SRI DHARMASTHALA MANJUNATHESHWARA COLLEGE (AUTONOMOUS)
UJIRE – 574 240
DAKSHINA KANNADA, KARNATAKA STATE
(Re-Accredited by NAAC at 'A++' Grade)
Ph: 08256-236221, 236101(O), Fax: 236220
e-Mail:sdmcollege@rediffmail.com, sdmcollege@sdmcujire.in, Website: www.sdmcujire.in

DEPARTMENT OF PG STUDIES & RESEARCH IN BIOTECHNOLOGY

Syllabus of
Masters' Degree in
BIOTECHNOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER SCHEME
(2016-2017 Onwards)

BOS meeting held on 18-08-2023
Academic Council meeting held on 02-09-2023

PREAMBLE

Revision of syllabus for the two years Master Degree programme in Biotechnology. The PG Board of Studies in Biotechnology has revised and prepared the Syllabus (CBCS based) for the Biotechnology course in its meeting held on 30th July 2016 based on the UGC letter (Ref, No. MU/ACC/CR.38/CBCS (PG)/2015-16 dated 05-05-2016) to offer Hard Core, Soft Core and Open Elective course papers with credits amounting to 92 credits, for the entire programme. The BOS has prepared the syllabus by adopting the pattern of 14 hard core and 11 soft core along with one project. Total credits for hard core is 52, soft core 30, project 4 and 6 credits are for open elective.
Detailed syllabus is prepared for all the four semesters

ELIGIBILITY FOR ADMISSION

B.Sc. degree from recognized university, in any branch of life sciences with Chemistry /Biotechnology as one of the major/optional/subsidiary subject with 45% aggregate excluding languages. (40% for SC/ST Category –1 candidate)

PROGRAMME OBJECTIVES

- Aims to provide an advanced understanding of the core principles and topics of Modern day Biotechnology, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a lecture series and a research project.
- To equip the students to apply knowledge of molecular mechanisms of cellular processes in living systems including microbes, plants, and higher order organisms to applied aspects.
- The laboratory training in addition to theory is included to prepare them for careers in the industry, agriculture, and applied research where biological system is increasingly employed.
- Basics and current updates in the areas of Industrial Microbiology, Fermentation Technology, Medical, and Agriculture& Environmental Biotechnology are included to train the students and also sensitize them to scope for research.
- Will address the increasing need for skilled scientific manpower with an understanding of research ethics involving animals and humans to contribute to application, advancement, and impartment of knowledge in the field of biotechnology globally.

- Will enable the students to pursue higher education and research in reputed institute at national and international level.

PROGRAMME SPECIFIC OUTCOMES

The learner will be able to:

PSO1: Demonstrate bimolecular knowledge and analytical skills at an advanced level.

PSO2: Show an ability to qualify various range of positions in industry, consultancy, education and public administration.

PSO3: Undertake further Study on biotechnology and its related disciplines such as genetics, animal biotechnology, food technology, plant biotechnology, etc.

PSO4: Show an ability to work in the capacities such as Sr. Associate Scientist, Research Biochemist, Sr. Regulatory Affairs Associate, Biotechnology Researcher, Associate Engineer, Quality Controller and Regional Manager and in industries such as Pharmaceuticals, Manufacturing, Biotechnology and Research Organizations besides colleges and universities as teachers.

PSO5: Undertake research projects on the leading edge in a chosen Specialized area of biotechnology, based on own research experience from a master's project and international literature.

PSO6: Show skills to qualify for research/ for further education in a doctoral program

COURSE/CREDIT PATTERN

Semester	Hard Core Theory	Soft Core Theory	Hard CorePractical	Soft CorePractical	Open Elective	Project	Total Credits
First	12	3	08	------	------	----	23
Second	08	06	04	03	03*	----	21+03*
Third	08	06	04	03	03*	----	21+03*
Fourth	0	0	04	03	---	0	21

	4	6			--	4	
Total	32	21	20	09	06*	04	86 + 06* = 92

Total credits from all the four semesters = 86+6*=92

Total hard core credits = 52 + 4 =56

ProjectCredits= 04 Total Soft core credits = 09+ 21 =30

*Open elective credits = 6

Open electives are given grades and they are not included in the CGPA

COURSE PATTERN AND SCHEME OF EXAMINATION

FIRST SEMESTER

Course Code	Course Title	Teaching hours per week	Credits	Marks		Total
				IA*	Exam	
	HARD CORE COURSES - THEORY					
BTH401	Biochemistry	4	4	30	70	**100**
BTH402	Microbiology	4	4	30	70	**100**
BTH403	Cell biology	4	4	30	70	**100**
	SOFT CORE COURSES-THEORY (CHOOSE ANY ONE)					
BTS404	Molecular Genetics	3	3	30	70	**100**
BTS405	Bio analytical Techniques					
	PRACTICALS					
BTP406	Biochemistry& Microbiology	6	4	30	70	100
BTP407	Cell biology & Molecular Genetics	5	4	30	70	100
	OR	5	4	30	70	100
BTP407	Cell biology & Bio analytical techniques					
	Total		23			**600**

IA consists of Seminars, Assignments, Internal Tests

SECOND SEMESTER

Course Code	Course Title	Teaching hours per week	Credits	Marks		Total
				IA*	Exam	
	HARD CORE COURSES -THEORY					
BTH451	Molecular biology	4	4	30	70	100
BTH452	Genetic Engineering	4	4	30	70	100
	SOFT CORE COURSES - THEORY (CHOOSE ANY TWO)					
BTS453	Metabolism	3	3	30	70	100
BTS454	Enzymology					
BTS455	Biostatistics & Bioinformatics	3	3	30	70	100
	PRACTICALS					
BTP456	Molecular biology & Genetic Engineering	6	4	30	70	100
BTP457	Metabolism &Enzymology	5	3	30	70	100
	OR		3	30	70	100
BTP457	Metabolism & Bioinformatics	5	3	30	70	100
	OPEN ELECTIVES					
BTE458	Fundamental Biotechnology	3	3	30	70	100
BTE459	Environmental Issues					
BTE460	Biodiversity & Conservation					
Total			21			700

IA consists of Seminars, Assignments and Internal Tests

THIRD SEMESTER

Course Code	Course Title	Teaching hours per week	Credits	Marks		Total
				IA*	Exam	
	HARD CORE COURSES - THEORY					
BTH501	Plant Biotechnology	4	4	30	70	100
BTH502	Animal Biotechnology	4	4	30	70	100
	SOFT CORE COURSES - THEORY (CHOOSE ANY TWO)					
BTS503	Bioprocess Technology	3	3	30	70	100
BTS504	Microbial Technology					
BTS505	Nano Biotechnology	3	3	30	70	100
	PRACTICALS					
BTP506	Plant Biotechnology& Animal Biotechnology	6	4	30	70	100
BTP507	Bioprocess & Microbial Technology	5	3	30	70	100
BTP507	OR Bioprocess Technology& Nano Biotechnology	5	3	30	70	100
	OPEN ELECTIVES					
BTE508	Immune system & Human health	3	3	30	70	100

BTE509	Basic concepts in clinical Biochemistry					
BTE510	Applications of Biotechnology in Food science					
Total			21			/00

IA consists of Seminars, Assignments and Internal Tests

FOURTH SEMESTER

Course Code	Course Title	Teaching hours per week	Credits	Marks		Total
				IA*	Exam	
	HARD CORE PAPERS– THEORY					
BTH551	Immunology	4	4	30	70	**100**
	SOFT CORE COURSES-THEORY (CHOOSE TWO ONE)					
BTS552	Environmental Biotechnology	3	3	30	70	**100**
BTS553	Agricultural Biotechnology					
BTS554	Food Biotechnology	3	3	30	70	100
	PRACTICALS					
BTP555	Immunology	6	4	30	70	100
BTP556	Environmental Biotechnology	5	3	30	70	100
	Agricultural/Food Biotechnology					
	PROJECT WORK					
BTH557	Project Work and Dissertation	4	4	30	70	**100**
Total			**21**			**600**
Grand Total			**92**			**2600**

IA consists of Seminars, Assignments, Internal Tests

BASIS FOR INTERNAL ASSESSMENT

Internal Assessment -30 marks

Theory

Seminar 5 marks(1 seminars per paper)

Assignment 5 marks

Attendance 5 marks

Internal test 15 marks (2 internals) Average of internals

Practical

Continuous assessment - 15 marks(Based on attendance, performance and record)

Internal test- 15 marks(1 internal)

End Semester Assesmnt-70marks

Theory

Part A:5*4=20(5 Questions to be answered out of 6)

Part B:5*6=30(5 Questions to be answered out of 6)

Part C:2*10=20(2 Questions to be answered out of 3)

Practical

Part A: Major Experiment:1*25=25

Part B:Minor Experiment:1*15=15

Part C: Spotters: (2)+ Problem(1/2)=10

Part D:Viva/voce:10

Record 10

THEORY QUESTION PAPERS PATTERN

Question Papers in all the four semesters shall consist of Two Parts, Part-A Part-B& Part-C. Part-A shall contain six (06) short answer type questions drawn equally from all units. Five out of six questions are to be answered (marks: 5x4=20). Part B shall contain Six (06) essay questions carrying 06 marks each drawn equally from all units. Five out of six questions are to be answered (marks: 5x6=30).Part-C shall contain four (04) long questions carrying 10 marks each drawn equally from all units. Two out of four questions

are to be answered (marks: 2x10=20).

Question Paper Format M.Sc. BIOTECHNOLOGY (TITLE OF THE PAPER)

Time: 3 Hours **Max.Marks:70**

PART A (Any Five)

(5 x4=20)

1.

2.

3.

4.

5.

6.

PART B

(Any Five)

(5x6=30)

7.

8.

9.

10.

11.

12.

PARTC

(2x10=20)

13.

14.

15.

16.

PRACTICAL EXAMINATION PATTERN

In the Practical Examination course, out of 70 marks, 10 marks each shall be allotted for Viva voce and practical record and 50 marks for practical proper. In the IV semester there shall be project work/dissertation of 70 marks. The Project work may be conducted either in the Department or in an Institution or Industry. Project report shall be valued for 70 marks.

I SEMESTER

BTH401: BIOCHEMISTRY

Teaching Hours: 4 Hrs per week

Learning Objectives:

LO1: To study about chemical bond, types and its effect on reactivity

LO2: To understand the structure, function and interaction between biological macromolecules in livingsystem

LO3: To study about structure and function of lipids

LO4: To understand nucleic acid structure, types and interaction with other molecules

Course Outcomes:

CO1: Understand chemical reactions and structures of biological molecules essential to life on Earth

CO2: Analyze structures of proteins and classification of proteins, folding of proteins, denaturation and renaturation and motifs of proteins

CO3: Study structure of lipids, classification-simple, compound and derived lipids, physical and chemical properties of fats, biological function of fat soluble and water soluble vitamins

CO4: Demonstrate structure and functions of nucleotide and nucleosides, development of structure of nucleic acids, types of nucleic acids

Unit-I **15Hrs**

Chemical basics of biology: The atom and chemical bonding, Ionization potential, nature and types of chemical bonding, electron affinity, bond length, bond energy and noncovalent bonds/interactions. Properties of water.

Carbohydrates: Classification, structure and properties of mono, oligo and polysaccharides. Chirality and optical activity, stereoisomerism, cyclic structure of monosaccharide, (pyranoses and furanoses), absolute and relative configuration (D & L and R & S nomenclature). Derived sugars- sugar acids (aldonic, aldaric and saccharicacids), Amino sugars. Disaccharides-structures of maltose, lactose, sucrose, trehalose, raffinose. Polysaccharides structure and properties of homo and hetero polysaccharides. Structural &

storage polysaccharides. (Starch, glycogen, cellulose, chitin) glycosaminoglycans and glycoproteins

Unit–II **12Hrs**

Amino acids and proteins: Classification and characteristics of amino acids. Nonstandard amino acids, peptide bond and chemical bonds involved in protein structure. Conformational determination of peptide, Ramachandran plot, classification of protein, Structural organization in proteins.-Primary , secondary, tertiary and quaternary structure , Structure of myoglobin, hemoglobin, keratin, collagen, silk fibroin. Biologically important peptides

Protein folding - Denaturation and renaturation of proteins (Work of Cristian Anfinsen on ribonuclease), folding pathways, the roles of folding accessory proteins. Motifs of proteins: Alpha structure: coiled coil, four helix bundles, & globin motifs with examples, Beta structures: up & down beta barrel, Greek key motif, jelly roll motifs, horse shoe motifs, TIM barrel motifs, Rosmann fold, beta alpha beta motifs

Unit–III **15Hrs**

Lipids: General structure and functions of Fatty acids. Classification – Simple lipids, Compound lipids (phospholipids and glycolipids), Derived lipids (Steroids, Sphingolipids, Terpenes and Carotenoids). Properties of fats and oils – physical properties and chemical properties (Reactions involving COOH group, double bond and OH groups). Biological functions of lipids and eicosanoids (prostaglandins, leucotrienes and thromboxanes).

Vitamins: Biological functions of fat-soluble vitamin and water soluble vitamins, Coenzymes.

Unit–IV **10Hrs**

Nucleic acids: Structure and functions of nucleosides and nucleotides. Deoxyribonucleic acid – inter nucleotide linkages, base composition, evolution of Watson - Crick Model (Chargaff's rule of base pairing in DNA). Denaturation and renaturation of DNA helix (hyperchromism, Tm cot).Variants of double helical DNA. DNA's with unusual structures. Interaction of DNA with other molecules (small molecules-ethidium bromide; large molecules-proteins) Ribonucleic acid – differences with DNA. Structure and types of RNA (rRNA, tRNA and mRNA).

References:

1. *Devlin, T.M. (1997). Biochemistry with clinical correlations, Wiley-Liss Inc.NY*
2. *Edwards and Hassall. Biochemistry and Physiology of the cell 2nd Edn. McGraw Hill Co. UK.Ltd.*

3. *Elliott, W.H., Elliott, D.C. Biochemistry and Molecular Biology 3rdIndian edition,*
4. *Kuchel, P.W., Ralston Schaums, G.B. Outlines of Biochemistry 2nd edition Pub:Tata.*
5. *Mathews, Van Holde and Ahern, Biochemistry by 3rd edition, Pub Pearsoneducation*
6. *Nelson, D.L., Cox, M.M. Lehninger. (2011). Principles of Biochemistry 4th edition Pub WH FreemanCo. Pub. Oxford.*
7. *Stryer, L. Biochemistry 4th Edn. W.H. Freeman and Co.NY.*
8. *Voet, D., Voet J.G. (2004). Biochemistry 2ndEdn.*
9. *Zubey, G.L. Parson, W.W., Vance, D.E. (1994). Principles of Biochemistry WmC Brown publishers.Oxford.*

BTH402: MICROBIOLOGY

Teaching Hours: 4 Hrs per week

Learning Objectives:

LO1: Studies about emergence & evolution of micro-organism, streamlining microbial groups into prokaryotes, eukaryotes & archaea with morphologicaldetails.

LO2: Tells about nutritional requirement, metabolism & growth kinetics of microorganisms. Microbialcommunity.

LO3: Viral classification with few examples of bacterial, animal & plant viruses with its life cycle.

LO4: Microbialpathogenesis

Course Outcomes:

CO1: Explain the microbial world, its beginning with basics of evolution of microorganism on early earth life & its gradual transformation to most resistant forms.

CO2: Demonstrate taxonomic grouping of microorganism through conventional & molecular approach and explain properly.

CO3: Demonstrate the knowledge of microbial nourishment: respiration, factors affecting growth, measurement of growth, Co-existence of microorganisms as microbial association, structure & life cycle of virus on the basis of viral genomes as dsDNA, ssDNA, ssRNA, dsRNA with few predominant viral form carrying replication in different host such as bacteria, animal, plant.

CO4: Give analysis of the dark side of microbial world that is microbe & host interaction leading to disease is explained with respect to few plant pathogens, animal pathogens etc. Pathogenesis caused by invading bacteria and few secreted microbial products such as toxin resulting in food poisoning and also the role played by micro-organisms in food spoilage, prerequisites contributing to food spoilage

Unit-I 13 Hrs

Historical perspectives, Microscopy, origin and evolution of microorganisms, principles of classifications, numerical and molecular taxonomy, Comparative morphology, structure and reproduction (Genetic recombination)in archaebacteria, eubacteria, cyanobacteria, Fungi.

Microbial nutrition, nutritional grouping of microorganism; growth kinetics, factors affecting growth and

death; methods of isolation, enumeration cultivation and preservation of microorganisms

Unit-II 13 Hrs

Microbial metabolism, Microbial respiration, aerobic and anaerobic respiration(w.r.t chemoorganotroph & chemolithotroph), fermentation, Bacterial photosynthesis. General account of symbiosis, mutualism, antagonism, parasitism, commensalism in microorganisms.

Unit-III 13 Hrs

Classification, morphology, ultra-structure and life cycle of plant viruses, animal viruses and bacteriophages. DNA viruses: Herpes virus, Adenovirus. RNA viruses: Polio, Influenza, Retroviruses, (HIV); Bacteriophages: Lambda phage, Bacteriophage MU, M13, T4.

Unit-IV 13 Hrs

Animal microbe interactions: Tuberculosis, Dermatophytes, Rabies, Mycoplasma, Rickettsiae, Typhoid, Leprosy and Cholera. Antibiotics: Types, mode of action and drug resistance (Cholera, Salmonella and Staphylococcus), Antimicrobial therapy.

Principles of microbial spoilage of food, Methods of food preservation by physical (freezing, canning, pasteurization and irradiation) and chemical (preservatives, lactic antagonism), Methods of Microbial food poisoning (Botulinum, Mycotoxins, Algal toxins(relevance to fresh water & marine algae, Cholera and Salmonellosis).

References:

1. Brock Biology of microorganisms**,** Michael T. Madigan , John M. Martinko , Kelly S. Bender 14th edition2012
2. Element of microbiology 5th edition– Pelczar J. and Chan ECS. MacGraw Hill NewYork,2008
3. General Microbiology .Schlegel HG 7th ed. Cambridge Univ. Press1993
4. Microbial biology. Rosenberg E and Cohen IR. .Saunders Coll.Pub.,1983
5. The microbial world. Stanier RY et al 5th ed. Prentice Hall NewDelhi.1990

TH403: CELLBIOLOGY

Teaching Hours: 4 Hrs per week

Learning Objectives:

LO1: To understand the structure, dimensions and functions of prokaryotic and eukaryotic cells as whole and their evolution

LO2: Cell structure with respect to sub-cellular organization.

LO3: To study structural organization of their membranes, transportation of solutes across membranes, cellular development, defense, division both in somatic and gametic cells, cell cycle regulation will bedealt.

LO4: Cell-cell integration, communication, cellular organization into tissue, signaling pathways and its regulation are also the key features which the students will be enlightened.

Course Outcomes:

CO1: Trace and relate the evolution of cells, their structural details

CO2: Understanding of cellular compartments, recent advancements in research to dig more into their organization

CO3: Show the conversant ability on different organelles present within the cell that has an evolutionary significance with respect to the changing environment, adaptations, improvisation of survival skills and the changing surroundings based on their activities.

CO4: Participate in academic meets or workshops concerning cell signaling, cell interactions

Unit-I **13 Hrs**

Introduction: Prokaryotic and eukaryotic cells; Differences between plant and animal cells.

Membrane structure: Different models of membrane; Structural Organization of Biomembranes - Lipid composition, protein components, membrane carbohydrates; Functions of Biomembranes; Ion channels, Electrical properties of membranes, Nerve impulse transmission; Transport across bio-membranes – active and passive; Endocytosis: Phagocytosis, receptor mediated endocytosis, protein trafficking in endocytosis; Chemical composition of cell walls in plants, bacteria and fungi; Tensile strength, turgor modifications.

Unit-II **13 Hrs**

Subcellular Organization: Ultrastructural organization and functions of Golgi complex, endoplasmic reticulum, mitochondria, chloroplast, peroxisomes, lysosomes, ibosomes, nucleus and nucleolus.

Unit-III **13 Hrs**

Chromosomes – Structure, organization and types of eukaryotic chromosomes; Types of Chromatin - Heterochromatin, Euchromatin. Types of chromosomes- Polytene and lamp brush chromosomes; Chromosomal Organization of Genes; Morphology and Functional Elements of Eukaryotic Chromosomes – Telomeres, Centromere, Kinetochore.

Chromosome dynamics during cell division: Mitosis, Meiosis; Centrosome, Microtubule dynamics and motor proteins. Metaphase and Anaphase movements.

Cell cycle and its regulations in yeasts and mammalian cells; extracellular signals, cell cycle check points, cyclins, MPF.

Unit-IV **13 Hrs**

Cell signaling: Broad types - endocrine, paracrine, juxtacrine, and autocrine.

Primary and secondary messengers; Hormones and growth factors; cyclic AMP, cyclic GMP, Nitric oxide, Phospholipids and Calcium; G-protein coupled recetpors; Enzyme coupled receptors – receptor protein tyrosine kinases, tyrosine kinase associated receptors, receptor protein serine/theonine kinases, non-receptor protein tyrosine kinases, receptor protein tyrosine phosphatases.

Wnt signaling pathway, NF-KB signaling pathway.

Integrating cells into tissues: Cell adhesion molecules; Cell junctions – Anchoring junctions, tight junctions, Gap junctions and Plasmodesmata; Extracellular matrix.

References:

1. Cell and MolecularBiology 8th Edition (2010)byE. D. P. DeRobertis. CBS Publishers &Distributors
2. Cell and Molecular Biology: Concepts and Experiments, 7th Edition (2013) Gerald Karp. Wiley &sons, NewYork.
3. Cell: A Molecular Approach, 6th Edition (English)Author:Robert E.Hausman,Geoffrey M. Cooper: Sinauer associates Inc.,2013
4. DevelopmentalBiology, 10th Edition (2013)byScott F Gilbert: Ingram International Inc
5. https://mcb.berkeley.edu/courses/mcb110spring/nogales/mcb110_s2008_4signaling.pdf
6. Molecular Biology of the Cell 5E (2008). Bruce Alberts, Alexander Johnson, Julian Lewis and Martin Raff, Garland Publishing, Inc., NewYork.
7. Molecular Cell Biology. – International Edition, (2012) by Harvey F. Lodish et al., WH Freeman and company, NewYork.

BTS404: MOLECULAR GENETICS

Teaching Hours: 3 Hrs per week

Learning Objectives:

LO1: To Understand genetics of inheritance

LO2: To understand types of mutation & repair mechanism

LO3: To understand genetics diseases through structural & numerical

Course Outcomes:

CO1: Explain the inheritance patterns of characters from one generation to another.

CO2: Show the expertise in Chromosomal mapping or gene mapping.

CO3: Analyse how modifications of chromosomes aka genes causes diseases in humans and populations.

Unit–I **9 Hrs**

Mendelian Genetics: Mendel's experiments, Principle of segregation, Symbols and terminology, Monohybrid Crosses (Dominance, Recessiveness, Codominance, Lethal), principle of Independent assortment (Dihybrid ratios, Trihybrid ratios, gene interaction, Epistasis), Genetic versus environmental effects (Penetrance and expressivity), multiple alleles, pleiotropy. Linkage, Crossing- over and Chromosome mapping. Sex determination, dosage compensation and extra-chromosomal inheritance.

Genetic material: DNA as genetic material: Experiments of Griffith, Avery MacLeod and McCarthy.

Unit–II **13Hrs**

Chromosome Structure: Histones, Nucleosomes, 300-A^{O}Filaments, Radial Loops and Polytene Chromosomes.

Human Cytogenetics: Variations in chromosome structure – Deficiencies, Duplications, Inversions, Translocations and position effects. Karyotyping human chromosomes – Classification and banding techniques. Chromosome aberrations in humans. Trisomy in humans – Down syndrome, trisomy 13 & 18, Turner syndrome, Klinefelter syndrome, Aneuploidy of X chromosomes and mental deficiency.

Prenatal diagnosis: Concept, procedure and applications, (Amniocentesis and Chronic Villus Sampling)

Population and evolutionary genetics: Genetic variation, Random mating and Hardy– Weinberg law of genetic equilibrium, Inbreeding, Out-breeding, Changes in allele frequencies and Evolutionary genetics(Molecular clock, Conversion of genetic distance into divergence time)

Unit–III **14Hrs**

Mutation: Spontaneous versus induced mutation, Mutation: Random rather than directed by the environment (Replica Plating), Phenotypic effects of mutations, Somatic and Germinal Mutations, molecular basis of mutation, Radiation induced mutation, Chemically induced mutation, DNA Repair mechanisms, Correlation between mutagenicity and carcinogenicity (Ames test).

Transposable elements: Discovery, types and their characteristics. Transposable elements in prokaryotes and eukaryotes – IS elements, Composite transposans, Tn3 elements, Ac and Ds elements, P elements, Retrotransposons and their significance.

References:

1. Conner, J. K., and D. L. Hartl, 2000 *A Primer of Ecological Genetics*.Sinauer Associates, Sunderland, Massachusetts. 304pp.
2. Gardner A, Howell RT, Davies T (2000) Biomedical sciences explained.*Human genetics*. Arnold,London.
3. Hartl, D. L. and E. W. Jones, 2002 *Essential Genetics*. 3 ed. Jones & Bartlett, Sudbury, Massachusetts. 613pp.
4. Hartl, D. L. and E. W. Jones, 2004 *Genetics: Analysis of Genes and Genomes*. 6 ed. Jones & Bartlett, Sudbury, MA. 854pp.
5. Lewin B (2000) *Genes* vII. Oxford University Press, NewYork.
6. Microbial genetics.Maloy SR. Friefelder /Jones and Bartlett pub.,1994.
7. Mobile genetic elements-Shapilo/NY Academic press,
8. pstein RJ (2002) *Human molecular biology*. Cambridge UniversityPress, Cambridge.
9. Strachan T, Read AP (2004) *Human molecular genetics 3*. Garland Science, New York.

BTS405: BIO ANALYTICAL TECHNIQUES

Teaching Hours: 3 Hrs per week

Learning Objectives:

LO1: To Introduce about principle and application of Biophysical methods

LO2: Demonstrate the theoretical knowledge and practical application of UV/VIS, IR, and NMR spectroscopy, electrophoresis, SDS-PAGE, Western blotting, Centrifugation.

LO3: Learn the principle and application of different spectroscopic andmass spectrometric methods for the structural analysis of biomolecules.

Course Outcomes:

CO1: Demonstrate the knowledge of the working principle, instrumentation, and applications of an age old technique, chromatography and also show how this traditional method has been modernized into the present day HPLC, UPLC etc.

CO2: Analyse the working principle, instrumentation and applications of electrophoresis, different centrifugation techniques, Show the familiarity of the usage of radio isotopes that has marveled modern biology, environment, medicine as well as in routine biological assays

CO3: Apply skills with Circular Dichorism, X-ray Diffraction and Radio isotope techniques like GM counter and liquid scintillation counter, understand principle, instrumentation and applications of various spectroscopic and mass spectrometric methods

Unit-I **9 Hrs**

Chromatographic techniques: General principles, Sample preparation, Selection of chromatographic system, Low pressure column chromatography, HPLC, Adsorption chromatography, Partition chromatography, Ion exchange chromatography, Exclusion chromatography, Affinity chromatography, GLC, TLC, Paper chromatography.

Unit-II **12Hrs**

Electrophoretic Techniques: General principles, Support media, Native gels, SDS- PAGE, Isoelectric Focusing, 2D gel electrophoresis, Agarose gel electrophoresis, Pulse field gel electrophoresis, Capillary

electrophoresis.

Centrifugation Techniques: Introduction, Basic principles of sedimentation, Types of centrifuges and their uses, Preparative and density gradient separation, Analytical ultracentrifuges and their applications.

Radioisotope techniques: Nature of radioactivity, detection and measurement, GM counter, scintillation counting, Safety aspects and applications of radioisotopes in biology.

Unit-III **15Hrs**

Spectroscopic techniques: Introduction, UV and visible light spectroscopy, IR and Raman spectroscopy, Electron Spin Resonance (ESR), NMR, Spectrofluorimetry, Luminometry, Atomic absorption spectrophotometry, X-ray diffraction, Optical Rotatory
Dispersion, Circular Dichroism.

Mass spectrometric techniques: Introduction, mass spectrometer and applications. Ionization techniques- Electron impact ionization (EI), Electrospray Ionization, Chemical ionization (CI), Field ionization (FI) and MALDI. Ion desorption and evaporation methods, Analyzers- Magnetic sector, time-of-flight, quadrapole, and ion trap. Detectors- electron multipliers. Tandem massspectrometry.

Reference:

1. *Basic concepts of analytical chemistry 2nd ed. S.N. Khopkar. New Age Pub.*
2. *Principles of instrumental analysis .Da Skooge Holt –Saunders,1985.*
3. *Biophysical Chemistry –Principles and techniques-A, Upadhaya – Himalayapub.*
4. *Nuclear and Radio chemistry -3rd ed. Gerhan Fried Lander John Wiley andsons,*
5. Text Book of Biochemistry with Clinical Correlations - Thomas M. Devlin (ed) (Wiley-Liss) - 4th Edition.

BTP406/BTP407

Colour reactions for mono-, di- andpolysaccharides
Identification of unknowncarbohydrates
Estimations of blood glucose, free fatty acids, cholesterol andproteins
Estimation of aminoacids
Estimation of serumproteins
Estimation of bloodurea
Determination of urinecreatinine
Tests for nonprotein nitrogen (NPN)substances
Determination of plant phenolics and ascorbicacid
Chromatography (TLC and Column)
Colorimetry
Flamephotometry
Electrophoresis

Microscopic observations ofmicroorganisms
Microbial staining techniques (simple and differential staining, cell wall, endospores, intracellular lipids, acid-fast, flagella,viability)
Microbial motilitytests
Sterilization techniques
Microbial culture media and their preparation
Qualitative and quantitative assessment of microflora in soil, water,air, andfood
Milkmicrobiology
Studies on bacteria,fungi andactinomycetes
Studies on symbiotic association ofmicroorganisms

* Practical exercises to be conducted with back ground of respective theory papers.(BTH401,BTH402,BTH403,BTS404)

II SEMESTER

BTH451: MOLECULAR BIOLOGY

Teaching Hours: 4 Hrs per week

Learning Objectives:

LO1: Study of transfer of sequential genetic information through central dogma of life

LO2: Introduce about replication of Nucleic acid, Transformation and translation

LO3: Explains DNA damage and Repair mechanism

LO4: Molecular and cellular biology of fertilization

Course Outcomes:

CO1: Show the understanding of the basic properties of Nucleic acid and its principle and mechanism of replication in prokaryotes and Eukaryotes.

CO2: Explain the role of different type of enzymes and accessory proteins involved in DNA replication.

CO3: Analyse the transcription process in prokaryotes and eukaryotes, RNA processing enzymes and modification in different types of RNA in view of translation, regulation of gene expression, DNA damage and types of repair mechanism.

CO4: Describe developmental biology in terms of gene action, ribosomal RNA synthesis during oogenesis and molecular genetics of pattern formation

Unit–I **15Hrs**

DNA Replication: Experimental evidence for semi conservative DNA replication, Replication Forks, Role of DNA Gyrase, Semi discontinuous Replication, RNA primers. Enzymes of replication – DNA polymerase I, DNA polymerase III, Helicases, Binding proteins, Nuclease and DNA Ligases. Prokaryotic replication mechanisms – Bacteriophage M13, Bacteriophage ØX174, *E. Coli*(DnaA protein) and Fidelity of replication. Eukaryotic DNA replication – Cell cycle, Eukaryotic DNA polymerases, Reverse transcriptase, Telomeres and Telomerases.

Repair of DNA: Direct reversal of damage, Nucleotide Excision repair, Recombination repair, The SOS response and identification of carcinogens.

Unit-II **15 Hrs**

Transcription: Role of RNA in protein synthesis – Enzyme induction (Lactose Operon), Messenger RNA.

RNA Polymerase – Enzyme structure, Template binding, Chain initiation, Chain Elongation, Chain termination and Eukaryotic RNA Polymerases.

Control of Transcription in Prokaryotes: Promoters, *lac* Repressor, Catabolite Repression (example of gene activation), Sequence-Specific Protein – DNA interactions,

*araBAD*Operon (Positive & negative control by same protein), *trp*Operon (Attenuation) and Regulation of Ribosomal RNA synthesis (Stringent response).

Unit–III **12 Hrs**

Genetic Code: Chemical mutagenesis, Codons Assignment (Deciphering the genetic code) and characteristics of genetic code.

Translation: Transfer RNA and its Aminoacylation – Primary and Secondary structures of tRNA, Tertiary structure of tRNA, Aminoacyl-tRNAsynthetases, Codon – Anticodon interactions (Wobble hypothesis) and nonsense suppression. Ribosomes – Structure, Polypeptide synthesis (An overview), Chain initiation, Chain Elongation, Chain Termination, Translational Accuracy and Protein synthesis inhibitors(Antibiotics).

Unit–IV **10 Hrs**

Control of Eukaryotic Translation: Translational control by Heme, Regulatory RNA: antisense RNA, micro RNA, RNA interference, CRISPR technology

Posttranscriptional Processing: Messenger RNA Processing, Ribosomal RNA Processing and Transfer RNA Processing.

Posttranslational Modification: Proteolytic cleavage and Covalent modifications Protein Degradation: Degradation specificity and degradation mechanisms

References:

1. Alberts, B., Bray D., Lewis J., Raff,M., Roberts K., Wtson ,J.D., (eds) 2002. Molecular biology of the Cell,4thedn., Garland Publishing ,Inc ., NewYork.
2. Cooper,GeoffreyM.Thecell–AMolecularApproach2nded.Sunderland(MA) :Sinauer Associates .,Inc;2000
3. De Robertis ,E.D.P and De Robertis ,E.M.F.1995 Cell and Molecular Biology .8thedn, B.I. Waverly Pvt Ltd., NewDelhi.
4. Griffiths ,Anthony J.F .; Gelbart, William M.;Miller, Jeffrey H., Lewontin,Richard C New York :W.H, Freeman &Co.,1999
5. Harvey Lodish, Arnold Berk,S. LawenceZipursky ,Paul Matsudaira&david Baltimore Molecular cell Biology,4th edn.2000, wH.freeman&Company,New York.
6. Karp G.1999 .Cell and Molecular Biology-Concepts, and experiments. 2nded ,JohnHarris ,D.(ed) Wiley &sons,New York.
7. Kleinsmith ,l.J.& Kish ,V.M 1995 Principles of cell and Molecular Biology.2ndedn, Mclaughlin ,S., Trost ,k., Mac Elree,E.(eds) ., Harper CollinsPublishe NewYork.
8. Lewin ,B., 2000 ,Genes VII .Oxford UniversityPress

BTH452: GENETIC ENGINEERING

Teaching Hours: 4 Hrs per week

Learning Objectives:

LO1: Introduces basics of genetic engineering with its tools &techniques

LO2: Explains *in-vitro* & *in-vivo* gene cloning, use of vectors, construction of compatible ends, creating rDNA, and its transfer into host, construction of genomic & cDNA libraries.

LO3: Methods of selection of recombinants.

LO4: Applications of genetic engineering

Course Outcomes:

CO1: Distinguish between *in-vitro* & *in-vivo* gene cloning through PCR, and discuss about various components used in PCR, types, & application

CO2: Show familiarity with the end processing of PCR products to be used for gene cloning experiments.

CO3: Be skilled in *in-vivo* gene cloning, importance of vehicles, availability of different types of vehicles for carrying gene of interest is dealt. Classification of vehicles on the basis of function as cloning vector, expression vector, shuttle vectors are discussed.

CO4: Show the familiarity with the process of ligation of gene of interest with vector with a prior generation of compatible ends to create rDNA & its transfer to subsequent host followed by screening & selection of recombinant cells

Unit-I **13 Hrs**

General introduction to concepts of genetic engineering. Host controlled restriction and modification, restriction endonucleases, target sites sticky, cohesive ends and blunt ended fragments. Role of DNA ligase, linkers, adaptors, homopolymer tailing.

Other methods of joining DNA molecules: TA cloning of PCR products, Construction of genomic libraries, construction of cDNA library, methods of cDNA synthesis;

PCR: Optimization of PCR reaction, analysis of products, Nested PCR, Multiplex PCR, RT-PCR and Real time PCR .Application of PCR in cloning, agriculture and medicine.

Unit-II **13 Hrs**

Vectors: Vectors in gene Cloning**,** Basic properties of plasmids, desirable properties of plasmid cloning vehicles, natural plasmid. Artificial vectors: PBR 322, improved vehicles derived from PBR 322, PUC.

Vectors for transforming bacteria and yeast, animals and plants Special vectors: Shuttle vectors, expression vectors, construction of artificial chromosomes vectors BACs, YACs and MACs. Cosmids, phagemids, viral vectors. Techniques of introducing genes in prokaryotes and eukaryotes: transformation, calcium phosphate method, DEAE – Dextran method, Liposome medicated transfer, microinjection, electroporation and gene gun.

Unit-III **13 Hrs**

Identifying the right clones; Direct screening: insertional inactivation of marker gene, visual screening, plaque phenotype .indirect screening: Immunological techniques, Hybrid arrest translation, Hybrid select translation. Screening using probes: construction of gene probes, hybridization and labeling. Nucleic acid hybridization – Southern blotting, colony hybridization, dot blot; Chromosome walking and chromosome jumping.

DNA sequencing: Maxim & Gilbert's method, Sanger & Coulson's method, Messing's shot gun method, automated sequencers. Analysis of genetic variation: Single nucleotide polymorphism, conserved and variable domains, RFLP, AFLP, RAPD. Genome sequencing: overview, strategies (e.g. Human genome project.)

Unit-IV **13 Hrs**

Mapping of DNA: Restriction mapping, DNase foot printing, Use of transposons in gene mapping.

Analysis of gene expression: Analysis of transcription by Northern blot, RNase protection assay, Primer extension assay, *in situ* hybridization. Comparing transcriptomes: Differential screening, subtractive hybridization, array based methods; implication of genetic engineering.

Translational analysis: Screening expression libraries with antibodies –Western Blot, two dimensional electrophoresis, Proteomics.

Manipulating gene expression: Transcriptional fusions, translational fusions, *In vitro* mutagenesis, Oligonucleotide directed mutagenesis, deletions, Insertional mutagenesis, direct single base mutagenesis

References:

1) From genes to clones –Winnaker ,panima educational bookagencGene IX - Lewin ,OxfordUniversityPress,2007
2) Principles of gene manipulation- Old and primrose –Blackwell scientificpub.,6th Ed,2006
3) Recombinant DNA technology –Watson JD et al Scientific American books, 3rd Ed1992
4) **https://nptel.ac.in/content/storage2/courses/102103013/pdf/mod7.pdf**
5) **https://nptel.ac.in/courses/102/103/102103013/**

BTS453 METABOLISM

Teaching Hours: 3 Hrs per week

Learning Objectives:

LO1: To learn how organisms acquire and use the energy and material resources needed to complete their life cycle, highlighting relationships between structure and function, and coordination of development, resource acquisition and environmental responses within and across cells, tissues andorgans

LO2: To learn how biological systems use free energy based on empirical data that all organisms require constant energy input to maintain organization, to grow and to reproduce and how changes in free energy availability affect organisms, populations and ecosystems

L**O3:**To understand what mechanisms and structural features allow organisms to capture, store and use free energy will be dealt in details under the heading of nucleic acid, protein, lipid and carbohydrate metabolism.

Course Outcomes:

CO1: Relate the living entities based on the principles of thermodynamics laws

CO2: Explain the complex reaction while calculating the free energy of a particular reaction.

CO3: Understand how the energy is stored inside the cell which is readily available whenever needed

Unit-I **13 Hrs**

Thermodynamic principles, free energy, enthalpy and entropy, chemical equilibrium, reaction kinetics, redox processes. ATP as an energy currency in the cell and other high energy compounds. Standard free energy, coupled reaction.

Carbohydrate metabolism: Glycolysis, inter conversion of various monosaccharides citric acid cycle, Amphibolic pathway of citric acid cycle, Anaplerotic reaction, Gluconeogenesis, Glycogenesis, Pentose phosphate pathway, ~~HMP shunt pathway.~~

Biological oxidation: Electron Transport Chain, Chemiosmotic hypothesis, ATP synthesis, Oxidative phosphorylation, Substrate level phosphorylation, Uncouplers and Inhibitors of respiration.

Unit-II **13hrs**

Amino acid metabolism: Deamination, transamination, transdeamination, decarboxylation,

Urea cycle, Ketogenic and Glucogenic amino acids. Metabolism of aromatic amino acids, histidine, cystein and serine.

Nucleic acid metabolism: Biosynthesis, *de novo* and salvage pathways, catabolism of purine and pyrimidine

Unit-III **13 hrs**

Oxidation of fatty acids, α, β and ω types. Energetics of beta oxidization. Biosynthesis of fatty acids, Cholesterol biosynthesis, Ketone body formation, ~~Intereonversion of phospholipids~~.Keto diet & its health impact

Photosynthesis: Photosystems, Light harvesting complexes, cyclic and non cyclic electron transfer, photophosphorylation, Calvin cycle, C3 and C4 plants, CAM

References:

1. Biochemistry –LubertStryer , 3rd ed. , Freeman & co ,New York,1988
2. Bio chemistry –Zubay 2nd ed. Mac millan pub.,1988
3. Harpers review of Biochemistry. Martin *et, al*., 25th edition. Large medical pub. 2000.
4. Principles of instrumental analysis .Da Skooge Holt –Saunders,1985.
5. Principle of Biochemistry –A. Lehninger, David L. Nelson and M.M Cox CBS pub. 1993
6. Text book of biochemistry with clinical correlation. TM Devlin John Wily and sons, 5thEdition., 2002.
7. https://wp.nyu.edu/biochemistry_2/wp-content/uploads/sites/1136/2015/04/Purine-Metabolism-de-novo-synthesis-and-salvage-pathway-2015.pdf
8. http://www.diva-portal.org/smash/get/diva2:142194/FULLTEXT01.pdfSalvage

BTS454 ENZYMOLOGY

Teaching Hours: 3 Hrs per week

Learning Objectives:

LO1: To make the students understand the basic structures & functions of enzymes & their role in physiology

LO2:To make the students appreciate the diversity of enzymes and their multiple roles in achieving systemhomeostasis.

LO3: To inculcate the knowledge & skills used in present day biotechnology industries, which find enzymes as one of the keytherapeutics.

Course Outcomes:

CO1: Show the familiarity of the basic structures &functions of enzymes & their role in physiology.

CO2: To understand the kinetics and mechanisms of action of enzymes, to become familiar with the basic methods of studying enzymes.

CO3: Apply skills in handling enzymes as key therapeutic ingredients in biotech industries

Unit–I **13 Hrs**

Enzyme catalysis: Nomenclature and classification, Isoenzymes, Biological role of enzymes, chemical nature of enzymes and characteristics of enzymes. Isolation of enzymes, enzyme assays, extraction of soluble and membrane bound enzymes. Purification of enzymes, Criteria of purity and determination of molecular weights of enzymes. Specificity of enzyme action – types of specificity, active site, Fischer 'lock- and-key' hypothesis and Koshland's 'induced-fit' hypothesis. Catalytic mechanisms – Acid-base catalysis, Covalent catalysis, Metal ion catalysis, electrostatic catalysis, and catalysis by preferential transition state binding and catalysis through proximity and orientation effects. Factors affecting enzyme catalyzed reaction

Unit–II **13 Hrs**

Enzyme Kinetics: Rates of reactions, transition state theory, Michaelis-Menten Equation, Significance of Vmax and Km, Lineweaver-Burk plot, Eadie – Hofstee and Hanes plot, Eisenthal and Cornish-Bowden plot.

Enzyme inhibition: Irreversible and Reversible inhibition – Competitive, Uncompetitive, non-

competitive, mixed, partial, substrate and allosteric inhibition, determination of Ki (Dixon plot).

Bisubstrate Reactions: Terminology, Sequential reactions, Ping pong reactions, Rate equations, Differentiating bisubstrate mechanisms and Isotope exchange.

Unit–III **10 Hrs**

Allosterism: Cooperativity-positive and negative cooperativity, Sigmoidal kinetics, MWC and KNF models, Aspartate carbamoyl transferase (ACTase).

Molecular mechanism of enzyme action: Mechanism of chymotrypsin, ribonuclease, and lysozyme.

Application of enzymes: In medicine – Reagents in clinical chemistry, assay in plasma enzymes, Enzymes and inborn errors of metabolism. In industry – Food, drink and other industries. Immobilized enzymes – Preparation, properties and applications.

Reference:

Enzymology And Enzyme Technology 1st Edition (2011) By S.M. Bhatt. S.Chand Publishing

1. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry By Trevor Palmer Horwood Publishing Ltd; 5th Revised Edition(2001)
2. Enzyme Technologies: Metagenomics, Evolution, Biocatalysis And Biosynthesis (Chemical Biology Of Enzymes For Biotechnology And Pharmaceutical Applications) By Wu-KuangYeh,Hsiu-Chiung Yang,James R. Mccarthy(2010). Publisher:Wiley-Blackwell
3. Enzyme Technologies: Pluripotent Players In Discovering Therapeutic Agent (Chemical Biology Of Enzymes For Biotechnology And Pharmaceutical Applications) By Wu-KuangYeh,Hsiu-Chiung Yang,James R. Mccarthy(2014). Publisher:Wiley-Blackwell
4. Enzyme Technology (1990) By Martin F. Chaplin,Christopher Bucke. Cambridge UniversityPress
5. Industrial Enzymes: Structure, Function And Applications (2007)ByJulio Polaina, Andrew P. Maccabe, Springer Publishing Group
6. Immobilization Of Enzymes And Cells (Methods In Biotechnology), 2006. By José M. Guisán. HumanaPress

BTS455 BIOSTATISTICS & BIOINFORMATICS

Teaching Hours: 3 Hrs per week

Learning Objectives:

LO1: Introduce the concept of statistics and its tools in biologicalsystem

LO2: understand different statistical techniques for measurement of central tendency and dispersions

LO3: To provide the basic knowledge about computers and information storagedevices, to understand the role and application of bioinformatics

Course Outcomes:

CO1: Understand the concept of Biostatistics, collection and measurement of data and hypothesis.

CO2: Measurement of data, sample, error calculation. Use statistical measures such as dispersion, normal, binominal and Poisson distribution, student's t-test, ANOVA, chi-square test etc.

CO3: Learn tools & techniques in bioinformatics, data retrieval, use databases, sequence alignment programs, BLAST and FASTA along with algorithms and applications.

Unit-I **10Hrs**

Introduction and definition of biostatistics, concept of variables in biological systems, collection, classification, tabulation, graphical and diagrammatic representation of numerical data, Measure of central tendency: Mean median and mode, and their relationship, Measure of dispersion: quantitative deviations, mean deviation, standard deviation, coefficient of variations. Correlation and regression, linear and quadratic regressions, Concept of Standard errors. Hypothesis testing (null &alternative hypothesis)

Unit-II **10Hrs**

Probability, concept of random experiment, various definition of probability, addition theorem of probability, random variables(discrete and continues), Probability distributions (viz. Binomial, Poisson and Normal) and their applications, Simple random sampling without replacement. Student 't-', 'F' and 'Chi' square distribution (derivations not required) their properties and use. ANOVA.

Unit-III **6Hrs**

Bioinformatics- an overview, Definition and History, Applications of Bioinformatics.Introduction to Data mining, NCBI, DDBJ & EMBL, EBI, Database search software: ENTREZ, SRS,Expasy.

Genomics-Introduction to Genomics, Nucleotide Sequence Analysis, Pair wise alignment, global and local alignment, and significance of alignment, Goals and types of alignment, Tools of sequence alignment, Homology sequence search, Parameters of Blast, BlastN, BlastP, Interpreting Blast Results. Sequence formats- Homology and similarity. Sequence analysis: Multiple sequence alignment: goal of multiple sequence alignment, consensus sequence, ClustalW /MUSCLE; Motif and Domain: Motif databases and analysis tools.

Proteomics- Introduction to Proteomics. Protein Sequence Databases, UNIPROT, Structure Database, PDB Sequence Analysis, definition of sequence analysis, multiple sequence analysis. RASMOL Display Styles Wire Frame, Ball and Stick, Space Fill, Ribbons, Cartoons. EMBOSS Introduction to emboss Software package or any other latest commercialsoftware.

Phylogenetic Analysis: Basics and tools for phylogenetic analysis, tree-building methods, construction of phylogenetic trees and identifying homologs, Maximum Parsimony and Maximum Likelihood method

References:

1. Bioinformatics (2002) BishopMartin
2. Bioinformatics: Sequence and Genome Analysis by DavidW. Mount, University of Arizona,Tucson
3. Biostatistics: P.N. Arora, P.K. Malha
4. Discovering Genomics, Proteomics, & Bioinformatics, SecondEdition by A. Malcolm Campbell, Davidson College; Laurie J. Heyer, Davidson College; With a Foreword by Francis S.Collins
5. Introductory statistics for Biology: Mahajan, S.K.
6. Molecular databases for protein and sequence and structure studies:Sillince A. and Sillince M.
7. Sequence Analysis primers: Gribskov, M. and Devereux,J.
8. Statistical Methods: Mishra andMishra
9. Basic Bioinformatics (2009) Manju Bansal, Atlantic Publishers

BTE458 FUNDAMENTAL BIOTECHNOLOGY

Teaching Hours: 3 Hrs per week

Learning Objectives:

LO1: Appreciate the intricacy existing between microbes, plants and animals and analyze the importance of microbes in various sectors.

LO2: Understand the importance of plants as a bioreactor and its crucial role in sustaining life on earth.

LO3: Understand the modern biological interventions which have eased the life of humans.

Course Outcomes:

CO1: Understand microbial diversity and micro flora associated with humans and animals, interaction between microbes, plants and animals, compare the interaction of microbes with plants based on benefits and harmful effects, know different products produced by fermentation

CO2: Demonstrate the principles of plant tissue culture that relies on to totipotency in modern day agriculture, horticulture and medicines, media preparation, asepticity and contamination. Describe commercial production of various biomolecules, Bt crops, mining etc.

CO3: Describe the Fertility restoration by means of In vitro fertilization and embryo transfer technology. Differentiate the techniques involved in the animal biotechnology for production of superior livestock, uses of assisted reproductive techniques for preservation and propagation of germplasm

Unit-I **13 hrs**

Origin of life. Microbial diversity – bacteria, viruses, fungi; Beneficial and harmful microbes. Normal microflora associated with humans and animals. Microbes in human and animal nutrition (e.g. ruminants and non-ruminants) and health. Interactions between microbes, plants and animals. Microbial biotechnology: Fermentation (e.g. ethanol, enzymes, hormones, biogas, biofuels, vitamins), Antibiotics and probiotics.

Unit II **13 hrs**

Plant biotechnology: Genetic manipulation (GM) of plants, GM plants (e.g. BT cotton, Golden rice, Flvr-savr tomato), Seed terminator technology. Litigations related to life (e.g. neem, Basmathi rice, turmeric). Plant tissue culture, synthetic seeds. Edible vaccines. Plant microbe associations, interactions (e.g.

symbiosis, mutualism) and benefits. Plant cells to generate biochemicals and medicines. Environmental Biotechnology: Revegetation and energy plantations (e.g. Neem, Jatropha, Pongamia). Bioremediation (plant and microbial). Microbes in mining. Waste processing and utilization.

Unit III **13 hrs**

Animal biotechnology: Transgenic animals (e.g. mice, sheep, fish). *In vitro* fertilization (IVF) and embryo transfer (ET), test-tube babies. Ethical issues (e.g. human and animal rights, surrogate mother). Animal cloning - Somatic and therapeutic cloning. Animal cell culture and organ culture. Animal cells as source of biochemicals (e.g. vaccines, hormones). Animals as bioreactors (e.g. mice).

References

1. Animal Transgenesis and Cloning. Houdebine,L.-M. John Wiley & Sons, 2003
2. Basic Biotechnology. Ratledge, C. & Kristiansen, B., Cambridge Univ. Press, 2006
3. Biology of microorganisms. Brock, T.B. & Madigan, M.T., Prentice Hall, 1996
4. Biotechnology of Higher Plants. Russell, G.E. Intercept Pub., 1988
5. Environmental Biotechnology. Jogdand, S.N., Himalaya Publishing House, 2012
6. Gene VII. Lewin,B., Oxford University Press, 2000
7. Microbial Biotechnology. Glazer, A.G., WH Freeman & Co., 1994
8. Microbial Ecology. Atlas, R.M.& Bartha, R. Benjamin Cummings, 1997
9. Plant Biotechnology. Mantell, S.H.& Smith, H. Cambridge University Press, 1983

BTE459 ENVIRONMENTAL ISSUES

Teaching Hours: 3 Hrs per week

Learning Objectives:

LO1: To understand global environmental issues caused by civilized societies

LO2: To understand local environment which is closely related to us

LO3: To understand the pollution related aspects, their causes and mitigation strategies

Course Outcomes:

CO1: By the end of the course, the students will have a better appreciation for the environment and become responsible citizens

CO2: *Awareness about the regional and global atrocities on environment and its impacts.*

CO3: *Knowledge about environmental pollutions, causes and outcomes. Information about the novel techniques using biology to control the pollution.*

Unit-I **12Hrs**

Global Environmental Issues: Green House effect – causes and associated hazards, Ozone layer depletion – causes and associated hazards, ~~Deforestation~~, Human Population Growth. Environmental problems associated with urbanization, industrialization, modernization of agriculture. Sustainability and problems: Solar panels, wind turbines and LED bulbs disposal issues

Unit-2 **12 Hrs**

Regional Environmental Issues: Forest and Wildlife management, desertification, reclamation of degraded land; Human intervention on wetlands, siltation and eutrophication, reclamation of wetlands, Mining and Environment, Open cast mining, Oil exploration and transportation, Deforestation and their impact on environment.

Unit-3 **12Hrs**

Pollution: Air Pollution : Causes of air pollution, Some important pollutants of air (CO, SOX, NOX and HC and Particulates) – their sources and effects on living and non-living organisms. Water Pollution: Sources of pollution of surface and ground water, Types of water pollutants. Solid Waste – Sources, characterization, disposal and management. Soil Pollution sources of soil pollution, Pollution and residual toxicity from the application of insecticides, pesticides and fertilizers; Soil erosion

Reference :

1. Environmental Chemistry : A. K. De
2. Environmental Chemistry : B.K. Sharma, and H. Kaur
3. Environmental Science (6th ed) (1997): Jr. G. T. Miller, Wadsworth Pub. Co.
4. Fundamentals of Ecology : E. P. Odum
5. Fundamentals of Environmental Science: G. S. Dhaliwal, G. S. Sangha and P. K. Raina, Kalyani Publication

BTE460 BIODIVERSITY AND ITS CONSERVATION

Teaching Hours: 3 Hrs per week

Learning Objectives:

LO1: Gain theoretical knowledge and appreciate the importance of biodiversity, Become familiar with and understand the key terminologies of Ecology, Know about Indian ecological/geographical diversity.

LO2: Describe the levels of biodiversity organizations.

LO3: Understand the relevance of biodiversity in conservation, can create an awareness about Biodiversity depletion & its conservation.

Course Outcomes:

CO1: Elucidate concept and types of biodiversity, understand ecosystem structure and components, describe Indian bio geographical regions

CO2: Understand different patterns of biodiversity and benefits of biodiversity

CO3: Demonstrate different methods of biodiversity conservation, understand organization of International union for conservation of nature, their objectives and principles

Unit-I **14Hrs**

Introduction to Biodiversity. Basic concepts & definitions, types of Biodiversity, biosphere, habitats, food chain, food web, Climatic Zones, Indian ecological/geographical diversity: Himalayan Region, Deserts, Gangetic plains, Semiarid region, Western Ghats, Coastal region; Hot spots in India.

UnitII **8 Hrs**

Patterns of Biodiversity. Introduction to biodiversity pattern, Species varying globally, Species varying locally, species varying over time, species – areas relationship.

Benefits of Biodiversity

Unit III **14Hrs**

Biodiversity Conservation: Causes and prevention of Plant and Animal biodiversity loss; Conservation of nature and natural resources - Soil, water and forests: IUCN Red List Categories and Criteria;Conservation strategies – Ex-situ and In-situ conservation, protected ecosystems – Biosphere reserves, National parks, Sanctuaries, Botanical gardens, sacred groves; Wildlife conservation and wildlife conservation act.

References:

1. Brummit, R.K. 1992, Vascular Plant Families and Genera, Royal Botanic Gardens, Kew, England.
2. Daniel, J.C. A century of natural history. Bombay natural History Society, Bombay. M 697pp.
3. Dwivedi,A.P., 1993. Forests. International book Distributors, Dehra Dun. 352 pp.
4. Eugene, P. Odum, 1983. Basic Ecology. Saunders College, London.
5. Gugjisberg, C.A.W., 1970. Man and Wildlife, Arco Publishing Company Inc., New York.
6. Haywood, V.H. and Watson, R.T., 1995. Global biodiversity assessment. United Nations Environmental Programme,New York.
7. Korringa, P., 1976. Farming of marine organisms law in the food chain. Elsevier, Amsterdam. 264 pp.
8. Krishnamoorthy, K.V 2003. An advanced textbook on Biodiversity. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi. pp. 260.
9. Levinton, J.S., 1982. Marine ecology, Prentice Hall, Englewood Cliffs. 526 pp.
10. Lieth, H., 1989. Tropical rain forest ecosystems. Elsevier, Amsterdam. 713 pp.
11. Nybakkan, J.N., 1982. Marine Biology – An ecological approach. Harper and Raw Publ., New York.
12. Reddy, P.A., 2000. Wetland ecology. Cambridge University Press, London. 614 pp.
13. Southwood, T.R.E., 1978. Ecological methods, Chapman and Hall, London. 524 pp.
14. Tiwari, S.K., 1985. Readings in Indian Zoogeography. Today and tomorrow’s Printers and Publishers, New Delhi. 604 pp.

BTP 456/457/458

Autoradiography to study the structure of molecules

Induction of tumors and its prevention

Structure of sperms and eggs

Spermatogenesis (e.g. grasshoppers)

Chick and Drosphila develop mental stages

Historical identification of germ layers of developing embryos

Induced breeding in fishes

Isolation of DNA and RNA from bacteria, plants and yeasts

Southern and Northern blotting techniques

Western Blotting

Studies on DNA replication

Studies on vectors

Tiplasmid

Probes

Chromosome mapping

Sequencing

PCR techniques

Construction of DNA libraries

Genomics and Proteomics

Study of mutagenesis

Extraction, isolation and purification of soluble and membrane bound enzymes

Enzyme assays

Study of enzyme kinetics (effect of substrate concentration, pH, temperature and metal ions)

Determination of Km and Vmax

Mechanism of enzyme inhibition

Immobilization of enzymes and their applications

Proximate analysis of foods and feeds (moisture, nitrogen, crude fiber, crude lipids and ash)

Analysis of antinutritional factors-(e.g., phenolics, tannins, DOPA, trypsin inhibitors)

Calculation of calorific value

Mineral analysis of foods and feeds

Vitamin assay (water soluble and fat soluble)

III SEMESTER

BTH501 PLANT BIOTECHNOLOGY

Teaching Hours: 4 Hrs per week

Learning Objectives:

LO1: To understand the impact of biotechnology on the agricultural industry, the limitations of conventional cross-breeding techniques as a means of developing new plant products and why plants are especially suitable for genetic engineering. Outline several ways in which biotechnology might reduce hunger and malnutrition around theworld

LO2: To learn different methods of in-vitro culture and maintenance of explants, role of gene banks, artificial seeds, cryopreservation, and tissue culture as a novel means of genestorage

LO3: To list and describe several methods used in plant transgenics emphasizing the use of *Agrobacterium* and the Ti plasmid as a genevector.

LO4: Listing transgenic crops improved by genetic engineering. Outline the environmental impacts, both pros and cons, of crops enhanced by biotechnology. Analyze the health concerns raised by opponents of plant biotechnology.

Course Outcomes:

CO1: Knowledge about genetic engineering sites other than the conventional regions

CO2: Establish different types of plant cultures

CO3: Apply the technical skills learnt to establish nurseries for horticultural and agricultural plants

CO4: Compare the pros and cons of transgenic plants on environment

Unit-I **13 Hrs**

Plant genome structure, gene families in plants, organization of chloroplast genome, mitochondrial genome and their interaction with nuclear genome, RNA editing in plant ~~mitochondria~~ organelle genome. Mitochondrial DNA and Cytoplasmic male sterility. Plant breeding: ~~mechanism~~: ~~types and applications~~ Brief introduction to selection, hybridization, introduction and acclimatization, mutation breeding

Plant Tissue Culture – ~~Historical perspective;~~ Lab set up, media components & sterilization, ~~Totipotency, Planthormones~~ Plant growth regulators

Unit-II **13 Hrs**

Micropropagation- Totipotency, Callus culture, Organogenesis, Meristem, embryo culture,Somatic Embryogenesis, their regulation and application; artificial seed production; Somaclonal variation; Haploids: Androgenesis, Gynogenesis, Parthenogenesis and its applications in genetics and plant breeding; Germplasm conservation and cryopreservation. Physical, genetic, chemical and genotypic factors. Problems in plant tissue culture (Recalcitrance, Contamination, Phenolic Browning and Seasonal Variation);

Unit-III13 Hrs

Genetic Transformation – Cointegrate and binary vectors and their utility; Ti&Ri plasmid based vectors, Screenable and selectable markers; *Agrobacterium*-mediated gene delivery; Direct gene transfer - PEG-mediated; Transgenic stability, gene silencing and removal of marker genes. Characterization of transgenics; Marker-free methodologies; Plant secondary metabolites-Hairy root culture

Process of Nitrogen fixation in legumes by *Rhizobium, Cyanobacteria and actinomycetes*, nif and nod genes.

Protoplast Culture and Somatic Hybridization – Protoplast isolation, culture and usage; Somatic hybridization- methods and applications; Cybrids and somatic cell genetics

Unit-IV **13 Hrs**

Transgenic plants — enhancing resistance to pests, nutritional value, modification of ornamental plants, bioengineered food, vegetable vaccines, plantibodies and biopharming.

Generation of agriculturally important plants: Expressing viral coat proteins and bacterial toxins in plants. New colours and patterns in flowers; Production of human proteins in plants. Development of transgenic plants for virus, bacteria, fungi, insect resistance, ~~herbicide tolerant plants~~, Abiotic stress resistant plants against salinity, draught, herbicides.

References:

1. Biotechnology in Agriculture and forestry Bajaj YPS series. Springer Verlag pub, 1986.
2. Biotechnology of higher plants-Russell ,1988.
3. Plant Cell, Tissue & Organ Culture: Fundamental Methods by O. L. Gamborg (Editor) and G. C. Phillips (Editor) (2004)J.Narosapub.Plant Biotechnology-Mantell and Smith-Cambridge univpress,1986.
4. Introduction To Plant Biotechnology/3rd Ednby Chawla H. S.(2009)
5. Plant Tissue Culture by Kalyan Kumar De (2008), Kalyani pub.,Kolkata
6. Plant Tissue Culture: Theory And Practice, 5th Revised Edition (2005) Author: Bhojwani S. S., ElsevierScience
7. Molecular Biotechnology: Principles and Applications of Recombinant DNA Hardcover – 4th Ed. (2010) by Bernard J. Glick,Jack J. Pasternak,Cheryl L. Patten. American Society forMicrobiology
9. https://cnx.org/resources/54c5aec33c8b17982c5da04e9ca6acea/PlantBioIII-TRANSFORMATION.pdf
10. https://www.ias.ac.in/public/Volumes/plnt/096/02/0079-0112.pdf

BTH502ANIMAL BIOTECHNOLOGY

Teaching Hours: 4 Hrs per week

Learning Objectives:

LO1: Introduction to cell culture basics of asepsis, role of media & its components, various equipments used in cell culture.

LO2: Initiation of cell culture, tissue degradation methods, cell separation techniques, viability assessments, mass culture of cells

LO3: Applications of cell cultures in IVF, creating transgenic fishes, synthesis of commercial important molecules from cells .Animals used as biorectors

Course Outcomes:

CO1:development of primary culture, characterising primary cell lines, & basic equipment, media, physical factors, asepsis design of lab.

CO2: Reflect the awareness of large scale culture of cell in Bioreactor for monolayer & suspension culture is studied.

CO3: Apply cell cultures in different fields like in vitro fertilisation, fish cell culture, mollusk culture, glandular cell.

CO4: Use various transgenic approaches used to improve animal as bioreactor CO5: Produce commercially important proteins from animal cell and use gene therapy and mechanism of gene therapy

Unit-I **13 Hrs**

Animal tissue culture: History,_laboratory design, aseptic conditions, methodology and media; Balanced salt solution and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Role of carbon dioxide. Role of serum and supplements. Serum & protein free defined media and their applications; Equipments and materials for animal cell culture technology.

Basic techniques: Mammalian cell culture *in vitro*; disaggregation of tissue and primary culture; maintenance of cell culture; Cell lines – Characteristics and routine maintenance. Measurement of viability and cytotoxicity. Cell separation techniques, Bioreactors used in animal cell culture

Unit-II **13 Hrs**

Biology and characterization of the cultured cells: measuring parameters of growth. Cell synchronization, Somatic cell fusion, Cell cloning. Organ and histotypic cultures. Application of animal cell culture: Stem cell cultures, embryonic stem cells and their applications. Cell culture based vaccines.

UnitIII **13 Hrs**

In vitro fertilization (IVF) & Embryo Transfer (ET); Sex determination or sex specific markers, sexing of sperm and embryos and Assisted Reproductive Technology (ART). *In vitro* gamete maturation, Intracytoplasmic sperm injection, Cryopreservation of gametes and embryo. Animal cloning - reproductive cloning ,theraploning, xenotransplantation

UnitIV **13 Hrs**

Transgenic approach for improvements of animals with specific examples - Animals as bioreactors. Applications of biotechnology in Sericulture. Production of Transgenic fishes- Transfer of Antifreeze Protein gene, jelly fish Aquarin (GF) gene, and Stress protein to fishes. General steps to make and analyse Transgenic fish, Genetically Improved Farmed Tilapia (GIFT).

Genetic engineering for production of regulatory proteins: blood products, and hormones., Gene therapy, Types of gene therapy, somatic versus germ line gene therapy , mechanism of gene therapy, Immunotherapy ,gene knockout

References:

1. Animal Transgenesis and Cloning by Louis –MarleHoudebineJohnWiley &Sons,2003.
2. Animal cell culture and Technology by Michel Butler BIOS Scientific Publishers; 2nd edition,2004.
3. Animal Cloning: The science of Nuclear transfer (The New Biology) by Joseph Panno Facts on File,2004.
4. At the Bench: A laboratory Navigator by KathyBarker.
5. Basic Cell Culture: A Practical Approach(Practical Approach Series) by J.MDavis ,2nd edition 2002 oxford university press, oxford.
6. Culture of animal Cells: A Manual ofBasicTechnique 4th edition by R. Ian Freshney Wiley-Liss,2000)
7. Gene VII, Oxford University Press ,NewYork,B.Lewin,2000.

BTS503 BIOPROCESS TECHNOLOGY

Teaching Hours: 3 Hrs per week

Learning Objectives:

LO1: To demonstrate, reinforce and extend the principles of bioprocess technology

LO2:To provide knowledge in microbial kinetics

LO3:To familiarize about types of fermentation process and optimization covering all areas of industrial microbiology

Course Outcomes:

CO1: Be aware of bioreactors, design media and optimize process parameters.

CO2:Explain different types of fermentation and bioreactors. Demonstrate the knowledge of Bioreactor, distillation, tray drying, chemical reactors, heat exchanger, Rheology and downstream processing

CO3:Apply the principles of Bioprocess engineering for designing and analysis of biological reactors for industrially important primary and secondary products.

Unit-I **10 Hrs**

Basic principles in bioprocess, advantages of bioprocess over chemical process. Isolation and improvement of industrially important strains. Media formulation, inoculum development, Sterilization- sterilization of medium, air and fermentors. Thermal death kinetics.

Unit-II **13 hrs**

Design of fermentors: criteria for ideal fermentor, aeration, agitation, valves, baffles, heat exchanges. Types of Fermentors- Waidhof-type fermentor, tower fermentor, cylindroconical vessels, air-lift fermentor, deep-jet fermentor, the cyclone column, the packed tower, rotating disc fermentor. Animal cell culture fermentor – stirred fermentor, micro carrier encapsulation, hollow fiber chambers, packed glass bead reactors. Cell immobilization techniques. Types of fermentation processes: submerged fermentation, surface or solid substrate fermentation, batch fermentation, continuous fermentation, kinetics of fermentation processes

Unit-III **13Hrs**

Downstream processing of biological molecules: separation of cells, foam separation, flocculation,

filtration, centrifugation (Basket and bowl centrifugation), cell lysis methods, physical and chemical methods, large scale separation techniques like Distillation, solvent
extraction, chromatography techniques, membrane filtration, ultrafiltration, reverse osmosis, crystallization, spray drying, drum drying, freeze drying, whole broth processing.
Biosensors- construction and application, fermentation economics

References*:*

1. Biochemical Engineering fundamentals, Baily & Ollis Mc Gram –Hill pub
2. Chemical engineering J.M Coulson Pregamon Press
3. Comprehensive biotechnology, vol 1, 2, 3 & 4 Murray Moo Young. Pergamon Press
4. Fundamentals of biotechnology P.Prave et al WCH Weinheinpub
5. Principles of fermentation technology P.F Stanbury& Whitaker Pragmon Press

BTS504 MICROBIAL TECHNOLOGY

Teaching Hours: 3 Hrs per week

Learning Objectives:

LO1: To make the students aware of the overall industrial bioprocess so as to help them to manipulate the process to the requirement of the industrial needs.

LO2: The course prepares the students for the bulk production of commercially important modern Bio products, Industrial Enzymes, Products of plant and animal cell cultures.

LO3: To demonstrate, reinforce and extend knowledge about production of different microbial beverages and foods

Course Outcomes:

CO1: Show the familiarity with different types of the microbial products and their essential roles in different fields. Analyze different types of vitamins, organic acids, antibiotics, hormones and other commercially important compounds and their production methods.

CO2: Apply the skills of commercial production of microbial enzymes, their purification methods, and their proper applications in different fields. Explain different types of polysaccharides produced by the microbes and their proper applications in the different industries.

CO3: Demonstrate the competencies through commercial methods to produce different types the microbial products - beverages, different types of the foods and also the production different types of eco-friendly fertilizers and their use to crops as well as the field

Unit-I **12hrs**

Microbial products: Microbial Biomass, Primary metabolites, Secondary metabolites, [Amino acids (Glutamic acid, L lysine,) Vitamins and hormones (vitamin B12, vitamin A, riboflavin, gibberellins). Organic acids, and other industrial chemicals, (Lactic acid, acetone, glycerol). Antibiotics (Penicillin, tetracycline), Lantibiotics (peptide antibiotics)]Microbial enzymes, Transformed products. Gene cloning in microorganisms other than *E. coli* (*Salmonella*, *Rhizobium, Agrobacterium, Bacillus subtilis, Streptomycetes, Aspergillus niger*)

Unit-II **12hrs**

Microbial Enzymes: Microbial production of enzymes (Protease, amylase, invertase, pectinase, xylanase) substrate, production, purification of enzymes, immobilization, their application in food and other industries. Microbial exopolysaccharides (EPS): Classification and applications (health, industrial, pharmaceutical and food); Alginate, Cellulose, Hyaluronic acid, Xanthan, Dextran, Gellan, pullulan, Curdlan. Polysaccharides of lactic acid bacteria: Chitin, chitosan and chitin derivatives

Unit-III **12 hrs**

Microbial beverages: Production of wine, beer and vinegar.Microbial food: Oriental foods, Baker's yeast, cheese, SCP, SCO (PUFA), Mushroom cultivation, sauerkraut and probiotics.Biofertilizers: *Rhizobium, Azotobacter, Azospirillum, Mycorrhizas,* Phosphate solubilizers, Biofuels, gasohol, biogas; waste utilization to generate biofuel

References:

1. *Biotechnology in Agriculture and forestry Bajaj YPS series. Springer Verlag pub, 1986.*
2. *Biotechnology of higher plants-Russell, 1988.*
3. *Industrial Microbiology. Cassida, L.E., John Wiley & Sons, 1968*
4. *Molecular Biotechnology: Principles and Applications of Recombinant DNA Hardcover – 4th Ed. (2010) by Bernard J. Glick , Jack J. Pasternak, Cheryl L. Patten. American Society forMicrobiology*
5. *Microbial Biotechnology. Glazer, A.G., WH Freeman and Company, 1994*
6. *Microbial Technology. Peppler, H.J., Vol. 1 & 2. Academic Press, 1979*
7. *Industrial Biotechnology. Crueger, W. &Crueger,A., Sinauer Associates Inc., 1990*
8. *Industrial Biotechnology. Demain, A.L., American Society for Microbiology, 1986*
9. Comprehensive Biotechnology. Vol. 1, 2, 3 & 4. Moo-Young, M., Pergamon Press, 2011
10. Fundamentals of Biotechnology. Prave,P.et al., Wiley-Blackwell Pub., 1987
11. *Microbial Technology. Peppler, H.J., Vol. 1 & 2. Academic Press, 1979*

BTS505 MEDICAL BIOTECHNOLOGY

Teaching Hours: 3 Hrs per week

Learning Objectives:

LO1:know the congenital or acquired pathological conditions in which it is possible to intervene with a biotechnological approach;

LO2: know the clinical diagnostic process of the main human diseases, including applied technologies.

LO3: Know diverse molecular techniques in diagnosis

Course Outcomes:

CO1: Explain the diagnostic, preventive and therapeutic strategies to human diseases

CO2: Demonstrate the practical skills on the use of basic tests in diagnosis of human diseases

CO3: Demonstrate use of molecular markers in identification

Unit-I **13 Hrs**

Bacteria: Representative diseases to be studied in detail are - tetanus, diphtheria, plague, and syphilis.Hospital acquired infections(nosocomial) and water borne disease. Infections caused by anaerobic bacteria, spirochetes, chlamydia, rickettsiae. viral cancers. Fungi: Diseases to be taken up in following categories: superficial, subcutaneous, systemic and opportunistic mycoses. Protozoa: Diseases to be discussed are - amoebiasis, toxoplasmosis, trichomoniasis &leishmaniasis.

Unit-II **13 Hrs**

Bacterial and viral vectors Biological warfare agents Mode of action of antibiotics and antiviral: molecular mechanism of drug resistance (MDR) Anti-viral chemotherapy. Anti-fungal chemotherapy Sterilization techniques: biohazard hoods; containment facilities, BSL 2, 3, 4.

Unit-III **13 Hrs**

Modern approaches for diagnosis of infectious diseases: Basic concepts of gene probes, southern, northern, dot hybridization, micro array, DNA finger printing and profiling (RAPD, ribotyping, VNTR, SNP) dot hybridization and PCR assays(multiplex, nested , real time).

PRACTICALS

Staining techniques.

Haemagglutination test.

Commercial kits-based diagnosis.

Antibiotic sensitivity(bacterial).

Electron microscopy (demo)

Bacterial culture Agar gel diffusion

ELISA Preparation of axenic cultures

PCR amplification

RAPD analysis

References:

1. An introduction to genetic engineering by ST Desmond and Nicholl Cambridge University Press 2nd edition(2004)
2. General Microbiology Vol. II by Powar and Daginawala Himalaya Publ. House8th edition (2004
3. Principles of Virology by SJ Flint, LW Enquist, RM Krug, VR Racaniello, AM
4. Skalka ASM Press Washington 1st edition (2002)
5. Textbook of Microbiology ;R. Ananthnarayan, C. K. J. Panicker, Orient Longman 6th Edition
6. Medical Biotechnology (2014), Bernard. R. Glick, Terry L. Delvitch and Cheryl L Patten. ASM Press. ISBN: 9781555817053

BTE508 IMMUNE SYSTEM AND HUMAN HEALTH

Teaching Hours: 3 Hrs per week

Learning Objectives:

LO1: The students will be able to identify the cellular and molecular basis of immune responsiveness.

LO2: The students will be able to describe the roles of the immune system in both maintaining health and contributing to disease.

LO3: Describes different medium of infection

Course Outcomes:

CO1: The students understand protection offered to infectious agents

CO2: The students will be able to transfer knowledge of immunology into clinical decision

CO3: Demonstrate infection cycle & its regulation

Unit 1: **10Hrs**

Immune system types & classification-Innate immunity, factors affecting, mechanism of innate immunity, Adaptive immunity, characteristics-Active & passive, Humoral & cell mediated immunity. Cell of immune system.

Unit 2: **13 Hrs**

Definition of infection and disease -Classification of infections: localized, generalized, endemic, epidemic, sporadic and pandemic. Classification of diseases as communicable and non-communicable with examples.

Unit 3: **13 Hrs**

Sources of infection: Air, humans, animals, insects, soil, water and food. Methods of transmission of infection: Contact, inhalation, ingestion. inoculation, insects, congenital and laboratory infections. Causes, prevention and treatment of infections /disease: Dengue, HIV, Tuberculosis, Typhoid, Malaria and Candidiasis. Sterilization and Disinfection. Vaccines and Immunization schedule. Chemotherapy - Use and abuse

Reference Books:

1. Benjamin E. (1996), Immunology – A short course 3rd Edition, John Wiley, New York
2. John E. Hall, Medical Physiology by Guyton, Saunders, 12th edition
3. Kuby J. (1997), Immunology, 3rd Edition, W.H. Freeman & Co., New York
4. Mims' Medical Microbiology By (author) Richard Goering, By (author) Hazel Dockrell, By (author) Mark Zuckerman, By (author)Ivan M. Roitt, By (author) Peter L. Chiodini Saunders (W.B.) Co Ltd.
5. Roitt, I.M. (1997), Essential Immunology, 9th Edition, Oxford Black Well Science, London
6. Tizard I.R. (1995), Immunology – An introduction, 4th Edition, PhiladephiaSauders College press

BTE509BASIC CONCEPTS IN CLINICAL BIOCHEMISTRY

Teaching Hours: 3 Hrs per week

Learning Objectives:

LO1: It trains the students to gain concepts of assessing the human physiology using biological fluid

LO2: Importance of Biomolecular measurements in different condition

LO3: Significance of endocrine systems

.

Course Outcomes:

CO1: It illustrates the mechanism of metabolic disorders at molecular level

CO2: Corelates the fluctuation of biomolecules with disease

CO3: Demonstrates normal levels in healthy individuals

Unit I- **12 Hrs**

Introduction to Clinical Biochemistry Definition and scope of clinical biochemistry in diagnosis, collection and preservation of biological fluids (blood, urine & CSF), normal values of important constituents of blood, CSF and urine. Requirements of setting up of clinical laboratory, collection preparation, preservation, and handling of clinical samples, quality control, Safety measures in clinical laboratory.

Unit II **12 Hrs**

Clinical Importance of Biomolecules Carbohydrates- Estimation of glucose, glycosurias, GTT's, hyper &hypoglycemia, blood glucose regulation and role of hormones; diabetic coma, Lipids- lipid profile estimation, hypercholesterolemia, hyperlipoproteinemia, atheroscerosis and it risk factors.Proteins - albumin, hypoalbuminemia, hypoproteinemia, Bence Jones proteins, proteins in CSF and their estimation.

Unit III – **12 Hrs**

Hormones Definition and different classes of hormones; Thyroid hormone and their mechanism of action; Pituitary hormones and their role in biological systems; Hormone regulation, Role of insulin in modulating blood glucose level.

Reference Books:

1. Clinical biochemistry, metabolic and clinical aspects by William J. Marshall, Stephan K
2. Clinical Biochemistry: An illustrated color text 3rd Ed. by Allan Gaw, Micheal Murphy, Robert Cowan, Denis O Reilly, Micheal Stewart and James Shepherd. Churchill Livingtons.
3. Fundamentals of Clinical Biochemistry by Teiz, W.B-Saunders Company.

BTE510 APPLICATIONS OF BIOTECHNOLOGY IN FOOD SCIENCE

Teaching Hours: 3 Hrs per week

Learning Objectives:

LO1: To know about the constituents and additives present in the food.

LO2: To gain knowledge about the microorganisms, which spoil food and food borne Diseases.

Course Outcomes:

CO1: To know different techniques used for the preservation of foods & quality standards

CO2: To gain the knowledge about balanced diet, and its importance

Unit 1 **13Hrs**

Scope of Food biotechnology, Difference between the modern biotechnology and the traditional biotechnology, Difference between Food technology and Food biotechnology

Foods produced through indigenous and modern biotechnical tools, merits and demerits of genetically modified foods,

Fermented Foods - Industrial production of Yoghurt, Cheese, Tempeh. Beer ,wine

Adulteration of food : Identification of adulterants both qualitative and quantitative; additives in foods; types, names, uses, maximum permissible limits.

Concept of Balanced Diet, Malnutrition – over and under. Basic Food Groups, Food Pyramid.

Unit 2 **12Hrs**

Food Chemistry : Vitamins- Importance, Water soluble vitamins, Fat soluble vitamins,

Proteins : Protein classification and structure, Nature of food proteins & its importance

Lipids : Classification of lipids, Physical properties of lipids. Chemical properties of lipids

Carbohydrates – Structure, classification & importance.

Unit 3 **11Hrs**

Food spoilage - definition, types, Food borne diseases and infections, food poisoning

Food Packaging and Storage Technology: Packaging material - Origin, types, chemistry, morphology and physical characteristics, advantages, defects.

Quality standards – Food Safety Act, FSSAI, ISO series, national laws and regulations: PFA, FPO, BIS and Agmark and international laws and regulations, HACCP

References:

1. Byong H. Lee, Fundamentals of Food Biotechnology, Wiley-Blackwell, 2014
2. Maheshwari, D. K. et. al., Biotechnological applications of microorganisms, IK . International, New Delhi, 2006
3. Meyer, Food Chemistry, New Age, 2004
4. Prescott and Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers.
5. Stanbury, P. F. et. al., Principles of Fermentation Technology, 2nd Edition, Elsevier, UK, 1995

BTP506/BTP507

Preparation of Plant extract (Organic andaqueous),

Crushing, grinding, maceration, homogenization, Filtration, Centrifugation, cold percolation extraction, hot extraction, using Sohxletapparatus

Synthesis of gold NPs for plantsextracts

Synthesis of Iron oxide nanoparticles by using chemicalmethods

Study of FTIR spectroscopy for materialscharacterization

Study of UV-Vis spectrophotometer for materialscharacterization

Surface modification Nanoparticles withpolymers

Synthesis of Ag nanoparticles using sodium borohydride (Creighton'smethod).

Cell counting and cell viabilitystudy

Estimation of particle size using particle sizeanalyser

Submerged and solid statefermentation

Estimation of microbialbiomass

Estimation of microbial enzymes, mycotoxins, organic acids andantibiotics.

Microbiological assays (antibiotics, amino acids andvitamins)

Properties of microbial exopolysaccharides (e.g., cell immobilization)

Uses of Chitin and itsderivatives

Pilot scale production of alcoholicbeverages

Microbial interactions with plants (rhizobia, mycorrhizas) and plantproduction

Assessment of nitrogen fixation (acetylene reduction test)

Phosphate solubilization in bacteria,fungi andactinomycetes.

Qualities of biofuels (e.g. biodiesel,biogas)

Isolation of microbes of industrialimportance

Instrumentation in bioprocesstechnology

Growth and death kinetics of microbialcultures

Cell encapsulation (immobilization) techniques anduses

Pilot-scale production of microbial (or plants or animal) cellproducts

Downstream processingtechniques

Methods of celllysis

Reverseosmosis

Dryingprocesses

Biosensers

Cleaning and sterilization methods for tissue culture

Preparation of media,buffers

Maintenance of cultures, (normal and tumor cell lines)

Separation of peripheral blood mononuclearcells

Cell counting(hemocytometer)

Lymphocyte culturetechnique

In vitro macrophage culture frommouse

Preparation of human metaphasechromosomes

Cell viabilitytests

Cell proliferationassay

Growth kinetics of cells inculture

In vitro fertilization and embryo transfertechniques

Cryopreservation techniques

Cytotoxicity tests

Estimation of plant hormones (e.g. auxins,gibberellins)

Plant tissue culturemethods

Callus culture (compact andfriable)

Ovule and antherculture

Cell suspensioncultures

Embryogenesis

Syntheticseeds

Protoplastpreparation

Protoplast fusiontechniques

Plant cellimmobilization

Methods of inducing resistance through tissueculture

Agrobacterium mediated genetictransformation

* Practical exercises to be conducted with back ground of respective theory papers (BTH 501, BTH502,BTS503 andBTS504)

IV SEMESTER

BTH551 IMMUNOLOGY

Teaching Hours: 4 Hrs per week

Learning Objectives:

LO1: Concept of Immunity, types of immunity, cells & organs involved in immune functioning

LO2: Foreign substance characteristic to evoke a immune response

LO3: Exaggerated levels of immune response in hypersensitivity, auto immune diseases

LO4: Briefing foundation of humoral immunity & vaccine development

Course Outcomes:

CO1: *Analyze and explain the body's functional role in fighting against invading pathogen.in this aspect it discusses various types of immunity like innate, acquired, humoral & cell mediated, effect or mechanism of activated cell in combating invading pathogen.*

CO2: *Express how streamlining of antigen from immunogen takes place by defining characteristics of an antigen. Explain the concept of self-tolerance during lymphocyte maturation failing of which leads to auto immune disease.*

CO3: *Show the knowledge of the exaggerated levels of immune reaction to a harmless particle leading to hypersensitive reaction, different types.*

CO4: *Express a comprehensive knowledge of Synthesis in terms diverse amount of antibodies with varied specificity; antibody gene rearrangement, different classes of antibody with structure & biological function, concept of vaccination, immune function during transplantation.*

Unit-I **13 Hrs**

History and scope of immunology. Types of immunity-humoral and cell mediated. Innate and adaptive immunity. Specificity and memory. Primary and secondary lymphoid organs; immunization

Cells involved in immune response- T- cells,B-cells. Clonal selection theory. Lymphocyte activation, clonal proliferation, differentiation. Effector mechanisms in immunity- macrophage activation.

Unit-II **13Hrs**

Antigens: Definitions, antigen: Self antigens and foreign antigens, haptens, epitopes, adjuvants and mitogens. Foreign antigen's antigenicity. Protein antigens, carbohydrate antigens, bacterial cell surface antigens, blood group antigens, tumor antigens and viral antigens. Immunogens in vaccination. Bases of antigen specificity, forces of antigen. Antibody interaction, T-dependent and T-independent antigens, super antigens.

Unit-III **13Hrs**

Human and mouse MHC , Transplantation immunology. HLA in human health and disease HLA tissue typing. Immune –suppression in transplantation. Hypersensitivity reaction, treatment approaches. Immunological tolerance.

Autoimmune diseases, Thyrotoxicosis, Systematic Lupus Erythromatosis, Antinuclearantibodies. Tumour immunology-tumor antigens, immunosurveillance, Immune deficiency diseases – AIDS; Immunological tolerance.

Unit-IV **13Hrs**

Immunoglobulins: Isolation and purification of immunoglobulins. Structure of antibodies. Classes and subclasses of immunoglobulins, biological and chemical properties of Igs. Hyper variable region, isotopic, allotypic and idiotypic variations and idiotypic network. Biosynthesis, theories of formation, diversity of antibodies, genetics of Ig diversity, mechanisms contributing to antibody diversity, Ig genes, isotype switching, Ag-Ab reactions, specificity, affinity binding of antibodies. Production of polyclonal and monoclonal antibodies.

Vaccines: Immunization: Active immunization, passive immunization. Adverse reactions from vaccines, experimental immunization procedures, production of recombinant vaccines and their uses.

Transplantation Genetics and Immunology**:** Types of grafts, major histocompatibility gene complex, ABO blood group compatibility, host response to transplantation, immunosuppressive therapy.

References:

1. Essential immunology- Ivan Riott 8th edition Blackwell scientificpub
2. Handbook of expt. Immunology vol. 1,2 .Wiler DM Blackwell scientificpub.
3. **https://nptel.ac.in/courses/102/105/102105083/**
4. Immunobiology-3rd edition, Janeway and Travers .Churchill Livingstonepublications
5. Immunology –Janis Kuby; Freeman and co publishers,2000
6. Immunology-3rd Edition .Ivan Riott , Jonathan Brostoff and David Male. Mosby publishers
7. Jordan S.Pober Cellular and molecular immunology. – Abdul K.Abba, Andrew H. Lichtman, SaundersCo
8. Practical Immunology. Hudsonetal Blackwell scientific pub.,1986

BTS552 ENVIRONMENTAL BIOTECHNOLOGY

Teaching Hours: 3 Hrs per week

Learning Objectives:

LO1: Understand the interactions between organisms and their environments, and the consequences of these interactions in natural populations, communities, and ecosystems evidenced by pollution.

~~**LO2:** To learn the extent of pollution in different industries including agriculture by analyzing the permissible limits and indices of different pollutants~~

~~**LO3:** Prevention of such bio-hazardous and chemicals accumulation in the environment using novel biotechnological methods using microorganisms and plants~~

LO2:-To learn the extent of pollution in different sectors by analyzing the permissible limits and indices of pollutants. Prevention of bio-hazardous and chemicals accumulation in the environment using novel biotechnological methods

LO3: Consequences of genetically modified organisms and their impact on natural environment, rules and regulations while handling these organisms, issues of aquaculture industries and prevention.

Course Outcomes:

CO1: *Show the basic and advanced information regarding environmental pollutions, causes and outcomes.*

CO2: *Apply the novel techniques using microorganisms and plants to control the pollutions*

CO3: *Notice positive changes after usage of organisms for mining and also for mining related issues and compare the scenarios wherein the danger of release of GMOs to the environments.*

Unit-I **14 Hrs.**

Environmental pollution; Soil, water and air pollution; Indicator organisms and human pathogens (*Salmonella, Vibrio, Hepatitis A*)

~~Microbial~~ Biological ~~degradation of toxic chemicals (pesticides, detergents, plastics). Degradation of organic compounds (cellulose, lignin, hydrocarbons: aliphatic, aromatic, alicyclic hydrocarbons) Microbial deterioration of leather.~~

Biological degradation of pesticides, detergents and plastics; Degradation of lignocellulose, Chlorinated Wastes, p-Nitrophenol Degradation, Dioxin, Selenium Microbial deterioration of leather

Microbial mining (with suitable examples), microbial influenced corrosion and remedies, bioaccumulation, biomagnification.

Unit-II **14 Hrs**

Principles of microbial bioremediation, *in situ* and *ex situ* bioremediation,microbiological treatment of solid wastes- composting, land farming, bioreactors. Biological treatment of liquid wastes - aerobic and anaerobic treatments sewage and effluent treatments.

Pollution control measures, international and national pollution regulatory acts; Permissible limits and indices for pollutants; Hazardous wastes: microbial processing and disposal of dyes & paints, radioactive wastes, pharmaceuticals, refinery, distillery and leather industryeffluents.

Unit-III **8 Hrs.**

Coastal regulatory zone (CRZ). Environmental issues of aquaculture; Biofilms and Biofouling – micro fouling and macro fouling; Biomaterials; Biomolecules from the sea; Issues associated with environmental release and monitoring of GMOs. Sources and types and constituents of E-wastes and its environmental consequences..

References*:*

1. Ecology-Odum
2. Environmental Biotechnology, Jogdanand ,Himalaya pubHouse
3. Environmental and Biochemistry Kudesia&JetleyPragathiPrakashanpub.
4. Microbial Ecology- Atlas andBartha
5. Microbial Biotechnology- Alexander.G, WH Freeman andcom.
6. Sewage and industrial effluent treatment John Arundel ,Blackwell sciencepub
7. Soil Microbiology,4th ed. N.S. Subba Rao ,Oxford & IBHpub.
8. Waste water engineering 3rded Metcalf &Eddy ,McGraw –Hill internationalEds.
9. https://mmbr.asm.org/content/mmbr/54/3/305.full.pdf

BTS553AGRICULTURAL BIOTECHNOLOGY

Teaching Hours: 3 Hrs per week

Learning Objectives:

LO1: Demonstrate the Understanding of the principles and the emerging concepts in agricultural biotechnology.

LO2: Explain the role of biofertilizers in agriculture crops.

Course Outcomes:

CO1: Discuss and analyse how modern agricultural biotechnology and genetic resources can be harnessed to achieve environmental sustainability.

CO2: Undertake the modernized farming practices both in plant and animals for betterment in a highly profitable manner.

Unit-I **10 Hrs.**

Bioinoculants Introduction and Importance of biofertilizers in agriculture, Mass culturing and quality control of microbial inoculants-mother culture, shake culture and large scale production of biofertilizers (Rhizobium, Azotobacter, Mycorrhiza, Actinorhiza) types of carrier materials, packing storage, shelf life and transportation of biofertilizers. Methods of application to seed, soil and nursery. Vermiculture, composting , current practices and production.

Biopesticides: *Bacillus thuringiensis,Trichoderma,Baculoviruses*

Unit-II **16 Hrs.**

Integrated pest management. Breif introduction to entomology: Importance of JH and JH analogues in insect pest control. Insect pheromones and their applications. Biological control of insect pests and weeds using natural enemies, mass multiplication of predators and parasites. Biological control of plant pathogens using antagonistic fungi and antagonistic bacteria.

Unit-III **10 Hrs.**

Applications of Biotechnology in Animal husbandry Introduction and importance of animal husbandry. Applications of biotechnology in poultry, aquaculture, sericulture, Improvement of poultry, disease resistance, recombinant vaccines for poultry, growth hormones for increasing biomass, fish breeding

techniques, silkworm as bioreactor for the production of commercially important proteins; improvement of livestock, molecular pharming of products - (Pharmaceuticals through milk or genetically engineered cows).

References:

1. Agricultural Microbiology: G.Rangaswamy and D.J. Bagyaraj 1993, 2nd Edition, Prentice Hall of India Private Limited, New Delhi.
2. Microbial Biotechnology –Fundamentals of applied Microbiology. Glazer and Nikaido (1995) W.H. Freeman Publication company.
3. Biotechnology theory and techniques –Chirikjian. Veena, D.P.S. and Hons T (1984) Plant gene resea

BTS554 FOOD BIOTECHNOLOGY

Teaching Hours: 3 Hrs per week

Learning Objectives:

LO1: To know about different types of fermented foods and use of enzymes in food industry

LO2: To know functional foods and phenolic compounds

LO3: To know different techniques used for the processing and preservation of foods and gain knowledge about the microorganisms, which spoil food, uses of nutraceuticals and starter cultures.

Course Outcomes:

CO1: Identify the different types of fermented foods like, food produced by vegetables, fruits, fish and meat. Show the understanding of the various enzymes used in different methods like enzymes in different industries like baking, dairy and in food and feed- different generic technologies used for preparation of different variety of foods

CO2: Demonstrate the basic information about the functional foods with respect to health benefits and different plant phenolic compounds which can bring the health benefits and standards of food authentication with respect to different tests for toxicity testing,

CO3: Apply the principles and techniques for the food processing, and different biotechnological methods in the production of different foods which includes GM foods

Unit-I **13Hrs**

Fermented foods, milk-based products, fermented vegetables, fermented meats, fish, beverages, vinegar, mould fermentation - tempeh, soy sauce, rice wine. Enzymes in dairy industry, cheese making and whey processing, impact of enzyme technology (bioethanol, protein hydrolysates, bioactive peptides), Enzymatic processing of fruit juices; role of enzymes in baking, meat and meat processing, phytase in animal feeds, DNA-based methods for food authentication, comparative methods of toxicity testing in (novel) foods, biological approach to tailor-made fats, application of generic

technologies in food and nutritional sciences; anti- cancer components in foods.

Unit-II **13Hrs**

Functional foods and Biotechnology: Biotechnological approaches to improve nutritional quality and shelf life of fruits and vegetables; biotechnology of food flavors production, Genetic modification of plant starches for food applications; bio-mobilization of major nutrients such sterols, lipids, vitamins and minerals, use of specific phenolic metabolites from botanical species. Pre- and Pro-biotics, single cell protein, single cell lipids. Manipulation of fruit ripening process.

Unit-III **13Hrs**

Food processing, principles and practices, food ingredients and processing aids from biotechnological processes, corn sweeteners, bacterial starter cultures,cold-adapted enzymes. Food spoilage, preservation, mycotoxins in food commodities. Genetically modified foods, designer foods, Nutraceuticals, detection of GM foods.

References:

1. B.Sivasanker–FoodProcessing andPreservation,Prentice-HallofIndiaPvt. Ltd. New Delhi2002.
2. J.M. Jay – Modern Food Microbiology, Cbs Pub. New Delhi,1987 New York 1988.
3. T.P. Coultate – Food – The Chemistry of Its Components, 2nd Edn. RoyalSociety, London, 1992.
4. W.C. Frazier and D.C. Westhoff – Food Microbiology, 4th Ed., Mcgraw-Hill Book Co.
5. Handbook of food analysis- Mollet (Leo M.L.) ed. 3rd Ed., CRC press, 2015.
6. Basic Food Microbiology- Banawart GJ. AVI Publ., 1979
7. Anthony Pometto, Kalidas Shetty, GopinadhanPaliyath, Robert E. Levin, (2005) Food biotechnology. CRC Press
8. Bibek Ray (2005) Fundamental food microbiology-3rd edition CRC Press.
9. James, M.J. Loessner, MJ. and David, A.G. (2008). Modern food microbiology (8thEd.)
10. Goldberg, I. (1994). Functional Foods: Designer Foods, Pharma Foods
11. Shi, J. (2006). Functional Food Ingredients and Nutraceuticals: Processing Technologies. CRC Press.

BTP555

Study of immune system inrats

Blood film preparation and study of immunecells

Histology of organs of immunesystem

Study of insecthemocytes

Production ofantiserum

Isolation oflymphocytes

Antigen-antibody reactions (*invitro*)

Phagocytosis (*invitro*)

Immunodottechnique

Immunodiffusiontechnique

Immunological diagnosis of pregnancy andinfection

Demonstration of ELISA technique

BTP556

Production of Compost(methods)

Vermicompost and itsanalysis

Cultivation ofmushrooms

Biogas (biofuels)production

Waste water treatmentmethods

Solid water treatmentmethods

Experiments of biofouling andbiofilms

Experiments on industrial waste treatment methods (e.g. distillery,whey)

Bioinoculants : Isolation and mass production of: Rhizobium,Azospirillum, Azatobacter, Anabena, andAzolla

Isolation of phosphate solubilizing microorganisms from soilsample.

Estimation of phosphate by Fiskay-Subbaraomethod.

Detection and quantification of mycorrhizae by root clearing technique from different crop plants.

Study of root /stem nodules and study ofVAM.

Assay of Biofertilizers (at least threetypes).

Testing of antagonism by dual culture plate technique.

Testing of antimicrobial property of antagonists culturefiltrate.

Bio-insecticidal effect of biopesticides from microbial and plantsources.

Protoplast fusion in Rhizobium for enhanced noduleformation.

Baculovirus stocks –Preparation and titration using plaquecolony.

Co-transfection of insect cells using linearized baculovirusstocks.

Induced breeding of commercially important fishes.

Microbial examination of

curd Yogurt preparation

Production of Saukrauet

Isolation & identification of microbes from fruits & vegetables

Isolation of Salmonella from poultry products

Analysis of aflatoxin by TLC

Mushroom cultivation

Alcohol fermentation from fruit juice

Preparation of beer

Probability test of water-MPN, presence /absence of coliform/Membrane filter techniques