

**Jaypee University of Information Technology, Waknaghat****Department of Biotechnology & Bioinformatics****B.TECH. BIOTECHNOLOGY****CORE THEORY COURSES: OUTLINES****SEMESTER- I**

<b>Course Code</b>	<b>Course Name</b>
<b>10B11PD111</b>	<b>PRESENTATION AND COMMUNICATION SKILL</b>
	Concept and Nature of Communication, Theoretical inputs into the process of communication, its different types, Stages of communication, Channels of communication, Communication in organizational settings, Listening, Non verbal communication, Effective presentation, Technical Writing Process.
<b>10B11MA111</b>	<b>MATHEMATICS-I</b>
	Two dimensional coordinate Geometry: Distance between two points, Equations of line & circle, ellipse and parabola, Equation of a tangent to a curve and area of a triangle; Matrices and Determinants: Algebra of matrices. Properties of determinants. Some simple type of matrices. Inverse of a matrix. Solution of equations; Complex Numbers: Definition, Algebra, Complex conjugate, Modulus and amplitude, Polar form, DeMoivre's theorem, Roots of complex numbers and Simple functions; Sets, Relations and Functions: Union, intersection and compliment, Mapping or function, One-one, onto mappings, Inverse and composite mappings; Differential Calculus: Basic concept of limit and continuity, Derivative, Rules of differentiation, Tangent to a curve, Taylor's series and Maxima and minima and Integral Calculus: Antiderivative, Fundamental theorem of calculus (statement only), Integrals of elementary functions, Substitution and partial fractions, Definite integral as a limit of sum, Properties of definite integrals and application to areas and lengths
<b>10B11BT111</b>	<b>FUNDAMENTAL BIOLOGY</b>
	Biological Classification: Five Kingdom Classification. Monera, Protista, Fungi, Plantae and Animalia. Characteristics of the Five Kingdoms, Kingdom Monera: Archaeobacteria, Eubacteria Bacteria of different shapes, Kingdom Protista: Chrysophytes, Dinoflagellates, Euglenoids, Slime Moulds, Protozoans, Kingdom Fungi: Phycomycetes, Ascomycetes, Basidiomycetes, Deuteromycetes, Kingdom Plantae: Algae, Bryophytes, Pteridophytes, Gymnosperms, Angiosperms, Plant Life Cycles and Alternation of Generations, Kingdom Animalia: Basis of classification, Level of organization, Symmetry, Diploblastic and Triploblastic Organisation, Coelom, Segmentation, Notochord, Classification of Animals. Phylum – Porifera, Coelenterata (Cnidaria), Ctenophora, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca, Echinodermata, Hemichordata, Chordata, Basics of Molecular Biology and the components involve in molecular biology, Carbohydrates: Structure, function and synthesis, Lipid: Structure and function and synthesis, Protein structure and functions, Nucleic acids; DNA and RNA and their structure and function in detail, DNA replication, Transcription,

	Translation.
<b>10B11PH111</b>	<b>PHYSICS-I</b>
	Interference, Diffraction and Polarization of Light, Special Theory of Relativity, Lorentz Transformations and Mass-Energy Equivalence, Laws of Radiation, Compton Scattering, Atomic Spectra, Angular Momenta, Atom in Magnetic Field, Classical and Quantum Statistical Distributions, Principle and Working of Different Types of Lasers.
<b>10B11EC111</b>	<b>ELECTRICAL CIRCUIT ANALYSIS</b>
	Introduction: Basic components and electric circuits, Voltage and current laws, basic nodal and mesh analysis and other techniques, Capacitors and inductors, basic RL, RC AND RLC circuit, Sinusoidal steady-state analysis, AC circuit power analysis, Two-port networks, Multi-port network, Polyphase circuits, Magnetically coupled circuits
<b>10B11CI111</b>	<b>INTRODUCTION TO COMPUTERS AND PROGRAMING</b>
	Basic Computer Architecture. Programming Language hierarchy. Program translation and execution. Algorithms, Pseudo codes and flowcharts. Program design and Basic SDLC. Program as State machine. Basic Testing and Debugging. Number system. Character & Instruction Representation. Structured Programming. Selection. Control Flow. Looping control structure. Arrays and Strings. Pointers. Functions. Structures and Unions. Enumerations. Preprocessor. Iteration. Recursion. Dynamic Memory Allocation. Linked-lists. File I/O. Basic Graphics. C Libraries. User defined header files.
<b>SEMESTER- II</b>	
<b>10B11PD211</b>	<b>GROUP AND COOPERATIVE PROCESSES</b>
	Individual: Ability, Personality, Perception, Learning, Attitudes, Values, Assertiveness, Emotional Intelligence. Group: Definition, Characteristics of a group, Group formation, Group structure, Group dynamics, Group cohesion, Group Performance, Group decision making. Teams: Definition, Origin of work teams, Types of teams, Principles of team work, Team structure, Team process, Decision making in teams. Motivation: Concept of motivation, Key elements, theories of motivation and their Implications, Motivating by changing work, Employee empowerment. Leadership : Concept of leadership, Approaches of leadership, Neocharismatic Theories, Developing leadership.
<b>10B11MA201</b>	<b>MATHEMATICS-II</b>
	Sequence and series: Convergence and divergence, Fourier series; Vectors and Coordinate Geometry (3D): Simple applications to geometry and mechanics, Unit vectors, vectors $i$ , $j$ and $k$ , Components of a vector, Position vector, Direction cosines and direction ratios, Dot and cross products, Projection of a vector on another, Distance between two points, Equations of a line, plane and sphere, Intersections and Shortest distance between lines; Calculus of two or more variables: Partial differentiation, Taylor's series, Differentiation of a vector, Tangent to a curve, Gradient of a scalar, Tangent to a surface, Integration of a vector, Line integral, Double integral and Change to polar coordinates; Differential Equations: Definitions of order, degree, linear, nonlinear, homogeneous and non-

	homogeneous, Solution of first order equations, Complementary function and particular integral, Initial and boundary value problems, Linear differential equations with constant coefficients, Cauchy-Euler equation and Solution in series; Numerical Methods: Method of least squares, Newton-Raphson method, linear and quadratic interpolation, Simpson's rule and Runge-Kutta method.
<b>10B11PH212</b>	<b>BIOPHYSICAL TECHNIQUES</b>
	Introduction to Molecular Spectroscopy, Molecular spectroscopy, spectral lines, Microwave spectroscopy, Infrared Spectroscopy, Raman spectroscopy, Electronic spectroscopy of diatomic and polyatomic molecules and their applications, ESR and NMR, X-ray crystallography. Mass spectroscopy, Electron microscopy (TEM & SEM) and applications.
<b>10B11EC211</b>	<b>BASIC ELECTRONICS DEVICES AND CIRCUITS</b>
	Semiconductors, Diode, applications, Breakdown diodes, Bipolar junction Transistor, Field Effect Transistors, Transistor amplifier, Feedback in amplifiers, Sinusoidal oscillators, Operational amplifiers, Number systems, Logic gates, Boolean Theorems
<b>10B11CI211</b>	<b>DATA STRUCTURES</b>
	Interactive Software. Problem analysis and Data design. Introduction to Complexity Analysis. Searching and Sorting Algorithms. Algorithm Visualization. Data Representation and Data Types. Abstract Data Types. Array based, Linked, Indexed, and Simulated pointer based storage. Orthogonal Lists. Sparse matrices. List of list. Doubly linked lists. Stack. Recursion removal. Queue. Dequeue. Buffer. Discrete event simulation. Tree. Binary Tree. K-ary Tree. BST. Tree traversal. Quad Tree, Octree. Graphs and graph traversal.
<b>SEMESTER- III</b>	
<b>10B11PD311</b>	<b>MANAGERIAL ECONOMICS</b>
	Introduction: Introduction to Managerial Economics (including some topics of Macroeconomics). Basics of Demand, Supply and Equilibrium: Demand, Supply, Equilibrium, Elasticity, Regression Analysis, Demand Forecasting. Production and Cost Analysis: Production, Cobb-Douglas production function, Isocost, Isoquant, Optimality, Economies of Scale and Scope, Cost, Operating Leverage, Break-Even. Market Structure: Perfect Competition, Monopoly, Monopolistic and Oligopoly.
<b>10B11MA311</b>	<b>PROBABILITY &amp; STATISTICS</b>
	Some basic concepts; Data and its presentation: Raw data and its graphical presentation by bars, pie-charts; Frequency distribution: histogram, frequency polygon, frequency curve, stem and leaf plot and their utility to identify the underlying distribution; Measures of central tendency- mean, median and mode. Dispersion and its measures, box plot; Probability: Random experiment, sample space, event; Types of events: basic approaches to probability, additive and multiplicative laws of probability, conditional probability, partition of sample space, total probability theorem and Bayes theorem; Random variable: the density and cumulative distribution function of a random variable; Determination of mean and variance, using the moment generating function of a random variable. Bernoulli, binomial, Poisson, normal and exponential distributions and their

	applications; Sampling and Statistical Inference: Random sample from binomial, Poisson, normal and exponential distributions and estimation of their parameters by the method of maximum likelihood; Tests of significance, Type I & II errors and their rates. Concept of p-value, testing the hypothetical value(s) of the parameter(s) of one and two normal distributions using Z, t, chi-square and F distributions and related confidence intervals; Chi-square test of goodness of fit and independence of attributes (2x2 contingency); Correlation and regression: Bivariate data, scatter diagram, product moment and rank correlation coefficients; Simple and multiple linear regression; ANOVA and simple designs: One-way and two-way, ANOVA; Concept of three basic principles of design of experiment, CRD and RBD and Statistical quality control: Meaning, natural and tolerance limits; and R, p, and c charts.
<b>10B11BT311</b>	<b>THERMODYNAMICS AND CHEMICAL PROCESS</b>
	Laws of thermodynamics, Concept of entropy, Applications to compression and expansion processes. Solution thermodynamics - Excess properties of mixtures, Gibb's free energy, Gibbs-Duhem equation, Chemical reaction equilibrium, Free energy and chemical reactions, Equilibrium constant and its evaluation, Phase equilibrium, Gibbs phase rule, Fugacity as criterion of equilibrium, Vapour-liquid equilibrium, Completely miscible liquids, Thermodynamics of biomolecules, Chemical Processes: importance of chemical process Calculations, Material balances in systems involving physical changes and chemical Changes, Energy balances for non reacting and reacting systems.
<b>10B11BT312</b>	<b>BIOCHEMISTRY</b>
	Cell structure and function, Exploring biomolecules, Enzymes: basic concepts and kinetics, catalytic and regulatory strategies, Membrane structure and dynamics, Introduction to signal transduction cascades, Metabolic Energy: generation, storage and regulation strategies, Metabolism and regulation of carbohydrate, Fatty acids, Amino acids, Nucleic acids, Metabolic disorders.
<b>10B11BT313</b>	<b>MICROBIOLOGY</b>
	History of microbiology, Classification of microorganisms, Growth and physiology, Different methods of microbial enumeration, Microbial metabolism and photosynthesis, Fermentation, Anaerobic respiration, Pathogenic microorganisms (bacteria, fungi, protozoa, and viruses, etc), Host-pathogen interactions, Microbes in industry, Extremophiles, Bioprospecting of microbes
<b>SEMESTER- IV</b>	
<b>10B11PD411</b>	<b>FINANCIAL MANAGEMENT</b>
	Introduction, scope and objectives, Types of Business, Financial System, Sources of Finance, Financial statement analysis, Capital Structure & Leverages: Operating Leverage, Financial Leverage, Combined Leverage, EBIT-EPS Analysis, Cost of capital: Concept and Calculation, Time Value of Money- PV, FV, Amortization, Capital Budgeting: Techniques- PB, DPB, NPV, IRR, Cash Flows, Working capital management: Concept, Business Cycle, Policies, Computation of Working Capital, Dividend policy.
<b>10B11PH411</b>	<b>BIOMATERIAL SCIENCE</b>
	Structure of Bio-Materials and Bio-Compatibility: Definition and classification of

	<p>bio-materials, mechanical properties, visco-elasticity, surface properties, Chemical, Thermal, Electrical and Optical properties, wound-healing process, body response to implants, blood compatibility; Implant Materials (Metals and Ceramics): Metallic implant materials, stainless steels, co-based alloys, Ti-based alloys, ceramic implant materials, aluminium oxides, hydroxyapatite glass ceramics carbons, medical applications; Implant Materials (Polymeric and Composite): Polymerisation, polyolefin, polyamides, Acrylic, polymers, rubbers, high strength thermoplastics, medical applications; Tissue Replacement Implants: Soft-tissue replacements, sutures, surgical tapes, adhesive, percutaneous and skin implants, maxillofacial augmentation, blood interfacing implants, hard tissue replacement implants, internal fracture fixation devices, joint replacements; Artificial Organs: Artificial Heart, Prosthetic Cardiac Valves, Limb prosthesis, Externally Powered limb Prosthesis, Dental Implants</p>
<b>10B11GE411</b>	<b>ENVIRONMENTAL STUDIES</b>
	<p>The Multidisciplinary nature of environmental studies: Definition, scope and importance, Need for public awareness, Types of Ecosystems, World Biomes, Ecosystem functioning, Biogeochemical cycles. Natural resources, their consumption &amp; Protection: Water, Land Energy (Renewable, non-renewable, wind, solar, hydro, Biomass), Mineral, Forest, &amp; Food resources, Role of an individual in conservation of natural resources, Equitable use of resources. Pollution- a threat to environment: Air, Water &amp; Land pollution, sources &amp; causes, Space pollution, Electronic waste pollution, causes &amp; effects, toxicity limits of pollutants. Critical issues concerning global Environment (Urbanization, population growth, global warming, climate change, acid rain, ozone depletion etc.) and the Roots in: Cultural, Social, Political, Commercial, industrial, territorial domains. Biodiversity loss: Diversity of flora and fauna, species and wild life diversity, Biodiversity hotspots, threats to biodiversity Environmental Impact assessment: Objectives of impact assessment, Study of impact parameters, Methods for impact identification, Economics. Environmental standards &amp; Quality: Air, Water &amp; Soil Quality, Pollutant sampling, pollution control systems. Sustainable building, Urban planning, Disaster Management and Contingency Planning, Modern safety systems. Sustainability &amp; Planned reversal of human destruction to environment: redevelopment of brown fields, energy plantations, social forestry, engineering aspects of Re-use &amp; Recycling, biogas for marginal income groups, organic farming, eco-consumerism, dematerialization, green technologies, eco-tourism. Regulation of technology and innovation, Policy and law: Environmental Laws &amp; Regulations (Different Acts – Environmental Protection Act, Air and Water Acts, Wildlife and Forest Acts), US-EPA, National Environmental Policy; Function of pollution control boards (SPCB and CPCB), their roles and responsibilities, Eco-mark Scheme, Laws relating to Urbana and Rural land use, Ethics. Case studies: Industry – Environment interface. Field Work: Explore the surrounding flora &amp; fauna (Study of common plants, insects, birds document environmental assets), documentation of industries in local region and their possible effects, measure of water, air and land quality, Visit to a local polluted site-Urban/Rural /Industrial / Agricultural, Study of simple ecosystems-pond, river, hill slopes etc.</p>
<b>10B11BT411</b>	<b>GENETICS</b>

	DNA-the hereditary material, Cell division, Mendelian genetics and beyond Mendelism, Chromosomes and chromosome theory of inheritance, Linkage, crossing over and mapping, Extra Chromosomal Inheritance, Sex determination and sex chromosomes, Mutations and their role in Evolution, Population genetics, Genetic disorders.
<b>10B11BT412</b>	<b>CELL CULTURE TECHNIQUES</b>
	Cell culture materials and tools, Growth conditions and other requirements for establishment and maintenance of plant and animal cells, Cell lines and tissues, <i>In vitro</i> conservation, Protoplast and haploid culture, Micro propagation, Animal cell cultivation, Primary culture, De-aggregation, Growth kinetics of cells in culture, Large scale production of biologicals in plant and animal cells, Stem cell technology and regenerative medicine.
<b>10B11BT413</b>	<b>MOLECULAR BIOLOGY</b>
	Central dogma of molecular biology, DNA as genetic material, Structure of DNA and RNA, Physical and chemical properties of nucleic acids, DNA super coiling, Basic techniques of molecular Biology, DNA damage and repair, DNA replication, Gene structure in prokaryotes and eukaryotes, DNA transcription and RNA processing, Genetic code and protein synthesis, Gene regulation, Post-translational modifications, Phage structure and biology.
<b>SEMESTER- V</b>	
<b>10B11PD511</b>	<b>SOCIAL AND LEGAL ISSUES</b>
	Social Structure and Institutions, Social Stratification, Social Inequalities: Overview, Rights and privileges of citizens, Public policy for Technology, Corporate Social responsibility, Ethics : Business Ethics and Values, Factory Act ,1942 – Overview, Labour Law – Overview, Minimum Wages Act, Child labour, Contract Act & Sales of Goods Act : Definition , Sale and Agreement to sell, Condition and Warranty, Consumer Protection Act, IT ACT 2000, Right to Information Act, Environment Protection Act, Corporate Governance.
<b>10B11BT511</b>	<b>INTRODUCTION TO BIOINFORMATICS</b>
	Sequence retrieval and analysis, Bio-algorithms, Biological databases and their search, Sequence alignment and construction of phylogenetic trees, Gene predictions, RNA and protein structure prediction, Use of bioinformatics tools in biotechnology biopharma.
<b>10B11BT512</b>	<b>PROCESS ENGINEERING</b>
	Microbial process development, Bioreactor systems including utilities, Fluid flow and mixing, Flow behavior, Mixing, Power consumption and Shear properties of rushton turbine, Helical, anchor, Bubble column, External loop, Airlift etc, Heat transfer: different modes of heat transfer, Design equation for maximum biomass production, Mass transfer in microbial processes, Modes of culture: batch, fed batch, continuous, recycle, Fluidized bed bioreactors and immobilized bioreactors, Scale up of microbial processes with case studies related applications in various biotech and biopharma industries.
<b>10B11BT513</b>	<b>GENETIC ENGINEERING</b>
	Concepts in genetic engineering, Enzymes in genetic engineering, Cloning vehicles, BAC / YAC vectors, Construction and screening of genomic libraries,

	Gene cloning strategies, DNA sequencing and mutagenesis, Cloning and expression of transgenes in prokaryotic and eukaryotic systems, PCR technologies, Gene transfer in plant and animals, Molecular markers, Applications and impact of rDNA technology, Ethical issues and biosafety regulation
<b>10B11BT514</b>	<b>IMMUNOLOGY</b>
	Basic immunology, Types of immunity, T-cells and B-cells, Antigen-antibody reaction, Cytotoxicity, Cellular and molecular aspects of antigens, Antibody structure, Function and diversity, T-cell receptors, Regulation of immune response and immunological tolerance, Complement system, Autoimmunity, Hypersensitivity, Tumor immunity, Tissue and organ transplantation, MHC and HLA, Hybridoma technology, Immunity against infectious diseases, Vaccines, Immunodeficiency diseases, Antibody engineering.
<b>10B11BT515</b>	<b>GLP &amp; INSTRUMENTATION</b>
	Historical background of GLPs, Organization and personnel, Animal care facilities, Separation and isolation of animals, Animal supply facilities, Facilities to handle test articles and control articles, Specimen / data storage, Testing facilities operation, Safety in the laboratory, Material safety, Environmental safety, Occupational hazardous safety management, Waste management and disposal, Emergency care, First aid in accidents and poisoning, Conduct of non-clinical studies, Theory, instrumentation and applications of Visible, UV, IR, NMR and MS spectroscopy, Centrifugation: types of centrifugation techniques, rotors, tubes, Gradient materials, Fermenter, Chromatography, Electrophoretic techniques: PAGE, isoelectric focusing, DNA agarose analysis by Gel Doc, Radio isotope techniques: detection and measurement of radioactivity, Geiger Muller counters, Scintillation counting, Autoradiography and RIA
<b>SEMESTER- VI</b>	
<b>10B11PD611</b>	<b>PROJECT MANAGEMENT</b>
	Introduction, Selection of project, Risk analysis of the project, Project organization, Planning the project, Budgeting and financing the project, Scheduling (Gantt chart, PERT, CPM), Resource allocation and monitoring, Project control, Project completion
<b>10B11BT611</b>	<b>COMPARATIVE AND FUNCTIONAL GENOMICS</b>
	Genes and genomes, High throughput genome sequencing, Model genomes, Genome annotation, Phylogenomics, Haplotyping, SNP technologies, Proteomics, Protein evolution, Pharmacogenomics, Gene expression profiling, Global gene cloning and expression platforms and technologies, Microarrays (DNA, RNA, proteins), Gene-knock out and silencing technologies, Protein-protein interactions, MALDI-TOF MS, LC-MS MS, High throughput identification of biomarkers.
<b>10B11BT612</b>	<b>FOOD AND AGRICULTURAL BIOTECHNOLOGY</b>
	Biotechnological strategies for producing specific food ingredients, Nutraceuticals and functional foods, Single cell cProteins, Probiotics, Food processing and engineering technologies, Biotechnology and food security, Biotechnological approaches in production of therapeutics and industrial products in animals and plants.
<b>10B11BT613</b>	<b>CELL AND DEVELOPMENTAL BIOLOGY</b>

	Biology of cell organelles and cytoskeleton, Membrane transport, Regulation of cell cycle and cell death, Principles of developmental biology, Developmental mutants, Transgenic organisms in development, Genes in development of Unicellular models: <i>Dictyostelium discoideum</i> , Multicellular models: <i>C. elegans</i> , <i>Drosophilla</i> , Chick, <i>Mus musculus</i> , <i>A. thaliana</i> , Vertebrate limb and organ development.
<b>10B11BT614</b>	<b>FERMENTATION AND DOWN STREAM PROCESSING</b>
	Modes of cell culture, Mathematical modeling of batch, fed batch, continuous, recycle continuous cultures, Cell growth kinetics, Operating considerations for bioreactors, Suspension and immobilized Cultures, Enzyme kinetics for fluidized and immobilized enzymes, Bioprocess considerations for animal and plant cell culture. Different modes of sterilization (batch, continuous), Rate of nutrient degradation, Theory of depth filters, mixed cultures, high throughput and industrial scale purification and recovery of end products.
<b>10B11BT615</b>	<b>DIAGNOSTICS AND VACCINE MANUFACTURE TECHNOLOGIES</b>
	General introduction, Collection and shipment of diagnostic specimens, Bio-safety and Bio-security in the veterinary/medical microbiology laboratory and animal facilities, Quality management in veterinary/medical testing laboratories, Principles of validation of diagnostic assays for infectious diseases, Validation and quality control of polymerase chain reaction methods used for the diagnosis of infectious diseases, Laboratory methodologies for bacterial antimicrobial susceptibility testing, Biotechnology in the diagnosis of infectious diseases and vaccine development, Principles of veterinary vaccine production, Tests for sterility and freedom from contamination of biological materials, Guidelines for international standards for vaccine banks, The role of official bodies in the international regulation of veterinary biologicals, Recent developments in vaccine technology.

## B.TECH. BIOTECHNOLOGY

### ELECTIVE THEORY COURSES: OUTLINES (For 7<sup>th</sup> & 8<sup>th</sup> SEMESTER)

<b>10B1WBT419</b>	<b>CANCER BIOLOGY</b>
	Tumor pathology and epidemiology, Tumor viruses and oncogenes, Intracellular signalling, Tumor suppressors, Multi-step carcinogenesis and Tumor progression, Genetic instability in cancer, Tumor-host interactions, Invasion and metastasis, Tumor immunology, Cancer therapy.
<b>10B1WBT432</b>	<b>ANTIBODY ENGINEERING AND MANUFACTURING TECHNIQUES</b>
	Antibody structure and function, Traditional methods for antibody productions, Human antibodies, Selecting and screening recombinant antibody libraries, Regulatory issues for the development of antibody therapeutics, Patents related to antibodies, Manufacture of antibodies, Engineered antibody fragments and the rise of single domains, Arming antibodies, Prospects and challenges for immuno-conjugates, Monoclonal antibody therapy of cancer and diseases, Recombinant antibodies in the clinic.
<b>10B1WBT433</b>	<b>GENE THERAPY</b>
	Overview of gene therapy, Principles of molecular genetics based therapies and



	treatment with recombinant proteins or genetically engineered vaccines, The technology of classical gene therapy, Retroviral vector for cell and gene therapy, Adenovirus vector for cell and gene therapy, Adeno-associated virus for gene delivery, Lentiviral vectors for gene delivery, Development of RNAi therapeutics, Suicide gene therapy, Stem cell and gene therapy, Gene therapy strategies for genetic disorder, Cardiovascular gene and cell therapy, Cardiovascular gene and cell therapy, Gene therapy strategies for neoplastic diseases, Ethical and safety issues in gene therapy.
<b>10B1WBT731</b>	<b>STEM CELLS AND HEALTHCARE</b>
	General characteristics of various kinds of stem cells and the mechanisms by which they carry out their functions, Ethical consideration facing stem cell research, Stem cell: Categories, Sources, Isolation, Signalling, Role in regenerative medicine, Stem cell banking and guidelines pertaining to stem cell research in India and abroad.
<b>10B1WBT733</b>	<b>BIOTERRORISM</b>
	Historical perspectives, Dangers of bio-warfare/terrorist acts, Estimates of socioeconomic impact, Biological agents employed against plants and animals, Anti-human biological agents: types and characteristics, Anthrax, Plague, Tularemia, Q fever, Smallpox, Viral hemorrhagic fevers, Viral equine encephalitis, Botulism, Ricin, Staphylococcus enterotoxin B (SEB) (Diagnosis, treatment prevention, control and potential use as bio-weapon), Bioethics and prevention of the misuse of biological sciences, Other possibilities and future concerns
<b>10B1WBT735</b>	<b>INDUSTRIAL PLANT TISSUE CULTURE</b>
	Plant tissue culture and micropropagation at a glance, Various routes and stages of micro propagation, Designing commercial tissue culture Units, Cost reduction and scale up of commercial micro propagation, New innovations to make commercial micro propagation efficient, Industrial production phyto-chemicals and secondary metabolites through plant cell cultures.
<b>10B1WBT736</b>	<b>PROTEIN ENGINEERING AND APPLICATIONS</b>
	Introduction to protein engineering, Molecular evolution, Combinatorial methods, Phage display and related methods, Methods of random mutagenesis, Expression of proteins in different systems, Engineering to improve purification processes, Applications of protein engineering.
<b>10B1WBI731</b>	<b>HIGH THROUGHPUT SCREENING TECHNIQUES</b>
	Defining high throughput screening techniques and their applications, Microarray and high throughput screening of genes, General protocols, types, fabrication and printing of microarray, Hybridization, Image segmentation, Data acquisition, Data normalizations, analysis and clustering, Protein array and high throughput screening of proteins, Screening and annotation of genes and proteins based on <i>in silico</i> approaches, Structure and ligand based approaches of screening of lead molecules
<b>10B1WBI732</b>	<b>MICROBIAL GENOMICS</b>
	Introduction to microbial world, Microbes of importance to: environment, health, energy, agriculture, and industry, Microbial genetics: bacteria, fungi, viruses etc, Organization of microbial genomes, Microbial genome sequencing and analysis,

	Case studies of selected bacteria and fungi, Microbial genome databases, Bioinformatics tools for comparative genome analysis, Genome evolution, Genome engineering (reduced genome, pathway engineering, genome transplantation in bacteria), Microbial genome arrays, Microbial bio-prospecting: industrial sectors, markets, and strategies, Extremophiles: genomics for discovery of novel genes and metabolites, Metagenomics: technologies and applications, Microbial e-Cell: concept and applications, Functional genomics of microbes: technologies and applications.
<b>11B1WBT832</b>	<b>IPR AND BIOETHICS</b>
	Introduction of IP and protection of IPR, Classification of IP (copyright, trademark, trade secret, industrial designs, IC and TK) and their procedures of protection, International IP treaties, International agreements relevant to biotechnology associated IP, Drafting patent application, Documentation, Registration, Patent Search databases, Revocation of patent, Litigation and infringement, Licensing and IP frame work and management, WIPO, EPC, WTO, GATT, UPOV India and TRIPS, Commercialization of biotechnology Patents, Plant breeders rights, Bioethics and biosafety, Biopiracy, Traditional knowledge vis-à-vis owner rights.
<b>11B1WBT834</b>	<b>FERMENTED FOOD PRODUCT TECHNOLOGY</b>
	Introduction, Microbiology and biochemistry of fermentation, Composition and nutrition of fermented products, Sensory evaluation of fermented foods, Bioreactors in food fermentation, Packaging of fermented food products, Economics of fermented products, Case studies: oriental fermented food and fruit-based alcoholic beverages, Production of single cell proteins, Fermented meat products, Fermented fruits and vegetables.
<b>11B1WBT835</b>	<b>STRESS PROTEINS IN MEDICINE</b>
	Overview of the structure and function of stress proteins, Stress Proteins as molecular chaperones, Clinical implications of the stress Response, Stress proteins in aging and disease, Stress proteins expression in diseased tissue, Stress proteins and specific immune responses, Heat shock proteins as emerging therapeutic targets.
<b>11B1WBT836</b>	<b>MANUFACTURING PROCESSES &amp; QC</b>
	Introduction to product development in pharmaceutical company, Process development, operation and system, Formulation development and of regulatory affairs involved in pharmaceutical industry, Manufacturing steps in pharmaceutical industry, Discovery of biopharmaceuticals, Initial product characterization, Unit operations in the production of biopharmaceuticals, Final product formulation, Product analysis, Manufacturing processes in: food, beverage and Dairy industry.
<b>11B1WBT837</b>	<b>CLINICAL TRIALS AND DATABASE MANAGEMENT</b>
	Types of clinical research, Study, Design, Treatment allocation, Randomization and stratification, Quality control, Sample size requirements, Patient consent and interpretation of results. Students design a clinical investigation data base in their own field of interest.
<b>11B1WBT838</b>	<b>GENETIC COUNSELLING</b>
	Genetic counselling overview, Diagnostic testing and management of genetic

	disorders, Human chromosomal, allelic, autosomal recessive and autosomal dominant disorders, Muscle, neurological and neoplastic disorders, Genetic basis, molecular mechanisms, management and possible available therapies, Gene therapy: principles and use in treatment of these disorders, Ethics of human gene therapy, Prenatal genetic counselling, Genetic counselling risk assessment and ethical issues.
<b>11B2WBT851</b>	<b>SYSTEM BIOLOGY</b>
	System biology approaches, Genetic network analysis, System discovery, Modelling complex biological system, Metabolic pathway analysis, Mass/Flux balance analysis, Simulation of regulatory pathways, System approaches to metabolic networks, Protein-protein interaction networks, Biocircuits: blocks and designing, case studies, E-cell project and applications in drug testing a case study.
<b>11B2WBT853</b>	<b>IMMUNOINFORMATICS</b>
	Immuno-informatics—the new kid in town, Immunological data and databases, Immuno-informatics prediction tools and algorithms for epitopes and antigens, Cancer informatics, Immune system response modelling and simulation, Applications of immune-informatics.