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B.Sc. Biotechnology 2015 Course SEMI

Course No. & Description	Title	Credits	Course Outcome
BBT 101 Core Course-Theory	Animal Science	3	i. Students understand the Basic classification and characterizing features of animal kingdom ii. Students to gain knowledge of physiology, endocrinology and parasitology iii. Animals for commercial applications; vermicomposting, apiculture, sericulture and
BBT 102 Core Course –Theory	Plant Science	3	i. Students understand the classification and characterizing features of each class of the plant kingdom ii. Organization, morphology and physiology of parts of plants and seeds
BBT 103 Core Course –Theory	Foundations of Chemistry & Biochemistry	3	i. Gain basic understanding of Structure and metabolism of carbohydrates and lipids ii. Fundamental knowledge of Physicochemical measurements and properties of their solutions
BBT 104 Core Course –Theory	Basics of Computer	3	i. Will be introduced to basic principles of computer learning ii. Understand the Basic of hardware and software theory iii. Will learn C programing
BBT 105 Core Course –Practical	Animal Science Lab	3	i. Practical study of morphology of specimens from each phylum ii. Study of human blood groups iii. Excursion tour to commercial animal biotechnology centers
BBT 106 Core Course –Practical	Plant Science Lab	3	i. Practical study of morphology, habitat and mode of nutrition of specimens from each phylum ii. Study and dissection of plant specimens from each phylum in detail iii. Visit to plant reserves/ forests
BBT 107 Core Course –Practical	Foundations of Chemistry & Biochemistry Lab	3	i. Students will have understanding of good laboratory practices, safe handling of equipments, safety, accuracy and reliability ii. Preparations of buffers and

			solutions iii. Quantitative estimations of biomolecules and determination of λmax iv. Learn thin layer chromatography
BBT 108 Core Course –Practical	Computer Fundamentals & C-Programming Lab	3	i. Hands on practice on MS office tools ii. Gain familiarity for use of internet for access of biological sites iii. Learn C-Programming language
BBT 109 Open Course I	Elective: General English. Option II: Basic Programming for Bioinformatics.	2	i. Understanding of phonics and accents. ii. Gain listening skills iii. Improve grammatically correct vocal and written English iv. Effective expression of ideas, opinions and presentations v.
BBT 110 General Course I	Elective Yoga & Meditation	2	i. Understand the principles and benefits of yoga ii. Practice various asanas and pranayama techniques

SEM-II

Course No. & Description	Title	Credits	Course Outcome
BBT 201 Core Course –Theory	Introduction to Microbiology	3	i. Understand principles and applications of various microscopes ii. Learn structure, properties and taxonomy of bacteria iii. Learn Bergey's manual of bacteriology iv. Understand microbial growth patterns and bactericidal agents
BBT 202 Core Course –Theory	Biochemistry I	3	i. Gain familiarity with protein chemistry ii. Learn primary, secondary and tertiary structures of proteins and nucleic acids, role of minerals, vitamins in protein functions iii. Mononucleotides and role of cAMP iv. Gain understanding of various analytical techniques used for study of biomolecules
BBT 203 Core Course –Theory	Cell Biology	3	i. Understand evolution of cell, structure and types of cells ii. Learn structure and function of various cell organelles iii. Explore fluid mosaic model of cell membrane and its role; active and passive transport across it iv. Knowledge of structure and function of cytoskeleton elements v. Learn cell division, cell cycle, cell interactions, signaling and cell death vi.
BBT 204 Core Course –Theory	Genetics	3	i. Gain knowledge of Mendelian and Non-Mendelian principles of inheritance ii. Learn structure of

			chromosomes, its segregation during cell division and generation of numerical and structural chromosomal abnormalities iii. Techniques for genetic analysis iv. Learn molecular basis of sex determination and associated characteristics v. Familiarity with applied and evolutionary genetics vi.
BBT 205 Core Course -Practical	Introduction to Practical Microbiology	3	i. Gain acquaintance with microbiology laboratory practices ii. Get introduced to microscopy iii. Techniques for pure culture, monochrome, gram and negative staining iv. Understand growth curve properties, staining of capsule, spore, cell wall and granules of bacteria
BBT 206 Core Course-Practical	Biochemistry I Lab	3	i. Gain skills for isolation of proteins from biological samples ii. Estimation of proteins using colorimetric and TLC methods iii. Determination of pKa values, titration curve of amino acids iv. Isolation and analysis of vitamins and pigments v. Learn ion exchange chromatography for isolation of natural dyes
BBT 207 Core Course –Practical	Cell Biology Lab	3	i. Students will be able to identify prokaryotic and eukaryotic cells and sub-cellular organelles by microscopic examinations ii. Skill in observing mitosis and meiosis in onion root tip cells iii. Learn enumeration of blood cells using hemocytometer chamber
BBT 208 Core Course –Practical	Genetics Lab	3	i. Will have experienced staining and observing chromosomes from specimen samples ii. Study for effect of mutagenic

			agents on seeds iii. Isolation, cultivation and study of first eukaryotic multicellular organism (C. elegance) as well as drosophila iv.
BBT 209 Open Course II	Elective Ecology, Gardening & Landscaping,	2	i. Students will know the importance, scope of ecology ii. Concept of ecosystems, its types and diversity iii. Principles of Ecological succession; ecological pyramids and functioning iv. Ecology conservation and sustainable development GARDENING & LANDSCAPING i. Types, components and planning of gardens ii. Nursery production and management iii. Learn propagation of ornamental plants, palm, cycus, bamboo, conifers and orchids using various techniques and tissue culture iv. Planting methods for lawns & grasses, making of terrerium v. Will have interacted with growers
BBT 210 General Course II	Elective Human Values	2	i. Inculcated the importance of values in life and lay foundation of human values ii. Create awareness towards realizing self iii. Salient values of truth, commitment, honesty and integrity iv. Inculcate sense of social responsibility, creation of its awareness and understand value of human relations v.

SEM-III

Course No. & Description	Title	Credits	Course Outcome
BBT 301 Core Course –Theory	Concepts in Microbiology	3	i. Understand principle and genetic exchange mechanisms in bacteria ii. Classification, structure, reproduction and economic importance of unicellular eukaryotic microorganisms iii. Knowledge of bacterial and plant viruses iv. Principles of infection and pathogenicity of various pathogens v. Antimicrobial chemotherapy
BBT 302 Core Course –Theory	Biochemistry II	3	i. Students will learn principles of thermodynamics and bioenergetics ii. They will gain detailed knowledge of classification, nomenclature and mechanism of action of enzymes iii. They will have learnt in detail the metabolic pathways for synthesis and breakdown of carbohydrates, lipids and nitrogen in the body iv. Bioenergetics and regulation of above pathways
BBT 303 Core Course –Theory	Principles & Techniques in Molecular Biology	3	i. Students will know structure and properties of nucleotides; Watson and Crick's structure of DNA double helix; Structures and types of RNAs ii. Types and consequences of various mutations iii. Organizations of prokaryotic and eukaryotic genomes iv. Students will be acquainted with modern techniques for analysis of nucleic acids
BBT 304 Core Course –Theory	Immunology	3	i. Students will learn innate and adaptive types of immunity ; know the concepts of humoral and cell mediated immune response ii. Structure of antibody, organs of immune system; Classes and subclasses iii. They will learn antigen presenting cells, major histocompatibility complex, B cell and T cell differentiation

			iv. Knowledge of immunological diseases and immunological techniques
BBT 305 Core Course-Practical	Practicals in Microbiology	3	i. Students will gain skill for micrometry, characterization of bacteria ii. They will learn maintenance and revival of cultures iii. Isolation of bacteriophages, fungi and yeast iv. Learn antibiotic susceptibility assay
BBT 306 Core Course-Practical	Practicals in Biochemistry II	3	i. Study of isolation and kinetics of enzymes activity ii. Gains skills for enzymatic preparation of glucose, malto-dextrin, invert sugars iii. Preparation of peptides using papain iv. Learn softening of various foods v. Study of digestive enzymes and metabolic pathways
BBT 307 Core Course-Practical	Practicals in Molecular Biology & Immunology	3	i. Students will learn the safety, precision parameters, preparation of buffers and stock/working solutions ii. Learn isolation of DNA and RNA from prokaryotic and eukaryotic sources iii. Students will gain skills for quantitative and qualitative analysis of DNA and RNA preparations iv. Students will learn blood grouping, differential count of WBC and basic immunology techniques such as Widal , VDRL and Dot ELISA assays
BBT 308 Open Course III	Elective Patent & IPR, Nutrition	2	i. The course focus on concepts of invention, creativity and intellectual property ii. Students will learn types of intellectual properties; patents, trademark, copyright, design and their protection iii. They will learn filing of patent application, role of patent office/ attorney and patent infringement
BBT 309 General Course III	Elective Communication skills& Personality Development	2	i. Demonstrate effective verbal and non-verbal communication skills in various personal and professional contexts. ii. Develop presentation skills, unforeseen situation handling iii. Learn interpersonal communication

			skills iv. Get insights in personality development and analyzing strengths and weaknesses and body language

SEM-IV

Course No. & Description	Title	Credits	Course Outcome
BBT 401 Core Course –Theory	Environmental Biotechnology	3	i. Understand the basic concepts and principles of environmental biotechnology ii. Gain knowledge of ecosystem, biosphere, natural resources and environment iii. Concept of biodiversity and critical need for its conservation iv. Types and causes of pollution, soil erosion v. Applications of biotechnology for addressing environmental challenges
BBT 402 Core Course –Theory	Fundamentals in Molecular Biology	3	i. Through this course students will learn the mechanism of DNA replication and repair in prokaryotic cells ii. They will learn types of RNA and their synthesis as well as processing in prokaryotic and eukaryotic cells iii. Students will understand the mechanism of synthesis of proteins and regulation of gene expression
BBT 403 Core Course –Theory	Developmental Biology	3	i. The course aims to provide concepts in gametogenesis, meiosis and embryology ii. Have awareness of types and patterns of cleavages during embryo development iii. Know about developmental plasticity in embryo development iv. Patterning, abnormal development and teratogenesis
BBT 404 Core Course –Theory	Analytical Techniques	3	i. Students will learn the principle and applications for analytical techniques ultrafiltration, centrifugation, MALDI-TOF, Chromatography, Magnetic Resonance etc. ii. Students will know various analytical techniques in biological research. iii. The course will enhance the employability of the candidates in Biotechnological, Pharmaceutical

			iv. Industries and Analytical Laboratories and research institutes
BBT 405 Core Course-Practical	Environmental Biotechnology Lab	3	i. Study of ecosystems and analyzing water samples for its quality ii. Students will learn the techniques for analysis of noise level, oxygen levels from water, potable quality of water, extent of pollution in water, iii. Learn to estimate biomass from organisms iv. Study production of biogas
BBT 406 Core Course-Practical	Practicals in Molecular & Developmental Biology	3	i. Students will gain the knowledge of isolation of nucleic acids (DNA and RNA) from prokaryotic and eukaryotic sources. ii. They will learn qualitative and quantitative analysis of nucleic acids iii. They will learn and observe the preparation of polytene chromosomes from chironomous larvae iv. They will study the dissection and chick embryo and observe various stages of chick embryo development v. Learn and study chick embryo whole mount preparation
BBT 407 Core Course-Practical	Analytical Techniques Lab	3	i. After completion of the course students will be able to prepare demineralized water ii. They will learn to analyze and separate nucleotides , purine and pyrimidine bases using HPLC iii. Estimate molecules on lambda max basis iv. They will learn the principle, mode of operation and applications of analytical techniques such as membrane filtration, steripad filtration, polyacrylamide gel electrophoresis, flame photometry, spray dryer, dialysis and reverse osmosis.
BBT 408 Open Course IV	Elective Nanotechnology,Bio fertilizer Technology	2	i. Students will gain understanding of basic principles of nanotechnology and various types of nanoparticles ii. They will learn characterization of nanoparticles using various

			techniques iii. They will gain an overview of applications in medicine, biological detection, agriculture and environment i. In Biofertilizer technology course the students will have technical knowledge of composition and types of soils. ii. Use of microorganisms for composting and humus formation and nitrogen fixation iii. They will understand the method of preparation liquid and carrier based combination of inoculants and their application. iv. Understand the concept of biofertilizers and their role in sustainable agriculture.
BBT 409 General Course IV	Elective Seminar & Journal Club	2	i. The course is essential to strengthen student's familiarity with scientific publications ii. They will learn to read critically with scientific thinking and hypothesis construction iii. Develop skills in critical evaluation iv. Improve written and oral communication skills with better understanding the research process

SEM-V

Course No. & Description	Title	Credits	Course Outcome
BBT 501 Core Course –Theory	Biostatistics	3	i. Students will be acquainted with basic principles of statistics ii. They will learn the graphical representation of data in various ways iii. They will learn concept of frequency, probability and various iv. They will be introduced to correlation, regression, analysis of variance, estimation of significance v. Students will learn application of spread sheets and statistical packages SPSS and PSPP
BBT 502 Core Course –Theory	Clinical Biotechnology	3	i. Understand the role and importance of biochemical tests in diagnosis and monitoring the therapy of diseases ii. They will have the technical understanding of specimen collection and processing; analysis of blood and urine iii. They will have knowledge of liver function abnormalities and lipid profile analysis iv. Learn importance of acid, base and electrolyte balance v. They will be acquainted with pathophysiology of carbohydrates, lipids and proteins
BBT 503 Core Course –Theory	Recombinant DNA Technology	3	i. The course will provide knowledge of basic principle and techniques involved in recombinant DNA technology ii. Students will gain technical concepts of various vectors and its manipulation iii. They will learn cloning strategies, development of genomic/cDNA libraries and expression of genes iv. They will have an overview of applications in agriculture, environment and medicine
BBT 504 Core Course –Theory	Food Biotechnology	3	i. Students will know the role of microorganisms in dairy and food

			industry ii. Learn the techniques for fermentation of cheese, bread, wine. iii. Understand the role of biotechnology in food industry, Preservation and processing of food
BBT 505 Core Course-Practical	Practicals in Clinical Biotechnology	3	i. Learn to make blood smear and take differential count ii. Estimations of hemoglobin, glucose, ketone bodies, urea creatinine and proteins iii. Learn principle and method of glucose tolerance, liver function and kidney function tests iv. Learn CSF and urine analysis
BBT 506 Core Course-Practical	Practicals in Recombinant DNA Technology	3	i. Students will learn the principle and methodology of preparation of competent cells, isolation of plasmid and transformation of plasmid DNA, restriction digestion and ligation of vector DNA ii. Student knowledge of Manipulation of genes, Transfer techniques, Expression systems and methods of selection
BBT 507 Core Course-Practical	Practicals in Food Biotechnology	3	i. Student will understand the role of biotechnology in food industry, Preservation and processing of food ii. They will learn the plate count of dairy products, determination of milk quality, water quality, presence of enteric pathogens and food adultration iii. They will learn the method of cheese production
BBT 508 Open Course V	Elective Biotechnology for forensics OR Biodiversity ORInformation security	2	i. Understand the basic principles and biotechnology methods used for foresnsics ii. Learn methods for collection and storage of biological samples iii. Understand the chemical, microscopic, molecular and serological methods of sample analysis iv. Will know court room testimony

			i. The Biodiversity course will help the students to understand the importance of ecological balance and human well-being. ii. They will have an overview of major biomes in the world iii. Gain knowledge of biodiversity, its threats and methods for sustainable ecosystem
BBT 509 General Course V	Elective Innovative ideas in Biotechnology	2	i. Students will think in terms of innovation and technology dvelopment ii. Apply the understanding and knowledge of biotechnology to find solution for the local issues/problems iii. Use the new skills and continue to independently learn more about the area of innovations,

SEM-VI

Course No. & Description	Title	Credits	Course Outcome
BBT 601 Core Course –Theory	Animal Biotechnology	3	i. Gain knowledge of Biotechnology applications in animal and livestock welfare ii. They will learn the methods of animal cloning and development of transgenic animals for various applications iii. Students will learn the technique of Animal Tissue Culture and its importance in basic and advance research iv. Will understand the principle and methodologies for vaccine, monoclonal antibodies and therapeutic proteins v. Know the properties, types and applications of stem cells
BBT 602 Core Course –Theory	Bioprocess Technology & Quality Control	3	i. Understand the basic principles and concepts of bioprocess technology ii. Will learn the production of biopharmaceuticals, biofuels, and industrial enzymes iii. They will know the design of fermenters and steps involved in downstream process iv. They will learn the parameters of quality control, packaging and product development process
BBT 603 Core Course –Theory	Plant Biotechnology	3	i. Gain an overview of various types of plant tissue culture; their micropropagation and strategies ii. Use of molecular marker assisted techniques for germplasm, taxonomic and plantbreeding studies iii. Production of secondary metabolites, genetic engineering methods and applications
BBT 604 Core Course –Theory	Basics of Bioinformatics	3	i. Gain an overview of the Bioinformatics discipline ii. Students will be introduced to biological databases and search engines iii. They will learn bibliographic and nucleotide sequence databases

			iv. Will gain knowledge of protein sequence databases, alignment and analysis v. Analysis of biological data and their interpretation by using software.
BBT 605 Core Course-Practical	Practicals in Animal Tissue Culture	3	i. Learn the concept of sterility, aseptic techniques and GLP ii. Will learn preparation of media, reagents and cell handling as well as routine maintenance iii. Will gain hands on practice for cell counting, microplate seeding and cellular assays
BBT 606 Core Course-Practical	Practicals in Plant Tissue Culture	3	i. Learn working in sterile environment ii. Will learn media preparation, micropropagation of monocot and dicot plants, organ and callus cultures iii. Will gain hands on training on microspore cultures and agrobacterium mediated transformation
BBT 607 Core Course-Practical	Exercises in Computer Applications & Bioinformatics	3	i. Students will know resources and search engines of biological and bibliographic databases ii. Understand various nucleotide sequence databases, sequence alignment and analysis iii. Will know protein databases, analysis tools and their analysis
BBT 608 Open Course VI	Elective Entrepreneurship in Biotechnology Elective Business management in Biotechnology	2	i. Students will have an overview of biotechnology industry ii. They will know about various agri, health and environment based industries iii. Understand the process of entrepreneurship development, production, project management, capital raising and role in Indian economy iv. Role of management, staff recruitment, motivation, leadership, packaging, advertising, pricing and start up process of biotechnology company v.

BBT 609 General Course VI	Scientific writing	2	i. Students will learn to select a topic of interest and write a review on available literature for the topic ii. The process will make the students understand technical ways of literature search, mining of relevant information and its analysis iii. Develop technical and scientific writing skills

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SEM-I

Course No. & Description	Title	Credits	Course Outcome
MBT&MedBT 101 Core Course-Theory	Microbiology	3	i. This course will help students to acquire skills and competency in microbiological laboratory practices applicable to microbiological research or clinical methods, including accurately reporting observations and analysis, applications of Microorganisms in various fields. ii. Understand principle and genetic exchange mechanisms in bacteria iii. Classification, structure, reproduction and economic importance of unicellular eukaryotic microorganisms iv. Knowledge of bacterial and plant viruses v. Principles of infection and pathogenicity of various pathogens vi. Antimicrobial chemotherapy
MBT&MedBT 102 Core Course – Theory	Biochemistry	3	i. Students will be imparted knowledge about structure and function of different biomolecules (proteins, lipids, nucleic acids, and carbohydrates), synthesis and metabolism of biomolecules. ii. Students will learn principles of thermodynamics and bioenergetics iii. They will gain detailed knowledge of classification, nomenclature and mechanism of action of enzymes iv. They will have learnt in detail the metabolic pathways for synthesis and breakdown of carbohydrates, lipids and nitrogen in the body v. Bioenergetics and regulation of above pathways.
MBT&MedBT 103 Core Course –	Cell & Developmental	3	i. Students will be able to identify prokaryotic and eukaryotic cells and sub-cellular organelles by microscopic

Theory	Biology		examinations ii. Skill in observing mitosis and meiosis in onion root tip cells iii. Learn enumeration of blood cells using hemocytometer chamber iv. The course aims to provide concepts in gametogenesis, meiosis and embryology v. Have awareness of types and patterns of cleavages during embryo development vi. Know about developmental plasticity in embryo development vii. Patterning, abnormal development and teratogenesis
MBT&MedBT 104 Core Course – Theory	Genetics	3	i. Gain knowledge of Mendelian and Non-Mendelian principles of inheritance ii. Learn structure of chromosomes, its segregation during cell division and generation of numerical and structural chromosomal abnormalities iii. Techniques for genetic analysis iv. Learn molecular basis of sex determination and associated characteristics v. Familiarity with applied and evolutionary genetics.
MBT&MedBT 105 Core Course – Theory	Molecular Biology	3	i. Students will know structure and properties of nucleotides; Watson and Crick's structure of DNA double helix; Structures and types of RNAs ii. Types and consequences of various mutations iii. Organizations of prokaryotic and eukaryotic genomes iv. Students will be acquainted with modern techniques for analysis of nucleic acids.
MBT&MedBT 106 Core Course – Practical	Biochemistry & Molecular Biology Lab	4	i. Students will have understanding of good laboratory practices, safe handling of equipment's, safety, accuracy and reliability ii. Preparations of buffers and solutions iii. Quantitative estimations of biomolecules and determination of lambda max iv. Learn thin layer chromatography v. Students will learn the safety, precision parameters, preparation of buffers and stock/working solutions vi. Learn isolation of DNA and RNA from prokaryotic and eukaryotic sources vii. Students will gain skills for quantitative and qualitative analysis of DNA and RNA preparations
MBT&MedBT 107	Cell Biology &	4	i. Students will be able to identify

Core Course – Practical	Genetics Lab		prokaryotic and eukaryotic cells and sub-cellular organelles by microscopic examinations ii. Skill in observing mitosis and meiosis in onion root tip cells iii. Learn enumeration of blood cells using hemocytometer chamber iv. Will have experienced staining and observing chromosomes from specimen samples v. Study for effect of mutagenic agents on seeds vi. Isolation, cultivation and study of first eukaryotic multicellular organism (C. elegance) as well as drosophila.
MBT&MedBT 108 Core Course – Practical	Microbiology Lab	2	i. Gain acquaintance with microbiology laboratory practices ii. Get introduced to microscopy iii. Techniques for pure culture, monochrome, gram and negative staining iv. Understand growth curve properties, staining of capsule, spore, cell wall and granules of bacteria.

SEM-II

Course No. & Description	Title	Credits	Course Outcome
MBT&MedBT 201 Core Course –Theory	Genetic Engineering	3	i. The course will provide knowledge of basic principle and techniques involved in recombinant DNA technology ii. Students will gain technical concepts of various vectors and its manipulation iii. They will learn cloning strategies, development of genomic/cDNA libraries and expression of genes iv. They will have an overview of applications in agriculture, environment and medicine.
MBT&MedBT 202 Core Course –Theory	Analytical Biotechnology	3	i. Students will learn the principle and applications for analytical techniques ultrafiltration, centrifugation, MALDI-TOF, Chromatography, Magnetic Resonance etc. ii. Students will know various analytical techniques in biological research. iii. The course will enhance the employability of the candidates in Biotechnological, Pharmaceutical Industries and Analytical Laboratories and research institutes.
MBT&MedBT 203 Core Course –Theory	Immunology	3	i. Students will learn innate and adaptive types of immunity; know the concepts of humoral and cell mediated immune response ii. Structure of antibody, organs of immune system; Classes and subclasses iii. They will learn antigen presenting cells, major histocompatibility complex, B cell and T cell differentiation iv. Knowledge of immunological diseases and immunological techniques
MBT&MedBT 204 Core Course –Theory	Genomics & Proteomics	3	i. Structure and organization of genomics and proteomics. ii. Students will be able to analyze, interpret and study biological data (sequence, structure, etc) stored in various databases available on internet. iii. The students will have an introduction to current methodologies and trends in the field of proteomics.
MBT&MedBT 205 Core Course - Theory	Nanobiotechnology	2	i. Students will learn to apply principles of engineering, biology, and chemistry to manipulate and engineer nanoscale materials for applications in medicine, diagnostics,

			environmental monitoring, and more. ii. Students will become proficient in designing and characterizing nanomaterials, exploring their interactions with biological systems, and developing innovative solutions to address complex challenges.
MedBT 206 Core Course -Theory	Human Physiology	3	i. To provide a course of study in mammalian, systems physiology, building on knowledge of basic physiological principles
MBT& Med BT 207 Core Course – Practical	Genetic Engineering and Genomics Lab	4	ii. Learning outcomes of this course are technical know-how on versatile techniques in recombinant DNA technology iii. Application of genetic engineering techniques in basic and applied experimental biology and proficiency in designing and conducting experiments involving genetic manipulation.
MBT&MedBT 208 Core Course – Practical	Analytical Techniques and Proteomics Lab	4	**i.** After completion of the course students will get hands on training on various analytical techniques in biological research. This significantly enhances the employability of the candidates in Biotechnological, Pharmaceutical Industries and Analytical Laboratories and research institutes. ii. The students should also obtain an overview and awareness of typical proteomics applications from lab work.
MBT&MedBT 209 Core Course - Practical	Immunology &Nanobiotechnology Lab	4	i. The course will provide technical knowledge knowledge of immune system deals with various pathogens, different processes and cell types involved in autoimmune disease. Synthesis and characterization of nanoparticles
MBT&MedBT 210 Elective Course I	Elective Bioentrepreneurship/ IPR I	2	i. Upon completing the Intellectual Property Rights (IPR) course, students will develop a solid understanding of the legal frameworks and principles surrounding intellectual property. ii. They will learn about various forms of intellectual property such as patents, copyrights, trademarks, and trade secrets, along with the processes for obtaining and protecting them.

SEM-III

Course No. & Description	Title	Credits	Course Outcome
MedBT 301 Core Course –Theory	Animal Tissue Culture & Stem Cell Biology	3	i. Theoretical knowledge of various topics as per the syllabus including basic cell culture techniques; Primary culture, secondary culture; Continuous cell lines; Suspension cultures; Transfection, pluripotency, stem cells. ii. Concept building in animal reproductive biology, Animal genomics and DNA forensics: Embryo transfer; Micromanipulation of animal embryos; Transgenic animal technology
MedBT 302 Core Course –Theory	Medical Biochemistry & Drug Discovery	3	i. Upon completing the Medical Biochemistry & Drug Discovery course, students will acquire a comprehensive understanding of the biochemical processes that underlie human health and disease. ii. They will learn to apply this knowledge to the field of drug discovery, exploring how molecules interact with biological systems to develop therapeutic interventions. iii. Students will become proficient in analyzing biochemical pathways, studying the mechanisms of drug action, and evaluating the efficacy and safety of potential drugs
MedBT 303 Core Course –Theory	Infectious Diseases	3	i. Studying Infectious Diseases offers students a comprehensive understanding of the causes, transmission, and impact of various infections on human health. ii. Upon completion of this course, students will be equipped to identify different types of infectious agents, including bacteria, viruses, fungi, and parasites. iii. They will gain insights into the epidemiology and factors influencing disease spread. Additionally, students will learn about the immune response to infections, diagnostic methods, and principles of infection control
MedBT 304	Pharmaceutical	3	i. The course in Pharmaceutical Biotechnology & Molecular

Core Course –Theory	Biotechnology & Molecular Diagnostics		Diagnostics offers students a comprehensive understanding of the intersection between biotechnology and pharmaceuticals, with a focus on molecular diagnostics. ii. Upon completion of the course, students will possess the knowledge and skills to develop and apply biotechnological tools for drug development and advanced diagnostic techniques. iii. They will learn about the principles of recombinant DNA technology, gene expression, and protein production.
MBT&MedBT 305 Core Course-Theory	Biostatistics	2	i. This course will help students' tools of biostatics in interpretation of biological data. ii. Students will be able to characterize data and understand different sampling methods.
MBT&MedBT 306 Core Course-Theory	Research Methodology	2	i. Course on research methodology will provide knowledge base as to how to design a research project and about different aspects involved in carrying out research. ii. Students will learn the methods of sampling, reviewing a research objective, conducting experiments and interpretation of results.
MedBT 307 Core Course-Practical	ATC & Pharma Biotech Lab	4	i. The course in Animal Tissue Culture & Pharma Biotech Lab provides students with practical expertise in animal cell culture techniques and their applications in pharmaceutical and biotechnology research. ii. Upon completion of the course, students will be adept at culturing and manipulating animal cells in controlled environments to produce biologically relevant models for drug testing, bioprocessing, and research. They will gain insights into cell behavior, growth factors, and cell line maintenance.
MedBT 308 Core Course-Practical	Infectious Diseases & Biostatistics Lab	4	i. Students will learn about the mechanisms of infection, host-pathogen interactions, and the body's immune responses. ii. The course aims to equip learners with the knowledge to identify, diagnose, and manage infectious diseases, as well as strategies for disease prevention and

			control. iii. This course will help students' tools of biostatics in interpretation of biological data. Students will be able to characterize data and understand different sampling methods.
MedBT 309 Core Course-Practical	Medical Biochemistry & Drug Discovery Lab	2	i. The Medical Biochemistry & Drug Discovery Lab course offers students practical skills in applying biochemistry principles to drug discovery processes. ii. Upon completion of the course, students will be proficient in performing laboratory techniques related to the identification, design, and testing of potential therapeutic agents.
MBT&MedBT 310 Elective Course II	Biomedical Waste Management/ Drug designing/ IPR II	2	i. The Biomedical Waste Management course educates students about the proper handling, disposal, and management of waste generated in healthcare and biomedical facilities. ii. Upon completion of the course, students will understand the potential risks associated with biomedical waste and the importance of adhering to regulations and protocols to ensure public health and environmental safety. iii. Upon completing the Intellectual Property Rights (IPR) course, students will develop a solid understanding of the legal frameworks and principles surrounding intellectual property. iv. They will learn about various forms of intellectual property such as patents, copyrights, trademarks, and trade secrets, along with the processes for obtaining and protecting them.

Sem-IV

Course No. & Description	Title	Credits	Course Outcome
MBT&MedBT 401 Core Course	Research Project	20	i. This course will include allotment of an individual research work to each student to be carried out in fourth semester. ii. This will not only enhance knowledge base of students but also provide them exposure as to how to conduct and carry out a research based task. iii. Students will also learn how to compile and interpret results.

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SEM-I

Course No. & Description	Title	Credits	Course Outcome
MBT&MedBT 101 Core Course-Theory	Microbiology	3	i. This course will help students to acquire skills and competency in microbiological laboratory practices applicable to microbiological research or clinical methods, including accurately reporting observations and analysis, applications of Microorganisms in various fields.
MBT&MedBT 102 Core Course –Theory	Biochemistry	3	i. Students will be imparted knowledge about structure and function of different biomolecules (proteins, lipids, nucleic acids, and carbohydrates), synthesis and metabolism of biomolecules.
MBT&MedBT 103 Core Course –Theory	Cell & Developmental Biology	3	i. To gain the knowledge of living cells such as prokaryotic and eukaryotic cells, formation of cells, cell adhesion and cellular signaling, role of cell division and its regulation on diseases like cancer
MBT&MedBT 104 Core Course –Theory	Genetics	3	i. Understand the concept of genes and their behavior. ii. Studying Genetics provides students with a comprehensive understanding of heredity, inheritance patterns, and the role of genes in shaping traits and characteristics in organisms.
MBT&MedBT 105 Core Course –Theory	Molecular Biology	3	i. Students will gain indepth knowledge of DNA, RNA, Central Dogma, Transcription and Translation
MBT&MedBT 106 Core Course – Practical	Biochemistry & Molecular Biology Lab	4	i. The "Biochemistry & Molecular Biology Lab" course provides hands-on experience in the practical applications of biochemistry and molecular biology principles. ii. Students will be imparted knowledge about structure and function of different biomolecules. iii. Students will engage in laboratory techniques to analyze biomolecules, study enzyme kinetics, perform DNA and RNA manipulations, and explore protein structure-function relationships.
MBT&MedBT 107 Core Course – Practical	Cell Biology & Genetics Lab	4	iv. The "Cell Biology & Genetics Lab" course offers a practical exploration of fundamental concepts in cell biology and genetics.

			v. Through laboratory exercises, students will gain hands-on experience in techniques such as cell culture, microscopy, DNA extraction, and genetic analysis. vi. By studying cellular structures, processes, and genetic inheritance patterns, participants will develop a comprehensive understanding of how cells function and how genetic information is transmitted.
MBT&MedBT 108 Core Course – Practical	Microbiology Lab	2	i. This course will help students to acquire skills and competency in microbiological laboratory practices applicable to microbiological research or clinical methods, including accurately reporting observations and analysis, applications of Microorganisms in various fields.

SEM-II

Course No. & Description	Title	Credits	Course Outcome
MBT&MedBT 201 Core Course –Theory	Genetic Engineering	**3**	i. Learning outcomes of this course are technical know-how on versatile techniques in recombinant DNA technology, application of genetic engineering techniques in basic and applied experimental biology and proficiency in designing and conducting experiments involving genetic manipulation.
MBT&MedBT 202 Core Course –Theory	Analytical Biotechnology	**3**	i. After completion of the course students will get hands on training on various analytical techniques in biological research. ii. This significantly enhances the employability of the candidates in Biotechnological, Pharmaceutical Industries and Analytical Laboratories and research institutes.
MBT&MedBT 203 Core Course –Theory	Immunology	**3**	i. The course will provide technical knowledge knowledge of immune system deals with various pathogens, different processes and cell types involved in autoimmune disease.
MBT&MedBT 204 Core Course –Theory	Genomics & Proteomics	**3**	i. Structure and organization of genomics and proteomics. Students will be able to analyze, interpret and study biological data (sequence, structure, etc) stored in various databases available on internet. ii. The students will have an introduction to current methodologies and trends in the field of proteomics
MBT&MedBT 205 Core Course - Theory	Nanobiotechnology	**2**	i. Students will learn to apply principles of engineering, biology, and chemistry to manipulate and engineer nanoscale materials for applications in medicine, diagnostics, environmental monitoring, and more. ii. Students will become proficient in designing and characterizing nanomaterials, exploring their interactions with biological systems, and developing innovative solutions to address complex challenges.
MBT 206	Animal Tissue Culture	**2**	i. Theoretical knowledge of various topics as per the syllabus including

Core Course -Theory			basic cell culture techniques; Primary culture, secondary culture; Continuous cell lines; Suspension cultures; Transfection, pleuripotency, stem cells. ii. Concept building in animal reproductive biology, Animal genomics and DNA forensics: Embryo transfer; Micromanipulation of animal embryos; Transgenic animal technology
MBT&MedBT 207 Core Course –Practical	Genetic Engineering and Genomics Lab	**4**	i. Learning outcomes of this course are technical know-how on versatile techniques in recombinant DNA technology, application of genetic engineering techniques in basic and applied experimental biology and proficiency in designing and conducting experiments involving genetic manipulation.
MBT&MedBT 208 Core Course –Practical	Analytical Techniques and Proteomics Lab	**4**	i. After completion of the course students will get hands on training on various analytical techniques in biological research. **ii.** This significantly enhances the employability of the candidates in Biotechnological, Pharmaceutical Industries and Analytical Laboratories and research institutes. iii. The students should also obtain an overview and awareness of typical proteomics applications from lab work.
MBT&MedBT 209 Core Course - Practical	Immunology & Nanotechnology Lab	**4**	i. The course will provide technical knowledge knowledge of immune system deals with various pathogens, different processes and cell types involved in autoimmune disease. Synthesis and characterization of nanomaterials
MBT&MedBT 210 Elective Course I	Bioentrepreneurship/ IPR I	**2**	i. Upon completing the Intellectual Property Rights (IPR) course, students will develop a solid understanding of the legal frameworks and principles surrounding intellectual property. ii. They will learn about various forms of intellectual property such as patents, copyrights, trademarks, and trade secrets, along with the processes for obtaining and protecting them.

SEM-III

Course No. & Description	Title	Credits	Course Outcome
MBT 301 Core Course –Theory	Environmental Biotechnology	**3**	i. Learning outcome of Environment Biotechnology is to gain the knowledge of biodiversity, bioremediation, pollution.
MBT 302 Core Course –Theory	Plant Biotechnology	**3**	i. Gain knowledge of Crop development, Callus culture, Biotechnological applications of plants
MBT 303 Core Course –Theory	Microbial Technology	**3**	i. The course will provide technical knowledge applications of Microrganisms in bioprocess industry, fermentation, downstream processing
MBT 304 Core Course –Theory	Food Biotechnology	**2**	i. Student will understand the role of biotechnology in food industry, Preservation and processing of food
MBT&MedBT 305 Core Course-Theory	Biostatistics	**2**	i. This course will help students' tools of biostatics in interpretation of biological data. ii. Students will be able to characterize data and understand different sampling methods.
MBT&MedBT 306 Core Course-Theory	Research Methodology	**2**	i. Course on research methodology will provide knowledge base as to how to design a research project and about different aspects involved in carrying out research. ii. Students will learn the methods of sampling, reviewing a research objective, conducting experiments and interpretation of results.
MBT 307 Core Course-Practical	Environment &Plant Biotech Lab	**4**	i. Learning outcome of Environment Biotechnology is to gain the knowledge of biodiversity, bioremediation, pollution. ii. Gain knowledge of Crop development, Callus culture, Biotechnological applications of plants
MBT 308 Core Course-Practical	Microbial & Food Biotech Lab	**4**	i. The course will provide technical knowledge applications of Microrganisms in bioprocess industry, fermentation, downstream processing ii. Student will understand the role of biotechnology in food industry, Preservation and processing of food

MBT 309 Core Course-Practical	Biostatistics Lab	**2**	i. This course will help students' tools of biostatics in interpretation of biological data. ii. Students will be able to characterize data and understand different sampling methods.
MBT&MedBT 310 Elective Course II	Biomedical Waste Management/ Drug designing/ IPR II	**2**	i. The Biomedical Waste Management course educates students about the proper handling, disposal, and management of waste generated in healthcare and biomedical facilities. ii. Upon completion of the course, students will understand the potential risks associated with biomedical waste and the importance of adhering to regulations and protocols to ensure public health and environmental safety. iii. Upon completing the Intellectual Property Rights (IPR) course, students will develop a solid understanding of the legal frameworks and principles surrounding intellectual property. iv. They will learn about various forms of intellectual property such as patents, copyrights, trademarks, and trade secrets, along with the processes for obtaining and protecting them.

Sem-IV

Course No. & Description	Title	Credits	Course Outcome
MBT&MedBT 401 Core Course	Research Project	20	i. This course will include allotment of an individual research work to each student to be carried out in fourth semester. ii. This will not only enhance knowledge base of students but also provide them exposure as to how to conduct and carry out a research-based task. iii. Students will also learn how to compile and interpret results.

M.Sc. Bioinformatics 2019 Course

SEMESTER I

Course No. & Description	Title	Credits	Course Outcome
MBI 101 Basic Course-Theory	Cell Biology **(C)**	**2**	i. To gain the knowledge of living cells such as prokaryotic and eukaryotic cells, formation of cells, cell adhesion and cellular signaling, role of cell division and its regulation on diseases like cancer. ii. Understand evolution of cell, structure and types of cells iii. Learn structure and function of various cell organelles iv. Explore fluid mosaic model of cell membrane and its role; active and passive transport across it v. Knowledge of structure and function of cytoskeleton elements vi. Learn cell division, cell cycle, cell interactions, signaling and cell death.
MBI 102 Basic Course –Theory	Biochemistry **(C)**	**2**	i. Students will be imparted knowledge about structure and function of different biomolecules (proteins, lipids, nucleic acids, and

			carbohydrates), synthesis and metabolism of biomolecules. ii. Gain familiarity with protein chemistry iii. Learn primary, secondary and tertiary structures of proteins and nucleic acids, role of minerals, vitamins in protein functions iv. Mononucleotides and role of cAMP v. Gain understanding of various analytical techniques used for study of biomolecules
MBI 103 Basic Course –Theory	Biomathematics **(C)**	**2**	i. They may be employed as statisticians, scientific programmers, or in areas of bio-science where training in quantitative techniques is needed. ii. Further, they are equipped to pursue graduate studies in theoretical biology, physiology, biostatistics, statistics, and areas of applied mathematics.
MBI 104 Basic Course –Theory	Biostatistics **(C)**	**2**	i. The subject and its relation with the other sciences, restate the principal concepts about biostatistics. ii. Collect data relating to variable/variables which will be examined and calculate descriptive statistics from these data. Identification of data relating to variable/variables.
MBI 105 Basic Course –Theory	C Programming and Data structure **(C)**	**3**	i. Understanding of Basics: Gain a fundamental understanding of programming concepts, including variables, data types, operators, and control structures in the C programming language. ii. Problem-Solving Skills: Develop the ability to analyze problems and design algorithms to solve them using C programming techniques. iii. Programming Proficiency: Acquire proficiency in writing, compiling, and debugging C programs to implement simple and complex tasks.
MBI 106 Basic Course – Theory	Biological Informatics **(C)**	**2**	i. i. Knowledge and Awareness of the Basic Principles and Concepts of Biology, Computer Science and Mathematics. ii. Existing Software Effectively to Extract

				Information from Large Databases and to Use This Information in Computer Modeling
MBI 107 Basic Course – Theory	DBMS & MongoDB **(C)**	**3**	i. ii. iii.	DBMS: Designs SQL queries to add data to the database, edit existing data, and to delete data from the database. Declares and enforces integrity constraints on a database. Understands and applies indexing mechanisms in databases. Will be able to describe and develop Relational Algebra and Relational Calculus queries. MongoDB: The Easiest Way to Deploy, Operate, and Scale *MongoDB* in the Cloud in Just a Few Clicks. Create Deployments in Minutes w/ *MongoDB* Atlas. Speeding Progress. Reducing TCO. Streamlines Operations. Types: Avail. on AWS, GCP, Azure, Zero-downtime migration.
MBI 108 Elective Course - Theory	PERL Programming / HTML Programming	**2**	i. ii. iii. iv. v. vi. vii. viii. ix. x. xi. xii. xiii.	Write Perl scripts to perform text processing and data manipulation tasks. Apply regular expressions effectively for pattern matching and substitution. Utilize modules from CPAN to solve various programming challenges. Develop scripts for system administration and automation. Create basic dynamic web content using Perl's CGI capabilities (if covered). Understand and implement basic programming concepts in Perl. Construct structured web pages using HTML elements for headings, paragraphs, lists, etc. Create hyperlinks to navigate between web pages and external resources. Apply semantic HTML elements for improved accessibility and search engine optimization. Embed images, audio, video, and other media using appropriate HTML tags. Understand the basics of web forms and input elements. Recognize the role of HTML in web development and its integration with CSS and JavaScript. Design and develop simple web pages using

			HTML.
MBI 109 Basic Course –Practical	Cell Biology and Biochemistry Lab **(C)**	**2**	i. Hands on practical training students will be able to identify prokaryotic and eukaryotic cells and sub-cellular organelles by microscopic examinations ii. Skill in observing mitosis and meiosis in onion root tip cells iii. Learn enumeration of blood cells using hemocytometer chamber. iv. Gain skills for isolation of proteins from biological samples v. Estimation of proteins using colorimetric and TLC methods vi. Determination of pKa values, titration curve of amino acids vii. Isolation and analysis of vitamins and pigments viii. Learn ion exchange chromatography for isolation of natural dyes
MBI 110 Basic Course –Practical	C Programming and Data Structure Lab **(C)**	**2**	i. Hands on practical training ii. Programming Proficiency: Acquire proficiency in writing, compiling, and debugging C programs to implement simple and complex tasks.
MBI 111 Basic Course –Practical	Biological Informatics Lab **(C)**	**2**	i. Hands on practical training ii. "Knowledge and Awareness of the Basic Principles and Concepts of Biology, Computer Science and Mathematics. iii. Existing Software Effectively to Extract Information from Large Databases and to Use This Information in Computer Modeling
MBI 112 Basic Course –Practical	DBMS & MongoDB lab **(C)**	**2**	i. Hands on practical training ii. DBMS: Designs SQL queries to add data to the database, edit existing data, and to delete data from the database. Declares and enforces integrity constraints on a database. Understands and applies indexing mechanisms in databases. Will be able to describe and develop Relational Algebra and Relational Calculus queries. iii. MongoDB: The Easiest Way to Deploy, Operate, and Scale *MongoDB* in the Cloud in Just a Few Clicks. Create Deployments in Minutes w/ *MongoDB* Atlas. Speeding Progress. Reducing TCO. Streamlines

				Operations. Types: Avail. on AWS, GCP, Azure, Zero-downtime migration.
MBI 113 Elective Course – Practical	PERL Programming Lab /HTML Programming Lab	**2**	i. ii. iii. iv. v. vi. vii. viii. ix. x. xi. xii. xiii. **xiv.**	Hands on practical training Write Perl scripts to perform text processing and data manipulation tasks. Apply regular expressions effectively for pattern matching and substitution. Utilize modules from CPAN to solve various programming challenges. Develop scripts for system administration and automation. Create basic dynamic web content using Perl's CGI capabilities (if covered). Understand and implement basic programming concepts in Perl. Construct structured web pages using HTML elements for headings, paragraphs, lists, etc. Create hyperlinks to navigate between web pages and external resources. Apply semantic HTML elements for improved accessibility and search engine optimization. Embed images, audio, video, and other media using appropriate HTML tags. Understand the basics of web forms and input elements. Recognize the role of HTML in web development and its integration with CSS and JavaScript. Design and develop simple web pages using HTML.

SEMESTER II

Course No. & Description	Title	Credits	Course Outcome
MBI 201 Core Course –Theory	Statistical Analysis System (SAS) **(C)**	**2**	i. Creating new knowledge (Cognitive) ii. Developing feelings and emotions (Affective) iii. Enhancing physical and manual skills (Psychomotor) iv. Learning objectives can also be scaffolded so that they continue to push student learning to new levels in any of these three categories.
MBI 202 Core Course –Theory	R and Data Analytics **(C)**	**3**	i. Master the use of the R and RStudio interactive environment. ii. Expand R by installing R packages. iii. Explore and understand how to use the R documentation. iv. Read Structured Data into R from various sources. v. Understand the different data types in R. vi. Understand the different data structures in R. vii. Proactivity & Anticipating Needs: ... viii. Mitigating Risk & Fraud: ... ix. Delivering Relevant Products: ... x. Personalization & Service: ... xi. Optimizing & Improving the Customer Experience.
MBI 203 Core Course –Theory	JAVA and BioJAVA Programming **(C)**	**3**	i. On completion of the course the student should be able to: Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs. ii. Read and make elementary modifications to Java programs that solve real-world problems.
MBI 204 Core Course –Theory	Science of Omics **(C)**	**3**	i. Students will be able to critically discuss and solve problems relating to: ii. The ways in which investigations of the four 'omics' realms (genome, transcriptome,

			proteome and metabolome) are tackled analytically; iii. The statistical approaches and workflow practices involved in genomics and in a range of transcriptomic approaches; iv. The ways in which protein functions can be understood in terms of their structures, and the relative advantages of different analytical approaches in protein structure determination; v. The relationship between the proteome and other 'omics' domains, and the ways in which the proteome can be investigated using a variety of technological approaches; vi. The source and variety of components of the metabolome and of their relationship with entities in the other 'omics' domains, and the ways in which the metabolome can be investigated using a variety of technological and statistical approaches; vii. The ways in which biological systems can be understood at a systems or network level, and the ways in which models can be constructed and analyses performed to draw biological inferences about the interactions between different parts of a network. viii. Use computers creatively to manipulate omics-level datasets and protein structure files; ix. Use computer programs to execute a variety of planned analyses in several areas relating to omics domains and to protein structure; x. Critically evaluate and synthesize the results of omics-level analyses to draw biological inferences
MBI 205 Core Course - Theory	Proteomics **(C)**	**2**	i. The students will have an introduction to current methodologies and trends in the field of proteomics. The students should also obtain an overview and awareness of typical proteomics applications both from lectures

			and an introduction to proteomics lab work. ii. After completed course the student should be able to describe and discuss the possibilities and advantages, and the complexity and drawbacks of various proteomics technologies compare traditional methods with emerging technologies. The student should be able to suggest suitable approaches for specified applications and motivate the choice speculate and argue about the future of proteomics technologies. With the acquired knowledge, the students should be able participate in scientific discussions regarding proteomics technologies critically evaluate scientific results.
MBI 206 Core Course -Theory	Molecular Biology	**2**	i. Students will know structure and properties of nucleotides; Watson and Crick's structure of DNA double helix; Structures and types of RNAs ii. Types and consequences of various mutations iii. Organizations of prokaryotic and eukaryotic genomes iv. Students will be acquainted with modern techniques for analysis of nucleic acids
MBI 207 Core Course -Theory	Recombinant DNA Technology	**2**	i. Learning outcomes of this course are technical know-how on versatile techniques in recombinant DNA technology, application of genetic engineering techniques in basic and applied experimental biology and proficiency in designing and conducting experiments involving genetic manipulation. ii. The course will provide knowledge of basic principle and techniques involved in recombinant DNA technology iii. Students will gain technical concepts of various vectors and its manipulation. iv. They will learn cloning strategies, development of genomic/cDNA libraries

			and expression of genes v. They will have an overview of applications in agriculture, environment and medicine.
MBI 208 Core Course-Theory	Structural Biology and Molecular Modeling	**3**	i. Students learn the basics of mathematical modeling and computer biomolecular systems, dynamics and simulation of selected regulatory processes using the methods of mechanic and molecular dynamics, Monte-Carlo methods, molecular models, and the basics of systems theory. ii. Students become familiar with well-known and popular molecular modeling and design packages as well as the virtual reality technology. iii. The lecture and exercises prepare students for independent modeling of biomolecular systems and designing of enzyme inhibitors – potential drugs.
MBI 209 Core Course - Practical	SAS and Data Analytics lab **(C)**	**2**	i. Hands on practical training ii. . Creating new knowledge (Cognitive) iii. Developing feelings and emotions (Affective) iv. Enhancing physical and manual skills (Psychomotor) v. Learning objectives can also be scaffolded so that they continue to push student learning to new levels in any of these three categories. vi. Master the use of the R and RStudio interactive environment. vii. Expand R by installing R packages. viii. Explore and understand how to use the R documentation. ix. Read Structured Data into R from various sources. x. Understand the different data types in R. xi. Understand the different data structures in R. xii. Proactivity & Anticipating Needs: ... xiii. Mitigating Risk & Fraud: ... xiv. Delivering Relevant Products: ... xv. Personalization & Service: ... xvi. Optimizing & Improving the Customer

			Experience.
MBI 210 Core Course - Practical	JAVA and BioJAVA Programming lab **(C)**	**2**	i. Hands on practical training ii. On completion of the course the student should be able to: Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs. Read and make elementary modifications to Java programs that solve real-world problems.
MBI 211 Core Course - Practical	Omics Analysis Lab **(C)**	**2**	i. Hands on practical training ii. The ways in which investigations of the four 'omics' realms (genome, transcriptome, proteome and metabolome) are tackled analytically; iii. The statistical approaches and workflow practices involved in genomics and in a range of transcriptomic approaches; iv. The ways in which protein functions can be understood in terms of their structures, and the relative advantages of different analytical approaches in protein structure determination; v. The relationship between the proteome and other 'omics' domains, and the ways in which the proteome can be investigated using a variety of technological approaches; vi. The source and variety of components of the metabolome and of their relationship with entities in the other 'omics' domains, and the ways in which the metabolome can be investigated using a variety of technological and statistical approaches; vii. The ways in which biological systems can be understood at a systems or network level, and the ways in which models can be constructed and analyses performed to draw biological inferences about the interactions between different parts of a network. viii. Use computers creatively to manipulate omics-level datasets and protein structure files;

			ix. Use computer programs to execute a variety of planned analyses in several areas relating to omics domains and to protein structure; x. Critically evaluate and synthesize the results of omics-level analyses to draw biological inferences
MBI 212 Core Course - Practical	Molecular Biology and Recombinant DNA Technology lab	**2**	i. Students will learn the principle and methodology of preparation of competent cells, isolation of plasmid and transformation of plasmid DNA, restriction digestion and ligation of vector DNA ii. Student knowledge of Manipulation of genes, Transfer techniques, Expression systems and methods of selection. iii. Students will gain the knowledge of isolation of nucleic acids (DNA and RNA) from prokaryotic and eukaryotic sources. iv. They will learn qualitative and quantitative analysis of nucleic acids v. They will learn and observe the preparation of polytene chromosomes from chironomous larvae.
MBI 213 Core Course- Practical	Structural Biology and Molecular Modeling Lab	**2**	i. Hands on practical training ii. Students learn the basics of mathematical modeling and computer biomolecular systems, dynamics and simulation of selected regulatory processes using the methods of mechanic and molecular dynamics, Monte-Carlo methods, molecular models, and the basics of systems theory. iii. Students become familiar with well-known and popular molecular modeling and design packages as well as the virtual reality technology. **iv.** The lecture and exercises prepare students for independent modeling of biomolecular systems and designing of enzyme inhibitors – potential drugs.

SEMESTER III

Course No. & Description	Title	Credits	Course Outcome
MBI 301 Core Course –Theory	Scientific Writing Skills	**2**	i. The SWS *course* aims developing knowledge and *skills* in *scientific writing* from the basic level; therefore, there are no requirements for the initial competence. ii. A goal of scientific writing is to communicate scientific information clearly and concisely. Flowery, ambiguous, wordy, and redundant language run counter to the purpose of the writing. It must be set within the context of other published work.
MBI 302 Advance Course –Theory	Chemoinformatics and Drug Designing	**3**	i. The student should be able to: Have the knowledge of the basic ligand/structure-based drug design¬ approaches. ii. Understand the basic algorithms used in the established software to¬ carry out the most common CADD project. iii. Understand the importance of proper use of various parameters in¬ cheminformatics application programs. Practical use of various computational tools available for computer¬ aided drug design including 2D/3D structural database.
MBI 303 Advance Course- Theory	Machine Learning Techniques	**3**	i. Develop an appreciation for what is involved in learning models from data. ii. Understand a wide variety of learning algorithms. iii. Understand how to evaluate models generated from data.
MBI 304 Advance Course- Theory	Current Bioinformatics	**2**	i. **Current Bioinformatics:** The learning objectives of the course is that the student demonstrates the ability to: Describe the basic principles for the most common NGS platforms such as Illumina, Ion torrent, Roche 454 and Pacific biosciences

			ii. Explain the advantages and disadvantages with the different NGS platforms and describe which of the platforms would be most optimal to study the genome, epigenome and transcriptome. iii. Explain the different steps of Illumina sequencing (DNA library synthesis, DNA sequencing and data analysis). iv. Describe different biochemical methods applied to enrich different parts of the genome and transcriptome before sequencing. v. Synthesize and quality control DNA libraries for Illumina sequencing – synthesis, purification and multiplexing. vi. Understand and apply different types of quality control methods before, during and after Illumina DNA library synthesis. vii. Understand the output data files from Illumina sequencing and be able to perform the most basic NGS analysis (demultiplexing, genome alignment and DNA quantification). viii. Use different types of NGS analysis tools.
MBI 305 Advance Course –Theory	Python Programming	**2**	i. Python programming is intended for software engineers, system analysts, program managers and user support personnel who wish to learn the Python programming language. Learning Outcomes: Problem solving and programming capability.
MBI 306 Elective Course- Theory	Introduction to Clinical Trials and Pharmacovigilance / Selenium	**2**	i. At the end of the course students will be able to; ii. Explain the regulatory requirements for conducting clinical trial iii. Describe in detail about various types of clinical trial designs iv. Explain the responsibilities of key players involved in clinical trials v. Describe the documentational

			requirements for Clinical trials vi. Explain Adverse drug reaction and its management vii. Describe basic concepts, and establishment of Pharmacovigilance viii. Explain ADR reporting, methods and tools used in Pharmacovigilance ix. Describe Pharmacoepidemiology, Pharmacoeconomics and safety pharmacology.
MBI 307 Elective Course- Theory	Cancer Genomics/ Biodiversity Informatics & Molecular Phylogenetics	**2**	**i. Cancer Genomics:** ii. Understand basic aspects of cancer pathology. What is cancer? Understand chromatin as it relates to gene expression. iii. Understand epigenetics and somatic genetic changes in tumors. iv. Understand modern aspects of RNA and protein biology. v. Understand the cell cycle, angiogenesis and apoptosis. vi. Be familiar with basic facets of carcinogenesis and methods to study the process. Be familiar with basic principles and applications of cell culture and animal models to study cancer. vii. Understand how genetics contributes to predisposition and progression of cancer. viii. Understand the differences and overlap of cancers by tissue type. ix. Understand how immunotherapy is, and can be, used to treat human illness: strategies, advantages, and hurdles to overcome to realize its potential. x. Biological Nomenclature & Species Description xi. Practical Aspects of Phylogenetic Data Collection & Analysis xii. The role of Phylogenetic Biology in Biological Problem Solving xiii. A Survey of the History of Life on Earth xiv. Principles of Bioinventory, Biodiversity Conservation
MBI 308	System	**2**	i. Understand the basics of Systems

Elective Course- Theory	Biology/Artificial Intelligence		Biology approaches in biological systems; apply systems approaches to the analysis of biological systems; apply model driven experimentation to solve biological questions; analyze biological systems in a systems-wide manner. ii. Artificial Intelligence: Students will be familiar with AI and its applications in biology.
MBI 309 Advance Course- Practical	Chemoinformatics and Drug Designing Lab	**2**	i. Hands on practical training ii. The student should be able to: Have the knowledge of the basic ligand/structure-based drug design¬ approaches. iii. Understand the basic algorithms used in the established software to¬ carry out the most common CADD project. iv. Understand the importance of proper use of various parameters in¬ cheminformatics application programs. Practical use of various computational tools available for computer¬ aided drug design including 2D/3D structural database.
MBI 310 Advance Course- Practical	Machine Learning Techniques Lab	**2**	i. Hands on practical training ii. Develop an appreciation for what is involved in learning models from data. iii. Understand a wide variety of learning algorithms. iv. Understand how to evaluate models generated from data.
MBI 311 Advance Course- Practical	Current Bioinformatics Lab	**2**	i. Hands on practical training ii. Explain the advantages and disadvantages with the different NGS platforms and describe which of the platforms would be most optimal to study the genome, epigenome and transcriptome. iii. Explain the different steps of Illumina sequencing (DNA library synthesis, DNA sequencing and data analysis). iv. Describe different biochemical methods applied to enrich different parts of the

			genome and transcriptome before sequencing. v. Synthesize and quality control DNA libraries for Illumina sequencing – synthesis, purification and multiplexing. vi. Understand and apply different types of quality control methods before, during and after Illumina DNA library synthesis. vii. Understand the output data files from Illumina sequencing and be able to perform the most basic NGS analysis (demultiplexing, genome alignment and DNA quantification). viii. Use different types of NGS analysis tools.
MBI 312 Advance Course -Practical	Python Programming Lab	**2**	i. Hands on practical training ii. Problem solving and programming capability.
MBI 313 Elective Course- Practical	Introduction to Clinical Trials and Pharmacovigilance Lab / Selenium lab	**2**	i. Using tools for clinical trial studies and pharmacovigilance

Course No. & Description	Title	Credits	Course Outcome
MBI 401 Core Course	Research Project	20	i. This course will include allotment of an individual research work to each student to be carried out in fourth semester. ii. This will not only enhance knowledge base of students but also provide them exposure as to how to conduct and carry out a research-based task. iii. Students will also learn how to compile and interpret results.

SEMESTER IV

Advanced Diploma in Bioinformatics 2019 Course

SEMESTER I

Course No. & Description	Title	Credits	Course Outcome
ADB 101 Basic Course-Theory	Cell Biology **(C)**	**2**	i. To gain the knowledge of living cells such as prokaryotic and eukaryotic cells, formation of cells, cell adhesion and cellular signaling, role of cell division and its regulation on diseases like cancer. ii. Understand evolution of cell, structure and types of cells iii. Learn structure and function of various cell organelles iv. Explore fluid mosaic model of cell membrane and its role; active and passive transport across it v. Knowledge of structure and function of cytoskeleton elements vi. vi. Learn cell division, cell cycle, cell interactions, signaling and cell death.
ADB102 Basic Course –Theory	Biochemistry **(C)**	**2**	i. Students will be imparted knowledge about structure and function of different biomolecules (proteins, lipids, nucleic acids, and carbohydrates), synthesis and metabolism of biomolecules. ii. Students will be imparted knowledge about structure and function of different biomolecules (proteins, lipids, nucleic acids, and carbohydrates), synthesis and metabolism of biomolecules. iii. Gain familiarity with protein chemistry iv. Learn primary, secondary and tertiary structures of proteins and nucleic acids, role of minerals, vitamins in protein functions v. Mononucleotides and role of cAMP vi. Gain understanding of various analytical techniques used for study of biomolecules
ADB103 Basic Course –Theory	Biomathematics **(C)**	**2**	i. They may be employed as statisticians, scientific programmers, or in areas of bio-science where training in quantitative

			techniques is needed. ii. Further, they are equipped to pursue graduate studies in theoretical biology, physiology, biostatistics, statistics, and areas of applied mathematics.
ADB104 Basic Course –Theory	Biostatistics **(C)**	**2**	i. The subject and its relation with the other sciences, restate the principal concepts about biostatistics. ii. Collect data relating to variable/variables which will be examined and calculate descriptive statistics from these data. Identify data relating to variable/variables
ADB105 Basic Course –Theory	C Programming and Data structure **(C)**	**3**	i. Understanding of Basics: Gain a fundamental understanding of programming concepts, including variables, data types, operators, and control structures in the C programming language. ii. Problem-Solving Skills: Develop the ability to analyze problems and design algorithms to solve them using C programming techniques. iii. Programming Proficiency: Acquire proficiency in writing, compiling, and debugging C programs to implement simple and complex tasks.
ADB106 Basic Course – Theory	Biological Informatics **(C)**	**2**	i. Knowledge and Awareness of the Basic Principles and Concepts of Biology, Computer Science and Mathematics. ii. Existing Software Effectively to Extract Information from Large Databases and to Use This Information In Computer Modeling
ADB107 Basic Course – Theory	DBMS & MongoDB **(C)**	**3**	i. DBMS: Designs SQL queries to add data to the database, edit existing data, and to delete data from the database. Declares and enforces integrity constraints on a database. Understands and applies indexing mechanisms in databases. Will be able to describe and develop Relational Algebra and Relational Calculus queries.

			ii. MongoDB: The Easiest Way to Deploy, Operate, and Scale MongoDB in the Cloud in Just a Few Clicks. Create Deployments in Minutes w/ MongoDB Atlas. Speeding Progress. Reducing TCO. Streamlines Operations. Types: Avail. on AWS, GCP, Azure, Zero-downtime migration.
ADB108 Elective Course - Theory	PERL Programming / HTML Programming	**2**	i. Write Perl scripts to perform text processing and data manipulation tasks. ii. Apply regular expressions effectively for pattern matching and substitution. iii. Utilize modules from CPAN to solve various programming challenges. iv. Develop scripts for system administration and automation. v. Create basic dynamic web content using Perl's CGI capabilities (if covered). vi. Understand and implement basic programming concepts in Perl. vii. Construct structured web pages using HTML elements for headings, paragraphs, lists, etc. viii. Create hyperlinks to navigate between web pages and external resources. ix. Apply semantic HTML elements for improved accessibility and search engine optimization. x. Embed images, audio, video, and other media using appropriate HTML tags. xi. Understand the basics of web forms and input elements. xii. Recognize the role of HTML in web development and its integration with CSS and JavaScript. xiii. Design and develop simple web pages using HTML.
ADB109 Basic Course –Practical	Cell Biology and Biochemistry Lab **(C)**	**2**	i. Students will be able to identify prokaryotic and eukaryotic cells and sub-cellular organelles by microscopic examinations ii. Skill in observing mitosis and meiosis in onion root tip cells

			iii. Learn enumeration of blood cells using hemocytometer chamber. iv. Gain skills for isolation of proteins from biological samples v. Estimation of proteins using colorimetric and TLC methods vi. Determination of pKa values, titration curve of amino acids vii. Isolation and analysis of vitamins and pigments viii. Learn ion exchange chromatography for isolation of natural dyes.
ADB110 Basic Course –Practical	C Programming and Data Structure Lab **(C)**	**2**	i. Hands on practical training ii. Programming Proficiency: Acquire proficiency in writing, compiling, and debugging C programs to implement simple and complex tasks.
ADB111 Basic Course –Practical	Biological Informatics Lab **(C)**	**2**	i. Hands on practical training ii. "Knowledge and Awareness of the Basic Principles and Concepts of Biology, Computer Science and Mathematics. iii. Existing Software Effectively to Extract Information from Large Databases and to Use This Information in Computer Modeling
ADB112 Basic Course –Practical	DBMS & MongoDB lab **(C)**	**2**	iv. Hands on practical training v. DBMS: Designs SQL queries to add data to the database, edit existing data, and to delete data from the database. Declares and enforces integrity constraints on a database. Understands and applies indexing mechanisms in databases. Will be able to describe and develop Relational Algebra and Relational Calculus queries. vi. MongoDB: The Easiest Way to Deploy, Operate, and Scale *MongoDB* in the Cloud in Just a Few Clicks. Create Deployments in Minutes w/ *MongoDB* Atlas. Speeding Progress. Reducing TCO. Streamlines Operations. Types: Avail. on AWS, GCP, Azure, Zero-downtime migration.

ADB113 Elective Course – Practical	PERL Programming Lab /HTML Programming Lab	**i. 2**	ii. Hands on practical training iii. Write Perl scripts to perform text processing and data manipulation tasks. iv. Apply regular expressions effectively for pattern matching and substitution. v. Utilize modules from CPAN to solve various programming challenges. vi. Develop scripts for system administration and automation. vii. Create basic dynamic web content using Perl's CGI capabilities (if covered). viii. Understand and implement basic programming concepts in Perl. ix. Construct structured web pages using HTML elements for headings, paragraphs, lists, etc. x. Create hyperlinks to navigate between web pages and external resources. xi. Apply semantic HTML elements for improved accessibility and search engine optimization. xii. Embed images, audio, video, and other media using appropriate HTML tags. xiii. Understand the basics of web forms and input elements. xiv. Recognize the role of HTML in web development and its integration with CSS and JavaScript. **xv.** Design and develop simple web pages using HTML.

SEMESTER II

Course No. & Description	Title	Credits	Course Outcome
ADB 201 Core Course –Theory	Statistical Analysis System (SAS) **(C)**	**2**	i. Creating new knowledge (Cognitive) ii. Developing feelings and emotions (Affective) iii. Enhancing physical and manual skills (Psychomotor) iv. Learning objectives can also be scaffolded so that they continue to push student learning to new levels in any of these three categories.
ADB 202 Core Course –Theory	R and Data Analytics **(C)**	**3**	i. Master the use of the R and RStudio interactive environment. ii. Expand R by installing R packages. iii. Explore and understand how to use the R documentation. iv. Read Structured Data into R from various sources. v. Understand the different data types in R. vi. Understand the different data structures in R. vii. Proactivity & Anticipating Needs: ... viii. Mitigating Risk & Fraud: ... ix. Delivering Relevant Products: ... x. Personalization & Service: ... xi. • Optimizing & Improving the Customer Experience.
ADB 203 Core Course –Theory	JAVA and BioJAVA Programming **(C)**	**3**	i. On completion of the course the student should be able to: Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs. ii. Read and make elementary modifications to Java programs that solve real-world problems.
ADB 204 Core Course –Theory	Science of Omics **(C)**	**3**	i. Students will be able to critically discuss and solve problems relating to: i. The ways in which investigations of the four 'omics' realms (genome, transcriptome, proteome and metabolome) are tackled analytically;

			ii. The statistical approaches and workflow practices involved in genomics and in a range of transcriptomic approaches; iii. The ways in which protein functions can be understood in terms of their structures, and the relative advantages of different analytical approaches in protein structure determination; iv. The relationship between the proteome and other 'omics' domains, and the ways in which the proteome can be investigated using a variety of technological approaches; v. The source and variety of components of the metabolome and of their relationship with entities in the other 'omics' domains, and the ways in which the metabolome can be investigated using a variety of technological and statistical approaches; vi. The ways in which biological systems can be understood at a systems or network level, and the ways in which models can be constructed and analyses performed to draw biological inferences about the interactions between different parts of a network. vii. Use computers creatively to manipulate omics-level datasets and protein structure files; viii. Use computer programs to execute a variety of planned analyses in several areas relating to omics domains and to protein structure; ix. Critically evaluate and synthesise

			the results of omics-level analyses to draw biological inferences
ADB 205 Core Course - Theory	Proteomics **(C)**	**2**	i. The students will have an introduction to current methodologies and trends in the field of proteomics. ii. The students should also obtain an overview and awareness of typical proteomics applications both from lectures and an introduction to proteomics lab work. iii. After completed course the student should be able to describe and discuss the possibilities and advantages, and the complexity and drawbacks of various proteomics technologies compare traditional methods with emerging technologies. iv. The student should be able to suggest suitable approaches for specified applications and motivate the choice speculate and argue about the future of proteomics technologies. With the acquired knowledge, the students should be able participate in scientific discussions regarding proteomics technologies critically evaluate scientific results.
ADB 206 Core Course -Theory	Advanced Bioinformatics	**2**	i. Current Bioinformatics: The learning objectives of the course is that the student demonstrates the ability to: ii. Describe the basic principles for the most common NGS platforms such as Illumina, Iontorrent, Roche 454 and Pacific biosciences iii. Explain the advantages and disadvantages with the different NGS platforms and describe which of the platforms would be most optimal to study the genome, epigenome and

			transcriptome. iv. Explain the different steps of Illumina sequencing (DNA library synthesis, DNA sequencing and data analysis). v. Describe different biochemical methods applied to enrich different parts of the genome and transcriptome before sequencing. vi. Synthesize and quality control DNA libraries for Illumina sequencing – synthesis, purification and multiplexing. vii. Understand and apply different types of quality control methods before, during and after Illumina DNA library synthesis. viii. Understand the output data files from Illumina sequencing and be able to perform the most basic NGS analysis (demultiplexing, genome alignment and DNA quantification). ix. • Use different types of NGS analysis tools.
ADB 207 Core Course -Theory	Data Mining through Machine Learning	**2**	i. Develop an appreciation for what is involved in learning models from data. ii. Understand a wide variety of learning algorithms. iii. Understand how to evaluate models generated from data.
ADB 208 Core Course-Theory	Molecular Modeling & Drug Designing	**3**	i. The student should be able to: Have the knowledge of the basic ligand/ structure based drug design¬ approaches. ii. Understand the basic algorithms used in the established software to¬ carry out the most common CADD project.
ADB 209 Core Course - Practical	SAS and Data Analytics lab **(C)**	**2**	i. Learning and using SAS software for analytical purposes
ADB 210 Core Course - Practical	JAVA and BioJAVA Programming lab **(C)**	**2**	i. On completion of the course the student should be able to: Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs. Read and make elementary modifications to Java

			programs that solve real-world problems.
ADB 211 Core Course - Practical	Omics Analysis Lab **(C)**	**2**	Students will be able to critically discuss and solve problems relating to: i. The ways in which investigations of the four 'omics' realms (genome, transcriptome, proteome and metabolome) are tackled analytically; ii. The statistical approaches and workflow practices involved in genomics and in a range of transcriptomic approaches; iii. The ways in which protein functions can be understood in terms of their structures, and the relative advantages of different analytical approaches in protein structure determination; iv. The elationship between the proteome and other 'omics' domains, and the ways in which the proteome can be investigated using a variety of technological approaches; v. The source and variety of components of the metabolome and of their relationship with entities in the other 'omics' domains, and the ways in which the metabolome can be investigated using a variety of technological and statistical approaches; vi. The ways in which biological systems can be understood at a systems or network level, and the ways in which models can be constructed and analyses performed to draw biological inferences about the interactions between different parts of a network. vii. Use computers creatively to manipulate omics-level datasets and protein structure files; viii. Use computer programs to execute a variety of planned analyses in several areas relating to omics domains and to protein structure; ix. Critically evaluate and synthesize the

			results of omics-level analyses to draw biological inferences
ADB 212 Core Course - Practical	Data Mining through Machine Learning lab	**2**	i. Develop an appreciation for what is involved in learning models from data. ii. Understand a wide variety of learning algorithms. iii. Understand how to evaluate models generated from data.
ADB 213 Core Course- Practical	Molecular Modeling & Drug Designing Lab	**2**	i. Performing docking studies to understand basic ligand/structure-based drug design¬ approaches.