

CHOICE BASED CREDIT SYSTEM
B.Sc (Hons.) Biotechnology Syllabus,

The University of Burdwan

Course	Title	Credit	Marks
CC-1	Biochemistry and Metabolism (Th) 4 CR	6	75
	Biochemistry and Metabolism (Pr) 2CR		
CC-2	Cell Biology (Th) 4 CR	6	75
	Cell Biology (Pr) 2CR		
CC-3	Mammalian Physiology (Th) 4 CR	6	75
	Mammalian Physiology (Pr) 2CR		
CC-4	Plant Physiology (Th) 4CR	6	75
	Plant Physiology(Pr) 2 CR		
CC-5	Genetics (Th) 4CR	6	75
	Genetics (Pr) 2 CR		
CC-6	General Microbiology (Th) 4 CR	6	75
	General Microbiology (Pr) 2 CR		
CC-7	Chemistry-1 (Th) 4 CR	6	75
	Chemistry-1 (Pr) 2 CR		
CC-8	Molecular Biology (Th) 4 CR	6	75
	Molecular Biology(Pr) 2 CR		
CC-9	Immunology (Th) 4 CR	6	75
	Immunology (Pr) 2 CR		
CC-10	Chemistry-II (Th) 4 CR	6	75
	Chemistry-II (Pr) 2 CR		
CC-11	Bioprocess Technology (Th) 4 CR	6	75
	Bioprocess Technology (Pr) 2 CR		
CC-12	Recombinant Biotechnology (Th) 4 CR	6	75
	Recombinant Biotechnology (Pr) 2 CR		
CC-13	Bio analytical Tools (Th) 4 CR	6	75
	Bio analytical Tools (Pr) 2 CR		
CC-14	Genomics & Proteomics (Th) 4 CR	6	75
	Genomics & Proteomics (Pr) 2 CR		

DISCIPLINE SPECIFIC ELECTIVE (Any Four)

DISCIPLINE SPECIFIC ELECTIVE	Title	Credit	Marks
DSE 1	Animal Biotechnology (Th) 4 CR	6	75
	Animal Biotechnology (Pr) 2 CR		
	OR		
	Plant Biotechnology (Th) 4CR	6	75
	Plant Biotechnology (Pr) 2CR		
DSE 2	Biostatistics (Th) 4 CR	6	75
	Biostatistics (Pr) 2 CR		
	OR		
	Bioinformatics (Th) 4 CR	6	75
	Bioinformatics (Pr) 2 CR		
DSE 3	Medical Microbiology (Th) 4CR	6	75
	Medical Microbiology (Pr) 2 CR		
	OR		
	Environmental Biotechnology (Th) 4CR	6	75
	Environmental Biotechnology (Pr) 2CR		
DSE 4	Intellectual Property Rights (Th) 4 CR	6	75
	Intellectual Property Rights (Pr) 2 CR		
	OR		
	Evolutionary Biology (Th) 4 CR	6	75
	Evolutionary Biology (Pr) 2 CR		

*** Semester V- Any one from DSE 1 & any one from DSE 2**

*** Semester VI- Any one from DSE 3 & any one from DSE 4**

GENERIC ELECTIVE [Only for the students of Biotechnology (Hons.)]

Generic Elective	Title	Credit	Marks
GE 1	Human Welfare (Th) 4 CR	6	75
	Human Welfare (Pr) 2 CR		
	Or	6	75
	Development Biology (Th) 4 CR		
	Development Biology (Pr) 2 CR		
GE 2	Microbial Physiology (Th) 4 CR	6	75
	Microbial Physiology (Pr) 2 CR		
	Or	6	75
	Biophysics & Instrumentation (Th) 4 CR		
	Biophysics & Instrumentation (Pr) 2 CR		
GE 3	Entrepreneurship Development (Th) 4 CR	6	75
	Entrepreneurship Development (Pr) 2 CR		
	Or	6	75
	Bioethics & Biosafety (Th) 4 CR		
	Bioethics & Biosafety (Pr) 2 CR		
GE 4	Human Genetics (Th) 4 CR	6	75
	Human Genetics (Pr) 2 CR		
	Or	6	75
	Immunotechnology (Th) 4 CR		
	Immunotechnology (Pr) 2 CR		

SKILL ENHANCEMENT COURSES (ANY TWO)

Skill Enhancement Courses	Title	Credit	Marks
SEC 1	Molecular Diagnostics (Th)	2	50
	Or		
	Industrial Fermentation (Th)	2	50
SEC 2	Enzymology (Th)	2	50
	Or		
	Basics of Forensic Sciences (Th)	2	50

ABILITY ENHANCEMENT COMPULSORY

AECC	Title	Credit	Marks
AECC 1	ENVS (Th)	4	100
AECC 2	English/MIL Communication (Th)	2	50

* Semester I- AECC 1

* Semester II- AECC-2

CHOICE BASED CREDIT SYSTEM

B.Sc (Hons) Biotechnology

SEMESTER -I

CC1- BIOCHEMISTRY AND METABOLISM (THEORY)

4 CREDITS

1. Carbohydrates: Definition; structure of carbohydrates- monosaccharide, aldohexoses and ketohexoses with examples; Haworth structure, anomeric structures of D-glucose, mutarotation, pyranose and furanose rings. Oligo- and polysaccharides, reducing (maltose) and non-reducing (sucrose), disaccharides; glycoproteins, proteoglycans. **10L**

2. Amino acids: Peptides and proteins; structures and important properties, classification of amino acids, important physical and chemical properties of amino acids (optical isomerism, UV-absorption, ionization, reactions due to amino group and carboxyl group). Primary structure of peptides. Primary, secondary, tertiary and quaternary structures, classification of proteins (based on solubility and composition). C and N terminal amino acid determination. **10L**

3. Lipids: Definition, distinction between fats and oils, structure of lipids (fatty acids, glycerolipids, sphingolipids) **5L**

4. Nucleic acids: Structure of nucleic acids; nucleosides, nucleotides, primary structure, A, B and Z form of DNA; preliminary idea of secondary structures of RNA and DNA; melting point and denaturation of DNA **8L**

5. Enzymes: Definition of enzymes, important terms (enzyme unit, specific activity), classification of enzymes; physico-chemical properties, factors affecting activity; mechanism of enzyme action, coenzymes, cofactors. **8L**

6. Carbohydrates metabolism: Reaction, energetic & regulation. Glycolysis: Fate of pyruvate under aerobic & anaerobic condition. Pentose phosphate pathway & its digestion. Gluconeogenesis, Glycogenolysis & Glycogen synthesis. TCA Cycle, Electron transfer chain, Oxidative phosphorylation, beta oxidation of fatty acids. **9L**

CC1- BIOCHEMISTRY (PRACTICAL)

2 CREDITS

1. Qualitative tests for sugars, amino acids, proteins & lipids; separation of amino acids by PC/TLC methods.
2. Quantitative estimation of sugars (DNS method) and proteins (Folin-Phenol).
3. Isolation and quantification of DNA (diphenylamine method) and RNA (orcinol method) analysis, saponification value of fat.
4. Quantitative assay for protease & catalase from plant source.
5. To study the effect of Ph, Temperature on the activity of salivary amylase

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.
6. Biochemistry Practical- Plummer
7. Biochemistry Practical- Swadashivam Manikap

CC2- CELL BIOLOGY (THEORY)

4 CREDITS

1. Cellular basis of life: Cell doctrine, cells in general, diversity of cell size and shape, cell theory; structure of eukaryotes and prokaryotes cells (including viruses) **6L**
2. Cellular information: The nucleus (ultra-structure), the organization of chromosomes (euchromatin and heterochromatin), nucleosome concept and chromosome packaging. **6L**
3. The cell surface: Plasma membrane, membrane fluidity, movement across plasma membrane, Modification of plasma membrane (Plasmodesmata and desmosome); Plants and bacterial cell walls; an outline of extracellular substances of animal cells. **10L**
4. Endo-membrane system: Endoplasmic reticulum, Mitochondria, Golgi apparatus, Chloroplast, lysosomal system, plant cell vacuoles, microbodies structure and function. **10L**
5. The cytoskeleton: Microtubules, microfilaments and intermediate filaments. **6L**
6. An outline of cell cycle: Mitosis and Meiosis. **4L**
7. Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecules basis of cancer. **8L**

CC2- CELL BIOLOGY (PRACTICAL)

2 CREDITS

1. Preparation of Meiotic Chromosome from grasshopper.
2. Preparation of Mitotic Chromosome from onion root tip.
3. Preparation of Meiotic Chromosome from *Rhoeo* discolor.
4. Preparation and study of polytene chromosome from *Drosophila/Chironomous* salivary gland.
5. Study of sex chromatin through preparation of Barr body from buccal epithelium and Drumstick from blood film.
6. Study of chromosomal aberration induced by BHC & pesticide in onion root tips.
7. Artificial induction of polyploidy/aneuploidy in onion root through colchicines exposure.

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.

AECC-1 ENVS

CHOICE BASED CREDIT SYSTEM

B.Sc (Hons) Biotechnology

SEMESTER II

CC3- MAMMALIAN PHYSIOLOGY (THEORY)

4 CREDITS

Digestion and Respiration

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 O₂ and CO₂, Oxygen dissociation curve, Chloride shift. **12L**

Circulation

Composition of blood, Plasma proteins & their role, blood cells, Haemopoiesis, Mechanism of coagulation of blood. Cardiac output, cardiac cycle, Origin & conduction of heart beat. **12L**

Muscle physiology and osmoregulation

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. Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation. **10L**

Nervous and endocrine coordination

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. **16L**

C3- MAMMALIAN PHYSIOLOGY (PRACTICAL)

2 CREDITS

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 salivary amylase
6. Haemoglobin estimation [Sahli's method]

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.

CC4- PLANT ANATOMY AND PHYSIOLOGY (THEORY)

4 CREDITS

Anatomy

12L

The shoot and root apical meristem and its histological organization, simple & complex permanent tissues, primary structure of shoot & root, secondary growth, growth rings, leaf anatomy (dorsi-ventral and isobilateral leaf)

Plant water relations and micro & macro nutrients

10L

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

Carbon and nitrogen metabolism

14L

Photosynthesis- Photosynthetic pigments, concept of two photo systems, photophosphorylation, calvin cycle, C4 cycle, CAM plants, SAM, photorespiration, compensation point, Nitrogen metabolism- inorganic & molecular nitrogen fixation, nitrate reduction and ammonium assimilation in plants.

Growth and development

14L

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 photo-periodism and vernalization; phytochrome and its role.

CC4- PLANT ANATOMY AND PHYSIOLOGY (PRACTICAL)

2 CREDITS

1. Study of evolution of oxygen during photosynthesis
2. Preparation of stained mounts of anatomy of monocot and dicot's root, stem & leaf.
3. Demonstration of opening & closing of stomata
4. Preparation of root nodules from a leguminous plant.
5. Seed viability test using TTC.
6. Study of rate of transpiration per unit area of leaf.

SUGGESTED READING

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

AECC-2 English/ MIL Communication

GENERIC ELECTIVE (SEMESTER I)

GE- 1:

HUMAN WELFARE (THEORY)

4 Credits

Industrial production of Alcohol and antibiotic (Penicilin)

10L

Application of biotechnology in agriculture, N₂ fixation, transfer of pest resistance genes to plants.

8L

Application of biotechnology in environments: e.g. chlorinated and non-chlorinated organic pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB.

14L

Application of biotechnology in 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.

8L

Application of biotechnology in health, Basic concept of therapy.

8L

HUMAN WELFARE (PRACTICAL)

2 Credits

(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. Study of ethanolic fermentation using Baker's yeast
2. Study of a plant part infected with a microbe
3. Isolation and analysis of DNA from minimal available biological samples
4. Preparation of root nodules from a leguminous plant
5. Dissertation based on applications of biotechnology (any one topic from theory syllabus) and viva-voce to be conducted on whole syllabus of the practical paper

**GE-1 OR
DEVELOPMENTAL BIOLOGY (THEORY)**

4 Credits

Gametogenesis and Fertilization

10 L

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.

Early embryonic development

20 L

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.

Embryonic Differentiation

20 L

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.

Organogenesis

10 L

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

DEVELOPMENTAL BIOLOGY (PRACTICAL)

2 Credits

(Principle & concepts can be demonstrated through videos/virtual labs or other materials)

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*. [From permanent slides or photomicrographs]
4. Study of the developmental stages of *Drosophila* from stock culture/ photographs..
5. Study of different types of placenta. [Photographs or models]

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.

GENERIC ELECTIVE (SEMESTER II)

GE-2

MICROBIAL PHYSIOLOGY (THEORY)

4 Credits

Nutritional classification of microorganisms based on carbon, energy and electron sources, Metabolite Transport, Diffusion: Passive and facilitated, Primary active and secondary active transport, Group translocation (phosphotransferase system), symport, antiport and uniport, electrogenic and electro neutral transport, transport of Iron. **12 L**

Microbial Growth. Definition of growth, balanced and unbalanced growth, growth curve, the mathematics of growth-generation time, specific growth rate, batch and continuous culture, synchronous growth, diauxic growth curve. Measurement of microbial growth. Measurement of cell numbers, cell mass and metabolic activity **13 L**

Effect of the environment on microbial growth: Temperature- temperature ranges for microbial growth, classification based on temperature ranges and adaptations, pH-classification based on pH ranges and adaptations, solutes and water activity, oxygen concentration, radiation and pressure. Chemolithotrophic metabolism, Physiological groups of aerobic and anaerobic chemolithotrophs. Hydrogenoxidizing bacteria and methanogens. **12 L**

Phototrophic metabolism. Historical account of photosynthesis, diversity of phototrophic bacteria, anoxygenic and oxygenic photosynthesis, photosynthetic pigments: action and absorption spectrum, type, structure and location, physiology of bacterial photosynthesis: light reactions, cyclic and non-cyclic photophosphorylation. Carbon dioxide fixation, Calvin cycle and reductive TCA cycle. **13 L**

MICROBIAL PHYSIOLOGY (PRACTICAL)

2 Credits

1. Laboratory rules & safety for Microbiology. General idea and demonstration of media preparation and sterilization.
2. To study and plot the growth curve of *E. coli* using turbidometric method and to calculate specific growth rate and generation time.
3. To study and plot the growth curve of *Aspergillus niger* by radial growth measurements.
4. To study the effect of pH on the growth of *E. coli*
5. To study the effect of temperature of *Aspergillus niger* by dry weight method.

SUGGESTED READING

1. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag
2. Madigan MT, Martinko JM and Parker J. (2003). Brock Biology of Microorganisms. 10th edition. Pearson/ Benjamin Cummings.
3. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons.
4. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India.
5. Stanier RY, Ingraham JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.
6. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

GE-2 OR

BIOPHYSICS & INSTRUMENTATION (THEORY)

4 Credits

General Biophysical methods – Measurement of pH, Radioactive labeling & counting, autoradiography **5 L**

Separation & Identification of Materials, Concept of Chromatography; Partition Chromatography, Paper Chromatography, Adsorption Chromatography, TLC, GLC, Ion Exchange Chromatography, Gel Chromatography, HPLC, Affinity Chromatography; Gel Electrophoresis, Paper Electrophoresis **15 L**

Centrifugation - Basic Principle of Centrifugation, Instrumentation of Ultracentrifuge (Preparative Analytical), Factor affecting Sedimentation Velocity, Standard Sedimentation Coefficient. **10 L**

Microscopy- Light Microscopy, Bright & Dark Field Microscopy, Phase Contrast Microscope, Fluorescence Microscopy, TEM, SEM. **10 L**

Spectroscopy- UV visible Spectroscopy, Principle, Beer-Lambert Law, Working Principle of Colorimeter, Spectrophotometer, Fluorometer. Application to biomolecules (Protein, DNA, Hb, Chlorophyll) **10 L**

BIOPHYSICS & INSTRUMENTATION (PRACTICAL)

2 Credits

1. Separation techniques- Centrifugation, Chromatography (Paper, TLC, Silica Gel Chromatography), & Electrophoresis
2. General Concept of Colorimeter, Spectrophotometer

SUGGESTED READING

1. Principles and Techniques of Biochemistry and Molecular Biology by K. Wilson and J. Walker
2. Molecular Spectroscopy by Jack D. Gray Beal

THE UNIVERSITY OF BURDWAN



Syllabus of B. Sc. Biotechnology (Honours) under CBCS Semester III

CC-5

GENETICS

6 CR

Theory

4 CR

UNIT I

(15 Periods)

Mendelian genetics: Monohybrid, di-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

(8 Periods)

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

UNIT III

(15 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, variations in chromosomes structure - deletion, duplication, inversion and translocation (reciprocal and Robertsonian), position effects of gene expression, chromosomal aberrations in human beings, abnormalities— Aneuploidy and Euploidy.

UNIT IV

(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 over Genetic mapping.

PRACTICALS

2 CR

1. Study of *Rhoeo* translocation.
2. Pedigree charts of some common characters like blood group, color blindness and PTC tasting.
3. 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.
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis, W. H. Freeman & Co.

CC-6**GENERAL MICROBIOLOGY****6 CR****Theory****4 CR****UNIT I**

Fundamentals, History 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 eg. 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**(15 Periods)**

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

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

UNIT IV**(15 Periods)**

Control of Microorganisms: By physical, chemical and chemotherapeutic Agents (antibacterial, antifungal, & antiviral and their mode of action)

Water Microbiology: Bacterial pollutants of water, coliforms and non coliforms. Sewage composition and its disposal.

Food Microbiology: Important microorganism in food Microbiology: Moulds, Yeasts, bacteria. Major food born infections and intoxications, Preservation of various types of foods. Fermented

Foods.

PRACTICALS

2 CR

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*. 5th 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.

CC- 7 CHEMISTRY-I (PHYSICAL CHEMISTRY)

6 CR

Theory

4 CR

1. Thermodynamics- Concept of energy, heat and work; thermodynamics functions- internal energy, entropy, enthalpy and free energy; bioenergetics- spontaneity equation in terms of entropy and concept of equilibrium; transport across membranes- Donnan equilibrium **(12 Periods)**
2. Radioactivity- Alpha, beta, gamma radiation, law of radioactive decay, unit of radioactivity, idea of artificial. Radioactivity, application-radiolabelling **(10 Periods)**
4. Electrochemistry- Electrolytic dissociation and conduction, ionic equilibrium, pH, indicator, acid base neutralization curve, buffer action, Bronsted acid, Henderson-Hasselbalch equation, preparation of buffer, buffer capacity **(12 Periods)**
5. Properties of molecules- Structure of atom, Electronic theory of valency, dipole moment, hydrogen bonds, Van der Waals' interactions, Electrostatic interactions, Hydrophobic interactions; **(8 Periods)**
6. Chemical Kinetics- Transition State theory, Arrhenius equation. preliminary ideas about

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

SEC-1 MOLECULAR DIAGNOSTICS

2 CR

UNIT I

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 immunoassays. Applications of enzyme immunoassays in diagnostic microbiology **(12 Periods)**

UNIT II

Molecular methods in clinical microbiology: Applications of PCR, RFLP, Nuclear hybridization methods **(5 Periods)**

UNIT III

Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies. Immunodiagnostic tests, Immuno florescence. **(8 Periods)**

SUGGESTED READING

1. Bioinstrumentation, Webster
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. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Century-Crofts publication.
7. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
8. Microscopic Techniques in Biotechnology, Michael Hoppert

OR

SEC-1 INDUSTRIAL FERMENTATIONS

2 CR

UNIT I

(12 Periods)

Production of industrial chemicals, biochemicals and chemotherapeutic products. gluconic acid,

Biofuels: Biogas, hydrogen, biodiesel, microbial electricity, starch conversion processes; Microbial insecticides.

UNIT II

(8 Periods)

Microbial products of pharmacological interest, steroid transformations. Secondary metabolism – its significance and products. Enzyme and cell immobilization techniques in industrial processing.

UNIT III

(5 Periods)

Purification & characterization of proteins, Upstream and downstream processing.

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,

Semester -IV

CC-8

MOLECULAR BIOLOGY

6 CR

Theory

4 CR

UNIT I: DNA structure and replication

(10 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, DNA polymerases, The replication complex: Pre-priming proteins, primosome, replisome,

UNIT II: DNA damage, repair and homologous recombination

(8 Periods)

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, and site specific recombination.

UNIT III: Transcription and RNA processing

(18 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, RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing, Exon- shuffling; RNAi

UNIT IV: Regulation of gene expression and translation (14 Periods)

Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation, Posttranslational modifications of proteins.

PRACTICALS 2 CR

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

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.

CC-9 IMMUNOLOGY 6 CR**Theory 4 CR****UNIT I (15 Periods)**

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

UNIT II (13 Periods)

Regulation of immunoglobulin gene expression – clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory.

UNIT III (10 Periods)

Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing, Autoimmune diseases, Immunodeficiency-AIDS.

UNIT IV (12 Periods)

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

PRACTICALS**2 CR**

1. Haemagglutination assay
2. Haemagglutination inhibition assay
3. Double immunodiffusion test using specific antibody and antigen.
4. ELISA.

SUGGESTED READING

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th 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, Edinberg.
6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

CC-10**CHEMISTRY-II (ORGANIC CHEMISTRY)****6 CR****Theory****4 CR**

1. Alkanes Structural formulae, nomenclature, homologous series, conformational analysis, alkenes and alkynes, orbital picture **(8 Periods)**
2. Monohydric alcohol, polyhydric alcohols, unsaturated alcohols, ether, carbonyl compounds and acids **(10 Periods)**
3. Stereochemistry: Different types of isomerism- Geometric and Optical isomerism, Diastereoisomerism, Enantiomers, Chirality and asymmetry in relation to biomolecules; Mesomerism, Racemic modifications; Stereochemical nomenclature, R-S, EZ, DL, Pro-R, Pro-S, Erythro- and Threo- designations of enantiotropic atoms, Fischer, Newman, Sawhorse and Wedge structures and their interconversions **(12 Periods)**
4. Aliphatic compounds of sulphur, phosphorus, organometallic compounds. Grignard Reagent and its use **(8 Periods)**
Nomenclature of aromatic compounds, reaction mechanism- SN1 and SN2 reactions, E1 and E2 reactions, Saytzeff and Hoffmann elimination, Nucleophilic and Electrophilic aromatic substitution reactions, Aromaticity, orbital picture, Electromeric and mesomeric effects, Resonance and delocalization of π -electrons in different organic compounds **(12 Periods)**

Practical Paper (Organic Chemistry)**2 CR****1. Experiment on Organic Chemistry (20 marks)**

- i) Examination of solid organic compound under the following heads:

variations in chromosomes structure - deletion, duplication, inversion and translocation (reciprocal and Robertsonian), position effects of gene expression, chromosomal aberrations in human beings, abnormalities– Aneuploidy and Euploidy. **(16 Periods)**

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. **(14 Periods)**

Population genetics: Hardy Weinberg law (prediction, derivation), allelic and genotype frequencies **(6 Periods)**

HUMAN GENETICS (PRACTICAL) 2 CR

1. Buccal smear study and staining methods for Barr bodies
2. PTC testing in a population and calculation of allele and genotype frequencies.
3. Isolation of genomic DNA (mammalian system)
4. Construction of Restriction digestion maps from data provided.

SUGGESTED READINGS:

1. Genetics- Strachan & Read
2. Human Genetics: Thompson & Thompson

SEC- 2 ENZYMOLOGY 2 CR

UNIT - I (10 Periods)

Enzyme classification (rationale, overview and specific examples) Zymogens and their activation (Proteases and Prothrombin). Enzyme substrate complex: concept of E-S complex, binding sites, active site, specificity, Kinetics of enzyme activity, Michaelis-Menten equation and its derivation, Different plots for the determination of K_m and V_{max} and their physiological significance, factors affecting initial rate, E, S, temp. & pH. Collision and transition state theories, Significance of activation energy and free energy.

UNIT – II (8 Periods)

Enzyme regulation: Product inhibition, feedback control, covalent modification. Isoenzymes– multiple forms of enzymes with special reference to lactate dehydrogenase. Multienzyme complexes. Ribozymes. Multifunctional enzyme- eg. Fatty Acid synthase

UNIT – III

Enzyme Technology: Methods for large scale production of enzymes. Thermal stability and catalytic efficiency of enzyme, site directed mutagenesis and enzyme engineering– selected examples, Methods for protein sequencing (Edman's degradation) **(7 Periods)**

CC12**RECOMBINANT DNA TECHNOLOGY****6CR****THEORY****4 CR****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, Principle and applications of Polymerase chain reaction (PCR), primer-design, and Reverse transcription Polymerase chain reaction(RT –PCR).

UNIT II**(18 Periods)**

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, 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 III**(10 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 IV**(10 Periods)**

Genetic engineering in plants: Use of *Agrobacterium tumefaciens* and *A. rhizogenes*, Ti and Ri-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**2CR**

1. Isolation of genomic DNA from plant cells
2. Qualitative and quantitative analysis of DNA using spectrophotometer
3. Restriction digestion of DNA
4. Making competent cells
5. Transformation of competent cells.
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, 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.

DSE 1 ANIMAL BIOTECHNOLOGY

6 CR

THEORY

4 CR

UNIT I

Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer. **(10 Periods)**

UNIT II

Introduction to transgenesis. Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect. Animal diseases need help of Biotechnology – Foot-and mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis. **(10 Periods)**

UNIT III

Animal propagation – Artificial insemination, Animal Clones. Conservation Biology – Embryo transfer techniques. Introduction to Stem Cell Technology and its applications. **(10 Periods)**

UNIT IV

Modification in Gene - gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics. **(20 Periods)**

PRACTICALS

2CR

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. DNA isolation from animal tissue
6. Quantification of isolated DNA.
7. 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.

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. 3rdedition. 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.

DSE 2 BIOSTATISTICS**6CR****THEORY****4CR****UNIT I****(10 Periods)**

Types of Data, Collection of data; Primary & Secondary data, Classification and Graphical representation of Statistical data. Measures of central tendency and Dispersion. Measures of Skewness and Kurtosis.

UNIT II**(16 Periods)**

Concepts of probability, Elementary ideas of Binomial, Poisson and Normal distributions.

UNIT III**(16 Periods)**

Methods of sampling, confidence level, critical region, testing of hypothesis and standard error, large sample test and small sample test. Problems on test of significance, t-test, chi-square test for goodness of fit and analysis of variance (ANOVA)

UNIT IV**(8 Periods)**

Correlation and Regression. Emphasis on examples from Biological Sciences.

PRACTICALS**2CR**

1. Based on graphical Representation
2. Based on measures of Central Tendency & Dispersion
3. Based on Distributions Binomial Poisson Normal
4. Based on t, f, z and Chi-square

SUGGESTED READING

1. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA
2. Glaser AN (2001) High YieldTM Biostatistics. Lippincott Williams and Wilkins, USA
3. Edmondson A and Druce D (1996) Advanced Biology Statistics, Oxford University Press.
4. Danial W (2004) Biostatistics: A foundation for Analysis in Health Sciences, John Wiley and Sons Inc.

OR**DSE 2 BIOINFORMATICS****6CR****THEORY****4CR****UNIT I**

History of Bioinformatics. The notion of Homology. Sequence Information Sources, EMBL, GENBANK, Entrez, Unigene, Understanding the format and structure of each source and using it on the web. **(8 Periods)**

UNIT II

Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web. **(10 Periods)**

UNIT III

Detecting Open Reading Frames, Outline of sequence Assembly, Mutation/Substitution Matrices, Pairwise Alignments, Multiple Sequence Alignment, Phylogenetic Analysis. **(20 Periods)**

UNIT IV

Analysis and result interpretation, Data Submission. Genome Annotation: Preliminary idea, Gene identification tools. **(12 Periods)**

PRACTICALS**2CR**

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.

SEMESTER VI**CC 13 BIO-ANALYTICAL TOOLS****6CR****THEORY****4CR****UNIT I****(10 Periods)**

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

UNIT II**(10 Periods)**

Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infra-red), 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**(15 Periods)**

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**2CR**

1. Preparation of protoplasts from leaves.
2. Separation of amino acids by paper chromatography.
3. To identify lipids in a given sample by TLC.

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.

CC 14 GENOMICS & PROTEOMICS**6CR****THEORY****4CR****UNIT I****(18 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**(14 Periods)**

Managing and Distributing Genome Data: Molecular marks and their applications. Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organisms' Genomes and Databases.

UNIT III**(18 Periods)**

Introduction to Proteomics, Analysis of proteomes SDS-PAGE; Native PAGE, 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**2CR**

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.
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.
8. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.

9. Russell, P. J. (2009). *iGenetics- A Molecular Approach*. III Edition. Benjamin Cummings.
10. Glick, B.R., Pasternak, J.J. (2003). *Molecular Biotechnology- Principles and Applications of recombinant DNA*. ASM Press, Washington.
- Pevsner, J. (2009). *Bioinformatics and Functional Genomics*. II Edition. John Wiley & Sons.

DSE 3 MEDICAL MICROBIOLOGY

6CR

THEORY

4CR

UNIT I

(15 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.tetani*, *C.botulinum*, *C.diphtheriae* *M.tuberculosis*.

UNIT II

(15 Periods)

Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy caused by Gram negative bacteria: *N. gonorrhoea*, *N. meningitidis*, *P. aeruginosa*, *S. typhi*, *T. pallidum* *M. pneumoniae*,

UNIT III

(10 Periods)

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

UNIT IV

(10 Periods)

Fungal and Protozoan infections. Dermatophytoses (*Trichophyton*,) Subcutaneous infection (*Cryptococcus*), systemic infection (*Histoplasma*) and opportunistic fungal infections (*Candidiasis*,), Gastrointestinal infections (*Amoebiasis*), Blood-borne infections (Malaria)

PRACTICALS

2CR

1. To perform antibacterial testing by Kirby-Bauer method.
2. To prepare temporary mounts of *Aspergillus* and *Candida* by appropriate staining.
3. 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.

OR

DSE 3 ENVIRONMENTAL BIOTECHNOLOGY 6CR
THEORY 4CR

UNIT I (15 Periods)

Conventional fuels and their environmental impact – Firewood, plant, animal, water, Coal and gas. Modern fuels and their environmental impact – methanogenic bacteria, biogas, microbial hydrogen production, conversion of sugar to alcohol and gasohol

UNIT II (20 Periods)

Bioremediation of soil & water contaminated with oil spills, heavy metals and pesticides. Degradation of lignin and cellulose using microbes. Phyto-remediation. Degradation of pesticides and other toxic chemicals by micro-organisms- degradation aromatic and chlorinated hydrocarbons and petroleum products.

UNIT III (5 Periods)

Treatment of municipal waste and industrial effluents. Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. . Bio-fertilizers: Algal and fungal biofertilizers (VAM)

UNIT IV (10 Periods)

Bioleaching, enrichment of ores by microorganisms (gold, and uranium). Environmental significance of genetically modified microbes, plants and animals.

PRACTICALS 2CR

1. Estimation of Total Dissolved Solids (TDS) of water sample.
2. Estimation of BOD of water sample.
3. Estimation of soil organic carbon (Walkley and Black, 1934).
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 Josef 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

DSE 4 INTELLECTUAL PROPERTY RIGHTS THEORY

6 CR

4 CR

IPR: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights, International overview on intellectual property, international - trade mark law, copy right law, international patent law, international development in trade secret law , liability for misappropriations and litigation of trade secret, protection for submission
(18 Period)

Patent: Foundation of patent law, patent searching process, ownership rights and transfer, WTO-TRIPS, Indian Patents Act, 1970, different layers of the international patent system (national, regional and international options)
(10 Periods)

Trademarks: Historical development of the concept of trademark and trademark law-National and International -- Introduction to Trademarks, International Legal Instruments on Trademarks. 6 Periods
(10 Periods)

Copy rights: Fundamental of copy right law, Indian Copy right act, 1957 with its amendments, copy right ownership issues, Infringement of copyrights and remedies copy right registration, notice of copy right, international copy right law.
(10 Periods)

Outline idea about industrial design and geographical indications
(2 Periods)

Intellectual Property Rights (Practical)

2 CR

1. Proxy filing of Indian Product patent
2. Proxy filing of Indian Process patent
3. Planning of establishing a hypothetical biotechnology industry in India

Suggested Readings:

1. N.S. Gopalakrishnan & T.G. Agitha, Principles of Intellectual Property (2009), Eastern Book Company, Lucknow
2. T. M Murray and M.J. Mehlman, Encyclopedia of Ethical, Legal and Policy issues in Biotechnology, John Wiley & Sons 2000
3. Intellectual property right - Unleashing the knowledge economy, prabuddha ganguli, Tata Mc Graw Hill Publishing Company Ltd.

OR

DSE 4 EVOLUTIONARY BIOLOGY (THEORY)**6 CR****THEORY****4 CR****Historical Review of Evolutionary Concept**

Lamarckism – Merits and demerits. Darwinism – Merits and demerits, Post-Darwinian era – Modern synthetic theory. **(6 periods)**

Life's Beginnings

Chemogeny – An overview of pre-biotic conditions and events; experimental proofs to abiotic origin of micro- and macro-molecules. Current concept of chemogeny – RNA first hypothesis. Biogeny – Cellular evolution based on proto-cell models (coacervates and proteinoid microspheres). Origin of photosynthesis – Evolution of oxygen and ozone buildup. Stromatolites and its significance. Endosymbiotic theory – Evolution of Eukaryotes from Prokaryotes **(10 periods)**

Evidences of Evolution

Paleobiological – Concept of Stratigraphy and geological timescale; fossil study (types, formation and dating methods). Anatomical – Vestigial organs; Homologous and Analogous organs (concept of parallelism and convergence in evolution). Taxonomic – Transitional forms/evolutionary intermediates; living fossils. Phylogenetic – a) Fossil based – Phylogeny of horse as a model. b) Molecule based – Protein model (Cytochrome C); gene model (Globin gene family). **(10 periods)**

Forces of Evolution – Quantitative Studies Based on Biomathematics

Population genetics – Gene pool; gene/allele frequency; genotypic frequency; phenotypic frequency (simple problems for calculation). Fluctuation Population-The basic unit of evolution, Origin of species, Phylogeny and systematic, Biological Species concept, Subspecies, Polyploid species, Sibling species and Ring species. **(16 periods)**

Speciation

Concept of species as a real entity, Mechanisms of speciation – Allopatric; sympatric; peripatric, Patterns of speciation – Anagenesis and Cladogenesis. **(8 periods)**

EVOLUTIONARY BIOLOGY (PRACTICALS)**2 CR**

1. Study of fossil evidences from plaster cast models and pictures. (Trilobite, Archaeopteryx, Brontosaurus, Stegosaurus, Plesiosaurus and Woolly mammoth)
2. Study of homology and analogy from suitable specimens /pictures
3. Charts: a) Phylogeny of Horse with diagrams/cut out of limbs and teeth of Horse ancestors b) Darwin's finches with diagrams/cut out of beaks of different species
4. Submission of report on-Evolution of Horse, Evolution of Camel, Evolution of Elephant, Evolution of Man.

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