

TUMKUR UNIVERSITY

Course Structure & Syllabus of M.Sc Biotechnology **Choice Based Credit System (CBCS)**

Eligibility Criteria: Bachelor's degree in Physical, Chemical, Biological, Agricultural, Veterinary, Fishery Sciences, Pharmacy, Engineering/ Technology, Horticulture, Dairy and Food Science from any University Recognized by UGC/ICAR/AICTE/Medical Council with at least 50 % marks (45 % in case of SC/ST and Cat-I candidates) in Optional subjects put together from all the years of the examinations of the course.

Course Structure I Semester

S. No.	Paper	Title of the paper	Instruction Hrs per Week	No. of Credits	Duration of the Exam.	Marks		
						Internal Assessment	Semester End Examn.	Total Marks
1	CPT-1.1	Microbiology	4	4	3 Hrs	20	80	100
2	CPT-1.2	Biochemistry	4	4	3 Hrs	20	80	100
3	CPT-1.3	Immunology	4	4	3 Hrs	20	80	100
4	SPT-1.4 A	Molecular Genetics	4	4	3 Hrs	20	80	100
	SPT-1.4.B	Toxicology and Forensic Biotechnology	4	4	3 Hrs	20	80	100
5	CPP-1.5	Practical's Based on Microbiology	4	2	3 Hrs	10	40	50
6	CPP-1.6	Practical's Based on Biochemistry	4	2	3 Hrs	10	40	50
7	CPP-1.7	Practical's Based on Immunology	4	2	3 Hrs	10	40	50
8	SPP – 1.8 A	Practical's Based on Molecular Genetics	4	2	3 Hrs	10	40	50
	SPP – 1.8 B	Practical's Based on Toxicology and Forensic Biotechnology	4	2	3 Hrs	10	40	50
		Total	32	24		120	480	600

Note: CPT: Core paper theory

SPT: Special paper theory

CPP: Core paper practical

SPP: Special paper practical

II Semester

S. No.	Paper	Title of the paper	Instruction Hrs per Week	No. of Credits	Duration of the Exam.	Marks		
						Internal Assessment	Semester End Examn.	Total Marks
1	CPT- 2.1	Molecular Biology	4	4	3 Hrs	20	80	100
2	CPT- 2.2	Enzyme Technology	4	4	3 Hrs	20	80	100
3	SPT- 2.3 A	Biostatistics and Bioinformatics	4	4	3 Hrs	20	80	100
	SPT- 2.3 B	Systems Biology	4	4	3 Hrs	20	80	100
4	OEPT – 2.4	Introduction to Biotechnology	4	4	3 Hrs	20	80	100
5	CPP-2.5	Practical's Based on Molecular Biology	4	2	3 Hrs	10	40	50
6	CPP-2.6	Practical's Based on Enzyme Technology	4	2	3 Hrs	10	40	50
7	SPP-2.7 A	Practical's Based on Biostatistics and Bioinformatics	4	2	3 Hrs	10	40	50
	SPP-2.7 B	Practical's Based on Systems Biology	4	2	3 Hrs	10	40	50
8	OEPP 2.8	Practical's Based on Introduction to Biotechnology	4	2	3 Hrs	10	40	50
		Total	32	24		120	480	600

Note: CPT: Core paper theory

SPT: Special paper theory

OEPT: Open Elective Paper Theory

CPP: Core paper practical

SPP: Special paper practical

OEPP: Open Elective Paper practical

III Semester

S. No.	Paper	Title of the paper	Instruction Hrs per Week	No. of Credits	Duration of the Exam.	Marks		
						Internal Assessment	Semester End Examn.	Total Marks
1	CPT- 3.1	Genetic Engineering	4	4	3 Hrs	20	80	100
2	CPT- 3.2	Plant and Agriculture Biotechnology	4	4	3 Hrs	20	80	100
3	SPT- 3.3 A	Environmental Biotechnology and IPR	4	4	3 Hrs	20	80	100
	SPT- 3.3.B	Pharmaceutical Biotechnology	4	4	3 Hrs	20	80	100
4	OEPT – 3.4	Industrial Biotechnology	4	4	3 Hrs	20	80	100
5	CPP-3.5	Practical's Based on Genetic Engineering	4	2	3 Hrs	10	40	50
6	CPP-3.6	Practical's Based on Plant and Agriculture Biotechnology	4	2	3 Hrs	10	40	50
7	SPP-3.7 A	Practical's Based on Environmental Biotechnology and IPR	4	2	3 Hrs	10	40	50
	SPP-3.7 B	Practical's Based on Pharmaceutical Biotechnology	4	2	3 Hrs	10	40	50
8	OEPP-3.8	Practical's Based on Industrial Biotechnology	4	2	3 Hrs	10	40	50
		Total	32	24		120	480	600

Note: CPT: Core paper theory

SPT: Special paper theory

OEPT: Open elective paper theory

CPP: Core paper practical

SPP: Special paper practical

OEPP: Open elective paper practical

IV Semester

S. No.	Paper	Title of the paper	Instruction Hrs per Week	No. of Credits	Duration of the Exam.	Marks		
						Internal Assessment	Semester End Examn.	Total Marks
1	CPT- 4.1	Animal Biotechnology	4	4	3 Hrs	20	80	100
2	CPT- 4.2	Bioprocess Technology	4	4	3 Hrs	20	80	100
3	SPT- 4.3 A	Medical Biotechnology	4	4	3 Hrs	20	80	100
	SPT - 4.3 B	Nano Biotechnology	4	4	3 Hrs	20	80	100
4	CPPD 4.4	Project Dissertation	4	4		20	80	100
5	CPP-4.5	Practical's Based on Animal Biotechnology	4	2		10	40	50
6	CPP-4.6	Practical's Based on Bioprocess Technology	4	2		10	40	50
7	SPP- 4.6 A	Practical's Based on Medical Biotechnology	4	2		10	40	50
	SPP- 4.6 B	Practical's Based on Nano Biotechnology	4	2		10	40	50
8	CPPP 4.8	Practical's Based on Project	4	2		10	40	50
		Total	32	24		120	480	600

Note: CPT: Core paper theory CPP: Core paper practical
 SPT: Special paper theory SPP: Special paper practical
 OET: Open Elective Theory OEP: Open Elective practical
 CPD: Core paper Dissertation CPPP: Core paper project practical's

Internal Assessment Marks Allotment Basis for Theory Papers:

1st Test for 10 marks
 2nd Test for 10 marks: Average of two tests for marks : 10
Seminar (Recent Biotechnological advances and Journal Club) : 05
Extra activities (Awareness programmes for general public, extension activities etc...) : 05
Total : 20

Internal Assessment Marks Allotment Basis for Practical Papers:

1. Internal Test based on the experiments in the syllabus: 07 Marks
2. Submission of Case studies: 03 Marks

THEORY QUESTION PAPER PATTERN

Max. Marks = 80

Time: 03 hours

1. Answer in Brief (Answer any eight) $8 \times 2 = 16$

- a.
- b.
- c.
- d.
- e.
- f.
- g.
- h.
- i.
- j.

2. Write short notes on the following (Answer any four) $4 \times 4 = 16$

- a.
- b.
- c.
- d.
- e.
- f.

3. Essay type questions (Answer any three) $16 \times 3 = 48$

- a.
- b.
- c.
- d.
- e.

Note: Equal Weightage should be given to all the units while setting the question paper

PRACTICAL QUESTION PAPER PATTERN

Max. Marks = 40

Time: 03 hours

- 1. Major Experiment: 12Marks
- 2. Minor Experiment: 06 Marks
- 3. Spotters (04): 12 Marks
- 4. Records: 05 marks
- 5. Viva -Voce: 05 marks

SYLLABUS

NOTE: ALL THE CPT/SPT/OEPT COURSES CONSISTS OF FOUR UNITS EACH AND EACH UNIT SHOULD BE TAUGHT FOR A MAXIMUM OF 16 HOURS

CPT-1.1 MICROBIOLOGY

UNIT I (16h)

Definition, scope and branches of Microbiology. Spontaneous generation theory. Contribution of various Scientists: Antony von Leeuwenhoek, Robert Koch, Edward Jenner, Joseph Lister, Louis Pasteur, Robert Hook, Alexander Fleming and Iwanowsky. Microscopy Techniques: Light, Dark field, Phase contrast, Fluorescence, Electron microscopes and Laser optic system. Haemocytometer and micrometry.

UNIT II (16h)

Microbiological Techniques: Sterilization; Physical methods, chemical methods and Radiation methods. Culture media and types of culture media. Nutritional requirements of microorganisms, Definition of growth; Growth curve, Mathematical expression of growth; Measurement of growth and growth yields; Synchronous growth, and continuous culture, growth as affected by environmental factors. Isolation of microorganisms- serial dilutions, streak plate, pour plate & spread plate and enrichment methods for isolation of chemoautotrophs and chemo heterotrophs and photosynthetic microorganisms. Staining Techniques: Simple and differential, fluorescent, negative; Structural staining: capsule, spore, cell wall and reserve food material. Preservation of cultures.

UNIT III (16h)

Bacterial Systematics-Introduction to taxonomy, nomenclature and systematic Types of classification Taxonomic ranks Techniques for determining microbial taxonomy and phylogeny. Phylogenetic trees Evolution of three domains of life. Biology of Microorganisms Ultra structure of Bacteria, Fungi, Algae, Yeast, Cyanobacteria, Actinomycetes, Virus, Protozoa and Algae, viroid's and Prions.

UNIT IV (16h)

Industrial applications: Microbes producing ethanol, antibiotics (penicillin and streptomycin), enzymes (amylase and lipase) and organic acids (citric acid and acetic acid). Food and Dairy Microbiology-A brief description on production and importance of Single Cell Protein and probiotics, microorganisms involved in producing fermented foods such as bread, cheese and curd.

CPP 1.5 PRACTICALS BASED ON MICROBIOLOGY

1. Safety guidelines in Microbiology laboratory practices.
2. Study of aseptic techniques-Disinfection and chromic acid preparation for glassware's
3. Study of apparatus used in microbiological experiments.
4. Preparation of culture media for growth of various microorganisms.

5. Isolation and Identification of various microorganisms (Bacteria, Fungi and Yeasts) from soil, water and air sample.
6. Study of colony characteristics of bacteria.
7. Staining of Microorganisms–Gram’s stain, Acid-fast stain and structural stain.
8. Biochemical tests used for the identification of microorganisms.
 - i. Fermentation of carbohydrates.
 - ii. Starch hydrolysis.
 - iii. Gelatin liquefaction.
 - iv. Urase test.
 - v. Catalase test.
 - vi. Oxidase test.
 - vii. Triple sugar Iron agar test (TSIA).
 - viii. Nitrate reduction Test.
 - ix. IMViC Tests.
9. Growth curve and measurement of bacterial population by turbidometry.
10. The study of synchronous growth of a bacterial population (E. coli).
11. Counting of microorganisms by using Haemocytometer (Smuts and yeast sample)/ SPC and DMC.
12. Study of bacterial motility by Hanging Drop Method.
13. Isolation of Phages by Plaque Count Method.
14. Isolation of *Candida* species and study its morphological characters (Budding, Mycelia, Spores).
15. Assay of antibiotics by agar disc method and dilution method.
16. Testing for quality of water (coliform test), H₂S strip method.
17. Isolation of rhizosphere/phyllloplane microflora microflora
18. Isolation of actinomycetes from soil.
19. Isolation of Rhizobium from legume root nodules
20. Identification of Rhizobium and Agrobacterium
21. Vesicular Arbuscular Mycorrhiza (VAM)
22. Field Visit to collect various soil samples for microbiological analysis

REFERENCES:

1. Alexander M (1977) Introductio to soil microbiology, John Wiley and sons inc. N.Y.
2. Atlas R.M. (1998) Microbiology, Fundamentals and applications (2nd Edition) McMillan Publishing company.
3. Brock, T.D. and Madigan, M.T.(1992) Biology of Microorganisms, 6th Edition, Prentice Hall, Englewood cliffs N.J.
4. Frazier, W.C and Westhaff, D.C. 91998) Food microbiology, Tata McGraw Hill Pub. Delhi.
5. Grabiell Balton (1994) Waste water Microbiology, Wiley Liss Inc.N.Y.
6. Holt, J.S.kreig N.R. Sneath P.H.A. and Williams S.T. (1994) Bergey’s Manual of systematic Bacteriology (9th Edition) William and Wilkins, Blatimore.
7. Pelezar Jr. M.J. Chan ECS and Kreig N.R. 91993) Microbiology, MCGraw Hill Inc. NY.
8. Prescott, L.M. , Harley , T.P and Klein D.A. (1996) Microbiology, Wm.C. Brown Publishers.

CPT – 1.2 BIOCHEMISTRY

UNIT I (16h)

Principles of thermodynamics (First and second law). Free energy, important energy rich molecules, Standard free energy change, concepts of redox reactions, weak bonds, covalent bonds, weak interactions in aqueous system, ionization of water, Acids and Bases, pH, pKa and pKb, Henderson-Hassel Balch equation, titration curves, buffers, buffer systems. Biological buffers and their action. Diffusion and osmosis.

UNIT II (16h)

Introduction of macromolecules such as Aminoacids, Proteins, Carbohydrates, Lipids and Vitamins, Classification, structure and its determines, metabolism and importance role in Human health.

UNIT III (16h)

Bioanalytical Techniques: UV-Visible spectroscopy, Flame emission spectroscopy and atomic absorption Spectroscopy, Fluorimetry, Infrared spectrophotometry, Nuclear magnetic resonance spectroscopy, Mass spectroscopy, Chromatographic techniques. Electrophoresis: Staining and detection, X-ray diffraction methods.

UNIT IV (16h)

Classification, characteristics and enzyme substrates reactions. Stereo specificity of enzyme and ES complex formation. Role of metal ions and coenzymes. Mechanism of enzyme reaction of single & double substrates: Nucleophilic, electrophilic, substitution and elimination reactions. Factors affecting catalytic efficiency. Isoenzymes, Ribozymes and Abzymes. Enzyme kinetics: Rate of reactions, steady state enzyme kinetics, Michaelis-Menten Equation, Significance of Vmax and Km, K/cat. Inhibitors-competitive, non-competitive and uncompetitive, mode of action and experimental determination. Enzyme activity, international units, specific activity, molecular activity, turns over number, end point kinetic assay. Allosteric enzymes, Industrial and medical application of enzymes.

CPP-1.6 PRACTICALS BASED ON BIOCHEMISTRY

1. Safety guidelines in Biochemistry laboratory practices.
2. Preparation of solutions and buffers (Tris-HCl, Phosphate, Citrate) and pH measurements (Including pH meter Calibration).
3. To determine pKa of a weak acid using pH - metric titration.
4. Titration of amino acids (Glycine)-Determination of pKa and pKb and pI values.
5. Determination of redox potential of Fe⁺⁺ and Fe⁺⁺⁺ by potentiometry method.
6. To determine the molecular weight of protein (BSA) and DNA by viscometry.
7. To measure the angle of rotation of Sugars, and amino acid solutions.
8. Determination of Chlorophyll-a, Chlorophyll-b & total Chlorophyll by Arnon method.
9. Qualitative tests for carbohydrates, aminoacids, lipid/fatty acids, (Including analysis of unknown).
10. Fractionation of total lipid by column chromatography.
11. Fractionation of phospholipids by TLC.
12. Extraction and Estimation of Glycogen/Starch
13. Extraction and Estimation of total soluble sugars (Glucose/Fructose/Maltose/ Sucrose).

14. Extraction and Estimation of total proteins from plant/animal source.
15. Separation and identification of Sugars and Amino acids by chromatography techniques.
16. Acid hydrolysis of methyl acetate/Ethyl acetate.
17. Determination of activity of Amylase / Invertase / and Protease.
18. Determination of Km and Vmax of Amylase / Invertase / Protease.
19. Effect of pH and Temperature on enzyme activity.
20. ELISA of selected hormone (demonstration only).
21. Visit to Institutions of national and International repute for studying various equipment's.

REFERENCES:

1. V. Voet and J.G.Voet, Biochemistry, 3rd edition, John Wiley, New York, 2004.
2. A.L. Lehninger, Principles of Biochemistry, 4th edition, W.H Freeman and Company, 2004
3. L. Stryer, Biochemistry, 5th edition, W.H. Freeman and Company, 2002
4. Geoffrey Zubey, Biochemistry, Wm C Brown Publishers, 1995
5. Garet and Grasham, Biochemistry, Sunders College Publishers, 1999.
6. Devlin, Biochemistry, John Wily & Sons, Inx Publications, 1997
7. Robert Scopes, Protein Purification.
8. J. Jayaraman, Laboratory Manual in Biochemistry, Wiley eastern ltd., New Delhi, 1988
9. S Sadasivan and A Manikam, Biochemical Methods, wiley eastern A ltd., New Delhi, 1992
10. S. K. Thimmaiah, Standard Methods of Biochemical Analysis, Kalyani Publishers, New Delhi, 1999
11. Isoenzymes By D. W. Moss
12. Immobilized Biocatalysts- W. Hartneir
13. Selected papers Allosteric Regulation -M. Tokushige
14. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, Trevor Palmer, (2004)

CPT-1.3 IMMUNOLOGY

UNIT I (16h)

Immune system and Immune Response: Innate and acquired immunity, structure and functions of immune cells-T cells, B cells, Macrophages, NK cells and dendritic cells, Eosinophils, Neutrophils, Mast cells. Organs of immune system-Primary and secondary lymphoid organs. Primary and secondary immune response, Clonal selection theory.

UNIT II (16h)

Hypersensitivity Reactions: Allergy, Hypersensitivity reactions -types (I, II, III, and IV), symptoms, immunodiagnosis. Lymphokines and cytokines: Interleukins and Interferons - Production, biological functions and assay methods. Immunological tolerance.

UNIT III (16h)

Immunization: Vaccines-conventional, peptide vaccines, subunit, DNA vaccines. Toxoids, antisera, edible vaccines, plantibodies, ISCOMs, recombinant antibodies, Immune stimulatory complexes. Common immunization programmes-BCG, small pox, PT, polio, measles, Hepatitis-B.

UNIT IV (16h)

Immunological Techniques: Agglutination, precipitation, immune-fluorescence, immunoelectrophoresis, immunoblotting, ELISA, RIA, Flow cytometry. Production and purification of antibodies, determination of antibody titre by RID and EID, production of hybridoma. T-cell cloning: Mechanism of antigen recognition by T and B -lymphocytes, Importance of antigen and MHC class II molecules in T-cell cloning. Antigen specific and alloreactive T-cell cloning -immunologically relevant antigens and T cell subtypes. Applications in vaccine development.

CPP -1.7 PRACTICALS BASED ON IMMUNOLOGY

1. Blood grouping.
2. Blood cell analysis.
3. Lymphocyte subset identification and enumeration.
4. Preparation of antigen - protocol of immunisation.
5. Methods of bleeding.
6. Preparation of serum and serum components.
7. Precipitation of IgG's from serum sample.
8. Dialysis of ammonium sulphate precipitated immunoglobulins. Dialysis against phosphate buffered saline.
9. Electrophoresis of the immunoglobulin preparation (SDS-PAGE)
10. Ouchterlony double diffusion test.
11. Radial Immunodiffusion
12. Rocket Immuno electrophoresis
13. Immuno precipitation test.
14. Diagnosis of *Salmonella typhi* by Widal test (Qualitative and Quantitative test)
15. To study the Dot-blot ELISA.
16. Western blotting.
17. Demonstration of ELISA for HIV diagnosis.
18. Isolation and staining of murine peritoneal macrophages.
19. Determination of Phagocytic Index of macrophages exposed to selected environmental particulate in vivo / invitro.
20. Study of haemagglutination.

REFERENCES:

1. Essentials of immunology, Ian&Roit Blackwell scientific publications,2001
2. Fundamentals of immunology-williamc.boyed (wileytoppan), 1998
3. Introduction to immunology-john w.kinball,2000
4. Fundamentals of immunology-ottos.view and others., 2004

5. Immunology: Janis Kuby (2001) second edition W.H. Freeman & Co.
6. Cellular & molecular immunology 3rd edn. Abul K. Abbas, Andrew Lichtman, Joseph S. Pober, 1989
7. Immunology and Immunotechnology. Rajasekara Pandian M and Senthilkumar B (2007). Panima Publishing Corporation, New Delhi.
8. Immunology and Immunotechnology. Rajasekara Pandian M and Senthilkumar B (2007). Panima Publishing Corporation, New Delhi.
9. Immunology 6th Edn. Goldsby RA, Kindt TJ, Osborne BA, Kuby J (2003) WH Freeman & Co. New York.
10. Immunology 4th Edn. Benjamin E, Coico R and Sunshine G (2000). A John Wiley & Sons, Inc. Publication.
11. Handbook of Experimental Immunology. Weir DM (1979). Black Well Scientific Publications. Oxford.
12. Microbiology (2006) 5th Edn. Pelczar MJ, Chan ECS and Krieg NR. Microbiology (2006) 5th Edn. Tata, McGraw-Hill Publishing Company Ltd. New Delhi.
13. Tizard IR (1995). Immunology 4th Edn. Saunders College Publishing Harcourt Brace College Publishers.
14. Immunology 4th Edn. Talwar GP and Guptha (2004). Vol II. CBS Publications.

SPT-1.4 A MOLECULAR GENETICS

UNIT I (16h)

Classical genetics: Mendel's principles, Chromosomal basis of inheritance, Gene interaction, Genetic linkage and gene mapping, Tetrad analysis, Sex chromosomes and sex determination.

UNIT II (16h)

General features of Genetic code, Cytogenetic: Human karyotype, Chromosome banding, ploidy, chromosome aberrations and position effect. Population genetics: Calculation of allelic frequencies, Hardy-Weinberg law. DNA replication, DNA repair, Transcription, RNA processing.

UNIT III (16h)

Regulation of gene transcription: Operon model, Tryptophan & Lac operon system and Riboswitches. Bacteriophage lambda: A transcriptional switch. Regulation of transcription in Eukaryotes: Influence of transcription in eukaryotes, DNA methylation and gene regulation and Post-transcriptional gene regulations. RNA interference: siRNAs and miRNAs Mediated RNAi. Mutations: Mutagen, Types of mutation, fluctuation test, Replica plating experiments, Ames test and Complementation test.

UNIT IV (16h)

Development genetics: Genetic control of embryonic development in *Drosophila*, Genetic control of Vulva development in *C.elegans*, Genetic control of flower development in Arabidopsis.

SPP-1.8 A PRACTICALS BASED ON MOLECULAR GENETICS

1. Study of *Drosophila* and its mutants.
2. Isolation of genomic DNA from Bacteria/plant cells / animal cells.
3. Isolation of plasmid DNA from different type of bacteria by adopting different methods, purification and calculation of molecular weight of plasmid DNA. , plasmid curing (acridine orange, heat shock).
4. Determination of T_m of Nucleic acid.
5. Estimation of DNA by Di-Phenylamine/C-TAB method.
6. Estimation of RNA by Orcinol method.
7. Study of conjugation in *E. coli*
8. Study of transduction in *E. coli*
9. Study of transformation in *E. coli*
10. Study of mutation in *E. coli* (antibiotic resistance).
11. Restriction mapping of genomic/plasmid DNA (*E. coli*).
12. Study of human genetic Disorders and Karyotypic studies and Imaging.
13. Studies on mutagenic treatment to seeds, pollen grains and its mitotic and meiotic analysis.
14. Tns-5 induced mutagenesis in *E. coli*.
15. Isolation of auxotrophic mutants of *E. coli* by chemical mutagenesis.
16. UV mutagenesis and screening of pigment deficient mutants of *Serratia* sp.
17. Determination of UV survival of *Serratia* sp.
18. Study of Mutation by Ames test.
19. Study of thermal death kinetics.
20. Visit to IISC

REFERENCES:

1. S.R. Maloy, J.E. Cronan, D. Friefelder, Microbial Genetics, 2nd Edition, Jones and Bartlett Publishers, 1994.
2. N. Trun and J. Trempy, Fundamental Bacterial Genetics, Blackwell publishing, 2004.
3. Strachan T and Read A P, Human molecular genetics, 3rd Edition Wiley Bios, 2006.
4. Mange E J and Mange A. P., Human genetics, 2nd Edition, Sinauer Associates publications, 1999.
5. Hartl L D and Jones B, Analysis of genes and genomes, 3rd Edition, Jones and Bartlett Publishers, 1994.
6. Molecular Biology of the Cell:-Alberts et al., 1983.
7. Molecular Biology of the Gene:J.D. Watson.
8. Molecular Cell Biology :Darnell et al.,
9. The Gene:-Benjamin Levine
10. Recombinant DNA:- Watson et al.,1983.
11. Principle of Genetics:-Snusted, Simmons and Jenkins, Hohn Wiley and Sons Inc. 1997.
12. Modern Genetics By Francis Co.J. Ayala, 1980. The Benjamin/Cummings
13. Essentials of Molecular Biology, Fourth Edition (2002) by G. M. Malacinski, Jones & Bartlett Publishers.

SPT-1.4 B TOXICOLOGY AND FORENSIC BIOTECHNOLOGY

UNIT I (16h)

Introduction to toxicology: History and scope of toxicology, Source of toxicants. Classification of toxic agents. Occupational toxicology: Workplace, hazardous exposure, and occupational diseases. Mechanism of toxicity: Toxicant delivery, reaction with the target molecule, cellular dysfunction, inappropriate repair and adaptation. Non target organ toxicity: Chemical carcinogenesis mechanisms of carcinogens. Cytotoxicity mechanisms of cell death mitochondrial dysfunction. Metabolism of toxicants: Phase I Reactions: Microsomal oxidation Nonmicrosomal oxidations Reduction Reactions, Hydrolysis, Epoxide Hydration. cooxidation. Phase II Reactions: Conjugation reactions, Methyltransferases and Acylation. Reactive Metabolites : nature, stability and fate of reactive metabolites, Elimination of Toxicants: renal, hepatic and respiratory elimination.

UNIT II (16h)

Toxicology Testing: Food toxicology: introduction, safety standards for foods and food ingredients and contaminants. In Vivo Toxicology: Testing of acute, subchronic and chronic toxicity. In Vitro testing: Cell Culture Methods, Ames forward mutation assay, Assessing genotoxicity: mitotic index, chromosomal aberrations, micronucleus assay, cytotoxicity and apoptosis assay. Neurotoxicity testing.

UNIT III (16h)

Introduction to Forensic science: Definition and Scope, History and Development of Forensic science, basic Principles of Forensic Science. Organization of crime Laboratory services, services provided by full service crime laboratories, Physical Science unit, Biological Unit, Firearm s Unit, Documentation Examination Unit -Function and Duties Performed by each unit and lab. The Crime Scene investigation -Making and recording observations (including sketches with measurements and digital photographs), Chain of Custody, Locard Exchange principle, Evidences and Collection techniques, Firearms, Marks and impressions, Drug of abuse. Polygraphy. Computer Forensics.

UNIT IV (16h)

Forensic Biology: Forensic Pathology: Rigor mortis, Lovor mortis, Algormortis. Forensic Anthropology, Forensic Entomology, Forensic Psychiatry, Forensic Odontology, Forensics Engineering, forensic serology, DNA Analysis, Dactyloscopy, Finger prints: history, fundamental principle of Fingerprints, Classification and patterns, AFIS, Method of Detecting fingerprint. Trace evidence and contact evidence - targeting potential traces, recovery of trace material assessment of significance-Hair, fiber and Paint

SPP-1.8 B PRACTICALS BASED ON TOXICOLOGY AND FORENSIC BIOTECHNOLOGY

1. Safety measures in Toxicology aspects
2. Qualitative analysis of Steroids, Terpenoids, Alkaloids, Saponins, Flavonoids
3. Extraction and estimation of vitamin C from citrus fruits / squashes.
4. Estimation of Ascorbic acid from commercially available tablets.
5. Extraction and estimation of Piperin from black pepper.
6. Extraction and estimation of Lycopene from tomato.
7. Extraction, purification of beta-carotene from carrot.

8. Spectrophotometric / Colorimetric assay of medicinally useful compounds.
9. Extraction and evaluation of Arecolin from arecanut.
10. Preparation of 4-hydroxy coumarins from resorcinol.
11. Synthesis of Chloramine-T and Dichloramine-T by Sulphonation method.
12. Synthesis of (Acetanilide, Aspirin, Acetylcysteine, Paracetamol) by Acetylation method.
13. Synthesis of (Benzoylglycine, Benzoylperoxide, Flavone) by Benzoylation method.
14. Synthesis of (p-Bromoacetanilide, p-Bromophenol) by Bromination method.
15. Solid phase synthesis of medically important chemicals and peptides.
16. Determination of partition Coefficients and Ionisation constant of Drug molecules.
17. Techniques: Crystallization, fractional crystallization, fractional distillation, vacuum distillation, sublimation.
18. Isolation of Natural products from Clove, Cinnamon by steam distillation. Also use Soxhlet apparatus for one natural product.

REFERENCES:

1. Barile FA (2008) principles of toxicology testing CRC Press is an imprint of the Taylor & Francis Group New York
2. Hodgson E (2004) A Textbook of Modern Toxicology Third edition John Wiley & Sons, Inc., publication
3. Curtis D. Klaassen (2001) Casarett and Doull's Toxicology The Basic Science Of Poisons Sixth Edition McGraw-Hill publishers New Delhi.
4. Osweiler GD (1996) Toxicology, Wiley-Blackwell Publisher
5. Marquardt H (1999) Toxicology, Academic Press.
6. Derelanko MJ (2002) Handbook of toxicology, CRC Press,

CPT-2.1 MOLECULAR BIOLOGY

UNIT – I (16h)

Genome Structure and Organization: Definition and organization of viral, prokaryotic and eukaryotic genomes. Structure of chromatin, nucleosome, chromatin organization and remodeling, higher order organization- chromosome, centromere, telomere. Histones and their effect on structure and function of chromatin. C value paradox and genome size, Cot curves, repetitive and non-repetitive DNA sequences, Cot ½ and Rot ½ values, satellite DNA, DNA melting and buoyant density. Gene families, clusters, Pseudogenes, super-families, Organelle genomes.

UNIT – II (16h)

DNA Replication DNA polymerases and mechanisms of DNA replication in prokaryotes and eukaryotes DNA replication models, connection of replication to cell cycle, Gene amplification (rRNA) Reverse Transcriptase. DNA damage and Repair Types of DNA damage, DNA repair mechanisms- nucleotide excision repair, base excision repair, mismatch repair, recombination repair, double strand break repair, transcriptional coupled repair.

Recombination Homologous and site-specific recombination, models for homologous recombination- Holliday junction, NHEJ, Proteins involved in recombination- RecA, RuvA, B, C, Gene conversion.

UNIT – III (16h)

Mobile DNA elements Transposable elements in bacteria, IS elements, composite transposons, replicative and non-replicative transposons, Mu transposition, Controlling elements in TnA and Tn 10 transposition. SINES and LINES, retrotransposons. Protein Synthesis, Modifications and Transport Components of protein synthesis, Mechanism of protein synthesis, Genetic code Regulation of protein synthesis, Post translational modifications Transport of proteins, Protein turnover and degradation

UNIT – IV (16h)

Gene Expression in Prokaryotes and Eukaryotes Transcription: Basic mechanism in prokaryotes and eukaryotes. RNA polymerases Chromatin remodeling in relation to gene expression, DNase hypersensitivity, DNA methylation. Regulation of transcription including transcription factors. Post-transcriptional processing and transport of RNA. Non coding RNAs, Organization and structure-function of ribonucleoproteins (Ribosome concept).

CPP-2.5 PRACTICAL BASED ON MOLECULAR BIOLOGY

1. Isolation of genomic DNA from bacteria.
2. Isolation of plasmid DNA from bacteria.
3. Determination of molecular weight of DNA
4. Restriction digestion analysis.
5. Ligation of restricted fragments.
6. Southern Hybridization study.
7. Western Blotting.
8. Transformation.
9. Conjugation.
10. PCR amplification study using thermal cyclor

REFERENCES

1. S.B. Primrose, R.M. Twyman and R.W.Old; Principles of Gene Manipulation. 6th Edition, S.B.University Press, 2001.
2. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL, 2001.
3. Brown TA, Genomes, 3rd ed. Garland Science 2006
4. Selected papers from scientific journals.
5. Technical Literature from Stratagene, Promega, Novagen, NewEnglandBiolab etc.
6. Principles of gene manipulations, R.N. Old and S.B. Primrose, 1994. Blackwell Scientific Publications.
7. DNA Cloning I & II, D.M. Glover & B.D. Hames, 1995. IRL Press.
8. PCR Strategies, M.A.Innis, D.H. Gelfant&J.J.Sninsky, 1995. IRL Press.
9. Recombinant DNA (2nd Ed), J.D.Watson, M.Gillman, J.Witknow Ski and M.Zoller, 1992. Scientific Americans books, N.Y.
10. Genetic Engineering of Animals, A.Puhler, 1993. VCH Publishes, Weinheim FRG.
11. Gene Transfer and expression protocols - methods in molecular biology volume 7, E.T. Murray, 1991. Humana Press.

CPT-2.2 ENZYME TECHNOLOGY

UNIT I (16h)

Allosteric interactions: Allosteric sites, Modulators, Protein ligand binding including measurements, analysis of binding isotherms, cooperativity, Hill and Scatchard plots and kinetics of allosteric enzymes. Enzyme regulation: Product inhibition, feedback control, enzyme induction and repression and covalent modification. Allosteric regulation.

UNIT II (16h)

Biotransformation and Enzyme assay: Reaction engineering for enzyme-catalyzed biotransformations. Catalytic antibodies. Biocatalysts from extreme Thermophilic and Hyperthermophilic microorganisms (extremozymes). Peptide synthesis. The design and construction of novel enzymes, artificial enzymes, Biotransformation of drugs (steroids, amino acid derivatives) and Hydrophilic, hydrophobic toxins, Host Guest complexation chemistry. Fundamentals of enzyme assay: Enzyme units coupled kinetic assay. Enzyme purification: criteria of purity of enzymes and its importance. Importance of enzymes in diagnostics, Enzyme pattern in diseases like Myocardial infarction (SGOT, SGPT & LDH), Isoenzymes (CK, LD, ALP). Use of isoenzymes as markers in cancer and other diseases. Clinical significance of choline esterases. Enzyme immunoassay techniques. Therapeutic enzymes.

UNIT III (16h)

Immobilized enzymes: Relative practical and economic advantage for industrial use, effect of partition on kinetics and performance with particular emphasis on charge and hydrophobicity (pH, temperature and K_m). Methods of immobilization – ionic bonding, adsorption, covalent bonding (based on R groups of amino acids), microencapsulation and gel entrapment, design and configuration of immobilized enzyme reactors, Immobilized multienzyme systems, Applications of immobilized enzyme technology.

UNIT IV (16h)

Industrial Applications: Enzymes used in detergents, use of proteases in food, leather and wool industries; methods involved in production of glucose syrup from starch (using starch hydrolyzing enzymes), production of maltose and sucrose, glucose from cellulose, use of lactase in dairy industry.

CPP 2.6 PRACTICALS BASED ON ENZYME TECHNOLOGY

1. Isolation and quantification of activity of – Amylase / Invertase / Alkaline phosphatase (salivary / yeast/ plant source).
2. Determining the Molecular Weight of Amylase by Gel Filtration/Size Exclusion Chromatography.
3. Determination of specific activity of enzyme (Amylase/Protease/Invertase).
4. Determination of temperature coefficient & energy of activation.
5. Determination of activity of enzyme in presence of activator and inhibitor.
6. Induction and assay of beta-galactosidase in E.Coli.
7. Enzyme production, purification and assay (Protease/Invertase).
8. Enzyme purification by crystallization-Urase

9. Kinetics of Immobilized enzyme (Amylase / Invertase).
10. Starch hydrolysis by a co-immobilized alpha-amylase and glucoamylase
11. Production of α -Amylase by using *Aspergillus* species.
12. Determination of adsorption isotherm of α -Amylase.
13. Estimation of proteins by Lowry's method.
14. Determination of SGOT in serum.
15. Determination of SGPT in serum.
16. Hydrolysis of egg protein by pepsin.
17. Determination of marker Enzymes: LDH, Serum glutamate
18. Isoenzyme profile study.
19. Hydrolytic Enzyme profiling of the fresh water isolates.

REFERENCES

1. Fundamentals of Enzymology- Price and Stevens
2. Enzymes -Dixon and Webb
3. Isoenzymes By D. W. Moss
4. Immobilized Biocatalysts- W. Hartneir
5. Selected papers Allosteric Regulation -M. Tokushige
6. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, Trevor Palmer, (2004)
7. Principles and Applications in Engineering Series: Biotechnology for Biomedical
8. Engineers - Martin L. Yarmush, CRC Press, Boca Raton London New York Washington, D.C.

SPT-2.3 A BIOSTATISTICS & BIOINFORMATICS

UNIT I (16h)

Principles of Biostatistics: Scope of Statistical methods in scientific studies: Population, Sample, variable, parameter, primary and secondary data, screening and representation of data. Frequency distribution, tabulation, bar diagram, histograms, per diagram, and cumulative frequency curves. Measures of central tendency-Mean, median, mode, quartiles and percentiles. Measures of Variability-Range, mean deviation, Analysis of variance, standard deviation and coefficient of variation.

UNIT II (16h)

Testing of hypothesis: basic concepts and definitions, types of Errors. Tests based on Normal T, F-Test, Chi-square. Probability: types of event, sample space, Definition, conditional probability, addition and multiplication rules of probability and some simple problems. Probability distributions Binomial, Poisson and Normal distributions and a few simple problems. Statistical package-Features of statistical software, SPSS for various applications in Bio-statistical programme.

UNIT III (16h)

Introduction to Bioinformatics: Concepts and Applications. Biological Databases-Concepts, types, specialization, limitations. Data retrieval from various Data bases, Homology searching and their applications. Sequence alignment-Algorithms, Scoring Matrices, Multiple sequences alignment (MSA). Structural Bioinformatics-Protein structure basics, Ramachandran plot, Protein structure-functional relationship, SCOP and CATH. Immunoinformatics: Databases, Epitope prediction and Vaccinology.

UNIT IV (16h)

Molecular modeling and simulations: Macro-molecular force fields, salvation, long-range forces, Geometry optimization algorithms: Steepest descent, conjugate gradient Various simulation techniques: Molecular Dynamics, Monte Carlo, docking strategies etc.. Molecular mechanics, conformational searches. Drug design: Drug discovery process, Role of Bioinformatics in drug design, Target identification and validation, lead optimization and validation, Structure-based drug design and ligand based drug design, Modeling of target-small molecule interactions.

SPP-2.7 A. PRACTICALS BASED ON A BIOSTATISTICS & BIOINFORMATICS

1. Measures of Central Tendency and Dispersion on Excel.
2. Statistical Analysis using EXCEL (Diagrammatic and graphical presentation).
3. Bibliographic search from PUBMED, SCIRUS, MEDMINER and Sequence retrieval from Nucleic acid and Protein databases.
4. Sequence (FASTA and BLAST) searches – Retrieval of homologs, paralogs, orthologs, and xenologs.
5. Pair wise comparison of sequences – Analysis of parameters affecting alignment.
6. Multiple alignments of sequences and pattern determination using PROSITE
7. Multiple sequence alignment by CLUSTALx/w (offline tool).
8. Retrieval of E.Coli glycolytic pathway from KEGG.
9. Evolutionary studies / Phylogenetic analysis – Analysis of parameters affecting trees.
10. Identification of functional sites in Genes / Genomes.
11. Secondary structure prediction of proteins and nucleic acid (DNA/RNA)
12. Study of posttranslational modifications using relevant tools.
13. PDB structure retrieval and visualization: Analysis of homologous structures.
14. Comparative Modeling of homologous sequences and validation of modeled (3D) structures.
15. Determination of ligand-protein interactions using SPDBV/ LIGPLOT
16. Superposition of structures – Calculation of RMSD.
17. Structure analysis: secondary, tertiary and Quaternary structure, bond angle, bond Length, different interactions by RasMol.
18. Docking studies – Analysis of substrate / ligand binding using homologous structures
19. Derivation of pharmacophore patterns for selective ligands.

REFERENCES

1. Bioinformatics by Andreas D Boxevanis. Wiley Interscience.
2. Bioinformatics by David W Mount, cold spring harbor.

3. Bioinformatics: A biologist's guide to biocomputing and the internet. Stuart M Brown, NYU Medical Center, NY USA.
4. Essentials Of Bioinformatics, Jin Xinog, Texas A & M University, Cambridge University press.
5. Analytical Tools for DNA, Genes & Genomes: by Arseni Markoff, New Age.
6. Discovering Genomics, Proteomics & Bioinformatics by A M Campbell & L J Heyer, Pearson Education.
7. Fundamental Concepts of Bioinformatics by D E Krane & M L Raymer, Pearson.
8. Computational methods in Molecular Biology. S.L.Salzberg, D B Searls, S Kasif, Elsevier.
9. Bioinformatics – Methods and Applications: Genomics, Proteomics And Drug Discovery By S C Rastogi, Nmendiratta & P Rastogi, Phi.
10. Introduction to Bioinformatics by Arthur Lesk, Oxford Publications.
11. Structural Bioinformatics by Philip E Bourne, John Wiley & Sons
12. Computational methods for macromolecular sequence analysis: R F Doolittle. Acad. Press.
13. Computational methods in Molecular Biology. S.L.Salzberg, D B Searls, S Kasif, Elsevier.
14. The molecular modeling perspective in drug design by N Claude Cohen, Academic Press.
15. Analytical Tools for DNA, Genes & Genomes: by Arseni Markoff, New Age.
16. Introduction to Bioinformatics by ANNA TRAMONTANO, TAYLOR
17. Applied Bioinformatics – an introduction – (springer) Selzer P.M and others
18. Bioinformatics Basics – (CRC) – Rashidi, HoomanH , Lukas K Buchler
19. Bioinformation a practical guide to the analysis of genes and proteins
20. BexevanisAndress D - ed
21. Practical Bioinformatics (springer) - Bujnicki, Janusz M.-ed
22. Biostatistics refoundation for analysis in health sciences (John wiley) Wayne, W Daniel
23. Fundamentals of Biostatistics a practical approach (Kanishka) – Narenkumar Dutta
24. Statistical methods in Biology (Cambridge University Press) – Bailey, Norman T. J
25. Principles of Biostatistics (Wadsworth, USA) – Pagano Marcello.
26. Biostatistics for the biological and health sciences (Pearson) Triola

SPT-3.3 B. SYSTEMS BIOLOGY

UNIT I (16h)

History of evolution of life on earth: elements, molecules to species. Mendelian inheritance. Hardy-Weinberg equilibrium: stability of gene (allele) frequencies under five conditions. Evolution of DNA, RNA and proteins, origin of the genetic code: chemical basis of evolution.

UNIT II (16h)

Genomics: Introduction and scope, whole genome-restriction mapping, FISH, STS mapping, hybridization assay, overview of sequence analysis, gene prediction, tools for genomics of prokaryotes, organelles, eukaryotes, Applications of DNA microarray for comparative &

evolutionary genomics, applications of microbial genomics. Evolution of the genome: Genomic sequencing and mapping: Genome databases Human Genome Project.

UNIT III (16h)

Proteomics: proteome technology & importance of proteomics, principles & applications of the separation technology (electrophoresis, centrifugation, chromatography etc.) In proteomics, mass spectrometry & its application of two dimensional gel electrophoresis in proteomics, importance of 2-D fluorescence difference gel electrophoresis for comparative proteomics, applications of proteomics for drug discovery

UNIT IV (16h)

Metabolomics: Introduction to metabolomics metabolic fingerprinting & metabolic profiling, biotechnological potentials, criteria, for the selection of chromatographic methods & their importance. Application for cellular metabolomics for metabolic pathway and its structure. Metabolite profiling for infectious disease. Application of metabolite profiling in heart disease. Metabolic signature and metabolite profiling in heart disease. Metabolomics in preclinical pharmaceutical discovery and development. Analytical considerations, and biological aspects and applications.

SPP - 2.7 B PRACTICALS BASED ON SYSTEMS BIOLOGY

1. Extraction and estimation of total proteins from plants/animal/microorganisms.
2. Estimation of protein by Micro-Kjeldahl's method.
3. Estimation of total amino acid composition.
4. Estimation of amino acid by ninhydrin method.
5. Protein profile studies (Case study).
6. Separation of proteins by electrophoretic method SDS-PAGE.
7. 2D-Gel Electrophoresis of protein and imaging.
8. Physical mapping of the alpha amylase gene.
9. Cloning and sub cloning of alpha-amylase gene in yeast.
10. Purification and analysis of alpha amylase by chromatographic techniques.
11. Determination of molecular weight of alpha amylase.
12. Determination of N'-terminal and C'-terminal amino acid sequence.
13. Gene structure and function prediction (Using Genscan, GenMark)
14. Molecular visualization of protein (Amylase) using RASMOL
15. Prediction of tertiary structure of protein using SWISS-MODEL server.

REFERENCES

1. Twyman, R.M. Principles of Proteomics. BIOS Scientific Publisher, New York. 2004.
2. Liebler, D.C. Introduction to Proteomics: Tools for the New Biology. Human Press, Totowa NJ. 2002.
3. Buchanan B, Gruissem G, and Jones R (2000) Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, USA.
4. Hammes GD (2005) Spectroscopy for the Biological Sciences; Wiley Interscience, USA.
5. Harlow and Lane D (Eds.) (1988) Antibodies – A Laboratory Manual; Cold Spring Harbor Laboratory, USA.

6. Lieber DC (2006) Introduction to Proteomics: Tools for New Biology; Humana Press, NJ.
7. Pennington SR, Dunn MJ (Eds.) (2002) Proteomics: From Protein Sequence to Function,
8. Singer M and Berg P (1991). Genes and Genomes: A Changing Perspective; University Science Books, CA, USA.
9. Westermeier, R and T. Naven. Proteomics in Practice: A Laboratory Manual of Proteome Analysis. Weinheim: Wiley-VCH, 2002.

OEPT-2.4 INTRODUCTION TO BIOTECHNOLOGY

Unit – I (16h)

Biotechnology: An overview-definition, scope and importance of Biotechnology, Concept of Recombinant DNA technology and Gene Cloning.

Microbial Biotechnology: A brief account of microbes in industry and agriculture, Metabolic engineering for over production of metabolites. Plant Biotechnology: Introduction to plant tissue culture and its applications, Gene transfer methods in plants, Transgenic plants (A brief introduction), Chloroplast and mitochondria engineering.

Unit – II (16h)

Animal Biotechnology: In-vitro fertilization and embryo transfer in humans and livestock, Transfection techniques and transgenic animals, Animal Cloning. Medical Biotechnology: (A brief account) Biotechnology in medicine, Vaccines, Diagnostic, Forensic, Gene therapy, Nano Medicine & Drug Delivery Cell & Tissue Engineering, Stem Cell therapy.

Environmental Biotechnology: (A brief account) Role of biotechnology in pollution control, Sewage treatment, Energy management, Bioremediation, Restoration of degraded lands and Conservation of biodiversity.

Unit – III (16h)

Nano Science & Technology: An Overview, Insights and intervention into the Nano world, Important Developments, Societal implications & Ethical issues in Nanotechnology, Applications of Nanobiotechnology in different areas.

Unit – IV (16h)

Bioinformatics: (A brief account) Importance, Scope of Bioinformatics, world wide web as a tool, Bioinformatics institutes and databases, Bioinformatics training & limitations. Bio-business and Bio-safety, Biotechnology for developing countries and IPR

OEPP 2.8 PRATICALS BASED ON INTRODUCTION TO BIOTECHNOLOGY

1. Isolation of genomic DNA from bacteria.
2. Isolation of plasmid DNA from bacteria.
3. Isolation of microbes from various sources
4. Microscopy of animal cells
5. Synthesis of nano particles
6. BLAST search

Recommended Books:

1. Das H.K. (2004), Textbook of Biotechnology, Willey Dreamtech. Pvt. Ltd, New Delhi.
2. Natesh S., Chopra V.L. and Ramachandran S. (1987), Biotechnology in Agriculture Oxford & IBH, New Delhi.

3. Kumar H.D. (2004), A Text Book of Biotechnology, Eastern Willey Press, New Delhi.
4. Tizard I.R. (2013) Immunology- An introduction, 5th Edition, Philadelphia Saunders College press.
5. Bhushan, Bharat (Ed.) 2012 Encyclopedia of Nanotechnology. Springer.
6. Bhushan, Bharat (Ed.) 2010 Handbook of Nanotechnology. Springer.
7. Gupta P.K. (2010), Biotechnology & Genomics, 5th Reprint, Rastogi Publications Meerut.
8. Singh B.D. (2010), Biotechnology, 4th edition, Kalyani Publication.
9. Black J.G (2008) Microbiology- Principles and Explorations, 7th edition, John Wiley & Sons.

CPT-3.1 GENETIC ENGINEERING

UNIT I (16h)

Tools in genetic engineering: DNA cloning, Enzymes for DNA manipulation: template – dependent DNA polymerase, Nucleases, End-modification enzymes, Ligases, Linkers and Adaptors.

UNIT II (16h)

Vectors: Vectors for E.coli, Cloning Vectors of yeast, Vectors for plants and animals. Expression Vectors, DNA Sequencing, Genome mapping, DNA profiling and Gene therapy.

UNIT III (16h)

In vitro mutagenesis-Site directed mutagenesis, deletion mutagenesis, PCR based mutagenesis. Gene transfer methods- Marker genes (reporter genes, selectable markers) Gene transfer in plants (Agrobacterium mediated gene transfer, physical gene transfer methods, chemical gene transfer methods) Gene transfer in animals (transfection methods, ES cell transfer, Targeted gene transfer).

UNIT IV (16h)

Analytical techniques: PCR – design and optimization, Types of PCR- multiplex, nested, Reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, Quantitative PCR use to engineer DNA, amplification of specific sequences from a cDNA library, use in diagnosis of diseases. DNA sequencing- Maxam-Gilbert method, Sanger's Dideoxy chain termination method, Automated DNA sequencing method. Human genome sequencing. Genetic and Physical mapping techniques. PCR in molecular diagnostics; Viral and bacterial detection; PCR based mutagenesis, Mutation detection: SSCP, DGGE, RFLP, Oligo Ligation Assay (OLA), MCC (Mismatch Chemical Cleavage, ASA (Allele-Specific Amplification), PTT (Protein Truncation Test). Molecular mechanism of antisense molecules, Si-RNA. Biochemistry of ribozymes-hammerhead, hairpin and other ribozymes, Strategies for designing ribozymes. Application of antisense and ribozyme technologies.

CPP-3.5 PRACTICALS BASED ON GENETIC ENGINEERING

1. Isolation of genomic DNA from bacteria/plant/Animal.
2. Isolation of plasmid DNA from bacteria.
3. Restriction digestion analysis.
4. Ligation of restricted fragments.
5. Primer Design: Factors affecting primer design.
6. Restriction mapping: Analysis of maps for suitable molecular biology experiment by using bioinformatics tools.

7. Cloning and sub cloning using plasmid and E.Coli expression vectors.
8. Selection of cloned microorganisms by blue /white colony, X-Gal method.
9. Transformation through CaCl₂ and PEG method.
10. Transformation of rDNA in E. coli by electroporation method.
11. PCR amplification study using thermal cycler and analysis of the products.
12. Competent cell preparation.
13. Preparation of competent cells in E.coli and yeast.
14. Western and southern blotting.

REFERENCES:

1. S.B. Primrose, R.M. Twyman and R.W.Old; Principles of Gene Manipulation. 6th Edition, S.B.University Press, 2001.
2. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL, 2001.
3. Brown TA, Genomes, 3rd ed. Garland Science 2006
4. Selected papers from scientific journals.
5. Technical Literature from Stratagene, Promega, Novagen, NewEnglandBiolab etc.
6. Principles of gene manipulations, R.N. Old and S.B. Primrose, 1994. Blackwell Scientific Publications.
7. DNA Cloning I & II, D.M. Glover & B.D. Hames, 1995. IRL Press.
8. PCR Strategies, M.A.Innis, D.H. Gelfant&J.J.Sninsky, 1995. IRL Press.
9. Recombinant DNA (2nd Ed), J.D.Watson, M.Gillman, J.Witknow Ski and M.Zoller, 1992. Scientific Americans books, N.Y.
10. Genetic Engineering of Animals, A.Puhler, 1993. VCH Publishes, Weninheim FRG.
11. Gene Transfer and expression protocols - methods is molecular biology volume 7, E.T. Murray, 1991. Humana Press.

CPT-3.2 PLANT & AGRICULTURAL BIOTECHNOLOGY

UNIT I (16h)

Plant tissue culture: - History, Laboratory organization, Sterilization methods, Media preparation, Plant Growth Regulators, Micropropagation via axillary and adventitious shoot proliferation; Somatic embryogenesis; production of artificial seeds; Double haploid production by androgenesis and gynogenesis; triploid production by endosperm culture; production of virus free plants by meristem, shoot-tip culture; Cell Suspension cultures; protoplast isolation and regeneration, somatic hybridization and cybridization; protoclonal, somaclonal and gametoclonal variation for crop improvement; Cryopreservation

UNIT II (16h)

Plant Genetic Engineering and Production of Transgenic Plants: Genetic material of plant cells with an introduction to chloroplast and mitochondrial DNA; Transformation of plant cells; Modes of gene delivery in plants: Particle bombardment, electroporation, microinjection; *Agrobacterium* mediated gene transfer, Ti and Ri plasmids; Screening and selection of transformants, PCR and hybridization methods; Transgene selection and

silencing; Generation and maintenance of transgenic plants, Bt cotton, golden rice and some others as examples.

UNIT III (16h)

Isolation of genes of economic importance. Gene constructs for tissue-specific expression. Different methods of gene transfer to plants, viz. direct and vector-mediated. Molecular analysis of transformants. Potential applications of plant genetic engineering for crop improvement, i.e. insect-pest resistance (insect, viral, fungal and bacterial disease resistance), abiotic stress resistance, herbicide resistance, storage protein quality, increasing shelf-life, oil quality, Current status of transgenics, biosafety norms and controlled field trials and release of transgenics (GMOs). Achievements and recent developments of genetic engineering in agriculture. Development of transgenes for biotic and abiotic stress tolerance.

UNIT IV (16h)

Importance and scope of biological control, history of biological control: Biocontrol agents- parasites, predators and insect pathogens. Important entomophagous insect Orders and Families. Ecological, biological, taxonomic, legal and economic aspects of biological control, phenomena of multiple parasitism, hyper parasitism, super parasitism and their applied importance. Principles and procedures of using exotic biocontrol agents. Utilization of natural biocontrol agents: conservation, habitat management and augmentation. Mass multiplication techniques and economics. Effective evaluation techniques, Biocontrol organizations in world and India. Successful cases of biological control of pests. Entomophilic pathogens: bacterial, fungi, viruses, rickettsiae, Protozoan and nematodes, Modes of transmission, methods of uses, symptoms of infection. Microbial insecticides and their formulation. Merits and demerits of microbial control. Role of biocontrol agents and microbial insecticides in Integrated Pest Management.

CPP-3.6. PRACTICALS BASED ON PLANT AND AGRICULTURE BIOTECHNOLOGY

1. Preparation and sterilization of glass wares, instruments and explant.
2. Preparation stock solution for MS, WPM, Whites, Nitsch & Nitsch (1967) media.
3. Initiation and maintenance of callus.
4. Organogenesis from callus
5. Somatic embryogenesis from root cultures.
6. Induction of haploids from anther and pollen cultures
7. Isolation and culture of protoplasts from leaf/callus by
8. Embryo culture and embryo rescue of different plant species.
9. Assessment of genetic variation related to plant taxa using allozyme method.
10. Production of secondary metabolites.
11. Protoplast isolation and fusion.
12. Isolation, culture and fusion of protoplasts.
13. In vitro morphogenetic studies using selected plant species.
14. Preparation of artificial seeds.
15. Isolation of plant genomic DNA (Pea shoot tip –CTAB, Cauliflower –SDS)
16. Isolation of plant chloroplasts.
17. Agrobacterium culture, selection of transformants.
18. Developing RFLP and RAPD maps.

19. Suspension culture and production of secondary metabolites.
20. Bioinoculants : Isolation and mass production of: Rhizobium, Azospirillum, Azatobacter, Anabena, and Azolla
21. Isolation of phosphate solubilizing microorganisms from soil sample.
22. Estimation of phosphate by Fiskay-Subbarao method.
23. Detection and quantification of mycorrhizae by root clearing technique from different crop plants.
24. Study of root /stem nodules and study of VAM.
25. Assay of Biofertilizers (at least three types).
26. Testing of antagonism by dual culture plate technique.
27. Testing of antimicrobial property of antagonists culture filtrate.
28. Bio-insecticidal effect of biopesticides from microbial and plant sources.
29. Protoplast fusion in Rhizobium for enhanced nodule formation.
30. Baculovirus stocks –Preparation and titration using plaque colony.
31. Co-transfection of insect cells using linearized baculovirus stocks.
32. Induced breeding of commercially important fishes.
33. Visit to Plant Biotechnology Industries

REFERENCES:

1. Bhojwani,S.S and Razdan.M.K. Palnt tissue culture,Elsevier,Amsterdam.
2. Razdan.M.K. Introduction to Palnt tissue culture, Beltsville,USA
3. Debergh,P.C. and Zimmerman,R.H.(Eds.) 1991.Micropropagation technology and application,Kluwer,Dordrecht.
4. Plant tissue culture I & II E.F.George,Exegetics.
5. Radenbaugh K. (ed.).Synseeds: application of synthetic seeds to crop improvement,CRC Press, Boca Raton,FL.
6. Handbook of Agriculture (1987), ICAR Publication New Delhi.
7. Disease of crop plants in India –G.Rangaswamy and D.H. Bagayraj 3rd Edition (1994), Prentice Hall of India Private Limited, New Delhi.
8. Plant Pathology –R.S. Mehrotra (1993) Tata McGraw Hill Publications Limited, New Delhi.
9. Agricultural Microbiology: G.Rangaswamy and D.J. Bagyaraj 1993, 2nd Edition, Prentice Hall of India Private Limited, New Delhi.
10. Microbial Biotechnology – Fundamentals of applied Microbiology. Glazer and Nikaido (1995) W.H. Freeman Publication company.
11. Biotechnology theory and techniques –Chirikjian. Veena, D.P.S. and Hons T (1984) Plant gene research, Springer Verlag, Heidelberg and New York.
12. Trevan, M.D. Boffey, S. Goulding, K.H. and Starberry P (1990) Biotechnology – the basic principles Tata McGraw Hill Edition.
13. Plant Pathology by Agrios. Powel C.L. and Bagyaraj, D.J. (1984) V. Mycorrhiza, CRD Press Florida.
14. Vincent J.M. (1982) Nitrogen fixation in legumes Cambridge University Press, London.
15. Stacey R.H. Evans H.J (1992) Biological Nitrogen fixation, Chapman and Hall Limited, London.

SPT-3.3 A ENVIRONMENTAL BIOTECHNOLOGY & IPR

UNIT I (16h)

Introduction to environment, Ecosystem structure and functions, abiotic and biotic component, Energy flow, food chain, food web, Ecological Pyramids-types, biogeochemical cycles, ecological succession, Types of Environmental pollution, Renewable and non renewable energy resources.

UNIT II (16h)

Bioremediation using microbes, in situ & ex-situ Bioremediation, Biosorption and accumulation of heavy metals, Xenobiotics in environment: Bioaccumulation, Biomagnification, Biodegradation, Biofilms, Biofuels and Bioplastics. Microorganisms involved in the degradation of plant fiber, cell wall, lignin, fungal de-lignification and pulping of wood, solving pitch problems in pulp and paper processes using enzymes or fungi hemicellulases in pulp bleaching.

UNIT-III (16h)

Introduction to IPR: IP definition and needs, GATT & WTO, Different forms of IPR – Copyrights, Trademarks, Industrial designs, Geographical Indications, Traditional Knowledge, Plant varieties, Trade Secrets. WIPO, TRIPS, Role of IPR in Research and Development. Trademarks and copyrights: nature of trademarks and branding, tips on names for trademarks, acquiring trademarks protection, brand valuation, packaging and selling, increase the value of a technology through the use of trademark. Introduction and characteristics of copyrights and neighboring rights, performers and broadcasting organizations rights, transfer of copyrights.

UNIT-IV (16h)

Introduction to Bioethics and Biosafety: definition and needs of Bioethics, Social and Ethical issues in biotechnology. Application of bioethics: the expanding scope of ethics from biomedical practice to biotechnology. Introduction to Biosafety: definition and needs of biosafety, levels of biosafety, applications of biosafety at work place, Biosafety during development of biotech products. Ethical issues regarding genetically modified organisms, bioethics in biodiversity and resource management.

SPP 3.7 A PRACTICALS BASED ON ENVIRONMENTAL BIOTECHNOLOGY & IPR

1. Detection of coli forms for determination of the purity of potable water.
2. Methods of Water and Soil sampling and assessment of pH.
3. Determination of dissolved oxygen (DO) concentration of different water samples.
4. Estimation of CO₂ and total hardness (calcium and magnesium) of different water samples.
5. Determination of Biological oxygen demand (BOD) and Chemical oxygen demand (COD) of a sewage sample.
6. Isolation of Bacteriophages from sweage sample.
7. Determination of Total dissolved solids (TDS) of water sample.
8. Isolation of xenobiontics degrading bacteria by selective enrichment technique.
9. Survey of degradative plasmids in microbes growing in polluted environment.

10. Isolation and characterization of Iron and Manganese reducing bacteria.
11. Study of microflora of Industrial wastes and effluents.
12. Acquisition of “Google Earth” images for the known and unknown area for land use - land cover mapping.
13. Determination of atmospheric pollutants (NO_x, SO_x, and particulate matters).
14. Effect of sulphur dioxide on crop plants.
15. Estimation of Nitrate, Chloride, Phosphates and sulphates in drinking water.
16. Study on biogenic methane production.
17. Visit to biofuel plant

REFERENCES:

1. Wastewater Engineering – Treatment, Disposal and Reuse. Metcalf and Eddy.
2. Comprehensive Biotechnology Vol.4, M.Moo-Young.
3. Environmental Chemistry, A.K.De,
4. Introduction to Biodeterioration, D.Allsopp and K.J.Seal
5. Biotechnology and Patent protection, Beier, F.K., Crespi, R.S. and Straus, T., 1985. Oxford and IBH Publishing Co, New Delhi.
6. Intellectual Property rights on Biotechnology, Singh K, BCIL, New Delhi
7. Allsopp D. and K.J. Seal (1999) Introduction to Biodeterioration –ELBS/Edward Arnold.
8. Christson, J.Harst (1997) Manual of Environmental Microbiology, ASM Press, Washington. DC.
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10. Ericksson Ed. (1998) Biotechnology in the pulp and paper industry, Springer.
11. Geetha Bali et al eds (2001) Environmental Biotechnology, ApS Pub.
12. Jitendraprakash and LM Pierik, (1993) Plant Biotechnology : Commercial aspect and problems Oxford and IBH.
13. Hurst C.J. et al eds (1997) Environmental microbiology , ASM Press, Washington, D.C.
14. Larry Anderson and David A. Tilman (1977) Fuels from waste, Academic press.
15. Moo –Young M (Ed-in-Chief), Comprehensive Biotechnology, Vol. 4- Pergamon Press, Oxford.
19. Ramamurthy et al. Ed (2001) , Biodiversity, APS publishers New Delhi.
20. Sinha R.K. (1997) Global Biodiversity, INA , Shree publishers, Jaipur
21. Whitaker, Joh Reed and S.Philip (1989) Biocatalysis in agricultural biotechnology, Washington ACS.

SPT-3.3 B PHARMACEUTICAL BIOTECHNOLOGY

UNIT I (16h)

Fundamental Principles of Pharmacology, Fundamentals of Cardiovascular, Endocrine, and Immunopharmacology, Principles of Chemotherapy, Principles of Toxicology, Contemporary

UNIT II (16h)

Drug development process of protein based therapeutics: Transforming New Molecular Entities into Drugs, Differences between Development of Biotechnology Products of Macromolecules and Chemical Products, Current Trends in Drug Development, Drug designing: Rational, combinatorial and High Throughput screening. Immuno-pharmacology: Overview to immunopharmacology, Antibody-mediated response, Vaccines, Cell mediated immune response, Cancer immunotherapy, Immuno suppressant and Immuno stimulators.

UNIT III (16h)

Biotherapeutics: Hematopoietic Growth Factors and Coagulation Factors, Interferon's and Cytokines for Anti-infective and Cancer Therapy, Hormones, Enzymes, Antibodies and Derivatives. Formulation of proteins and peptides: Making Small Protein Particles, Lyophilization, Multiphase Drug Delivery Systems, Protein Compaction, Self-Emulsifying Drug Delivery Systems, skin and parental drug delivery system

UNIT IV (16h)

Basic concepts and applications, composition, preparation, physicochemical considerations in manufacture of current biotech products and herbal medicines. Quality control (QC), storage and stability of biotech products. Concept and testing of preformulations and their parameters. Tablets: compressed, granulation, coatings, pills, capsules. Parental preparations, Herbal extracts, Oral liquids, Ointments. Pharmacotherapy; Special emphasis on vitamins, growth regulators, Growth factors, cold remedies, laxatives, analgesics, non-steroidal contraceptives, external antiseptics, antacids, biological, herbal products. Pharmacotherapy of migraine, Alzheimers, TB, Diabetes and male sexual dysfunction.

SPP-3.7 B. PRACTICALS BASED ON PHARMACEUTICAL BIOTECHNOLOGY

1. Method of injecting drugs by various routes.
2. Assay of Ibuprofen/Aspirin by alkalimetry.
3. Assay of Adrenalin by acidimetry.
4. Assay of Ethambutol hydrochloride by acidimetry.
5. Assay of Analgin by Iodimetry.
6. Assay of Ephedrin hydrochloride/Phenobarbitone sodium by non-aqueous titrations.
7. Assay of Procaine/Benzocaine by Diazotization.
8. Assay of vitamin B₁₂ in commercially available capsules/tablets.
9. Assay of Piperazine phosphate/ Benzylpenicillin Na⁺ or K⁺ Salt by Gravimetry.
10. Assay of Nitrazepam /Allopurinol/ Chloridine hydrochloride by potentiometry.
11. Assessment of cytotoxicity of drug by mitotic index.
12. Sterility testing methods for pharmaceutical products.
13. Tests for disinfectants (Phenol coefficient/RWC)
14. Determination of antibacterial spectrum of drugs/antibiotics
15. Chemical assays for antimicrobial drugs.
16. Testing for antibiotic/drug sensitivity/resistance.
17. Determination of MIC value for antimicrobial chemicals.
18. Microbiological assays for antibiotics (Liquid tube assay, agar tube, agar plate assays)
19. Toxicity tests in lab animals; Pyrogenicity tests in lab animals.

20. Analysis of Pharmaceutical products by TLC, HPLC and GC

REFERENCES:

1. An Introduction to synthetic drugs- Singh & Rangnekar, Himalya Publishing House, 1980.
2. Principles of Medicinal chemistry-Foye, L W Publishers 2008.
3. Biopharmaceuticals, Biochemistry and Biotechnology- Gary Walsh, Wiley Pub, 2nd Edn. 2003.
4. Industrial Pharmaceutical Biotechnology- Heinrich Klefenz- Wiley-VCH Edn, 2002
5. Biopharmaceutical Drug Design and Development-S Wu Pong, Y Rojanasakul, and J Robinson, Humana Press 1999.
6. Pharmaceutical Biotechnology- K Sambamurthy and Ashutosh Kar, New age International Publishers-New Delhi 2006.
7. Pharmaceutical Biotechnology-S P Vyas and V K Dixit, CBS Publishers, 2007
8. Drug Delivery and Targeting for Pharmacists and Pharmaceutical Scientists by Anya M.Hillery et.,al. 2005.
9. Experimental Design and Analysis by Howard J. Seltman 2014.
10. A Text Book of Modern Toxicology by Ernest Hodgson 3rd Edn. John Wiley & Sons, Inc. 2004.

OEPT-3.4 INDUSTRIAL BIOTECHNOLOGY

UNIT I (16h)

Introduction: Industrial Technology, Principles of fermentation and Historical back ground. Microbial Strain Improvement: Isolation, selection and improvement of microbial cultures; Screening of microorganisms for primary and secondary metabolites, enrichment, specific screening for the desired product. Strain improvement for the selected organism -random and strategic screening methods; Media for Industrial Fermentation: Natural and synthetic media; Media formulations- Carbon sources, Nitrogen sources, minerals, vitamin sources, nutrient recycle; Buffers; Precursors and metabolic regulators and Oxygen requirement.

UNIT II (16h)

Bioreactor configurations: Design features, culture vessel, cooling and heating devices. Mass transfer in reactors : Transport phenomena in fermentation-Gas- liquid exchange and mass transfer, oxygen transfer, critical oxygen concentration, determination of $K_L a$; Heat transfer, aeration/agitation. Sterilization of Bioreactors, nutrients, air supply, products and effluents, process variables; Measurement and control of Bio-process - probes for online monitoring and computer control of fermentation process.Reactors for specialized applications: Stirred tank reactors, Cyclone reactors, Packed bed reactors, Fluidized bed reactors and Trickle flow reactors.

UNIT III (16h)

Down Stream Processing: Cell disintegration- Physical, chemical and enzymatic methods. Biomass separation by centrifugation, filtration and flocculation.Extraction- solvent, two phase, liquid extraction, whole broth and aqueous multiphase extraction. Purification –

Chromatography, concentration, ultra-filtration, reverse osmosis, drying and crystallization.

UNIT IV (16h)

Microbiological fermentation Products:-Alcohol- Ethanol, Alcoholic beverage – Wine, Beer & Whisky. Microbial production of therapeutic compounds: Antibiotics (Penicillin, Streptomycin, Tetracycline, Rifamycin and Quinolones). Enzymes in Industrial Processing: Structure, characteristics, metabolic pathways, control mechanisms. Role of cellulases, hemicellulases and, Lipases. Immobilization techniques: Industrial techniques, for whole cell and enzyme immobilization.

OEPP-3.8 PRACTICALS BASED ON INDUSTRIAL BIOTECHNOLOGY

1. Fermentation of wheat bran/ cellulose/ birchwood xylan by *Trichoderma*
2. Analysis of spent broth
3. Purification and precipitation secreted proteins from spent broth
4. 2-D gel electrophoresis of precipitated protein
5. Estimation of cellulase activity of cellulose degraders
6. Estimation of cellulose/xylanase activity in broth and precipitated protein fraction
7. Production of algal biomass.
8. Microbial production of Vitamin B₁₂ and assay
9. Fermentation of lignocellulolytic biomass
10. Detection of GMO food
11. Microbial load of canned foods
12. Analysis of preserved food stuff for presence of pathogens
13. Detection of viable, non-viable and viable but nonculturable cells by fluorescence microscopy in GMO products
14. Visit to Bioprocessing plant

REFERENCES

1. Gautam, N. C., Food Biotechnology in Comprehensive Biotechnology, Vol. 6., Shree Publishers, New Delhi, 2007
2. Gutierrez – Lopez, G. F. et. al., Food Science and Food Biotechnology. CRC Publishers, Washington, 2003
3. Maheshwari, D. K. et. al., Biotechnological applications of microorganisms, IK . International, New Delhi, 2006
4. Stanbury, P. F. et. al., Principles of Fermentation Technology, 2nd Edition, Elsevier, UK, 1995.
5. Waites, M. J. et. al., Industrial Biotechnology: An Introduction, Blackwell publishing, UK, 2007.
6. Bisen P.S (1994) Frontiers in Microbial Technology, 1st Edition, CBS Publishers.
7. Glaser A.N and Nilaido.H (1995) Microbial Biotechnology, W.H Freeman and Co.
8. Prescott and Dunn (1987) Industrial Microbiology 4th Edition, CBS Publishers & Distributors.
9. Prescott and Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers.

CPT-4.1 ANIMAL BIOTECHNOLOGY

UNIT I (16h)

Animal Tissue culture and Hybridoma Technology: Cell culture media and preparations. Cell culture techniques: Monolayer and suspension culture, cell lines, organ culture- techniques, three dimensional cultures. Somatic cell fusion and its applications (cybrids, membrane fluid mobility and hybridoma technology). Cryopreservation and storage of animal cells. Primary and immortalized cells, Cell transformation and malignancy. Advanced cell culture techniques and application of cultured cells Microscopic techniques: light, electron microscopic, fluorescent and phase contrast microscopic studies. Cell culture and viability, Cell Synchronization and cell cycle Analysis (mitotic and flow cytometry). Gene transformation: Transfection, electroporation and liposome). Immuno-techniques IFA (membrane, cytoplasmic and nuclear proteins) Detection of contamination in cell culture.

UNIT-II (16h)

Artificial animal Breeding and Transgenic Technology: Artificial insemination, Transplantation, in vitro fertilization and embryo transfer, Advantages of cell manipulation, Nuclear transplantation and cell cloning, selective animal breeding and their potential. Production and uses of transgenic animals. Application of functional genomics and discovery of new genes, animal welfare and human health.

UNIT-III (16h)

Stem cells and its application: Source and isolation of stem cells, Embryonic and adult stem cells, culture and maintenance of stem cells. Generation and manipulation of mouse and human embryonic stem cells. Germ Cell Development: Epigenesis and Reprogramming of adult-stem cells. Molecular mechanisms of self-renewal and differentiation, pluri/multi potency and lineage differentiation. Bone transplant and reconstitution of hematopoietic system. Stem cells and therapeutics. Novel sources of multipotent stem cells. Science policies and Ethics in Stem Cell Research

UNIT-IV (16h)

Applications of Animal Biotechnology: Animal improvement: dairy, fishery and poultry). Medicine: diagnosis of diseases, detection of genetic disorders. Treatment: vaccines, gene and cell therapy, tissue transplantations. Production of pharmaceutical chemicals, interferons, interleukins, stem cell factors and hormones. Industrial applications: metabolites production, bio control agents, industrially important enzymes. Drug testing and evaluation.

CPP- 4.5 PRACTICALS BASED ON ANIMAL BIOTECHNOLOGY

1. Safety measures in Animal cell culture laboratory.
2. Designing of animal cell culture laboratory.
3. Cleaning and sterilization of glassware and plastic tissue culture flasks.
4. Preparation of tissue culture media.
5. Preparation of sera for animal cell culture.
6. Preparation of single cell suspension from chicken liver (Primary cell culture).

7. Trypsinization of monolayer and sub culturing; Cryopreservation and thawing
8. Macrophage monolayer from PEC and measurement of phagocytic activity.
9. Isolation and staining of liver parenchyma cells.
10. Initiation of Primary cell culture.
11. Continuous cell culture.
12. Drug/Toxicity testing
13. MTT assay
14. Morphological characterization of cell death.
15. Acridine orange/Ethidium bromide staining.
16. Biochemical characterization of cell death.
17. Isolation of Genomic DNA and RNA.
18. DNA laddering assay.
19. Cell counting and viability testing:
Staining of cells - A. Vital Staining (Trypan blue, Erythrosin B) b) Giemsa staining.
20. Role of serum in cell culture;
21. MTT assay for cell viability and growth; Cell fusion with PEG.
22. Embryonic development and stem cells (Fish/ chick/ frog)

REFERENCES:

1. Animal Cells Culture and Media, D.C.Darling and S.J.Morgan, 1994. BIOS Scientific Publishers Limited.
2. Methods in Cell Biology, Volume 57, Jennie P.Mathur and David Barnes, 1998. 3.
3. Animal Cell Culture Methods Academic Press.
4. Epithelial Cell Culture, Ann Harris, 1996. Cambridge University Press
5. Animal Biotechnology, M.M. Ranga, 2000. Agrobios, India.
6. Biotechnology, Satyanarayana, U., 2006. Books and Allied (P) Ltd.
7. Culture of Animal cells, 3rd Edition, R. Ian Freshney. A John Wiley & Sons, Inc., publications.
8. Animal Cell Culture- Practical Approach, R.W. Masters, Oxford.
9. Animal Cell Culture Techniques. Ed. Martin Clynes, Springer.
10. Animal Cell Biotechnology, Methods and protocols, Nigel Jenkins, Humana Press.
11. Biotechnology of Animal Tissue. P.R.Yadav& Rajiv Tyagi. 2006. Discovery Publishing House. New Delhi.
12. Animal Cell Culture- Practical Approach. John, R.W.Masters. 2000. 3rd Edition. Oxford University Press.

CPT-4.2 BIOPROCESS TECHNOLOGY

UNIT I (16h)

Basic principle of Biochemical engineering Isolation, screening and maintenance of industrially important microbes; Microbial growth and death kinetics (an example from each group, particularly with reference to industrially useful microorganisms); Strain improvement for increased yield and other desirable characteristics.

UNIT II (16h)

Concepts of basic mode of fermentation processes Bioreactor designs; Types of fermentation and fermenters; Concepts of basic modes of fermentation - Batch, fed batch and continuous; Conventional fermentation v/s biotransformation; Solid substrate, surface and submerged fermentation; Fermentation economics; Fermentation media; Fermenter design- mechanically agitated; Pneumatic and hydrodynamic fermenters; Large scale animal and plant cell cultivation and air sterilization; Upstream processing: Media formulation; Sterilization; Aeration and agitation in bioprocess; Measurement and control of bioprocess parameters; Scale up and scale down process.

UNIT III (16h)

Downstream processing Bioseparation - filtration, centrifugation, sedimentation, flocculation; Cell disruption; Liquid-liquid extraction; Purification by chromatographic techniques; Reverse osmosis and ultra-filtration; Drying; Crystallization; Storage and packaging; Treatment of effluent and its disposal.

UNIT IV (16h)

Applications of enzymes in food processing Mechanism of enzyme function and reactions in process techniques; Enzymic bioconversions e.g. starch and sugar conversion processes; High-Fructose Corn Syrup; Interesterified fat; Hydrolyzed protein etc. and their downstream processing; baking by amylases, deoxygenation and desugaring by glucoses oxidase, beer mashing and chill proofing; cheese making by proteases and various other enzyme catalytic actions in food processing. Applications of Microbes in food process operations and production Fermented foods and beverages; Food ingredients and additives prepared by fermentation and their purification; fermentation as a method of preparing and preserving foods; Microbes and their use in pickling, producing colours and flavours, alcoholic beverages and other products; Process wastes-whey, molasses, starch substrates and other food wastes for bioconversion to useful products; Bacteriocins from lactic acid bacteria – Production and applications in food preservation

CPP-4.6 PRACTICALS BASED ON BIOPROCESS TECHNOLOGY

1. Media formulation - Sterilization of bioreactors.
2. Study of fermenters-Demonstration only.
3. Media standardization (C: N ratio) for maximum biomass production of an industrially important microorganism.
4. Detection and quantification of siderophores produced by *Psuedomonas spp*
5. Isolation of industrially important microorganisms (amylase, pectinase, cellulase) for Microbial process & maintenance of bacterial & fungal cultures.
6. Determination of thermal death point and thermal death time of microorganisms.
7. Study of alcohol fermentation-alcohol from different substrates-estimation of percentage of alcohol, total acidity and volatile acidity.

8. Production and analysis of SCP and SCO.
9. Microbial production of citric acid using *Aspergillus niger*.
10. Microbial production of pectinase by *Aspergillus niger* by agrowastes.
11. Microbial production and assay of vitamins and amino acids.
12. Cell disruption by sonication and product recovery.
13. Microbial production of Penicillin and product recovery.
14. Citric acid production by *Aspergillus niger* and *Penicillium citriarium*
15. Production of amylase, cellulose, pectinase in a bioreactor.
16. Aqueous two phase extraction of enzymes.
17. Production and Estimation of Alkaline Phosphatase.
18. Downstream process – purification of any one protein / enzyme from fermented broth.
19. Cell and enzyme immobilization.
20. Conservation of bacteria by lyophilisation.

REFERENCES

1. Biochemical engineering, Alba.S, Humphrey,A.Eand Millis
2. Biochemical reactors,Atkinson,B,
3. Principles of fermentation technology, Stanbury,P.F and Whitaker
4. Process engineering in biotechnology, Jackson, A.T., Prentice Hall,Engelwood
5. Bioreaction engineering principles, Nelson,J and Villdsen, J. Plen
6. Comprehensive Biotechnology Vol. 1- 4: M.Y. Young (Eds.), Pergamon Press.
7. Biotechnology: A Text Book of Industrial Microbiology: T.D. Brock, Smaeur Associates, 1990.
8. Industrial Microbiology: L.E. Casida, Willey Eastern Ltd., 1989.
9. Industrial Microbiology: Prescott & Dunn, CBS Publishers, 1987.
10. Bioprocess Technology- fundamentals and applications, S O Enfors& L Hagstrom (1992), RIT, Stockholm.
11. Biotechnology, Economic & Social Aspects: E.J. Dasilva, C Rutledge & A Sasson, Cambridge Univ. Press, Cambridge.
12. Biotechnology - a handbook of industrial microbiology: W. Crueger and A. Crueger.
13. Microbial Biotechnology: Channarayappa, University press, Hyderabd, 2003
14. Basic Biotechnology by Colin Ratledge and Bjorn Kristiansen : 2nd Edition, Cambridge, University Press.

SPT 4.3 A MEDICAL BIOTECHNOLOGY

UNIT I (16h)

Introduction scope and applications in Medical Biotechnology: Disease: bacterial, viral, fungal and parasites. Investigation of epidemics. Methods of culturing and assaying: bacterial, viral and parasitic. Viral vaccines: conventional: killed/attenuated; DNA; peptide; recombinant proteins. Future development and scope of vaccines. Hemopoietic Stem Cells: Haematopoietic stem cells differentiation, Trans differentiation and growth factors. Classification and manifestations of Hemopoietic stem cell disorders, aplastic Hemopoietic stem cell disorders, clinical applications of colony stems, complications of germ therapy, replacement therapy and bone marrow transplantation, immunological principles,

preservation and clinical use of blood and blood components. Clinical diagnosis of diseases; Molecular Genetics of the host and the pathogen.

UNIT II (16h)

Biochemical disorders; Immune, Genetic and Neurological disorders; Molecular techniques for analysis of these disorders; Assays for the Diagnosis of inherited diseases; Bioinformatic tools for molecular diagnosis. Antibody based diagnosis; Monoclonal antibodies as diagnostic reagents; Production of monoclonal antibodies with potential for diagnosis; Diagnosis of bacterial, viral and parasitic diseases by using; ELISA and Western blot.

UNIT III (16h)

General gene therapy strategies, Targeted killing of specific cells, Targeted mutation correction, Targeted inhibition of gene expression. Gene replacement therapy by viral vectors: Oncovirus, Lentivirus, Adenovirus, Adeno associated virus, Herpes Simplex virus, Naked DNA or direct injection or particle bombardment-gene gun, Liposome mediated DNA transfer, Receptor mediated endocytosis, Repair of mutations in situ through the cellular DNA repair machinery, Antisense induced exon splicing, In-utero fetal gene therapy.

UNIT IV (16h)

Cancer Biology- Characteristics of tumor cells, cell culture and transformation, characteristics of transformed cells, changes in cell-cell interaction. Etiology of cancer- Agents of transformation –viruses as agents and oncogenes, DNA viruses, RNA viruses-retroviruses, chemical carcinogenesis and radiation carcinogenesis. Growth pattern, immortalization, angiogenesis. Molecular basis of cancer- apoptotic and tumor suppressor gene. Chemotherapy of cancer and other contemporary therapies- immunotherapy and gene therapy. Immunotherapy; Monoclonal antibodies and their role in cancer; Role of recombinant interferons; Immunostimulants; Immunosuppressors in organ transplants; Role of cytokine therapy in cancers; Vaccines:types, recombinant vaccines and clinical applications.

SPP-4.6 A PRACTICALS BASED ON MEDICAL BIOTECHNOLOGY

1. Preparation of selective and differential media used in diagnostic microbiology.
2. Laboratory examination of sputum: Collection of sputum. Microbiological examination of sputum by differential staining
3. Normal micro flora of throat and skin on Blood agar /Nutrient agar/Chocolate Agar.
4. Microbiological examination of pus, urine and blood.
5. Mycology - Laboratory diagnosis of fungal diseases. Direct microscopy - cultures using Sabouraud's Dextrose Agar medium - Filamentous fungi, yeasts, yeast-like fungi, and dimorphic fungi. *Aspergillusniger*, *Nocardia*, *Candida albicans*. (Slides).
6. Medical Parasitology - *E. histolytica*, *G. lanibilia*, *Trypanosomas*, *Leishmania* and *Plasmodium* (Slides).
7. Laboratory diagnosis of diseases-Widal, VDRL.
8. Detection of virus by ELISA technique.

REFERENCES

1. Medical Microbiology by David Greenwood Richard Slack & John Peutherer Churchill Livingstone Company.
2. Medical Microbiology by Jawetz, Melnick, Geo R. Brookes McGraw-Hill Company.
3. Medical Microbiology by Anantanarayan & Panekar Orient Longman Limited.
4. Practical Medical Microbiology by Mackic & McCartney.
5. Bacterial Diseases by Wilson & Topley.
6. General Virology by Luria & Parnel.

SPT 4.3B NANO BIOTECHNOLOGY

UNIT I (16h)

Introduction to Nanotechnology and Nano biotechnology. History and scope of nano technology; role of size in nanomaterials: Properties of nano materials- Physical & Chemical properties. Classification of nano particles- nano-clusters, nanotubes, nanowires and nanodots. Synthesis of Nanomaterials: Chemical, Physical and Biological Methods. Characterization of Nanomaterials: Structural Characterization: Ultra violet-visible spectroscopy (UV-Vis), X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), Scanning Electron Microscopy (SEM), Transmission electron microscopy (TEM), Atomic force Microscopy (AFM), X-ray Photoelectron Spectroscopy (XPS) and Nuclear Magnetic Resonance (NMR).

UNIT II (16h)

Protein based nanostructures building blocks and templates –Proteins as transducers and amplifiers of biomolecular recognition events –Nanobioelectronic devices and polymer nanocontainers –Microbial production of inorganic nanoparticles –Magnetosomes .DNA based nanostructures –Topographic and Electrostatic properties of DNA and proteins – Hybrid conjugates of gold nanoparticles –DNA oligomers –Use of DNA molecules in nanomechanics and Computing.

UNIT III (16h)

Nanotechnology in Agriculture and Food Technology: Nanotechnology in Agriculture - Precision farming, Smart delivery system –Insecticides using nanotechnology –Potential of nano-fertilizers -Nanotechnology in Food industry -Packaging, Food processing -Food safety and bio-security –Contaminant detection –Smart packaging.

UNIT-IV (16h)

Nanotechnology in Biomedical and Pharmaceutical Industry: Nanoparticles in bone substitutes and dentistry –Implants and Prosthesis -Reconstructive Intervention and Surgery – Nanorobotics in Surgery –Photodynamic Therapy -Nano sensors in Diagnosis–Neuro-electronic Interfaces–Protein Engineering –Drug delivery –Therapeutic applications -Future of Bionanotechnology. Nanotechnology in Textiles and Cosmetics: Nanofibre production- Electrospinning –Controlling morphologies of nanofibers –Tissue engineering application – Polymer nanofibers-Nylon-6 nanocomposites from polymerization -Nano-filled polypropylene fibers -Bionics–Swim-suits with shark-skin-effect, Soil repellence, Lotus effect -Nano finishing in textiles (UV resistant, antibacterial, hydrophilic, self-cleaning, flame retardant finishes) –Modern textiles(Lightweight bulletproof vests and shirts, Colour changing property, Waterproof and Germ proof, Cleaner kids clothes, Wired and Ready to

Wear)Cosmetics –Formulation of Gels, Shampoos, Hair-conditioners (Micellar self-assembly and its manipulation) –Sun-screen dispersions for UV protection using Titanium oxide – Color cosmetics.

SPP-4.6 B PRACTICALS BASED ON NANO BIOTECHNOLOGY

1. Synthesis of metal oxide nanoparticles using sol gel method.
2. Extracellular synthesis of silver nanoparticles by using microorganism
3. Synthesis of metal oxide nanoparticles using biological process.
4. Preparation of nanocomposites from
5. Characterization of Nano materials using analytical techniques.
6. Biological activity of Nano materials.
7. Synthesis of Fe_2O_3 , AuCl_2 and AgO_2 nanoparticles by chemical method.
8. Synthesis of semiconductor nanoparticles by chemical method
9. Synthesis of nanoparticles using biological process – (2-3 methods).
10. Detection of nanoparticles in colloidal solutions using UV-Vis absorption Technique.
11. Size determination of nanoparticles using laser beam.
12. Biological sample preparation for SEM

REFERENCES:

1. Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology- Hari Singh Nalwa.
2. Nanobiotechnology; ed. C.M.Niemeyer, C.A. Mirkin.
3. Nanocomposite Science & Technology Ajayan, Schadler& Braun
4. Introduction to Nanoscale Science and Technology (Nanostructure Science and Technology) -Massimiliano Di Ventra.
5. Nanosystems: Molecular Machinery, Manufacturing, and Computation- K. Eric Drexler.
6. Springer Handbook of Nanotechnology- Bharat Bhushan.
7. Nanobiotechnology; ed. C.M.Niemeyer, C.A. Mirkin.
8. Nanofabrication towards biomedical application: Techniques, tools, Application and impact – Ed. Challa S., S. R. Kumar, J. H. Carola.

CPPD-4.4 PROJECT /DISSERTATION WORK:

Will be conducted according to the existing CBCS regulations of the University.