Teaching Plan of Molecular Biology General for B.Sc. Sem 1 (2020 – 2021) July to December

Learning Objective : The students should be able to understand

1) the various types of interaction governing physiological process
2) the properties of water and how they influence cellular events
3) the basic components of different types of cell and their organisation.
4) how microscopy is used to study cells

Paper	Unit no acc. to syllabus & Topic	Subtopic	No of Lectures	Teacher	Duration
CC-1—TH Cell biology – Principles and techniques	1. Cell Biology	CC1.1.1. Cells as basic functional unit and 3 domain classification	2	JGR	9^{th} – 11^{th} week
		CC1.1.2. Prok. Cell Organization	2		
		CC1.1.3. Euk. Cell Organization	6		
		CC1.1.4. Cell Cycle	2		12^{th} week
	2. Molecules of Life 1	CC1.2.1. Importance of Carbon	2	JGR	1^{st} – 3^{rd} week
		CC1.2.2. Diff. types of interaction	3		
		CC1.2.3. Water, pH, buffer	5		
		CC1.2.4. Carbohydrates	8	RC	4^{th} – 10^{th} Week
		CC1.2.5. Lipids	4		
		CC1.2.5. Roles of lipids in membrane structure and transport of small molecules	6	JGR	11^{th} week
	3. Microscopy techniques	CC1.3.1. Optical Microscopy	12	JGR	4^{th} – 6^{th} week
		CC1.3.2. Electron Microscopy	8		7^{th} – 8^{th} week

Learning Outcome :

Studying Cell Biology as a part of B.Sc. general course can lead to several outcomes :

1. Students can gain a solid understanding of the basic principles of cell biology, including cell structure, function, and processes
2. A strong foundation in cell biology is essential for pursuing further studies in biology-related fields, such as molecular biology, biochemistry, genetics, or biotechnology.
3. It can also prepare you for careers in research, healthcare, pharmaceuticals, biotechnology, education or science communication

Teaching Plan of Molecular Biology General for B,Sc. Sem 3 (2020 – 2021)

Learning Objective : The students should be able to

1. understand the key events of molecular biology comprising of mechanism of DNA Replication, Transcription and Translation in Prokaryotes and Eukaryotes.
2. have adequate knowledge about Post Transcriptional Modifications and Processing of Eukaryotic RNA
3. give detailed explanation of Transcriptional Regulation with examples of lac operon in prokaryotic.
4. develop comprehensive understanding regarding DNA Repair Mechanisms in the course learners.

Paper	Topic	Subtopic	No of Lectures	Teacher	Duration
CC-3-1-TH Concepts of Molecular Biology	CC3.1. Basic concepts of genome and its organisation	CC3.1.1. Griffith's expt, Avery, McLeod and McCarty's Expt. Hershey-Chase Expt, Importance of Molecular Biology, Central Dogma, Model organisms for studying Mol. Biol.	5	JGR	1st week
		CC3.1.2. Structure and function of Nucleic acid, Biologically imp nucleoside	5		2nd week
		CC3.1.3. Watson Crick model of DNA structure, A, B, & Z forms of DNA, Supercoiled & relaxed DNA, Denaturation, renaturation, melting temoerature, hypochromic effect	5		3rd week
		CC3.1.4. Genome & its organisation Chloroplast DNA & Mitochondrial DNAon : idea about gene, coding sequence, regulatory sequence, intron, exon, Nucleosome structure, and packageing of DNAinto higher order structure, Brief idea of	5		4 th week
	CC3.2. Replication of DNA in prokaryotes	CC3.2.1. Features of DNA replication, Proof of semiconservativenature of DNA replication, Features of biderectional DNA replication	5		5th week
		CC3.2.1 Mechanisim of bidirectional DNA replication	5		6th week
	CC3.3. Gene expression	CC3.3.1. RNA structure, different types of RNA structure, Transcription in Prokaryotes with *E. coli* as model, Prok RNA polymerase, role of sigma factor, promoter	5		7 th week
		CC3.3.2. Genetic code, its properties, Wobble hypothesis	3		8th week 9th week
		CC3.3.3. Components of protein synthesis machinery, Mechanism of protein synthesis	7		8th . - 9th week
		CC3.3.4. Principles of Gene regulation, negative, positive regulation, concept of operons, lac operon concept	5		10thweek
	CC3.4. Damage, repair, mutation	CC3.3.5. Causes and types of DNA damage	2		11th. week
		CC3.3.6. Mechanism of DNA repair, different types of repair	3		12th. week
		CC3.3.7. Molecular basis of mutation, different types of mutation	5		13th. week

Learning Outcome :

Studying molecular biology as a part of a B.Sc. general course can lead to several outcomes :

1. Students will gain insight into the molecular mechanisms that govern biological processes such as DNA replication, transcription, translation, and gene regulation.
2. Understanding molecular biology provides insights into the molecular basis of genetic disorders and diseases, enabling you to comprehend the underlying mechanisms and potential therapeutic interventions.
3. A solid foundation in molecular biology is essential for further study or careers in fields such as biotechnology, medicine, genetics, pharmaceuticals, agriculture, and environmental science.

Teaching Plan of Molecular Biology General for B,Sc. Sem 5 (2020 – 2021)

Learning Objective : The students should be able to

1. Understand the importance of recombinant DNA technology.
2. Learn isolation of DNA and its separation on an agarose gel.
3. Understand restriction and ligase enzymes and their application in gene cloning.
4. Understand vectors and their application in gene cloning and expression.

Paper	Topic	Subtopic	No of Lectures	Teacher	Duration
DSE-A-5-1-TH	Recombinant DNA technology	DSE-A-5-1.1a. Cloning vectors (pBR322, pUC18/19, YACs), Bacteriophage lambda	20	JGR 8	6 th – 7 th week
		DSE-A-5-1.1b. M13, cosmids, Ti plasmids transformation vector, use of linkers and adaptors, Homopolymeric tailing, c-DNA synthesis and cloning, Genomic DNA and cDNA libraries		MM 12	6 th – 8 th week
		DSE-A-5-1.2a. Restriction and modification systems in bacteria : types, mode of action, nomenclature, application in genetic engineering,	10	JGR 5	1st – 2nd week
		DSE-A-5-1.2b. Mapping, Restriction fragment length polymorphism		MM 5	9th. – 10th. week
		DSE-A-5-1.3. Enzymes used in combinant DNA techniques : DNA ligase, polynucleotide kinase, DNA polymerase, reverse transcriptase, terminal deoxynucleotidyl transferase, phosphatases	10	JGR	3rd – 5th week
		DSE-A-5-1.4. Polymerase chain reaction, qPCR, electrophoresis, blotting techniqes, site-directed mutagenesis, DNA sequencing, reporter gene assays, DNA-proteininteraction assays, protein-protein interactionassays, DNA fingerprinting	20	MM	10th – 14th week

Learning Outcome :

Studying recombinant DNA technology as a part of a B.Sc. general course can lead to several outcomes :

1. Students will learn about the diverse applications of biotechnology in fields such as medicine (e.g., pharmaceuticals, gene therapy), agriculture (e.g., genetically modified crops, livestock breeding), environmental science (e.g., bioremediation, waste treatment), and industry (e.g., biofuels, biomaterials.
2. Biotechnology courses often include hands-on laboratory experiences where students will learn techniques such as DNA manipulation, gene cloning, PCR (polymerase chain reaction), protein purification, and cell culture.
3. Students can explore explore the ethical, legal, and societal implications of biotechnology, including issues related to genetic modification, intellectual property rights, biosecurity, and biopolicy.
4. A background in biotechnology prepares the students for further study or careers in biotechnology companies, pharmaceutical firms, research institutions, government agencies, healthcare organizations, and academia. You may pursue roles such as biotechnologist, research scientist, laboratory technician, bioinformatician, or regulatory affairs specialist.

Teaching Plan of SEC paper for Molecular Biology General for B.Sc. Sem 3 / Sem 5 (2020 – 2021) July to December

Learning Objective : The students should be able to

1. Know the types of particles emitted during radioactive decay .
2. Understand the different forms of electromagnetic energy.
3. Know the terms and units associated with dose and exposure (absorbed dose, equivalent dose, and effective dose).
4. Know deterministic dose-dependent syndromes that occur with ionizing radiation exposure.
5. Understand the ways in which electromagnetic causes cell damage.
6. Know the possible stochastic effects that occur with ionizing radiation exposure and the relationship to severity and dose.
7. Understand the risks associated with in utero ionizing radiation exposure and the possible effects.

Paper	Subtopic	No of Lectures	Teacher	Duration
SEC-A-1-TH Radiation Biology	SEC-A.1.1. Radiation quantites: Exposure, absorbed dose, equivalent dose, effective dose, activity, linear energy transfer.	10	JGR	1st – 3rd week
	SEC-A.1.2. Cellular response to radiation: radiolysis of water, radical formation, indirect & direct action, time scale of radiation effect, cell kinetics, mitotic death & apoptosis, DNA damage & chromosomal aberrations, radiation sensitivity, sublethal damage & cell survival curves, dose rate effect, oxygen effect, relative biological effectiveness, radioprotectors & radiosensitizers	10		4th – 10th Week
	SEC-A.1.3. Sources of radiation to the human population, radiation carcinogenesis, wholebody radiation effects, doses & risks associatedwith medical radiology, radiation protection	10		11th -14th week

Learning Outcome :

Studying Radiation Biology as a part of B.Sc. general course can lead to several outcomes :

1. Students will gain a comprehensive understanding of how various types of radiation (such as ionizing and non-ionizing radiation) interact with biological systems, including cells, tissues, and organisms.
2. Students will learn about radiation protection principles and safety measures to minimize radiation exposure risks in occupational and environmental settings. This includes understanding radiation shielding, dose limits, and radiation monitoring techniques
3. Students will also gain insights into the principles of radiation oncology, including the mechanisms of tumor cell killing, fractionation schedules, and strategies to enhance therapeutic efficacy while minimizing damage to normal tissues.
4. Radiation biology coursework may cover the environmental and occupational health implications of radiation exposure, including radiation hazards in nuclear power plants, medical facilities, industrial settings, and space exploration.
5. A background in radiation biology prepares the students for further study or careers in radiation oncology, medical physics, radiological sciences, nuclear medicine, environmental health, radiation protection, and related fields. Students may pursue roles such as radiation biologist, radiation therapist, medical physicist, health physicist, or environmental health specialist.

Teaching Plan of Molecular Biology General for B,Sc. Sem 2 (2020 – 2021)

Learning Objective : The students should be able to understand

2) the importance of polymers and macromolecules in cell structure and function.
3) the basic organizing principles of metabolism, including the critical position of glycolysis.

Paper	Topic	Subtopic	No of Lectures	Teacher	Duration
CC-2-1-TH Basics of Biomolecules	CC2.1. Molecules of Life 1	CC2.1.1. Amino acids	8	JGR	1st – 2nd week
		CC2.1.2. Proteins	10		3rd – 5th week
		CC2.1.3. Enzymes	12		6 th – 8 th week
	CC2.2.Bioenergetics and Metabolism	CC2.2.1. Carbohydrate metabolism	20	RC	4th – 12th week
		CC2.2.2. Beta-oxidation of saturated fatty acids	4	JGR	9 th week
		CC2.2.3. Transamination, oxidative deamination & urea cycle	6		10th – 11th week

Learning Outcome :

Studying different macromolecules as part of a B.Sc. general course can lead to several outcomes :

1. Knowledge of Biomolecular Structure and Function can lead understand how biological systems operate at the molecular level.
2. A strong foundation in the study of macromolecules prepares the students for further study in specialized fields such as biochemistry, molecular biology, genetics, biotechnology, or pharmacology.
3. Overall, studying different macromolecules in a BSc general course provides a comprehensive understanding of the molecular basis of life and prepares the students for further study or careers in various scientific discipline.

Teaching Plan of Molecular Biology General for B,Sc. Sem 4 (2020 – 2021)

Learning Objective : The students should be able to understand the different techniques useful for purification, isolation and identification different macromolecules

Paper	Topic	Subtopic	No of Lect.	Teacher	Duration
CC-4-1-TH Biophysical techniques	CC4-1. Diffusion	CC4-1.1. Boyle's law, Charles' law, Gas laws (Ideal gas and real gas equation), Dalton's law of partial pressure. Diffusion in fluids ,Fick's laws(St atement and explanation), Facilitated diffusion e.g. gas exchanges in lungs.	6	JGR	1st – 2nd week
	CC4-2. Osmosis	CC4-2.1. Definition,contrast with diffusion,Tonicity and isotonic solutions.Effect of tonicity on R.B.C. Cell nutrition.	4		3rd – 5th week
	CC4-3. Viscosity	CC4-3.1. Definition, Laminar and turbulent flow, Concept of Reynolds number, Newton's law of viscosity, Newtonian and non- Newtonian fluids, Coefficient of viscosity, Relative viscosity and fluidity. Measurement by Ostwald's viscometer. Dependence of viscosity on temperature and other factors e.g. size and shape of solutes (general idea)Viscosity of human blood (general idea)	10		6 th – 8 th week
	CC4-4. Centrifugation	CC4-4.1. Theory of ultracentrifugation, Relative centrifugal force (RCF), Sedimentation rate sedimentn. coefficient, Isopycnic (equilibrium) sedimentation, (discussion with example e.g. Meselson and Stahl Experiment)	8		9 th – 10 th week
	CC4-5. Spectrophotometry and other methods	CC4-5.1. Absorption of light, Transmittance, Absorbance (Optical density), Lambert-beer law, Method of determining Absorption spectrum of chlorophyll by spectrophotometer. CC4-5.2. A brief idea on Dialysis, Chromatography (Gel filtration, Ion exchange), CC4-5.3. Electrophoresis.	12		11th - 13th week
	CC4-6. Immunology	CC4-6.1. Immune Response - An overview, Primary and secondary immune response, components of mammalian immune system. Basic concept on Molecular structure of Immunoglobulin or Antibodies, Humoral & Cellular immune responses, T-lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells. Basic concept in Autoimmune diseases, Immunodeficiency-AIDS and vaccination. Introduction to immunodiagnostics – RIA, ELISA.	20	TG	2nd – 11th week

Learning Outcome :

1. Biophysical techniques bridge the gap between biology and physics, chemistry.. Students will gain interdisciplinary knowledge, understanding how principles from these fields are applied to study biological systems. This broad perspective can lead to innovative approaches to research problems.
2. Through laboratory sessions, students gain hands-on experience in using biophysical techniques. This includes sample preparation, data collection, analysis, and interpretation. These practical skills are essential for a career in biological research or related fields.

Teaching Plan of Molecular Biology General for B,Sc. Sem 6 (2020 – 2021)

Learning Objective : The students should be able to

1. learn the diagnosis of the disease according to the levels of various enzymes.
2. understand the pathophysiology and molecular basis of the most prevalent diseases
3. learn the importance of tumor markers in clinical diagnosis.
4. understand the biological properties that contribute to the prevention, diagnosis, prognosis, and monitoring of diseases

Paper	Unit no acc to the syllabus	Subtopic	No of Lectures	Teacher	Duration
DSE-B-6-2-TH Clinical Biochemistry	1.	DSE-B-6-2.1.1. Features of pathogenic and non-pathogenic microorganisms, Properties of synthetic and naturally occurring antimicrobial drugs, selective toxicity,	20	RC 10	1st – 5 th week
		DSE-B-6-2.1.2 Modes of action of Penicillin, Chloramphenicol, Streptomycin,			1st – 3rd week
		DSE-B-6-2.1.3. Antibiotic resistance : mechanism, origin and transmission of drug resistance in microbes		JGR 10 (6+4)	4 th – 5 th week
	2.	DSE-B-6-2.2.1. Mechanism of bacterial pathogenicity: entry, colonization, pathogenicity, course of infectious disease, duration of symptoms	20	RC 14 (10+4)	6 th – 9 th week
		DSE-B-6-2.2.2. Mechanism of Exo and endotoxin, definition, general properties.			10 th week
		DSE-B-6-2.2.3. General properties and importance of clinically important enzymes like SGOT, SGPT, Alkaline phosphatase and lactate dehydrogenase		JGR 6	6 th – 7 th week
	3.	DSE-B-6-2.3.1. Disorders of thyroid, pituitary, adrenal, hypothalamic, ovarian, testicular and renal hormones	20	JGR (10+4+6)	8th – 10th week
		DSE-B-6-2.3.2. use of tumor markers in oncology			11th – 12th week
		DSE-B-6-2.3.3. iron status, protein abnormalities, therapeutic drug monitoringand drugs of abuse testing and the genetic basis of disease			12th – 14th week

Learning Outcome :

Studying clinical biochemistry in a BSc general biology course can lead to several outcomes :

1. The students will gain a deep understanding of the biochemical processes underlying health and disease.
2. The students will learn how to interpret laboratory test results and understand their clinical significance in the diagnosis, prognosis, and treatment of various medical conditions.
3. Clinical biochemistry courses often address ethical issues related to patient confidentiality, informed consent, and professional conduct in healthcare settings.
4. This prepares the students for careers in clinical laboratory science, medical research, healthcare administration, and related fields. You may pursue roles such as clinical biochemist, medical laboratory technologist, research scientist, or healthcare consultant.

Teaching Plan of SEC paper for Molecular Biology General for B.Sc. Sem 4 / Sem 6 (2020 – 2021) July to December

Learning Objective : The students should be able to

8. Know the types of particles emitted during radioactive decay .
9. Understand the different forms of electromagnetic energy.
10. Know the terms and units associated with dose and exposure (absorbed dose, equivalent dose, and effective dose).
11. Know deterministic dose-dependent syndromes that occur with ionizing radiation exposure.
12. Understand the ways in which electromagnetic causes cell damage.
13. Know the possible stochastic effects that occur with ionizing radiation exposure and the relationship to severity and dose.
14. Understand the risks associated with in utero ionizing radiation exposure and the possible effects.

Paper	Topics	No of Lectures	Teacher	Duration
SEC-B-2-TH Bioinformatics	SEC-B.2.1. Nucleic acid and protein sequences, sequence databases and information retrieval. Pairwise sequence comparisons, PAM and BLlOSUM scoring matrices, global and local alignment, statistical significance of pairwise alignments, BLAST and FASTA	7	JGR	1st – 3rd week
	SEC-B.2..2. Multiple sequence alignments (MSA) hierarchical & non-hierarchical methods, tools for MSA	3		4th Week
	SEC-B.2.3. Molecular phylogenic analysis: Introduction to molecular evolution, molecular clock hypothesis, neutral evolution, tree nomenclature & structure, tree building methods, neighbour joining, MP. ML, tree-evaluation methods , bootstrapping	12		5th. – 10th. week
	SEC-B.2.4. Protein and nucleic acid structure database, PDB, structure comparison. SCOP, and CATH	8		11th -14th week

Learning Outcome :

Studying Bioinformatics as a part of B.Sc. general course can lead to several outcomes :

1. Students will develop quantitative skills through the study of statistical methods and computational techniques used in analysing biological data.
2. Students will be introduced to databases, algorithms, and software tools used for sequence analysis, sequence alignment, phylogenetics, structural biology, and functional genomics.
3. Students can understand how this how these disciplines contribute to personalized medicine, drug discovery, disease diagnosis, and biomarker identification.
4. This course prepares the students for further study or careers in fields such as bioinformatics, computational biology, biostatistics, data science, genetics, molecular biology, and biotechnology.