M.Sc. BIOTECHNOLOGY

SEM	COURSE CODE	COURSE	COURSE TITLE	HRS / WEEK	CREDIT	CIA MARKS	SE MARKS	TOTAL MARKS
I	14PBT1C1	CORE I	Advanced Biochemistry	6	5	40	60	100
	14PBT1C2	CORE II	Cell and Molecular Biology	6	5	40	60	100
	14PBT1C3	CORE III	Applied Microbiology	6	5	40	60	100
	14PBT1C4P	CORE IV	Advanced Biochemistry, Cell andMolecular Biology and Applied Microbiology - Practical	6	5	40	60	100
	14PBT1CE1	CORE BASED ELECTIVE – I#		6	5	40	60	100
TOTAL				**30**	**25**	**200**	**300**	**500**
II	14PBT2C5	CORE V	Immunology and Immunotechnology	6	5	40	60	100
	14PBT2C6	CORE VI	Recombinant DNA Technology	6	5	40	60	100
	14PBT2C7	CORE VII	Animal Biotechnology	6	5	40	60	100
	14PBT2C8P	CORE VIII	Immunology and Immunotechnology, Recombinant DNA Technology and Animal Biotechnology - Practical	6	5	40	60	100
	14PBT2CE2	CORE BASED ELECTIVE - II#		6	5	40	60	100
TOTAL				**30**	**25**	**200**	**300**	**500**
III	14PBT3C9	CORE IX	Bioprocess Technology	6	5	40	60	100
	14PBT3C10	CORE X	Plant Biotechnology	6	5	40	60	100
	14PBT3C11	CORE XI	Bioinformatics and Biostatistics	6	5	40	60	100
	14PBT3C12P	CORE XII	Bioprocess Technology, Plant Biotechnology and Bioinformatics and Biostatistics - Practical	6	5	40	60	100
	14PBT3CE3	CORE BASED ELECTIVE - III#		6	5	40	60	100
	14PBT3EC1	EXTRA CREDIT - I	Bioinstrumentation	-	5*	-	100*	100*
TOTAL				**30**	**25**	**200**	**300**	**500**
IV	14PBT4C13	CORE XIII	Environmental Biotechnology	6	5	40	60	100
	14PBT4C14	CORE XIV	Pharmacognacy and Pharmacology	6	5	40	60	100
	14PBT4EC2	EXTRA CREDIT -II	Research Methodology, IPR and Biosafety	-	5*	-	100*	100*
	14PBT4PW	PROJECT WORK		18	5	40	60	100
TOTAL				**30**	**15**	**120**	**180**	**300**
GRAND TOTAL				**120**	**90**	**720**	**1080**	**1800**

Core Based Electives

SEMESTER	CORE BASED ELECTIVE
I	Molecular Genetics
	Molecular Modelling and Drug Design
II	Enzymology and Enzyme Technology
	Analytical Techniques in Biotechnology
III	Nanobiotechnology
	Genetic Toxicology

* Not considered for Grand Total and CGPA

SEMESTERI: CORE I

ADVANCED BIOCHEMISTRY

Course Code: 14PBT1C1 **Max Marks: 100**

Hours/week: 6 **Internal Marks: 40**

Credit: 5 **External Marks: 60**

Objectives:

To study the structure, properties and metabolism of different biomolecules.To know the interrelationships between different metabolisms.

UNIT I: **18 hours**

Carbohydrate metabolism: Glycolysis and gluconeogenesis– pathway, key enzymes and co-ordinate regulation. Mechanism of pyruvate dehydrogenase,#multienzyme complex and the regulation of this enzyme through reversible covalent modification#.The citric acid cycle and regulation.The pentose phosphate pathway.Metabolism of glycogen and regulation.

UNIT II: **18 hours**

Metabolism of amino acids:Overview of biosynthesis of nonessential amino acids. Catabolism of amino acid nitrogen– transamination, deamination, ammonia formation, the urea cycle and regulation of ureogenesis.Importance of glutamate dehydrogenase.#Catabolism of carbon skeletons of amino acids3– overview only.

UNITIII: **18 hours**

Lipid metabolism:Fatty acid biosynthesis. Regulation of biosynthesis of triacylglycerol, phospholipids and cholesterol.α, β, γ, Oxidation of fatty acids– Role of carnitine cycle in the regulation of oxidation.Ketogenesis and its control.#Lipoprotein metabolism exogenous and endogenus pathways#.

UNIT IV: **18 hours**

Metabolism of purines and pyrimidines:Digestion and absorption of nucleoproteins, Metabolism of purines- *de novo* and salvage pathways for purine biosynthesis, regulation of biosynthesis of nucleotides. #Purine catabolic pathway#.Hyperuricemia.Metabolism of pyrimidines- biosynthesis and catabolism.Oroticaciduria.

UNITV: **18 hours**

Inborn errors of metabolism: Disorders of carbohydrate metabolism-Glycogen storage disease.Disorders of amino acid metabolism-Phenylketonuria,maple syrup urine disease,Albinism and Alkaptonuria.Disorders of fatty acid oxidation and mitochondrial metabolism-Medium chain acyl-coenzyme A dehydrogenase deficiency.#Disorders of purine and pyrimidine metabolism# – Lesch-Nyhansyndrome,Lysosomal storage disorders-Gaucher'sdisease,Niemann Pick disease.

#**Self-study portion**

Text Books:

1. Voet, D.andVoet, J.G. Biochemistry, 3rd Edition, John Wiley& Son, 2004.

UNIT-I -Chapter 17, 18

UNIT-II Chapter 26

UNIT-III Chapter 25

UNIT-IV Chapter 28

UNIT-V Chapter 12

Books for References:

1. Conn, E.E.,. "Outlines of Biochemistry" 5th Edition, John Wiley & Sons.(1987)
2. Murray, R.K.,. "Harper's Illustrated Biochemistry", 27th Edition, McGraw-Hill.(2006)
3. Nelson, D. L and M.M. Cox.,. "Lehninger's Principles of Biochemsitry", 4th Edition,W.H. Freemen & Co.(2005)
4. Rastogi, S.C.. "Biochemistry" 2nd Edition, Tata McGraw-Hill.(2003)
5. Satyanarayana, U. and U. Chakerapani,. "Biochemistry" 3rd Rev. Edition, Books & Allied (P) Ltd.,(2006)
6. Voet, D. and Voet, J.G.,. "Biochemistry", 3rd Edition, John Wiley & Son.(2004)

SEMESTERI: CORE II
CELL AND MOLECULAR BIOLOGY

Course Code: 14PBT1C2 **Max. Marks: 100**

Hours/week: 6 **Internal Marks: 40**

Credit: 5 **External Marks: 60**

Objective:

To develop basic knowledge and skills in cell and molecular biology and to aware of the complexity and harmony of the cell.

UNITI: **18 hours**

CellBiology: Cell Theory- Prokaryotic and Eukaryotic cell structure and Intracellular organelles. DNA & RNA as genetic material - structure and function.Prokaryotic and eukaryotic genome organization.#Cytoskeleton# - Mitosis and Meiosis.

UNITII: **18 hours**

Replication: Enzymes in DNA replication - modes of replication. #Prokaryotic and eukaryotic replication#– Events- Plasmids – Types and replication.

UNIT III: **18 hours**

Transcription:Mechanism of transcription in prokaryotes and eukaryotes- RNA polymerases, #promoter sequences for RNA polymerases#, enhancers and silencers, transcription factors and initiation of transcription, elongation and termination of transcription. Post transcriptional modifications.

UNITIV: **18 hours**

Translation:Protein synthesis in prokaryotes and eukaryotes. Initiation, elongation and termination of translation.Comparison of protein synthesis in prokaryotes and eukaryotes.#Post translational modification of proteins#.

UNITV: **18 hours**

DNA Repair and Protein Localization:DNA repair and recombination-Chaperons and protein folding - #nuclear localization signals for nucleus# – mitochondria – chloroplast – Golgi - endoplasmic reticulum- membrane and secretory proteins and targeting.

#**Self-study portion**

Text book:

1. Gerald Karp,.Cell and Molecular Biology: Concepts and Experiments,. John Wiley & Sons, (2009)
2. Harvey Lodish et al.,.Molecular Cell Biology, W. H. Freeman Publication. (2008)
3. Maloy, S.R., J.E.Cronan and D.Friefelder. Microbial Genetics Jones and Bartlett publishers.(1994)

UNIT I: Chapter 1 & 5.T.B.2

UNIT II: Chapter 4, T.B.2

UNIT III: Chapter 11 ,T.B.1

UNIT IV: Chapter 12,T.B.1

UNIT V: Chapter 4, T.B.1

References:

1. Levin. B., Genes VII Oxford University Press.(2004)
2. Philip C. Turner,.Molecular Biology, Garland Science. (2005)
3. Buchanan,.Biochemistry and Molecular Biology of Plants.(2000)

SEMESTERI:CORE III
APPLIED MICROBIOLOGY

Course Code: 14PBT 1C3 **Max Marks: 100**
Hours/week: 6 **Internal Marks: 40**
Credit: 5 **External Marks: 60**

Objective:

To understand and study the applications of microbesin various industries.

UNIT I: **18 hours**

Soil Microbiology: Soil microbes: Bacteria, Fungi, Actinomycetes, Algae, Protozoa, Viruses. Interaction among soil microorganisms: Neutral association, Beneficial association, Alagae and Fungi, Harmful association. Role of microorganisms in Biogeochemical cycle: Carbon cycle, Nitrogen cycle. #Proteolysis: Amino acid degradation, Nitrification, Reduction of Nitrate to Ammonia, Denitrificaiton, Nitrogen fixation#. Sulphur cycle, Rhizophere, Role of Mycorrhizal fungi in plants.

UNIT II: **18 hours**

Agricultural Microbiology: Sources of organic matter, Formation of Humus, Decomposition of organic matter. Inorganic Nutrients in soil, Microbes and Agriculture, Phosphorous uptake, Nitrogen fixation.#Microbes as Biofertilizers: Biofertilizers, Steps in preparing Biofertilizer#. Advantages of Blue green algal biofertilizers, Development of BGA strains.Algalization and crop yield. Microbial Insect pest control; Bacterial insecticides (*Verticilliumlecanii, Thirustellathomposonii, Nomuraearileyi, Pseudomonas* as Bacterial insecticides, Bacillus species as Bacterial insecticide, #Viral insecticide: Entomopathogenic fungi (*Metarhiziumanisopliae, Beauveriabassiana*)#.

UNIT III: **18 hours**

Industrial Microbiology: Produciton of yeast, recovery, preservation. Ethyl Alcohol from Molasses; Uses of Alcohol; Beer production, Composition of Beer, Manufacture of Beer.#VinegarProduciton; Methods of Manufacture, Defects of vinegar and uses, Citric acid production; Lactic acid production, Production of Antibiotic, Vitamin production#.

UNIT IV: **18 hours**

Microorganisms Harmful to Animals: Animals resistance to pathogens -organisms causing diseases and Mode of transmission and control - Bacteria, Virus, Fungi, #Protozoa, Helminths#, Prions.

UNIT V: **18 hours**

Medical microbiology: Pathogenicity of microorganisms; Host parasite relationships, pathogenesis of viral diseases, Pathogenesis of Bacterial diseases, Techniques and applications of detection and removal of endotoxins; #Antimicrobial chemotherapy – General characteristics of Antimicrobial drug – determining the level of Antimicrobial activity – mechanisms of action of antimicrobial agents#; Clinical microbiology – Tehniques and applications of health care professionals and monoclonal antibodies in clinical microbiology.

#**Self-study portion**

Text Books:

T.B. 1.Moshrafuddin Ahmed, BasumataryS.K..Applied Microbiology.MJP Publishers, Chennai – 600005.(2006)

T.B. 2.Cappuccino Sherman.Microbiology a Laboratory Manual 6th Edition. 2004.

UNIT I Chapter V, T.B.1

UNIT II Chapter VIII, T.B. 1

UNIT III Chapter IX, T.B.1

UNIT IV Chapter XIV, T.B. 1

UNIT V Chapter XIV, T.B. 2

Books for References:

1. Davis BD- Dulbecco R- Eisen HN- Ginsberg HS.. Microbiology- Harper Intl. Edition.(1980)
2. Lancing M. Prescott., John P. Harley and Donald A. Klein.. Microbiology. McGraw Hill Higher Education.(2005)
3. Michael J. Pelczar., E.C.S. Chan and Noel R. Krieg.. Microbiology. Tata McGraw Hill Education.(2001)
4. Tortora- F. C. Microbiology – An Introduction- Benjamin-Cummings Publications. (1995).

SEMESTERI:CORE IV

ADVANCED BIOCHEMISTRY, CELL AND MOLECULAR BIOLOGYAND APPLIED MICROBIOLOGY - PRACTICAL

Course Code:14PBT1C4P **Max Marks: 100**
Hours/week: 6 **InternalMarks:40**
Credit:5 **External Marks:60**

Objective:

To provide students with an advanced integrated knowledge on biochemistry and understanding of core topics, with general principles on molecular biology and microbiology.

1. Theory and application of colorimeter- Spectrophotometer- Electropphoresis - pH meter.
2. Study of Mitosis from Onion root tip.
3. Study of Meiosis from Grass hopper testis.
4. Staining of buccal epithelial cell.
5. Preparation of a few regularly used buffers in molecular biology.
6. Estimation of proteins- amino acids- sugars.
7. Preparation of competent cells and transformation- Transduction- Conjugation.
8. Theory and application of Microscopy, SEM, TEM, Fluorescence microscope.
9. Microbial culture Media preparation- Sterilization.
10. Culture transfer techniques- Isolation of pure cultures.
11. Bacterial staining (Simple- Negative- Gram's- Spore).
12. Bacterial growth curve.
13. Isolation of Antibiotic producing organism and determination of antimicrobial spectrum of isolates.
14. Extracellular activities of microorganisms.

Text Books:

1. Murray, R.K., Harpers Iiustrated Biochemistry, 27th edition, McGraw- Hill. 2006.

2. Lancing M. Prescott., John P. Harley and Donald A. Klein. Microbiology, McGraw Hill Higher Education. 2005.

3. Maloy, S.R., J.E. Cronan and D. Friefelder. Microbial Genetics Jones &Barlett Publishers. 1994.

SEMESTERI:CORE BASED ELECTIVE – I

MOLECULAR GENETICS

Course Code: 14PBT1CE1 **Max Marks: 100**
Hours/week: 6 **Internal Marks: 40**
Credit: 5 **External Marks: 60**

Objective:

This paper provides insight on recombination, jumping genes and regulation processes in prokaryotes and eukaryotes, mutations and their repair mechanisms.

UNITI: 18 hours

Crossing over and Recombination: Linkage mapping techniques in eukaryotes – Ordered and un-ordered, Genetics of Bacteria and virus: Conjugation - Transduction – Discovery- generalized transduction- specialized transduction- Transformation – the process-competency. #Bacterial viruses- discovery- genetic fine structure#; Elucidation of fine Structure of genes by Benzer's experiment- Cis-Trans complementation.

UNITII: 18 hours

Mutation& DNA Repair: Mutation – Genetic variability required for evolution. Mutation – basic features of the process – somatic- Germinal- spontaneous- induced random-non – adaptive- reversible nature of mutations. #Molecular basis of mutation – chemical-Radiation.orgin of spontaneous mutations#.Conditional lethal mutations and their uses.Amestest suppression of mutation.

UNITIII: 18 hours

Regulation of gene expression in prokaryotes: Operon systems – lactose operon – induction- catabilite repression. Tryptophan operon - Repression- attenuation. Arabinose operon - positive and negative controls. #Translational control & gene expression- post – translational regulatory mechanisms#.Molecular biology of lambda phage life cycle- HIV – structure & genome.

UNIT IV: 18 hours

Gene regulation in eukaryotes: spatial and temporal regulation of eukaryotic genes – tubulin genes in plants- globins genes in animals. #Induction & transcriptional activity by environmental and biological factors – temperature- molecular control & Transcription in eukaryotes- enhancers- silencers.#Eukaryotes transcription factors#.Epigenetic regulation- RNA mediated regulation. DNA methylation.

UNIT V: **18 hours**

Transposable genetic elements: IS Elements- composite transposons- Tn3- Tn5- Tn 9- Tn10 elements- medical significance. #Eukaryotes – Ac and Ds elements in maize- P elements in *Drosophila.*Retro transposons#.Genetic and evolutionary significance of transposable elements.#Cell cycle – genetic control of cell division.

#**Self-study portion**

Text Book:

1. David Freifelder. Microbial Genetics, , 2nd Edition. NarosaPublishing House. (1994)
2. Hartl, D.L and E.W. Jones. Genetics- analysis of genes and genomes.. 6th edition. Jones and Bartlett publishers. (2005)
3. Nancy Trun, Janine Trempy. Fundamental Bacterial Genetics, Blackwell Publishing. (2004)

UNIT I: Chapter 9, T.B.1
UNIT II: Chapter 3 & 4. T.B.3
UNIT III: Chapter 12. T.B.2
UNIT IV: Chapter 11, T.B.1
UNIT V: Chapter 6, T.B.3

Books for References:

1. Daniel Hartl and Maryellen Ruvolo. Genetics.. Jones & Bartlett Publishers.(2011)
2. Gardner, E.J., Simmons, M.J., and Snusted D.P.,. Principles of Genetics, John Wiley and Sons, New York. (1991)
3. Karvita B. Ahluwalia, AhluwaliaKarvita B. Genetics.. New Age International.(2009)

SEMESTERI:COREBASED ELECTIVE – I
MOLECULAR MODELLING AND DRUG DESIGN

Course Code: 14PBT1CE1 **Max Marks: 100**
Hours/week: 6 **Internal Marks: 40**
Credit: 5 **External Marks: 60**

Objective:

To understand the critical relationship among biomolecular structure, function and force field Models.

UNIT I: **18 hours**

Introduction to Molecular Modelling: Introduction - Useful Concepts in Molecular Modelling: Coordinate Systems. Potential Energy Surfaces.MolecularGraphics.Surfaces.Computer Hardware and Software.#The Molecular Modelling Literature#.

UNIT II: **18 hours**

Force Fields: Fields. Bond Stretching.AngleBending.Introduction to Non-bonded Interactions.ElectrostaticInteractions.Van der Waals Interactions.Hydrogen Bonding in Molecular Mechanics.#Force Field Models for the Simulation of Liquid Water#.

UNIT III: **18 hours**

Energy Minimisation and Computer Simulation: Minimisation and Related Methods for Exploring the Energy Surface. Non-Derivative method, 1st and 2nd order minimisation methods. Computer Simulation Methods.#Simple Thermodynamic Properties and Phase Space.Boundaries.#Analyzing the Results of a Simulation and Estimating Errors#.

UNIT IV: **18 hours**

Molecular Dynamics & Monte Carlo Simulation: Molecular Dynamics Simulation Methods. Molecular Dynamics Using Simple Models.Molecular Dynamics with Continuous Potentials.#Molecular Dynamics at Constant Temperature and Pressure.Monte Carlo Simulation of Molecules.#Models Used in Monte Carlo Simulations of Polymers#.

UNIT V: **18 hours**

Structure Prediction and Drug Design: Structure Prediction - Introduction to Comparative Modeling. Sequence Alignment. #Constructing and Evaluating a Comparative Mode#l. Predicting Protein Structures by 'Threading', Molecular Docking, AUTODOCK and HEX. Structure based De Novo Ligand design, Drug Discovery – QSAR.

#Self-study portion

Text Books:

1. H.D. Holje, W. Sippl, D. Rognan. Molecular Modelling. Willey-VCH & Co. 2000.

UNIT I Chapter II
UNIT II Chapter II
UNIT III Chapter X
UNIT IV Chapter III
UNIT V Chapter IV

Books for References:

1. Claude Cohen, N.. Guidebook on Molecular Modeling in Drug Design, Gulf Professional Publishing, (1996)
2. Haile, J.M.. Molecular Dynamics Simulation Elementary Methods, John Wiley and Sons, (1997)
3. Leach, A.R,. Molecular Modelling: Principles And Applications, Pearson Education India. (2009)
4. Leach, A.R.. Molecular Modelling Principles and Application, Longman. (2001)
5. SatyaPrakash Gupta,. QSAR and Molecular Modeling, Springer - Anamaya Publishers.(2008)
6. Vintner,. Molecular Modelling and Drug Design, CRC Press. (1994)

SEMESTERII:CORE V

IMMUNOLOGY AND IMMUNOTECHNOLOGY

Course Code: 14PBT2C5 **Max Marks: 100**
Hours/week: 6 **Internal Marks: 40**
Credit: 5 **External Marks: 60**

Objective:

The objective of this course is to learn about the structural features of the components of the immune system and its functions.

UNIT I: **18 hours**

Anatomy of the immune system: Components of innate and acquired immUNITy; Haematopoesis; Organs and cells of the immune system- primary and secondary lymphoid organs. #Mucosal and Cutaneous associated Lymphoidtissue(MALT&CALT)#; Antigens – immunogens -haptens.

UNIT II: **18 hours**

B and T lymphocytes Immune response: Immunoglobulins-basic structure, classes & subclasses of immunoglobulins, antigenic determinants; Multigene organization of immunoglobulin genes; Cytokines-properties, receptors and therapeutic uses; Antigen processing and presentation. #Complement activation – classical and alternative pathways.

UNITIII: **18 hours**

ImmunodeficienciesandTransplantationImmunology: Primaryimmunodeficiencies– #Lymphoid and myeloid immunodeficiencies. Immune –complex diseases, Secondary Immunodeficiencies – HIV/AIDS. #Immunologicbasis of graft rejection#.

UNITIV: **18 hours**

Cancer & Immune system: Cancer: origin & terminology, Oncogenes & cancer induction. #Tumors of the immune system, tumor antigens, tumor evasion of immune system.Cancer immunotherapy.#Immunosupressive therapy#.

UNITV: **18 hours**

Immunotechnology: Advanced immunological techniques- RIA, ELISA, FISH, FACS, Western blotting, ELISPOT assay, immunofluorescence, #flow cytometryand immune electronmicroscopy;#Biosensor assays for assessing ligand –receptor interaction; Immunodiagnostics.

#**Self-study portion**

Text Book:

1. Ivan Roitt, Essential Immunology, 10th Edn. Blackwell Scientific Publication, 2002.
2. Kuby, J. Immunology. W.H. Freeman and Company, New York. 2002.

UNIT1: TB:1Chapter -1

UNIT2: TB:2Chapter-3

UNIT3: TB:2Chapter-11,12

UNIT4: TB:2Chapter –14

UNIT5: TB :1Chapter -9

References:

1. Brostoff J, Seaddin JK, Male D, Roitt IM.,. Clinical Immunology, 6th Edition, Gower Medical Publishing,.(2002)
2. Janeway et al.,.Immunobiology, 4th Edition, Current Biology publications..(1999)
3. Paul,. Fundamental of Immunology, 4th edition, Lippencott Raven.(1999)

SEMESTERII:CORE VI

RECOMBINANT DNA TECHNOLOGY

Course Code: 14PBT2C6 **Max. Marks:100**

Hours/week: 6 **Internal Marks: 40**

Credit: 5 **External Marks: 60**

Objective:

To understand the potential scientific consequences of rDNA and discuss its ethical, legal, and social issues.

UNITI: **18 hours**

Enzymes in genetic engineering - restriction endonucleases - ligases - alkaline phosophatase - polynucleotide kinase - terminal deoxynucleotidyltransferase - S1 nuclease - DNA polymerase I, holoenzyme - DNA polymerase III, Klenow fragment - Taq DNA polymerase - RNases - ribonuclease - reverse transcriptase – poly (A) polymerase - #deoxyribonuclease#.

UNITII: **18 hours**

Vectors - plasmids - replication - size - copy number - amplification - types - cloning vectors based on bacterial plasmids - plasmid pBR322 - origin - advantage - Col E1 plasmid DNA - pMB9 plasmid; cosmid vectors and their use; #virus vectors for animal cells; vector for plant cells; shuttle vectors; #expression vectors#.

UNITIII: **18 hours**

Cloning strategies - Techniques in gene manipulation; cutting and joining DNA - introduction of DNA into cells.#Construction of genomic libraries and cDNA libraries# - probe construction, labeling.

UNITIV: **18 hours**

Methods of selection and screening of recombinant DNA - gene transfer techniques - molecular mechanism of anti-sense technology - inhibition of splicing - poly adenylation& translation, #disruption of RNA structure & capping - application of anti-sense technology#.

UNITV: **18 hours**

rDNA Technology in solving human problems - insulin production, Safety regulations in rDNAtechniques.#Environmental release of GMOs#- risk analysis and assessment.

18 Hours

#Self-study portion

Text Book:

1. Murray, E.T.. Gene Transfer and expression protocols - methods in molecular biology volume Humana Press.(1991)
2. Old, R.N. and S.B. Primrose,. Principles of gene manipulations, Blackwell Scientific Publications.(1994)
3. Watson, J.D., M.Gillman, J.Witknow Ski and M.Zoller,. Recombinant DNA (2^{nd} Ed), Scientific Americans books, New York.(1992)

UNITI: Chapter 2. T.B.2
UNITII: Chapter 3-5,T.B.2
UNITIII: Chapter 5. T.B.3
UNITIV: Chapter 11. T.B.3
UNITV: Chapter 7, T.B.2

References:

1. Glover, D.M and B.D. Hames,. DNA Cloning I & II,. IRL Press. (1995)
2. Innis, M.A., D.H. Gelfant&J.J.Sninskey,. PCR Strategies,. IRL Press.(1995)
3. Puhler, A.,. Genetic Engineering of Animals, VCH Publishes, Weninheim FRG. (1993).

SEMESTERII:CORE VII
ANIMAL BIOTECHNOLOGY

Course Code: 14PBT 2C7 **Max. Marks:100**
Hours/week: 6 **Internal Marks: 40**
Credit: 5 **External Marks: 60**

Objectives:

To study the basic principles and techniques involved in animal cell culture and to understand the concepts achievements in Animal systems.

UNIT I: **18 hours**

Gametogenesis and Embryodevelopment: Molecular biology of animal development - Oogenesis and fertilization- Blastula- gastrulation and morphogenesis. Genetic analysis of development in drosophila- a model system- sex determination in drosophila- maternal gene activity- zygotic gene activity- #vertebrate homologues of invertebrate genes#.

UNITII: **18 hours**

***Animal cell and tissue culture*:** Primary cell culture- Different types of cell lines - transformed cell lines- cell culture media – components and their function- serum- and serum free media; CO_2 incubator; Organ culture methods of introducing of DNA into cell lines – microinjection- calcium phosphate transfection- lipofection- electroporation; #Reporter gene systems – luciferase and green fluorescent protein- CAT assay#. Preservation of animal cells; American type culture collection.

UNIT III: **18 hours**

In vitrofertilization and embryo transfer: Embryo technology, Development and use of transgenic animals – retroviral method- embryonic stem cell method- micro –injection method. Generation of gene knockouts and insertional mutants in mice. Stem Cells – types- Gene therapy. #Cloning of animals#. Stem cell therapy – reproductive cloning.

UNIT IV: **18 hours**

***Hybridoma technology*:** monoclonal antibody production, Fusion methods, Selection and screening methods for positive hybrids.Purification of monoclonal antibodies.Application of monoclonal antibodies.#T cell cloning and applications – cytokine technology#.

UNITV: **18 hours**

***Vaccine Production*:** – active / passive immunization- whole organism vaccines- purified macromolecules as vaccines- recombinant vector vaccines- DNA vaccines- multivalent subUNIT vaccines strategies for Hepatitis B- Malaria- HIV and Cancer;#Dendrites cells as therapeutic agents;#Multi-valent vaccines#.

Self- study portion

Text Books:

T.B.1 Kuby,J. Immunology.W.H.Freeman and Company, New York.2002.

T.B.2 Bernard R.Glick and Jack J. Pasternak.Molecular Biotechnology, Panima publishing house- New Delhi, 2002.

UNIT-I Chapter 5 Page no 118-150 T.B.1

UNIT-II Chapter 7 Page no 243-267 T.B.1

UNIT-III Chapter 6 Page no 222-245T.B.1

UNIT-IV Chapter 4 Page no 99-121T.B.2

UNIT-V Chapter 5 Page no 413-425 T.B.2

Books for References:

1. Bernard R. Glick and Jack J. Pasternak. Molecular Biotechnology, Panima Publishing House- New Delhi.(2002)
2. Goldsby R. A., T.J. Kindt., B. A. Osborne and J. Kuby., Immunology, W.H. Freeman and company.(2003)
3. Griffiths A. J., J.H. Miller., D.T. Suzuki- R.C. Lewontin and W.M. Gelbart. An introduction to Genetic analysis, W. H.Freeman and Company.(2000)
4. Masters, J.R.W., Animal Cell culture, Oxford University Press.(2000)
5. Ranga, M.M., Animal Biotechnology, Student Edition- Jodhpur.(2003)
6. Springer, T. A. Hybridoma Technology in Biosciences and Medicine by Plenum Press- New York.(1985).

SEMESTERII:CORE VIII

IMMUNOLOGY AND IMMUNOTECHNOLOGY, RECOMBINANT DNA TECHNOLOGY AND ANIMAL BIOTECHNOLOGY – PRACTICAL

Course Code: 14PBT 2C8P **Max. Marks:100**
Hours/week: 6 **Internal Marks: 40**
Credit: 5 **External Marks: 60**

1. Demonstration of Lymphoid organs (*Primary, Secondary and Lymph nodes*)
2. Double Immunodiffusion – Ouchterlony Method.
3. Immunoelectrophoresis.
4. Rocket Immunoelectrophoresis.
5. Isolation of genomic DNA from plant tissue.
6. Isolation of genomic DNA from animal tissue.
7. Restriction Digestion of DNA with Restriction Endonuclease.
8. Ligation of Restriction Digested Fragments using Ligase Enzyme.
9. Quantification of Nucleic acids –animal and plant cells.
10. Demonstration of gene transfer techniques- Cloning a gene.
11. Agarose gel electrophoresis- resolution and purification of DNA fragments.
12. SDS – PAGE.
13. PCR amplifications- RFLP- RAPD.
14. Introduction to Animal Cell culture.
15. Animal cell culture media preparation.
16. Primary cell culture - fibroblasts from mouse & Chick embryo.
17. Cell viability.
18. Isolation and culture of lymphocyte from human blood.
19. MTT Assay.

Text Books:

1. Springer, T.A. Hybridoma Technology in Biosciences- New York, 1985.
2. National Workshop on Techniques in Animal cell culture& In vitro Toxicology December 24, 2011- January 2, 2012 Mahatma Gandhi Doerankamp Center (MGDC).
   Ex. no 1-12 Page no 455-566.
   Ex. no 13-19 Page no 10-52.

SEMESTERII: CORE BASED ELECTIVE – II
ENZYMOLOGY AND ENZYME TECHNOLOGY

Course Code: 14PBT 2CE2 **Max. Marks:100**
Hours/week: 6 **Internal Marks: 40**
Credit: 5 **External Marks: 60**

Objective:

The objective of this paper is to educate the students to understand the importance of biocatalysts and the recent developments in enzyme technology.

UNIT I: **18 hours**

Enzymes- General characteristics, classification and IUB nomenclature, methods of enzyme isolation and purification. Methods of enzyme assay, Enzyme UNITs, specific activities and turnover number. Active site, #A brief account of non-protein enzymes- ribozymes#, DNA enzymes.

UNIT II: **18 hours**

Enzyme kinetics–Pre steady state and steady state kinetics.Effect of pH, temperature, enzyme and substrate concentration.Michaelis- Menten plot, linear transformation Lineweaver-Burk plot.Eadie-Hofsteeplot, and #Hanes-Woolf equation#.Significance of Km and Vmax.Kinetics of allosteric enzymes, co-efficient.

UNIT III: **18 hours**

Coenzymes- Coenzymic role of NAD, FAD, CoQ, biotin, cobalamine, thiamine pyrophosphate, pyridoxal phosphate and folic acid.#Multienzymecomplexes#.Metal-dependent and metalloenzymes.

UNIT IV: **18 hours**

Enzyme inhibition- Irrerversible and reversible, competitive, non competitive, uncompetitive, #Clinical uses of competitive inhibition using methotrexate#, methanol poisoning and insecticide poisoning, allosteric inhibition.

UNIT V: **18 hours**

Enzyme Technology- Immobilized enzymes- methods of immobilization, Applications. Enzymes of industrial and clinical significance, #Sources and clinical applications of Amylase#, Protease and Lipases, Therapeutic use of Asparginase and Streptokinase.

 # # Self-study portion

Text Books

1.Palmer,.Understanding enzymes.Prentice Hall.(2004)
2. Principles of Biochemistry – Zubay 4th ed. 1998, William C.Brown Publ.

UNIT1:T.B.2-Chapter 6,T.B.1-Chapter 1.

UNIT 2:T.B.2-Chapter 6.

UNIT 3:T.B.2-Chapter 6.

UNIT 4:T.B.2-Chapter 6,T.B.1.

UNIT 5:T.B.1-Chapter 20

Books for References:

1. Dixon and Webb. Enzymes 3rd ed. Longmans, 1979.

2.Stryer. Biochemistry 5th ed. Freeman, 2002.

SEMESTER II: CORE BASED ELECTIVE - II
ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY

Course Code: 14PBT 2CE2 **Max Marks: 100**
Hours/week: 6 **Internal Marks: 40**
Credit: 5 **External Marks: 60**

Objective:

To understand the principles of analytical techniques involved in Biotechnology.

UNIT I: **18 hours**

Analytical Techniques in Biochemistry & Molecular Biology: Preparation of solution – Standard, stock, saturated and acid solutions. Buffers & their preparation.Spectrophotometry, p^H meter, chromatography, centrifugation, isotopic methods.Protein purification techniques, cell disruption and fractionation.#PCR, isolation of DNA,RNA, plasmid, quantitative estimation Of DNA /RNA, electrophoresis, recovery of DNA fragments from agarose gel, #Isolation of mRNA from affinity chromatography#.

UNIT II: **18 hours**

Analytical Techniques in Genetics & Microbiology: probes, labelingand reading of the signal. FISH, insitu PCR, ASO technique: dot-blot and reverse dot-blot. ARMS technique, VNTR, microsatellite, SNP. SSCP, PTT. #Microscope, staning techniques#, microbial detection and counting, biochemical and sterility testing, labelled antibody methods for detection and identification of microorganisms.

UNIT III: **18 hours**

Analytical techniques in plant and animal biotechnology: RFLP, RAPD, DAF, AP-PCR, AFLP, RAMP, S-SAP, STM, SCARS.CO_2 incubator, Magnet activted cell sorting, staining technique in animal cell culture, Inverted microscope, #DNA STR profiling#.

UNIT IV: **18 hours**

Analytical techniques in rDNA technology & Immunology: PFGE, SDS-PAGE, Iso electric focusing, 2-dimensional electrophoresis, blotting techniques, Dot blot technique, autoradiography. #Antigen – antibody interactions, ELISA, RIA, FACS#.

UNIT V: **18 hours**

Analytical techniques in pharmaceutical biotechnology: solid phase extraction, solid phase microextraction, liquid phase micro extraction, molecularly imprinted polimers, turbulent flow chromatography. Supersomes.#Immobilized enzyme reactor#.

Self-study portion

Text Books:

1. Chawla, H. S,. Introduction To Plant Biotechnology, Oxford and IBH Publishing, (2009)
2. Dr. IstvanBak, Modern analytical techniques in the pharmaceutical- and bioanalysis, (2011).
3. Ghosal&Srivastava, Fundamentals of Bioanalytical Techniques and Instrumentation, PHI Learning Pvt. Ltd., (2009).

UNIT I: Chapter 5, T.B.3
UNIT II: Chapter 3, T.B.3
UNIT III: Chapter 22, T.B.1
UNIT IV: Chapter 14, T.B.1.
UNIT V: Chapter 33, T.B.2

Books for References:

1. J.G. Chirikjian, Jones & Bartlett Learning,. Biotechnology: Theory and Techniques, McGraw Hill Publication.(1995)
2. Jean Louis Serre,. Diagnostic Techniques in Genetics, , John Wiley & Sons, .(2007)
3. RajanKatoch, Springer, . Analytical Techniques in Biochemistry and Molecular Biology.(2011)

SEMESTER III: CORE IX
BIOPROCESS TECHNOLOGY

Course Code: 14PBT 3C9 **Max Marks:100**
Hours/week: 6 **Internal Marks: 40**
Credit: 5 **External Marks: 60**

Objectives:

To study the avenues of exploiting microbes in bioconversion technology.To study the downstream processing for product recovery in fermentation.

UNITI: 18 hours

Isolation and screening of industrially important microbes. Strain improvement – mutation and recombination. #Substrates for industrial fermentation#.

UNITII: 18 hours

Concepts of basic modes of fermentation – Batch - Fed batch and Continuous fermentation. Bioreactor designs - Media formulation; Air and media sterilization - #Aeration and agitation in bioprocess#.

UNITIII: 18 hours

Bioprocess control and monitoring variables such as temperature,pH, agitation, pressure, online measurement, on / off control, PID control, #computers in bioprocess control system#.

UNITIV: 18 hours

Downstream processing– Filtration, Centrifugation, cell disruption, chromatography, Liquid - liquid extraction, membrane process, drying crystallization, broth processing; Effluent treatment – disposal, treatment process, by- products. Fermentation economics, #Bioprocess for the production of amino acids, organic acids, #nucleotides and related compounds#.

UNIT V: 18 hours

Bioprocess for the production of enzymes, vitamins, antibiotics, #SCP and microbial cells#.

#**Self-study portion**

Text Books:

1. Arnold L. Demain& Julian E.,. Davis Industrial Microbiology & Biotechnology, ASM Press.(2004)
2. Gungalu I.C. and stainer. The Bacterial Vol. III by Academic press. New York.(2003)
3. P.F.Stanbury, A.Whitakerand S.J.Hall, Principles of fermentation technology, 2nd Edition, 2003.
   UNIT I Chapter 3, T.B-5
   UNITII Chapter 2, 4, T.B-5
   UNITIII Chapter 9, 12,T.B-5
   UNITIV Chapter 10,T.B-5
   UNITV Chapter 1,T.B-5

Books for References:

1. SalaTeh JR., Bacterial physiology and metabolism, Academic press- New York.(2001).
2. Mansi& CFA. Bryce. Fermentation Microbiology &Biotechnology,Taylor& Francis Ltd.(2004).
3. J.M. Coulson and J.F. Richardson. Chemical Engineering, Pergamon Press.(1984).

SEMESTER III: CORE X
PLANT BIOTECHNOLOGY

Course Code: 14PBT3C10 **Max Marks: 100**
Hours/week: 6 **Internal Marks: 40**
Credit: 5 **External Marks: 60**

Objectives:

To study the basic principles and techniques involved in plant tissue and the concepts of transformation and achievements of biotechnology in Plant.

UNITI: 18 hours

Plant Tissue Culture: History of Plant tissue culture **-** Tissue culture media (composition and preparation),Callus and suspension culture; Somaclonal variation; Micropropagation; Organogenesis; Somatic embryogenesis; Hardening and acclimatization; Embryo culture and embryo rescue; Artificial seeds; Protoplast isolation and culture, somatic hybridization; cybrids; haploid and triploids plant production;#Cryopreservation and germplasm conservation; Greenhouse technology#.

UNIT II: 18 hours

Techniques for plant transformation: Gene transfer methods: Vector mediated gene transfer – Agrobacterium mediated gene transfer – crown gall disease and Ti plasmid – Hairy root disease of *A.rhizogenes* (Ri plasmid); #Virus mediated gene transfer: Caulimovirus as vector and Geminivirus as vector, RNA plant virus as vector; Direct gene transfer: Physical and chemical method; Marker gene for Plant transformation#: Antibiotic resistant gene – Herbicide resistant gene – Reporter genes.

UNITIII: 18 hours

Transgenic plants: Herbicide resistance: phosphoinothricin,glyphosate -sufonyl urea and atrazine. Insect resistance: *Bt* genes, non-*Bt* genes like protease inhibitors, alpha amylase inhibitor. #Plant disease resistance: Plant pathogen interaction, Existing approaches to combating disease, Natural disease resistant pathways; overlap between pests and disease#, Biotechnological approaches to disease resistant. Abiotic stress: Drought, cold and salt. Post-harvest losses: long shelf life of fruits.

UNITIV: 18 hours

Metabolic Engineering and Industrial Products: Plant secondary metabolites, controlmechanisms and manipulation of phenylproponoid pathway, #shikimate pathway; alkaloids, industrial enzymes, bioplastics, therapeutic proteins#, custom made antibodies, edible vaccines, nif and *nod* genes.

UNITV: 18 hours

Plant Molecular Techniques and their Application: MolecularMarker-aided breeding: Molecular markers – Basic principle of molecular marker detection – #marker based on DNA hybridization – RFLP – Markers based on PCR amplification# – RAPD –AFLP - STS – Microsatellites.

#**Self-study portion**

Text books:

T.B.1. Kalyankumar D.An Introduction to Plant Tissue Culture Techniques.New Central Book Agency, Kolkata.(2007).

T.B. 2.Adrian Slater, Nigel W. Scott and Mark R. Fowler., Plant Biotechnology (The genetic manipulation of plants), Oxford University press, UK. (2003).

UNIT I Chapter I - XII, T.B.1
UNIT II Chapter III, T.B. 2
UNIT III Chapter IV, T.B.2
UNIT IV Chapter XI, T.B.2
UNIT V Chapter XIII, T.B.2

Books for References:

1. Donald Grierson and S.V. Convey., Plant Molecular Biology. Blackie and Son Limited. New York.(1984).
2. Gilmartin and Bowler.,. Molecular Plant Biology: A practical approach (Vol. I and II), Oxford University press, UK.(2002).
3. M.J. Chrispeels and D.F. Sadava.,. Plants, genes and agriculture, The American Scientific Publishers, USA. (2000).
4. Mantell, S.H and Smith, H., Plant Biotechnology by. Cambridge University press, UK.(1983).
5. Mathews and Mickee,. An introduction to genetic engineering in plants, Blackwell Scientific Publishers. London. (1985).
6. R.J. Henry., Practical Application of Plant Molecular Biology. Chapmans and Hall. (1997).
7. R.L.M. Pierik.*In Vitro* culture of higher plants, MartinusNijhoff Publisher, Dordrecht. (1987).

SEMESTERIII:CORE XI
BIOINFORMATICS AND BIOSTATISTICS

Course Code: 14PBT 3C11 **Max. Marks:100**
Hours/week: 6 **Internal Marks: 40**
Credit: 5 **External Marks: 60**

Objectives:

Introduce the basics, models and applications of different biological sequence describe the database designing concepts and the languages used.

UNIT I: **18 hours**

Structural Biology: Overview of the Protein Structure –Protein Structure Visualization. Structural Protein Classification.#Protein classification approaches#.

UNITII: **18 hours**

Databases: Introduction to databases - Types of databases. Flat file database - Relational databases - Object oriented databases - Database software: Overview of Sequence Retrieval System – Oracle - MySQL. #Database design: visualization of databases#.

UNIT III: **18 hours**

Biological Sequence analysis: Pair wise sequence comparison - Scoring matrix, Dynamics programming, – FASTA, BLAST. Multiple sequence alignments -Phylogenetic alignment.#Protein structure visualization tools# - RasMol, Swiss PDB Viewer.

UNIT IV: **18 hours**

ProgrammingIn C & Perl: C-language-Introduction-Operators-Expressions- variables- input output statements- control statements- function- arrays- pointers- structures- unions- file handling and case studies. #Introduction to PERL- variables#- strings and numbers- lists conditional loops- strings- pattern matching- applying PERL to bioinformatics.

UNIT V: **18 hours**

Biostatistics: measures of central Tendency - mean arithmetic's- harmonic and geometric median and mode - measures of dispersion - standard deviation and standard error; correlation coefficient- simple linear regress- #Basic idea of significance test- hypothesis test – #SPSS Packages#.

#**Self-study portion**

Text Books:

1. Glovery and Mitchell.. An Introduction to Biostatistics.(2009)
2. Mike McGrath,. Perl in Easy steps.(2005)
3. D. Higgins and W. Taylor (Eds), Bioinformatics- Sequence, structure and databanks, Oxford University Press, New Delhi (2000).

UNIT I Chapter I Sections 1, 8-11
UNIT II Chapter II Sections 6-9
UNIT III Chapter I Sections 1.2, 1.1, 3.2
UNIT IV Chapter VIII Sections 180-191
UNIT V Chapters VI Sections 77-80

Books for References:

1. R.S.N. Pillai and V. Bagavathi.,. Statistics – Theory and Practice. S. chand and Company Ltd. New Delhi.(2006)
2. S.C Rastogi ,N.Mendiratta, P.Rastogi.,. Bioinformatics Methods and Application Genomics, Proteoics and Drug Discovery.(2004)
3. Object Oriented Programming in C++ - Robert Lafore, Galgotia. 2008.

SEMESTERIII:CORE XII

BIOPROCESS TECHNOLOGY, PLANT BIOTECHNOLOGY AND BIOINFORMATICS AND BIOSTATISTICS - PRACTICAL

Course Code: 14PBT3C12P **Max. Marks:100**
Hours/week: 6 **Internal Marks: 40**
Credit: 5 **External Marks: 60**

1. Introduction to bioprocess technology parts and designs of bioreactors.
2. Production of biomass; batch and continuous fed batch fermentation- recovery of products.
3. Wine Production.
4. Laboratory scale fermentation of antibiotics- immobilization of cells and enzymes.
5. Introduction to plant tissue culture.
6. Plant tissue culture medium preparation.
7. Direct organogenesis.
8. Indirect organogenesis.
9. Cell suspension cultures.
10. Anther and Pollen culture
11. Protoplast isolation and culture.
12. *Agrobacterium*– mediated gene transformation
13. GUS expression.
14. ExtractionofDNAfrom transformed plants.
15. Study of Internet resources in Bioinformatics- Eg. NCBI, EMBL.
16. Searches on NCBI- Pub Med bibliographic databases and Genome annotation.
17. Multiple alignment-CLUSTALW
18. Protein Structure and classification databases-PDB, SCOP.
19. Phylogenetic analysis using web tools.
20. Protein Structure Prediction (Homology Modeling) using SPDBV.
21. Program to get the length of an array.
22. Program to insert an element at a random position in an array.
23. Program to count nucleotide in a sequence.
24. Program to find the percentage of G and C in a DNA sequence.
25. Program to find the percentage of type of amino acid in a sequence.

Text Books:

1. Andreas D.BaxevanisB.F.Francis Ouellette (Third Edition 2006). Bioinformatics. A Practical Guide to the Analysis of Genes and Proteins.
2. 4. A. Baxevanis and B.F. Ouellette. Bioinformatics: A practical Guide to the Analysis of Genes and Proteins, Wiley-Inter science, Hoboken, NJ (1998).
3. S.Parthasarathy (Essentials of Programming in C for Life Science).(2008).

Practical: 15 to 20 T.B-1

Practical : 21 to 25 T.B-3

Books for References

1. S.C. RastogiNamitaMendirattaParagRastogi (First Edition 2003). Bioinformatics Concepts, Skills & Applications.
2. Teresa K.Attwood& David J. Parry Smith. Introduction to bioinformatics. (1999)
3. Arthur M.Lesk (Internal Student Edition Second Edition. Introduction to Bioinformatics.(2005)

SEMESTERIII: CORE BASED ELECTIVE - III

NANOBIOTECHNOLOGY

Course Code: 14PBT 3CE3 **Max. Marks:100**
Hours/week: 6 **Internal Marks: 40**
Credit: 5 **External Marks: 60**

Objective:

To understand the basis of knowledge for developing, implementing and evaluating Nanobiotechnological applications.

UNIT I: **18 hours**

Introduction to Nanobiotechnology: Nanoparticles:Quantum Dots - metal and metal oxide nanopartices - Silica Nanoparticles –Lipoparticles - Paramagnetic and Super paramagnetic Nanoparticles - Fluorescent Nanoparticles -Cubosomes, Dendrimers, protein and DNA–Nanoparticle Conjugates, #DNA Octahedron, #Fullerenes, #Nanoshells, Carbon Nanotubes#, Nanopores.

UNIT II: **18 hours**

Nano devices: Micro- and nanoelectromechanicalsystems,BioMEMS, microarrays and nanoarrays, protein nanoarrays, microfluidics and nanofluidics, lab on a chip, use of nanotechnology in microfluidics.#Nanogenomics: DNA nanotechnologyandRNA nanotechnology#.

UNIT III: **18 hours**

NanomolecularDiagnostics:Nanoarrays for molecular diagnostics, nanoparticles for molecular diagnostics, DNA–protein and DNA–nanoparticle conjugates, DNA nanomachines for molecular diagnostics, nanobarcodestechnology, #nanoparticle based colorimetric DNA detection method#.

UNIT IV: **18 hours**

Regenerative Medicine and Tissue Engineering:Three-dimensionalnanofilament based scaffolds, nanomaterials for combining tissue engineering and drug delivery, exosomes for drug-free organ transplants, organ-assisting devicesand nanotechnology based human nephron filter for renal failure, blood compatible membranes for renal dialysis. #Nano-oncology:Detection,management, cancer therapy#.

UNIT V: **18 hours**

Role of Nanotechnology in Biological therapies:Vaccination, cell therapy, gene therapy, antisense therapy, RNA interference, #Nanodentistry: Bonding materials, dental caries.Ethical, safety, and regulatory issues of nanbiotechnology#.

#**Self-study portion**

Text Books:

1. Boisseau, P. Houdy ,M. Lahmani.,. Nanoscience: Nanobiotechnology and Nanobiology, Springer-Verlag Berlin Heidelberg, New York. (2010)
2. Hester, R.E., R.M. Harrison.,. Nanotechnology: Consequences for Human Health and the Environmentthe Royal Society of Chemistry, UK.(2007)

UNIT I: Chapter 1.1 – 1.3, T.B.3 &Chapter 2 & 15, T.B.4
UNIT II: Chapter 17, T.B.1
UNIT III: Chapter 3, T.B.4
UNIT IV: Chapter 7.1, T.B.3
UNIT V: Chapter 17, T.B.4

Books for References:

1. Kewal K. Jain.,. The handbook of nanomedicine Humana Press, USA.(2008)
2. Vicki H, Grassian.,.Nanoscience and Nanotechnology: Environmental and Health Impacts John Wiley & Sons, Inc., Hoboken, New Jersey.(2008)

SEMESTER III: CORE BASED ELECTIVE - III
GENETIC TOXICOLOGY

Course Code: 14PBT 3CE3 **Max. Marks:100**
Hours/week: 6 **Internal Marks: 40**
Credit: 5 **External Marks: 60**

Objective:

To understand the basis of knowledge for Genetic Toxicology.

UNIT-1: **18 hours**

Principles of Toxicology- Intoduction, Mechanisms of Toxicity, ADME + Toxicokinetics, Biotransformation of Xenobiotics -Pharmacokinetics, pharmacodynamics and toxicokinetics of xenobiotic chemicals through the mammalian body - metabolism, principles of Phase I metabolism, oxidation, reduction, hydroysis and the enzymes involved. #Cytochrome P450s#.

UNIT-2: **18 hours**

Testing Methods in Genetic Toxicology - Overview of the diversity of methods ranging from the use of viruses to whole animals to assess the potential genotoxicity of chemicals.-#In vitro micronucleus assay, structural numerical changes, centromere and kinetochore staining, binucleate cell assay and measurement of non-disjunction#.

UNIT -3: **18 hours**

Environmental Mutagenesis - In vitro gene mutation assays, HPRT methods, thymidine kinase (TK) mutations and the value of the mouse lymphoma assay, #Detection methods for gene and chromosome changes such as SSCP, RSM, FISH, CGH#.

UNIT-4: **18 hours**

DNA Lesions, Repair and Mutation Induction- DNA modifications by ionising and non-ionising radiations, Chemically induced lesions, DNA adducts by the alkylating agents, oxidative DNA damage, Lesion and adduct detection methods, 32P postlabelling, comet assay, immunological methods, radiolabelled compounds, mass spectrometry, Replication fidelity, mismatch repair, sensitivity to colorectal cancer. #Base excision repair, Nucleotide excision repair, post-replication and double strand break repair, Repair defective mutations. #Human repair syndromes and their implications#.

UNIT-5: **18 hours**

Chemical Carcinogenesis, Epigenetics I: DNA Methylation, Epigenetics II: #Apoptosis &Peroxisomal Proliferation#- Molecular Toxicology &Toxicogenomics.

#**Self-study portion**

Text Books:

1. Hartl, D.L and E.W. Jones. Genetics- analysis of genes and genomes.. 6th edition. Jones and Bartlett publishers. (2005).
2. M.A. Subramaniyan. Toxicology. MJP Publication. 2004.
3. G.S. Miglani. Advance Genetics. Narosa Publishing House. 2004.

UNIT I Chapter 9, T.B – 2
UNIT II Chapter 6, T.B-3
UNIT III Chapter 6, T.B-3
UNIT IV Chapter 14, T.B-1
UNIT V Chapter 25, T.B-3

Books for References:

1. Daniel Hartland MaryellenRuvolo. Genetics.. Jones & Bartlett Publishers.(2011)
2. Gardner, E.J., Simmons, M.J., and Snusted D.P.,. Principles of Genetics, John Wiley and Sons, New York. (1991)
3. Karvita B. Ahluwalia, AhluwaliaKarvita B. Genetics.. New Age International.(2009)

SEMESTERIII: EXTRA CREDIT – 1
BIOINSTRUMENTATION

Course Code: 14PBT3EC1 **Max Marks: 100***
Hours/week: -- **Internal Marks : --**
Credit: 5* **External Marks: 100***

Objectives:

The objective is to educate the students on the basic principles of instrumentation and applications of the analytical tools of biochemistry.

UNITI:

Microscopy and Microtome Techniques: Viscosity – Viscosity of macromolecules, relationship with conformational changes. Electron microscopy – Transmission and Scanning.Scanning Tunneling Microscopy.Specimen preparation for Electron Microscopy - freeze, fracture techniques, specific staining of biological materials. Microtome: types, principle and applications.

UNITII:

Separation Techniques: Chromatography – Principles of partition chromatography, paper, thin layer, ion exchange and affinity chromatography, gel permeation chromatography, HPLC. Electrophoretic techniques – Principles of electrophoretic separation.Continuous, zonal and capillary electrophoresis, different types of electrophoresis including paper, cellulose, acetate/nitrate and gel.Electroporation, pulse field gel electrophoresis.

UNITIII:

Centrifugation: Principles of centrifugation, concepts of RCF, different types of instruments and rotors, preparative, differential and density gradient centrifugation, analytical ultra-centrifugation, determination of molecular weights and other applications, subcellular fractionation.

UNITIV:

Tracer Techniques: Radioactive isotope and half life and isotope; Assessing the metabolic pathways - Meselson and Stahl experiment - autoradiography. Counting techniques: Liquid scintillation counting- Photomultiplier tubes- Chemiluminescence and bioluminescence. Green fluorescent protein.

UNITV:

Spectroscopic Techniques: Spectroscopy – Concepts of spectroscopy, Visible and UV spectroscopy, Laws of photometry. Beer-Lambert's law, Principles and applications of colorimetry.Principles of UV-Vis- IR- NMR- spectroscopy.

Text Books:

1. Canter and Schimmel, Biophysical Chemistry.(1996)
2. VatsalaPiramal. Biophysics. D-Dominant Publishers and Distributers. 2005.

UNIT I Chapter 10, T.B – 2

UNIT II Chapter 13, T.B-2

UNIT III Chapter 11, T.B-2

UNIT IV Chapter 5, T.B-2

UNIT V Chapter 7, 12 T.B-1

Books for References:

1. Glick and Pasternack, Molecular Biotechnology by. ASM Press.(1994)
2. Soni, P.L.,. Physical chemistry, S. Chand publications.(2006)

SEMESTERIV:CORE XIII
ENVIRONMENTAL BIOTECHNOLOGY

Course Code: 14PBT4C13 **Max Marks: 100**
Hours/week: 6 **Internal Mark: 40**
Credit: 5 **External Marks: 60**

Objectives:

To study the principles of microbiological treatment technologies to clean up polluted environments and to create valuable resources for the human society.

UNIT I: **18 hours**

Global Environmental Problems: Greenhouse effect and global warming: Greenhouse gases – Measures to control greenhouse effect; The problem of ozone: Depletion of ozone – ozone hole– effect of ozone depletion – Measures to control ozone depletion: #Acid rain: Development of acid rain –effect of acid rain# –Measures to control acid rain: Environmental sustainability and biotechnology.

UNITII: **18 hours**

Environmental Pollution: Origin of pollution; Classification and nature of Environmental Pollutants; Industrial pollutions. Overview of Noise pollution.#Radiation Pollution Types and possible hazards of radioactive substances; #Soil Pollution - Waste land formation.Impact of Dams, Loss of soil fertility#.

UNIT III: **18 hours**

Waste water management*:* Need for water management, measurement and sourceswater pollution. Waste water treatment: waste water collection, #physico-chemical properties of waste water, physical, chemical and biological treatment processes. activated sludge, oxidation ditches, trickling filter, rotating discs, rotating drums, oxidation ponds. #Anaerobicdigestion, anaerobic filters, up flow anaerobic sludge blanket reactors#. Biotechnology in tannery, dairy, distillery, textile, pulp, paper and Antibiotic industries effluent treatment.

UNIT IV: **18 hours**

Xenobiotic: Ecological considerations, degradative plasmids; #hydrocarbons, substitutedhydrocarbons, oil pollution, surfactants, pesticides#. biopesticides; bioremediation of contaminated soils and wastelands.Phytoremediation: degradation of xenobiotic by plants.

UNIT V: **18 hours**

Environmental Quality Assessment and Monitoring: Quality of environment for life on earth and man - Deterioration of environmental quality with reference to anthropogenic impact;#Methods of assessment of environmental quality#; Impacts of genetically engineered microbes, plants and animals.

 # #Self-study portion

Text Books*:*

T.B. 1. K.C. Agrawal. Environmental Biotechnology, Nidhi Publishers (India), Bikaner. 2004.

T.B. 2.Pradipta K. Mohapatra. Environmental Biotechnology, I.K. International Publishing House Pvt. Ltd. 2008.

UNIT I Chapter I, T.B.1
UNIT II Chapter II and III, T.B.1
UNIT III Chapter VIII and IX, T.B.1
UNIT IV Chapter XIII, T.B.1
UNITV Chapter I, T.B.2

Books for References:

1. Abbasi S.A and E Ramaswami,. Biotechnological Methods of Pollution Control. Universities Press. (2004)
2. Allsopp D. and K.J. Seal.. Introduction to Biodeterioration by, ELBS/Edward Arnold. (2005)
3. Bruce Rittmann and Perry McCarty.,. Environmental Biotechnology: Principles and Applications. McGraw Hill.(2001)
4. Cunninghum WP and BW Saigo,. Environmental Science (5th Edition). McGraw Hill. (1999)
5. De Wiley A.K..,. Environmental chemistry, Eastern Ltd. NewDelhi. (2001)
6. Gray N F.,. Biology of wastewater Treatment.. McGraw Hill. (2004)
7. Hans JoachinJordening and Josef Winter.,. Environmental Biotechnology - Concepts and Applications.Winter-VCH. (2005)
8. Nicholas P,. Biotechnology for Wastewater Treatment. Prentice Hall Of India. (2001)

SEMESTERIV:CORE XIV
PHARMACOGNOSY AND PHARMACOLOGY

Course Code: 14PBT4C14 **Max. Marks:100**
Hours/week: 6 **Internal Marks: 40**
Credit: 5 **External Marks: 60**

Objective:

To understand the pharmacokinetics and pharmacodynamics of drugs and pharmaceutical industry.

UNITI: 18 hours

Pharmacognosy: Definition history and scope of Pharmacognosy including indigenous system of medicine. Classification of drugs of natural origin.Occurrence, distribution, #organoleptic evaluation, #microscopical evaluation and Biological evaluation#.

UNITII: 18 hours

Introduction to Medicinal plant: Cultivation,collection and processing of Herbal drugs,Cultivation and utilization of Medicinal and Aromatic plants in India, #Indian trends in Medicinal and aromatic plants#.

UNITIII: 18 hours

Secondary metabolites: Structure and Classification, Synthesis, #Extraction and Isolation of Alkaloids#, Flavonoids,Terpenoids,Saponins. Dietary sources and its significance.

UNITIV: 18 hours

Basic Pharmacology: Introduction to Pharmacology, Sources of Drugs, Dosage forms and routes of administration and drug delivery system; Mechanism of action, drug receptors and cellular signaling systems ;Combined effect of drugs, #Factors modifying drug action, tolerance and dependence#; Pharmocogenetics.

UNITV: 18 hours

Pharmacokinetics: Absorption – Structure of cell membrane, Gastro-intestinal absorption of drugs, Mechanism of drug absorption, Absorption of drug from non-per oral routes. Distribution, Metabolism – Phase-I, and Phase-II reactions, #Excretion of drugs, Principles of basic and clinical Pharmacokinetics#.

#**Self study portion**

Text Books:

1. A textbook of Pharmacology For Nurses By PadmajaUdaykumar ,Thearora medical book publishers Pvtltd.(2005).

UNIT1:TB :1 Section 1.1 To 1.5
UNIT2: TB:1Section 1.1 To 1.5
UNIT3: TB :1Section 5
UNIT4: TB:1Chapter7,9
UNIT5: TB:1, Chapter 11

Books for References:

1. Kokate, C.K. and S.B.GokhaleAText book of Pharmacognosy,6th Edition ,NiraliPrakashan.(2009)
2. Satoskar, R.S. and S.D. BhandarkarPharmacology and Pharmacotherapeutics,20th Edition, Popular Prakashan.(2010)
3. Tripathi, K.D. Essentials of Medical Pharmacology 6th Edition, Jaypee Publications.(2012).

SEMESTER IV: EXTRA CREDIT – II
RESEARCH METHODOLOGY, IPR AND BIOSAFETY

Course Code: 14PBT 4EC2 **Max Marks : 100***
Hours/week: -- **Internal Marks: --**
Credit: 5* **External Marks: 100***

Objective:

Students get an idea about the advantages and disadvantages of biotechnologicalapplications, ethical implications, and intellectual property rights.

UNITI: 18 hours

Research Concepts And Data Collection: Definition of Research, Qualities of Researcher, Components of Research Problem, Various Steps in Scientific Research, Types of Research; Hypotheses Research Research Reports: Structure and Components of Research Report, Hierarchy of funding agencies in India and their operations.

UNITII: 18 hours

Model Organisms in Biology: definition of model organism and research resources – classification of model organisms. Non-human mammalian models – mouse *(Musmusculus)*; Non-mammalian models – Bacteria (*Escherichia coli*), Viruses (T4 and Lambda Bacteriophage), Yeast (*Saccharomyces cerevisae*), Fruit fly *(Drosophila melanogaster)*.

UNITIII: 18 hours

Introduction to ethics/bioethics: Framework for ethical decision making; biotechnology and ethics – biotechnology in agriculture and environment: benefits and risks – benefits and risks of genetic engineering – ethical aspects of genetic testing – ethical aspects relating to use of genetic information – genetic engineering and biowarfare.

UNITIV: 18 hours

Introduction to Biosafety:Biosafetyissues in biotechnology – risk assessment and risk management – safety protocols: risk groups – biosafety levels – biosafety guidelines and regulations (National and International) – operation of biosafety guidelines and regulations – types of biosafety containments.

UNITV: 18 hours

Introduction to intellectual property rights and types: patents, copy rights, trade marks, design rights, geographical indications – importance of IPR – patentable and non patentables – patenting life – legal protection of biotechnological inventions – world intellectual property rights organization (WIPO).

Text Books

T.B. 1. C. R. Kothari. Research Methodology – Methods and Techniques, New Age International Pvt. Ltd Publishers, New Delhi, 2004.

T.B. 2.M.K. Sateesh, Bioethics and Biosafety, International Publishing House Pvt. Ltd. 2008.

UNIT I Chapter I – III, T.B. 1
UNIT II Chapter IV, T.B. 1
UNIT III Chapter I, VII & XIX, T.B. 2
UNIT IV Chapter VII, T.B. 2
UNIT V Chapter XV & XVI, T.B.2

Books for References:

1. Beier F.K., Crespi R.S., and Straus T., Biotechnology and Patent protection, Oxford and IBH Publishing Co. New Delhi. (2007).
2. Jeffrey M. Gimble,. Academia to Biotechnology, Elsevier, Academic Press.(2006)
3. Jose Cibelli, Robert P. lanza, Keith H. S. Campbell, Michael D.West,. Principles of cloning, Academic Press.(2002)
4. Martin. M.W. and Schinzinger.R., (2003). Ethics in engineering,. III Edition, Tata McGraw-Hill, New Delhi. 2006
5. Sasson A,. Biotechnologies and Development, UNESCO Publications.
6. Biosafety issues related to transgenic crops - DBT guidelines, Biotech Consortium India Limited, New Delhi.(2002)

SEMESTER IV: PROJECT WORK

Course Code: 14PBT4PW
Hours/week: 18
Credit: 5

Max. Marks :100
Internal Marks: 40
External Marks: 60

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