

JAMAL MOHAMED COLLEGE (*Autonomous*)
College with Potential for Excellence
Re-accredited (3rd Cycle) with 'A' Grade by NAAC
(Affiliated to Bharathidasan University)
Tiruchirappalli – 620 020



Since 1951

**P.G. & RESEARCH DEPARTMENT
OF MICROBIOLOGY**

**CHOICE BASED CREDIT SYSTEM
(2017 - 2018)**

M.Sc. MICROBIOLOGY-2017-2018

SEM	COURSE CODE	COURSE	COURSE TITLE	HRS/ WEEK	CREDIT	MARKS		TOTAL MARKS
						Internal	External	
I	17PMB1C1	Core I	Fundamentals of Microbiology	6	5	25	75	100
	17PMB1C2	Core II	Microbial Physiology and Cell biology	6	5	25	75	100
	17PMB1C3	Core III	General Biochemistry	6	4	25	75	100
	17PMB1C4P	Core IV	Fundamentals of Microbiology, Microbial Physiology and Cell Biology and General Biochemistry Practical	6	4	20	80	100
	17PMB1CE1	Core Based Elective -I	Any one from list	6	4	25	75	100
TOTAL				30	22	120	380	500
II	17PMB2C5	Core V	Microbial Genetics and Molecular Biology	6	5	25	75	100
	17PMB2C6	Core VI	Microbial Biotechnology	6	5	25	75	100
	17PMB2C7	Core VII	Environmental and Agricultural Microbiology	6	4	25	75	100
	17PMB2C8P	Core VIII	Microbial Genetics and Molecular biology, Microbial Biotechnology, Environmental and Agricultural Microbiology Practical	6	4	20	80	100
	17PMB2CE2	Core Based Elective –II	Any one from list	6	4	25	75	100
TOTAL				30	22	120	380	500
III	17PMB3C9	Core IX	Medical Microbiology	6	5	25	75	100
	17PMB3C10	Core X	Immunology	6	5	25	75	100
	17PMB3C11	Core XI	Bioenergetics and Enzymology	6	4	25	75	100
	17PMB3C12P	Core XII	Medical Microbiology, Immunology, Bioenergetics and Enzymology Practical	6	4	20	80	100
	17PMB3CE3	Core Based Elective – III	Any one from list	6	4	25	75	100
	17PMB3EC1	Extra Credit -I	Cyanobacteriology	-	5*	-	100*	100*
TOTAL				30	22	120	380	500
IV	17PMB4C13	Core XIII	Fermentation Technology	6	5	25	75	100
	17PMB4C14	Core XIV	Food and dairy Microbiology	6	5	25	75	100
	17PMB 4C15	Core XV	Biostatistics and Bioinformatics	6	5	25	75	100
	17PMB4PW	Project Work	Dissertation	12	9	50	150	200
	17PMB4EC2	Extra Credit II	Microbial products and Quality Control	-	5*	-	100*	100*
TOTAL				30	24	125	375	500
GRAND TOTAL				120	90	485	1515	2000

*Not considered for Grand total and CGPA

**Core based Elective

Semester	Course Title
I	1. Virology 2. Bioinstrumentation and Bioethics
II	1. Drug Discovery and Design 2. Marine Microbiology
III	1. Microbial Ecology 2. Microbial Taxonomy and Phylogeny

SEMESTER I: CORE I

FUNDAMENTALS OF MICROBIOLOGY

Course Code : 17PMB1C1

Hours/Week : 6

Credit : 5

Max marks : 100

Internal Marks : 25

External Marks: 75

Objectives:

1. To understand the origin of life
2. To explain taxonomy and classification
3. To differentiate prokaryotes and Eucaryotes.

UNIT I

18 hours

Microbial origin and evolution: Origin of Life –theories of origin of life -fossil evidence- Introduction to Evolution. Mechanism- the process of evolution-micro evolution-speciation-macro evolution. Evidence of evolution. Evolutionary theory-Lamarckism-Darwinism and natural selection. Neo Darwinism- #History and developments on Microbiology#.

UNIT II:

18 hours

Microbial system and Taxonomy: Various criteria used in bacterial classification:- classical characteristics morphological characteristics, physiological and metabolic characteristics, ecological characteristics and genetic analysis. Molecular characteristics- comparison of proteins, nucleic acid base composition. Microbial kingdom concept-two, three, four, five, #six and eight# Outline of Bergey's manual of systemtic bacteriology

UNIT III

18 hours

Diversity of Prokaryotes : General characteristics, Structure and Reproduction of Eubacteria, Archaeobacteria, #Mycoplasma# Actinomycetes, Rickettsiae, Chlamydiae, Spirochaete. Cyanobacteria- General characteristics and classification and structure

UNIT IV

18 hours

Kingdom Fungi: History of mycology. General characteristics,habit,habitates and mode of nutrition. Outline Classification of Fungi by Alexopoulos (1979). Heterokaryon-Dimorphic fungi and imperfecti fungi. Cell wall of fungi. Lifecycle of fungi- sexual and parasexuality- Spore release, dispersal dormancy and germination. cellular structure and growth requirements. #fungi symbiont's#. Fungi as food and mushroom poisoning. Hyphae vs yeast forms and their significance.

UNIT V

18 hours

Kingdom Algae: General characteristics- Habit and habitat of algae. Classifications of algae by Smith (1955). Nuclear Organization- Nature of Cell Wall - Pigmentation and Photosynthetic Apparatus- #Reserve Food- Flagellation#. Reproduction and characteristics of Algae Chlorophyta (Green algae), Diatoms, Rhodophyta (Redalgae).

#--#Self study

Text Books

1. Alexopoulos, C.J and Mims, C.W. Introductory Mycology (4th edition). Wiley East Ltd., New Delhi, 1988.
2. Cappuccino, J.G. and Sharman, N. Microbiology: A laboratory Manual (4th edition) Benjamin/Cummings Publication Company, California,1996.
3. Dubey, R.C and Maheshwari,D.K. A Textbook of Microbiology, S.Chand & Co. Ltd. NewDelhi, 2000.
4. Lansing, M. Prescott, John Harley, P. and Donald Klein, A. Microbiology, Wm.C.Brown Publishers, Dubuque, USA, 1990
5. Michael,J Pelczar Jr, MJ. Chan, E.C.S. and Kreig, N.R. Microbiology, McGraw Hill. Inc, New York, 1986.

Books for Reference

1. Holt. J.S. Kreig, N.R., Sneath, P.H.A and Williams, S.T. Bergey's Manual of Systematic Bacteriology (9th edition), Williams and Wilkins, Baltimore,1994.
2. John L. Ingraham and Catherine Ingraham, A. Introduction to Microbiology (3rd edition). Thomson Brooks/cole publication, 2004.
3. John Webster. Introduction to Fungi (2nd edition).Cambridge University press, Cambridge, 1993.
4. Michael, Madigan, T. John and Martinko, M. Brock Biology of microorganisms (11th edition) Pearson Education international, USA,2006.
5. Nester, E.W. Roberts, C.V. and Nester, M.T. Microbiology, A human perspective. IWOA, USA, 1995.
6. Tortora, G. J. Funke B.R and Case, C. L . Microbiology an Introduction (8th edition). LPE-Pearson Education, Inc, 2005.

Books for Study

UNIT I	Text Book 1	Chapter 1& 2
UNIT II	Text Book 2	Chapter 4
UNIT III	Text Book 3	Chapter 3
UNIT IV	Text Book 4	Chapter 13-16
UNIT V	Text Book 5	Chapter 2& 5, 6- 9 & 22

SEMESTER I: CORE II
MICROBIAL PHYSIOLOGY AND CELL BIOLOGY

Course Code : 17PMB 1C2

Hours/Week : 6

Credit : 5

Objectives:

Max Marks : 100

Internal Marks: 25

External Marks: 75

1. To understand the function of internal organelles
2. To provide knowledge on microbial growth and metabolism.
3. To Know the physiological regulation.

UNIT I

18 hours

Ultra structure of Eubacteria and Archae bacteria: Cell theory- types and structure of cell wall, Plasma membrane, outer membrane, Mitochondria, Chloroplast, Golgi complex, PHB, Gas vesicles, Ribosome, Endoplasmic reticulum, Nucl. pili, fimbriae and Microtubules and Flagella-chemotaxis and Quorum sensing. Endospore and Sporogenesis.

UNIT II

18 hours

Microbial Growth: Microbial Nutrition-autotroph, phototroph, heterotroph, Organotroph, lithotrophs and Winogradsky column. Nutrient Transport mechanisms- uniport, symport and antiports- active, passive, facilitated diffusions and group translocation-Siderophore in Iron transport. Phases of growth- Synchronous growth, diauxic growth and continuous growth. #Factors affecting microbial growth# Cell division-mechanisms involved in formation of Z-ring. Sporulation and vegetative cell formation in *Bacillus* sp.

UNIT III

18 hours

Microbial metabolism: Carbon assimilation- oxygenic and anoxygenic photosynthesis- Calvin cycle. Metabolism: catabolism- Fermentation and Respiration-EMP pathway-Pasture effect, ED pathway, Glyoxalate pathway, Krebs cycle. Anabolism- Gluconeogenesis and #reverse TCA cycle#.

UNIT IV

18 hours

Microbial pigments: Brief account of photosynthetic and accessory pigments. Fluorescences and phosphorescences in bacteria. #bacteriochlorophyll, # rhodopsin, carotenoids, phycobiliproteins, Pulcherrimin, indigoidin, voalecin. Defensive role of pigments. Bioluminescence mechanism – advantages. Electron carriers – artificial electron donors – inhibitors – uncouplers – energy bond – phosphorylation.

UNIT V

18 hours

Extremophiles physiology: Effect of oxygen toxicity, pH, osmotic pressure, heat shock on bacteria Adaptations in thermophiles, halophiles, alkaliphiles, acidophiles. Osmolarity porin regulation (Omp system) and Pho system in *E.coli*. #Extremophiles- adaptations & significance in biotechnology#

#--#Self study

Text Books

1. Murray R.K. Granner M.D., Mayes P.A. and Rodwell V.W. Biochemistry – Prentice Hall International Inc., London.1990
2. Stryer L.. Biochemistry (4th edn.) W.H.Freeman and company, New York. 1995
3. Madigan, M.T., Mrtinko, J.M. and Parker,J. Brock Biology of Microbiology (9edition). Prentice Hall International, USA.2000
4. Moat A .G., Foster, J. W. and Spector, M.P. Microbial Physiology, (4th edition): Wiley Publication, India. 2009
5. Pelczar M.J.R., Chan, E.C.S. and Kreig, N.R. Microbiology, McGraw Hill. Inc. New York, 1993.
6. Prescott, L.M., Harley, J.P. and AKlein, D. Microbiology (7th edition).Mc Grow Hill, 2007

Books for Reference

1. Caldwell, D.R. Microbial Physiology and metabolism, Wm. C. Brown Publishers, (USA edition). LPE-Pearson Education, Inc,1995
2. John L. Ingraham and Catherine A. Ingraham. Introduction to Microbiology (3rd edition).Thomson Brooks/cole publication, 2004.
3. Gottychalk, G. Bacterial Metabolism (2nd edition) Springer - Verlag, Berlin. Hissar, Agricultural University, Prentice Hall of India Pvt. Ltd., Delhi, 1986.
4. Doelle,H.W.Bacterial Metabolism(2nd edition)Academic press,Elsevier Publication, New Delhi, India.2005.

Books for Study

UNIT I	Text Book 1	Chapter 3
UNIT II	Text Book2	Chapter 8
UNIT III	Text Book 3	Chapter 5&6
UNIT IV	Text Book 4	Chapter 2
UNIT V	Text Book 5,6	Chapter 9,12

SEMESTER I: CORE III
GENERAL BIOCHEMISTRY

Course Code : 17PMB 1C3
Hours/Week : 6
Credit : 4

Max Marks : 100
Internal Marks: 25
External Marks: 75

Objectives

1. To provide an overview on microbial molecules and their metabolism

UNIT I

18Hours

Foundation of Biochemistry: The chemical unity of diverse living organisms, composition of living matter. Macromolecules and their monomeric subunits. Structure of atoms. Principles and types of Chemical Bonding. Properties of water, Acids and Bases. Bond strength and interaction between biomolecules.[#] Basic concept on pH, pKa value and buffer[#]

UNIT II

18 hours

Carbohydrates and Proteins: Properties and classification- Monosaccharides – isomerism and anomerism. Disaccharides and Polysaccharides- [#]Structures of starch and glycogen[#]. **Protein-**properties of aminoacids. Classification of proteins. Structure of Protein-primary, secondary, tertiary and quaternary structure.

UNIT III

18 hours

Lipid and Nuclie acids :Biological importance and classification of Lipids. Properties and types of Fats and fatty acid - β -oxidation. Biosynthesis of cholesterol. **Nucleic acid** biosynthesis and degradation (de novo and salvage path way)

UNIT IV

18 hours

Vitamins and Hormones: Definition, structure, properties and classification of vitamins- fat soluble vitamins-vitamin A, D, E and K; water soluble vitamins B12, B2, B6 group and vitamin-C. Microbial assay of vitamins and amino acids. Coenzyme activity of vitamins. Protein and peptide hormones – auxin, [#]gibberellins[#] and abscisic acid.

UNIT V

18 hours

Bio signaling: Molecular mechanism of signal transduction-gated ion channel, cell surface receptor and hormones. Signaling through G protein coupled receptor and second messengers. Protein kinase in signal transduction. Regulation of signaling pathways and [#]programmed cell death[#].

#---#Self study

Text Books

1. Prescott, L.M., Harley, J.P. and AKlein, D. Microbiology (7th edition).Mc Grow Hill, 2007
2. Microbiology, M.S. Pelczar, R.D. Reid, E.C.S. Chan, Mc Graw Hill, New York (1986)
3. General Microbiology (5th Edition), R.Y. Stanier, Prentice Hall (1986)
4. Principles of Biochemistry – Lehninger – CBS Publishers.

Books for Reference

1. Stryer L. Biochemistry (4th edn.) W.H.Freeman and company, New York. 1995

Books for Study

UNIT I	Text Book 1	Chapter 40
UNIT II	Text Book 2	Chapter 8
UNIT III	Text Book 3	Chapter 5-10
UNIT IV	Text Book 4	Chapter 10-15
UNIT V	Text Book 4	Chapter 20-25

SEMESTER I: CORE IV

FUNDAMANTALS OF MICROBIOLOGY, MICROBIAL PHYSIOLOGY AND CELL BIOLOGY AND GENERAL BIOCHEMISTRY- PRACTICAL

Course Code : 17PMB 1C4P

Max Marks : 100

Hours/Week : 6

Internal Marks : 20

Credit : 4

External Marks: 80

Objectives:

1. To learn the principles and methodology for isolation and biochemical characterization of microorganism
2. To know the concepts pertaining to Biomolecules estimation

FUNDAMANTALS OF MICROBIOLOGY

1. Enumeration of Bacteria and Fungi- Viable plate count.
2. Pure culture techniques- Streak plate method
3. Measurement of size of microbes - micrometry method.
4. Motility determination - Hanging drop method and stab method
5. Staining methods- Gram staining, Acid fast, Endospore, PHB and Capsule staining.

MICROBIAL PHYSIOLOGY AND CELL BIOLOGY

6. Measurement of growth curve- Direct and indirect methods.
7. Effect of pH and Temperature on microbial growth.
8. Biochemical tests: IMVIC, Catalase, Oxidase, TSI test, Gelatin, casein, starch Hydrolysis, and Urease test.

BIOMOLECULES

9. Acid base Titration and PKa determination
10. Estimation of total and reducing sugar
11. Separation of amino acid by Thin layer chromatography
12. Total protein estimation – Lowery *et al* method

Practical manuals

1. Aneja, K.R. Experiments in Microbiology, Plant pathology and Biochemistry (4th edition) New age International publishers, India, 2003.
2. Cappuccino and James, G. Microbiology a laboratory manual, Addison Wesley Publishing Company Inc. (4th edition) England, California. 1996.
3. Wilson K. Walker. Practical Biochemistry, Principles and Techniques, Cambridge University Press, 1995.
4. Jayaraman J. Laboratory Manual in Biochemistry 2nd edn Newage publication. 2011

**SEMESTER I: CORE BASED ELECTIVE I
VIROLOGY**

Course Code : 17PMB 1CE1

Hours/Week : 6

Credit : 4

Max Marks : 100

Internal Marks: 25

External Marks: 75

Objective: To provide knowledge on Virus life cycle and cultivation

Unit I

18 hours

General Virology: History and brief outline on discovery of viruses, Virus taxonomy, nomenclature and classification. Distinctive properties of viruses; morphology and ultrastructure; capsids and capsomers arrangements; types of envelopes and their composition, #viral genome#, introduction to replication strategies. Virus related agents (viroids, prions).

Unit II

18 hours

General characters and Ultra structure of major plant viruses: Tobamovirus group (TMV); Tymovirus group (Circular mosaic virus); #Tomato spotted wilt virus#, potato virus X, cauliflower mosaic virus, effects of these viruses on plants and various histological and physiological changes induced due to viral infection. Transmission of plant viruses with vectors insects, nematodes, fungi and without vectors (contact, seed and pollens).

Unit III

18 hours

Ultra structure of major human and animal viruses: Adenovirus, Pox virus (DNA containing), Picornavirus, Rota virus, Retrovirus (RNA containing). Mechanism of virus adsorption and entry into host cell including genome replication and mRNA production by animal viruses, mechanism of RNA synthesis, mechanism of DNA synthesis, transcription mechanism and post transcriptional processing, #translation of viral proteins#, assembly, exit and maturation of progeny virions. Oncogenic viruses.

Unit IV

18 hours

Bacteriophages: Morphology, ultrastructure and classification of phages. #one step growth curve and burst size#. life cycle pattern of bacteriophages: T-even phages; filamentous ϕ and μ phage; Bacteriophage typing; structure of Cynophages, Mycophages. General principles of phage-bacterium interaction and growth cycle studies of RNA and DNA phages, The biochemistry of phages infected bacterium. Phage genetics- Lambda and Mu phage.

Unit V

18 hours

Cultivation of viruses: Growth of viruses in embryonated egg, in experimental animals and in cell cultures-primary, secondary, Diploid and continuous cell culture. Susceptible cell lines. Assay of viruses: physical and chemical methods of assay, (protein, nucleic acid, radioactivity tracers, electron microscopy. infectivity assay of animal virus (plaque method, pock counting, end point method) and #infectivity assay of plant viruses#. Biosafety and contaminant facility in virology lab.

---#**Self study**

Text Books

1. Alan J.Cann (1997). Principles of Molecular virology.(2nd edition). Academic press,California.
2. Conrat HF, Kimball PC and Levy JA. (1988). Virology. II edition. Prentice Hall, Englewood Cliff, New Jersey.
3. Dimmock NJ, Primrose SB. (1994) Introduction to Modern Virology IV edition. Blackwell Scientific Publications, Oxford
4. Flint, S.J., Enquist, L.W., Krung, R. Racaniello, VR. and Skalka, A.M. (2000). Principles of Virology,

Books for Reference

1. Nicklin, J. Greame Cook and Killington, R. (2003). Instant Notes in Microbiology.(2nd edition).Viva Books private limited, NewDelhi. India

Books for Study

UNIT I	Text Book 1	Chapter 14
UNIT II	Text Book 2	Chapter 12
UNIT III	Text Book 3	Chapter 5
UNIT IV	Text Book 4	Chapter 10
UNIT V	Text Book 4	Chapter 18

SEMESTER I: CORE BASED ELECTIVE I

BIOINSTRUMENTATION AND BIOETHICS

Course Code : 17PMB 1CE1

Max Marks : 100

Hours/Week : 6

Internal Marks: 25

Credit : 4

External Marks: 75

Objectives:

1. To know the working principles of laboratory instrument
2. Develop and understand the important concepts and principle of bioethics.
3. To present the different theoretical approaches to bioethics applied to the human and animal sphere.

UNIT -I

18 hours

Basic laboratory Instruments: Principles and Applications of Phase contrast and Fluorescence. Electron Microscope- TEM and SEM, Polarized light Microscope, #AFM #and Laser scanning Confocal Microscopy. **Centrifuges:** centrifugal force- sedimentation velocity, sedimentation equilibrium. Principles of preparative and analytical centrifuges. Types of rotors and centrifuges. Low speed, High speed. Types of centrifugation: differential, Ultra centrifuge, density gradient centrifugation (Rate zonal and isopycnic)

UNIT- II

18 hours

Spectrophotometry: Principle and applications of Spectrometry- UV-Visible and atomic absorption and emission Spectroscopy and Flame Photometry. Scintillation counter-types and application. Basic principle and applications of FTIR-NMR-X ray diffraction. #Autoradiography# and its application in biology.

UNIT- III

18 hours

Molecular Techniques: Chromatography-types and application-Gel permeation, Thin layer-HPTLC, nano LC, Column, Ion-exchange, Gas and HPLC. Electrophoresis- AGE, PFGE, isoelectric point and focusing, Capillary electrophoresis, mobility shift electrophoresis and Native PAGE, SDS-PAGE and #two dimensional PAGE. #

UNIT- IV

18 hours

Bioethics: Importance of bioethics-legal and socioeconomic impacts of biotechnology- ethical concerns of biotechnology research and innovation, #Bioethics committees#. **Intellectual property rights:** patent, copyright, trade mark, TRIP- GATT and PBR, WTO. Ethical limits of Animal use and cultural plants. **Biosafety:** GLP - Containment facilities – Bio safety levels - Genetically modified organisms and its release - Genetically modified foods. Biological Safety Cabinets, Primary Containment for Biohazards.

UNIT- V

18 hours

Patent system – patenting laws-Legal development-Patentable subjects and protection in biotechnology.#The patenting of living organisms#. **Human Gene Therapy:** Ethics of Somatic Cell Gene Therapy: Efficiency of treatment; Safety of Transferred Genes; Protecting Human life; Affect on family life; Economic factors.

#--#Self study

Textbooks

1. N.Gurumani (2006).Research Methodology for Biological Sciences. MJP publishing, Chennai.
2. C. R. Kothari. Research Methodology Methods and Techniques, 2nd edition, New Age International Publishers Pvt Ltd, New Delhi, 2004.
3. Rajmohan Joshi. Biosafety and Bioethics. Isha Books, New Delhi, 2006
4. Nancy, S. Jecker., Albert R. Johnson, Robert A. Pearlman. Bioethics: An Introduction to history, methods and practice (1997). Sudbury, M.A.; Jones and Barlett Publishers. Tom, L.
5. Beauchamp., Childress, F. Principles of biomedical ethics, 5th Edition, Oxford Univerisity Press. 2000.

Books for Reference

1. Sasson, A. Biotechnologies in developing countries present and future, UNESCO publishers,1993
2. Keith Wilson John walker . principles and techniques of Practical Biochemistry. 4th edn. Cambridge university press. 1997

Books for Study

UNIT I	Text Book 1	Chapter 1
UNIT II	Text Book 1	Chapter 3
UNIT III	Text Book 2	Chapter 5
UNIT IV	Text Book 2	Chapter 10
UNIT V	Text Book 3	Chapter 5

SEMESTER II: CORE V
MICROBIAL GENETICS AND MOLECULAR BIOLOGY

Course Code : 17PMB 2C5

Hours/Week : 6

Credit : 5

Max Marks : 100

Internal Marks: 25

External Marks: 75

Objectives:

1. To provide key concepts on Gene and DNA
2. To understand the principles on classical and molecular genetics
3. To provide an idea about research on molecular genetics

UNIT I

18 hours

Nucleic Acids: Genome organization of Prokaryotes and Eukaryotes. Structural aspects of Nucleic acid – the double helical model- Various forms of DNA and RNA. hyperchromicity – Nucleic acid as a genetic material-Griffith, Blender jar experiment, Avery experiment, RNA as a genetic material, Beadle and Tatum experiment. Genetic code- general features, wobble hypothesis, #Code is triplet – Molecular evidence#.

UNIT II

18 hours

Maintenance of Genetic Information: DNA replication- basic rules, Semi conservative model- Meselson and Stahl experiment, replication of circular DNA molecule, Discontinuous replication, Bi directional replication, Rolling circle mechanism. DNA damage and repair mechanism-Photo reactivation- Albert Kelner experiment- Mismatch Repair- #Nucleotide Excision Repair#. -recombination repair- SOS repair.

UNIT III

18 hours

Gene transfer mechanisms: Horizontal gene transfer. Transformation process and regulation. Transduction – general and specialized- Lederberg and Zinder experiment. Conjugation– F⁺, F, Hfr and F', triparental mating, self transmissible and mobilizable plasmids and pili. Transposable elements and #retrotransposons types and applications#.

UNIT IV

18 hours

Mutation and their biochemical basis: Mutation and mutagenesis- Definition and types- Spontaneous mutation and induced mutation- substitution, Insertions, Deletions and frameshifts. Mutations genetics of Neurospora sp. Mutagenesis- physical and chemical-UV, alkylators, Base analogs, intercalating agents and mutator genes. Detection, isolation, characterization of mutant and their uses. #Ames test for mutagenicity#.

UNIT V

18 hours

Molecular aspect of gene expression: Organization of Gene and gene expression in Prokaryotes and Eukaryotes- Transcription and translation . Gene rearrangement by RNA splicing. Catalytic RNA. Gene regulation in prokaryotes: Operon concept- Lac, Trp operon and #outline on *ups* operon#. #---#Self study

Text Books

1. Benjamin, L. Gene (4th edition). Oxford Univ. Press, Oxford, 1990.
2. Brown, T.A. Essential Molecular Biology - A Practical approach. Vol-1, Oxford Univ. Press. Oxford, 1991.
3. Freifelder, D. Microbial genetics (2nd edition). Narosa Pub. Home. India, 1990.
4. Gardner, E.J. Principles of Genetcis. John Wiley and Sons Inc. NY, 1991.
5. Primrose, S.B. Principles of Gene Manipulation (4th edition) Black Well Scientific Pub. London, 1989

Books for Reference

1. Desmond, S.T., and Nicholl. An Introduction to genetic Engineering Cambridge Univ. Press. Cambridge, 1994.
2. Lewin B. Genes VII. Oxford University press, 2000.
3. James D. Watson, Tania A. Baker, Stephen P. Bell, and Alexander Gann. Molecular Biology of the Gene (5th edition) The Benjanun/cummmgs Publishing Company Inc. NY, 1987.
4. Rastogi,V.B. Fundamentals of molecular biology. Ane books publication, India.2008.
5. David, J., Ulley and Eckstein, F. Nucleic Acids and Molecular Biology. Vol-6 Springer-verlag Berlin Heidelberg, 1992.
6. Steller, P. and Bianchi, D.E.Cell and molecular biology(3rd edition)Wiley publication.India,2009.
7. Watson, JB., Gflnian, M., Witkowshi, J. and Zoller, M. Recombinant DNA(2nd edition) Scientific American Books, 1992.

Books for Study

UNIT I	Text Book 1	Chapter 5-7
UNIT II	Text Book 2	Chapter 6-9
UNIT III	Text Book 3	Chapter 14
UNIT IV	Text Book 4	Chapter 12
UNIT III	Text Book 5	Chapter 9-13

SEMESTER II: CORE VI
MICROBIAL BIOTECHNOLOGY

Course Code : 17PMB 2C6
Hours/Week : 6
Credit : 5

Max Marks : 100
Internal Marks: 25
External Marks: 75

Objectives

1. To improve the knowledge on recombinant DNA technology and applications in advanced Molecular Biology research.
2. To gain information on tools involved in genetic manipulation of organisms

UNIT I

18 hours

Introduction to Biotechnology: History and achievements. Vectors-properties and classification. Plasmid: types and properties. Structure and application of Bacterial plasmids: ColE1, pBR322 and pUC19. Bacteriophages vectors - M13 vector and Lambda phage vector. Phagemids, Cosmids. Artificial chromosomes - YACs, BACs and [#]HACs[#]. Vector for Streptomyces. Viral vectors used in gene therapy.

UNIT II

18 hours

Enzymes in Biotechnology: application of Restriction enzymes (Type I, II and III). Role of Ligases, Alkaline phosphatase, Polynucleotide kinase, Terminal nucleotidyl transferase, DNA Polymerases, Taq DNA polymerases, RNase, Reverse transcriptase in rDNA technology. Conversion of blunt end by Linkers, Adaptors & [#]Homopolymer tailing[#].

UNIT III

18 hours

Gene manipulation: Safety guidelines of r-DNA research. Transfection- Gene manipulation in animals- Knockout mice and its application, gene transfer in Drosophila, gene transfer in plants and protoplast: Particle bombardment, microinjection, macro injection and T DNA mediated. Gene transfer in Bacteria- physical and chemical methods-Electroporation, CaPO₄ mediated, DEAE, [#]liposomes[#] and DMSO.

UNIT IV

18 hours

rDNA technology: Cloning strategies-Gene Library construction-shotgun cloning and cDNA cloning. Cloning in *Saccharomyces cerevisiae* and other fungi. Screening of recombinants: Insertional inactivation, Blue white selection, positive selection, colony and plaque hybridization. Blotting technique- Southern, Northern and Western blotting. Analyzing DNA –principle of PCR. Types of PCR: inverse PCR, RT PCR, Multiplex-PCR, VNTR PCR, ISSR PCR, Nested PCR, colony PCR and MSP PCR. [#]DNA Microarray analysis[#].

UNIT V

18 hours

rDNA Application – Molecular probes production, labeling and applications[#]. sequencing by chemical and enzymatic method. next generation sequencing. Application of rDNA technology- GMO's, BT cotton, Production of Insulin, human growth hormone and Recombinant Hepatitis vaccine. Expression screening in eukaryotic cells. Introduction to Gene therapy (in vivo & ex vivo), Antisense therapy. DNA finger printing -RFLP, RAPD&[#]AFLP[#]. [#]---[#]Self study

Text Books

1. Glick, B.R. and Pasternak, J.J. . Molecular Biotechnology (2nd edition) ASM press, Washinton DC., 2003.
2. Ghosh, T.K. Bioprocesses, Computation in Biotechnology. Vol-I Euis Harwood NY, 1990.
3. Halvorson, H.O., Pramer, D. and Rogul, M. Engineered Organisms in the Environment. Scientific Issues. American Society for Microbiology, Washington. NY, 1985.
4. Old, R.W. and Primrose, S.B. Principles of Gene Manipulation (4th edition). Black Well Scientific Pub. London, 1989.
5. Rastogi, V.B. Fundamentals of molecular biology. Ane books publication, India. 2008.
6. Wilson, K. and Walker, J. Principles and techniques of biochemistry and molecular biology (6th edition) Cambridge University Press, NY, 2008.

Books for Reference

1. Peppier, H.J. and Prelman, D. Microbial Technology and Fermentation Technology. Vol.1 and II. Academic Press. NY. 1979.
2. Sussman, S.C.H. Coflms, F.H, Skimmer and Stewartful, D.E. The release of genetically engineered microorganisms. Academic Press, London, 1988.
3. Ward, O.P. Fermentation Biotechnology: Principles, Processes and products. Prentice Hall Engle wood Cliffs New Jersey, 1989.
4. Watson, J.B., Gflnian, M., Witkowshi, J. and Zoller, M. Recombinant DNA. (2nd edition). Scientific American Books, 1992.
5. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A and Weiner, A.M. Molecular biology of the gene (4th edition) Benjamin/cummings Publishing Company Inc. NY, 1987.
6. 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

Books for Study

UNIT I	Text Book 1	Chapter 4&5
UNIT II	Text Book 2	Chapter 16
UNIT III	Text Book 3	Chapter 3
UNIT IV	Text Book 4	Chapter 6
UNIT V	Text Book 5,6	Chapter 16,12

SEMESTER II: CORE VII

ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

Course Code : 17PMB 2C7

Max Marks : 100

Hours/Week : 6

Internal Marks: 25

Credit : 4

External Marks:75

Objectives:

1. To understand the vital role and application of microorganisms on soil and agricultural field.
2. To learn the microbial processes on Bioleaching and treatment of waste materials.

UNIT I

18 hours

Soil Microbiology: Soil Microbiology-Structure, Types, Physical and Chemical properties. Weathering and Humus formation, Soil pollution. Soil microbes-Types and Microbial interaction. Outline Biogeochemical cycles-Carbon, nitrogen, oxygen, hydrogen, phosphorous, #sulfur and iron#.

UNIT II

18 hours

Recycling of Liquid and Solid wastes: Characterisation and types of liquid waste management and treatment- Primary, Secondary treatment and Tertiary treatment. Characterization and types of solid waste-solid waste management and treatment- Silage, Pyrolysis and saccarification. #Composting and Biogas process and production#. Bioconversion of Solid Waste and utilization as fertilizer.

UNIT III

18 hours

Environmental Application: #Deterioration of paper, leather#, woods, textiles and pharmaceutical products. Bioaccumulation of heavy metal ions from industrial effluents. Bio degradation of complex polymer-cellulose, hemicelluloses, and lignin. Microbial leaching-copper and uranium. Xenobiotics degradation -Heavy metals, Radionuclides, Recalcitrants and Halogenated compounds. Application of GIS and RS techniques in Environmental Monitoring.

UNIT IV

18 hours

Diazotrophs: Ecology of diazotrophs.. Biological fixation of nitrogen, Nitrogen fixation sites, symbiotic and nonsymbiotic nitrogen fixation. Mechanism of biological nitrogen fixation. Nitrogenase enzyme complex - azoferredoxin and molybdo ferredoxin. Physiological electron donors and mechanism of nitrogen reduction, #regulation of nitrogenase enzyme#. Nif genes and its regulation. Role of hydrogenase enzyme in nitrogen fixation.

UNIT V

18 hours

Bio inoculants: Biofertilizers: Characteristics, Production and application of Rhizobium, Azotobacter, Azospirillum, Phosphate solublizing and mobilizing bacteria #Blue green algae#, Azola and Mycorrhizae. Formulation of biofertilizer. Biopesticides- types, mechanism and application of Bacterial, Fungal and Viral insecticides.

#---#Self study

Text Book

1. Alexander, M. Microbial Ecology. John Wiley and Sons Inc. NY,1971.
2. Atlas R.M and Bartha, R. Microbial Ecology Fundamentals and Application (4th edition) - LPE , pearson Education.Inc, 2005.
3. Baker, K.F. and Cook, R.J. Biological control of plant pathogens. W.H. Freeman and Co, 1974.
4. Dirk J, Elas V, Trevors JT, Wellington, EMH. Modern Soil Microbiology. Marcel Dekker INC, New York, Hong Kong, 1997.
5. Eldowney, S., Hardman, DJ., Waite, DJ.and Waite, S. Pollution: Ecology and Biotreatment. Longman Scientific Technical, 1993.
6. Pelczar M.J.R., Chan, E.C.S. and Kreig, N.R. Microbiology, McGraw Hill. Inc. New York, 1993

Books for Reference

1. Forster, C.F. Biotechnology and Wastewater Treatment. Cambridge Uni. Press. Cambridge, 1985.
2. Grant WD, Long PL. Environmental Microbiology. Blackie Glasgow. London, 1981.
3. Gray, N.F. Biology of waste water Treatment. Oxford University Press Oxford, 1989.
4. Rai, MK. Handbook of Microbial biofertilizers. Food Products Press, New York, 2005.
5. Gareth M. Evans and Judith C Furlong. Environmental Biotechnology Theory and Application, John Wiley and sons Ltd. 2003.

Books for Study

UNIT I	Text Book 1	Chapter 5
UNIT II	Text Book 2	Chapter 7
UNIT III	Text Book 3	Chapter 12
UNIT IV	Text Book 4	Chapter 20
UNIT V	Text Book 5&6	Chapter 16, 12

SEMESTER II: CORE VIII

MICROBIAL GENETICS AND MOLECULAR BIOLOGY, MICROBIAL BIOTECHNOLOGY, ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY PRACTICAL

Course Code : 17PMB 2C8P

Max Marks : 100

Hours/Week : 6

Internal Marks: 20

Credit : 4

External Marks: 80

Objectives

1. To train and develop the skills on Molecular Biology experiments
2. To understand the principles and methodology of experiments on environmental microbiology

MICROBIAL GENETICS AND MOLECULAR BIOLOGY

1. Scoring of mutants through physical agents.
2. Isolation and Characterization of chromosomal DNA
3. Isolation and Characterization of plasmid DNA
4. Principle and separation of protein gel electrophoresis (SDS PAGE).

MICROBIAL BIOTECHNOLOGY

5. Restriction digestion of DNA
6. Isolation of Protoplast and Spheroplast.
7. DNA amplification- PCR analysis
8. Bacterial Transformation-DEMO.

ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

1. Effect of high salt concentration on microbial growth.
2. Determination of oligodynamic action
3. Determination of BOD of polluted / pond water.
4. Determination of COD of polluted / pond water.
5. Assessment of water quality by MPN technique
6. Phosphate solubilization index test
7. Localization of AM fungi colonization
8. Isolation of *Rhizobium* from root nodules of leguminous plant.
9. Isolation of cellulase producing microbes from soil
10. Algae as indicators of water pollution.

Practical manual

1. Laboratory Manual in Bio Chemistry, Jayaraman, New Age International Pub, 2000.
2. Laboratory manual in Biochemistry T.N.Pattabiraman. All India publishers, 1998. 5.
3. Lab Manual in General Microbiology - N Kannan, Palaniappa Brothers, 2000.
4. Aneja, K.R. Experiments in Microbiology, Plant pathology and Biochemistry (4th edition) New age International publishers, India, 2003.
5. Atlas, R.M and Brotha .R. Microbial Ecology Fundamentals and Application (4th edition) - LPE pearson Education.Inc,2005.

**SEMESTER II: CORE BASED ELECTIVE II
DRUG DISCOVERY AND DESIGN**

Course Code : 17PMB 2CE2

Hours/Week : 6

Credit : 4

Max Marks : 100

Internal Marks: 25

External Marks: 75

Objectives

1. To know the basic principles of modern drug design, discovery and development.
2. To gain information on tools involved in genetic manipulation of organisms

UNIT I

18 hours

Regulatory Aspects: Drug Laws, FDA, OECD, ICH, Schedule Y, Design non clinical toxicity studies and clinical development, clinical risk/benefit analysis. Drug registration: Regulatory affairs, WTO, Patent regime, Accreditation and harmonization process. #Regulations of human pharmaceuticals and biological products#.

UNIT II

18 hours

General approach to discovery of new drugs - physiochemical principles of drug action. drug stereo chemistry and drug action - 3D database search – computer aided drug design – Docking - AUTODOCK and other docking software, Scoring Functions, Simple Interaction Energies, GB/SA scoring (implicit solvation), CScore (consensus scoring algorithms). – structure based drug design – pharmacophores – #QSAR#.

UNIT III

18 hours

Drug development process- Impact of genomics and related technologies upon drug discovery: Gene chips, Proteomics, Structural genomics, Chemoinformatics and #Pharmacogenetics#.

UNIT IV

18 hours

Lead pharmaceuticals of natural origin: Anticancer drugs: Taxols, Etoposide, Tenoposide. Cardiovascular drugs: Statins, Teprotide, Dicoumarol. Anti inflammatory drugs: Khellin, Sodium chromoglycate. Drugs affecting CNS: Morphine alkaloids. Antiparasitic drugs: Artemisinin and Quinine. Neuromuscular blocking drugs: Curare alkaloids. #Anti asthmatic drugs: Vasicine#.

UNIT V

18 hours

Biological targets: Pharmoco kinetics and dynamics of ADME properties. DHFR, HMG-CoA Reductase, Phosphodiesterase, ACE, Transpeptidase, β -lactamase. Agents acting on receptors: PPAR, protein kinases. Agents acting on Nucleic acids: #Topoisomerase#, Reverse transcriptase, DNA and RNA polymerase.

#---#Self study

Text Books

1. Povl Krogsgaard-Larsen, Ulf Madsen and Kristian Stromgaard. Textbook of Drug Design and Discovery, Fourth Edition, CRC press, 2009.
2. Thomas J. Dougherty and Steven J. Projan. Microbial Genomics and Drug Discovery, Taylor and Francis, 2003
3. William H, Malick JB “Drug Discovery and Development” Humana Press Clifton.
4. David, B. Weiner and William V. Williams. Biological Approaches to Rational Drug Design (Handbooks in Pharmacology and Toxicology) CRC press, 1994,

Books for Reference

1. Kenneth, M. Merz, Dagmar Ringe and Charles H. Reynolds. Drug Design: Structure- and Ligand-Based Approaches, Cambridge University press, 2010.
2. Tommy Liljefors, Povl Krogsgaard-Larsen and Ulf Madsen. Textbook of Drug Design and Discovery, Third Edition, Taylor and Francis, 2002
3. Gary Wlash, Biopharmaceuticals, Biochemistry and Biotechnology, Wiley. 1998.

Books for Study

UNIT I	Text Book 1	Chapter 4
UNIT II	Text Book 2	Chapter 2-5
UNIT III	Text Book 3	Chapter 6
UNIT IV	Text Book 3	Chapter 12
UNIT V	Text Book 4	Chapter 8

**SEMESTER II: CORE BASED ELECTIVE II
MARINE MICROBIOLOGY**

Course Code : 17PMB 2CE2

Hours/Week : 6

Credit : 4

Max Marks : 100

Internal Marks: 25

External Marks: 75

Objective: To provide basic knowledge on significance of marine environment.

UNIT I

18 hours

Introduction to Oceanography: History of oceanography- origin of oceans- bottom topography, abyssal hills- plains- submarine canyons- ocean trenches. Estuaries- origin and classification estuarine circulations- #estuarine zonation#- lagoons.

UNIT V

18 hours

Marine Institutions: National Institute of Oceanography (Goa), National Institute of Ocean Technology (Chennai), Woods Hole Oceanography Institute (USA). Marine institute of technology japan. Sampling: JZ Bacteriological Bottle, Surface Sample Bottle, Van Dorn Bottle, Wash Bucket, Messengers, ZoBell Bacteriological water sampler, Bottom Corer sediment trap, dredge, Hudson River Sampler, Lux meter, Peterson crab, Plankton net, #Deck Plankton Collector#.

UNIT III

18 hours

Sea as a biological environment: Plankton- classification based on size, mode of life and habitat. Phytoplankton- primary producers and Zooplankton-primary consumers. Adaptation of plankton- structural and physiological mechanism. Phytoplankton and #Zooplankton interrelationship# - microbial loop- red tide phenomenon- causes and effects.

UNIT II

18 hours

Coastal Ecology: shallow and deep sea microorganism - importance and their significance. Diversity of microorganism - Archaea, bacteria, cyanobacteria, algae, fungi, viruses and actinomycetes in the mangroves and #coral environs#.

UNIT IV

18 hours

Marine Biotechnology: Antibiotic, anti-tumour - anti-inflammatory, analgesic, cytotoxic, anti-viral, anti-fouling compounds of marine origin. Marine toxins-saxitoxin, brevetoxin and ciguatoxin. Marine peptides and Alkaloids- pyridoacridine, pyrrolocridine indole and #isoquinoline alkaloids#.

#--#Self study

Text Books

1. Thurman and Harold. Introduction to Oceanography, Prentice Hall Inc. New Jersey, 2001.
2. Tomas and Carmelo R. Identifying Marine Phytoplankton. Academic Press, 1997.
3. Reiheimer G. Aquatic Microbiology. 4th edn, 1991.
4. Prescott L.M., Harley J.P. Klein. Microbiology, WCB, Mc Grow Hill Publications, 1999.
5. James W. Nybakker. Marine Biology, Benjamin Cummings, 2001.
6. Shimshon Belkin and Rita R. Colwell. Ocean and Health: Pathogens in the marine environment. Springer, 2005.

Books for Reference

1. Sverdrup H.U. Johnson M.W. Fleming R.H. The Oceans- their Physics, Chemistry and General Biology, Prentice- Hall Inc. New Jersey, 1958.
2. Raina M. Maier, Ian L. Pepper, Charles, Gerba, P . Environmental Microbiology, Academic press, 2006.
3. Scheper T. Advances in Biochemical Engineering/Biotechnology- Marine Biotechnology, Springer, 2005

Books for Study

UNIT I	Text Book 1,2	Chapter 2,7
UNIT II	Text Book 3	Chapter 1,5
UNIT III	Text Book 4	Chapter 4
UNIT IV	Text Book 5	Chapter 6-8
UNIT V	Text Book 6	Chapter 22, 25

**SEMESTER III: CORE IX
MEDICAL MICROBIOLOGY**

Course Code : 17PMB 3C9
Hours/Week : 6
Credit : 5

Max Marks : 100
Internal Marks: 25
External Marks: 75

Objectives:

1. To learn the pathogenesis and epidemiology of Microbes.
2. To create awareness against Pathogenic Microbes.

UNIT I

18 hours

Fundamentals of Medical Microbiology: Factors responsible for Microbial pathogen – Microbial flora of the human body -Host-parasite interactions-Virulence and virulence factors-Toxigenicity Epidemiology- Prophylaxis- Diagnostics - Molecular Diagnosis (MT-PCR, FISH, Reverse Dot Blot Hybridization & Microchips).Collection of blood, urine, CSF and Swabs (naso and oesopharyngeal)

UNIT II

18 hours

Viral Diseases: Description of the viral infections, Vectors, pathogenesis and laboratory diagnosis of following diseases-Reovirus, Hepatitis A, B and C, Haemophilus influenza, Epstein-Bar virus, Papilloma virus, Varicella Zoster virus, Alpha virus, Rubella virus, Retrovirus, SARS and Swine Flu, Dengue, Ebola and Zika virus. Anti viral drugs and vaccines.

UNIT III

18 hours

Bacterial Diseases : Description of the infection, pathogenesis, laboratory diagnosis and prophylaxis of following diseases -Leptospirosis, *H.pyroli*, Pneumonia, Spotted and typhus fever, enteric fever, Meningitis, Diphtheria, Tuberculosis, Leprosy, Tetanus, Cholera infection and Syphilis. Outline of Bacterial vaccines.

UNIT IV

18 hours

Fungal Disease: Clinical features, laboratory diagnosis and prophylaxis of following infection: Superficial Mycoses: Ring worm, Candidiosis and *Pityriasis versicolor*. Subcutaneous mycoses: Mycetoma, Chromoblastomycosis and Sporotrichosis. Systemic mycoses: Coccidioidomycosis, Histoplasmosis, Blastomycosis and Systemic candidiosis. Fungal keratitis and OHS.

UNIT V

18 hours

Protozoan diseases: Description of the infections and sample collection. Life cycle, laboratory diagnosis and the treatment of following diseases- Plasmodium infection, *Wuchereria bancrofti*, *E.hiastolytica*, Leishmaniasis, Giardiasis, *A.lumbricoides* and Hook worm.

#--#Self study

Text Books

1. David Greenwood, Richard Slack and John Peutherer . Medical Microbiology (15th edition) ChurchHill Living stone Publication, 2000.
2. Anathanarayanan,R and Jayaram Paniker,C.K. Text book of Microbiology (8th edition).University Press,Hyderabad,India. 2009.
3. Dimmock ,N.J., Easton,A.J. and Leppard,K.N. Introduction to Modern Virology, (6th edition) Blackwell Scientific Publications, Australia, 2007.
4. Purohit,S.S.Microbiology:Fundamental and Application(7th edition) Agrobiose publication,Jodhpur,India.2008.
5. Chatterjee. K.D. Medical Parasitology (7th edition) 2005

Books for Reference

1. Baumberg. S., Hunter. I.S. and Rhodes, P.M. Microbial Products -New approaches. Cambridge Univ. Press. Cambridge,1989.
2. Sikyta B. Methods in Industrial Microbiology, Ellis Horwood Limited,1983.
3. Stanbury, P.F. Whitaker, A and Hall,S.J. Principles of Fermentation Technology (7th edition) Elsevier Science limited Aditya Books Private Limited, New Delhi.
4. Jawetz, Melnickand Adelberg's, .Medical Microbiology (22nd edition) McGraw Hill Medical Publication division, 2001.
5. Flint, S.J., Enquist, L.W., Krung, R. Racaniello, V.R. and Skalka. A.M. Principles of Virology, Molecular Biology, Pathogenesis and control, ASM Press, Washinton, 2000.
6. Subhas Chandra Parija . Text book of Medical Parasitology(2nd edition).2004.

Books for Study

UNIT I	Text Book 1	Chapter 2-8
UNIT II	Text Book 2	Chapter 5-10
UNIT III	Text Book 3	Chapter 8
UNIT IV	Text Book 4	Chapter
UNIT V	Text Book 5	Chapter 1-6

**SEMESTER III: CORE X
IMMUNOLOGY**

Course Code : 17PMB 3C10
Hours/Week : 6
Credit : 5

Max Marks : 100
Internal Marks: 25
External Marks: 75

Objectives:

1. To understand the key concepts on the role of immune system and immunological disorders
2. To Practically perform and interpret the Immunological techniques for diagnosis.

UNIT I

18 hours

Elements of Immune system: Properties of Immune system- Innate, adaptive and mucosal immunity. Haematopoiesis-T cell, B cells, NK cells, Monocytes, Macrophages, eosinophils, neutrophils, basophils, mast cell, dendritic cells. Lymphoid organs of immune system. Humoral and cell mediated immunity. Induction of immune response-Cytokines, lymphokines and #chemokines#.

UNIT II

18 hours

Antigens, and Immunoglobulins: Antigens- properties and types. Haptens, adjuvants, #Mitogen (superantigens)#. T dependent and independent antigens. antigenic determinants. Immunogens and chemical nature. Immunoglobulins-structure, properties, types and subtypes. Monoclonal antibody: production and their applications. Tumor antigen and immunotherapy. Complement- Classical, Alternate and Membrane attack pathways

UNIT III

18 hours

Immune cell activation: B-Cell Activation, Differentiation and receptor. T cell- Generation, Activation, Differentiation and receptors. Clonal selection Theory and process.

UNIT IV

18 hours

Regulation of Immune response: MHC genome-Structure, types and function of HLA antigen. MHC antigen processing. History of organ Transplantation and types. HLA typing methods. Graft rejection mechanism. #Graft disease (GVHD)# and immunosuppressive drugs. Autoimmunity -systemic and organ specific. Hypersensitivity-types and mechanism.

UNIT V

18 hours

Immunological techniques: Antigen antibody interaction-Affinity, Avidity and epitope mapping. Theories of Ag-Ab interaction. *In vitro* immunological methods-Neutralization-VDRL and RPR test. Types and application of agglutination-Ascoli test, coombs test and widal test, precipitation-SRID, Ouchterlony, Immunoelectrophoresis- CCIE, RIE. Complement fixation direct and indirect, Viral neutralization test, Immunofluorescent antibody technique. ELISA, Radio immunoassays (RIA) and #Flow cytometry#

#--#Self study

Text Books

1. Benjamin, E., Coico, R. and Sunshine,G. Immunology (5th edition). Wiley Publication, USA. 2003
2. Donal, M. Weir, John Steward. Immunology (8th edition). ELBS, London , 1993.
3. David male, Jonathan Brostoff, Roth, D.B. and Ivan Roitt. Immunology (7th edition) Mosy Elsevier publication,Canada.2006.
4. Topley & Wilson's. Text Book on principles of Bacteriology, Virology and Immunology (8th edition). Edward Arnold, London, .1995.
5. William E. Paul Fundamental Immunology. II edition, Raven press, New York. (1993).

Books for Reference

1. Ivan M. Roit . Essential Immunology – Blackwell Scientific Publications, Oxford, 1994.
2. Kuby J. Immunology (4th edition) – WH Freeman and Company, New York, 2001
3. Richard M. Hyde. Immunology (3rd edition) National Medical series, Williams and Wilkins, Harward Publishing company, 1995.

Books for Study

UNIT I	Text Book 1	Chapter 4
UNIT II	Text Book 2	Chapter 10
UNIT III	Text Book 3	Chapter 25
UNIT IV	Text Book 4	Chapter 8
UNIT V	Text Book 5	Chapter 6

**SEMESTER III: CORE XI
BIOENERGETICS AND ENZYMOLOGY**

Course Code : 17PMB 3C11

Hours/Week : 6

Credit : 4

Max Marks : 100

Internal Marks: 25

External Marks: 75

Objectives:

1. To know the basics on thermodynamics
2. To understand the types and use of enzymes.

UNIT I

18 hours

Energy and Regulation: Introduction to thermodynamics-law of thermodynamics-relation between internal energy & enthalpy, heat capacity, free energy. The concept of Gibbs free Energy, exergonic and endergonic reactions, redox potential. Spontaneous & non spontaneous reactions. Gibbs-Helmholtz equation. Application of first and second law of thermodynamics to biological systems.

UNIT II

18 hours

Energy Conversions - Mitochondria: Chemical activity of mitochondria. Sequence of electron carriers and sites of oxidative phosphorylation, ATP generation, heme and non- heme iron proteins. Thermodynamic considerations, oxidation - reduction electrodes, standard electrode potential, redox couples, phosphate group transfer potential. Respiratory controls. Theories of oxidative phosphorylation, uncouplers and inhibitors of energy transfer.

UNIT III

18 hours

Enzymes and properties : Classification of enzymes into six major groups with suitable examples. Numerical classification of enzymes. Different structural conformations of enzyme proteins. Enzymes as biocatalysts, catalytic power, activation energy, [#]substrate specificity and active site[#]. Monomeric, Oligomeric and multienzyme complex, isozymes and allosteric enzymes. Ribozymes and abzymes.

UNIT IV

18 hours

Mechanism of Enzymes Action: Theories of mechanisms of enzyme action -Enzyme specificity- Active site- Study of Mechanism of enzyme reaction. Pathway of enzyme catalyzed reactions. Enzyme Kinetics. Mechanism of action of lysozyme, chymotrypsin and ribonuclease. [#]Enzyme inhibition[#] and regulation.

UNIT V

18 hours

Enzyme kinetics: Importance of enzyme kinetics, factors affecting rates of enzyme mediated reactions (pH, temperature, substrate concentration, enzyme concentration and reaction time). Derivation of Michaelis - Menton equation and its significance in enzyme kinetic studies. Lineweaver - Burke plot, Haldane-[#]Briggs relationship[#].

[#]---[#]Self study

Text books

1. Shanmugam, S. And Sathiskumar, T. Enzyme Technology. International Pvt Ltd,2009
2. Prescott, L.M, Harley, J.P, Klein, D.A . Microbiology, WCB Mc Graw Hill,1999.
3. Bhatt, S.M. Enzymology and Enzyme Technology. S.Chand Publication,2011.
4. 3. Malcolm Dixon and Edwin Clifford Webb. Enzymes . 3rd Edition Academic Press, New York.
5. Stryer L.(1995). Biochemistry (4th edn.) W.H.Freeman and company, New York.

Books for reference

1. Athel Cornish – Bowden. Principles of Enzyme Kinetics. - Portland press, 2004.
2. Chaplin, M.F. and Bucke, C. Enzyme Technology.Cambridge University press,1990.

Books for Study

UNIT I	Text Book 1	Chapter 6
UNIT II	Text Book 2	Chapter 10
UNIT III	Text Book 3	Chapter 3
UNIT IV	Text Book 4	Chapter 5
UNIT V	Text Book 5	Chapter 14

SEMESTER III: CORE XII
MEDICAL MICROBIOLOGY, IMMUNOLOGY,
BIOENERGETICS AND ENZYMOLOGY- PRACTICAL

Course Code : 17PMB 3C12P

Max Marks : 100

Hours/Week : 6

Internal Marks: 20

Credit : 4

External Marks: 80

Objective: To expand the knowledge on clinical microbiology and Immunology techniques

1. Isolation and identification of pathogenic microbes from – pus and urine
2. Testing sensitivity of bacteria to antibiotics.
3. Assessing Minimum Inhibitory concentration
4. Germ tube test and KOH mount for fungal pathogen
5. Wet mount and Iodine test for Cyst
6. Concentration method for CYST and OVA
7. Blood smear for MP- demonstration
8. Haem agglutination slide method- Blood grouping and Rh typing
9. Tube agglutination method-WIDAL test
10. Latex agglutination- ASO test for RA.
11. Double immunodiffusion- identity pattern
12. Purification of Immunoglobulins: Ammonium sulphate precipitaion.
13. Qualitative ELISA-hcG Test demonstration
14. Estimation of Alkaline phosphatase from patient's serum
15. Alkaline protease Enzyme assay
16. Immobilization of enzyme by alginate beads

Practical manual

1. Balows, A., Hausser Jr. K.L., Isenberg, H.D., Shalomy, H.J .Manual of Clinical Microbiology, ASM, Washington, 1991.
2. Cappuccino and Sherman.. Microbiology: A Laboratory manual by (7th edition) Berjamin cummings publications, 2004.
3. Gerhardt, P., Murray, R.G., Wood, W.A. and Kruz, N.R. Methods for General and Molecular Bacteriology, ASM, Washington , 1994.
4. Karen Messley. Microbiology Lab manual (2nd Edition) Berjamin cummings Publisher,2003.
5. Lorian, V. Antibiotics in laboratory medicine (3rd edition) Williams and Wilkins, Baltimore, 1991.

**SEMESTER III: CORE BASED ELECTIVE III
MICROBIAL ECOLOGY**

Course Code : 17PMB 3CE3

Max Marks : 100

Hours/Week : 6

Internal Marks: 25

Credit : 4

External Marks: 75

Objective:

1. To introduce the field of microbial ecology and environmental microbiology
2. To explore the functional ubiquity and diversity of microorganisms

UNIT I

18 hours

Environment and Ecosystems: Concept and components of ecosystem, Biosphere - food chain, food web and energy flow, productivity . Types of ecosystems, Population ecology and biological control; Community structure and organization- Ecological pyramids. Methods of studying Microbial ecosystem. #biological equilibrium#. Meaning of succession: Tolerance and inhibition patterns of succession, theories of succession.

UNIT II

18 hours

Aerobiology: layers of atmosphere. Microbial contamination of air-Sources of contamination- Biological indicators of air pollution. Droplet and Droplet Nuclei. Enumeration of bacteria from air, Air sampling devices. Significance of air Microflora, Outline of Airborne diseases (Bacterial - Whooping cough, Diphtheria, Pneumonia; Fungal - Aspergillosis, Cryptococcosis; Viral – Chickenpox, Influenza, Measles). #Air sanitation#.

UNIT III

18 hours

Aquatic Microbiology: Fresh and marine water zone. Microbial ecology of lakes, ponds, rivers, stream, ground water wetland, Factors affecting the microbial population-oxygen availability, pH, temperature, salinity, hydrostatic pressure, radiation. Techniques for the study of aquatic microbes. Indicators of faecal pollution. Eutrophication- #factors controlling eutrophication#. Water treatment: preliminary- aeration, sedimentation, coagulation and flocculation. Filtration- rapid and slow sand filters and Microfilters. Bacteriological techniques for the examination of water-MPN index.

UNIT IV

18 hours

Microbiology of potable water: Water quality measures: guideline, methods, identification and validation. Waterborne disease: Enteric bacteria (indicators and pathogens) Opportunistic pathogens: Legionella, Vibrio, Pseudomonas and Staphylococcus. Viruses: Polio, adenovirus, enterovirus, Rotavirus and norovirus. Protozoa: Giardia, Cryptosporidium and #Toxoplasma#. Pathogens source tracking and disinfection.

UNIT V

18 hours

Ecology and Genetics: Genetic structure of population:-Genotype frequency, allele frequencies. Hardy-Weinberg Law:-Assumptions, predictions, derivation, extension and natural selection. Measuring genetic variation at protein level, measuring genetic variation at DNA level. Factors effecting gene frequencies:-Mutation, Random genetic drift, migration, Hardy -Weinberg natural selection, Assortative mating, Inbreeding.

#---#Self study

Text Books

1. Alexander M. Microbial Ecology. John Wiley and Sons Inc. NY, 1971.
2. Atlas R.M and Bartha, R. Microbial Ecology, Fundamentals and Application (4th edition) LPE, Pearson Education. Inc, 2005.
3. Ec Eldowney, S. Hardman, D.J and Waite, S. Pollution: Ecology and Biotreatment. Longman Scientific Technical, 1993.
4. Mitchell, R. Introduction to Environmental Microbiology, 1974.
5. Campbell, R. Microbial Ecology. 2nd Ed, Pub. Blackwell. 1983.

Books for Reference

1. Reiheimer G. Aquatic Microbiology. Pub. John Wiley & Sons Inc. 4 ed, 1991.
2. Grant WD, Long PL. Environmental Microbiology. Blackie Glasgow. London, 1981.
3. Eldowney S., Hardman, DJ., Waite, DJ.and Waite, S. Pollution: Ecology and Biotreatment. Longman Scientific Technical, 1993.
4. Pelczar M.J.R., Chan, E.C.S. and Kreig, N.R. Microbiology, McGraw Hill. Inc. New York, 1993.

Books for Study

UNIT I	Text Book 1	Chapter 12
UNIT II	Text Book 2	Chapter 11
UNIT III	Text Book 3	Chapter 4
UNIT IV	Text Book 4	Chapter 6-8
UNIT V	Text Book 5	Chapter 2& 5 & 22

**SEMESTER III: CORE BASED ELECTIVE III
MICROBIAL TAXONOMY AND PHYLOGENY**

Course Code : 17PMB 3CE3

Hours/Week : 6

Credit : 4

Max Marks : 100

Internal Marks: 25

External Marks: 75

Objective

1. To gain knowledge about microbial taxonomy and molecular phylogeny

Unit I

18 hours

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

UNIT II

18 hours

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

Unit III

18 hours

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 fingerprinting#.

UNIT IV

18 hours

Sequence analysis Submission: 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

18 hours

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.

#--#Self study

Text 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. 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.

Books for Reference

1. Roderic DM Page and Edward C Holmes. Molecular Evolution: A Phylogenetic Approach. Blackwell publishing, USA. 1998. 8. Sandy B Primrose and Richard M Twyman. Principles of Genome Analysis and Genomics, Blackwell Publishing, USA. 2005.
2. Perry JJ, Staley JT and Lory S. Microbial Life. Sinauer Associates, Publishers, Sunderland, Massachusetts. 2002.

Books for Study

UNIT I	Text Book 1	Chapter 4-6
UNIT II	Text Book 2	Chapter 2-8
UNIT III	Text Book 3	Chapter 9-12
UNIT IV	Text Book 4	Chapter 7
UNIT V	Text Book5	Chapter 6-8

**SEMESTER III: EXTRA CREDITI
CYANOBACTERIOLOGY**

Course Code : 17PMB3EC1

Hours/Week : --

Credit : 5*

Max Marks : 100*

Internal Marks: --

External Marks: 100*

Objective:

1. To understand the basic knowledge of taxonomy and molecular biology methods of cyanobacteria

UNIT I

Introduction to Cyanobacteria: Definition– Distribution of Cyanobacteria: Fossil history of cyanobacteria. Important features – Cell structure – Cell wall, protoplast, Gas vesicles, granules, pigment, nucleus and nuclear material, Heterocyst and akinetes, photosynthetic apparatus and storage food – Isolation, Purification, #Maintenance and Preservation of Cyanobacterial cultures#.

UNIT II

Reproduction in Cyanobacteria – Vegetative Reproduction: Fission, Fragmentation, Hormogonia –Asexual reproduction: Exospores, Endospores, Akinetes and Nannocytes – Economic importance of Cyanobacteria – Exploitation of Pigments in Industry – Environmental factors affecting cell growth: Light – Salinity – Temperature – #Physical Stability of the water column#.

UNIT III

Molecular Biology of cyanobacteria: Molecular biology of cyanobacteria and chloroplast origins and evolution; supramolecular membrane organization; phycobilisome and phycobiliprotein structures; The Use of cyanobacteria in the study of the structure and function of photosystem II and The cytochrome complex; #photosystem I in cyanobacteria#.

UNIT IV

The biochemistry and molecular regulation: carbon dioxide metabolism in cyanobacteria, genetic analysis of cyanobacteria, heterocyst metabolism and development, #differentiation of hormogonia# and relationships with other biological processes.

UNIT V

Applications: Biotechnological potentials of microalgae – food – feed – colourant - fuel and pharmaceutically variable compounds. Phylogeny, molecular systematics and applications. #Economic importance of algae.#

#--#Self study

Text Books

1. Antonia Herrero and Enrique Flores. The Cyanobacteria: Molecular Biology, Genomics and Evolution, Caister academic press, 2008.
2. Sarma, T. A. Handbook of Cyanobacteria, CRC press, 2012
3. Percy, M. Gault and Harris J. Marler. Handbook on Cyanobacteria: Biochemistry, Biotechnology and Applications (Bacteriology Research Developments), Nova Science Publishers, Inc 2009.

Books for Reference

1. Bryant, D.A. The Molecular Biology of Cyanobacteria (Advances in Photosynthesis and Respiration) Springer 1995.
2. Samit Ray. Cyanobacteria, New Age International Pvt Ltd Publishers, 2006.

Books for Study

UNIT I	Text Book 1	Chapter 2-7
UNIT II	Text Book 1	Chapter 12
UNIT III	Text Book 2	Chapter 4
UNIT IV	Text Book 2	Chapter 8
UNIT V	Text Book 3	Chapter 18

SEMESTER IV: CORE XIII
FERMENTATION TECHNOLOGY

Course Code : 17PMB 4C13

Hours/Week : 6

Credit : 5

Max Marks : 100

Internal Marks: 25

External Marks: 75

Objectives:

1. To provide the knowledge and interest on fermentation process and product recovery
2. Guide the student to design, develop and operate bioreactors.

UNIT I

18 hours

General concept of industrial microbiology- History and scope of industrial microbiology. Isolation and screening of industrially important microorganism. Strain improvement. Types of industrial fermentation processes: Batch continuous, surface, submerged and #solid state fermentation#.

UNIT II

18 hours

Fermentor Types and Processes - Fermentor: Basic structure, construction and various types-typical stirred aerated fermentor, tower fermentor, airlift fermentor and bubble cap fermentor. Downstream processing – precipitation – filtration, centrifugation, cell disruption and drying.

UNIT III

18 hours

Industrial Fermentation Process- Media components and formulation, crude media components, antifoam agents, precursors, inducer and inhibitors and buffering agents. Sterilization of media and raw materials. Maintenance of sterility at critical points during fermentation.# Inoculum preparation#.

UNIT IV

18 hours

Industrial production of primary metabolites - Raw material, organism and process involved in the alcohol production -Production of organic acids – Vinegar, Lactic acid, citric acid- Alcoholic beverages- Beer and #Wine production#.

UNIT V

18 hours

Industrial production of secondary metabolites- Production of antibiotics- Penicillin and Streptomycin, amino acid – L- Glutamic acid and L- Lysine. Enzymes– Amylase, Pectinase and Protease. Vitamins – Cyanocobalamine and #Riboflavin#.

#--#**Self study**

Text Books

1. Casida L.E. Industrial Microbiology, Wiley Eastern Limited, New Delhi,2007.
2. Demain A.L, Davies, J.E. Manual of Industrial Microbiology & Biotechnology. ASM press, 1999.
3. Prescott, L.M, Harley, J.P, Klein, D.A . Microbiology , WCB Mc Graw Hill, 1999.
4. Wulf Crueger, Anneliese Crueger, Thomas D. Brock . Biotechnology: A Textbook of Industrial Microbiology, 1991.

Books for Reference

7. Baumberg. S., Hunter. I.S. and Rhodes, P.M. Microbial Products -New approaches. Cambridge Univ. Press. Cambridge,1989.
8. Prescott, S.C. and Dunn ,C.C. Industrial Microbiology, Tata McGraw-Hill Publishing Company limited, New Delhi.
9. Sikyta B. Methods in Industrial Microbiology, Ellis Horwood Limited,1983.
10. Stanbury, P.F. Whitaker, A and Hall,S.J. Principles of Fermentation Technology (7th edition) Elsevier Science limited Aditya Books Private Limited, New Delhi.

Books for Study

UNIT I	Text Book 1	Chapter 5
UNIT II	Text Book 2	Chapter 7
UNIT III	Text Book 2	Chapter 14-15
UNIT IV	Text Book 3	Chapter 8-12
UNIT V	Text Book 4	Chapter 16

SEMESTER IV: CORE XIV
FOOD AND DAIRY MICROBIOLOGY

Course Code : 17PMB 4C14

Hours/Week : 6

Credit : 5

Max Marks : 100

Internal Marks: 25

External Marks: 75

Objectives:

1. To gain knowledge about the extrinsic and intrinsic parameters that affect bacterial growth.
2. To familiarize the primary sources of microorganisms in meat, poultry and vegetable products as well as the establishment's environment.
3. To create awareness about food contamination and food borne illness

UNIT I

18 hours

Food as substrate for microorganisms: Microorganisms important in food microbiology- Molds, yeasts and Bacteria- General characteristics- classification and importance. Principles of food preservation- physical, chemical preservatives and food additives. Factors influencing Microbial growth in food- Extrinsic and #Intrinsic factors#.

UNIT II

18 hours

Contamination and spoilage: Cereals, sugar products, vegetables, fruits, meat and meat products, milk and milk products- fish and fish products- #spoilage of canned foods#. Detection of spoilage and characterization.

UNIT III

18 hours

Food-borne infection and intoxications: Bacterial and non bacterial- with examples of infective and toxic types- *Brucella*, *Bacillus*, *Clostridium*, *Salmonella*, *Escherichia*, *Shigella*, *Staphylococcus*, *Vibrio*, *Yersinia*, *Camphylobacter*, Nematodes, Protozoa, algae, fungi and #viruses#.

UNIT IV

18 hours

Industrial Food fermentations: Starter cultures and their biochemical activities, production and preservation of the following fermented foods- Soy sauce fermentation by Moulds - Fermented vegetables – #Sauerkraut# - Fermented Meat – Sausages -Production and application of SCP and Baker's products in food industry.

UNIT V

18 hours

Dairy Microbiology: Probiotics and Prebiotics use of *Lactobacilli*, #homo and heterolactic fermentations# and their therapeutic and nutritional value. Microbiology of fermented milk products -acidophilus milk, yoghurt and cheese. Preservation methods- periodic transfer, mineral oil slant, liquid nitrogen, lyophilization and other preservative methods

#--#Self study

Text Books

1. Adams M.R. and Moss MO. Food Microbiology, The Royal Society of Chemistry, Cambridge, 1995.
2. Andrews A.T, Varley J. Biochemistry of milk products. Royal Society of Chemistry, 1994.
3. Banwart G.J. Basic food microbiology, Chapman & Hall, New York, 1989.
4. Edward Harth, J.T. Applied Dairy Microbiology. Marcel Decker Inc. New York, 1998.
5. Frazier W.C and Westhoff DC. Food microbiology, TATA McGraw Hill Publishing Company Ltd. New Delhi, 1988.
6. May J.M. Modern Food microbiology, CBS Publishers and distributors, New Delhi, 1987.

Books for Reference

1. Hobbs B.C and Roberts D. Food poisoning and food hygiene, Edward Arnold (A division of Hodder and Stoughton), London, 1993.
2. Robinson R.K. The microbiology of milk. Elsevier Applied Science, London, 1990.

Books for Study

UNIT I	Text Book 1	Chapter 1
UNIT II	Text Book 2,3	Chapter, 11-15,18&19
UNIT III	Text Book 4	Chapter 24
UNIT IV	Text Book 5	Chapter 9
UNIT V	Text Book 6	Chapter 7

SEMESTER IV: CORE XV
BIOSTATISTICS AND BIOINFORMATICS

Course Code : 17PMB 4C15
Hours/Week : 6
Credit : 5

Max Marks : 100
Internal Marks: 25
External Marks: 75

Objectives:

1. To gain insight about computer based technology for the study of biological molecules.
2. To equip statistical skills to solve biological problems.

UNIT I

18 hours

Introduction to Biostatistics: Basic definitions and applications. Sampling: Representative sample, sample size, sampling bias and sampling techniques. Data collection and presentation: Types of data, methods of collection of primary and secondary data, methods of data presentation, graphical representation by histogram, polygon, Ogive curves and pie diagram. confidence limits, Probability distribution, normal, [#]binomial and Poisson distribution[#] -

UNIT II

18 hours

Measures of Central Tendency: Mean, Median, Mode: Measures of variability: Standard deviation, standard error, range, mean deviation and coefficient of variation. Correlation and regression: Positive and negative correlation and calculation of Karl- Pearsons co-efficient of correlation. Linear regression and regression equation and multiple linear regression, ANOVA, one and two way classification. [#]Calculation of an unknown variable using regression equation[#] .

UNIT III

18 hours

Tests of significance: Tests of significance: Small sample test (Chi-square t test, F test), large sample test (Z test) and standard error. Introduction to probability theory and distributions, (concept without deviation) binomial, poison and normal (only definitions and problems) Computer oriented statistical techniques. Frequency table of single discrete variable, bubble spot, computation of mean, [#]-variance and standard Deviations[#] -, t test, correlation coefficient

UNIT IV

18 hours

Bioinformatics: Basic computation languages. History-Classification of Biological data bases- Nucleic acid data base- Protein data base. Biological Sequence analysis – Pairwise sequence comparison – Sequence queries against biological databases – BLAST and FASTA – Multiple sequence alignments - Phylogenetic alignment- [#]clustal W[#] .

UNIT V

18 hours

Proteomics: Protein Data Bank, Swiss-prot - biochemical pathway databases - Predicting Protein structure and function from sequence – Determination of structure – feature detection – secondary structure prediction – predicting 3 D structure - [#]protein modeling[#] -.

#--#Self study

Text Books

1. Ruchi Singh and Richa Sharma. Bioinformatics: Basics, algorithms and applications, Universities Press, (India) Pvt. Ltd, Hyderabad, India. 2010.
2. molecBryan Bergeron. Bioinformatics Computing First Indian Edition, Prentice Hall.2003.
3. Cynthia Gibas and Per Jambeck Developing Bioinformatics Computer Skills: First Edition Shroff Publishers and Distributors Pvt. Ltd (O'Reilly), Mumbai.2001.
4. Rashidi HH and Buehler LK. Bioinformatics Basics: Applications in Biological Science and Medicine, Second Edition CRC Press, London. 2005.
5. Des Higgins and Willie Taylor Bioinformatics: Sequence, structure and databanks, Oxford University Press (2002).
6. Baxevanis AD and Ouellette BEF, Bioinformatics: A practical guide to the analysis of genes and proteins, First Edition Wiley Interscience – New York (2001)

Books for Reference

1. Arora PN and Malhon PK Biostatistics Himalaya Publishing House, Mumbai (2008).
2. Stanton A and Clantz, Primer of Biostatistics. The McGraw Hill Inc., New York (2005).
3. Pranabkumar Banerjee Introduction to Biostatistics, S.chand and company Ltd., (2007).
4. www.bioinformaticssoftwareandtools.co.in.
5. www.bioinformaticsweb.net/datalink.html.
6. Evolution.genetics.washington.edu/phylip.html.

Books for Study

UNIT I	Text Book 1	Chapter 3
UNIT II	Text Book 2,3	Chapter, 12: 2-8
UNIT III	Text Book 3	Chapter 22
UNIT IV	Text Book 4,5	Chapter 14; 18
UNIT V	Text Book 6	Chapter 8

**SEMESTER IV: PROJECT WORK
DISSERTATION**

Course Code : 17PMB 4PW

Hours/Week : 12

Credit : 9

Max Marks : 200

Internal Marks: 50

External Marks: 150

Objectives:

1. The aim of project work is to inculcate students to learn an adequate knowledge on research skills and specialize in their field of interest.
2. To bring an ideal platform for broadening student technical skills, writing of reports and publications.
3. It aims to bridges students respectively with national research institutes and Industries

SEMESTER IV: EXTRA CREDIT-II
MICROBIAL PRODUCTS AND QUALITY CONTROL ASPECTS

Course Code : 17PMB 4EC2

Max Marks : 100*

Hours/Week : --

Internal Marks: --

Credit : 5*

External Marks: 100*

Objectives:

1. To gain knowledge about the healthful diet and maintaining a healthy body.
2. To familiarize the diet and weight should address the individual behavior.
3. To create awareness about nutrient intake and nutritional disorder.

UNIT I

Industrially Important Microorganisms: Biology of industrially important microorganisms – *Spirullina*, *Dunaliella*, Yeasts, *Streptomyces*, *P.rockiforti* Commercial products obtained from microorganisms – single cell protein, and β – Carotene. #GMO'S and its industrial application#.

UNIT II

Modern trends in microbial production: Bioplastics – PHB and PHA. Bioinsectices – thuricide. Biopolymer- dextran, alginate and xanthan. Biotransformation of Steroids, Methanogenesis, and #Mushroom Cultivation#.

UNIT III

Microbes in food, medicine & dairy industries- Probiotics and Prebiotics use of *Lactobacilli*, homo and heterolactic fermentations and their therapeutic and nutritional value. Fermented dairy products and their nutritional values of buttermilk, acidophilus milk, cream, kefir, koumiss, and #cheese and yoghurt#.

UNIT IV

Quality control aspects: Policies and objectives of Quality control, Microbiology of the food product. Good manufacturing practices. Hazard analysis critical control points (HACCP). Microbiological examination of food and dairy products- Control of microbes. Food control agencies and its regulations. Pest control systems in industries. #Indian standard organizations and its procedures#.

UNIT V

Legal protection & IPR:GATT and IPR, forms of IPR, IPR in India, WTO Act, Convention on Biodiversity(CBD), Patent Co-operation Treaty (PCT), forms of patents and patentability, process of patenting, Indian and international agencies involved in IPR & patenting of biological material, GLP, GMP. #Bio safety level#.

#--#Self study

Text Books

1. Baumberg, S. Hunter, I.S and Rhodes, P.M. Microbial Products –New approaches. Cambridge Univ Press, Cambridge,1989.
2. Demain, A.L and Davies, J.E. Manual of Industrial Microbiology & Biotechnology, ASM press,1999.
3. Frazier, W.C, Westhoff, D.C. Food Microbiology, TATA Mc Graw Hill, 1988.
4. Mittal, D.P. Indian Patents Law. Taxmann Allied Services (p) Ltd,1999.

Books for Reference

1. Robinson ,R.K. Dairy Microbiology, Elsevier, 1990.
2. Tortora, G.J, Funke, B.R, Case, C.L . Microbiology – An introduction , Benjamin Cummings,2001.
3. Creuger and Creuger. Biotechnology, A textbook of industrial Microbiology, Sinaeur Associates, 2001.
4. Prescott ,L.M. Harley, J.P and Klein, D.A . Microbiology, WCB Mc Graw Hill, 1999.

Books for Study

UNIT I	Text Book 1	Chapter 5
UNIT II	Text Book 1	Chapter 14
UNIT III	Text Book 2	Chapter 22
UNIT IV	Text Book 3	Chapter 6
UNIT V	Text Book 4	Chapter 8-12