

**UNIVERSITY DEPARTMENT OF BIOTECHNOLOGY**  
**RADHA GOVIND UNIVERSITY**  
**RAMGARH, JHARKHAND**



**COURSE CURRICULUM FOR UNDERGRADUATE COURSES UNDER  
CHOICE BASED CREDIT SYSTEM**

**B.Sc. (Biotechnology)**

**With effect from 2019 - 2021**

**UNIVERSITY DEPARTMENT OF BIOTECHNOLOGY**  
**RADHA GOVIND UNIVERSITY**  
**RAMGARH**

**PROPOSED SYLLABI FOR CHOICE BASED CREDIT SYSTEM  
B.Sc.Hons. InBiotechnology**

**(Six Semester Course)**

**SEMESTER-I**

<b>COURSE</b>	<b>Code Of Papers</b>	<b>Name of Papers</b>	<b>Credit</b>	<b>Total Credit</b>
<b>(A) CORE Course</b>	<b>C-1</b>	<b>Biochemistry and Metabolism</b>	<b>04</b>	<b>12</b>
	<b>C-2</b>	<b>Cell biology</b>	<b>04</b>	
	<b>P-1</b>	<b>Practical based in C-1 &amp; C-2</b>	<b>04</b>	
<b>(B) AECC Ability Enhancement Compulsory Course</b>	<b>AECC-1</b>	<b>Communication Skill</b>	<b>02</b>	<b>02</b>
<b>(C) Generic Elective</b>	<b>GE-1</b>	<b>Developmental Biology</b>	<b>04</b>	<b>06</b>
		<b>Practical-GE</b>	<b>02</b>	
			<b>Total credits</b>	<b>20</b>

**Semester II**

<b>COURSE</b>	<b>Code Of Papers</b>	<b>Name of Papers</b>	<b>Credit</b>	<b>Total Credit</b>
<b>Core Course</b>	<b>C-3</b>	<b>Mammalian Physiology</b>	<b>04</b>	<b>12</b>
	<b>C-4</b>	<b>Plant Anatomy and Physiology</b>	<b>04</b>	
	<b>P-2</b>	<b>Practical based on C-3 &amp; C-4</b>	<b>04</b>	
<b>(B) AECC Ability Enhancement Compulsory Course</b>	<b>AECC-2</b>	<b>Communication Skill / Environmental Science</b>	<b>02</b>	<b>02</b>
<b>(C) Generic Elective</b>	<b>GE-2</b>	<b>IPR, Bioethics and Biosafety</b>	<b>04</b>	<b>06</b>
			<b>Total credits</b>	<b>20</b>

**Semester –III**

<b>COURSE</b>	<b>Code Of Papers</b>	<b>Name of Papers</b>	<b>Credit</b>	<b>Total Credit</b>
<b>Core Course</b>	<b>C-5</b>	<b>Genetics</b>	<b>04</b>	<b>18</b>
	<b>C-6</b>	<b>General Microbiology</b>	<b>04</b>	
	<b>C-7</b>	<b>Chemistry-1</b>	<b>04</b>	
	<b>P-3</b>	<b>Practical based on C-5,C-6&amp; C-7</b>	<b>06</b>	
<b>(B) Skill Enhancement Course</b>	<b>SEC-1</b>	<b>Molecular Diagnostics</b>	<b>02</b>	<b>02</b>
<b>Generic Elective</b>	<b>GE-3</b>	<b>Biotechnology and Human Welfare</b>	<b>04(T)+02(P)</b>	<b>06</b>
			<b>Total</b>	<b>26</b>

**Semester -IV**

<b>COURSE</b>	<b>Code of Papers</b>	<b>Name of Papers</b>	<b>Credit</b>	<b>Total Credit</b>
<b>Core Course</b>	<b>C-8</b>	<b>Molecular Biology</b>	<b>04</b>	<b>18</b>
	<b>C-9</b>	<b>Immunology</b>	<b>04</b>	
	<b>C-10</b>	<b>Chemistry -II</b>	<b>04</b>	
	<b>P-4</b>	<b>Practical based on C-8,C-9&amp; C-10</b>	<b>06</b>	
<b>(B) Skill Enhancement Course</b>	<b>SEC-2</b>	<b>Entrepreneurship Development</b>	<b>02</b>	<b>02</b>
<b>Generic Elective</b>	<b>GE-4</b>	<b>Basics of Forensic Science</b>	<b>04+02</b>	<b>06</b>
				<b>26</b>

**SEMESTER V**

<b>COURSE</b>	<b>Code Of Papers</b>	<b>Name of Papers</b>	<b>Credit</b>	<b>Total Credit</b>
<b>Core Course</b>	<b>C-11</b>	<b>Bioprocess Technology</b>	<b>04</b>	<b>12</b>
	<b>C-12</b>	<b>Recombinant DNA Technology</b>	<b>04</b>	
	<b>P-5</b>	<b>Practical based on C-11&amp; C-712</b>	<b>04</b>	
<b>Discipline specific Elective</b>	<b>DSE-1</b>	<b>Bioinformatics</b>	<b>04</b>	<b>12</b>
	<b>DSE-2</b>	<b>Plant Diversity</b>	<b>04</b>	
	<b>P-6</b>	<b>Practical based on DSE-1 &amp; DSE-2</b>	<b>04</b>	
			<b>Total</b>	<b>24</b>

**SEMESTER VI**

<b>COURSE</b>	<b>Code Of Papers</b>	<b>Name of Papers</b>	<b>Credit</b>	<b>Total Credit</b>
<b>Core Course</b>	<b>C-13</b>	<b>Bio Analytical Tools</b>	<b>04</b>	<b>12</b>
	<b>C-14</b>	<b>Genomics and Proteomics</b>	<b>06</b>	
	<b>P-7</b>	<b>Practical based on C-11</b>	<b>02</b>	
<b>Discipline specific Elective</b>	<b>DSE-3</b>	<b>Animal Biotechnology</b>	<b>04</b>	<b>12</b>
	<b>DSE-4</b>	<b>Medical Microbiology</b>	<b>04</b>	
	<b>P-8</b>	<b>Practical based on DSE-3 &amp; DSE-4</b>	<b>04</b>	
			<b>Total</b>	<b>24</b>

**B.Sc.(Hons.) Biotechnology**

Semester I

Core Course C-1

**BIOCHEMISTRY AND METABOLISM**

**(Credit 4)**

**THEORY**

**UNIT I**

Introduction to Biochemistry:

**(10 Periods)**

A historical prospective.

Amino acids & Proteins: Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins.

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

**UNIT II**

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

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

**UNIT III**

Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, activation energy and transition state, enzyme activity. Biocatalysts from extreme thermophilic and hyperthermophilic archaea and bacteria. Role of: NAD<sup>+</sup>, NADP<sup>+</sup>, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxalphosphate, lipoic-acid, Biotin vitamin B12.

**UNIT IV**

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.  $\beta$ -oxidation of fatty acids.

## **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.

**Core course II**  
**Cell Biology**

**THEORY**

**(Credits 4)**

**UNIT I**

**(10 Periods)**

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**

**(15 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.

Golgi complex: Structure, biogenesis and functions including role in protein secretion.

**UNIT III**

**(20 Periods)**

Lysosomes: Vacuoles and micro bodies: Structure and functions

Ribosomes: Structures and function including role in protein synthesis.

Mitochondria: Structure and function, Genomes, biogenesis.

Chloroplasts: Structure and function, genomes, biogenesis

Nucleus: Structure and function, chromosomes and their structure.

**UNIT IV**

**(15 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. 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.7<sup>th</sup>edition. Pearson Benjamin Cummings Publishing, San Francisco.

## **Generic Developmental Biology**

### **UNIT I: Gametogenesis and Fertilization**

**(10 Periods)**

Definition, scope & historical perspective of development Biology, Gametogenesis – Spermatogenesis, Oogenesis Fertilization - Definition, mechanism, types of fertilization. Different types of eggs on the basis of yolk.

### **UNIT II: Early embryonic development**

**(20 Periods)**

Cleavage: Definition, types, patterns & mechanism Blastulation: Process, types & mechanism Gastrulation: Morphogenetic movements– epiboly, emboly, extension, invagination, convergence, de-lamination. Formation & differentiation of primary germ layers, Fate Maps in early embryos.

### **UNIT III: Embryonic Differentiation**

**(20 Periods)**

Differentiation: Cell commitment and determination- the epigenetic landscape: a model of determination and differentiation, control of differentiation at the level of genome, transcription and post-translation level Concept of embryonic induction: Primary, secondary & tertiary embryonic induction, Neural induction and induction of vertebrate lens.

### **UNIT IV: Organogenesis**

**(10 Periods)**

Neurulation, notogenesis, development of vertebrate eye. Fate of different primary germ layers. Development of behaviour: constancy & plasticity, Extra embryonic membranes, placenta in Mammals.

### **PRACTICALS**

1. Identification of developmental stages of chick and frog embryo using permanent mounts
2. Preparation of a temporary stained mount of chick embryo
3. Study of developmental stages of *Anopheles*.
4. Study of the developmental stages of *Drosophila* from stock culture/ photographs.
5. Study of different types of placenta.

### **SUGGESTED READING**

1. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
2. Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
3. Kalthoff, (2000). Analysis of Biological Development, II Edition, McGraw-Hill Professional.

**Semester II**  
**CORE COURSE III**  
**MAMMALIAN PHYSIOLOGY**  
**(Credits 4)**

**THEORY**

**UNIT I: Digestion and Respiration**

**(15 Periods)**

Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and fats.  
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 Circulation**

**(15 Periods)**

Composition of blood, Plasma proteins & their role, blood cells, Haemopoiesis, Mechanism of coagulation of blood.

Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat.

**UNIT III Muscle physiology and osmoregulation**

**(15 Periods)**

Structure of cardiac, smooth & skeletal muscle. Muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction.

Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation

**UNIT IV Nervous and endocrine coordination**

**(15 Periods)**

Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitters

Mechanism of action of hormones (insulin and steroids)

Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions.

**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. Harcourt Asia PTE Ltd. /W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & Sons, Inc.

## **Core course IV**

### **Plant Anatomy and Physiology**

#### **THEORY**

**(Credits 4)**

#### **UNIT I: Anatomy**

**(10 Periods)**

The shoot and root apical meristem and its histological organization, simple & complex permanent tissues, primary structure of shoot & root, secondary growth.

#### **UNIT II: Plant water relations and micro & macro nutrients**

**(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 III: Carbon and nitrogen metabolism**

**(20 Periods)**

Photosynthesis- Photosynthesis pigments, concept of two photo systems, photophosphorylation, calvin cycle, CAM plants, photorespiration, compensation point

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

#### **UNIT IV: Growth and development (18 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. Fahh, 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, 4<sup>th</sup> edition, 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, 4<sup>th</sup> edition, Sinauer Associates Inc .MA, USA

**Generic  
IPR, Bioethics and Biosafety**

**Unit I - Introduction to Ethics & Bioethics** Ethical issues in genetic engineering, patenting human genes, cloning; Biotechnology & social responsibility.

**Unit II - Intellectual property Rights** TRIPS; GATT; International Conventions; Patent-basic principle & requirements.

**Unit III - Biosafety regulatory frame work** for GMOs in India; Biosafety regulatory frame work for GMOs at International level.

**Unit IV - Hazard assessment** Use of genetically modified organisms & their release in environment; Biosafety in laboratory- Laboratory associated infections and other hazards.

**Unit V- International dimensions** in Biosafety- Bioterrorism & conventions on biological weapons.

**PRACTICALS**

1. Proxy filing of Indian Product patent
2. Proxy filing of Indian Process patent
3. Planning of establishing a hypothetical biotechnology industry in India
4. A case study on clinical trials of drugs in India with emphasis on ethical issues.
5. Case study on women health ethics.
6. Case study on medical errors and negligence.
7. Case study on handling and disposal of radioactive waste

**SUGGESTED READING**

1. Entrepreneurship: New Venture Creation : David H. Holt
2. Patterns of Entrepreneurship : Jack M. Kaplan
3. Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka, Sultan Chand & Sons.
4. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
5. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers

**Semester III**  
**CORE COURSE V**  
**Genetics**  
**(Credits 4)**

**THEORY**

**UNIT I**

**Introduction & Inheritance Pattern** –Mendelism& Chromosome Theory – Mendel's principles, applications of Mendel's principles, Chromosome Theory of Heredity (Sutton-Boveri), Inheritance patterns, phenomenon of Dominance, Linkage & Crossing over.

**UNIT II**

**Interaction of Genes:** Allelic Variation & Gene function Multiple allele, Genetic interaction, Penetrance (complete & incomplete), Expressivity, Pleiotropism. Non-Mendelian inheritance Evidences for Cytoplasmic factors, cytoplasmic inheritance &extranuclear inheritance (mitochondrial, chloroplast)

**UNIT III**

**Nucleic acids:** Structure, function and properties of DNA and RNA. Watson and Crick model of DNA. DNA forms (A, B and Z), their characteristic. Different types of RNA, their structure and function.

**UNIT IV**

**Chromosomes&aberrations:** Chromosomal variation in Number & Structure Euploidy, Aneuploidy, Polyploidy in Plants & Animals, Induced Polyploidy, applications of Polyploidy, Deletion, Duplication, Inversion, Translocation,Chromosomal aberrations & evolution. Human karyotype, Banding techniques

**UNIT V**

**Mutation:** Introduction, Types, causes and detection, insertional mutagenesis. Bacterial genetics (conjugation, transformation, transduction)

**PRACTICALS**

1. Permanent and temporary mount of mitosis.
2. Permanent and temporary mount of meiosis.
3. Mendelian deviations in dihybrid crosses 12
4. Karyotyping with the help of photographs
5. Pedigree charts of some common characters like blood group, colour blindness and PTC tasting.
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 and 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.

**Core course VI**  
**General Microbiology**

**THEORY**

**(Credits 4)**

**UNIT I** Fundamentals, History and Evolution of Microbiology.

**(10 Periods)**

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 e.g. Bacteria, Algae, Fungi, Protozoa and Unique features of viruses.

**UNIT II**

**(10 Periods)**

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

**UNIT III**

Growth and reproduction in bacteria, fungi, virus & bacteriophages – lytic cycle, lysogenic. Factors affecting growth – pH, temperature, O<sub>2</sub> requirement. Bacterial Reproduction: Transformation, Transduction and Conjugation.

**UNIT IV**

Principles of food preservation: Spoilage of food by microbes; Methods of food preservation, Removal of microorganisms, Asepsis, Preservation by using high temperature and low temperatures. Preservation by drying: Methods of drying. Factors in the control of drying. Preservation by food additives.

**UNIT V**

Microbes in extreme environments – Thermophiles, psychrophiles and alkalophiles. Pathogenesis and pathogenic microorganisms, defense mechanism against microorganisms. (Typhoid, AIDS, Dermatomycoses).

**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 12<sup>th</sup> 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<sup>th</sup> edition Pearson Education.
8. Willey JM, Sherwood LM, and Woolverton CJ.(2008). Prescott, Harley and Klein's Microbiology 7<sup>th</sup> edition McGraw Hill Higher Education.

**Core course VII**  
**Chemistry-I**  
**Chemistry (Pass)**  
**SEC-1**  
**Molecular Diagnostic**  
**(Credit 02)**

**UNIT I**

**(15 Periods)**

**Enzyme Immunoassays:**

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. Enzyme immuno histochemical techniques. Use of polyclonal or monoclonal antibodies in enzymes immuno assays.

Applications of enzyme immunoassays in diagnostic microbiology

**UNIT II**

**(15 Periods)**

Molecular methods in clinical microbiology:

Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology

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 III**

**(18 Periods)**

Concepts and methods in idiotypes. Anti-idiotypes and molecular mimicry and receptors. Epitope design and applications.

Immunodiagnostic tests. Immuno florescence. Radioimmunoassay.

**UNIT IV (12 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. Bioinstrumentation, Webster
3. Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe, Kluwer Academic
4. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.
5. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
6. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
7. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Century-Crofts publication.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
9. Microscopic Techniques in Biotechnology, Michael Hoppert

**Generic**  
**Biotechnology and Human Welfare**  
**(Credit 04)**

**UNIT I** **(10 Periods)**

Industry: protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation.

**UNIT II** **(10 Periods)**

Agriculture: N<sub>2</sub> fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

**UNIT III** **(15 Periods)**

Environments: e.g. chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB..

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

Forensic science: e.g. solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing.

**UNIT V** **(13 Periods)**

Health: e.g. development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in *E.coli*, human genome project.

**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 of ethanolicfermentaion using Baker's yeast
2. Study of a plant part infected with a microbe
3. To perform quantitative estimation of residual chlorine in water samples
4. Isolation and analysis of DNA from minimal available biological samples
5. Case studies on Bioethics (any two)

**SUGGESTED READING**

1. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
2. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international Publishers

**Semester IV**  
**CORE COURSE VIII**  
**MOLECULAR BIOLOGY**  
**(Credits 4)**

**THEORY**

**UNIT I**

**DNA as the genetic material** – experiments proving DNA and RNA as genetic material. Eukaryotic genomes: Chromosomal organization and structure. Euchromatin, heterochromatin, centromere, telomere. Chromatin structure (nucleosome), histone and non-histone proteins.

**UNIT II**

**DNA Replication:** Semi-conservative mode of DNA replication, experimental proof. Unidirectional and bidirectional mode of DNA replication, theta model and rolling circle model. DNA replication in prokaryotes and eukaryotes, different stages, proteins and enzymes involved. DNA damage and repair: causes of DNA damage, mutations. Repair mechanisms- photoreactivation, excision repair, mismatch repair, SOS repair.

**UNIT III**

**Transcription in prokaryotes and eukaryotes**, different stages, mechanism, promoters, transcription factors, RNA polymerases. Post transcriptional modifications- 5' cap formation, 3'-end processing/polyadenylation and gene splicing and generation of mature mRNA. Inhibitors of transcription.

**UNIT IV**

**Translation/Protein synthesis:** Mechanism of initiation, elongation and termination of protein synthesis in prokaryotes and eukaryotes. Inhibitors of translation. Post-translational modifications.

**UNIT V**

**Regulation of Gene Expression in prokaryotes and eukaryotes**, induction and repression, positive and negative regulation. Operon model- lac, trp, catabolite repression, transcription attenuation.

**Molecular mechanisms of DNA recombination**– Site Specific and Homologous recombination. **Genetic Code:** concept, elucidation or cracking of genetic code, features of genetic code, Wobble hypothesis.

## **Core course IX**

### **Immunology**

**(Credit 4+2)**

#### **THEORY**

##### **UNIT I**

**(20 Periods)**

Immune Response - An overview, components of mammalian immune system, molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses, Tlymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors.

##### **UNIT II**

**(15 Periods)**

Regulation of immunoglobulin gene expression – clonal selection theory, allotypes&idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, antibody diversity.

##### **UNIT III (13 Periods)**

Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing.

Immunity to infection – immunity to different organisms, pathogen defense strategies, avoidance of recognition. Autoimmune diseases, Immunodeficiency-AIDS.

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

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

Introduction to immunodiagnosics – 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. ELISA.

#### **SUGGESTED READING**

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6 th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11<sup>th</sup> edition 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. 2nd edition Churchill Livingstone Publishers, Edinburgh.
6. Richard C and Geoffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

**Core course X**  
**Chemistry-II**

**Chemistry (Pass)**

**SEC-2**  
**Entrepreneurship Development**  
**(Credit 02)**

**Unit -I**

**Introduction:**

**(10 Periods)**

Need, Scope & Characteristics of Entrepreneurship.

Identification of opportunities.

Exposure to Demand based, Resource based, Service based, Import Substitute and Export Promotion Industries.

Market Survey Techniques.

**UNIT II**

**(20 Periods)**

Entrepreneurship: Selection of a product, line, design and development processes, economics on material and energy requirement, stock the product and release the same for making etc. The basic regulations of excise: Demand for a given product, feasibility of its production under given constraints of raw material, energy input, financial situations export potential etc.

**Unit III**

**Business Plan**

Elements of Marketing and Sales Management.

(a) Nature of Product and Market Strategy.

(b) Packaging and Advertising After sales Service

## **Unit IV**

### **Human Behaviour**

Management of self and understanding human behavior.

Sickness in Small Scale Industries and their Remedial measures.

### **Recommended Books:**

1. Couger, Creativity & Innovation
2. Dollinger M.J.-Entrepreneurship Development(Prentice Hall 1994)
3. Holt Entrepreneurship; New Venture Creation (Prentice Hall 1999)

## **Generic**

### **Basics of Forensic Science**

**(Credit 4+2)**

#### **Unit I (15 Periods)**

Introduction & Basics: Introduction and principles of forensic science, forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science.

#### **Unit II (15 Periods)**

Crime & Crime Scene: Causes of crime, role of modus operandi in criminal investigation. Classification of injuries and their medico-legal aspects, method of assessing various types of deaths.

#### **Unit III (15 Periods)**

Fingerprints & Toxicology: Role of the toxicologist, significance of toxicological findings, Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal Identification, Principle of DNA fingerprinting, application of DNA profiling in forensic medicine.

#### **Unit V**

Investigation Tools: Discovery, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security.

### **PRACTICALS**

1. Case studies to depict different types of injuries and death.
2. Separation of nitro compounds (explosives)/ ink samples by thin layer chromatography.
3. Investigate method for developing fingerprints by Iodine crystals.
4. PCR amplification on target DNA and DNA profiling,
5. E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Recovering deleted evidences, Password Cracking

## **SUGGESTED READING**

1. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
2. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001).
3. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).
4. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).

### **Semester V**

### **CORE COURSE XI**

### **BIOPROCESS TECHNOLOGY**

**(Credits 4+2)**

#### **THEORY**

##### **UNIT I (10 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 (20 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. Principles of upstream processing – Media preparation, Inocula development and sterilization.

##### **UNIT III (15 Periods)**

Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa. Bioprocess measurement and control system with special reference to computer aided process control.

##### **UNIT IV (15 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.

## **Core course XII**

### **RECOMBINANT DNA TECHNOLOGY**

**(Credit 4+2)**

## **THEORY**

### **UNIT I**

**Introduction:** History, scope & guidelines of Genetic Engineering, Gene Cloning & Patenting, Restriction Enzymes, their types and mode of action

### **UNIT II**

**Vectors:** Plasmids, Cosmids, Phasmids, BAC, YAC, Bacteriophage, *Agrobacterium tumefaciens* & *Agrobacterium rhizogenes*, Plant and Animal viruses.

### **UNIT III**

**Selection & Screening:** Isolation and purification of DNA (Bacteria & Plants), Introduction of Recombinant DNA into living cells, Selection & Screening of recombinant clones.

### **UNIT IV**

**PCR & DNA Sequencing:** Introduction, Types, Application, DNA sequencing methods, Southern, Northern and Western hybridization, *In situ* hybridization.

### **UNIT V**

**Applications of Genetic Engineering:** Genetic engineering in animals: Production of transgenic mice, Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines, transgenic animals.

## **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
6. 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-Applying 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, 7<sup>th</sup> edition. Blackwell Publishing, Oxford, U.K.
5. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3<sup>rd</sup> edition. Cold Spring Harbor Laboratory Press.

### **DSE-1**

#### **Bioinformatics (Credits 4+2)**

#### **THEORY**

##### **UNIT I**

**(10 Periods)**

History of Bioinformatics. The notion of Homology. Sequence Information Sources, EMBL, GENBANK, Entrez, Unigene, Understanding the structure of each source and using it on the web.

##### **UNIT II**

**(20 Periods)**

Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web. Introduction of Data Generating Techniques and Bioinformatics problem posed by them- Restriction Digestion, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry.

##### **UNIT III**

**(20 Periods)**

Sequence and Phylogeny analysis, Detecting Open Reading Frames, Outline of sequence Assembly, Mutation/Substitution Matrices, Pairwise Alignments, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment, Phylogenetic Analysis.

## UNIT IV

(10 Periods)

Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission. Genome Annotation: Pattern and repeat finding, Gene identification tools.

### PRACTICALS

1. Sequence information resource
2. Understanding and use of various web resources: EMBL, Genbank, Entrez, Unigene, Protein information resource (PIR)
3. Understanding and using: PDB, Swissprot, TREMBL
4. Using various BLAST and interpretation of results.
5. Retrieval of information from nucleotide databases.
6. Sequence alignment using BLAST.
7. Multiple sequence alignment using Clustal W.

### SUGGESTED READING

1. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.

## DSE-2

### Plant Diversity (Credits 4+2)

### THEORY

#### UNIT I

##### Algae:

(20 Periods)

General character, classification and economic importance. Life histories of algae belonging to various classes:

Chlorophyceae – *Volvox*, *Oedogonium*

Xanthophyceae – *Vaucheria*

Phaeophyceae – *Ectocarpus*

Rhodophyceae – *Polysiphonia*

#### UNIT II

##### Fungi:

(20 Periods)

General characters, classification & economic importance.

Life histories of Fungi:

Mastigomycotina- *Phytophthora*

Zygomycotina-*Mucor*

Ascomycotina- *Saccharomyces*

Basidiomycotina-*Agaricus*

Deutromycotina-*Colletotrichum*

### **UNIT III**

#### **Lichens :**

**(10 Periods)**

Classification, general structure, reproduction and economic importance. Plant diseases:

Casual organism, symptoms and control of following plant diseases.

Rust & Smut of Wheat.

White rust of Crucifers.

Late blight of Potato.

Red rot of Sugarcane.

Citrus Canker.

### **UNIT IV**

#### **Bryophytes:**

**(10 Periods)**

General characters, classification & economic importance.

Life histories of following:

*Marchantia*.

*Funaria*.

### **PRACTICALS**

1. Comparative study of thallus and reproductive organs of various algae mentioned in theory
2. Comparative study of vegetative and reproductive parts of various fungi mentioned in theory.
3. Study and section cutting and lectophenol mount of plant disease materials studied in theory.
4. Study of various types of lichens.
5. Study of external features & anatomy of vegetative and reproductive parts of *Marchantia* and *Funaria*
6. Collection of algae, fungi, plant diseases materials and bryophytes available locally.

### **SUGGESTED READING**

1. Agrios, G.N. 1997 Plant Pathology, 4<sup>th</sup> edition, Academic Press, U.K.

2. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 1996 Introductory Mycology, 4<sup>th</sup>edition, John Wiley and Sons (Asia) Singapore.
3. Bold, H.C. & Wayne, M.J. 1996 (2<sup>nd</sup>Ed.) Introduction to Algae.
4. Kumar, H.D. 1999. Introductory Phycology. Aff. East-West Press Pvt Ltd., Delhi.
5. Lee, R.E. 2008. Phycology, Fourth Edition, Cambridge University Press, USA.
6. Sambamurty 2008 A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. IK International Publishers.
7. Shaw, A.J. and Goffinet, B. 2000 Bryophyte Biology. Cambridge University Press.
8. Van den Hoek, C.; Mann, D.J. & Jahns, H.M. 1995. Algae: An introduction to Phycology. Cambridge Univ. Press.
9. Vander-Poorteri 2009 Introduction to Bryophytes. COP.
10. Webster, J. and Weber, R. 2007 Introduction to Fungi. 3<sup>rd</sup>edition, Cambridge University Press, Cambridge.
11. Wickens, G.E. 2004 Economic Botany: Principles and Practices, Springer. Kuwer Publishers, Dordrecht, The Netherlands

**Semester VI**  
**CORE COURSE XIII**  
**BIO ANALYTICAL TOOLS**  
**(Credits 4+2)**

**UNIT I**

**(10 Periods)**

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

**UNIT II**

**(15 Periods)**

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

**UNIT III**

**(15 Periods)**

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 IV**

**(20 Periods)**

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

**PRACTICAL**

1. Native gel electrophoresis of proteins
2. SDS-polyacrylamide slab gel electrophoresis of proteins under reducing conditions.
3. Preparation of protoplasts from leaves.
4. Separation of amino acids by paper chromatography.
5. To identify lipids in a given sample by TLC.
6. 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. 7<sup>th</sup> edition. Pearson Benjamin Cummings Publishing, San Francisco.

**Semester VI**  
**CORE COURSE XIV**  
**Genomics and Proteomics**  
**(Credits 4+2)**

**UNIT I**

**(15 Periods)**

Introduction to Genomics, DNA sequencing methods – manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clone contig) methods, Computer tools for sequencing projects: Genome sequence assembly software.

**UNIT II**

**(10 Periods)**

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**

**(20 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. Determination of sizes (Sedimentation analysis, gel filtration, SDS-PAGE); Native PAGE, Determination of covalent structures –Edman degradation.

**UNIT IV**

**(15 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. Native PAGE
7. 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.
5. Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989.
6. Principles of Gene Manipulation 6th Edition, S.B.Primrose, R.M.Twyman and R.W. Old. Blackwell Science, 2001.
7. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics.V Edition.John Wiley and 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). *i*Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
5. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
6. Pevsner, J. (2009). Bioinformatics and Functional Genomics.II Edition.John Wiley & Sons.

**DSE-3**  
**ANIMAL BIOTECHNOLOGY**  
**(Credit 4+2)**

**UNIT I**

**(10 Periods)**

Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer.

**UNIT II**

**(10 Periods)**

Introduction to transgenesis. Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect. Animal diseases need help of Biotechnology – Foot-and mouth disease, Coccidiosis, Trypanosomiasis.

**UNIT III**

**(20 Periods)**

Animal propagation – Artificial insemination, Animal Clones.  
Conservation Biology – Embryo transfer techniques. Introduction to Stem Cell Technology and its applications.

**UNIT IV**

**(20 Periods)**

Genetic modification in Medicine - gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics.

**PRACTICALS**

1. Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization
2. Sources of contamination and decontamination measures.
3. Preparation of Hanks Balanced salt solution
4. Preparation of Minimal Essential Growth medium
5. Quantification of isolated DNA.
6. Resolving DNA on Agarose Gel.

**SUGGESTED READING**

1. Brown, T.A. (1998). Molecular biology Labfax II: Gene analysis. II Edition. Academic Press, California,USA.
2. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers.

3. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications of recombinant DNA.IV Edition.ASM press, Washington, USA.
4. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA.
5. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNA genes and genomes- A short course.III Edition. Freeman and Co., N.Y., USA.

#### **DSE-4**

### **MEDICAL MICROBIOLOGY (Credit 4+2)**

#### **UNIT I**

**(18 Periods)**

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

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 II**

**(15 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 III**

**(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 IV**

**(15 Periods)**

Fungal and Protozoan infections. Dermatophytoses (*Trichophyton*, *Microsporun* and *Epidermophyton*) Subcutaneous infection (*Sporothrix*, *Cryptococcus*), systemic infection (*Histoplasma*, *Coccidoides*) and opportunistic fungal infections (*Candidiasis*, *Aspergillosis*), 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.

