VIDYASAGAR UNIVERSITY

Midnapore, West Bengal

PROPOSED CURRICULUM & SYLLABUS (DRAFT) OF

BACHELOR OF SCIENCE WITH BIOCHEMISTRY (MULTIDISCIPLINARY STUDIES)

3-YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2023-2024)

Based on

Curriculum & Credit Framework for Undergraduate Programmes (CCFUP), 2023 & NEP, 2020

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VIDYASAGAR UNIVERSITY
BACHELOR OF SCIENCE IN LIFE SCIENCES with BIOCHEMISTRY
(*Under CCFUP, 2023*)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. in Life Sciences with Bio-chemistry	3rd	V	**SEMESTER-V**							
			Major-A4	BCMPMJ04	T Gene Organization, Expression and Regulation *(To be studied by students taken Biochemistry as Discipline- A)*	4	3-0-1	15	60	75
			Major-A5	BCMPMJ05	T: Nutritional Biochemistry *(To be studied by students taken Biochemistry as Discipline- A)*	4	3-0-1	15	60	75
			Major-A6	BCMPMJ06	T: Molecular Diagnostics *(To be studied by students taken Biochemistry as Discipline- A)*	4	3-0-1	15	60	75
			Major (Elective) -2	BCMMJE02	Molecular Basis of Infectious Diseases OR Basic Microbiology *(To be studied by students taken Biochemistry as Discipline- A)*	4	3-0-1	15	60	75
			Minor-5 (Disc.-C5)	BCMMIN05	T: Gene Organization, Expression and Regulation *(To be studied by students taken Biochemistry as Discipline- C)*	4	3-0-1	15	60	75
					Semester-V Total	20				375
		VI	**SEMESTER-VI**							
			Major-B4		*To be decided (Same as Major–A4 for Biochemistry taken as Discipline-B)*	4	3-0-1	15	60	75
			Major-B5		*To be decided (Same as Major–A5 for Biochemistry taken as Discipline-B)*	4	3-0-1	15	60	75
			Major-B6		*To be decided (Same as Major–A6 for Biochemistry taken as Discipline-B)*	4	3-0-1	15	60	75
			Major (Elective) -3	BCMMJE03	Molecular Basis of Non-Infectious Human Diseases OR Advanced Cell Biology *(To be studied by students taken Biochemistry as Discipline- A)*	4	3-0-1	15	60	75
			Minor -6 (Disc.-C6)	BCMMIN06	T: Molecular Diagnostics *(To be studied by students taken Biochemistry as Discipline- C)*	4	3-0-1	15	60	75
					Semester-VI Total	20				375
					TOTAL of YEAR-3	40	-	-	-	700
			Eligible to be awarded Bachelor of Science in Multidisciplinary Studies with Biochemistry *on Exit*			126	**Marks (Year: I+II+III)**			2325

MJP = Major Programme (Multidisciplinary), MI = Minor, A/B = Choice of Major Discipline; C= Choice of Minor Discipline; CA= Continuous Assessment, ESE= End Semester Examination, T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical

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MAJOR (MJ)

Major A4/B4: Gene Organization, Expression and Regulation **Credits 04 (Full Marks: 75)**

Major A4/B4T: Gene Organization, Expression and Regulation **Credits 03 (Lectures: 45)**

Course contents:

Unit 1: Structure of genes and chromosomes
Definition of a gene, chromosomal organization of genes in viruses, bacteria and eukaryotes. Supercoiling of DNA.

Unit 2: Replication of genomes
General features of DNA replication, properties of prokaryotic and eukaryotic DNA polymerases. Replication of DNA and teleomeres in linear chromosomes. Replication of RNA genomes.

Unit 3: Recombination of DNA
Homologous genetic recombination, Holliday model, proteins and enzymes mediating recombination.

Unit 4: Gene mutations and repair
Molecular basis of mutations, multiple repair systems, mismatch repair, base excision repair, nucleotide excision repair, direct repair and translesion DNA synthesis.

Unit 5: Transcription of genes
General features of gene transcription, procaryotic and eukaryotic RNA polymerases, and stages of transcription, initiation, elongation and termination. Inhibitors of transcription.

Unit 6: RNA processing
Processing of eukaryotic mRNA, splicing of introns, alternate splicing and editing, ribosomal and tRNA processing.

Unit 7: Protein synthesis
Features of the genetic code, amino acylation of tRNAs, structure and assembly of ribosomes; three stages of protein synthesis - initiation, elongation and termination. Inhibitors of protein synthesis.

Unit 8: Regulation of gene expression
Regulation of transcription in prokaryotes, concept of operons. Lac operon - control by negative and positive regulatory proteins, Trp operon - control by attenuation. Regulation of transcription in eukaryotes, regulatory sequences - enhancers, silencers response elements, nucleosome alterations, DNA-protein interactions and RNA interference.

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Major A4/B4P: Gene Organization, Expression and Regulation (Practical) Credits 01 (30 hrs.)

Practical:

1. Quantitative determination of DNA and RNA by absorbance at 260 nm and using A260/A280 ratio to distinguish between them.
2. To study the viscosity of DNA solutions.
3. Isolation of chromosomal DNA from *E. coli.*
4. Isolation of total RNA from yeast cells.

Suggested Readings:

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York),

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Major A5/B5: Nutritional Biochemistry **Credits 04 (FM: 75)**

Major A5/B5T: Nutritional Biochemistry **Credits 03 (45Hrs.)**

Course Contents:

Unit 1: Introduction to Nutrition and Energy Metabolism

Defining Nutrition, role of nutrients. Unit of energy, Biological oxidation of foodstuff, Measurement of energy content of food, Physiological energy value of foods, SDA, Measurement of energy expenditure. Direct and Indirect Calorimetry, factors affecting thermogenesis, energy utilization by cells, energy output – Basal and Resting metabolism, physical activity, factors affecting energy input - hunger, appetite, energy balance Energy expenditure in man. Estimating energy requirements, BMR factors, Recommended Nutrient Intakes (RNI) and Recommended Dietary Allowances for different age groups.

Unit 2: Dietary carbohydrates and health

Review functions of carbohydrates. Digestion, absorption, utilization and storage, hormonal regulation of blood glucose. Dietary requirements and source of carbohydrates, Dietary fiber, role of fibre in lipid metabolism, colon function, blood glucose level and GI tract functions.

Unit 3: Dietary lipid and health

Review of classification, sources, functions, digestion, absorption, utilization and storage.
Essential Fatty Acids; Functions of EFA, RDA, – excess and deficiency of EFA. Lipotropic factors, role of saturated fat, cholesterol, lipoprotein and triglycerides. Importance of the following: a) Omega – fatty acids. Omega 3/ omega 6 ratio b) Phospholipids c) Cholesterol in the body d) Mono, Polyunsaturated and Saturated Fatty Acids. Dietary implications of fats and oils, Combination ratios of n6 and n3, MUFA, PUFA and SFA.

Unit 4: Dietary Proteins and Health

Review of functions of proteins in the body, Digestion and absorption. Essential and Nonessential amino acids. Amino Acid Availability Antagonism, Toxicity and Imbalance, Amino acid Supplementation. Effects of deficiency. Food source and Recommended Dietary Allowances for different age group. Amino acid pool. NPU, Biological Value, Nitrogen balance. PEM and Kwashiorkor.

Unit 5: Fat and water soluble Vitamins

Vitamin A, C, E, K and D Dietary sources, RDA, Adsorption, Distribution, Metabolism and excretion(ADME), Deficiency. Role of Vitamin A as an antioxidant, in Visual cycle, dermatology and immunity. Role of Vitamin K in Gamma carboxylation. Role of Vitamin E as an antioxidant. Extra-skeletal role of Vitamin D and its effect on bone physiology. Hypervitaminosis. Vitamin C role as cofactor in amino acid modifications. Niacin- Metabolic interrelation between tryptophan, Niacin and NAD/ NADP. Vitamin B6-Dietary source, RDA, conversion to Pyridoxal Phosphate. Role in metabolism, Biochemical basis for deficiency symptoms. Vitamin B12 and folate; Dietary source, RDA, absorption, metabolic role Biochemical basis for deficiency symptoms.

Unit 6: Minerals

Calcium, Phosphorus and Iron - Distribution in the body digestion, Absorption, Utilization, Transport, Excretion, Balance, Deficiency, Toxicity, Sources, RDA. Calcium: Phosphorus ratio, Role of iron in

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prevention of anemia. Iodine and iodine cycle. Iodine, Fluoride, Mg, Cu, Zn, Se, Manganese, Chromium, Molybdenum Distribution in the human body, Physiology, Function, deficiency, Toxicity and Sources

Unit 7: Assessment of Nutritional status

Anthropometric measurements; Z scores, BMI, skinfold, circumference ratios. Biochemical assessment; Basal metabolic panel, Comprehensive metabolic panel, CBC, Urine Analysis, Assessment of Anemia, ROS assessment, GTT and glycosylated Hb, Differential diagnosis of B12 and folate.

Unit 8: Food and drug interactions and Nutriceuticals

Nutrient interactions affecting ADME of drugs, Alcohol and nutrient deficiency, Antidepressants, psychoactive drugs and nutrient interactions, Appetite changes with drug intakes and malnutrition. Food as medicine.

Major A5/B5P: Nutritional Biochemistry (Practical) Credits 01 (30Hrs.)

Practical:

1. Bioassay for vitamin B12/B1.
2. Homocystiene estimation.
3. Serum/ urine MMA estimation.
4. Anthropometric identifications for Kwashiorkor, Marasmus and Obesity.
5. Determination of oxidative stress: TBARS, antioxidant enzymes in hemolysate.
6. Vitamin A/E estimation in serum.
7. Bone densitometry /bone ultrasound test demonstration (visit to a nearby clinic)

Suggested Readings:

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York),
2. Nutrition for health, fitness and sport (2013); Williams.M.H,Anderson,D.E, Rawson,E.S. McGraw Hill international edition
3. Krause's Food and Nutrition Care process.(2012); Mahan, L.K Strings,S.E, Raymond,J. Elsevier's Publications.
4. The vitamins, Fundamental aspects in Nutrition and Health (2008); G.F. Coombs Jr. Elsevier's Publications.
5. Principles of Nutritional Assessment (2005) Rosalind Gibson. Oxford University Press.

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Major A6/B6: Molecular Diagnostics **Credits 04 (Full Marks: 75)**

Major A6/B6T: Molecular Diagnostics **Credits 03 (Lectures: 45)**

Course contents:

Unit-1: Introduction to Biochemical Diagnostics

Evaluation of biochemical changes in diseases, basic hepatic, renal and cardiovascular physiology; Biochemical symptoms associated with disease and their evaluation; Diagnostic biochemical profile. Inborn errors of metabolism.

Unit-2: Diagnostic Enzymes

Principles of diagnostic enzymology; Clinical significance of aspartate aminotransferase, alanine aminotransferase, creatine kinase, aldolase, lactate dehydrogenase, enzyme tests in determination of myocardial infarction, enzymes of pancreatic origin and billiary tract.

Unit-3: Immunodiagnostics

Introduction, antigen-antibody binding and assays; Immunoassays–types [RIA, ELISA, Chemiluminescent IA, FIA] and specific applications; Immunohistochemistry-principle and techniques. Immunodiagnostics for detection of infectious agents, cancer, and autoimmune diseases; Immunosensors.

Unit-4: Molecular Diagnostics

Introduction to DNA based diagnostic techniques; Polymerase chain reaction in diagnostics and analysis; Analysis of DNA in forensic science and archaeology. Applications of DNA finger printing, Techniques of chromosome analysis.

Chromosome preparation from cultured lymphocytes, cell lines and solid tumors. Karyotyping, chromosome banding and fluorescence In-situ hybridization techniques Disease identification and Genetic tests for following disorders: Thalassemia, Fanconi anemia, Sickle Cell anemia, Fragile-X syndrome, Down Syndrome, Duchenne Muscular Dystrophy/Becker's Muscular Dystrophy, Sex-linked inherited disorders, Allelic susceptibility test for multifactorial disorders (Neural Tube Defect, Cleft Lip and Palate, Cardio Vascular Disorder, Male infertility)

Major A6/B6 P: Molecular Diagnostics (Practical) **Credits 01**

List of Practical

1. Gram staining and acid fast staining
2. Dot Blot ELISA for insulin
3. Lipid profile: triglycerides and total cholesterol.
4. Permanent slides (histology/cytology) for different types of cancer and comparison with slides from normal tissues

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Suggested Readings:

1. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol. I (2010), Mukherjee, K.L., Tata Mc Graw–Hill Publishing Company Limited (New Delhi).
2. Medical Biochemistry (2005) 2nd ed., Baynes, J.W. and Dominiczak, M.H., Elsevier Mosby Ltd. (Philadelphia),
3. Recombinant DNA by Watson
4. Harper's Biochemistry

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MAJOR ELECTIVE

(To be studied by students taken Biochemistry as Discipline- A)

Major Elective (MJE)-02:

(Molecular Basis of Infectious Diseases OR Basic Microbiology)

MJE-02: Molecular Basis of Infectious Diseases **Credits 04 (Full Marks: 75)**

MJE-02T: Molecular Basis of Infectious Diseases **Credits 03 (Lecture: 60 Hrs.)**

Course contents:

Unit 1: Classification of infectious agents

Bacteria, Viruses, protozoa and fungi. Past and present emerging and re-emerging infectious diseases and pathogens. Source, reservoir and transmission of pathogens, Antigenic shift and antigenic drift. Host parasite relationship, types of infections associated with parasitic organisms. Overview of viral and bacterial pathogenesis. Infection and evasion.

Unit 2: Overview of diseases caused by bacteria

Detailed study of tuberculosis: History, causative agent, molecular basis of host specificity, infection and pathogenicity, Diagnostics, Therapeutics, inhibitors and vaccines. Drug resistance and implications on public health. Other bacterial diseases including Typhoid, Diphtheria, Pertussis, Tetanus, Typhoid and Pneumonia.

Unit 3: Overview of diseases caused by Viruses

Detailed study of AIDS, history, causative agent, pathogenesis, Diagnostics, Drugs and inhibitors. Other viral diseases including hepatitis, influenza, rabies, chikungunya and polio.

Unit 4: Overview of diseases caused by Parasites

Detailed study of Malaria, history, causative agents, Vectors, life cycle, Host parasite interactions, Diagnostics, Drugs and Inhibitors, Resistance, Vaccine development. Other diseases including leishmaniasis, amoebiasis.

Unit 5: Overview of diseases caused by other organisms

Fungal diseases, General characteristics. Medical importance of major groups, pathogenesis, treatment.

MJE-02P: Molecular Basis of Infectious Diseases **Credits 01 (30 Hrs.)**

Practical:

1. Permanent slides of pathogens. Mycobacterium tuberculosis, Leishmania, Plasmodium falciparum
2. WIDAL test
3. Gram staining
4. Acid fast staining
5. PCR based diagnosis
6. Dot Blot ELISA

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Suggested Readings:

1. Prescott, Harley, Klein's Microbiology (2008) 7th Ed., Willey, J.M., Sherwood, L.M., Woolverton, C.J. Mc Graw Hill International Edition (New York) ISBN: 978-007- 126727.
2. Mandell, Douglas and Bennett.S, Principles and practices of Infectious diseases, 7th edition, Volume, 2. Churchill Livingstone Elsevier.
3. Sherris Medical Microbiology: An Introduction to Infectious Diseases by Kenneth J. Ryan, C. George Ray, Publisher: McGraw-Hill
4. Medical Microbiology by Patrick R. Murray, Ken S. Rosenthal, Michael A. Pfaller, Elsevier Health Sciences

OR

Major Elective (MJE)-02: Basic Microbiology **Credits 04 (Full Marks: 75)**

Major Elective (MJE)-02T: Basic Microbiology **Credits 03 (Lecture: 60 Hrs.)**

Course Contents:

Unit 1: History of Development of Microbiology

Development of microbiology as a discipline, Spontaneous generation vs. biogenesis. Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming. Role of microorganisms in fermentation, Germ theory of disease, Development of various microbiological techniques and golden era of microbiology, Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich, Elie Metchnikoff, Edward Jenner

Unit 2: Diversity of Microbial world

Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms. General characteristics of different groups: acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.

Unit 3: Viruses, viroids and prions

An introduction to viruses with special reference to the structure and replication of the following: Poxvirus, Poliovirus, HIV, T4 and λ phage, lytic and lysogenic cycles.

Unit 4: Bacteria

An account of typical eubacteria, chlamydiae & rickettsiae (obligate intracellular parasites), mycoplasma, and archaebacteria (extremophiles). Applications of bacteria in industry, environment and food.

Unit 5: Algae

History of phycology; General characteristics of algae including occurrence, thallus organization, algae cell ultra-structure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction. Applications of Algae in agriculture, industry, environment and food.

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Unit 6: Fungi

Historical developments in the field of Mycology, significant contributions of eminent mycologists. General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction, sexual reproduction, heterokaryosis, heterothallism and parasexual mechanism. Economic Importance of Fungi in Agriculture, environment, Industry, medicine, food, biodeterioration, mycotoxins

Unit 7: Protozoa

General characteristics with special reference to Amoeba

Major Elective (MJE)-02P: Basic Microbiology **Credits 01 (30 Hrs.)**

Practical

1. Microbiology Laboratory Practices and Biosafety.
2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter)
3. Preparation and sterilization of culture media for bacterial cultivation
4. Study of different shapes of bacteria, fungi, algae, protozoa using permanent slides/ pictographs
5. Staining of bacteria using Gram stain
6. Isolation of pure cultures of bacteria by streaking method.
7. Estimation of CFU count.

Suggested Readings

1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. W M.T.Brown Publishers.
2. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company

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Major Elective (MJE)-03:

(Molecular Basis of Non-Infectious Human Diseases* OR *Advanced Cell Biology)

MJE-03: Molecular Basis of Non-Infectious Human Diseases **Credits 04 (Full Marks: 75)**

MJE-03T: Molecular Basis of Non-Infectious Human Diseases **Credits 03 (Lecture: 60 Hrs.)**

Course contents:

Unit 1: Nutritional disorders

Overview of major and minor nutrient components in the diet. Balanced diet and the concept of RDA. Nutrient deficiencies; Kwashiorkor and Marasmus, Scurvy, beri beri, pellagra and B12 deficiency, Xerophthalmia and Night blindness, Vitamin D deficiency, Vitamin K deficiency. Discuss with relation to biochemical basis for symptoms.

Unit 2: Metabolic and Lifestyle disorders

Obesity and eating disorders like Anorexia nervosa and Bullemia. Diabetes mellitus A metabolic syndrome and the relationship with hypertension, obesity, hypothyroidism and stress. Cardio vascular disorders and Atherosclerosis-defining the broad spectrum of ailments that fall in this category, understanding the factors that contribute to the syndrome, stages of disorder and the management of the condition. Irritable bowel syndrome- biochemistry behind the disorder and the influence of diet, stress and environment on the condition.

Unit 3: Multifactorial complex disorders and Cancer

Understanding the definition of multifactorial diseases. Polygenic diseases and the relationship of environmental factors and genetic makeup in the onset of diseases. Cancer: characteristics of a transformed cell, causes and stages of Cancer, molecular basis for neoplastic growth and metastasis, Proto-oncogenes and tumor suppressor genes; Cancer causing mutations; Tumor viruses; Biochemical analysis of cancer; Molecular approaches to cancer treatment.

Disorders of mood: Schizophrenia, dementia and anxiety disorders. Polycystic ovarian syndrome, Parkinson's disease, ALS.

Unit 4: Diseases due to misfolded proteins

Introduction to protein folding and proteosome removal of misfolded proteins; etiology and molecular basis for Alzheimer's, Prion diseases, Huntington's Chorea, sickle cell anemia, Thalassemia.

Unit 5: Monogenic diseases

In born errors in metabolism: PKU, Alkaptonuria, Maple syrup urine disease; Receptor and transport defects: Cystic fibrosis, Long QT syndrome, familial hypercholesterolemia, Achondroplasia. Hemoglobinopathies and clotting disorders.

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MJE-03P: Molecular Basis of Non-Infectious Human Diseases **Credits 01 (30 Hrs.)**

Practical

1. Anthropometric measurements for normal and high risk individuals and identifications for Kwashiorkor, Marasmus and Obesity
2. Estimation of homocysteine levels in serum
3. Estimation of glycosylated hemoglobin
4. Permanent slides for different types of cancer
5. Diagnostic profile for assessment of CVS and Diabetes mellitus using case studies.
6. Bone densitometry test demonstration (visit to a nearby clinic)

Suggested Readings:

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.
2. Introduction to Human Physiology (2013) 8th edition; Lauralee Sherwood. Brooks/Cole, Cengage Learning.
3. The World of the cell, 7th edition (2009)
4. Genetics (2012) Snustad and Simmons,
5. Cooper, G.M. and Hausman, R.E. 2009 The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

OR

Major Elective (MJE)-03: Advanced Cell Biology **Credits 04 (Full Marks: 75)**

Major Elective (MJE)-03T: Advanced Cell Biology **Credits 03 (Lecture: 60 Hrs.)**

Course Contents:

Unit 1: Plasma Membrane and Nuclear Transport

Properties and Composition of Cell Membrane; Structure of Nuclear Envelope; Nuclear Pore Complex; Transport Across Nuclear Envelope; Regulation of Nuclear Protein Import and Export.

Unit 2: Cell-Cell Interaction

Cell-Cell Interactions and Cell-Matrix Interactions; Components of Extracellular Matrix: Collagen and Non-Collagen Components; Tight Junctions; Gap Junctions; Desmosomes; Hemidesmosomes; Focal Adhesions and Plasmodesmata; Cell Wall; Role of Cell Interaction in Development.

Unit 3: Cell Cycle and Programmed Cell Death

Overview of The Cell Cycle; Eukaryotic Cell Cycle; Events Of Mitotic Phase; Cytokinesis; Events Of Meiosis And Fertilization; Regulation Of Cell Division And Cell Growth; Apoptosis And Necrosis, Stem Cells And Maintenance of Adult Tissues, Hematopoiesis, Embryonic Stem Cells and Therapeutic Cloning.

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Unit 4: Cancer Biology

Development and causes Of Cancer; Genetic Basis of Cancer; Oncogenes, Tumor Viruses; Molecular Approach to Cancer Treatment.

Unit 5: Advanced Methods in Cell Biology

Ultracentrifugation, Fluorescence Microscopy- FACS, Confocal Microscopy, Electron Microscopy, Plant and Animal Cell Culture, Immunohistochemistry.

Major Elective (MJE)-03P: Advanced Cell Biology **Credits 01 (30 Hrs.)**

Practical

1. Isolation of organelles by sub-cellular fractionation.
2. Study of cell viability /death assay by use of trypan blue and MTT assay.
3. Study of apoptosis through analysis of DNA fragmentation patterns in mitochondria.
4. Identification and study of cancerous cells using permanent slides and photomicrographs.

Suggested Readings

1. Cooper, G.M. and Hausman, R.E. 2009 The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
2. Karp, G. 2010 Cell and Molecular Biology: Concepts and Experiments. 6 edition. John Wiley & Sons. Inc.
3. Alberts, B., Johnson,A., Lewis, J., and Enlarge, M. 2008 Molecular Biology of the Cell. 5th ed., Garland Science (Princeton),
4. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell.
5. J. 2012. Molecular Cell Biology. 7th ed., W.H. Freeman & Company (New York),
6. 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.

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MINOR (MI)

(To be studied by students taken Biochemistry as Discipline- C)

MI-5/C5: Gene Organization, Expression and Regulation **Credits 04 (Full Marks: 75)**

MI-5/C5T: Gene Organization, Expression and Regulation **Credits 03 (Lectures: 45)**

Course contents:

Unit 1: Structure of genes and chromosomes

Definition of a gene, chromosomal organization of genes in viruses, bacteria and eukaryotes. Supercoiling of DNA.

Unit 2: Replication of genomes

General features of DNA replication, properties of prokaryotic and eukaryotic DNA polymerases. Replication of DNA and teleomeres in linear chromosomes. Replication of RNA genomes.

Unit 3: Recombination of DNA

Homologous genetic recombination, Holliday model, proteins and enzymes mediating recombination.

Unit 4: Gene mutations and repair

Molecular basis of mutations, multiple repair systems, mismatch repair, base excision repair, nucleotide excision repair, direct repair and translesion DNA synthesis.

Unit 5: Transcription of genes

General features of gene transcription, procaryotic and eukaryotic RNA polymerases, and stages of transcription, initiation, elongation and termination. Inhibitors of transcription.

Unit 6: RNA processing

Processing of eukaryotic mRNA, splicing of introns, alternate splicing and editing, ribosomal and tRNA processing.

Unit 7: Protein synthesis

Features of the genetic code, amino acylation of tRNAs, structure and assembly of ribosomes; three stages of protein synthesis - initiation, elongation and termination. Inhibitors of protein synthesis.

Unit 8: Regulation of gene expression

Regulation of transcription in prokaryotes, concept of operons. Lac operon - control by negative and positive regulatory proteins, Trp operon - control by attenuation. Regulation of transcription in eukaryotes, regulatory sequences - enhancers, silencers response elements, nucleosome alterations, DNA-protein interactions and RNA interference.

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MI-5/C5P: Gene Organization, Expression and Regulation (Practical) Credits 01 (30 hrs.)

Practical:

1. Quantitative determination of DNA and RNA by absorbance at 260 nm and using A260/A280 ratio to distinguish between them.
2. To study the viscosity of DNA solutions.
3. Isolation of chromosomal DNA from *E. coli.*
4. Isolation of total RNA from yeast cells.

Suggested Readings:

2. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York),

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MI-6/C6: Molecular Diagnostics **Credits 04 (Full Marks: 75)**

MI-6/C6T: Molecular Diagnostics **Credits 03 (Lectures: 45)**

Course contents:

Unit-1: Introduction to Biochemical Diagnostics

Evaluation of biochemical changes in diseases, basic hepatic, renal and cardiovascular physiology; Biochemical symptoms associated with disease and their evaluation; Diagnostic biochemical profile. Inborn errors of metabolism.

Unit-2: Diagnostic Enzymes

Principles of diagnostic enzymology; Clinical significance of aspartate aminotransferase, alanine aminotransferase, creatine kinase, aldolase, lactate dehydrogenase, enzyme tests in determination of myocardial infarction, enzymes of pancreatic origin and billiary tract.

Unit-3: Immunodiagnostics

Introduction, antigen-antibody binding and assays; Immunoassays–types [RIA, ELISA, Chemiluminescent IA, FIA] and specific applications; Immunohistochemistry-principle and techniques. Immunodiagnostics for detection of infectious agents, cancer, and autoimmune diseases; Immunosensors.

Unit-4: Molecular Diagnostics

Introduction to DNA based diagnostic techniques; Polymerase chain reaction in diagnostics and analysis; Analysis of DNA in forensic science and archaeology. Applications of DNA finger printing, Techniques of chromosome analysis.

Chromosome preparation from cultured lymphocytes, cell lines and solid tumors. Karyotyping, chromosome banding and fluorescence In-situ hybridization techniques Disease identification and Genetic tests for following disorders: Thalassemia, Fanconi anemia, Sickle Cell anemia, Fragile-X syndrome, Down Syndrome, Duchenne Muscular Dystrophy/Becker's Muscular Dystrophy, Sex-linked inherited disorders, Allelic susceptibility test for multifactorial disorders (Neural Tube Defect, Cleft Lip and Palate, Cardio Vascular Disorder, Male infertility)

MI-6/C6 P: Molecular Diagnostics (Practical) **Credits 01 (30 Hrs.)**

List of Practical

5. Gram staining and acid fast staining
6. Dot Blot ELISA for insulin
7. Lipid profile: triglycerides and total cholesterol.
8. Permanent slides (histology/cytology) for different types of cancer and comparison with slides from normal tissues

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Suggested Readings:

1. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol. I (2010), Mukherjee, K.L., Tata Mc Graw–Hill Publishing Company Limited (New Delhi).
2. Medical Biochemistry (2005) 2nd ed., Baynes, J.W. and Dominiczak, M.H., Elsevier Mosby Ltd. (Philadelphia),
3. Recombinant DNA by Watson
4. Harper's Biochemistry

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