

M. Sc. Integrated Programme

Subject (Course Code)

V SEMESTER (2016-17)

Department: - Biotechnology, Biochemistry, Microbiology, Environmental Sciences

COURSE CODE	SUBJECT NAME	CREDITS
BI-301	Biochemistry	04
BI-302	Plant & Animal Physiology	04
BI-303	Cell Biology & Genetics	04
BI-305	Practical's	04
ICHT-502	Organic Chemistry-II	04

Semester V

BI 301: Biochemistry

Unit I (Kinetics and thermodynamics)

- Water, pH, buffer, Henderson–Hasselbalch equation, bioenergetics and thermodynamic principles, concept and calculation of free energy, coupled reaction, enzyme kinetics, Michaelis-Menten equation, transition state analogues, enzyme inhibitions and regulation.

Unit II (Conformation of Biomolecules)

- Conformation of protein, peptide bond, secondary structure, α helix, β pleated sheet & bends. Ramachandran plot, tertiary structure, forces stabilizing tertiary structure, domains and motifs, quaternary structure, conformation of DNA, RNA, folding motifs, conformational flexibility and super-coiling, structures of carbohydrates, epimerization, anomerization, structure of fatty acids.

Unit III (Metabolism)

- Concept of metabolic pathways, glycolysis, TCA, oxidative phosphorylation, gluconeogenesis, glycogenesis and glycogenolysis, oxidation and synthesis of fatty acids, lipoproteins, glycoproteins, biosynthesis of purines and pyrimidines, urea cycle, essential and nonessential amino acid, peptide neurotransmitter.

Recommended Reading

1. Nelson, D. C. and Cox, M.M., Lehninger Principles of Biochemistry, 5th Edition, W. H. Freeman, 2010.
2. Voet D., Voet J.G, Biochemistry 4th Edition. John Wiley and Sons, 2011.
3. Berg J.M., Tymoczko J.L. and Stryer L., Biochemistry. 7th edition, W.H. Freeman and Co. New York, 2011.
4. Grisham C. M. & Garrett R. H. Biochemistry. 8th Ed.

BI 302: Plant & Animal Physiology

Unit I (Plant Physiology)

- **Water relations and Plant Metabolism:** Concept of water potential, water uptake, ascent of sap, transpiration and guttation, anti-transpirants. Photosynthesis- chloroplast structure, Z-scheme, RUBISCO, CAM their regulation and significance. Respiration, photorespiration and their significance. Effect of environmental factors on transpiration, photosynthetic and respiration.

Unit II (Plant Physiology b)

- **Plant growth and flowering:** Plant growth hormones their mechanism of action and biosynthesis (auxins, gibberellins, cytokinins, ABA, ethylene etc.). Apical dominance, senescence, abscission. Synthetic growth regulators and retardant, Physiology of flowering- photomorphogenesis, photo-receptors., phytochrome with special reference to photoperiodism and vernalisation.

Unit III (Animal Physiology)

- **Functions of (i) Respiratory System:** Exchange of gases, transport of gases, control and regulation of respiration. Disorders of respiratory systems. **(ii) Tissues and Glands:** classification tissue types and glands. **(iii) Endocrine System:** Histology, nature and functions of endocrine glands, nature of hormones, regulation of hormone secretion, mode of action, effects of abnormal secretions of hormones and placental hormones. **(iv) Skeleton System:** Structure and types, ossification, bone growth, resorption and bone disorders; **(iv) Nervous System:** General characteristics and organization of nervous system. Types of synapses and synaptic transmission. **(v) Reproductive System:** Histology of male and female reproductive systems, puberty, physiology of male and female reproduction; Methods of contraception. Disorders of reproductive system.

Recommended Reading

1. Advances in Plant Physiology; P. C. Trivedi. I. K. International Pvt. Ltd.
2. Taiz L, Zeiger E. Plant Physiology, Sinauer Associates, Inc.; Fifth edition, 2010
3. Guyton and Hall Textbook of Medical Physiology.
4. Gerard J. Tortora. Principles of Anatomy and Physiology: Maintenance and Continuity of the Human Body. John Wiley & Sons, 02-May-2008

BI 303: Cell Biology and Genetics

Unit I (Cell Biology)

- Cell theory, Prokaryotic and Eukaryotic, cell wall, cytoskeleton, plasma membrane- their structure, composition and functions. Cell organelles; (nucleus, chromosomes, mitochondria, chloroplast, lysosomes, ER, golgi, ribosomes): morphology, ultra-structure, chemical composition, enzymes, Co-enzymes and functions. . Cell cycle: mitosis and meiosis. Cell signaling and signal transduction.

Unit II (Genetics)

- History, definition and scope of Genetics. Premendelian, Mendelian and Non-Mendelian inheritance. Probability & binomial methods, pedigree analysis, testing of goodness. Genetic linkage, recombination and crossing over. DNA as the genetic material. Chromosomal basis of inheritance, chromosomal abnormalities. Genetic basis of sex determination. Transposable genetic elements. Extra-nuclear inheritance. Exchange of genetic material. Gene Mutation. Population genetics. Hardy-Weinberg principle, Evolutionary agents: selection, differential selection, fitness, gametic selection, zygotic selection; Migration and Random drift.

Recommended Reading:

1. Gerald Karp: Cell and Molecular Biology. John Wiley Publication. 2007
2. Albert Bruce: Molecular Biology of Cell.
3. Snustad & Simmons: Principles of Genetics:
4. Anthony J.F. Griffiths, Susan R. Wessler, Sean B. Carroll and John Doebley. Introduction to Genetic Analysis: International Edition. 2011
5. T. A. Brown. Introduction to Genetics: A Molecular Approach 2011.

BI 305: Practical's

- Estimation of chlorophyll.
- Preparation of Acetic-Na Acetate Buffer and Phosphate buffer.
- Identification of carbohydrates: Aldose, Ketose and Pentose
- Identification of amino acids
- Separation of amino acid by Paper chromatography
- Estimation of protein concentration by Bradford methods
- Isolation of plasmid and genomic DNA, quantitation of DNA
- Separation of DNA on Agarose gel electrophoresis
- PCR amplification of genomic DNA
- Restriction Enzyme digestion of DNA

ICHT-502**ORGANIC CHEMISTRY – II****4 CREDITS (60 L)**

1. Chemistry of Cycloalkanes: Chemistry of Cyclohexane and its derivatives, 1, 3 diaxial interactions, locking effect, enantiomeric and geometrical isomerism in disubstituted cyclohexanes, reactivity in di-substituted cyclohexane, special nature of cyclopropane ring and reactivity. **10L**

2. Organic Synthesis via enolates: Acidity of α -hydrogens, alkylation of diethyl malonate and ethyl acetoacetate; synthesis of ethyl acetoacetate, elementary concept of regio selectivity, Hard and soft nature of nucleophile and electrophile, Claisen condensation & Knoevenagel reaction, overview of carbonyl α -substitution and carbonyl condensation reactions

12 L

3. Aromaticity & aromatic compounds: Different criteria of aromaticity – anisotropy, delocalization, Huckel's rule, pseudo-aromaticity, homo-aromaticity, anti-aromaticity, benzenoids and non-benzenoids, naphthalene, anthracene & polynuclear aromatic hydrocarbons, electrophilic aromatic substitution, directive influence of substituent groups, nucleophilic aromatic substitution, addition, elimination mechanism, substitution effect, elimination – addition, benzyne mechanism in aryl halides, phenols, reactions involving phenoxide ions as a nucleophile, aromatic ethers, aromatic-aldehydes, carboxylic acids and their derivatives, aromatic amines & nitro compounds and diazonium salts.

23 L

4. Chemistry of Heterocycles: Introduction to heterocyclic compounds and nomenclature; heterocycles containing one heteroatom (furan, thiophene, pyrrole, pyridine), aromatic character; Methods of synthesis with emphasis on mechanism of electrophilic substitution; comparison of basicity of pyridine, piperidine and pyrrole their derivatives – preparation, properties and reactions; Introduction to condensed five and six-membered heterocycles such as indole, quinoline and isoquinoline including Fisher indole synthesis, Skraup synthesis and Bischler-Napieraski synthesis; their preparation, properties and mechanisms.

15 L

Reference Books:

1. Organic Chemistry, Morrison and Boyd, Printice Hall, LPE, 2005.
2. Fundamentals of Organic Chemistry, T. W. G. Solomons and C. B. Fryhle, John Wiley and Sons, 2000.
3. Organic Chemistry, J. Clayden, N. Greeves & S. Warren, Oxford University Press
4. Heterocyclic Chemistry, John Joule and K. Mills, Blackwell Science, UK, 2000.
5. Heterocyclic Chemistry, T. L. Gilchrist, Pearson, LPE, 2010.
6. An introduction to the Heterocyclic compounds, R. M. Acheson, Wiley

M.Sc. Integrated Programme
Subject (Course Code)
VI SEMESTER (2016-17)

Department: - Biotechnology, Biochemistry, Microbiology, Environmental Sciences

COURSE CODE	SUBJECT NAME	CREDITS
BI-307	Microbiology & Immunology	04
BI-308	Molecular Biology & Biotechnology	04
BI-309	Global Environmental issues & Environmental Pollution	04
BI-310	Practical	04
BI-311	Project	04
ICHT-602	Chemistry of Biomolecules	04

BI 307: Microbiology and Immunology

Unit-I (Microbiology)

- Definition, history, scope and of Microbiology. Distinguishing features of major groups of microorganisms Microbial cultures: methods for isolation and characterization of pure cultures, environmental factors, microbial nutritional diversity, and measurement of microbial growth. Bacterial classification systems, international codes bacterial nomenclature and its role in taxonomy. Microbial interactions: animal-microbe, plant-microbe, microbe-microbe, symbiosis, microbial symbiosis with insects, cyanobacteria and invertebrates. Sewage (waste water) treatment procedures. General account of role of biofertilizers. Microorganisms in genetic engineering. Microbial flora of soil, water and air, normal microflora of animals and humans.

Unit-II (Immunology)

- Overview of immune response, history of development of immunological ideas. Types of immunity. Specific and non-specific defense mechanism & responses. Structure, properties and functions of the immune cells & organs. Antigens and its properties. Super antigens. Antibodies: Structure, function and properties of the antibodies. Different classes and biological activities of antibodies. Diversity of antibodies. Monoclonal antibodies and its function. Genetics of antibody. Antibody kinetics. MHC molecules, their structure and role in antigen presentation to T cells. Antigen processing and presentation. Complement system. Development and survival of B and T cells. T cell biology: T-cell receptors, Type of T- Cells activation. B-Cell biology: B-cell activation. Hypersensitivity: Types and mechanism of hypersensitive reactions. Autoimmunity, autoimmune diseases, transplantation (tissue) rejection. Immunodeficiency disorders. Antigen-antibody reaction: precipitation, immunodiffusion, immunoblotting, immunoelectrophoresis, agglutination (Direct, Indirect, hemagglutination, opsonisation, complement fixation), neutralization, radio-immuno assay (RIA), Enzyme-Linked Immuno-sorbent Assay (ELISA), flow cytometry.

Recommended Reading

1. Pelczar M.J., Chan E.C.S. and Krieg N.R., Microbiology – Application based approach, 5th edition, McGraw Hill, 2009.
2. Microbiology by Prescott, Harley and Klein's, Willey J, Sherwood and Woolwerton C. 8th Edition, McGraw Hill International, 2010.
3. A Textbook of Microbiology (Revised Edition) by R. C. Dubey and D. K. Maheshwari, S. Chand & Company Ltd., New Delhi 2012.
4. Practical Microbiology by R. C. Dubey and D. K. Maheshwari, S. Chand & Company Ltd, New Delhi, 2010.
5. Microbiology: A Laboratory Manual (7th Edition) by James Cappuccino, Natalie
6. Essential Immunology by Roit, I. Blackwell Science, Oxford
7. Immunology by Kuby, J. W.H. Freeman and Company, New York
8. Immunology by Tizard. Saunders College Publishing, Philadelphia
9. Cellular and Molecular Immunology by Abbas, Lichtman and Pober, W.B. Saunders Company, Philadelphia.

BI 308: Molecular Biology and Biotechnology

Unit I (Molecular Biology)

- Nucleic acid as a genetic material, basic structure of DNA and RNA, structure of chromatin-nucleosomes, structure and functional organization of centromeres and telomeres. Chromatin structure and remodeling. Prokaryotic DNA Polymerase I, II and III, Eukaryotic DNA Polymerases, okazaki fragments, Origin of replication, primosomes, concurrent replication mechanism involving leading and lagging strands of DNA, molecular basis of recombination, mutations and repair. Prokaryotic RNA polymerase and sigma factors, prokaryotic and eukaryotic promoters, eukaryotic RNA polymerases, Class I, II and III gene promoters, mechanism of transcription - prokaryotic and eukaryotic. Genetic code, ribosome structure, tRNAs, aminoacyl tRNA synthetase, initiation, elongation, termination. Translational control and regulation, Lac operon and Trp operon.

Unit II (Biotechnology)

- Introduction to the concept of Recombinant DNA Technology, genes: concept, expression and regulation, cloning vectors, restriction and modifying enzymes, transformation techniques (microbial, plants and animals). Molecular analysis of DNA, RNA and Proteins (i.e. Southern, Northern and Western blotting), polymerase chain reaction, DNA sequencing (Maxam-Gilbert and Sanger methods, NGS), Genomics and its types (structural, functional and comparative), Construction and screening of DNA libraries and DNA microarrays. Molecular markers of plant and animal genomes (RFLP, RAPD & AFLP). Molecular diagnosis of genetic diseases (Cystic fibrosis, Huntington's disease and Sickle cell anemia), Recombinant vaccines, Recombinant DNA in medicines (Recombinant insulin and Human growth hormone). Production and applications of transgenic plants (resistant to biotic, and abiotic stresses, and improvement in nutritional quality) and transgenic animals (generation of medicines and hormones), production and application of primary and secondary metabolites. Single Cell Protein (SCPs), Ethics and regulation of GM organisms. Intellectual property right (IPR) and patenting.

Recommended Reading

1. Principles of Gene Manipulation and Genomics (Seventh Edition); S. B. Primrose & R. M. Twyman. Blackwell Publishing. 2007
2. Genetics Analysis and Principles. Robert j. Brooker. fourth edition. McGraw-Hill publication.
3. Molecular Cell Biology, 4th edition Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell. New York: W. H. Freeman; 2000.

BI 309: Environmental Pollution and Global Issues

Unit I (Air pollution):

- Sources, classification – criteria and specific pollutants, effects of air pollution on plants, human health, material and ecosystem, sampling and analysis of air pollutants – SO_x, NO_x, ozone, suspended particulate matter (SPM) - coarse and fine, air quality and emission standards. General methods of control of air pollutants, Problems associated with automobile pollution and control methods.

Unit II (Water and Soil pollution)

- Sources, species and water quality, eutrophication, bioaccumulation, biomagnification, bioindicators, sampling and analysis, CPCB discharge standards, fluoride distribution in ground water, defluoridation technique, industrial effluents, Effluent Treatment Plants, sewage Treatment Plants, Restoration of water bodies, Sources of soil pollution – fertilizers, pesticides, detrimental effects of soil pollutants on flora, fauna, groundwater, Bioremediation.

Unit III (Global Environmental Issues and International Conventions):

- Acid rain and its effects on ecosystems; Chemistry of ozone and Ozone depletion- causes, consequences and remedies, Greenhouse effect, global warming & Climate change- causes and impact, International initiatives to control global warming, Kyoto Protocol, Montreal protocol, UNFCCC, Hazardous waste and trans-boundary movements, Ramsar convention, UN Summit, Millennium Development Goals, Stockholm Conference on Human Environment Earth Summit, Convention to Combat Desertification.

Recommended Reading

1. Baird, C., and Cann, M., Environmental Chemistry, W.H. Freeman and Company, 2008.
2. Botkin, Daniel B. and Keller, Edward A. *Environmental Science: Earth as a Living Planet*. 6th ed. John Wiley & Sons, USA. 2007.
3. Cunningham, W. P. and Cunningham, M. A. *Principles of Environment Science. Enquiry and Applications*. 2nd ed. Tata McGraw Hill, New Delhi. 2004.
4. De, A.K., Environmental Chemistry, New Age International (P) Ltd. Publishers, New Delhi. 2000.

*The course content for practical classes would be as per theory papers in different semesters.

BI 310: Practical's:

- Isolation and purification of bacteria and fungi from environmental samples.
- Sterilization, disinfection, safety in microbiological laboratory.
- Preparation of media for growth of various microorganisms.
- Identification and culturing of various microorganisms.
- Staining and enumeration of microorganisms.
- Growth curve, measure of bacterial population by turbidometry and studying the effect of temperature, pH and salt concentration.

