, ASO test, \square -HCG test and CRP test
5. Precipitation reaction - Ouchterlony's Double Immuno-diffusion test & Counter immune-electrophoresis

Food Microbiology

1. Detecting Milk Quality by Methylene Blue Reductase (MBRT) test
2. Enumeration/ Viable count Plate of Microbial population of fruits, vegetables, meat, soft drinks and preserved foods
3. Milk coagulase test
4. Preservative efficacy test
5. Complete microbiological analysis of various food products.

Text Book:

1. Dubey RC and Maheswari DK (2004). Practical Microbiology 1st Edition, S.Chand & Company Ltd., New Delhi.

Reference Books:

1. Immunology (2000) by K. R. Joshi, N.O. Osama, Agrobios Ltd, India.
2. Donal M. Weir, John Steward (1993) Immunology – VII edition. ELBS, London Richard M. Hyde (1995). Immunology III edition. National Medical series, Williams and Wilkins, Harward Publishing company.
3. Ward, O.P. 1989. Fermentation Biotechnology: Principles, Processes and products. Prentice Hall Engle wood Cliff..
4. Peppier, H,J and Prelman, D.1979. Microbial tech & Fermentation tech.. Vol.1 and II. Academic Press. NY.

SEMESTER – III
ELECTIVE COURSE III – IPR, BIOSAFETY AND BIOETHICS

Course Code: 18PMB3EC3:1
Hours: 5
Credit: 5

Total Marks: 100
External Marks: 75
Internal Marks: 25

Objectives

- To know about the biosafety guidelines and regulations with biosafety levels and cabinets
- To understand the basic concepts in IPR with agreement and treaties
- To provide the knowledge about Bioethics

Unit I - Introduction to Intellectual Property Rights (IPR)

Intellectual Property Rights (IPR)- Patents – Copyrights – Trademarks – Trade Secrets - Importance of IPR – patentable and non-patentable products – patenting life - Industrial Design -Traditional Knowledge - Geographical Indications-- legal protection of biological inventions – World Intellectual Property rights Organization (WIPO).

Unit II – Patent Filing Procedures

National and Patent Cooperation Treaty filing procedure -Time frame and cost -Status of the patent applications filed -Precautions while patenting – disclosure and non-disclosure while patenting - Financial assistance for patenting - Patent licensing- Patent Agreement - Patent infringement.

Agreements and Treaties: GATT Agreement - TRIPS Agreement - Madrid Agreement - Hague Agreement - WIPO Treaties -Budapest Treaty – Patent Cooperation Treaty - Indian Patent Act 1970 and recent amendments.

Unit III - Biosafety

Introduction - Biosafety issues - Historical background - Introduction to Biological Safety Cabinets - Biohazards - Biosafety Levels of Specific Microorganisms - Recommended Biosafety Levels for Infectious Agents and infected animals.

Unit IV – Biosafety Guidelines

Biosafety guidelines and regulations - Operation of biosafety guidelines and regulations of Government of India - Definition of GMOs and LMOs - Roles of IBC, RCGM, GEAC - GMO applications in food and agriculture - Environmental release of GMOs - Risk Analysis; Risk Assessment; Risk management and communication - Cartagena Protocol.

Unit V - Bioethics

Introduction to Bioethics -Microbiology and ethics –Benefits and risks of genetic engineering – Reducing Genetic Diversity – Biological warfare – Gene therapy- Ethics of somatic cell gene therapy - Germ line therapy - Embryonic and adult stem cell research-Medical ethics – Hippocratic tradition- Profession and Philanthropy – Western medicine – Animal Rights.

Text Book:

1. Senthil Kumar Sadhasivam and Mohammed, Jaabir. 2008. IPR, Biosafety and Biotechnology Management. Jasen Publications, Tiruchirapalli, India.

Reference Books:

1. Ethics in engineering, Martin. M.W. and Schinzinger.R. III Edition, Tata McGraw-Hill, New Delhi. 2003.
2. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
3. Kankanala, K. C. 2007. Genetic Patent Law & Strategy, 1st Edition. Manupatra Information Solution Pvt. Ltd., Noida, India.
4. Nancy, S. Jecker., Albert R. Johnson, Robert A. 1997. Pearlman. Bioethics: An Intro. to history, methods and practice
5. Sudbury, M.A.; Jones and Barlett Publishers. Tom, L. Beauchamp., Childress, F. Principles of biomedical ethics, 5th Edition, Oxford University Press. 2000.
6. Hoosetti, B.B.2002. Glimpses of Biodiversity. Daya, New delhi.
7. <http://www.cbd.int/biosafety/background.shtml>
8. <http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section3.html>

SEMESTER – III
ELECTIVE COURSE III – GENERAL BIOLOGY

Course Code: 18PMB3EC3:2

Hours: 5

Credit: 5

Total Marks: 100

External Marks: 75

Internal Marks: 25

Objectives

- To understand the plant taxonomy and classification kingdom
- Provides the knowledge about plant breeding and conventional methods
- To know about the animal cell culture and genetic engineering of animals

Unit I – Biosystematics

Principles of Taxonomy as applied to the systematics and Classification of Plant Kingdom: Taxonomic structure; Biosystematics; Plant geography; Floristics.

Principles of taxonomy as applied to the systematics and classification of the animal kingdom: Classification and interrelationship amongst the major invertebrate phyla; Minor invertebrate phyla, Functional anatomy of the nonchordates; Larval forms and their evolutionary significance.

Unit II - Evolutionary Biology

Origin of life (including aspects of prebiotic environment and molecular evolution); Concepts of evolution; Theories of organic evolution; Mechanisms of speciation; Hardyweinberg genetic equilibrium, genetic polymorphism and selection; Origin and evolution of economically important microbes; plants and animals.

Unit III – Plant Breeding

Principles of plant breeding - Important conventional methods of breeding self and cross pollinated and vegetative propagated crops - Non conventional methods – Polyploidy - Genetic variability - Plant diseases and defensive mechanisms.

Unit IV – Genome Organization

Plant genome organization - Organisation of chloroplast and mitochondrial genome - cytoplasmic male sterility - Genomic interaction – Protoplasmic fusion - Genetic engineering in plants - Pest resistance, Herbicide resistance - Resistance to fungi and Bacteria - .

Unit V - Animal Cell Culture

Fundamentals - Facilities and Applications - Media for Animal cells - Types of cell culture - cell transformation - cell lines - stem cell cultures - Cell viability and cytotoxicity - Biology of cultured cells - measurement of growth - cell synchronization- cryopreservation – Gametogenesis - Genetic engineering in animals - methods of DNA transfer into animal cells- Hybridoma technology - Vaccine production. Gametogenesis in animals: Molecular events during fertilization..

Text Book:

1. Grierson,D., and S.N. Covey. 1988. Plant Molecular Biology. Blackie& Sons. Ltd. Glasgow.

Reference Books:

1. Lycett, G.W. and D. Grierson (Eds) .1990.Genetic Engineering of Crop Plants. Heinemann, London.
2. Chrispeeds, M.J. and D.F. Sadava .1994. Plants, Genes and Agriculture.. Jones and Bartlett, Boston.
3. Mantel. S. H, Mathews. J. A, Mickee. R.A. 1985. An Introduction to Genetic Engineering in Plants. Blackwell Scientific Publishers, London
4. 1. Freshney, E. D.2000. Animal Cell Culture: A practical approach. John Wiley Pub.,New York.
2. Mather, J.P. and Barnes, D. (Eds.). 1998.
5. Animal Cell Culture Methods (Methods in Cell Biology. VOL. 57). Academic Press, London.

SEMESTER – III
ELECTIVE COURSE IV – ENVIRONMENTAL TOXICOLOGY AND MANAGEMENT

Course Code: 18PMB3EC4:1
Hours: 5
Credit: 5

Total Marks: 100
External Marks: 75
Internal Marks: 25

Objectives

- To understand the human impacts on the ecosystems
- To learn the role of toxic substances and their nexus on environment
- To know the EIA, EIS & EMP details and basic concept of environmental management

Unit I – Introduction of environmental toxicology

Brief details about air, water, soil and noise pollution - sources, measurement, indices and mitigation. Toxic chemicals in the environment - air, water & their effects. Impact of anthropogenic activity.

Unit II – Toxic materials and their impacts

Pesticides in water, Biochemicals aspects of arsenic, cadmium, lead mercury, carbon monoxide, ozone and PAN pesticide. Mode of entry of toxic substance, biotransformation of xenobiotics, detoxification, bioleaching, Carcinogens in air, chemical carcinogenicity, mechanism of carcinogenicity, Environmental carcinogenicity testing.

Unit III – Toxic chemicals vs Eco-health

Insecticides, MIC effects. Concept of major, trace and Rare Earth Element (REE)- possible effects of imbalance of some trace elements. Biogeochemical factors in environmental health. Epidemiological issues goiter, fluorosis, arsenic poisoning.

Unit IV – Introduction of environmental management

Introduction and scope of environmental management, basic concepts of sustainable development, industrial ecology and recycling industry. Role of natural products and bio-diversity in international trade, fundamentals of fossil fuels use, energy production and trade, energy balance and energy audit. Eco-marketing.

Unit V – EIA, EIS and EMP

Environmental Impact Assessment (EIA), general guidelines for the preparation of environmental impact statement (EIS), scope and types of environmental audit, cost benefit analysis, environmental management plan (EMP), international organization for standardization (ISO), ISO 14000 standards and certification, environmental clearance for establishing industry, environmental safety, risk management and emergency preparedness, international summit and treaties, important dates dedicated to environmental management.

Text Book:

1. Stake, M. Y. Mido, M.S. Sethi, S.A. Iqbal, H. Yasuhisa, S. Taguchi (1997) environmental Toxicology, Discovery publishing house, New Delhi.

Reference Books:

1. Casseret, L. J and Doull, J (1982) Toxicology. The basic science of Poisons. Macmillan publishers, New York.
2. De, A. K. (1986) Environmental Chemistry, Willey Eastern Limited, New Delhi.
3. Timbrel (1989) Elements Toxicology, British Council Library.
4. Trivedy, R. K (1994) Encyclopaedia of Environmental Pollution and Control. Enviromedia publications, Karad.
5. Munn, R. E. (1982) Environmental Impact Assessment. McGraw-Hill, New York.

SEMESTER – III
ELECTIVE COURSE IV – ADVANCED MICROBIAL TAXONOMY

Course Code: 18PMB3EC4:2
Hours: 5
Credit: 5

Total Marks: 100
External Marks: 75
Internal Marks: 25

Objectives

- To learn the basic knowledge about microbial taxonomy and phylogeny
- To gain the knowledge about advanced microbial identification studies

Unit I – Introduction of 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 – Ribosomal 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 – ClastalW, 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:

1. Sandy B Primrose and Richard M Twyman. Principles of Genome Analysis and Genomics, Blackwell Publishing, USA. 2005.

Reference Books:

1. Anna Tromontano. Introduction to Bioinformatics, CRC Press, Florida, USA. 2002.
2. Baxavanis and Oullette. Bioinformatics. A practical Guide to the Analysis of gene and proteins, 3rd edition. John Wiley and Sons, New York. 2005.
3. Brendan Wren and Nick Dorrell. Functional Microbial Genomics (Volume 33) (Methods in Microbiology), Academic Press, UK. 2002.
4. Higgins. Bioinformatics: Sequence structure and data banks: A practical approach, Blackwell Publishers, UK. 2005.
5. Perry JJ, Staley JT and Lory S. Microbial Life. Sinauer Associates, Publishers, Sunderland, Massachusetts. 2002.
6. 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.
7. Roderic DM Page and Edward C Holmes. Molecular Evolution: A Phylogenetic Approach. Blackwell publishing, USA. 1998.

SEMESTER – IV
CORE COURSE IX – BIOPRODUCTS TECHNOLOGY

Course Code: 18PMB4CC9
Hours: 5
Credit: 5

Total Marks: 100
External Marks: 75
Internal Marks: 25

Objectives

- To study the industrial important microorganisms and their large scale productions
- To learn the fermentation (FMN) technology and applied this to both large and small scale level
- To learn the up-stream and down-stream process of FMN
- To learn the production of bioproducts through fermentation method by fermenter

Unit I - Introduction

Basics of Industrial Microbiology: Historical account of microbes in industrial microbiology; sources and characters of industrially important microbes; their isolation, purification and maintenance; Screening of useful strains; primary screening and secondary screening; Strain improvement through random mutation and genetic engineering.

Unit II - Fermenters

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 – An overview of up-stream and down-stream process.

Unit III - Fermentations

Fermentation in batch, fed-batch and continuous culture: Microbial growth kinetics, measurement of growth (cell number, direct and indirect methods) growth and nutrient, growth and product formation, heat evolution, effect of environment (temperature, pH, high nutrient concentration) media formulation. Sterilization, kinetics of thermal death of micro-organisms, batch and continuous sterilization. (All in relation to fermentation).

Unit IV - Fermented Microbial products I

Fermented Microbial products: Microbial production of Primary and secondary metabolites. Commercial production of antibiotics with special reference to penicillin and streptomycin. Large scale production of recombinant molecules interferon, insulin and vaccines.

Unit V - Fermented Microbial products II

Fermented Microbial products: Microbiology and production of alcoholic beverages; Commercial production of citric and gluconic acids; Commercial production of important amino acids (glutamic acid and lysine) and vitamin (riboflavin), enzymes (amylase and proteases) and biopolymer (bioplastics).

Text Book:

1. Waites, M.J., Morgan, N.L., Rockey, J.S. and Higton, G. (2002). Industrial Microbiology: An Introduction. Blackwell Science Publishers.

Reference Books:

1. Nduka Okafor (2007). Modern Industrial Microbiology and Biotechnology. 1st Edition: Science Publishers.
2. Stanbury, P.F., Whitaker, A. and Hall, S.J. Principles of Fermentation Technology, Pergamon Press.
3. Demain, A.L. and Davies, J.E. (1999). Manual of Industrial Microbiology and Biotechnology. ASM Press.
4. Principles of Fermentation Technology by P.F. Stanbury, W. Whitaker & S.J. Hall, Aditya Books (P) Ltd., New Delhi, 1997.
5. Richard H. Baltz, Julian E. Davies, and Arnold L. Demain (2010). Manual of Industrial Microbiology and Biotechnology. 3rd Edition, ASM Press.

SEMESTER – IV
CORE COURSE X – ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

Course Code: 18PMB4CC10
Hours: 5
Credit: 5

Total Marks: 100
External Marks: 75
Internal Marks: 25

Objectives

- To understand the role of microbes in soil and agricultural environment
- To know about the bio-inoculants
- To study the soil, aquatic and air microorganisms and its applications

Unit I – Microbial ecology

Microbial ecology: Interaction between abiotic and biotic factors in an ecosystem, ecological niche, limiting factor, concept of community, fluctuation and succession. Ecological pyramid, energy flow, food chain, food webs and their dynamism, stability and complexity of ecosystem. Interactions between microbes: commensalism, mutualism, parasitism and predation with examples. Microbial communities: Microenvironment and niche, communities in soil, water, air. Biofilms, microbial mats and their significance.

Unit II – Air and Aquatic microbiology

Aerobiology- Significance of air microflora - Microbial air pollution- sources. Enumeration of bacteria from air, Air sampling devices - Airborne diseases (Bacteria) - Air sanitation.

Aquatic Microbiology: The aquatic environment - major environmental conditions influencing microflora. Distribution of microorganisms in the aquatic environments - freshwater environment, estuaries and marine environment. Microbiology of drinking water, water pollution, purification of water for human consumption. Assessment of microbial status in water and waste water. Waste water treatment.

Unit III – Soil and plant microbiology

Soil Microbiology: Roles of microbes in biogeochemical cycles – carbon, nitrogen, phosphorus, sulphur. Soil microbes and fertility of soil. Nitrogen fixation: Biochemistry of Nitrogen fixation - mechanism of nitrogenase - hydrogenase - Assay of nitrogen fixation - physiology of legume root nodule, leghaemoglobin - Synthesis, Genes involved in nitrogen fixation.

Unit IV – Waste management and bioremediation

Recycling of Liquid and Solid wastes: Composting - Solid waste treatment - saccharification and pyrolysis. Liquid waste treatment. Bioremediation: Factors affecting the bioremediation process, Bioremediation of toxic waste sites; Role of microbes; Microbial degradation of environmental pollutants- industrial solvents, pesticides, petroleum hydrocarbons, xenobiotics; Bioremediation practices and technologies.

Unit V – Bio-inoculants

Biofertilizers: Bacterial bio fertilizer: *Rhizobium*, *Azotobacter*- *Azopirillum*, *Acetobacter diazotrophicus* - phosphobacteria and Frankia. PSM. Algal fertilizer - Blue green algae, Azolla – Importance. Fungal fertilizers - Mycorrhizae – ecto and endomycorrhiza. Biopesticides – Bioinsecticides.

Text Book:

1. Mohapatra P. K. Textbook of Environmental Microbiology. IK International Pvt. Ltd.

Reference Books:

1. Atlas Ronald, M., Bartha, and Richard (1987). Microbial Ecology 2nd Edition. Cummings Publishing Company.
2. Dirk, J. Elsas, V., Trevors, J.T., Wellington, E.M.H. (1997). Modern Soil Microbiology, Marcel Dekker INC, NY
3. Mitchel, R. (1992). Environmental Microbiology. Wiley – John Wiley and Sons. New York.
4. Prabhakaran, G. 2004. Introduction to Soil and Agricultural Microbiology, Himalaya Publishing House.
5. George N. Agrios. 2005. Plant Pathology. 5th Edition. Academic Press.
6. Hand Book Of Biofertilizers & Vermiculture, Engineers India Research Inc., Jan (2007)-332 pages.
7. Raina M. Maier, Ian A. Pepper and Charles Gerba (2009) Environmental Microbiology. Academic Press.

SEMESTER – IV
CORE PRACTICAL IV – BIOPRODUCTS TECHNOLOGY & ENVIRONMENTAL AND
AGRICULTURAL MICROBIOLOGY

Course Code: 18PMB4CP4
Hours: 8
Credit: 4

Total Marks: 100
External Marks: 60
Internal Marks: 40

Objectives

- To learn principles, functions and simple operating procedures of fermentation techniques
- To know what types of microorganisms are found in air, terrestrial and aquatic environments
- To provide a sound background in microbial processes and their applications in agriculture
- To provide information on ecological relationship among soil microorganisms

Bioproducts technology

1. Immobilization technique (sodium alginate method)
2. Production, quantification, extraction and characterization of followings: Alcohol, Citric acid and Amylase
3. Design of various types of fermentors & bioreactors
4. Production of ethanol & wine from grapes and wheat flour

Environmental, Agricultural and Soil Microbiology

1. Isolation of Rhizobium from legume nodule, cyanobacteria from water, fungi from molting leaves and *Xanthomonas malvacearum* from infected cotton plants
2. Mycorrhizae in infected plant root
3. Water analysis by MPN technique
4. Microbial assessment of air quality – open plate method and air sampler-technique
5. Isolation and counting of faecal bacteria from water and soil
6. Soil Analysis – Physiochemical analysis
7. Cellulase reduction test

Text Book:

1. Demain, A.L. and Davies, J.E. (1999). Manual of Industrial Microbiology and Biotechnology. ASM Press

Reference Books:

1. Ward, O.P. 1989. Fermentation Biotechnology: Principles, Processes and products. Prentice Hall Engle wood Cliff..
2. Peppier, H,J and Prelman, D.1979. Microbial tech & Fermentation tech.. Vol.1 and II. Academic Press. NY.
3. Rangaswamy, G. and Bagyaraj, D.J. (2001). Agricultural Microbiology, 2nd Ed. Prentice Hall of India Pvt. Ltd.
4. Russell F. Bey. (2001). Microbiology Laboratory Manual, BROOKS/COLE, Australia. Schaechter, M. Medoff, G. and
5. Subba Rao, N.S. (2002). Soil Microbiology, 4th Ed. (soil Microorganisms and plant growth), Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

SEMESTER – IV
ELECTIVE COURSE V – MARINE MICROBIOLOGY

Course Code: 18PMB4EC5:1
Hours: 5
Credit: 4

Total Marks: 100
External Marks: 75
Internal Marks: 25

Objectives

- To understand the microorganisms role in coastal zone environment
- To learn the marine microbial products and their negative impacts on living things
- To provide the knowledge about microbial interactions in marine environment

Unit I - Introduction of Microbial Oceanography

Introduction to Microbial Oceanography – marine ecosystem: benthic & littoral zone, saltpan, mangroves, sea grasses and estuarine microbes, microbial loop - marine microbial communities - phytoplankton, protozoa, bacteria, fungi, and virus. Microbial endosymbionts – epiphytes - coral-microbial association, sponge-microbial association.

Unit II – Dynamics of Marine Microbes

Dynamics of Marine Microbes - Carbon cycle: Phototrophic microbes, the oceanic carbonate system and global warming - Nitrogen cycle: Nitrogen fixers – Iron limitation – ocean fertilization - phosphorus cycle; Decomposition of organic matter; Bioleaching and biodeterioration of natural and synthetic materials. Algal blooms.

Unit III – Microbial Products

Microbial products: Microbial interaction Microbes of Biotechnological importance; Primary and secondary metabolites - enzymes, antibiotics, organic acid, toxins, biosurfactants and pigments.

Unit IV – Microbes of extreme environments

Microbes of extreme environments – mechanism of extremophiles – halophiles – halorhodopsin – deep sea microbes – microbes of hydrothermal vents - thermophilic, alkalophilic, asomophilic and barophilic, psychrophilic microorganisms – hyperthermophiles and halophiles – importance in biotechnology.

Unit V – Seafood Microbiology

Seafood microbiology - normal genera associated with fish, food spoilage, fish & human pathogens; zoonotics – Brief account on aquaculture pathogens - Vibriosis – shrimp diseases – WSSV – MBV etc. Rapid diagnosis of contamination in sea foods and aquaculture products.

Text Book:

1. James W. Nybakker (2001). Marine Biology, Benjamin Cummings

Reference Books:

1. Rheinheimer, G., 1980. Aquatic Microbiology, Johnwiley & Sons, pp. 235.
2. Elay, A.R.1992. Microbial food poisoning. Chapman and Hall, London, 191 pp.
3. Ford, T.E., 1993. Aquatic microbiology. An ecological approach. Blackwell scientificpublications,London, 518 pp.
4. Krichman, D.L., 2000. Microbial ecology of the oceans. Wiley – liss, New york, 542 pp
5. Bhakuni, D.S. and Rawat, D.S. (2005). Bioactive marine natural products. Anamaya Publishers, New Delhi.
6. Joseph Selvin and A. S. Ninawe (2009). Shrimp Disease Management. ANE Publishers
7. James W. Nybakker (2001). Marine Biology, Benjamin Cummings
8. Bhakuni, D.S. and Rawat, D.S. (2005). Bioactive marine natural products. Anamaya Publishers, New Delhi.
9. Shimshon Belkin and Rita R. Colwell (2005). Ocean and Health: Pathogens in the marine environment. Springer.

SEMESTER – IV
ELECTIVE COURSE V – CLINICAL LABORATORY TECHNOLOGY

Course Code: 18PMB4EC5:2

Hours: 5

Credit: 4

Total Marks: 100

External Marks: 75

Internal Marks: 25

Objectives

- To learn the basic knowledge about microbial taxonomy and phylogeny
- To gain the knowledge about advanced microbial identification studies

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:

1. Barbara H Estridge and Anna P Reynolds. Basic clinical laboratory techniques 5th edition, Cengage learning publisher. 2011.

Reference Books:

1. Rafi MD. Textbook of Biochemistry for medical students, 2nd edition, Universities Press, Pvt. Ltd, Hyderabad, India. 2014.
2. Ramnik Sood. Medical lab technology (methods and interpretations-sets of 2vols), Jaypee brothers. 2009.
3. Kanai L Mukherjee. Medical laboratory technology (Procedure manual for routine diagnostic tests-Vol: 1), McGraw Hill Education India Pvt. Ltd. 2010.
4. Robert H Carman. Handbook of CMAI medical laboratory technology-3rd edition), Christian medical association of India. 2011.
5. Ramnik Sood. Concise book of medical laboratory technology (methods and interpretations-2nd edition). Jaypee brothers. 2014.
6. Medical Laboratory technician URL: <http://libguides.mercyhurst.edu/content-mobile>
7. Clinical laboratory international. URL: <http://get free books. tradepub. com/free/cli/?p=cli content-mobile>.