SRI DHARMASTHALA MANJUNATHESHWARA COLLEGE (AUTONOMOUS), UJIRE-574240

(Re-Accredited by NAAC at 'A' Grade with CGPA 3.61 out of 4)

Department of PG Studies and Research in Biotechnology

M.Sc. DEGREE PROGRAMME

SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS) SEMESTER SCHEME

FIRST SEMESTER SYLLABUS

HARD CORE PAPERS	SOFT CORE PAPERS	OPEN ELECTIVE
BTH401Biochemistry	BTS404 Molecular Genetics	Nil
BTH402 Microbiology	BTS405 Bio analytical techniques	
BTH403 Cell biology		
BTP406 Biochemistry& Microbiology		
BTP407 Cell biology & Molecular Genetics OR BTP407 Cell biology & Molecular Genetics & Bio analytical techniques		

BTH401 BIOCHEMISTRY

Objectives

No of Credits: 4
No. of Hours: 52

- To study about chemical bond, types and its effect on reactivity
- To understand the structure, function and interaction between biological macromolecules in living system

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 saccharic acids), 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 and prediction of protein structures (Chou and Fasman scheme).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. Nelson, D.L., Cox, M.M. Lehninger. (2011). Principles of Biochemistry 4th edition Pub WH Freeman Co.

2. Elliott, W.H., Elliott, D.C. Biochemistry and Molecular Biology 3rd Indian edition,

Pub. Oxford.

3. Mathews, Van Holde and Ahern, Biochemistry by 3rd edition, Pub Pearson education

4. Stryer, L. Biochemistry 4th Edn. W.H. Freeman and Co. NY.

5. Kuchel, P.W., Ralston Schaums, G.B. Outlines of Biochemistry 2nd edition Pub: Tata.

6. Voet, D., Voet J.G. (2004). Biochemistry 2nd Edn.

7. Devlin, T.M. (1997). Biochemistry with clinical correlations, Wiley-Liss Inc. NY

8. Zubey, G.L. Parson, W.W., Vance, D.E. (1994). Principles of Biochemistry WmC Brown publishers. Oxford.

9. Edwards and Hassall. Biochemistry and Physiology of the cell 2nd Edn. McGraw Hill Co. UK. Ltd.

BTH402 MICROBIOLOGY

No of Credits: 4

No. of Hours: 52

Objective:

- Studies about emergence & evolution of micro-organism, streamlining microbial groups into prokaryotes, eukaryotes & archaea with morphological details.
- Tells about nutritional requirement, metabolism & growth kinetics of micro organisms. Microbial community.
- Viral classification with few examples of bacterial, animal & plant viruses with its life cycle.
- Microbial pathogenesis

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 chemorganotroph & 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 edition 2012
2. Element of microbiology 5th edition– Pelczar J. and Chan ECS. MacGraw Hill New York,2008
3. General Microbiology .Schlegel HG 7th ed. Cambridge Univ. Press 1993
4. Microbial biology. Rosenberg E and Cohen IR. .Saunders Coll .Pub.,1983
5. The microbial world. Stanier RY et al 5th ed. Prentice Hall New Delhi.1990

Skill components Identified :

Various bio-safety issues including physical and biological containment, universal containment, personal protective equipment for biological agents

Various isolation precautions including standard and transmission based precautions

In-depth knowledge about various method of Sterilization, and disinfection

Nomenclature, classification and morphology of bacteria as well as other microorganisms

Requirements for growth and nutrition of bacteria along with bacterial metabolism 9.

Microbiology of air, soil, water

Various types of host-parasite relationship and their significance

Various antimicrobial agents and mechanisms drug resistance

Bacterial genetics, bacteriophages and molecular genetics relevant for medical microbiology .

Applications of quality assurance, quality control in microbiology and accreditation of laboratories

BTH403CELL BIOLOGY

No of Credits: 4

No. of Hours: 52

Objective:

- To Understand the structure and function of prokaryotic and eukaryotic cells as whole and in terms of their sub-cellular processes.
- To study structural organization of their membranes, transportation of solutes across membranes, cellular development, defence, division both in somatic and gametic cells, cell cycle regulation will be dealt.
- Cell-cell integration, communication, cellular organization into tissue, signalling pathways and its regulation are also the key features which the students will be enlightened.

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, ribosomes, 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. Molecular Biology of the Cell 5E (2008). Bruce Alberts, Alexander Johnson, Julian Lewis and Martin Raff, Garland Publishing, Inc., New York.
2. Cell: A Molecular Approach, 6th Edition (English)Author: Robert E. Hausman, Geoffrey M. Cooper: Sinauer associates Inc., 2013
3. Cell and Molecular Biology 8th Edition (2010) by E. D. P. De Robertis. CBS Publishers & Distributors

4. Developmental Biology, 10th Edition (2013) by Scott F Gilbert: Ingram International Inc
5. Molecular Cell Biology. – International Edition, (2012) by Harvey F. Lodish et al., WH Freeman and company, New York.
6. Cell and Molecular Biology: Concepts and Experiments, 7th Edition (2013) Gerald Karp. Wiley &sons, New York.
7. https://mcb.berkeley.edu/courses/mcb110spring/nogales/mcb110_s2008_4signaling.pdf

Skill component Identified:

We learn the how and why of biology by exploring the function of the molecular components of cells, and how these cellular components are organized in a complex hierarchy. Learners will have a deep intuition for the functional logic of a cell. Together we will ask how do things work within a cell, why do they work the way they do, and how are we impacted? In laboratory, they will master the most important instrumental techniques required for work in biotechnological and other chemical laboratories.

BTS404 MOLECULAR GENETICS

No of Credits: 3

No. of Hours: 36

Objective:

- To Understand genetics of inheritance
- To understand types of mutation & repair mechanism
- To understand genetics diseases through structural & numerical chromosomal abberations

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

BTS405 BIO ANALYTICAL TECHNIQUES

No of Credits: 3

No. of Hours: 36

Objectives

- Introduces about principle and application of Biophysical 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 **12 Hrs**

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 **15 Hrs**

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 mass spectrometry.

Reference:

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

Skill component identified :

1) Analytical and Preparative Chromatography
2) Basic electrophoretic principles
3) Centrifuges used for separation
4) UV/ Visible Spectrophotometer
5) Chromatography – TLC , Paper Chromatography
6) Buffers used in Downstream Lab.

Colour reactions for mono-, di- and polysaccharides
Identification of unknown carbohydrates
Estimations of blood glucose, free fatty acids, cholesterol and proteins
Estimation of amino acids
Estimation of serum proteins
Estimation of blood urea
Determination of urine creatinine
Tests for nonprotein nitrogen (NPN) substances
Determination of plant phenolics and ascorbic acid
Chromatography (TLC and Column)
Colorimetry
Flame photometry
Electrophoresis

Microscopic observations of microorganisms
Microbial staining techniques (simple and differential staining, cell wall, endospores, intracellular lipids, acid-fast, flagella, viability)
Microbial motility tests
Sterilization techniques
Microbial culture media and their preparation
Qualitative and quantitative assessment of microflora in soil, water,air, and food
Milk microbiology
Studies on bacteria,fungi and actinomycetes
Studies on symbiotic association of microorganisms

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

SECOND SEMESTER SYLLABUS

HARD CORE PAPERS	SOFT CORE PAPERS	OPEN ELECTIVE
BTH451 Molecular biology	BTS453 Metabolism	BTE458 Fundamentals of Biotechnology
BTH452 Genetic Engineering	BTS454 Enzymology	BTE459 Environmental Issues
BTP456 Molecular biology & Genetic Engineering	BTS455 Biostatistics & Bioinformatics	BTE560 Biodiversity & conservation
	BTP457 Metabolism & Ezymology OR BTP457 Metabolism & Biostatistics & Bioinformatics	

BTH451 MOLECULAR BIOLOGY

No of Credits: 4

No. of Hours: 52

Objectives

- Study of transfer of sequential information through central dogma of life
- Introduce about replication of Nucleic acid, Transformation and translation
- Explains DNA damage and Repair mechanism
- Molecular and cellular biology of fertilization

Unit – I **15 Hrs**

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-tRNA synthetases, 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,4th edn., Garland Publishing ,Inc ., New York.
2. Cooper, Geoffrey M.The cell –A Molecular Approach 2nd ed.Sunderland (MA) :Sinauer Associates .,Inc;2000
3. De Robertis ,E.D.P and De Robertis ,E.M.F.1995 Cell and Molecular Biology .8th edn, B.I. Waverly Pvt Ltd., New Delhi.
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. Lawence Zipursky ,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. 2nd ed. ,JohnHarris ,D.(ed) Wiley & sons,New York.
7. Kleinsmith ,l.J.& Kish ,V.M 1995 Principles of cell and Molecular Biology.2nd edn, Mclaughlin ,S., Trost ,k., Mac Elree,E.(eds) ., Harper Collins Publishers ,NewYork.
8. Lewin ,B., 2000 ,Genes VII .Oxford University Press

BTH452 GENETIC ENGINEERING

No of Credits: 4

No. of Hours: 52

Objective:

- ∑ Introduces basics of genetic engineering with its tools & techniques
- ∑ Explains invitro & invivo gene cloning, use of vectors, construction of compatible ends, creating rDNA, and its transfer into host, construction of genomic & cDNA libraries .
- ∑ Methods of selection of recombinants.
- ∑ Applications of genetic engineering

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, Application of PCR in cloning, agriculture and medicine. RT-PCR – technique and applications. 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 book agency

2) Gene IX- Lewin ,Oxford UniversityPress,2007
3) Principles of gene manipulation- Old and primrose –Blackwell scientific pub.,6th Ed,2006
4) Recombinant DNA technology –Watson JD et al Scientific American books, 3rd Ed1992
5) https://nptel.ac.in/content/storage2/courses/102103013/pdf/mod7.pdf
6) https://nptel.ac.in/courses/102/103/102103013/

Skill component Identified :

Techniques for isolation, handling and processing of nucleic acids

Principles of nucleic acid hybridization

Gel electrophoresis techniques

Enzymes used in gene manipulation, features of plasmid vectors and DNA cloning, transformation assay

BTS453 METABOLISM

No of Credits: 3

No. of Hours: 39

Objective:

- 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 and organs
- 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
- 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.

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 **13 hrs**

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, Interconversion of phospholipids.

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

References:

1. Biochemistry –Lubert Stryer , 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, 5th Edition., 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

Skill component Identified:

Students will extend their knowledge of biochemistry fundamentals and will learn about important metabolic processes taking place in organisms. In this course, they will acquire

a detailed knowledge about photosynthesis, metabolism of Saccharides, metabolism of nitrogen compounds and regulation. In laboratory, they will master the most important instrumental techniques required for work in biotechnological and other chemical laboratories.

BTS454 ENZYMOLOGY

No of Credits: 3

No. of Hours: 36

Objectives:

- To make the students understand the basic structures & functions of enzymes & their role in physiology
- To make the students appreciate the diversity of enzymes and their multiple roles in achieving system homeostasis.
- To inculcate the knowledge & skills used in present day biotechnology industries, which find enzymes as one of the key therapeutics.

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:

1. Enzymology And Enzyme Technology 1st Edition (2011) By S.M. Bhatt. S.Chand Publishing
2. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry By Trevor Palmer Horwood Publishing Ltd; 5th Revised Edition (2001)
3. 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
4. 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
5. Enzyme Technology (1990) By Martin F. Chaplin, Christopher Bucke. Cambridge University Press
6. Industrial Enzymes: Structure, Function And Applications (2007)By Julio

Polaina, Andrew P. Maccabe, Springer Publishing Group

7. Immobilization Of Enzymes And Cells (Methods In Biotechnology), 2006. By José M. Guisán. Humana Press

BTS455 BIOSTATISTICS & BIOINFORMATICS

No of Credits: 3
No. of Hours: 36

Objectives

- Introduce the concept of statistics and its tools in biological system
- To provide the basic knowledge about computers and information storage devices
- Application of computer software in handling biostatistical problems
- To understand the role and application of bioinformatics

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 **16Hrs**

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

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 Proteiomics. 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 commercial software.

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) Bishop Martin
2. Molecular databases for protein and sequence and structure studies: Sillince A. and Sillince M.
3. Sequence Analysis primers : Gribskov, M. and Devereux, J.
4. Bioinformatics: Sequence and Genome Analysis By David W. Mount, *University of Arizona, Tucson*
5. Discovering Genomics, Proteomics, & Bioinformatics, Second Edition By A. Malcolm Campbell, *Davidson College;* Laurie J. Heyer, *Davidson College;* With a Foreword by Francis S. Collins
6. Biostatistics:P.N.Arora ,P.K.Malha
7. Introductory statistics for Biology: *Mahajan , S. K.*
8. Statistical Methods :*Mishra and Mishra*

BTE458

FUNDAMENTAL BIOTECHNOLOGY Hours: 39

CO1: Appreciate the intricacy existing between microbes, plants and animals.
CO2: Analyse the importance of microbes in various sectors.
CO3: Understand the importance of plants as a bioreactor and its crucial role in sustaining life on earth.
CO4: Understand the modern biological interventions which have eased the life of humans.
CO5: Understand how useful the microbes and plants are these days on contrary to the chemical agents.

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

BTE459

Environmental Issues **36 Hrs**

CO1:The main objective of this paper is to create an awareness among the students about the environment

CO2: By the end of the course, the students will have a better appreciation for the environment and become responsible citizens

Unit-1 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

12Hrs

Unit-2 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. 12 Hrs

Unit-3 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.

12Hrs

Reference Books:

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

BTE460
Biodiversity & it's Conservation

No. of Hours: 36

CO1: Students will be able to: Gain theoretical knowledge and appreciate the importance of biodiversity.

CO2: Understand the relevance of biodiversity in conservation.
CO3: Become familiar with and understand the key terminologies of Ecology.
CO4: Describe the levels of biodiversity organizations.
CO5: Know about Indian ecological/geographical diversity.
CO6 : Can create a awareness about Biodiversity depletion & its conservation.

14hours

Unit 1: 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.

8 hours

Unit 2: Patterns of Biodiversity
Introduction to biodiversity pattern, Species varying globally, Species varying locally, species varying over time, species – areas relationship.
Benefits of Biodiversity

14hours

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

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. grass hoppers)
- Chick and Drosphila developmental 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
- Ti plasmid
- 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)
- Production and quantification of organic acids (e.g., citric acid, lactic acid, butyric acid)
- Catabolism of purine and pyrimidine.
- Fatty acid oxidation
- Experiments on photosynthesis (C3 and C4 plants)
- Estimation of secondary metabolites (e.g., alkaloids, antibiotics)
    - *Practical exercises to be conducted with background of respective theory papers (BTH 451 ,BTH 452 ,BTS453, BTS454)

THIRD SEMESTER SYLLABUS

.HARD CORE PAPERS	SOFT CORE PAPERS	OPEN ELECTIVE
BTH501 Plant Biotechnology	BTS503 Bioprocess Technology	BTE508 Immune system & Human health
BTH502 Animal Biotechnology	BTS504 Microbial Technology	BTE509 Basics concepts in clinical Biochemistry
BTP506 Plant Biotechnology& Animal Biotechnology	BTS505 Medical Biotechnology	BTE510 Applications of Biotechnology in Food science
	BTP507Bioprocess & Microbial Technology OR BTP507 Bioprocess Technology & Nano Biotechnology	

BTH501 PLANT BIOTECHNOLOGY

No of Credits: 4

No. of Hours: 52

Objective:

- 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 the world
- 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 gene storage
- To list and describe several methods used in plant transgenics emphasizing the use of *Agrobacterium* and the Ti plasmid as a gene vector.
- 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.

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. Mitochondrial DNA and Cytoplasmic male sterility. Plant breeding mechanism: types and applications

Plant Tissue Culture – Historical perspective; Lab set up,media components & sterilization, Totipotency, Plant hormones

Unit II **13 Hrs**

Micropropagation- 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 III **13 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.

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.Narosa pub.

4. Plant Biotechnology-Mantell and Smith-Cambridge univ press,1986.
5. Introduction To Plant Biotechnology/3rd Edn by Chawla H. S. (2009)
6. Plant Tissue Culture by Kalyan Kumar De (2008), Kalyani pub., Kolkata
7. Plant Tissue Culture: Theory And Practice, 5th Revised Edition (2005) Author: Bhojwani S. S., Elsevier Science
8. Molecular Biotechnology: Principles and Applications of Recombinant DNA Hardcover – 4th Ed. (2010) by Bernard J. Glick , Jack J. Pasternak, Cheryl L. Patten. American Society for Microbiology
9. https://cnx.org/resources/54c5aec33c8b17982c5da04e9ca6acea/PlantBioIII-TRANSFORMATION.pdf
10. https://www.ias.ac.in/public/Volumes/plnt/096/02/0079-0112.pdf

Skill component Identified

Students are introduced to the principles, practices and application of plant biotechnology, tissue culture, plant genomics, genetic transformation and molecular breeding of plants. Applied aspects of plant biotechnology in the sectors such as medicine, agriculture, industry will be explored. In laboratory, they will master the most important techniques required for work in many of the related companies.

BTH502 ANIMAL BIOTECHNOLOGY

No of Credits: 4

No. of Hours: 52

Objective:

- ∑ Introduction to cell culture basics of asepsis, role of media & its components, various equipments used in cell culture.
- ∑ Initiation of cell culture, tissue degradation methods, cell separation techniques, viability assessments, mass culture of cells
- ∑ Applications of cell cultures in IVF, creating transgenic fishes, synthesis of commercial important molecules from cells .Animals used as biorectors

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.

Unit III **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 , therapeutic cloning, xenotransplantation

Unit IV **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 –MarleHoudebine John Wiley & 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 Kathy Barker.
5. Basic Cell Culture: A Practical Approach(Practical Approach Series) by J.M Davis ,2nd edition 2002 oxford university press, oxford.
6. Culture of animal Cells: A Manual of Basic Technique 4th edition by R. Ian Freshney Wiley -Liss,2000)
7. Gene VII, Oxford University Press , NewYork,B.Lewin,2000.

8. Gene Biotechnology, Second Edition by William Wu, Michael J. Welsh ,Peter B. Kaufman ,Helen H. Zhang CRC Press; 2nd Edition,2003.
9. Molecular Biotechnology , ASM Press , Washington , B.R Glick & J.J Pasternak, 1994.
10. Principles of Gene Manipulation by Blackwell Publishers; 6th edition, 2002, Sandy B. Primrose , Richard M. Twyman , Robert W.Old.
11. Principles of Cloning by Jose B . Cibelli, Robert P, Lanza, Keith Campbell Michael D. West Academic Press,2002.
12. Recombinant DNA Technology, 2nd Edition, Scientific American Books, NewYork,J.D Watson , M .Gilman , J . Witkowski&M.Zoller, 1992.
13. Studies in Biotechnology series 7_ Fish Biotechnology ,Dr. MM .Ranga& Dr. Q.J ShamniAgrobios (India), Agro House.
14. **https://nptel.ac.in/courses/102/104/102104059/**

Skill component indentified:

General safety measures

Personal protection

Cell isolation techniques by physical method

Trypsinization

Viability check

Toxicity assessment & Determination of LD50

BTS503 BIOPROCESS TECHNOLOGY

No of Credits: 3

No. of Hours: 36

Objectives

- To demonstrate, reinforce and extend the principles of bioprocess technology
- To provide knowledge in microbial kinetics
- To familiarize about types of fermentation process and optimization covering all areas of industrial microbiology

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 **13 hrs**

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, ultra filtration, 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 Weinhein pub
5. Principles of fermentation technology P.F Stanbury& Whitaker Pragmon Press

BTS504 MICROBIAL TECHNOLOGY

No of Credits: 3

No. of Hours: 36

Objective:

- 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.
- The course prepares the students for the bulk production of commercially important modern Bioproducts, Industrial Enzymes, Products of plant and animal cell cultures.

Unit I **12 hrs**

Microbial products: Microbial Biomass, Primary metabolites, Secondary metabolites, [Aminoacids (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 **12 hrs**

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, silage and probiotics.

Biofertilizers: *Rhizobium, Azotobacter, Azospirillum, Mycorrhizas,* Phosphate solubilizers

Bioconservation, 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. Plant Cell, Tissue & Organ Culture: Fundamental Methods by O. L. Gamborg (Editor) and G. C. Phillips (Editor) (2004)J.Narosa pub.
4. Plant Biotechnology-Mantell and Smith-Cambridge univ press,1986.
5. Introduction To Plant Biotechnology/3rd Edn by Chawla H. S. (2009)
6. Plant Tissue Culture by Kalyan Kumar De (2008), Kalyani pub., Kolkata
7. Plant Tissue Culture: Theory And Practice, 5th Revised Edition (2005) Author: Bhojwani S. S., Elsevier Science
8. Molecular Biotechnology: Principles and Applications of Recombinant DNA Hardcover – 4th Ed. (2010) by Bernard J. Glick , Jack J. Pasternak, Cheryl L. Patten. American Society for Microbiology

Skill component Identified:

1) Analytical and Preparative Chromatography
2) Basic electrophoretic principles
3) Centrifuges used for separation
4) UV/ Visible Spectrophotometer
5) Chromatography – TLC , Paper Chromatography
6) Buffers used in Downstream Lab.

BTS505 MEDICAL BIOTECHNOLOGY

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

BTE 508

Immune System & Human health 36Hrs

CO:1 The students will be able to identify the cellular and molecular basis of immune responsiveness.

CO:2 The students will be able to describe the roles of the immune system in both maintaining health and contributing to disease.

CO:3 The students will be able to transfer knowledge of immunology into clinical decision

Unit 1: Immune system types & classification. Cell of immune system 10Hrs

Unit 2: 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. 13 Hrs

Unit 3: 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 13 Hrs

Reference Books:

1. John E. Hall, Medical Physiology by Guyton, Saunders, 12th edition
2. 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.
3. Benjamin E. (1996), Immunology – A short course 3rd Edition, John Wiley, New York
4. Kuby J. (1997), Immunology, 3rd Edition, W.H. Freeman & Co., New York
5. Roitt, I.M. (1997), Essential Immunology, 9th Edition, Oxford Black Well Science, London
6. Tizard I.R. (1995), Immunology – An introduction, 4th Edition, Philadephia Sauders College press.

BTE509

Basic concepts in Clinical Biochemistry 36 Hrs

CO1: It trains the students to gain concepts of assessing the human physiology using biological fluid.

CO:2 It illustrates the mechanism of metabolic disorders at molecular level.

UNIT I-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. 12 Hrs

UNIT II-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, atherosclerosis and it risk factors.Proteins -albumin, hypoalbuminemia, hypoproteinemia, Bence Jones proteins, proteins in CSF and their estimation.

12 Hrs

UNIT III – 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 12 Hrs

Reference Books:

1. Clinical biochemistry, metabolic and clinical aspects by William J. Marshall, Stephan K

2.Elsevier science health.

3. Fundamentals of Clinical Biochemistry by Teiz, W.B-Saunders Company.

4. 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.

BTE510
Applications of Biotechnology in Food Science

CO1: To know about the constituents and additives present in the food.

CO2:To gain knowledge about the microorganisms, which spoil food and food borne Diseases.

CO3:To know different techniques used for the preservation of foods & quality standards

CO4:To gain the knowledge about balanced diet, and its importance.

No. of Hours: 36

13hours
Unit 1
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.
12hours

Unit 2
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.
11hours
Unit 3
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. Meyer, Food Chemistry, New Age, 2004
2. Maheshwari, D. K. et. al., Biotechnological applications of microorganisms, IK . International, New Delhi, 2006
3. Stanbury, P. F. et. al., Principles of Fermentation Technology, 2nd Edition, Elsevier, UK, 1995
4. Prescott and Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers.
5. Byong H. Lee, Fundamentals of Food Biotechnology, Wiley-Blackwell, 2014
6. Srilakshmi. Food Science, 4th Edition. New Age International Ltd, 2007.
7. Prescott L M, Harley J P, Klein D A., 2008. Microbiology 6th ed., WMC Brown Publishers
8. Pelczar MJ, Chan ECS, Krieg N. 1993. Microbiology 5th ed., Tata McGraw Hill Publishing Co. Ltd
9. Garbutt John, 1997. Essentials of Food Microbiology, Arnold London

- Preparation of Plant extract (Organic and aqueous),
- Crushing, grinding, maceration, homogenization, Filtration, Centrifugation, cold percolation extraction, hot extraction, using Sohxlet apparatus
- Synthesis of gold NPs for plants extracts
- Synthesis of Iron oxide nanoparticles by using chemical methods
- Study of FTIR spectroscopy for materials characterization
- Study of UV-Vis spectrophotometer for materials characterization
- Surface modification Nanoparticles with polymers
- Synthesis of Ag nanoparticles using sodium borohydride (Creighton's method).
- Cell counting and cell viability study
- Estimation of particle size using particle size analyser

  - Submerged and solid state fermentation
  - Estimation of microbial biomass
  - Estimation of microbial enzymes, mycotoxins, organic acids and antibiotics.
  - Microbiological assays (antibiotics, amino acids and vitamins)
  - Properties of microbial exopolysaccharides (e.g., cell immobilization)
  - Uses of Chitin and its derivatives
  - Pilot scale production of alcoholic beverages
  - Microbial interactions with plants (rhizobia, mycorrhizas) and plant production
  - Assessment of nitrogen fixation (acetylene reduction test)
  - Phosphate solubilization in bacteria ,fungi and actinomycetes.
  - Qualities of biofuels (e.g. biodiesel , biogas)

    - Isolation of microbes of industrial importance
    - Instrumentation in bioprocess technology
    - Growth and death kinetics of microbial cultures
    - Cell encapsulation (immobilization) techniques and uses
    - Pilot-scale production of microbial (or plants or animal) cell products
    - Downstream processing techniques
    - Methods of cell lysis
    - Reverse osmosis
    - Drying processes
    - Biosensers

Cleaning and sterilization methods for tissue culture

- Preparation of media, buffers
- Maintenance of cultures, (normal and tumor cell lines)
- Separation of peripheral blood mononuclear cells
- Cell counting (hemocytometer)
    - Lymphocyte culture technique
- In vitro macrophage culture from mouse
- Preparation of human metaphase chromosomes
- Cell viability tests
- Cell proliferation assay
- Growth kinetics of cells in culture
- In vitro fertilization and embryo transfer techniques
- Cryopreservation techniques
- Cytotoxicity tests

- Estimation of plant hormones (e.g. auxins, gibberellins)
- Plant tissue culture methods
- Callus culture (compact and friable)
- Ovule and anther culture
- Cell suspension cultures
- Embryogenesis
- Synthetic seeds
- Protoplast preparation
- Protoplast fusion techniques
- Plant cell immobilization
- Methods of inducing resistance through tissue culture
- *Agrobacterium* mediated genetic transformation

* Practical exercises to be conducted with back ground of respective theory papers (BTH 501, BTH502,BTS503 and BTS504)

FOURTH SEMESTER SYLLABUS

HARD CORE PAPERS	SOFT CORE PAPERS	OPEN ELECTIVE	Project/Dissertation
BTH551 Immunology	BTS552Environmental Biotechnology	**Nil**	**BTH557 :Project work & Dissertation**
BTP555Immunology	BTS553Agricultural Biotechnology		
	BTS554Food Biotechnology		
	BTP556 Environment Biotechnology & Agricultural Biotechnology/ Food Biotechnology		

BTH551 IMMUNOLOGY

No of Credits: 4

No. of Hours: 52

Objective:

- Concept of Immunity, types of immunity, cells & organs involved in immune functioning
- Foreign substance characteristic to evoke a immune response
- Exaggerated levels of immune response in hypersensitivity, auto immune diseases
- Briefing foundation of humoral immunity & vaccine development

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, Antinuclear

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

Skill component identified :

Antigen and antibody reactions employed in diagnostics

Antibody purification methods

Immune cell structure/function and molecular basics and techniques of immunology .

BTS552 ENVIRONMENTAL BIOTECHNOLOGY

Objective:

- Understand the interactions between organisms and their environments, and the consequences of these interactions in natural populations, communities, and ecosystems evidenced by pollution.
- To learn the extent of pollution in different industries including agriculture by analyzing the permissible limits and indices of different pollutants
- Prevention of such bio-hazardous and chemicals accumulation in the environment using novel biotechnological methods using microorganisms and plants
- Consequences of genetically modified organisms and their impact on natural environment, rules and regulations while handling these organisms, issues of aquaculture industries and prevention.

Unit I **14 Hrs.**

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

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

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 industry effluents.

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.

References:

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

Skill component Identified

The course content aims to make the students understand how biotechnology can help in monitoring or removing the pollutants and developing an understanding of new trends such as biofuels, renewable energy sources or microbial technologies which can minimize the harmful impact of pollutants in the environment.

No of Credits: 3 No. of Hours: 36

BTS553 AGRICULTURAL BIOTECHNOLOGY

No of Credits: 3

No. of Hours: 36

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).

BTS554 FOOD BIOTECHNOLOGY

No of Credits: 3

No. of Hours: 39

Objective:

To enable the students

- ∑ To know about the constituents and additives present in the food.
- ∑ To gain knowledge about the microorganisms, which spoil food and food borne diseases.
- ∑ To know different techniques used for the preservation of 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 foods, catabolic processes and oxygen-dependence reactions in food, application of generic technologies in food and nutritional sciences; anti-cancer components in foods.

Unit-II **13Hrs**

Functional foods and Biotechnology: Biochemical processing in the improvement of functional foods with targeted health benefits and increased nutrient value; applying molecular, biochemical, cellular and bioprocessing concepts, 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. W.C. Frazier And D.C. Westhoff – Food Microbiology, 4th Ed., Mcgraw-Hill Book Co.,

New York 1988.

2. J.M. Jay – Modern Food Microbiology, Cbs Pub. New Delhi, 1987

3. T.P. Coultate – Food – The Chemistry Of Its Components, 2nd Edn. Royal Society, London, 1992.

4. B. Sivasanker – Food Processing And Preservation, Prentice-Hall Of India Pvt. Ltd. New Delhi 2002

- Study of immune system in rats
- Blood film preparation and study of immune cells
- Histology of organs of immune system
- Study of insect hemocytes
- Production of antiserum
- Isolation of lymphocytes
- Antigen-antibody reactions (*in vitro*)
- Phagocytosis (*in vitro*)
- Immunodot technique
- Immunodiffusion technique
- Immunological diagnosis of pregnancy and infection
- Demonstration of ELISA technique

- Production of Compost (methods)
- Vermicompost and its analysis
- Cultivation of mushrooms
- Biogas (biofuels) production
- Waste water treatment methods
- Solid water treatment methods
- Experiments of biofouling and biofilms
- Experiments on industrial waste treatment methods (e.g. distillery, whey)

- Bioinoculants : Isolation and mass production of: Rhizobium, Azospirillum,
- Azatobacter, Anabena, and Azolla
- Isolation of phosphate solubilizing microorganisms from soil sample.
- Estimation of phosphate by Fiskay-Subbarao method.
- Detection and quantification of mycorrhizae by root clearing technique from different crop plants.
- Study of root /stem nodules and study of VAM.
- Assay of Biofertilizers (at least three types).
- Testing of antagonism by dual culture plate technique.
- Testing of antimicrobial property of antagonists culture filtrate.
- Bio-insecticidal effect of biopesticides from microbial and plant sources.
- Protoplast fusion in Rhizobium for enhanced nodule formation.
- Baculovirus stocks –Preparation and titration using plaque colony.
- Co-transfection of insect cells using linearized baculovirus stocks.
- Induced breeding of commercially important fishes.

Certificate Course/ Value added course
QC Microbiology

Quality Control Microbiology-Theory

Unit I **10Hr**

Principles and applications of GMP in pharmaceuticals and cosmetics : Principles – Applications and Definitions .The concept of Quality .Quality management and regulatory aspects -Premises and contamination control, location, design, structure, layout, services and cleaning. Personnel management, training, Hygiene and health. Documentation. Quality control and GCLP. Sterile and other products. Global regulatory and toxicological aspects of cosmetic preservation

Unit II **11Hr**

Analytical aspects for pharmaceutical and cosmetic Products - Quality control and GCLP. Sterile and other products. Validation .Cosmetics microbiology- testing methods and preservation. Antimicrobial preservation efficacy and microbial content testing . Validation method for cosmetics. Preservation strategy. Evaluation of antimicrobial mechanism

SUGGESSTED BOOKS:

I: 1. Sharp John (2000) Quality in the manufacture of medicines and other healthcare products. Pharmaceutical Press.
2. Iyer S. (2003) Guidelines on cGMP and quality of Pharmaceutical products. D K Publishers Mumbai.
3. Philip A , Taylor and Francis (2006) Cosmetic Microbiology a practical approach.2nd Ed.
4. Denyer S p, Hodges N A and Gorman S P (2005) Hugo and Russell's Pharmaceutical Microbiology. Blackwell Publishing.
5. Bibek Ray and Arun Bhunia (2008) Fundamental Food Microbiology. 4th Ed. CRC Press.
6.Sharp John (2000) Quality in the manufacture of medicines and other healthcare products. Pharmaceutical Press.
7. Bhatia R and Ichhapujani R L (1995) Quality Assurance in Microbiology. CBS publishers and distributors.
8.Sharp John (2000) Quality in the manufacture of medicines and other healthcare products. Pharmaceutical Press.
9. Philip A , Taylor and Francis (2006) Cosmetic Microbiology a practical approach.2nd Ed.
10. Hillisch A and Hilgenfeld R (2009) Modern Methods of drug discovery. Springer International Edition.
11.Kadam s s, Mahadik K R and Bothara K G (2009). Principles of medicinal Chemistry. Vol II Nirali Prakashan Pune.
12. Lemke T L and Williams D A (2008) Foye's Principles of Medicinal Chemistry. 6th Ed. Wolter Luwer, Lippincott Williams and Wilkins. N Delhi.

Quality Control Microbiology- (Practical's) **20Hr**

1.Sterility testing and reporting (as per Pharmacopia)
2. Microbial load in cosmetic product
3. Efficacy testing of preservatives like parabens
4. Efficacy of preservation and shelf life study.
5. Preparation of cosmetic product and its preservation study
6. Report on LAL and other tests for QC