Syllabus for M.Sc., Biotechnology

PG and Research Department of Biotechnology

THANTHAI HANS ROEVER COLLEGE (Autonomous)

Affiliated to Bharathidasan University, Trichy

Nationally accredited by NAAC

Perambalur – 621 220

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

THANTHAI HANS ROEVER COLLEGE (Autonomous), Perambalur – 621220

M.Sc. Biotechnology – Course Structure under CBCS

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

	Course and Subject code	Title of the course	Ins. Hrs/ Week	Credit	Exam hrs	Marks		Total
						Int	Ext	
Semester I	Core Course I (18PBT1CC1)	General Microbiology	6	4	3	25	75	100
	Core Course II (18PBT1CC2)	Biochemistry	6	4	3	25	75	100
	Core Course III (18PBT1CC3)	Cell and Molecular Biology	5	4	3	25	75	100
	Core Course IV (18PBT1CC4)	Enzyme Technology	5	4	3	25	75	100
	Core Practical I (18PBT1CP1)	Practical Covering Core Courses I, II, III and IV	8	4	3	40	60	100
		TOTAL	**30**	**20**				**500**
Semester II	Core Course V (18PBT2CC5)	Genetic Engineering	6	5	3	25	75	100
	Core Course VI (18PBT2CC6)	Immunotechnology	6	5	3	25	75	100
	Core Practical II (18PBT2CP2)	Practical Covering Core Courses V and VI	8	4	3	40	60	100
	Elective Course I (18PBT2EC1:2)	Human Anatomy and Physiology	5	5	3	25	75	100
	Elective Course II (18PBT2EC2:2)	Pharmaceutical Biotechnology	5	5	3	25	75	100
		TOTAL	**30**	**24**				**500**
Semester III	Core Course VII (18PBT3CC7)	Plant Biotechnology	6	5	3	25	75	100
	Core Course VIII (18PBT3CC8)	Animal Biotechnology	6	5	3	25	75	100
	Core Practical III (18PBT3CP3)	Practical Covering Core Courses VII and VIII	8	4	3	40	60	100
	Elective Course III (18PBT3EC3:1)	Biostatistics and Bioinformatics	5	5	3	25	75	100
	Elective Course IV (18PBT3EC4:2)	Stem cell basics and Application	5	5	3	25	75	100
		TOTAL	**30**	**24**				**500**
Semester IV	Core Course IX (18PBT4CC9)	Industrial and Food Biotechnology	5	5	3	25	75	100
	Core Course X (18PBT4CC10)	Environmental Biotechnology and Nanotechnology	5	5	3	25	75	100
	Core Practical IV (18PBT4CP4)	Practical Covering Core Courses IX and X	8	4	3	40	60	100
	Elective Course V (18PBT4EC5:1)	Herbal medicine and Biotechnology for Entrepreneurs	5	4	3	25	75	100
	Project Work* (18PBT4PW)	Project work	7	4	3	-	-	100
		TOTAL	**30**	**22**				**500**
		GRAND TOTAL	**120**	**90**				**2000**

***Note: Project – 100 marks; Dissertation – 80 marks; Viva voce – 20 marks**

List of Elective Courses

Elective Course - I

1. Biophysics
2. Human anatomy and Physiology

Elective Course - II

1. Analytical Tools and Techniques in Biotechnology
2. Pharmaceutical Biotechnology

Elective Course - III

1. Biostatistics and Bioinformatics
2. Cancer Biology

Elective Course - IV

1. Diary technology
2. Stem cell basics and Application

Elective Course - V

1. Herbal medicine and Biotechnology for Entrepreneurs
2. Marine Biotechnology

Semester:I **Course Code: 18PBT1CC1**

Hours: 6 **Credit: 4**

CORE COURSE-I: GENERAL MICROBIOLOGY

Objectives

- To understand about the distribution, classification and life cycle of microorganisms.
- To know about cultivation of microorganism.
- To understand about the sterilization methods and microbial nutrition and growth.

UNIT - I

Introduction to microbiology - Microscopy: Principles and applications of simple, compound, bright field, dark field, phase contrast, fluorescent and electron microbiology. Principles of staining. Nature of dyes, types of staining – simple, differential, negative and spore staining, Sterilization: Principles and methods – physical (moist heat, dry heat, filtration, pasteurization, tyndallization, radiations) and chemical (alcohols, aldehydes, phenols, halogens and hypochlorite).

UNIT - II

Structure of microorganism - Ultra structure of algae, bacteria, fungi, viruses and protozoan, sub cellular structures and cell envelope-slime, capsule, cell wall, cell inclusion, biosynthesis of bacterial cell wall. Cultivation of Virus moulds and yeast.

UNIT - III

Microbial Nutrition and growth - Nutritional requirements-carbon-hydrogen-oxygen-nitrogen-phosphorus and sulphur-growth factors and nutritional types of microorganisms. Microbial growth-culture media - isolation of pure culture. Growth curve: Diauxy – continuous culture-chemostat-turbidostat - synchronized growth. Measurement of microbial growth-Total cell count method-viable cell count method. Effect of environment on microbial growth: temperature-pH-osmotic pressure and Light.

UNIT - IV

Antimicrobial agents - Physical and chemical, Antibiotics (each with one example) affecting cell membrane, nucleic acid synthesis, protein synthesis and metabolism, Mode of action – Kinds of side effects – Antifungal and antiviral drugs, Mechanisms of drug resistance, Bioactive natural products (anti-bacterial, anti-fungal, anti-viral) from macroalgae, marine bacteria, dinoflagellates etc.

UNIT - V

Microbial products - Biofertilizers. Microbes as a source of protein – SCP, Microbes in the production of organic acids – Lactic acid, antibiotics -Penicillin and tetracycline, Enzyme – Amylase and protease.

Text Books

1. Rajan S and Selvi Christy R. Essentials of Microbiology, Anjanaa Book House, Chennai, 2015.
2. Powar and Daginawala. 2010. General Microbiology. Volume I&II. Himalaya Publishing House.
3. Prescott LM, Harley JP, and Klein DA. Microbiology (7th edition) McGraw Hill, Newyork. 2008.

References

1. Davis BD- Dulbecco R-Eisen HN- Ginsberg HS. 1980. Microbiology- Harper Intl. Edition.
2. Pelczar MJ., Jr- Chan ECS- Krieg NR. 2001. Microbiology- Tata McGraw Hill Publishing Co.
3. Tortora, G.J., Funke, B.R. and Case, C.L. 2012. Microbiology - An Introduction. 11th Edition. Pearson Education.
4. Prescott LM- Harley JP- Klein DA. 1996. Microbiology- W.C. Brown Publishers.
5. R.A. Atlas. 1998. Microbiology, Fundamental and Applications. 2nd Edition. McMillan Publishers.

Semester:I **Course Code: 18PBT1CC2**

Hours: 6 **Credit: 4**

CORE COURSE-II: BIOCHEMISTRY

Objectives

- To know about Bio-molecules
- To understand the metabolic pathway of bio molecules.
- To know about structure, properties and functions of bio molecules.

UNIT - I

Carbohydrates - Properties and biological importance of ribose, deoxyribose, glucose, fructose, galactose, lactose, maltose, sucrose, starch, glycogen, cellulose and chitin. Carbohydrate metabolism-glycolysis, gluconeogenesis, HMP Shunt, TCA Cycle. ETC (Mitochondria) – arrangement of electron carriers in the electron transport chain, Oxidative phosphorylation (Chemiosmotic theory), Fate of pyruvate in aerobic and anaerobic condition.

UNIT - II

Lipids - Definition and classification of lipids. Fatty acids-classification, structure and properties. Structure and biological functions of phospholipids, sphingolipids, glycolipids. Steroids. Structure, properties, functions of cholesterol, sex hormones, bile acids, phytosterols and cytosterol. Membrane composition and structure, Fatty acid oxidation. Regulation of fatty acid metabolism, Ketone bodies.

UNIT - III

Proteins and Aminoacids - Biological significance, Structure of Proteins-primary,secondary, tertiary and quaternary- Ramachandran plot. Classification of protein-based on solubility, shape, composition function. Globular proteins. Hemoglobin and myoglobin. Fibrous proteins- keratin and collagen. Properties of proteins in aqueous solutions: Isoelectric pH, electrophoretic mobility, hydrolysis of proteins, denaturation and renaturation of proteins, protein stability and protein folding. Biosynthesis of amino acids. Amino acid deamination-transamination, oxidative deamination; urea cycle & its regulation.

UNIT - IV

Nucleic acid and Vitamins - Structure of Purines, Pyrimidines, nucleosides and nucleotides. DNA double helical structure. A,B and Z forms of DNA. Structure of RNA. RNA-types and biological role. Vitamins classification and Functions.

UNIT - V

Inborn error 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-Nyhan syndrome, Lysosomal storage disorders-Gaucher's disease, Niemann Pick disease.

Text Books

1. Nelson, D.L., Cox, M.M. 2008. Lehninger Principles of Biochemistry, 5th Edition. W.H Freeman and Company, USA.

2. Stryer, L. 2000. Biochemistry, 4th Edition. W.H. Freeman and Company, New York.

3. Voet, D and Voet, J.G. 2012. Biochemistry, 4th Edition. John Wiley&Sons Publishers

References

1. A.L. Lehninger- D.L. Nelson and M.M Cox (2003) - Principles of Biochemistry - Worth publishers- New York.
2. L. Stryer- (2002) - Biochemistry- W.H. Freeman and Co. New York.
3. C. Branden J.Tooze. (1999)- Introduction to protein structure – Publishing Inc.
4. Thomas Devlin (2002) - Textbook of Biochemistry by John publishers.
5. Voet and Voet - Principles of Biochemistry
6. Van Holde and Mathew- Principles of Biochemistry.

Semester:I **Course Code: 18PBT1CC3**

Hours: 6 **Credit: 4**

CORE COURSE-III: CELL AND MOLECULAR BIOLOGY

Objectives

- To understand the molecular events & regulations of cell cycle
- To know the structure and functions of cell organelles
- To know about protein synthesis and DNA replication.

UNIT - I

Cell Biology - Cell Theory-Prokaryotic and Eukaryotic cell structure and Intracellular organelles structure and function Prokaryotic and eukaryotic genome organization. Cytoskeleton. Cell division-Mitosis and Meiosis.

UNIT - II

Transport across cell membrane - Passive & active transport, permeases, sodium potassium pump, Ca^{2+} ATPase pump, ATP dependent proton pumps, co transport, symport, antiport, trans-membrane potential coupled ATP generation, ion-selective gated channel against neuronal cell membrane, Transport into prokaryotic cells, endocytosis and exocytosis.

UNIT - III

Transcription - Prokaryotic and Eukaryotic transcription-RNA polymerase-Transcription factors-mechanism of transcription-Post Transcriptional modifications -inhibitors-RNA splicing, RNA editing. Translation-Elucidation of Codons-mRNA-ribosomes-aminoacyl tRNAsynthetase. Prokaryotic and eukaryotic translation. Regulatory elements in translation-Post-translational modification. Regulation of gene expression - Operon concepts-Lac-Trp, Ara.

UNIT - IV

Structure of Nucleic Acid & Replication - Structure of DNA, different forms of DNA and RNA, Identification of DNA as genetic material-Griffith, Avery, McLeod and McCarthy, Frankel and Singer, Hershey and Chase, Meselson and Stahl experiment, Semi conservative replication, different models of replication in prokaryotes and Eukaryotes. Genetic code.

UNIT - V

DNA repair-DNA damage and repair mechanism, DNA recombination, Mutation and its types, Site directed Mutagenesis. Plasmids (PBR322) Cosmid, transposon in maize and bacteria.

Text Books

1. Bruce Alberts, Alexander Johnson. Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter. 2014. Molecular Biology of Cell. Garland Science publication.

2. Burton E. Tropp. 2012. Molecular Biology - Genes to Proteins. Jones and Bartlett Publishers.

3. David Frifelder. Molecular Biology.2008. Narosa publishing house, New Delhi. 2nd edition.

4. Karp G. Cell and Molecular Biology: Concepts and Experiments. 2010. 6th edition, John Wiley and Sons. Inc.

References

1. S.R. Maloy- J.E. Cronan and D.Friefelder (1994) Microbial Genetics Jones and Bartlett publishers.
2. Watson JD- Hopokins NH- Roberts JW- Steitz JA- Weiner A.M. 2004. Molecular Biology of Gene) Benjamin / Cummings Publishing Company.
3. B. Levin. (2004). Genes VII Oxford University press.
4. D. P. Snustand M. J. Simmons and J. B. Jenkins. (1997). Principles of Genetics John Wiley and sons.
5. George M. Malacinski. 2013. Freifeder's Essentials of Molecular Biology. Norosa Publishing House.
6. Sambaurthy AVSS. Molecular Biology.2008. Narosa publishing house, New Delhi.
7. Channarayappa A. Cell Biology.2010. Universities Press, (India) Pvt. Ltd, Hyderabad, India.

Semester: I **Course Code: 18PBT1CC4**

Hours: 6 **Credit: 4**

CORE COURSE-IV: ENZYME TECHNOLOGY

Objectives

- To know about Enzymes
- To understand the Enzymes activity and kinetics
- To understand the application of Enzymes

UNIT - I

Enzyme Introduction - Classification, nomenclature & general properties, factors, affecting enzyme action pH, Temp, ions, substrate concentration, enzyme concentration, inhibitors, extraction, assay and purification of enzymes, units of activity and kinetics of enzyme catalysed reactions–The transition state.

UNIT - II

Steady state kinetics - Bi substrate and multi substrate reaction-enzyme catalyzed Reaction-different types of inhibitors and activators– Machalies Menton (MM-equations) lineweaver and burke equations, km, kcat and ki value, enzyme specificity – absolute and rigid Specificity, nucleophilic and electrophilic attack.

UNIT - III

Role of co-enzyme in enzyme catalysis - Co-enzyme regeneration, mechanism of enzyme action, eg. Lysozyme, chymotrypsin, DNA polymerase, ribonuclease, LDH and Zymogen, Enzyme activation, allosteric enzymes and metabolic regulations, Clinical and industrial uses of enzymes.

UNIT - IV

Techniques of enzyme immobilization and their applications - Medical, food, leather, Textile and paper industries. Enzyme Engineering. Biosensors- types and its application.

UNIT - V

Industrial utilization of enzymes - Use of soluble enzymes, enzyme reactors, membrane reactors, continuous flow, packed bed reactors, large-scale application of microbial enzymes in food and allied industries. Enzyme therapy.

Text Books

1. Renuga Harekrishnan Biomolecules and Enzymes,
2. Thomas M Devlin. Textbook of Biochemistry with Clinical Correlations, 7th edition, Wiley publisher. 2010.
3. Albert L Lehninger, David L Nelson and Michael M Cox. Lehninger Principles of Biochemistry, 2nd edition, Wiley publisher. 2010.
4. Sathyanarayana U and Chakrapani U. Biochemistry, 4th edition, Elsevier publishers. 2013.

References

1. Blazej, a. &Zemek.j. 1987. Inter Biotech, 87, Enzyme technologies, Elsevier.

2. Murray moo - Young. 1988. Bioreactor immobilized enzyme and cells. Fundamentals and applications, elseyler, applied science.

3. Rehm,h.j and Yeed, g. 1988. Biotechnology, Vol. 7a, Enzyme technology, Elsevier.

4. William, b. Jakoby, 1984. Methods in Enzymology, vol.104, enzyme purification and related techniques.

5. Charlotte W Pratt and Kathleen Comely. Essential Biochemistry, 3rd edition Wiley publisher. 2013

6. Deb AC. Fundamentals of Biochemistry, 10th edition, New Central Book Agency (p) ltd, London. 2011.

7. Rajagopal G. Concise textbook of Biochemistry, 2nd edition, Ahuja Publishing House. 2010.

8. Reginald H Garrett and Charles M Grisham, 5th edition. Biochemistry, Brooks Cole publishers. 2012.

Semester:I **Course Code: 18PBT1CP1**

Hours: 8 **Credit: 4**

CORE PRACTICAL I: PRACTICAL COVERING THE CORE COURSES I, II, III & IV

Objectives

- To learn about the basic principles and techniques involved in Microbiology, Biochemistry and Cell biology.
- To learn about the basic principles and techniques involved in Enzyme technology.

MICROBIOLOGY

1. Preparation of solid and liquid culture media, pure culture techniques- pour plate,spread plate and streak plate.
2. Microscopic observation, staining and identification of bacteria (simple and gram staining) fungi and algae - staining techniques.
3. Motility test.

BIOCHEMISTRY

1. Reaction of carbohydrates: glucose, fructose, lactose and sucrose
2. Qualitative test for amino acid, lipids
3. Estimation of protein by – Lowry method, Bradford method
4. Estimation of serum cholesterol by Zak's method
5. Estimation of glucose by Ortho-toluidine method, total sugars by Anthrone Method.
6. Determination of glycine (Sorensen formal titration), amino acid by ninhydrin Method.
7. Titrimetric determination of sugars by benedict's method

CELL BIOLOGY

1. Isolation of genomic DNA from different sources, human check cells and cauliflower.
2. Isolation of mitochondria
3. Isolation of Chloroplast
4. RNA isolation from yeast cells

5. Quality and quantity checking of DNA and RNA by UV spectrophotometer
6. Isolation of chromosomal DNA from *E-Coli, Bacillus lichemiformis*

ENZYME TECHNOLOGY

1. Quantitative enzyme assay
2. Determination and optimization of physical factors affecting enzyme activity
   a) P^H and b)Temperature,
3. Enzyme activity of salivary amylase
4. Determination of Kinetic constants for enzyme – Kent, Vmax and Km

References

1. Rodney Boyer (2003), An Introduction to Practical Biochemistry, Pearson Education.
2. J. G. Cappuccino and N. Sherman (2004), Microbiology. A laboratory manual, Pearson Education.
3. J. Sambrook and D. W. Russell (2001), Molecular Cloning, Cold Spring Harbour Lab. Press.
4. J.Jayaraman (1988), Laboratory Manual of Biochemistry, Wiley Eastern
5. Wilson and Walker (1994), Practical Biochemsitry by Cambridge University Press
6. J.H. Miller (1992), A short course in Bacterial Genetics Cold Spring Harbor Laboratory.
7. Ed. RGF Murray- WA. Wood and NB krieg (1994), Methods for Genetics and molecular Bacteriology American society for Microbiology.
8. N. Kannan (2003), Handbook of Laboratory culture media- Reagents- Stains and Buffers - Panima Publishers- New Delhi.

Semester: II **Course Code: 18PBT2CC5**

Hours: 6 **Credit: 5**

CORE COURSE-V: GENETIC ENGINEERING

Objectives

- To know about the isolation of nucleic acids
- To understand the character& importance of cloning vectors
- To learn the gene transfer techniques
- To know about genetic engineering

UNIT - I

Introduction to Genetic Engineering - Scope and importance of Genetic Engineering. Tools of Genetic Engineering- Enzymes; Non-specific endo andexo nucleases, DNase, RNase. Restriction modification; restriction endonucleases- types, nomenclature, recognition sequences and mechanism of action. Methylation, RNA modification. Role of Kinases, phosphotases, polynucleotide phosphorylase, polynucleotide kinases. Ligases.

UNIT - II

Gene Cloning Strategies and Construction of Gene Libraries - Cloning from mRNA: Isolation and purification of RNA, synthesis of cDNA, Isolation of plasmids, cloning cDNA in plasmid vectors, cloning cDNA in bacteriophage vectors. cDNA libray. Cloning of genomic DNA: Isolation and purification of DNA, preparation of DNA fragments and cloning. Construction of genomic libraries (Using λ gt 10 and 11 vector). *In vitro* packaging of λ phage.

UNIT - III

Vectors - General characteristics of vectors, Brief account of naturally occurring plasmids. Promoter, MCS, Ori, and marker genes-lac Z. Construction of pBR 322, pUC 18 and 19 vectors and expression vectors.M13 derived vectors, Lambda based vectors, cosmids, phagemids, minichromosomes, BAC's, YAC's, Shuttle vectors, Ti plasmids, vectors for animals-SV40 and Bovine papilloma virus.

UNIT - IV

Labelling and Detection Techniques - Labeling of DNA, RNA and Proteins by radioactive isotopes, non-radioactive labeling, *in vivo* labeling, autoradiography and autofluorography. DNA sequencing by enzymatic and chemical methods, Agarose gel electrophoresis, PAGE, PFGE. Methods of nucleic acid hybridization; Southern, Northern and Western Blotting techniques.PCR and its applications.

UNIT - V

Applications of Genetic Engineering - DNA chips and microarray. Applications of transgenic animals and transgenic plants. Applications in medical field-Recombinant vaccines development. Gene therapy; Molecular basis of genetic diseases, genetic counseling.

Text Books

1. Molecular Biotechnology (2003) by Bernard R. Glick and Jack J.Pasternak., 2nd edition by ASM press.

2. Gene Cloning and DNA analysis (2004) by T.A.Brown 2nd edition. By ASM press.

3. Principles of Gene Manipulation and Genomics (2006) Sandy Primrose. 7th Edition, Black Well Publishers.

References

1. Nicholl D.S.T. Introduction to Genetic Engineering Cambridge (3rd Ed.) University press.UK. 2008..
2. Old R.W., Primrose S.B. Principles of gene manipulation - An introduction to genetic engineering (5th Ed.), Blackwell Scientific Publications, UK. 1996.
3. David S L. Genetics to Gene Therapy – the molecular pathology of human disease (1st Ed.) BIOS scientific publishers, 1994.
4. Ernst-L Winnacker, From Genes to Clones: Introduction to Gene Technology. WILEY-VCH Verlag GmbH, Weinheim, Germany Reprinted by Panima Publishing Corporation, New Delhi. 2003.
5. Benjamin Lewis, Genes VIII (3rd Ed.) Oxford University and Cell Press, NY. 2004.

Semester: II **Course Code: 18PBT2CC6**

Hours: 6 **Credit: 5**

CORE COURSE-VI: IMMUNOTECHNOLOGY

Objectives

- To learn the types of immunity
- To learn about the cells and organs involved in immune system
- To understand the diagnostic process of diseases by immunotechniques

UNIT - I

The Immune System - Introduction - Cells of the Immune system – Innate and Acquired immunity - Primary and secondary lymphoid organs - Nature of antigens - Chemical and molecular basis of antigenecity - Immunogenecity - Haptens - Adjuvants - Primary and Secondary Immune Responses - Theory of Clonal selection.

UNIT - II

Humoral Immunity - B-lymphocytes and their activation - Structure and function of Immunoglobulin - Isotypes of immunoglobulins - Antigen- Antibody interactions - Antibody affinity- avidity; Agglutination - Precipitation - Idiotypic antibodies - monoclonal antibodies - antibody engineering - Generation of antibody diversity - Major Histocompatibility Complex.

UNIT - III

Cell Mediated Immunity - Biology of T lymphocyte - Classification of T lymphocytes - Structure of T Cell Receptor (TCR) - TCR diversity and genetics - Antigen presenting cells (APC) - macrophages - dendritic cells - Origin and functions of APC - Antigen processing and presentation - Cytokines - Cell mediated cytotoxicity - mechanism of T cell and NK cell mediated lysis - Complement- Hypersensitivity.

UNIT - IV

Immunity and Infection Mechanism - Tissue injury and Inflammation- Immunosuppression- Immunological Tolerance - Immunity to infectious agents - Transplantation - Autoimmunity - Tumor Immunology - Vaccines: Conventional- Molecular vaccines -Types of vaccines - Recent trends in Immunology of Infectious diseases.

UNIT - V

Experimental Immunology - Immunodiffusion and Immunoelectrophoresis- Hemagglutination - production of polyclonal and monoclonal antibodies - Western Blotting - ELISA - Radio Immunoassay - FACS.

Text Books

1. A.K. Chakravarty, "*Immunology and Immunotechnolog"y,* Oxford University Press, 2006

2. Richard A.Goldsby, Thomas. J.Kindt, Barbara. A.Osborne, JanisKuby, Immunology, 5th Edition, W.H.Freeman and Company, 2003

References

1. Kuby J- Cameron J- Todd C- Mitchell J-2000 Immunology- W.H. Freeman and Co.
2. Elgert KD- 1996 Immunology: Understanding Immune system- John Wiley and sons.
3. Roitt I- Brostoff- Male- 2001 Immunology- Mosby Publications.

Semester: II **Course Code: 18PBT2CP2**

Hours: 8 **Credit: 4**

CORE PRACTICAL II: PRACTICAL COVERING THE CORE COURSES V AND VI

Objectives

- To learn about the basic principles and techniques involved in molecular genetics and genetic engineering.
- To learn about the basic principles and techniques involved in Immuno technology.

GENETIC ENGINEERING

1. Experiments with lac-operon- induction and assay of beta-galactosidase.
2. Preparation of competent cells and transformation- Transduction-Conjugation
3. Isolation and quantification of Nucleic acids – Bacterial- fungal- animal- plant
4. Restriction digestion of DNA
5. Ligation of DNA fragments.
6. Demonstration of gene transfer techniques- Cloning a gene
7. Agarose gel electrophoresis- purification of DNA fragments.
8. PCR amplifications of bacterial gene.

IMMUNOTECHNOLOGY

1. Blood group - typing.
2. Blood Cell counting. (RBC and WBC counting)
3. Immuno electrophoresis
4. Immuno diffusion
5. Rocket Immuno electrophoresis.
6. ELISA technique
7. Western blotting.
8. Preparation of Ag-Protocols of immunization - methods of bleeding-Routes of administration of antigen.

References

1. J.H. Miller (1992), A short course in Bacterial Genetics by Cold Spring Harbor Laboratory.
2. DM. Glover and BD. Hames (1995), DNA cloning I and II by IRL Pres.
3. MA. Innis- DH- GelfandandD JJ Sninskey (1995), PCR strategies by Acadmic Press.
4. Molecular cloning Volume I- Volume II and Volume III- Academic Press.

Semester: II **Course Code: 18PBT2EC1:2**

Hours: 5 **Credit: 5**

ELECTIVE COURS-I: HUMAN ANATOMY AND PHYSIOLOGY

Objectives

- Acquire comprehensive knowledge of structure and functions of human body.
- The course focuses on anatomical terminology, anatomical identification and physiological processes of human body systems.

UNIT - I

Human organs Anatomical view - Sensory organs: eye, Ear, Nose. Circulatory organ: Heart,Lungs, Kidney, liver. Digestive system: Small and large intestine.

UNIT - II

Respiration - Respiratory organ and its functions. Transport of gases [CO_2+O_2]- Respiratory quotient. Circulation: - Types, Composition, Properties and Functions of blood.

UNIT - III

Excretion - kinds of excretory products - mechanism of urine formation in mammals - Hormonal regulation of excretion. Kidney failure and Transplantation.

UNIT - IV

Nervous tissue - Neuron - Structure, types of neurons. Nerve Impulse - Synapse - Synaptic transmission of impulses-Neuro-transmitters. Receptors - Photoreceptor-eye, structure of retina - visual pigments - Physiology of vision.

UNIT - V

Endocrine glands - structure, secretions and functions pituitary, Hypothalamus, thyroids, Adrenal, Thymus, Islets of Langerhans. Gonad-Testis, Ovary.

Text Books

1. S.C. Rastogi. Essentials of Animal Physiology. New Age International Publishers. 2001.

References

1. Parameswaran, Anantakrishnan and Ananta Subramananiam. Outlines of Animal Physiology, S. Viswanathan [Printers and Publishers] Pvt. Ltd., (1975)

2. Prosser, C.L. Brown. Comparative Animal Physiology, Satish Book Enterprise, Agra - 282 003. (1985)
3. Sambasivaiah, Kamalakararao and Augustine chellappa. A Text book of Animal Physiology and Ecology, S. Chand and co., Ltd., New Delhi - 110 055. (1990)

Semester: II **Course Code: 18PBT2EC2:2**
Hours: 5 **Credit: 5**

ELECTIVE COURSE-II: PHARMACEUTICAL BIOTECHNOLOGY

Objectives

- To create general understanding regarding basic principles involved in modern medicinal/structural chemistry systems.
- To know about Chemotherapeutic drugs

UNIT - I

History & principle of pharmacology - Drug names & classification systems. General principle of drug action - Pharmacokinetics, Pharmacodynamics. Measurement of drug action.

UNIT - II

Chemotherapeutic drugs - Protein Synthesis Inhibitors, Anti-Inflammatory, Antibacterial, Antifungal, Antiviral, Antihelminthic, Anticancer Drugs.

UNIT - III

Production of biological - Human insulin, HGH, Erythropoietins, IFN, TNF, IL, Clotting factor VIII. Synthetic therapy: Synthetic DNA, therapeutic ribozymes, synthetic drugs.

UNIT - IV

Prenatal diagnosis - Invasive Techniques- Amniocentesis, Fetoscopy, Chronic Villi sampling (CVS), Non Invasive Techniques - Ultra Sonography. Diagnosis using protein & enzymes markers, DNA/RNA based diagnostics.

UNIT - V

Tissue Engineering - Skin, Liver, Pancreas. Recombinant vaccines, Cell adhesion based therapy: Integrins, Inflammation.

Text Books

1. S.S. Purohit, Kaknani, Saleja Pharmaceutical Biotechnology.

References

1. Mary J. Myuk, Richard A.Hoarey, Pamala Lippinwitt Williams Pharmacology edition.

2. H.P. Rang, M.M. Pale, J.M. Moore , Churchill Livingston. Pharmacology.

3. Page, Curtis, Sulter, Walker, Halfman Integrated pharmacology. Mosby Publishing Co.

4. N.Murugesh, A concise Text Book of Pharmacology. Sixth edition. Sathya Publishers, Madurai.

5. R.C. Dubey, A Text Book of Biotechnology. S.Chand& Co Ltd, New Delhi.

Semester: III **Course Code: 18PBT3CC7**

Hours: 6 **Credit: 5**

CORE COURSE-VII: PLANT BIOTECHNOLOGY

Objectives

- To learn about the basic principles and techniques involved in plant cell culture
- To understand the concepts of transformation and achievements of biotechnology in Plant systems.
- To learn the Gene cloning techniques
- To learn the Protoplast Culture & Genetic Manipulation
- To understand the importance and applications of Transgenic plants

UNIT - I

Basics of Plant Tissue culture Plant tissue culture techniques - *In-vitro* pollination and fertilization. Embryo culture and its applications. Embryogenesis and organogenesis. Micropropagation, haploids and their applications. Somaclonal variations and applications. Endosperm culture and production of triploids.

UNIT - II

Protoplast Culture & Genetic Manipulation - Introduction to protoplast isolation, culture and regeneration, methods of fusing protoplasts, somatic hybridization. Protoplast and tissue culture manipulation for genetic manipulation of plants.

UNIT - III

Plant Transgenesis - Agrobacterium mediated gene transfer, Agrobacterium based vectors (Ti plasmids and Ri plasmids), viral vectors and their applications. Direct gene transfer methods -electroporation, microinjection and particle bombardment. Characterization of transgenics, screenable and selectable markers. Marker free methodologies and gene targeting.

UNIT - IV

Transgenic plants - Transgenic rice with Vitamin A, transgenic plants with stress tolerance for drought and salinity, crop improvement, herbicide resistance, insect resistance, virus resistance, plants as bioreactors. Genetically modified foods - application, future applications, ecological impact of transgenic plants. Organic food, types of organic food, identifying organic food, organic food & preservatives. Genetic modification in food industry - background, history, controversies over risks, application, future applications.

UNIT - V

Plant Molecular Biology Techniques - Quantitative Real time PCR, Southern blotting, Northern blotting, Western blotting, DNA sequencing methods and their applications. DNA finger printing in plants. Marker assisted selection (MAS) for crop improvement.

Text Books

1. Gamborg O.L and Philips, G.C. 1995. Plant Cell, Tissue and organ culture - Fundamental methods. Narosa Publishing House, New Delhi.

2. Slater A., Scott N.W. and Fowler, M.R. 2008. Plant Biotechnology -The genetic manipulation of plants. 2nd Edition. Oxford University press, USA.

3. H.S. Chawla, 2002. Introduction to Plant Biotechnology. Oxford and IBH P Publishing Co. Pvt. Ltd. New Delhi.

References

1. Phundan Singh. 2013. Principles of Plant Biotechnology. Kalyani Publishers, India.

2. V. Kumaresan. 2015. Applied Plant Biotechnology. Saras Publication, India.

3. Singh. 2014. Plant Biotechnology, 2nd Revised Edition, Kalyani Publishers, India.

4. Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore and James Darnell. 2000. Molecular cell Biology. 4th Edition, W.H. Freeman & Company.

5. Monica. A. Hughes. 1999. Plant Molecular Genetics. Pearson Education limited, England.

Semester: III **Course Code: 18PBT3CC8**

Hours: 6 **Credit: 5**

CORE COURSE-VIII: ANIMAL BIOTECHNOLOGY

Objectives

- To understand the process of *in-vitro* fertilization
- To know the production methods of transgenic animals
- To understand Molecular markers and regulations about the use of Biotechnology.

UNIT - I

Animal Cell, Tissue and Organ Culture - History - Definitions - steps for preparation of cell culture room, culture Environment (Substrate and Media) - Techniques for establishing of cell lines - insect cell culture - organ and embryo culture - cryo preservation - valuable products. Artificial insemination (IUI, ICSI) - Embryo transfer - cloning (DOLLY, MOLLY and POLLY). Nuclear transplantation, *invitro* fertilization technology. Genetic Engineering in animals: Transformation of animal cells – Cloning vectors – RTPCR - animal viral vectors

UNIT - II

Transgenic Animal - Development and uses - mice, cattle, goat, fish and sheep and transgenic pets. Tendered meat production. Transgenic breeding strategies - Molecular farming (products with strategic importance). Insulin production using GMO.

UNIT - III

Pest and Animal Management - Juvenile hormone analogues - pheromones and genetic manipulation. Biotechnology of silkworms. Transgenic silk production - Baculo viruses vector and foreign gene expression. Biotechnological approach to the production of live feed.

UNIT - IV

Molecular Markers - Use of nucleic acid probes and antibodies in clinical diagnosis and tissue typing. Mapping of human genome – HGP (Human genome project), RFLP, RAPD and its applications. Genetic engineering approaches for the correction of genetic disorders. Human cloning, Gene silencing. Animal right activities Blue cross in India - Society for prevention of cruelty against animals. Ethical limits of Animal use - Human Rights and Responsibilities. Proteomics in disease biomarkers identification.

UNIT - V

Regulating the use of Biotechnology - Regulating DNA technology - DNA barcoding. Regulating food and food ingredients. Human gene therapy. Initial public concerns - accumulation of defective genes in future generation. Future of gene therapy.Patenting Biotechnology inventions - patenting multi-cellular organisms.

Text Books

1. B Singh, SK Gautam and MS Chauhan. 2015. Textbook of Animal biotechnology. Teri Publication.

2. M.K. Sateesh. 2010. Biotechnology: V: (Including Animal Cell Biotechnology, Immunology and Plant Biotechnology). 2nd Edition. New Age International Pvt. Ltd. Publishers.

References

1. Harrison, M.S. and Bal, I.R. 1997. General techniques of all culture Cambridge University press.

2. Prasash M. and Arora. C.K. 1998. Plant tissue culture, Ammol publication Pvt. Ltd.

3. Darling D.C. and Morgan S.J. 1994. Animal cells, culture Media. Wiley, New York.

4. R. Ian Freshney. 2010. Culture of Animal cells & Manual of basic technique. 6th Edition. Wiley – Blakwell publication.

5. Bernard B. Glick, Jack J. Pastunak. 2009. Molecular Biotechnology principles and application of Recombinant – DNA.

6. R. Sasidhara. 2006. Animal Biotechnology. MJP publishers.

7. Bobert Matheson. 1994. Entomology- an introductory course. 2nd Edition. Comstock Publishing Company.

Semester: III **Course Code: 18PBT3CP3**

Hours: 8 **Credit: 4**

CORE PRACTICAL-III: PRACTICAL COVERING THE CORE COURSES VII AND VIII

Objectives

- In this course is planned to give hands on training on plant & animal tissue culture.
- To learn about the basic principles and techniques involved in plant and animal cell culture.
- To know about Gene isolation and estimation techniques.

PLANT BIOTECHNOLOGY

1. Introduction to the laboratory and general Safety Practices for plant cell, Plant growth and development. Laboratory Report Guidelines (Theory & Demo).
2. Aseptic culture techniques for establishment and maintenance of cultures (Hands on).
3. Tissue culture media preparation: Preparation of stock solutions of Murashige Skoog basal medium and plant growth regulator stocks (Hands on).
4. Mechanical isolation of protoplast. Enzymatic isolation of protoplast and culture (Hands on).
5. Isolation of plant genomic DNA by modified CTAB method (Hands on).
6. Transformation of leaf discs with Agrobacterium (Hands on).
7. Expression of foreign genes into plant cells: use of Agrobacterium tumefaciens (Theory).
8. Morphogenesis in tobacco leaf tissue (Hands on).
9. Regeneration abilities of the Shoot Apical Meristem (SAM).
10. Preparation of chloroplast from leaves (Hands on).
11. Effect of different light wavelengths on germinating corn embryos (Hands on).
12. Measurement of photosynthesis (Hands on).
13. Separation of thylakoid and stromal proteins by SDS-Gel electrophoresis. .

ANIMAL BIOTECHNOLOGY

1. Isolation of DNA from Animal liver.
2. Isolation of DNA from human cheek cells.
3. Isolation of DNA from blood.

4. Quantification of DNA by spectrophotometeric method.
5. Size analysis of DNA by Agarose gel electrophoresis.

References

1. M. S. Clark. 1997. Plant Molecular Biology: A Laboratory Manual. Springer-Verlag.

2. Slater A., Scott N.W. and Fowler, M.R. 2008. Plant Biotechnology - The genetic manipulation of plants. 2nd Edition. Oxford University press, USA.

3. H.S. Chawla, 2002. Introduction to Plant Biotechnology. Oxford and IBH P Publishing Co. Pvt. Ltd. New Delhi.

4. Monica. A. Hughes. 1999. Plant Molecular Genetics. Pearson Education limited, England.

5. Harrison, M.S. and Bal, I.R. 1997. General techniques of cell culture. Cambridge University press.

6. Prasash M. and Arora. C.K.. 1998. Plant tissue culture, Ammol publication Pvt. Ltd.

7. Darling D.C. and Morgan S.J. 1994. Animal cell culture Media. Wiley, New York.

Semester: III **Course Code: 18PBT3EC3:1**
Hours: 5 **Credit: 5**

ELECTIVE COURSE-III: BIOSTATISTICS AND BIOINFORMATICS

Objectives

- To learn the fundamentals of bio informatics
- To learn the tabulation and statistical representation of data
- To know the intellectual rights

UNIT - I

Biology in the computer age - Computational Approaches to Biological questions.Basics of computers – servers, workstations, operating systems, Unix, Linux. World Wide Web. Search engines, finding scientific articles - Pubmed – public biological databases.

UNIT - II

Genomics - Sequence analysis - Sequencing genomes - sequence assembly - pairwise sequence comparison - genome on the web - annotating and analyzing genome sequences. Genbank - sequence queries against biological databases - BLAST and FASTA - multifunctional tools for sequence analysis. Multiple sequence alignments, Phylogenetic alignment - profiles and motifs.

UNIT - III

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 3D structure - protein modeling.

UNIT - IV

Biostatistics-I: Introduction - Population and sample - Variables - Collection and presentation of data - Descriptive statistics - Measures of Central tendency - mean (arithmetic, harmonic and geometric) median and mode - Measures of dispersion - range, mean deviation, variance and standard deviation.

UNIT - V

Biostatistics-II: Inferential statistics - Probability and distributions - Poisson, Binomial and Normal distribution - Chi-square test - Hypothesis test - Student’s t-test - Correlation and Regression - ANOVA-SPSS Software Package.

Text Books

1. HH Rashidiand LK Buehler (2002). Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London.

2. Arora PN and Malhon PK (1996). Biostatistics. Himalaya Publishing House, Mumbai.

References

1. W.J. Ewens, Gregory Grant, (2005). Statistical Methods in Bioinformatics: An Introduction (Statistics for Biology and Health), Springer.
2. Bryan Bergeron, (2003). Bioinformatics Computing First Indian Edition, Prentice Hall.
3. Cynthia Gibas and Per Jambeck (2001). Developing Bioinformatics Computer Skills: Shroff Publishers and Distributors Pvt. Ltd (O'Reilly), Mumbai.
4. HH Rashidiand LK Buehler (2002). Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London.
5. Des Higgins and Willie Taylor (2002). Bioinformatics: Sequence, structure and databanks, Oxford University Press.
6. Baxevanis AD and Ouellette BEF (2001) Bioinformatics: A practical guide to the analysis of genes and proteins, Wiley Interscience – New York.
7. Arora PN and Malhon PK (1996). Biostatistics. Himalaya Publishing House, Mumbai.
8. Sokal and Rohif (1973). Introduction to Biostatistics, Toppan Co. Japan.
9. Stanton A and Clantz, Primer of Biostatistics (2005). The McGraw Hill Inc., New York.

Semester: III **Course Code: 18PBT3EC4:2**
Hours: 5 **Credit: 5**

ELECTIVE COURSE-IV: STEM CELL BASICS AND APPLICATION

Objectives

- To strengthen the knowledge of students on Stem cell basics and their applications for the benefit of mankind
- To impart knowledge about stem cell culturing and stem cell signaling.

UNIT - I

Fundamentals of stem cell biology - Embryogenesis - Developmental stages - properties of stem cells - pluripotency - totipotency. Definitions and molecular mechanisms factors that dictate stem cell behaviour. Identification and characteristic of pluripotent stem cells in animal and humans.

UNIT - II

Embryonic Stem Cells - *In vitro* fertilization - culturing of embryos - isolation of human embryonic stem cells - growing ES cells in labs- stimulation ES cells for differentiation - identification - properties of ES cells. **Germ Line Stem Cell -** Determination of the Germ Line; Identification, Characterization and Purification of Germ Line Stem cells; Germ Line Stem cell Niche;Establishment of Germ Line cells *in vitro* - Properties of Germ Line Stem cells.

UNIT - III

Adult stem cell - Somatic stem cells - test for identification of adult stem cells - adult stem cell differentiation - trans differentiation - plasticity - different types of adult stem cells - properties of adult stem cell**.**

UNIT - IV

Gene therapy, application and preparative medicine - Gene therapy - stem cells and animal cloning, introduction to modeling cell behaviour unique characteristic of stem cell and modeling of signal transduction. Mechanisms for stem cell manipulation in controlled microenvironments. Therapeutic applications and reparative medicine - parkinson disease - neurological disorder - limb amputation – heart disease - spinal cord injuries - diabetes - burns- HLA typing - Alzheimer’s Disease.

UNIT - V

Stem cell - based tissue regeneration and ethical issue - Tissue engineering application - production of complete organ - kidney - eyes - heart - brain. Establishment of human stem cell bank. Stem cell policy and ethics, stem cell research: Hype, hope and controversy.

Text Books

1. Kursad Turksen, Embryonic Stem cells - Protocols, 2nd Edition, Humana Press, 2002.

2. Stem cell and future of regenerative medicine. By committee on the Biological and Biomedical applications of Stem cell Research. National Academic press, 2002.

References

1. AriffBongso, EngHin Lee "Stem Cells: From Bench to Bedside" World Scientific Publishing Company. 2005.
2. C S Potten "Stem Cells" Elsevier,1996.
3. Daniel R. Marshak "Stem cell biology" Cold Spring Harbor Laboratory Press.
4. Robert Lanza "Essentials of Stem Cell Biology" Elsevier, 2009.
5. Peter Quesenberry "Stem cell biology and Gene Therapy" Wiley-Liss,1988.

Semester: IV **Course Code: 18PBT4CC9**

Hours: 5 **Credit: 5**

CORE COURSE-IX: INDUSTRIAL AND FOOD TECHNOLOGY

Objectives

- To learn the process of fermentation
- To learn the production of industrial and food products
- To know the applications of Enzymes in various industries
- To learn the food processing and preservation

UNIT - I

Introduction to white biotechnology - Isolation and screening of industrially important microbes. Strain improvement - mutation and recombination. Media/substrates for industrial fermentation/process - typical media, media formulation, water, energy and carbon sources, nitrogen sources, minerals, growth factors, buffers, precursors, inhibitors, inducers and antifoams. Preservation of industrially important micro organisms.

UNIT - II

Fermentation and fermentor/bioreactor design - Concepts of basic modes of fermentation - Batch, Fed batch and Continuous fermentation. Fermentor/Bioreactor design and operations - basic function, design, components and body construction. Sterilization of Fermentor/Bioreactor - air and media sterilization. Bioprocess control and monitoring - control and monitoring of variables such as temperature - pH - aeration - agitation - pressure -computers in bioprocess control system.

UNIT - III

Types of fermentors and Products - Mechanical - Stirred tank bioreactors, Airlift fermentors, photo bioreactors, packed bed bioreactor, tower fermentors, and cylindro conical fermentor. Industrial production: Production of enzymes-amylases and proteases. Acetone - Butanol - fermentation. Antibiotic production - penicillin, streptomycin and tetracycline. Amino acid - Lysine and glutamic acid. Vitamin production - Vitamin B12. Organic acid production - citric acid and Acetic acid.

UNIT - IV

Microbiology of Food - Sources and activity of microorganisms associated with food. Food fermentation, Food borne diseases - infections and intoxications. Food spoilage -causes. Food Preservation: Use of high temperatures - sterilization, pasteurization, blanching, canning

concept, procedure and application; Low temperature storage - freezing curve characteristics. Factors affecting quality of frozen foods. Irradiation preservation of foods.

UNIT - V

Manufacture of Food Products - Bread and baked foods. Dairy products - milk processing, cheese, butter, ice-cream. Vegetable and fruit products. Edible oils and fats. Meat, poultry and fish products. Confectionery, beverages.

Text Books

1. Wulf Cruger and Anneliese Crueger, (2003) Biotechnology: A Textbook of Industrial Microbiology, Panima Publishing Corporation.
2. Stanbury, A.H., A. Whittaker and Hall S.J. 1995. Principles of fermentation technology 2nd edition, Pergamon Press.
3. Sivasankar, B. 2002. Food processing and preservation. Prentice Hall, New Delhi.

References

1. Glazer, A N. and Nikaldo, H.1995 Microbial Biotechnology -W H Freeman and company network.
2. Prescott, L M., Harley, J P and Klein, D A.1999. Microbiology 4th edition Mc Graw Hill.
3. Casida L.E. (1968) Industrial Microbiology, JohnWiley and Sons.
4. Arnold L. demainand Julian E. Davis. (2004) Industrial Microbiology and Biotechnology ASM Press.
5. Emt.El - Mansi and CFA. Bryce (2004). Fermentation Microbiology and Biotechnology Taylor and Francis Ltd.
6. Frazier, W.C. and Westhoff, D.C. 1988. Food Microbiology, 4th Edition. McGram-Hill, New York.
7. Pyke, M. 1981. Food Science and Technology, 4th Edition. John Murray, London.

Semester: IV **Course Code: 18PBT4CC10**

Hours: 5 **Credit: 5**

CORE COURSE-X: ENVIRONMENT BIOTECHNOLOGY AND NANOTECHNOLOGY

Objectives

- To know about types of Pollution and its control
- To plan to give an idea about Solid waste management
- To know about biodiversity and its conservation
- To expose the students to biological nano structures with characterization and their applications for Drug delivery, diagnostics, Imaging and development of sensors.
- To Synthesis of nonmaterial, characterization and their application is also planned.

UNIT - I

Introduction to Pollution - Introduction - Types of pollution - Air, water, sound pollution. Measurement of pollution. Global environmental problems - ozone depletion, green house effect and acid rain. Control of pollution through Biotechnology.Biotechnological approaches for industrial waste water treatment - dairy, distillery, tannery, sugar, and pharmaceutical industries. Biodegradation of inorganic and organic wastes, lignin, tannin. Bioremediation of oil spills. Biomonitoring of water pollution using algae, bacteria, plankton. Management for effluent toxicity, heavy metal pollution, thermal and radioactive pollution.

UNIT - II

Solid waste management - Types of solid wastes. Solid waste characteristics and its impact on environment. Solid waste disposal - land filling, incineration, composting, mushroom farming, vermiculture and biogas production. Processing of sugar factory wastes, residential and municipal wastes, coir wastes and mycostraw wastes. Biodegradation of xenobiotics compounds. Biotechnological methods for hazardous waste management.

UNIT - III

Conservation Biotechnology - Biodiversity - types, uses and values. Loss of Biodiversity. Conservation and sustainable management of Biodiversity - In situ and Ex-situ ecorestoration. Environmental and biodiversity laws, environmental education.

UNIT - IV

Synthesis of Nano Materials and Characterisation - Definition of a nano system - dimensionality and size dependent phenomena, Quantum dots, Nanowires and Nanotubes. Methods for synthesis of Nanoscale Materials. Basic concepts and properties of nanostructured

materials. Gold Nanoparticles. Nanopores. Characterisation of Nanomaterials: Scanning electron microscopes, transmission electron microscopes, Nuclear Magnetic Resonance Spectroscopy.

UNIT - V

Applications of nanotechnology - Nanosensors - types and its applications. Nanocarriers for Drug Delivery - Polymeric Nanoparticles as Drug Carriers. Micelles for Drug Delivery. Micro-array and Genome Chips. Microemulsions as Drug Delivery Vehicles. Lipoproteins as Pharmaceutical Carriers. Solid Lipid Nanoparticles as Drug Carriers. Nanocapsules- preparation, characterization and therapeutic Applications. Nanomedicine- Nanotechnology for Cancer Research and Therapy. Environmental Nano Remediation Technology - Thermal, Physico-Chemical and Biological Methods. Nano Filtration for the Treatment of Wastes, Removal of Organics, Inorganics and Pathogens. Nanotechnology for Water Purification.

Text Books

1. Jogdand, S.N. 1995. Environmental Biotechnology. 1st Edition. Himalaya Publishing House, Bombay.

2. Technoglous, G., Burton, F.L. and Stensel, H.D. 1995. Wastewater Engineering – Treatment, Disposal and Reuse. 3rd Edition. Metcalf and Eddy, Inc., Tata Mc Graw Hill, New Delhi.

3. Jain, K.K. 2006. Nanobio-Technology in Molecular Diagnostics: Current Techniques and Applications. Horizon Biosciences, India.

4. Parag Diwan and Ashish Bharadwaj. 2006. Nano Medicines Pentagon Press. ISBN 81-8274-139-4.

References

1. Alan Scragg. 1999. Environmental Biotechnology. Pearson Education Limited, England.

2. De, A.K. 2004. Environmental Chemistry. Wiley Eastern Ltd. New Delhi.

3. Allsopp, D. and K.J. Seal. 1986. Introduction to Biodeterioration. ELBS/Edward Arnold, London.

4. Ratner, M. and Ratner, D. 2005. Nanotechnology: A Gentle Introduction to the Next Big idea. Pearson Education, Inc. NJ, USA.

5. Christef M. Niemeyer, C. A. Mirkin. 2004. Nanobiotechnology: Concepts, Application and Properties. Wiley - VCH Publishers, New York.

6. Tuan Vo-Dinh. 2007. Nanotechnology in Biology and Medicine: Methods, Devices and Applications. Taylor and Francis Inc., London.

7. Pradeep, T. 2006. NANO. Tata McGraw Publishers, New Delhi,India.

8. Challa S.S.R. Kumar (Ed). 2006. Biological pharmaceutical Nanomaterial, WileyVCH Verlag Gmbh & Co, KgaA. Weinham, Germany.

9. Vladimir P.Torchilin (Ed.). 2006. Nanoparticulates as Drug Carriers. Imperial College Press, North Eastern University, USA. ISBN 1-86094.

Semester: IV **Course Code: 18PBT4CP4**
Hours: 8 **Credit: 4**

CORE PRACTICAL-IV: PRACTICAL COVERING CORE COURSES IX AND X

Objectives

- To know about isolation of industrially important micro organisms
- To learn the production of industrial and food products
- To learn the process of fermentation
- To strengthen the knowledge of students on Stem cell basics and their applications.
- To impart knowledge about stem cell culturing and stem cell signaling

INDUSTRIAL AND FOOD TECHNOLOGY

1. Isolation of industrially important microorganisms.
2. Isolation and enumeration of lactic acid bacteria.
3. Wine production by yeast - setting up a lab experiment.
4. Estimation of alcohol content by colorimetric method
5. Enzyme production - amylase production.
6. Production of organic acids - citric acid production.
7. Antibiotic production by different strains of microbes (Theory).
8. Immobilization of yeast cell by alginate beads
9. Visit to Distillery unit; alcohol production and pharmacological industries. Pasteur Institute (Field visit).
10. Isolation & identification microbes from spoiled food.
11. Production of butter.
12. Production of Beer

ENVIRONMENTAL BIOTECHNOLOGY AND NANO TECHNOLOGY

1. Detection of coli forms for determination of purity of fresh water.
2. Determination of total dissolved solids of sewage.
3. Determination of COD and BOD of sewage samples.
4. Estimation of nitrates in soil.
5. Study of biogenic methane production in different habitats. (Demo)
6. Estimation of chloride in soil.
7. Silver nano particle synthesis from microbes (Theory)
8. Gold nano particle synthesis from microbes (Theory)

References

1. E. Mans, E.M.T, C.F.A. Bryce, Taylor and Francis, UK. 2002. Fermentation technology and Biotechnology.

2. Ghose, T.K and P.Ghose. 2003. Biotechnology in India. Springer Publishers, India.

3. Glazer, A.N and H. Nikaido. 1995. Microbial Biotechnology. W.H. Freeman and Co., New York.
.
4. Stanbury, P.F., A. Whitaker ans S.J. Hall. 1995. Principles of fermentation Technology, Pergamon, UK.

5. Wolf. Cruzer and Annalise Cruzer. 2000. Biotechnology Text Book of Industrial Microbiology. Panima Publishing House, New Delhi.

6. Patel, A.H. 2001. Industrial Microbiology, Mac-Millan India Ltd.

Semester: IV **Course Code: 18PBTEC5:1**

Hours: 5 **Credit: 4**

ELECTIVE COURSE-V: HERBAL MEDICINE AND BIOTECHNOLOGY FOR ENTREPRENEURS

Objectives

- This purpose of this course is to give an understanding about medicinal plants
- This purpose of this course is to give an learning about various medicinal plants
- This purpose of this course is to give an understanding about biotechnology based entrepreneurship among students.

UNIT - I

Herbal medicine - Definition, history and its scope - Importance of medicinal plants - role in human health care. Classification of medicinal plants.traditional system of medicine - Siddha,Ayurvedha,unani and Chinese system

UNIT - II

Traditional knowledge and utility of some medicinal plants in Tamilnadu - *Solanum trilobatum, Cardiospermum halicacabum, Vitex negundo, Adathoda vasica, Azadirachta indica, Gloriosa superba, Eclipta alba, Aristolochia indica*, *Phyllanthus fraternus* and *Catharanthas roseus.*

UNIT - III

Plants in day today life - *Ocimum sanctum, Centella asiatica,Cassia auriculata, Aloe vera.* Nutritive and medicinal value of some fruits (Guava, Sapota, Orange, Mango, Banana, Lemon, Pomegranate) and vegetables - Greens (*Moringa,Solanum nigrum* Cabbage).

UNIT - IV

Introduction to Entrepreneurship - Entrepreneurship definition, factors necessary for entrepreneurship, biotech company road map, legal, regulatory and other business factors. Generation of Fund: Funding of biotech business, funding agencies in India support mechanisms for entrepreneurship Role of knowledge centers and R&D (knowledge centers like universities and research institutions, role of technology and upgradation).

UNIT - V

Biotech enterprises - Setting up Small, Medium & Large scale industry, Quality control in Biotech industries, Location of an enterprise, steps for starting a small industry, incentives and subsidies, exploring export possibilities.

Text Books

1. Ethnobiology – R.K.Sinha & Shweta Sinha. Surabhe Publications – Jaipur. 2001.
2. D. Hyne & John Kapeleris. 2006. Innovation and entrepreneurship in Biotechnology: Concepts, theories & cases.
3. Richard Dana Ono. 1991. The Business of Biotechnology: From the Bench of the Street. Butterworth- Heinemann.
4. Martin Grossmann. 2003. Entrepreneurship in Biotechnology: Managing for growth from start-up to Initial Public Offering.

References

1. Tribal medicine - D.C. Pal & S.K. Jain Naya Prakash, 206, Bidhan Sarani, Calcutta , 1998.
2. Contribution to Indian ethnobotany - S.K. Jain, 3rd edition, Scientific publishers, B.No. 91, Jodhpur, India. 2001.
3. A Manual of Ethnobotany - S.K.Jain, 2nd edition, 1995.
4. Yali Friedman. 2008. Best Practices in Biotechnology Education. LogosPress.
5. Robert Nicholas Trigiano and Dennis John Gray. 2004. Plant Development and Biotechnology, CRC Press. 358 pages.
6. Vasant Desai. 2005. Dynamics of Entrepreneurial Development and Management. 6th Edition. Himalaya Publishing House, 2005.
7. Prasannan Projects Planning Analysis, Selection, Implementation & Review. 7th Edition.

Semester: II **Course Code: 18PBTEC1:1**

Hours: 5 **Credit: 5**

ELECTIVE COURSE-I: BIOPHYSICS

Objectives

- To know about structures of macromolecules
- To learn structural analysis of macromolecules
- To learn the biophysical techniques in macromolecules

UNIT - I

Introduction - Levels of structures in Biological macromolecules. Basic strategies in biophysics.

UNIT - II

Conformational Analysis - Forces that determine protein and nucleic acid structure, basic problems, polypeptide chains geometrics, potential energy calculations, observed values for rotation angles, hydrogen bonding, hydrophobic interactions and water structures ionic interactions, disulphide bonds.

UNIT - III

Structural Analysis of Macromolecules - Prediction of proteins structure, nucleic acids, general characteristics of nucleic acid structure, geometrics, glycosidic bond rotational isomers and those puckering backbone rotational isomers and ribose puckering forces stabilising ordered forms, base pairing, base stacking tertiary structure of nucleic acids.

UNIT - IV

Kinetics of Ligand Interaction - Biochemical Kinetics studies, unimolecular reactions, simple biomolecular multiple intermediates, steady state kinetics, catalytic efficiency, relaxation spectrometry, ribonuclease as an example.

UNIT - V

Techniques for the Study of Biological Structure & Function - Size and shape of macromolecules, methods of direct visualisation, macromolecules ashydrodynamic particles, macromolecular diffusion, ultracentrifugation, Viscometry, X-ray crystallography – X–ray diffraction, determination of molecular structures ,electron microscopy, neutron scattering, light scattering.

Text Books

1. Cantor R., Schimmel P.R., Biophysical Chemistry, Vol. I, II, W.H. Freeman & Co.1985.

References

1. Daniel. M, Basic Biophysics for Biologists, 1998.
2. Kensal E.Van Holde, W.Curtis Johnson and P.Shing Ho, Principles of Physical Biochemistry, 2nd Edition, Prentice Hall, New York 2004.
3. Jones, D.W., Introduction to Spectroscopy of Biological Polymers, Academic Press, New York, 2003.

Semester: II **Course Code: 18PBTEC2:1**

Hours: 5 **Credit: 5**

ELECTIVE COURSE-II: ANALYTICAL TOOLS AND TECHNIQUES IN BIOTECHNOLOGY

Objectives

- To know about structures of macromolecules
- To learn structural analysis of macromolecules
- To learn the biophysical techniques in macromolecules

UNIT - I

Principles and applications of microscopy and Spectroscopy - Light, phase contrast, fluorescence, scanning and transmission electron microscopy. UV, visible, infrared, CD, NMR spectroscopy. Spectrofluorimetry and mass spectrometry, X-ray diffraction. Flow cytometry.

UNIT - II

Principles and applications of Chromatography and centrifuge - Gel-filtration, ion-exchange and affinity chromatography. TLC, GCMS and HPLC. Basic principles of sedimentation. Applications of preparative and analytical and ultra centrifuges.

UNIT - III

General principles of electrophoretic techniques - Poly Acryl amide Gel Electrophoresis. Isoelectric focusing. Immuno electrophoresis 2-D Electrophoresis. Capillary electrophoresis. Agarose gel electrophoresis of DNA and RNA.

UNIT - IV

Radioactive isotopes - Detection and measurement of radioactivity. Applications of radioisotopes in biological sciences. Autoradiography. GM counter liquid and solid Scintillation. Non-isotopic tracer techniques. Principles and range of electrochemical techniques. Operation of pH electrodes. Principles and applications of Ion-selective and gas sensing electrodes. Oxygen electrodes.

UNIT - V

Techniques in Biotechnology - Methods of gene sequencing – Maxam - Gilberts and Sanger's dideoxy chain termination methods; Polymerase chain reaction technique (PCR), Blotting techniques. RFLP and RAPD. DNA finger printing.

Text Books

1. Analytical Biochemistry by David J.Holme (Long man).
2. Biophysical chemistry principles and techniques by Upadyay, Upadyay and Nath, (Himalaya publishing).
3. Biophysical chemistry principles and techniques by Keithwilson and Walker.

References

1. A Biologists guide to Principles and techniques of practical Biochemistry. Ed.by.B.D.williams
2. Instrumental methods of chemical analysis by G.K.Sharma (Goel).
3. Modern experimental Biochemistry by Rodney Boyer (Pearson Education).
4. Physical Biochemistry by Frefielder (Freeman & Co).
5. Instrumental methods of chemical analysis by Chatwal & Anand.

Semester: III **Course Code: 18PBT4EC3:2**

Hours: 5 **Credit: 5**

ELECTIVE COURSE-III: CANCER BIOLOGY

Objectives

- To know about human cancer
- To learn Molecular genetics of cancer
- To learn the diagnosis and treatment of cancer

UNIT - I

Charecteristics of human cancer - Classification of human cancer, features of cancer-causes of cancer - carcinogens,genetic susceptibility, multiple mutation, DNA repair mechanism, Epidemiology of human cancer.

UNIT - II

Biochemistry and cell biology of cancer - Growth charecteristics of malignant cells, modification of extacellular matrix component cells - Extacellular matrix and cell – cell adhesion, cell cycle regulation, Apoptosis, Growth factor, signal transduction mechanism angiogenesis, biology of human metastasis.

UNIT - III

Molecular genetics of cancer - Chromatin structure and function, Split genes and RNA processing, genetic recombination, gene amplification, DNA methylation, Genomic imprinting, oncogenes, Tumor suppressor genes, mechanism of gene silencing, Genetherapy of cancer

UNIT - IV

Cancer diagnosis - Tumor markers, Gene expression microarray, proteomic method, Molecular imaging, Nanotechnology, Pharmacogenomics.

UNIT - V

Tumor prevention - Diet and cancer prevention, Chemoprevention - Molecular targets of chemoprevention, Immunotherapy, Radiation therapy: Advantages and limitation.

Text Books

1. Maly B.W.J .Virology: A Practical approach IRL Press, Oxford, 1987.

References

1. Margaret A. Knowles, Peter J Selby, An Introduction to Cellular and Molecular Biology of Cancer, 4th Edition, Oxford Medical Publication, 1991.

2. Dunmock N.J and Primrose S.B; Introduction to Modern Virology, Blackwell Scientific publication, Oxford, 1988.

Semester: III **Course Code: 18PBTEC4:1**

Hours: 5 **Credit: 5**

ELECTIVE COURSE-IV: DAIRY TECHNOLOGY

Objectives

- To learn the production of Industrial dairy products
- To learn the process of fermentation
- To know the applications of Enzymes in various industries

UNIT - I

Dairy Chemistry and Microbiology - Introduction, Basic dairy terminology, milk as raw material, composition, food value, contaminants, milk reception in dairies and tests, Quality and Quantity tests at reception, Cell count and other tests, Milk transport and storage in dairy plants, Cholesterol, fatty acids and their relation to cardiovascular diseases - Dietary recommendations - Applications of enzymes in dairy industry

UNIT - II

Dairy Processing Equipments - Milk processing terminology, Processing flow sheet, Equipment employed, Pasteurisers (Heat Exchangers), Plant piping, Pumps, Cream separating Centrifuges, Homogenizers,Bottle and pouch fillers, Milk Chillers, Ice Cream Freezers. Vacuum Evaporators, Spray and Drum Dryers, Product instantizing equipment. Packaging of milk in bottles and sachets.

UNIT - III

Manufacture of Dairy Products - Cheese – Types of cheese, Defects in cheese, Manufacture of paneer, Toned Milk, Sweetened Condensed milk, Khoa, Milk powder – Quality aspects**.**

UNIT - IV

Manufacture of Ice Cream and other Dairy Products - Manufacture of Ice cream - Chemistry and technology-Microbiology of ice cream-Quality aspects-Manufacture of Butter, Ghee-Grading of butter-Quality aspects-Extraction of casein from milk, properties, composition and industrial uses Production of lactose and whey

UNIT - V

Fermented dairy products - Fermented products - Yoghurt, Curd, acidophilus milk etc Energy use in Dairy plant, sources of energy, cost of energy, Control of energy losses and Energy conservation.

Text Books

1. National Institute of Industrial Research, Modern Technology of Milk processing and Dairy products, II Edition, NIIR Publications, India, 2004.

2. Tufail Ahmad: Dairy Plant Systems Engineering Kitab Mahal, Allahabad, India (1985).

References

1. Arthur W. Farral: Engineering of Dairy and food Products (II Edition 1970) Robert E. Krieger Publishing Co. NY
2. Garret Smit : Dairy Processing (Improved Quality) Woodhead Publishing Ltd. CRC Press (2003).
3. W.M. Clunie Harvey and Harry Hill: Milk Products Bio Tech Books, New Delhi (1999)
4. Prof. H.G. Kessler: Food Engineering and Dairy Technology Verlog Kessler Publishing House, Germany (1981).
5. W. James Harper and Carl W. Hall: Dairy Technology and Engineering AVI Publishing, Westport, USA (1976)
6. Edger Spreer: Milk and Dairy Product Technology Mercel Dekkar Inc. New York, USA (2005).

Semester: IV **Course Code: 18PBT4EC5:1**

Hours: 5 **Credit: 4**

ELECTIVE COURSE-V: MARINE BIOTECHNOLOGY

Objectives

- To know about Marine biodiversity
- To know about Aquaculture
- To know the applications of marine organisms

UNIT - I

Introduction to marine microbes in the ocean - Marine biodiversity: Diversity & adaptation - Euphotic - mesopelagic - bathopelagic- benthos - deep sea. Marine microbial diversity: Marine microbial habitats - Microbial distribution in the oceans - Macro ecological theory and ocean microbes - Factors that impact marine microbial diversity - Interactions between marine microbes and marine macro organisms - Symbiosis with invertebrates - Microbial effects on the ecology and life history of marine invertebrates- Marine viruses.

UNIT - II

Aquaculture and biotechnology - Importance of aquaculture-Criteria of selection of species for aquaculture. Culture practices of milkfish, mullets and sea bass. Monoculture, polyculture and integrated fish farming. Culture practices of tiger shrimp, *Macrobrachium rosenbergi*, crabs and lobsters. Culture practices of edible oyster, pearl oyster and mussel. Culture practices of Seaweeds. Fish genetics: gynogenesis, androgensis, polyploidy, control of sex, artificial insemination, eye stalk ablation. Transgenesis and DNA Vaccine development for aquacultured fish, cryopreservation.

UNIT - III

Biomedical importance of marine organisms - Screening for new metabolites from marine microorganisms - Production of useful chemicals by marine microalgae - Bioenergy production- Marine enzymes - Fatty acids from lipids of marine organisms. Marine pharmacology: Potentialities in the treatment of infectious diseases - Osteoporosis - Alzheimer's disease. New antibiotics and medicines from marine organisms. The secondary metabolites and

biosynthetic gene clusters of marine cyanobacteria. Secondary metabolites from marine actinomycetes and fungi - Probiotics.

UNIT - IV

Biomaterials and bioprocessing - Byproducts: processing of low cost fish, minced meat, fish oil, fish meal, fish sausages, isinglass, glue, fish silage, fin rays, chitosan, chitin pearl essence, agar, alginates, carrageenan and heparin.

UNIT - V

Environmental impacts of aquatic biotechnology - Human impacts on marine microbial diversity - Critical microbially-mediated equilibria that impact environmental and human health - Using marine microbes to ameliorate environmental deterioration. Control of oil spills and bioremediation. Environmental issues: Effects of bio-fouling and bio-deterioration on marine structures. Protection methods against corrosion and fouling. Application of biotechnology in controlling the bio-deterioration of wood and synthetic substances in the sea. Red tides: Causative factors and effects on the organisms of marine environment.

Text Books

1. Proksch and Werner E.G.Muller, Frontiers in Marine Biotechnology, Horizon Bioscience, 2006.

References

1. Le Gal, Y., Ulber, R, Marine Biotechnology I, Advances in Biochemical Engineering/Biotechnology (Series editor: T. Scheper). Springer-Verlag Berlin Heidelberg. Vol. 96. pp. 287, 2005.
2. Le Gal, Y., Ulber, R, Marine Biotechnology II: Advances in Biochemical Engineering/Biotechnology (Series editor: T. Scheper) Springer-Verlag Berlin Heidelberg. Vol. 97. pp. 261, 2005.
3. Jennie Hunter-Cevera, David Karl and Merry Buckley, Marine microbial diversity: The key to earth's habitability: A Report from the American academy of microbiology, Published by American Academy of Microbiology, held (April 8- 10, 2005) in San Francisco,California. pp. 28, 2005.