MSc in Molecular Medicine Course structure

Semester-1

S.No	Course title	Course Code	L-T-P-C	Full/Half semester
1	Basics of Cell Biology and Genetics	BB 301	2-1-0-6	Full semester
2	Biostatistics	BB 405	3-0-0-3	Half semester
3	Genomics and proteomics	BB 608	3-0-0-3	Half semester
3	Anatomy and Human Physiology	NA	3-0-0-6	Full semester
4	Molecular Biology	BB 407	2-1-0-6	Full semester
5	Python and R Programming	NA	2-0-2-6	Full semester
6	Biology Lab-II	BB 412	0-0-3-3	Full semester
	Total Credits		33	

Semester-II

S.No	Course title	Credits	L-T-P-C	Full/ Half semester
1	Metabolism and Bioenergetics	BB 403	2-1-0-6	Full semester
2	Infectious Disease Biology	NA	3-0-0-6	Full semester
3	Immunology	BB 607	2-1-0-6	Full semester
4	Molecular Mechanisms of Human Disease	NA	3-0-0-6	Full semester
5	Genetic Engineering lab	BB 506	0-0-6-6	Full semester
6	Medical Biochemistry Lab	NA	0-0-3-3	Full semester
	Total		33	

Semester-III

S.No	Course title	Credits	L-T-P-C	Full/Half semester
1	Molecular Targets in Drug Design and Therapy	NA	3-0-0-6	Full semester
2	Molecular Diagnostic technique	NA	3-0-0-6	Full semester
3	Program Elective-I	NA	3-0-0-6	Full semester
4	Program Elective-II	NA	3-0-0-6	Full semester
5	Program Elective-III	NA	3-0-0-6	Full semester
6	Cell and Molecular Biology Lab	BB 609	0-0-3-3	Full semester
8	Mini project	NA	0-0-3-3	Full semester
	Total Credits		36	

Semester-IV

S.No	Course title	Credits	L-T-P-C	Full/Half semester
1	Seminar (Including Guest lecture)	NA	NA	-
2	MSc. Thesis	NA	0-0-24-24	-
	Total	28		

Credit Requirement :133

Electives

1. Molecular and Cellular Neuroscience (BB614)
2. Biomedical Spectroscopy and Imaging (BB604)
3. Molecular Biology Techniques and Applications (BB915)
4. Molecular Biology of Cancer (BB 913)
5. Autoimmunity & Autoimmune Diseases (new course, Needs approval)
6. Cardiovascular Biology (new course, Needs approval)

1	**Title of the course** (L-T-P-C)	**Basics of Cell Biology and Genetics** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	None
3	**Course content**	**1.** 1. Introduction to genetics **2.** Mendelian genetics: Mendel's law and examples, Monohybrid and di- hybrid cross, recessive and dominant mutation, concept of allele **3.** Non-Mendelian genetics: incomplete dominance, semi- dominance, and introduction to epigenetics, Cytoplasmic inheritance, infection heredity. **4.** Genetic interactions: approach towards generating a network (epistasis, redundancy, synthetic lethality, lethal interactions) **5.** Model organisms and studies on molecular and genetic interactions **6.** Structure of prokaryotic and eukaryotic cells **7.** Introduction of cell biology, classification of living organisms, Prokaryotic cells, eukaryotic cells. **8.** Membrane structure and function. **9.** Structure and Composition of the Cell Membrane, Membrane Proteins, Transport across the Cell Membrane. **10.** Structural organization and function of intracellular organelles **11.** Structure and function of cytoplasm, Cytoskeletal elements and architecture, Structure and Function of mitochondria, Ribosomes, Endoplasmic reticulum, Rough endoplasmic reticulum and protein secretion, Lysosomes, The Golgi Complex, Peroxisomes, Vacuoles, plant cell organelles, Cell locomotion
4	**Texts/References**	**1**. Anthony JF Griffiths et al., An Introduction to Genetic Analysis W.H. Freeman and Co 7th Edition 2000 **2**. Watson et. al., Molecular Biology of the Gene, Pearson, 7th Edition 2013 **3**. Jocelyn E. Krebs et al., Lewin's Gene Jones & Bartlett Learning; 11 edition (December 31, 2012) 4. Richard Kowles, Solving Problems in Genetics Springer; 2001 edition (June 21, 2001) **4.** Gerald Karp, Cell Biology, WILEY (Feb. 4th, 2013) **5.** Bruce Alberts et al., Essential Cell Biology; Richard Goldsby and Thomas J, &F/Garland, 4th Edition, (2014). **6.** Alberts, Bruce.; Molecular Biology of the Cell, Garland Science; 5th edition (2 January 2008)

1	**Title of the course** (L-T-P-C)	**Biostatistics** **(3-0-0-3)**
2	**Pre-requisite courses(s)**	None
3	**Course content**	• **Introduction to statistics for biologists:** importance of statistics, hypothesis testing, overview of statistical tests, variables. • **Summarizing and visualizing data:** types of data, summarizing data, displaying data, descriptive statistics, tools for graphical display. • **Probability & distributions:** basic probability, laws of probability, types of distributions, statistics of distributions, probability distributions. • **Methods of sampling:** populations and samples, sampling & non-sampling errors, various methods of sampling, experimental design. • **Hypothesis testing**: need for statistical testing, acceptable errors, P-values. • **Parametric & non-parametric tests:** concept of parametric & non-parametric statistics, tests for differences. • **ANOVA:** one-way ANOVA, Two-way ANOVA, Three-way ANOVA, Multiway ANOVA, Nested ANOVA, ANCOVA. • **Correlation & regression:** scatter plot, correlation coefficient, partial correlation coefficient, linear regression, non-linearity, non-linearity. • **Survival analysis:** censoring, survival times, summarizing and presentation. • **R for biostatistics:** introduction, performing common statistical tests in R, visualizing data in R, exporting data and analysis.
4	**Texts/References**	**1.** Michael C. Whitlock and Dolph Schluter, The Analysis of Biological Data, Roberts And Company Publishers, 2015. **2.** Steve McKillup, Statistics Explained: An Introductory Guide for Life Scientists, Cambridge University Press, 2006. **3.** Calvin Dytham, Choosing and Using Statistics: A Biologist's Guide, Wiley-Blackwell, c2011

1	**Title of the course** (L-T-P-C)	**Genomics and proteomics** **(3-0-0-3)**
2	**Pre-requisite courses(s)**	None
3	**Course content**	**Introduction to Genomics and Proteomics:** Organization and structure of genomes. Introduction to Proteomics. **Gene Identification and Expression:** Genome annotation, routes of gene identification, ORF, gene ontology, comparative genomics, determining gene function by sequence comparison and through conserved protein structure, Global expression profiling, applications of genome analysis and genomics. **Analysis of Proteomes I: Analysis of proteomes** – 2D gel electrophoresis, Image analysis of 2-DE gels. **Analysis of Proteomes II**: Mass spectrometry-based methods for protein identification. 2-DE gel electrophoresis coupled with mass spectrometry, **Micro array and RNA-seq techniques** **Applications of Genomics and Proteomics Analysis:** Analysis of Genomes – Human, Mouse, Plasmodium falciparum, Saccharomyces cerevisiae, Mycobacterium tuberculosis. Application of proteome analysis- drug development and toxicology, Pharmaceutical Applications.
4	**Texts/References**	**1.** Concepts and Techniques in Genomics and Proteomics by N Saraswathy P Ramalingam, first edition, 2011 (Woodhead Publishing). **2.** Introduction to Genomics by Arthur M. Lesk. 3rd edition (Oxford university press). **3**. Lewin's Genes XII by Elliott S. Goldstein, Jocelyn E. Krebbs, and Stephen T. Kilpatrick. 12th edition (2017) **4.** Human Genetics and Genomics by Bruce R. Korf. 4th edition (Blackwell publication). **5.** Introduction to Proteomics: Principles and Applications by Nawin C Mishra, Gunter Blobel 1st edition (Wiley publication).

1	**Title of the course**	**Anatomy and Human Physiology** **(3-0-0-6)**
2	**Pre-requisite courses**	None
3	**Course content**	**Introduction to human body** Definition and scope of anatomy and physiology, levels of structural organization (cellular and Tissue level) and body systems, basic life processes, homeostasis, basic anatomical terminology. **Integumentary system(** Structure and functions of skin), Skeletal system (Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction), Joints (Structural and functional classification, types of joints movements and its articulation) **Body fluids and blood** - Body fluids, composition and functions of blood, hemopoeisis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticulo endothelial system, Lymphatic system Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system **Peripheral nervous system**: Classification of peripheral nervous system: Structure and functions of sympathetic and parasympathetic nervous system. Origin and functions of spinal and cranial nerves, Special senses Structure and functions of eye, ear, nose and tongue and their disorders. **Cardiovascular system Heart** – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and heart beat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart
4	**Texts/References**	**1.** Netter Atlas of Human Anatomy. Frank H Netter, 8th Edition, 2022 **2.** Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. 8th Edition, Jaypee medical publishers, 2022 **3.** Text book of Medical Physiology- John.E. Hall, Elsevier, 14thedition, 2020, **4.** Principles of Anatomy and Physiology. Gerard J. Tortora, Bryan H. Derrickson, 15th Edition, Wiley, 2016

1	**Title of the course** (L-T-P-C)	**Molecular Biology** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	None
3	**Course content**	**1.** **Nucleic acid:** building blocks, nucleotide analogs as drugs **2.** **DNA structure**- base pairing and stabilizing forces, different forms of DNA. minor and major grooves, supercoiling, organization into chromosomes, nucleosomes, heterochromatin, euchromatin, genes and organization, unique genes, operons, gene families, repetitive DNA, genome organization, transposons. **3.** **Replication:** basic processes in bacteria and eukaryotes, telomeres and telomerase **4.** **DNA damage and repair:** Basic steps in gene expression and regulation, transcriptional and post-transcriptional regulation of gene expression **5.** **Bacterial translation:** **6.** **Eukaryotic translation:** **7.** **Epigenetics:** DNA methylation in prokaryotes and eukaryotes, epigenetic gene regulation by DNA methylation in plants and mammals. Methods to detect epigenetic modifications **8.** **Protein-nucleic acid interactions** - nucleic acid recognition by proteins binding motifs - techniques to study protein-nucleic acid interactions. **9.** **Non-coding RNA:** Biogenesis and its function.
4	**Texts/References**	**1.** Molecular Biology of the cell by Bruce Alberts et al. 6th edition. **2.** Lewin's Genes XII by Elliott S. Goldstein, Jocelyn E.Krebbs, and Stephen T. Kilpatrick. 12^{th} edition (2017) **3.** DNA Repair and Mutagenesis (2nd Edition) Friedberg and others. **4.** Mehta, A. and Haber J. E. (2014) sources of DNA double strand breaks and Models of Recombination DNA repair Cold Spring Harb Perspect Biol 6: a016428. **5.** Anand, R.P, Lovett, S.T. and Haber J.E. (2013) Break Induced DNA Replication. Cold Spring Harb Perspect Biol 5: a010397.

1	**Title of the course**	**Python and R Programming** **(2-0-2-6)**
2	**Pre-requisite courses**	None
3	**Course content**	**Introduction to Computational Programming :** Importance of computational programming in biology Introduction to Python and R programming languages. **Basic Python Programming :** Python syntax and basic constructs, Variables, data types, and control structures, Writing and running simple Python scripts **Data Structures and File Handling in Python:** Lists, dictionaries, and sets File input/output operations, Handling and processing biological data files. **Introduction to R Programming:** R syntax and basic constructs, Data types and control structures in R Writing and running simple R scripts. **Data Manipulation and Analysis in R** Data frames and lists, Basic data manipulation with dplyr, Summary statistics and exploratory data analysis. **Data Visualization** Plotting and visualization in Python with Matplotlib and Seaborn, Plotting and visualization in R with ggplot2 , Creating publication- quality figures
4	**Texts/References**	**1.** Python Programming: An Introduction to Computer Science, by John M. Zelle, 4th edition, Franklin, Beedle and Associates. 2024 **2.** Think Python: How to Think Like a Computer Scientist. Allen B. Downey. 2nd SPD publication, 2015 **3.** The Art of R Programming – A Tour of Statistical Software Design. Norman Matloff, 1st edition, 2011

1	**Title of the course** (L-T-P-C)	**Metabolism and Bioenergetics** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	
3	**Course content**	**1.** Design principles of metabolism **2.** Principles of energy release from biological macromolecules. **3.** Principles of bioenergetics. **4.** Carbohydrate metabolism **5.** Alternative oxidation of glucose by Pentose Phosphate pathway (PPP). **6.** Krebs /TCA /CAC cycle **7.** Strategies in citrate cycle. **8.** Oxidative phosphorylation **9.** Photosynthesis **10.** Fatty acid metabolism **11.** Amino acid metabolism **12.** Nucleic acid metabolism **13.** One carbon metabolism **14.** Secondary metabolism **15.** Interconvertibility of fuels **16.** Molecular chaperones in protein folding, experimental strategies to study protein mis-folding and disease, regulation of metabolism through metabolic networks, metabolic messengers, generation of NO and oxygen radicals.
4	**Texts/References**	**1**. Rodney F Boyer, Concepts in Biochemistry. John Wiley & Sons; 3rd Edition edition (2 December 2005) **2**.Thomas Millar, Biochemistry Explained: A Practical Guide to Learning Biochemistry. CRC Press; 1 edition (30 May 2002) **3**.Lubert Stryer et al., Biochemistry. W. H. Freeman; 6th Edition edition (14 July 2006) **4.**John E. McMurry and Tadgh Begley. The Organic Chemistry of Biological Pathways. WH Freeman; 2nd edition (11 December 2015) **5.**Laurence A Moran, Principles of Biochemistry. Pearson; 5 edition (30 July 2013) **6.**David L. Nelson and Michael M. Cox, Lehninger Principles of Biochemistry WH Freeman; 7th ed. 2017 edition (1 January 2017)

1	**Title of the course**	**Infectious Disease Biology** **(3-0-0-6)**
2	**Pre-requisite courses**	None
3	**Course content**	Introduction to infectious disease Types of microbes, Epidemic, Endemic, Pandemic, Antibiotics and resistance **Bacteria**: Background, Epidemiology,Transmission, Reservoirs, Pathogenesis, Immune Evasion (Mycobacterium tuberculosis, Salmonella, Shigella, Staphylococcus) **Viruses**: Background, Epidemiology, Transmission, Reservoirs, Disease caused by Coronavirus, Japanese encephalitis virus(JEV), SEV, Zika virus, Nipah virus. Chikungunya virus, Viral structure and replication Pathogenesis and virulence **Parasites**: Background,Epidemiology,Transmission, Reservoirs, Pathogenesis, Immune Evasion, , Disease caused by Malaria, Leishmania, Trypanosoma, Toxoplasma, Wuchereria bancrofti. **Fungi**: Background, Epidemiology, Transmission, Reservoirs, , Disease and pathogenesis caused by Aspergillus
4	**Texts/References**	**1.** Pelczar Microbiology. Pelczar M.J., Chan E.C.S. & Kreig N.R., McGraw Hill. 5th Edition, 2023 **2.** Prescott's Microbiology. Joanne Willey, Kathleen Sandman, Dorothy Wood, Mc Graw Hill, 12th edition, 2022 **3.** Brock Biology of Microorganisms, Madigan M.T., Martinko J.M. and Parker J., Prentice Hall.14th Edition, 2017. **4.** Medical Microbiology. Michael R. Barer, Will L Irving, Andrew Swann, Nelun Perera, 19th Edition, Elsevier, 2018.

1	**Title of the course** (L-T-P-C)	**Immunology** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	Basic Cell biology and Genetics, Microbiology
3	**Course content**	**1.** Introduction, Organization of the immune system (lymphoid tissues and organs). **2.** Immune cell development (hematopoiesis, T and B cell development). **3.** Innate and adaptive immunity (including cellular and humoral responses). **4.** Antigens and Antibodies (antibody classes, Ag/Ab structure and function). **5.** Immune signaling (T cell receptor, TLRs, inflammatory and cytokine responses) and cancer. **6.** The MHC and Ag presentation and T cell development. Immunity mechanisms in disease (allergies, autoimmunity, immuno-deficiency).
4	**Texts/References**	**1**. Judith A. Owen, Jenni Punt, Sharon A. Stranford, Patricia P. Jones., Kuby Immunology, W.H. Freeman and Company, 2013. **2**. Kenneth Murphy , Paul Travers , Mark Walport, Janeway's Immunobiology, Garland Science, Taylor & Francis Group, 200

1	**Title of the course**	**Molecular Mechanisms of Human Disease (3-0-0-6)**
2	**Pre-requisite courses**	None
3	**Course content**	**Molecular basis of cancer**: Oncogenes and tumor suppressor genes, Cell cycle and apoptosis, Genetic and Epigenetic Factors in Cancer: DNA methylation and histone modification, Non-coding RNAs **Cardiovascular Diseases:** Molecular basis of atherosclerosis, Hypertension and heart failure, Genetic predispositions **Metabolic Disorders:** Diabetes mellitus: Type 1 and Type 2 Obesity and metabolic syndrome, Mitochondrial diseases **Infectious Diseases:** Mechanisms of bacterial pathogenesis, Viral infections: HIV, influenza, SARS-CoV-2,Host-pathogen interactions **Immune System Disorders:** Autoimmune diseases: rheumatoid arthritis, lupus, Immunodeficiency diseases: SCID, AIDS,Molecular basis of allergies and asthma **Genetic disorders:** Albinism, Cystic fibrosis (CF), Ankylosing spondylitis, Duchenne muscular dystrophy, Haemophilia
4	**Texts/References**	**1.** The Molecular Basis of Cancer By John Mendelsohn, Peter M. Howley, Mark A. Israel, Joe W. Gray, Craig B. Thompson, Elsevier. 4th Edition, 2014 **2.** Molecular Pathology : The Molecular Basis Of Human Disease. William B. Coleman, AP press, 2nd edition, 2018 **3.** Hypertension and Cardiovascular Disease. Emmanuel A. Andreadis, Springer. 1st Edition, 2016 **4.** Infectious Diseases. Jonathan Cohen, 4th Edition, Elsevier, 2017 **5.** Basic Immunology Functions and Disorders of the Immune System Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai, Elsevier, 7th edition, 2023.

1	**Title of the course**	**Medical Biochemistry Lab** **(0-0-3-3)**
2	**Pre-requisite courses**	None
3	**Course content**	**1.** Qualitative analysis of Carbohydrates **2.** Glucose estimation **3.** identification of proteins (Albumin, Casein) **4.** Determination of activity of human salivary amylase **5.** Determination of blood creatine **6.** Determination of blood cholesterol **7.** Determination of blood creatinine.
4	**Texts/References**	**1.** Laboratory Manual of Biochemistry and Clinical Pathology By Dr. Remeth J. Dias, Dr. Prashant D. Aragade, 2nd edition, Trinity publishing house, 2023 **2.** Biochemistry in the Lab A Manual for Undergraduates By Benjamin F. Lasseter, AP press, 2nd edition, CRC press, 2019. **3.** Basic Concepts in Clinical Biochemistry: A Practical Guide. Vijay Kumar, Kiran Dip Gill, 2nd edition, Springer Nature, 2018.

1	**Title of the course**	**Molecular Targets in Drug Design and Therapy (3-0-0-6)**
2	**Pre-requisite courses**	None
3	**Course content**	**Introduction to Drug Targets:** Definition and types of drug targets (proteins, nucleic acids, etc.), Characteristics of an ideal drug target, Historical perspective and examples of successful drug targets **Methods of Target Identification and Validation:** Genomic and proteomic approaches, Bioinformatics tools and databases, Experimental validation techniques (e.g., RNA interference, CRISPR/Cas9), High-throughput screening methods. **Mechanisms of Drug Action:** Binding interactions (receptor-ligand interactions), Enzyme inhibition and activation, Signal transduction pathways. **Biologics and Targeted Therapies:** Monoclonal antibodies, Antibody-drug conjugates, Targeted delivery systems, Therapeutic proteins and peptides **Pharmacokinetics and Pharmacodynamics:** Principles of pharmacokinetics (absorption, distribution, metabolism, excretion), Principles of pharmacodynamics (dose-response relationships, therapeutic index), Factors affecting drug efficacy and safety. **Drug Resistance Mechanisms:** Types of drug resistance (intrinsic and acquired), Molecular mechanisms of resistance, Strategies to overcome resistance **Future Directions in Drug Therapy:** Personalized medicine, Gene therapy, Nanomedicine, Emerging trends and future directions.
4	**Texts/References**	**1.** Molecular Medicine: An Introduction. Jens Kurreck, Wiley-VCH, 1st edition, 2016 **2.** Principles of Pharmacology: The Pathophysiologic Basis of Drug Therapy. 2. Golan, D. E., Tashjian, A. H., Armstrong, E. J., & Armstrong, Wolters Kluwer, 4th edition, 2016 **3.** Pharmacological Basis of Therapeutics. Brunton, L. L., Hilal- Dandan, R., & Knollmann, B. C., McGraw-Hill, 13th edition, 2018

1	**Title of the course**	**Molecular Diagnostic technique** **(3-0-0-6)**
2	**Pre-requisite courses**	None
3	**Course content**	FACS, FISH Specimen types and uses Principle DNA and RNA extraction and isolation Application Polymerase chain reaction (PCR) in diagnosis Resolution and detection of nucleic acids by electrophoresis. DNA and RNA sequencing Detection and identification of microorganisms using molecular techniques. Polymorphisms (RFLP) and mutations. SNP detection by probe ligation and amplification (e. g. MLPA) Immunological Diagnostics: agglutination, Rapid, ELISA's, immunofluorescence, Western blots --Bioluminescence to monitor hygiene and contamination
4	**Texts/References**	**1.** Molecular Diagnostics: George P. Patrinos, Phillip B. Danielson, Wilhelm Ansorge, Elseviers, 3rd edition, 2017 **2.** Techniques in Molecular Diagnostics: The Pathophysiologic Basis of Drug Therapy. Kandarpa Kr. Saikai, Nipa publication, 5th edition, 2016. **3.** Molecular Diagnostics Techniques and Applications for the Clinical Laboratory. Charles Strom, Frederick L. Kiechle, Robert M. Nakamura, Wayne W. Grody, 1st edition, 2009.

1	**Title of the course**	**Cell and Molecular Biology Lab** **(0-0-3-3)**
2	**Pre-requisite courses**	None
3	**Course content**	Isolation of plasmid from bacteria and restriction digestion, ligation. Isolation of total RNA from human cells Fluorescence microscopy to examine intracellular compartments, Cell fractionation and centrifugation methods, isolation of intracellular compartments by differential centrifugation techniques, nuclei, cytoplasm etc. Basics of cell culture methods: cell counting, culture media preparation. Proliferation and using live cell imaging and MTT assay, Fluorescence-activated cell sorting (FACS) and analysis of cells Immunostaining and imaging.
4	**Texts/References**	**1.** Molecular Biology of the cell . Bruce Alberts, Rebecca Heald, David Morgan, Martin Raff, Keith Roberts, and Peter Walter W. W. Norton & Co., 7th Edition, 2022. **2.** Cell and Molecular Biology Lab Manual, David a Thompson, Create Space Independent Publishing Platform, 1st edition, 2011.

1	**Title of the course**	**Autoimmunity & Autoimmune Diseases (3-0-0-6)**
2	**Pre-requisite courses**	None
3	**Course content**	**1. Immunologic Basis of Autoimmunity:** Overview of immune system components and functions, Mechanisms of self-tolerance, Introduction to autoimmunity. Autoimmune disease stats (systemic autoimmune diseases, organ specific and localized autoimmune disease, haemolytic autoimmune disease) **2. Mechanisms and Pathophysiology of Autoimmunity :** Breakdown of self-tolerance, Role of autoantibodies and autoreactive T cells, Regulatory T Cells, Genetic predisposition to autoimmunity, Environmental triggers and epigenetic factors **3. Common Autoimmune Diseases and Diagnosis:** Systemic Lupus Erythematosus (SLE), Rheumatoid Arthritis (RA), Multiple Sclerosis (MS), Type 1 Diabetes Mellitus (T1DM), Hashimoto's Thyroiditis, Myasthenia gravis (MG), Dermatological autoimmune diseases, Primary biliary cirrhosis (PBC), Sjögren's syndrome. **4. Diagnosis, Prevention and Therapy :** Autoantibodies assay, Testing and Standardization, T cell assay. **5. Autoimmunity Current Research and Future Directions :** Autoimmune disease prevention and vaccine development, Role of microbiome
4	**Texts/References**	**1.** The autoimmune diseases: Noel R. Rose and IAN R. Mackay, Elseviers, 5th edition, 2013 **2.** The Immune System, Peter Partham, W.W. Norton, 5th edition, 2021. **3.** Autoimmune Disease Pathogenesis, Genetics, Immunotherapy, Prophylaxis and Principles for Organ Transplantation. Duncan Dartrey Adams and Christopher Dartrey Adams, Springer, 1st edition, 2013

1	**Title of the course**	**Autoimmunity & Autoimmune Diseases (3-0-0-6)**
2	**Pre-requisite courses**	None
3	**Course content**	**1. Introduction to Cardiovascular Biology:** Overview of the cardiovascular system: anatomy and physiology, Embryonic development of the heart and blood vessels, Cardiovascular homeostasis and hemodynamics. **2. Molecular and Cellular Basis of Cardiovascular Function Cardiac muscle cell biology:** structure and function of cardiomyocytes. Endothelial cell biology: roles in vascular function. Vascular smooth muscle cells and their regulation. Signal transduction in cardiovascular cells: ion channels, receptors, and intracellular signaling pathways. **3. Cardiovascular Diseases:** Mechanisms and Pathophysiology Hypertension: causes, mechanisms, and consequences. Atherosclerosis: lipid metabolism, inflammation, and plaque formation. Ischemic heart disease: myocardial infarction and ischemia-reperfusion injury. Heart failure: molecular mechanisms and compensatory mechanisms. Vascular disorders: aneurysms, thrombosis, and stroke **4. Cardiovascular Therapeutics :** Pharmacological approaches: antihypertensives, statins, antiplatelets, and anticoagulants. Gene and cell therapies: CRISPR, stem cells, and regenerative medicine. Emerging therapies: RNA-based therapies, immunotherapies, and targeted drug delivery systems. Personalized medicine in cardiovascular diseases **5. Cardiovascular System and Systemic Diseases:** Metabolic syndrome and cardiovascular diseases. Cardiovascular implications of diabetes, obesity, and dyslipidemia. Cancer and the cardiovascular system: tumor-vascular interaction **Experimental Models and Techniques in Cardiovascular Research**
4	**Texts/References**	**1.** Cardiovascular Physiology: David E. Mohrman and Lois Jane Heller. McGraw Hill, 10th edition, 2021 **2.** Cardiovascular Pathology, L. Maximilian Buja and Jagdish Butany, Elsevier, 5th edition, 2022. **3.** The ESC Textbook of Cardiovascular Medicine. A. John Camm, Oxford, 3rd edition, 2018

Elective

1	**Title of the course** (L-T-P-C)	**Biomedical Spectroscopy and Imaging (3-0-0-6)**
2	**Pre-requisite courses(s)**	--
3	**Course content**	Module 1: Medical Imaging Module 2: Spectrometry and Instrumentation Module 3: Hyperspectral Imaging, line scanning, and Pointspectroscopy Module 4: Fluorescence spectroscopy and applications Module 5: Infrared spectroscopy and applications Module 6: Raman spectroscopy and applications
4	**Texts/References**	Laser fundamentals, William. T Silfvast, 2004 Photonics, Volume 4: Biomedical spectroscopy, photonicsand microscopy, David L Andrews,2015 Biophotonics: vibrational spectroscopic diagnostics, Mathew baker, Caryn Hughes, Katherine A Hollywood,2016 Fundamentals of Medical imaging, Suetens P, 2017

1	**Title of the course** (L-T-P-C)	**Molecular biology techniques and applications (3-0-0-6)**
2	**Pre-requisite courses(s)**	NA
3	**Course content**	The course will include content on techniques involved in the molecular study, its mechanism, and mode of applications. Laboratory techniques such as biochemical estimation, microbial culture, chromatography, protein purification and estimation methods, PCR techniques, immunological assays, and sequencing techniques will be discussed in detail.
4	**Texts/References**	**1** Locquin and Langeron (1983). Handbook of Microscopy. Butterwaths **2** Ausubel et al (2002). Short Protocols in Molecular Biology. Wiley **3** Brown (2000). Essential Molecular Biology VI. AP **4** Brown (2000). Essential Molecular Biology VII. AP **5** Brown (2006). Gene Cloning and DNA Analysis - An Introduction. Blackwell **6** Glick and Pasternak (2003). Molecular Biotechnology. ASM Press **7** Kracher. Molecular Biology - A Practical Approach. **8** Krenzer and Massey (2000). Recombinant DNA and Biotechnology. ASM **9** Micklos and Freyer (1990). DNA Science. CSHL **10** Primrose (2001). Molecular Biotechnology. Panima **11** Robertson et al (1997). Manipulation & Expression of Recombinant DNA. AP **12** Sambrook et al (2001). Molecular Cloning. CSHL **13** Twyman (1999). Advanced Molecular Biology. Viva **14** Watson et al (1992). Recombinant DNA. Freeman **15** Primrose and Twyman (2006). Principles of Gene Manipulation and Genomics. Blackwell

1	**Title of the course** (L-T-P-C)	**Molecular Biology of Cancer** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	None
3	**Course content**	• Describe the six hallmarks of cancer • Explain the types of gene mutations possible and how these mutations can contribute to cancer formation • Describe an oncogene and why it is important in cancer development • Explain the cell cycle, its regulation, and how cell cycle dysfunction can lead to cancer • Describe the function of tumor suppressor genes • Explain how external or internal stimuli can lead to apoptosis • Clarify how cancer cells escape cell death • List and describe the steps that lead to metastasis • Give details on how chronic inflammation and infectious agents can lead to cancer • Explain the role of diet in cancer development and cancer prevention
4	**Texts/References**	**1.** The Biology of Cancer: Robert A. Weinberg, Garland Science 2014, Second Edition. **2.** Principles of Cancer Biology: Lewis J. Kleinsmith, Pearson 2016, First Edition. **3.** Biology of Cancer: Dorothy Lobo, Pearson Education 2012, Second Revised Edition **4.** The Biology of Cancer: Janice Gabriel, John Wiley & Sons Inc 2007, Second Edition.