

## B.Sc Biotechnology (Honors)

<b>SEMESTER I</b>		<b>SEMESTER II</b>	
<b>BTH-C 1</b>	Biochemistry & Metabolism	<b>BTH-C3</b>	Mammalian Physiology
<b>BTH-C2</b>	Cell Biology	<b>BTH-C4</b>	Plant Physiology
<b>BTH-AECC 1</b>	Eng.Comm	<b>BTH-AECC 2</b>	EVS
<b>BTH-G1 A/B</b>	A-Human pathology B-Entrepreneurship Development	<b>BTH-G2 A/B</b>	A-Toxicology B-Developmental Biology
<b>SEMESTER III</b>		<b>SEMESTER IV</b>	
<b>BTH-C 5</b>	Genetics	<b>BTH-C 8</b>	Molecular Biology
<b>BTH-C 6</b>	General Microbiology	<b>BTH-C 9</b>	Immunology
<b>BTH-C 7</b>	Chemistry – 1	<b>BTH-C 10</b>	Chemistry -2
<b>BTH-SEC 1 A/B</b>	A-Molecular Diagnostics B-Microbial Diagnosis in Health Clinics	<b>BTH-SEC 2 A/B</b>	A-Industrial Fermentations B-Biofertilizers and Biopesticides
<b>BTH-G3 A/B</b>	A-Concepts of Medicinal Chemistry and Drug Designing B- Biotechnology and Human Welfare	<b>BTH-G4 A/B</b>	A-Pharmacology B-Bioethics ,Biosafety and IPR
<b>SEMESTER V</b>		<b>SEMESTER VI</b>	
<b>BTH-C 11</b>	Bioprocess Technology	<b>BTH-C 13</b>	Bio Analytical Tools
<b>BTH-C 12</b>	Recombinant DNA Technology	<b>BTH-C 14</b>	Genomics and Proteomics
<b>BTH-DSE 1 A/B</b>	A-Environmental Biotechnology B-Ecology and Environment Management	<b>BTH-DSE 3 A/B</b>	A-Medical Microbiology B-Microbial Physiology
<b>BTH-DSE 2 A/B</b>	A-Biostatistics B-Plant Biotechnology	<b>BTH-DSE 4</b>	Project

<b>BTH-C: Core Courses</b>	<b>14*6=84</b>	<b>Total hours- 60 (Credits:4 Th /T+2 Pr)</b>
<b>BTH-GE: Generic Elective</b>	<b>4*6=24</b>	<b>Total hours- 60 (Credits: 4 Th/T+2 Pr)</b>
<b>BTH-AECC: Ability Enhancement Compulsory Course</b>	<b>2*4=8</b>	<b>Total hours- 60 (Credits: 4 Th /T)</b>
<b>BTH-SEC: Skill Enhancement Courses</b>	<b>2*4=8</b>	<b>Total hours- 30 (Credits: 4 Th /T)</b>
<b>BTH-DSE: Discipline Specific Elective</b>	<b>4*6=24</b>	<b>Total hours- 60 (Credits:4 Th/T+2 Pr)</b>
<b>Total Credits</b>	<b>148</b>	<b>-</b>

## B.Sc Biotechnology (Honors)

<b>SEMESTER I</b>		<b>SEMESTER II</b>	
BTH 111	Biochemistry & Metabolism	BTH 121	Mammalian Physiology
BTH 112	Cell Biology	BTH 122	Plant Physiology
BTH 113	Human pathology	BTH 123	Toxicology
	Eng.Comm		EVS
<b>SEMESTER III</b>		<b>SEMESTER IV</b>	
BTH 211	Genetics	BTH 221	Molecular Biology
BTH 212	General Microbiology	BTH 222	Immunology
BTH 213	Chemistry – 1	BTH 223	Chemistry -2
BTH 214	Fundamentals of Medicinal Chemistry and Drug Designing	BTH 224	Pharmacology
BTH 215	Molecular Diagnostics	BTH 225	Industrial Fermentations
<b>SEMESTER V</b>		<b>SEMESTER VI</b>	
BTH 311	Bioprocess Technology	BTH 321	Bio Analytical Tools
BTH 312	Recombinant DNA Technology	BTH 322	Genomics and Proteomics
BTH 313	Environmental Biotechnology	BTH 323	Medical Microbiology
BTH 314	Plant Biotechnology	BTH 324	Project

<b>BTH-C: Core Courses</b>	<b>14*6=84</b>	<b>Total hours- 60 (Credits:4 Th /T+2 Pr)</b>
<b>BTH-GE: Generic Elective</b>	<b>4*6=24</b>	<b>Total hours- 60 (Credits: 4 Th/T+2 Pr)</b>
<b>BTH-AECC: Ability Enhancement Compulsory Course</b>	<b>2*4=8</b>	<b>Total hours- 60 (Credits: 4 Th /T)</b>
<b>BTH-SEC: Skill Enhancement Courses</b>	<b>2*4=8</b>	<b>Total hours- 30 (Credits: 4 Th /T)</b>
<b>BTH-DSE: Discipline Specific Elective</b>	<b>4*6=24</b>	<b>Total hours- 60 (Credits:4 Th/T+2 Pr)</b>
<b>Total Credits</b>	<b>148</b>	<b>-</b>

**B.Sc (HONORS) BIOTECHNOLOGY**  
**SEMESTER I**

**BTH111 -BIOCHEMISTRY AND METABOLISM**

**Credits 6 : 4 Th/T+2 Pr (Total hours- 60)**

**UNIT I (12 Periods)**

A historical prospective. Amino acids & Proteins: Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.

Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions

**UNIT II (12 Periods)**

Lipids: Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol. Biosynthesis and oxidation of fatty acids.

**UNIT III (12 Periods)**

Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines,. Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA

**UNIT IV (12 Periods)**

Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites, enzyme specificity: types & theories, Role of: NAD<sup>+</sup>, NADP<sup>+</sup>, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxal phosphate, lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions

**UNIT V (12 Periods)**

Carbohydrates Metabolism: Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance,

Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation.

### **PRACTICALS**

1. To study activity of any enzyme under optimum conditions.
2. To study the effect of pH, temperature on the activity of salivary amylase enzyme.
3. Determination of - pH optima, temperature optima, Km value, Vmax value, Effect of inhibitor (Inorganic phosphate) on the enzyme activity.
4. Estimation of blood glucose by glucose oxidase method.
5. Principles of Colorimetry: **(i)** Verification of Beer's law, estimation of protein. **(ii)** To study relation between absorbance and % transmission.
6. Preparation of buffers.
7. Separation of Amino acids by paper chromatography.
8. Qualitative tests for Carbohydrates, lipids and proteins

### **SUGGESTED READING**

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.
3. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
4. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons.
5. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.

**BTH112 - CELL BIOLOGY**  
**Credits 6 : 4 Th/T+2 Pr (Total hours- 60)**

**UNIT I (12Periods)**

Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation. Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport.

**UNIT II (12 Periods)**

Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation.

**UNIT III (12 Periods)**

Golgi complex: Structure, biogenesis and functions including role in protein secretion. Lysosomes: Vacuoles and micro bodies: Structure and functions Ribosomes: Structures and function including role in protein synthesis.

**UNIT IV (12 Periods)**

Mitochondria: Structure and function, Genomes, biogenesis. Chloroplasts: Structure and function, genomes, biogenesis Nucleus: Structure and function, chromosomes and their structure. Types of chromosomes.

**UNIT V (12 Periods)**

Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction. Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer.

**PRACTICALS**

1. Study the effect of temperature and organic solvents on semi permeable membrane.
2. Demonstration of dialysis.
3. Study of plasmolysis and de-plasmolysis.
4. Cell fractionation and determination of enzyme activity in organelles using sprouted seed or any other suitable source.
5. Study of structure of any Prokaryotic and Eukaryotic cell.

6. Microtomy: Fixation, block making, section cutting, double staining of animal tissues like liver, oesophagus, stomach, pancreas, intestine, kidney, ovary, testes.
7. Cell division in onion root tip/ insect gonads.
8. Preparation of Nuclear, Mitochondrial & cytoplasmic fractions.

#### **SUGGESTED READING**

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7<sup>th</sup> edition. Pearson Benjamin Cummings Publishing, San Francisco.



## **BTH-113: HUMAN PATHOLOGY**

**Credits 6 : 4 Th/T+2 Pr (Total hours- 60)**

### **Unit I (12 periods)**

Cellular Adaptations, Cell Injury and Cell Death-Causes and mechanisms of cell injury: reversible and irreversible injury, Cellular responses: Hyperplasia, Hypertrophy, Atrophy, Metaplasia, Necrosis, Apoptosis, subcellular and intracellular response, (with suitable examples of diseases), Cellular ageing.

### **Unit II (12 periods)**

Role of Inflammation in diseases-General features of acute and chronic inflammation: Vascular changes, cellular events, termination of acute inflammatory response. Cells and molecular mediators of inflammation, morphological effects and outcome of acute inflammation. Systemic effects of chronic inflammation, granulomatous inflammation.

### **Unit III (12 periods)**

Tissue Renewal And Repair, Healing And Fibrosis- Mechanism of tissue regeneration, role of ECM, repair by healing, scar formation and fibrosis, cutaneous wound healing, tissue remodelling in liver (fibrosis and cirrhosis).

Hemodynamic Pathology - Edema, hyperaemia, congestion, haemorrhage, haemostasis and thrombosis, Embolism, Infarction and shock and hypertension.

### **Unit IV (12 periods)**

Nutritional diseases - malnutrition, deficiency diseases of vitamins and minerals, nutritional excess and imbalances. Role and effect of metals (Zinc, Iron and Calcium) and their deficiency diseases.

Cell proliferation: Cancer - Definitions, nomenclature, characteristics of benign and malignant neoplasms, grading and staging of cancer, biology of tumor growth, mechanism of tumor invasion and metastasis, carcinogens and cancer, concept of oncogenes.

### **Unit V(12 periods)**

Pathophysiology diseases-Aetiology and Pathophysiology of: Diabetes, Arteriosclerosis, Myocardial infarction, restrictive and obstructive respiratory diseases (COPD), Parkinson, Schizophrenia, Silicosis

Infectious Diseases: Pathogenesis of diseases and overview of modes of infections, prevention and control with suitable examples like Typhoid, Dengue, Swine flu and HIV.

## **PRACTICALS**

**(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)**

1. Tissue Processing, embedding, sectioning. Staining and preparation of permanent histological slide.
2. Study of histological slides showing hypertrophy, hyperplasia, dysplasia, leukemia, cirrhosi and any common cancer.
3. Diagnostic tests for detection of epidemic and common infectious diseases
4. Diagnostic tests for OGTT, post prandial hyperglycemia, TSH and other endocrine profiles.
5. Bleed analysis for hemoglobin content and clotting time
6. Measurement of Erythrocyte Sedimentation Rate.

## **SUGGESTED READINGS**

1. Robbins and Cotran Pathologic Basis of Disease, 8th edition (2009), Vinay Kumar, Abul K. Abbas, Jon C. Aster, Nelson Fausto; Saunders Publishers, ISBN-13: 978-1416031215.
2. General and Systematic Pathology, 2nd edition (1996), J., Ed. Underwood and J. C. E. Underwood; Churchill Livingstone, ISBN-13: 978-0443052828.
3. Robbins Basic Pathology, 9th edition (2012), Kumar, Abbas, Fausto and Mitchell; Saunders Publication, ISBN-13: 978-1437717815.
4. Medical Laboratory Technology Methods and Interpretations Volume 1 and 2, 6th edition (2009), Ramnik Sood; Jaypee Brothers Medical Publishers, ISBN-13: 978-8184484496.
5. Pathophysiology, 3rd edition (2012), Lee-Ellen C. Copstead-Kirkhorn and Publisher Saunders, ISBN-13: 978-1455726509.

**B.Sc (HONORS) BIOTECHNOLOGY**  
**SEMESTER II**

**BTH 121: MAMMALIAN PHYSIOLOGY**

**Credits 6 :4 Th/T+2 Pr (Total hours- 60)**

**UNIT I (12 Periods)**

Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice. Respiration: Exchange of gases, Transport of O<sub>2</sub> and CO<sub>2</sub>, Oxygen dissociation curve, Chloride shift.

**UNIT II (12 Periods)**

Composition of blood, Plasma proteins & their role, blood cells, Haematopoiesis, Mechanism of coagulation of blood. Blood groups. Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat.

**UNIT III (12 Periods)**

Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction. Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitters

**UNIT IV (12 Periods)**

Excretion – Formation of ammonia, urea and uric acid; structure and functions of nephron; control of renal functions – role of kidney in the regulation of water and salt.

Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions. Mechanism of action of hormones (insulin and steroids)

**UNIT V (12 Periods)**

Reproductive physiology – reproductive mechanisms, functional morphology of reproductive organs. Gametogenesis –Spermatogenesis, Oogenesis. Fertilization Different types of eggs on the basis of yolk. Embryonic stages and embryonic membrane. Reproductive cycle, hormonal control.

**PRACTICALS**

1. Finding the coagulation time of blood
2. Determination of blood groups
3. Counting of mammalian RBCs

4. Determination of TLC and DLC
5. Demonstration of action of an enzyme
6. Determination of Haemoglobin

#### **SUGGESTED READING**

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons,Inc.

**BTH 122: PLANT PHYSIOLOGY**  
**Credits 6 :4 Th/T+2 Pr (Total hours- 60)**

**UNIT I (12 Periods)**

Plant water relations: Importance of water to plant life, diffusion, osmosis, plasmolysis, imbibition, guttation, transpiration, stomata & their mechanism of opening & closing.

Micro & macro nutrients: criteria for identification of essentiality of nutrients, roles and deficiency systems of nutrients, mechanism of uptake of nutrients, mechanism of food transport.

**UNIT II (12 Periods)**

Photosynthesis : significance, historical aspects, photosynthetic pigments, action spectra and enhancement effects, concept of two photosystems, Z-scheme, photophosphorylation, Calvin cycle, C4 pathway, CAM plants, photorespiration.

**UNIT III (12 Periods)**

Respiration : ATP-the biological energy currency, aerobic and anaerobic respiration, Kreb's cycle, electron transport mechanism (chemi-osmotic theory), redox potentials, oxidative phosphorylation, pentose phosphate pathway, Gluconeogenesis.

**UNIT IV (12 Periods)**

Nitrogen metabolism- inorganic & molecular nitrogen fixation, nitrate reduction and ammonium assimilation in plants.

Primary and secondary metabolism in plants. Structure, biosynthesis and functions of phenolics, lignins and lignans, alkaloids, terpenoids, flavonoids, suberins, coumarins and furanocoumarins, stilbins.

**UNIT V (12 Periods)**

Growth and development: Definitions, phases of growth, growth curve, growth hormones (auxins, gibberlins, cytokinins, abscisic acid, ethylene) Physiological role and mode of action, seed dormancy and seed germination, concept of photoperiodism and vernalization.

**PRACTICALS**

1. Preparation of stained mounts of anatomy of monocot and dicot's root, stem & leaf.
2. Demonstration of plasmolysis by *Tradescantia* leaf peel.
3. Demonstration of opening & closing of stomata
4. Demonstration of guttation on leaf tips of grass and garden nasturtium.
5. Separation of photosynthetic pigments by paper chromatography.

6. Demonstration of aerobic respiration.
7. Preparation of root nodules from a leguminous plant.

#### **SUGGESTED READING**

1. Dickinson, W.C. 2000 Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Esau, K. 1977 Anatomy of Seed Plants. Wiley Publishers.
3. Fahn, A. 1974 Plant Anatomy. Pergmon Press, USA and UK.
4. Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.
5. Mauseth, J.D. 1988 Plant Anatomy. The Benjamin/Cummings Publisher, USA.
6. Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, W.H. Freeman and Company, New York, USA.
7. Salisbury, F.B. and Ross, C.W. 1991 Plant Physiology, Wadsworth Publishing Co. Ltd.
8. Taiz, L. and Zeiger, E. 2006 Plant Physiology, Sinauer Associates Inc .MA, USA

**BTH 123: TOXICOLOGY**  
**Credits 6 :4 Th/T+2 Pr (Total hours- 60)**

**Unit I (12 periods)**

Brief history, Different areas of modern toxicology, classification of toxic substances, various definitions of toxicological significance. Toxic exposure and response- Effect of duration, frequency, route and site of exposure of xenobiotics on its toxicity. Characteristic and types of toxic response. Types of interactions between two and more xenobiotics exposure in humans. Tolerance and addiction. Evaluation of toxicity - Various types of dose response relationships, assumptions in deriving dose response, LD50, LC50, TD50 and therapeutic index.

**Unit II (12 periods)**

Mechanism of toxicity- Delivery of the toxicant, mechanisms involved in formation of ultimate toxicant, detoxification of ultimate toxicant. Clinical toxicology- Management of poisoned patients, clinical methods to decrease absorption and enhance excretion of toxicants from the body use of antidotes.

**Unit III(12 periods)**

Fate of xenobiotics in human body -Absorption, Distribution, Excretion and Metabolism of xenobiotics (biotransformation, Phase- I reactions including oxidations, hydrolysis, reductions and phase II conjugation reactions). Toxic insult to liver, its susceptibility to toxicants with reference to any two hepatotoxicants.

**Unit IV(12 periods)**

Toxic agents -Human exposure, mechanism of action and resultant toxicities of the following xenobiotics: Metals: lead, arsenic, Pesticides- organophosphates, carbamates, organochlorine, bipyridyl compounds and anticoagulant pesticides.

**Unit V(12 periods)**

Eco-toxicology -Brief introduction to aquatic toxicology, movement and effect of toxic compounds in food chain (DDT, mercury), bioaccumulation, biomagnification, acid rain and its effect on ecosystems, concept of BOD and COD.

## **PRACTICALS**

**(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)**

1. Separation of a mixture of benzoic acid, beta- naphthol and naphthelene by solvent extraction and identification of their functional Groups.
2. Determination of Dissolved oxygen (DO) using Winkler's method.
3. Determination of Biological oxygen demand (BOD) of water.
4. To perform quantitative estimation of residual chlorine in water samples.
5. To determine the total hardness of water by complexo-metric method using EDTA.
6. To determine acid value of the given oil sample.
7. To estimate formaldehyde content of given sample.
8. Calculation of LD50 value of an insecticide from the data provided.
9. Determination of COD (chemical oxygen demand) of the given water sample.

## **SUGGESTED READINGS**

1. Cassarett and Doull's Toxicology "The Basic Science of The Poisons" 7th edition (2008), Curtis D. Klaassen Editor, McGrawHill Medical. ISBN: 9780071470513.
2. Cassarett and Doull's "Essentials of Toxicology" 2nd edition (2010), Klaassen and Whatkin, McGraw Hill Publisher. ISBN-13: 978-0071622400.
3. Introduction to Toxicology, 3rd edition (2001), John Timbrell, Taylor and Francis Publishers.
4. Principles of Toxicology, 2nd edition (2006), Stine Karen and Thomas M Brown, CRC press.
5. Lu's basic toxicology: Fundamentals target organ and risk assessment, 5th edition (2009), Frank C Lu and Sam Kacow, Informa Health care.



**B.Sc (HONORS) BIOTECHNOLOGY**  
**SEMESTER III**  
**BTH 211: GENETICS**  
**Credits 6 :4 Th/T+2 Pr (Total hours- 60)**

**UNIT I (12 Periods)**

Introduction: Historical developments in the field of genetics. Organisms suitable for genetic experimentation and their genetic significance. Cell Cycle: Mitosis and Meiosis: Control points in cell-cycle progression in yeast. Role of meiosis in life cycles of organisms.

Mendelian genetics : Mendel's experimental design, monohybrid, di-hybrid and tri hybrid crosses, Law of segregation & Principle of independent assortment. Verification of segregates by test and back crosses, Chromosomal theory of inheritance, Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, semi-dominance, pleiotropy, multiple allele, pseudo-allele, essential and lethal genes, penetrance and expressivity.

**UNIT II (12 Periods)**

Non allelic interactions: Interaction producing new phenotype complementary genes, epistasis (dominant & recessive), duplicate genes and inhibitory genes.

Chromosome and genomic organization: Eukaryotic nuclear genome nucleotide sequence composition –unique & repetitive DNA, satellite DNA. Centromere and telomere DNA sequences, middle repetitive sequences- VNTRs & dinucleotide repeats, repetitive transposed sequences- SINES & LINES, middle repetitive multiple copy genes, noncoding DNA. Genetic organization of prokaryotic and viral genome.

**UNIT III (12 Periods)**

Structure and characteristics of bacterial and eukaryotic chromosome, chromosome morphology, concept of euchromatin and heterochromatin. packaging of DNA molecule into chromosomes, chromosome banding pattern, karyotype, giant chromosomes, one gene one polypeptide hypothesis, concept of cistron, exons, introns, genetic code, gene function.

Chromosomal variations : A general account of structural and numerical aberrations.

**UNIT IV (12 Periods)**

Chromosome and gene mutations: Definition and types of mutations, causes of mutations, Ames test for mutagenic agents, screening procedures for isolation of mutants and uses of mutants.

Sex determination and sex linkage: Mechanisms of sex determination, Environmental factors and

sex determination, sex differentiation, Barr bodies, dosage compensation, genetic balance theory, Fragile-X-syndrome and chromosome, sex influenced dominance, sex limited gene expression, sex linked inheritance.

### **UNIT V (12 Periods)**

Genetic linkage, crossing over and chromosome mapping: Linkage and Recombination of genes in a chromosome crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Crossing over at four strand stage, Multiple crossing overs Genetic mapping. Extra chromosomal inheritance: Rules of extra nuclear inheritance, maternal effects, maternal inheritance, cytoplasmic inheritance, organelle heredity, genomic imprinting.

Evolution and population genetics: In breeding and out breeding, Hardy Weinberg law (prediction, derivation), allelic and genotype frequencies, changes in allelic frequencies, systems of mating, evolutionary genetics, natural selection.

### **PRACTICALS**

1. Permanent and temporary mount of mitosis and meiosis.
2. Mendelian deviations in dihybrid crosses
3. Demonstration of - Barr Body -*Rhoeo* translocation.
4. Karyotyping with the help of photographs.
5. Pedigree charts of some common characters like blood group and color blindness.
6. Study of polyploidy in onion root tip by colchicine treatment.

### **SUGGESTED READING**

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley & Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.
4. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis, W. H. Freeman & Co.

**BTH 212 : GENERAL MICROBIOLOGY**  
**(Total hours- 60)Credits:4 Th/T+2 Pr**

**UNIT I (12 Periods)**

Fundamentals, History and Evolution of Microbiology. Classification of microorganisms: Microbial taxonomy, criteria used including molecular approaches, Microbial phylogeny and current classification of bacteria.

Microbial Diversity: Distribution and characterization Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms eg. Bacteria, Algae, Fungi, Protozoa and Unique features of viruses.

**UNIT II (12Periods)**

Microbial Metabolism: Metabolic pathways, amphi-catabolic and biosynthetic pathways Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria.

**UNIT III (12Periods)**

Cultivation and Maintenance of microorganisms: Nutritional categories of micro-organisms, methods of isolation, Purification and preservation.

Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria.

**UNIT IV (12 Periods)**

Control of Microorganisms: By physical, chemical and chemotherapeutic Agents Water Microbiology: Bacterial pollutants of water, coliforms and non coliforms. Sewage composition and its disposal. Concept of microbial remediation.

**UNIT V (12Periods)**

Food Microbiology: Important microorganism in food Microbiology: Moulds, Yeasts, bacteria. Major food born infections and intoxications, Preservation of various types of foods. Fermented Foods- Yoghurt, Buttermilk, Idli, Dosa, Cheese, Tempeh, Olive, Sausages.

**PRACTICALS**

1. Isolation of bacteria & their biochemical characterization.
2. Staining methods: simple staining, Gram staining, spore staining, negative staining, hanging drop.

3. Preparation of media & sterilization methods, Methods of Isolation of bacteria from different sources.
4. Determination of bacterial cell size by micrometry.
5. Enumeration of microorganism - total & viable count.

#### **SUGGESTED READING**

1. Alexopoulos CJ, Mims CW, and Blackwell M. (1996). *Introductory Mycology*. 4 th edition. John and Sons, Inc.
2. Jay JM, Loessner MJ and Golden DA. (2005). *Modern Food Microbiology*. 7th edition, CBS Publishers and Distributors, Delhi, India.
3. Kumar HD. (1990). *Introductory Phycology*. 2nd edition. Affiliated East Western Press.
4. Madigan MT, Martinko JM and Parker J. (2009). *Brock Biology of Microorganisms*. 12th edition. Pearson/Benjamin Cummings.
5. Pelczar MJ, Chan ECS and Krieg NR. (1993). *Microbiology*. 5th edition. McGraw Hill Book Company.
6. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). *General Microbiology*. 5<sup>th</sup> edition. McMillan.
7. Tortora GJ, Funke BR, and Case CL. (2008). *Microbiology: An Introduction*. 9 th edition. Pearson Education.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). *Prescott, Harley and Klein's Microbiology*. 7th edition. McGraw Hill Higher Education.

## **BTH 214: FUNDAMENTALS OF MEDICINAL CHEMISTRY AND DRUG DESIGNING**

**(Total hours- 60)Credits:4 Th/T+2 Pr)**

### **Unit I (12 periods)**

General Introduction - Definition and scope of medicinal chemistry . Drug target classification I- *Nucleic acids as drug targets*:Classes of drugs that interact with DNA: DNA intercalators (amsacrine), Groove binders (netropsin), DNA alkylators (amines: mechlorethamine; nitrosoureas: carmustine), concept of antisense therapy.

### **Unit II (12 periods)**

Drug target classification II-*Proteins as drug targets* :Receptors: The receptor role, ion channels, membrane bound enzyme activation, agonist and antagonists, concept of inverse agonist, desensitization and sensitization of receptors, affinity, efficacy and potency.

Enzymes: Enzyme inhibitors (competitive, non-competitive, suicide inhibitors), medicinal use of enzyme inhibitors.

### **Unit III (12 periods)**

Molecular aspects of drug action-Structure and functions of cell surface receptors, signal transduction mechanism (GPCRs, Tyrosine kinase, guanylate-cyclase linked receptors and intracellular receptors that regulate DNA transcription).

### **Unit IV(12 periods)**

Physico-chemical principles of drug action- Partition coefficient, drug dissolution, acid-base properties, surface activity, bioavailability, stereochemical aspects of drug action, electronic structure (Hammett correlations), and determining relationship between chemical and biological data (Hansch approach).Measurement of drug effects -Kinetic analysis of ligand receptor interactions using scatchard plot, double reciprocal plot, Hill plot, forces involved, relationship between dose and effect (graded and quantalresponse).

### **Unit V(12 periods)**

Principles of drug design -Introduction to SAR, strategies in the search for new lead compounds, analogue synthesis versus rational drug design, concept of prodrugs. Introduction to Combinatorial

Synthesis-Methods of parallel synthesis, methods in mixed combinatorial synthesis (mix and split method), limitations of combinatorial synthesis.

## **PRACTICALS**

**(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)**

1. Preparation of Benzocaine.
2. Preparation of Benzoquinone.
3. Preparation of Aspirin and determination of partition coefficient in octanol-water system.
4. Preparation of Paracetamol.
5. Preparation of Phenacetin.
6. Preparation of Hippuric acid.
7. Preparation of s-benzyl thiuronium salt.
8. Extraction of caffeine from tea leaves and study its absorption properties.
9. Phytochemical screening and qualitative chemical examination of various plant constituents by Solvent extraction. (Detection of alkaloids, carbohydrates, glycosides, phytosterols, oils and fats, tannins, proteins, gums and mucilages).

## **SUGGESTED READINGS**

1. Introduction to Medicinal Chemistry, 4th edition (2009), Graham I. Patrick, Oxford University Press. ISBN-13: 978-0199234479.
2. The Organic Chemistry of Drug Design and Drug Action, 2nd edition (2004), Richard B. Silvermann, Elsevier, Academic Press. ISBN: 978-0126437324.
3. Medicinal Chemistry: A Molecular and Biochemical Approach, 3rd edition (2005), Thomas Nogrady and Donal F. Weaver, Oxford University Press. ISBN-13: 978-0195104561.
4. Wilson Gisvold textbook of Organic Medicinal and Pharmaceutical Chemistry, 11th edition (2003), edited by Block and Beale, Baltimore, Lippincot. ISBN-13: 978-0781734813.
5. The Practice of Medicinal Chemistry, 2nd edition (2003), Camille G. Wermuth, Academic Press. ISBN-13: 978-0127444819.
6. Principles and Practice of Medicinal Chemistry, 2nd edition (2003), Frank. D. King. The Royal Society of Chemistry. ISBN-13: 978-0854046317.

## **BTH 215: MOLECULAR DIAGNOSTICS**

**Credits 4: 2 Th/T+2 Pr (Total hours- 30)**

### **UNIT I (06 Periods)**

Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogeneous and heterogeneous enzyme immunoassays. Enzyme immunoassays after immuno blotting.

### **UNIT II (06 Periods)**

Enzyme immuno histochemical techniques. Use of polyclonal or monoclonal antibodies in enzymes immuno assays. Applications of enzyme immunoassays in diagnostic microbiology. Molecular methods in clinical microbiology: Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology

### **UNIT III (06 Periods)**

Laboratory tests in chemotherapy: Susceptibility tests: Micro-dilution and macro-dilution broth procedures. Susceptibility tests: Diffusion test procedures. Susceptibility tests: Tests for bactericidal activity. Automated procedures for antimicrobial susceptibility tests.

### **UNIT IV (06 Periods)**

Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies. Concepts and methods in idiotypes. Antiidiotypes and molecular mimicry and receptors. Epitope design and applications. Immunodiagnostic tests. Immuno florescence. Radioimmunoassay.

### **UNIT V (06 Periods)**

GLC, HPLC, Electron microscopy, flowcytometry and cell sorting. Transgenic animals.

### **PRACTICALS**

*(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)*

1. Perform/demonstrate RFLP and its analysis
2. Kirby-Bauer method (disc-diffusion method) to study antibiotic sensitivity of a bacterial culture
3. A kit-based detection of a microbial infection (Widal test)
4. Study of Electron micrographs (any four).

5. Perform any one immuno diagnostic test ( Typhoid, Malaria, Dengue)

### **SUGGESTED READING**

1. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
2. Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe, Kluwer Academic
3. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.
4. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
5. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
6. Microscopic Techniques in Biotechnology, Michael Hoppert



**B.Sc (HONORS) BIOTECHNOLOGY**  
**SEMESTER IV**

**BTH 221 : MOLECULAR BIOLOGY**

**Credits 6 :4 Th/T+2 Pr (Total hours- 60)**

**UNIT I (12 Periods)**

DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, Enzymes of DNA replication.

**UNIT II (12 Periods)**

DNA polymerases, The replication complex: Pre-priming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication. DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion synthesis, recombinational repair, nonhomologous end joining. Homologous recombination: models and mechanism.

**UNIT III (12 Periods)**

RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains  
Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation.

**UNIT IV (12 Periods)**

RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing. Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics.

**UNIT V: Regulation of gene expression and translation (18 Periods)**

Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation., Posttranslational modifications of proteins.

**PRACTICALS**

1. Preparation of solutions for Molecular Biology experiments.
2. Isolation of chromosomal DNA from bacterial cells.
3. Isolation of Plasmid DNA by alkaline lysis method
4. Agarose gel electrophoresis of genomic DNA & plasmid DNA
5. Preparation of restriction enzyme digests of DNA samples
6. Demonstration of AMES test or reverse mutation for carcinogenicity

#### **SUGGESTED READING**

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

**BTH 222: IMMUNOLOGY**  
**Credits 6 :4 Th/T+2 Pr (Total hours- 60)**

**UNIT I (12 Periods)**

Defense system in humans. Various lines of defense. Immune Response - An overview, components of mammalian immune system, molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses,

**UNIT II (12 Periods)**

T-lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination.

**UNIT III (12 Periods)**

Regulation of immunoglobulin gene expression – clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypothesis (germ line & somatic mutation), antibody diversity.

**UNIT IV (12 Periods)**

Major Histocompatibility complexes – class I and class II MHC antigens, antigen processing. Immunity to infection – immunity to different organisms, pathogen defense strategies, avoidance of recognition. Autoimmune diseases, Immunodeficiency-AIDS.

**UNIT V (12 Periods)**

Vaccines & Vaccination – adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, passive & active immunization.

Introduction to immunodiagnostics – RIA, ELISA.

**PRACTICALS**

1. Differential leucocytes count
2. Total leucocytes count
3. Total RBC count
4. Haemagglutination assay
5. Haemagglutination inhibition assay
6. Separation of serum from blood
7. Double immunodiffusion test using specific antibody and antigen.
8. ELISA.

**SUGGESTED READING**

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H.Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. Churchill Livingstone Publishers, Edinberg.
6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

**BTH 224: PHARMACOLOGY**  
**Credits 6 :4 Th/T+2 Pr (Total hours- 60)**

**Unit I(12 periods)**

General Pharmacology-Nature and Source of drugs, pharmacological classification of drugs. Routes of drug administration and their advantages, receptor and receptor subtypes.

**Unit II (12 periods)**

Pharmacokinetics -Principles and mechanism of drug action . Factors affecting drug action. Drug absorption, distribution, metabolism, and excretion, bioavailability, First Pass metabolism, excretion and kinetics of elimination, Bioavailability, Biological half life of drug and its significance, Drug-drug interactions.

**Unit III(12 periods)**

Hormones and hormone antagonists -Insulin and oral hypoglycaemic agent (tolbutamide, rosiglitazone), thyroid and anti-thyroid drugs (eltroxin, carbimazole), estrogen and progestins (progesterone, hydroxyl progesterone caproate).

**Unit IV(12 periods)**

Drugs acting on CNS-(a) Mechanism of General anaesthesia, Stages of anaesthesia, General anaesthetics (Nitric oxide, halothane), (b) Principles of hypnosis and sedatives: sedative and hypnotics drugs (Phenobarbitone, diazepam), (c) Opioid analgesics (Morphine) (d) CNS stimulants (strychnine, amphetamine).

**Unit V(12 periods)**

Brief introduction to autocoids -Drug therapy of inflammation, NSAID and other drugs (aspirin, celecoxib).Chemotherapy of microbial diseases - Antibacterial (sulfonamides), antifungal (amphotericin B).

**PRACTICALS**

**(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)**

1. Handling of laboratory animals.
2. Routes of drug administration (Oral, I.M.)
3. To study the presence of acetaminophen in given sample.
4. To study the stages of general anesthesia.
5. To determine partition coefficient of general anesthetics.

6. Effect of analgesic (Tail-flick test).
7. Anti-anxiety effect of valium (Plus maze test).
8. Fixing of organ bath and kymograph.
9. To record CRC of acetylcholine using guinea pig ileum / rat intestine.
10. Determination of dose ratio.
11. Study of competitive antagonism using acetylcholine and atropine.

### **SUGGESTED READINGS**

1. Essentials of Medical Pharmacology, 7th edition (2010), K.D. Tripathi, Jaypee Brothers, ISBN: 9788184480856.
2. Pharmacology, 7th edition (2011), H.P. Rang, M.M. Dale, J.M. Ritter and P.K. Moore, Churchill Livingstone. ISBN: 9780702045042.
3. Hand book of Experimental Pharmacology, 4th edition (2012), S.K. Kulkarni, Vallabh Prakashan, 2012. ISBN 13: 9788185731124.

## **BTH 225: INDUSTRIAL FERMENTATIONS**

**Credits 4 : 2Th/T+2 Pr (Total hours- 30)**

### **UNIT I (06 Periods)**

Production of industrial chemicals, biochemicals and chemotherapeutic products. Propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid. Microbial Polysaccharides- starch conversion processes.

### **UNIT II (06 Periods)**

Microbial products of pharmacological interest, steroid fermentations and transformations. Over production of microbial metabolite, Secondary metabolism – its significance and products. Metabolic engineering of secondary metabolism for highest productivity.

### **UNIT III (06 Periods)**

Enzyme and cell immobilization techniques in industrial processing, enzymes in organic synthesis, proteolytic enzymes, hydrolytic enzymes, glucose isomerase, enzymes in food technology/organic synthesis.

### **UNIT IV (06 Periods)**

Rate equations for enzyme kinetics, simple and complex reactions. Inhibition kinetics; effect of pH and temperature on rate of enzyme reactions. Mathematical derivation of growth kinetics, batch and continuous culture operations; single stage CSTR; mass transfer in aerobic fermentation; resistances encountered; overall mass transfer co-efficient ( $K_a$ ) determination, factors depending on scale up principle and different methods of scaling up.

### **UNIT V (06 Periods)**

Production of Biofuels: Biogas, Ethanol, butanol, hydrogen, biodiesel, microbial electricity, Microbial insecticides; microbial flavours and fragrances, newer antibiotics, anti cancer agents, amino acids.

### **PRACTICALS**

1. Comparative analysis of design of a batch and continuous fermenter.
2. Calculation of Mathematical derivation of growth kinetics.
3. Solvent extraction & analysis of a metabolite from a bacterial culture.
4. Perform an enzyme assay demonstrating its hydrolytic activity (protease /peptidase / glucosidase etc.)

**SUGGESTED READING**

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
5. Salisbury, Whitaker and Hall. Principles of fermentation Technology.



**B.Sc (HONORS) BIOTECHNOLOGY**  
**SEMESTER V**

**BTH 311: BIOPROCESS TECHNOLOGY**  
**Credits 6 :4 Th/T+2 Pr (Total hours- 60)**

**UNIT I (12 Periods)**

Introduction to bioprocess technology. Range of bioprocess technology and its chronological development. Basic principle components of fermentation technology. Types of microbial culture and its growth kinetics– Batch, Fedbatch and Continuous culture.

**UNIT II (12 Periods)**

Design of bioprocess vessels- Significance of Impeller, Baffles, Sparger; Types of culture/ production vessels- Airlift; Cyclone Column; Packed Tower and their application in production processes.

**UNIT III (12 Periods)**

Principles of upstream processing – Media preparation, Inocula development and sterilization. Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa.

**UNIT IV (12 Periods)**

Bioprocess measurement and control system with special reference to computer aided process control and its commercial applications and limitations.

**UNIT V (12 Periods)**

Introduction to downstream processing, product recovery and purification. Effluent treatment. Microbial production of ethanol, amylase, lactic acid and Single Cell Proteins.

**PRACTICALS**

1. Bacterial growth curve.
2. Calculation of thermal death point (TDP) of a microbial sample.
3. Production and analysis of ethanol.
4. Production and analysis of amylase.
5. Production and analysis of lactic acid.
6. Isolation of industrially important microorganism from natural resource.

**SUGGESTED READING**

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.

2. Crueger W and Crueger A. (2000). *Biotechnology: A textbook of Industrial Microbiology*. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). *Industrial Microbiology*. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). *Principles of Fermentation Technology*. 2nd edition, Elsevier Science Ltd.

# **BTH 312: RECOMBINANT DNA TECHNOLOGY**

**Credits 6 :4 Th/T+2 Pr(Total hours- 60)**

## **UNIT I (12 Periods)**

Molecular tools and applications- restriction enzymes, ligases, polymerases, alkaline phosphatase. Gene Recombination and Gene transfer: Transformation, Episomes, Plasmids and other cloning vectors (Bacteriophage-derived vectors, artificial chromosomes), Microinjection, Electroporation, Ultrasonication.

## **UNIT II (12 Periods)**

Principle and applications of Polymerase chain reaction (PCR), primer-design, and RT- (Reverse transcription) PCR. Restriction and modification system, restriction mapping. Southern and Northern hybridization. Preparation and comparison of Genomic and cDNA library, screening of recombinants, reverse transcription. Genome mapping, DNA fingerprinting.

## **UNIT III (12 Periods)**

Applications of Genetic Engineering. Genetic engineering in animals: Production and applications of transgenic mice, role of ES cells in gene targeting in mice, Therapeutic products produced by genetic engineering- blood proteins, human hormones, immune modulators and vaccines (one example each).

## **UNIT IV (12 Periods)**

Random and site-directed mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, Random mutagenesis, Gene shuffling, production of chimeric proteins, Protein engineering concepts and examples (any two).

## **UNIT V (15 Periods)**

Genetic engineering in plants: Use of *Agrobacterium tumefaciens* and *A. rhizogenes*, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors.

## **PRACTICALS**

1. Isolation of chromosomal DNA from plant cells
2. Isolation of chromosomal DNA from *E.coli*
3. Qualitative and quantitative analysis of DNA using spectrophotometer
4. Plasmid DNA isolation
5. Restriction digestion of DNA
6. Making competent cells

7. Transformation of competent cells.
8. Demonstration of PCR

### **SUGGESTED READING**

1. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K.
2. Clark DP and Pazdernik NJ. (2009). Biotechnology-Appling the Genetic Revolution. Elsevier Academic Press, USA.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington
4. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
5. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.

# **BTH 313: ENVIRONMENTAL BIOTECHNOLOGY**

**Credits 6 :4 Th/T+2 Pr(Total hours- 60)**

## **UNIT I (12 Periods)**

Conventional fuels and their environmental impact – Firewood, Plant, Animal, Water, Coal and Gas. Modern fuels and their environmental impact on environment. Methanogenic bacteria and their ecophysiology.

## **UNIT II (12 Periods)**

Bioremediation of soil & water contaminated with oil spills, heavy metals , detergents and dyes. Degradation of lignin and cellulose using microbes. Superbug

## **UNIT III (12 Periods)**

Phyto-remediation- Degradation of pesticides, aromatic and chlorinated hydrocarbons, petroleum products and other toxic chemicals by micro-organisms

## **UNIT IV (12 Periods)**

Treatment of municipal waste and Industrial effluents. Bio-fertilizers

Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM)

## **UNIT V (12 Periods)**

Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium).Use of microbes for the treatment of hazardous clinical disposal.

## **PRACTICALS**

1. Calculation of Total Dissolved Solids (TDS) of water sample.
2. Calculation of BOD of water sample.
3. Calculation of COD of water sample.
4. Bacterial Examination of Water by MPN Method.

## **SUGGESTED READING**

1. Environmental Science, S.C. Santra
2. Environmental Biotechnology, Pradipta Kumar Mohapatra
3. Environmental Biotechnology – Concepts and Applications, Hans-Joachim Jordening and Jesef Winter
4. Waste Water Engineering, Metcalf and Eddy, Tata McGraw hill

5. Agricultural Biotechnology, S.S. Purohit
6. Environmental Microbiology : Methods and Protocols, Alicia L. Ragout De Spencer, John F.T. Spencer
7. Introduction to Environmental Biotechnology, Milton Wainwright
8. Principles of Environmental Engineering, Gilbert Masters
9. Wastewater Engineering – Metcalf & Eddy

# **BTH 314: PLANT BIOTECHNOLOGY**

**Credits 6 : 4 Th/T+2 Pr (Total hours- 60)**

## **UNIT I (12 periods)**

Fundamentals of plant tissue architecture- Meristematic tissue, permanent tissues, simple and complex tissue. Concept of cell totipotency, pluripotency, polarity and *in vitro* differentiation, dedifferentiation and redifferentiation.

## **UNIT II (12 periods)**

Basic tools and techniques of plant tissue culture, Concept of asepsis and methods of sterilization (physical and chemical methods). Nutrient media, their composition and methods of preparation. Role of plant growth regulators, vitamins and other adjuvants in tissue culture.

## **UNIT III (12 periods)**

Explant types, initiation of cultures, maintenance of cultures, callus and liquid culture and single cell culture. Somaclonal and gametoclonal variation. Meristem tip culture for elimination of viruses in plants.

Somatic embryogenesis – induction of embryogeny *in vitro*, indirect and direct somatic embryogenesis, stages of embryogenesis, factors influencing embryogenesis. Artificial seeds

## **UNIT IV (12 periods)**

Anther and pollen culture – production of haploids. *In vitro* fertilization, embryo, endosperm, ovary and ovule culture. Embryo rescue. Methods of cryopreservation for germplasm conservation.

## **UNIT V (12 periods)**

Protoplast isolation, purification, culture and regeneration. Steps of micropropagation- management of donor plants, culture establishment, shoot multiplication, rooting and hardening and acclimatization. Application of plant tissue culture in crop improvement.

## **PRACTICALS**

1. Preparation of simple growth nutrient (knop's medium), full strength, half strength, solid and liquid.
2. Preparation of complex nutrient medium (Murashige & Skoog's medium)
3. To selection, Prune, sterilize and prepare an explant for culture.
4. Significance of growth hormones in culture medium.

5. To demonstrate various steps of Micropropagation.

### **SUGGESTED READING**

1. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.
2. Brown, T. A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication.
3. Gardner, E.J. Simmonns, M.J. Snustad, D.P. 2008 8th edition Principles of Genetics. Wiley India.
4. Raven, P.H., Johnson, GB., Losos, J.B. and Singer, S.R. 2005 Biology. Tata MC Graw Hill.
5. Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Narosa Publishing House.
6. Russell, P.J. 2009 Genetics – A Molecular Approach. 3rd edition. Benjamin Co.
7. Sambrook & Russel. Molecular Cloning: A laboratory manual. (3rd edition)
8. Slater, A., Scott, N.W. & Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press.



**B.Sc (HONORS) BIOTECHNOLOGY**  
**SEMESTER VI**

**BTH-321: BIO-ANALYTICAL TOOLS**

**(Total hours- 60)Credits:4 Th/T+2 Pr**

**UNIT I (10 Periods)**

Simple microscopy, phase contrast microscopy, fluorescence and electron microscopy (TEM and SEM), pH meter, absorption and emission spectroscopy.

**UNIT II (12 Periods)**

Basic principles of Centrifugation and Filtration and their application. Types of centrifuge. Analytical centrifugation. Determination of molecular weight by sedimentation velocity & sedimentation equilibrium methods.

**UNIT III (12 Periods)**

Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infrared), centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and particles.

**UNIT IV (12Periods)**

Introduction to the principle of chromatography. Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC.

**UNIT V (12Periods)**

Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno- electrophoresis, isoelectric focusing, Western blotting. Introduction to Biosensors and Nanotechnology and their applications.

**PRACTICAL**

1. Native gel electrophoresis of proteins
2. SDS-polyacrylamide slab gel electrophoresis of proteins under reducing conditions.
3. Preparation of the sub-cellular fractions of rat liver cells.
4. Preparation of protoplasts from leaves.
5. Separation of amino acids by paper chromatography.
6. To identify lipids in a given sample by TLC.

7. To verify the validity of Beer's law and determine the molar extinction coefficient of NADH.

### **SUGGESTED READING**

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

## **BTH 322: GENOMICS & PROTEOMICS**

**Credits 6 :4 Th/T+2 Pr (Total hours- 60)**

### **UNIT I (12 Periods)**

Introduction to Genomics, DNA sequencing methods – manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clone contig) methods.

### **UNIT II (12Periods)**

Computer tools for sequencing projects: Genome sequence assembly software. Managing and Distributing Genome Data: Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organisms' Genomes and Databases.

### **UNIT III (12 Periods)**

Introduction to protein structure, Chemical properties of proteins. Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions.

### **UNIT IV (12 Periods)**

Qualitative and quantitative analysis of proteins.Determination of sizes (Sedimentation analysis, gel filtration, SDS-PAGE); Native PAGE, Determination of covalent structures – Edman degradation.

### **UNIT V (12 Periods)**

Introduction to Proteomics, Analysis of proteomes. 2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE. Mass spectrometry based methods for protein identification. *De novo* sequencing using mass spectrometric data.

### **PRACTICALS**

1. Use of SNP databases at NCBI and other sites
2. Use of OMIM database
3. Detection of Open Reading Frames using ORF Finder
4. Proteomics 2D PAGE database
5. Softwares for Protein localization.
6. Hydropathy plots
7. Native PAGE
8. SDS-PAGE

**SUGGESTED READING**

1. Genes IX by Benjamin Lewin, Johns and Bartlett Publisher, 2006.
2. Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing, 1987.
3. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition, B.R. Glick, J.J. Pasternak and C.L. Patten, 2010.
4. Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989.
5. Principles of Gene Manipulation, S.B.Primrose, R.M.Twyman and R.W. Old. Blackwell Science.
6. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.

**BTH 323: MEDICAL MICROBIOLOGY**  
**(Total hours- 60) Credits:4 Th/T+2 Pr**

**UNIT I (12 Periods)**

Introduction: Normal microflora of human body, nosocomial infections, carriers, septic shock, septicemia, pathogenicity, virulence factors, toxins, biosafety levels.

**UNIT II (12 Periods)**

Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy of gram positive bacteria: *S.aureus*, *S.pyogenes*, *B.anthraxis*, *C.perferinges*, *C.tetani*, *C.botulinum*, *C.diphtheriae* *M.tuberculosis*, *M. leprae*.

**UNIT III (12 Periods)**

Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy caused by gram negative bacteria: *E.coli*, *N. gonorrhoea*, *N. meningitidis*, *P. aeruginosa*, *S. typhi*, *S. dysenteriae*, *Y. pestis*, *B. abortus*, *H. influenzae*, *V. cholerae*, *M.pneumoniae*, *T. pallidum* *M. pneumoniae*, *Rickettsiaceae*, *Chlamydiae*.

**UNIT IV (12 Periods)**

Diseases caused by viruses- Picornavirus, Orthomyxoviruses, Paramyxoviruses, Rhabdoviruses, Reoviruses, Pox virus, Herpes virus, Papova virus, Retro viruses (including HIV/AIDS) and Hepatitis viruses.

**UNIT V (12 Periods)**

Dermatophytoses (*Trichophyton*, *Microsporun* and *Epidermophyton*) Subcutaneous infection (*Sporothrix*, *Cryptococcus*), systemic infection (*Histoplasma*, *Coccidoides*) and opportunistic fungal infections (*Candidiasis*, *Aspergillois*), Gastrointestinal infections (Amoebiasis, Giardiasis).Blood-borne infections (Leishmaniasis, Malaria)

**PRACTICALS**

1. Identification of pathogenic bacteria (any two) based on cultural, morphological and biochemical characteristics.
2. Growth curve of a bacterium.
3. To perform antibacterial testing by Kirby-Bauer method.
4. To prepare temporary mounts of Aspergillus and Candida by appropriate staining.
5. Staining methods: Gram's staining permanent slides showing Acid fast staining, Capsule staining and spore staining.

**SUGGESTED READINGS**

1. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
2. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier. .
3. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.