### Uttarakhand Technical University

**B.TECH (BIOTECHNOLOGY)**

**IV YEAR, SEMESTER VII**

<table>
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<tr>
<th>S.No.</th>
<th>Subject Code</th>
<th>Subject Title</th>
<th>Contact Hours / Week</th>
<th>Evaluation Scheme</th>
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<td><strong>THEORY SUBJECTS</strong></td>
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* Any one Elective to be opted from the list of open Elective subjects.

** The students will go to various organizations for practical training in summer vacations after semester VI. The presentation and evaluation will be done in semester VII.

***Project marks for { Stage I}

CT - Cumulative Test      TA - Teacher's Assessment      ESE- End Semester Examination
Unit I
Introduction: Elements of Quantum Mechanics: Quantization of energy, Atomic structure wave equation, Quantum Mechanical Tunnelling

Unit II

Unit III

Unit IV
Muscular movement: Molecular structure of muscle - actin, myosin, troponin, tropomyosin, physico & bio chemical events, muscle contraction, Mechanical properties of skeletal muscles, mechanical model of muscle. Mechanical events of muscle contraction, Force velocity, Power velocity and Tension, Length relationship curves.

Unit V
Ion channels: Neurons, synopsis, Action potential and its propagation through nerve fiber. Neural networks. Photo chemical events of vision

Recommended Books:
3. Biophysics an introduction; Rodney Cotton II
4. An introduction to Neural computing - Aleksander & Morten
PLANT BIOTECHNOLOGY

TBT 702

Unit I
Introduction Definition, Classical versus modern approach. Production of disease free plants explant, shoot tip culture, shoot tip grafting. Micropropagation Basic technique, Automation in the area scope as an commercial venture.

Unit II
Tissue Culture as some of Genetic Variability Somaclonal and gametoclonal variation, Selection, Sources and causes of variation, Application in crop improvement.

Unit III
Protoplast Related Techniques Protoplast, Isolation, Culture and fusion, Selection of hybrid cells, regeneration of hybrid plants, somatic hybridization and cybridization, Applications in crop improvement. Plant as Biofactories Concept, Production of Chemicals, Pigments, Perfume, Flavors, Insecticides, anticancer agents and other important compounds.

Unit IV
Transformation Techniques Physical methods, Agrobacterium, Mediated transformation Transgenics Basic concept and essential steps of the process, Some examples of transgenic plants, Use of suitable promoters, Gene silencing and measures to overcome it, Commercial aspects of the technology.

Unit V
Nitrogen Fixation Basic concepts, nif genes and their regulation, potential scope in crop Improvement. Transformation of organelles: Methods and success, advantages of organller transformation.Molecular Markers Concept, SNPs, RAPD, RFLP, ISSR, STMS, role in crop improvement and genome mapping.

Text / Reference Books
3. Transgenic plants – Lindsey and Jones
4. Plants, genes & crop improvement, Crispeels – ASPB, 2002
5. Agricultural Biotechnology – A. Altman.
FOOD BIOTECHNOLOGY
TBT 703

Unit I
History of Microorganisms in food, Historical Developments. role and significance of microorganisms in foods. Intrinsic and Extrinsic Parameters of Foods that affect microbial growth., (pH, Moisture content, Water activity, Oxidation reduction Potential, Nutrient content, Biological Structure and Other inhibitory substance).

Unit II
Microorganism important in Food microbiology: Yeast, Mould, Protozoa, Helminthes, Bacteria and Viruses, Contamination of Food From soil, water, air and through handling and during. Processing, General principle of Spoilage, cause of spoilage, Factor affecting and Kind and number of Microorganism in Food.

Unit III

Unit IV
Food fermentation: Bread, Beer, Cheese Production, SCP, medical foods, probiotics and health benefits of fermented milk and foods products. Food borne Illness by Bacillus cereus, Salmonellae, Clostridium perfringens and Enteropathogenic E. coli.

Unit V
Quality control of Food, Detection of food borne pathogen, Bacteriology of Water, Microbiology of the food product, Good Manufacturing Practice.

Text / Reference Books:
1. Total bacterial count of Food sample
2. Detection of presence of Coliforms in water sample
3. MPN test
4. MBRT test for testing the quality of Milk
5. Detection and identification of Salmonella from meat.
6. Yeast and Mould count in food sample
BIOMEDICAL SIGNAL PROCESSING  
TEC 034

Unit 1
Introduction to Bio-Medical Signals: Classification, Acquisition and Difficulties during Acquisition Basics of Electrocardiography, Electroencephalography, Electromyography & electro-retinography. Role of Computers in the Analysis, Processing, Monitoring & Control and image reconstruction in bio-medical field

Unit 2
ECG: Measurement of Amplitude and Time Intervals, QRS Detection (Different Methods), ST Segment Analysis, Removal of Baseline Wander And Power line Interferences, Arrhythmia Analysis, Portable Arrhythmia Monitors

Unit 3
Data Reduction: Turning Point algorithm, AZTEC Algorithm, Fan Algorithm, Huffman and Modified Huffman Coding, Run Length Coding.

Unit 4
EEG: Neurological Signal Processing, EEG characteristic, linear prediction theory, Sleep EEG, Dynamics of Sleep/Wake transition. Study of pattern of brain waves, Epilepsy-Transition, detection and Estimation.

Unit 5

TEXT BOOKS
2. Biomedical Signal Processing, D.C Reddy McGrawhill
3. Biomedical Instrumentation and Measurement., Crommwell, Weibel and Pfeifer, PHI

REFERENCE BOOKS:
Biomedical Signal Analysis A Case Study Approach, Rangaraj M. Rangayyan, John Wiley and Sons Inc.
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*Any one Elective to be opted from the list of Departmental Electives I.

**Any one Elective to be opted from the list of Departmental Electives II.

** *Project marks for { Stage II}
List of Departmental electives

Elective 1

1. Herbal biotechnology
2. Biotechnology & Entrepreneurship Development
3. Vaccine Biotechnology
4. Cancer Biology
5. Industrial Biotechnology

Elective II

1. Drug Designing
2. Metabolic Engineering
3. Nano-Biotechnology
4. Molecular Diagnostics and Therapeutics
5. Biosensors
ANIMAL BIOTECHNOLOGY
TBT 803

Unit I

**Introduction to Animal Tissue Culture:** Background, Advantages, Limitations, Application, Culture Environment, Cell Adhesion, Cell Proliferation, Differentiation Structure and organization of animal cell and equipments and material for animal cell culture technology.

Unit II


Unit III

**Primary Culture:** Isolation of Tissue, Steps involved in primary cell culture, Cell Lines, Nomenclature, Subculture and Propagation, Immortalization of cell lines, Cell line designations, Routine maintenance. Need for characterization, Morphology, Chromosome Analysis, DNA Content, RNA and Protein, Enzyme Activity, Antigenic Markers, Transformation, Immortalization, Source of contamination, Type of microbial contamination, Monitoring, Eradication of Contamination, Cross-Contamination

Unit IV

**Cryopreservation:** Need of Cryopreservation, Preservation, Cell banks, Transporting Cells, Cytotoxicity its in vitro limitations, Nature of assay, Viability assay, Survival assay, Microtitration assay, Transformation assay, Methods of Producing Transgenic Animals: Embryonic Stem Cell method, Microinjection. method, Retroviral vector method, Applications of transgenic animals

Unit V

**Gene Therapy:** Ex-vivo gene therapy, In vivo gene therapy, Viral gene delivery system, Retrovirus vector system, Adenovirus vector system, Adeno-Associated virus vector system, Herpex simplex virus vector system, Non-viral gene delivery system, Prodrug activation therapy, Nucleic acid therapeutic agents

Text / Reference Books:

1. Animal Cell Culture by John R.W. Masters
   Oxford University Press
2. Introduction to Cell and Tissue Culture by Jennie P. Mather and Penelope E. Roberts
LIST OF ELECTIVE I

HERBAL BIOTECHNOLOGY

TBT 8011

Unit-I
History, definition and scope of herbal medicine, the great contributors of medicine. Traditional and alternative system of medicine. Medicinal plants of Uttrakhand scope of plant origin medicine in Uttrakhand.

Unit II
Classification of crude drugs of plant origin. Alphabetical classification, taxonomical classification, morphological classification, chemical classification, pharmalogical (Therapeutic classification), Chemotaxonomic classification.

Unit III
Introduction to parts of medicinal plant cell organells of plant cell, plant tissue, microscopy of plant, leaves, stems, flowers, fruits, seeds, basks, woods, underground drugs.

Unit IV
Cultivation Methods Of propagation, methods of pest control, types of insertions used in cultivation and part harvest the of herbal plants Plant growth regulators.

Unit V
Cultivation and utilization of medicinal and aromatic plant in India. Genetic as applied to medicinal herbs research, genetic engineering and recumbent DNA technology. Plant tissue culture as source of biomedical Bio medicinal.

Reference book
1- Pharmacgrey by hohate, purohit gothallec by Nirali publication.
2- Sumant SS, phar UP palni LMS, medicinal plant of Indian Himalaya. Diversity, Distribution and potential values. Gyanoly pranasha mainital 1928.
4- Chaula H.S. plant Biotechnology Oxfords IBH publication.
BIOTECHNOLOGY AND ENTREPRENEURSHIP DEVELOPMENT
TBT 8012

Unit I
Need to commercialize biotechnology. Development process, success rates and costs etc., Creating and marketing the image of the biotechnology company. Art of negotiation & effective communication.

Unit II
Role of venture capitalism, business plan, selection of CEO and personnel, real estate for a biotech start-up., Management portray and role of a biotechnology manager, technology decision-making and resource decision-making etc., Product marketing decision.

Unit III
Role of research & development, university-industry technology transfer arrangements, benefits of a biotech company.

Unit IV
Positioning, power and importance of a company name, product, workable marketing and the strength of distribution., Effective advertising and marketing.

Unit V
Opportunities international, marketing and lessons to be learned, Indian and foreign prospective of biotechnology and current challenges for the biotechnology based products.

Recommended books:

3. Latest review articles and papers on the subject.
VACCINE TECHNOLOGY

TBT 8013

Unit I
History of Immunisation, Immunisation types: active and passive immunization, Rationale of immunization, Adjuvant, Age of commencement of immunization, Dosage and Dosage spacing. Vaccine schedule, Hazard of immunization

Unit II
Vaccine: Difference between live and killed vaccine, Rationale vaccine design based on clinical requirements, Different types of vaccine: subunit vaccine, Recombinant Vaccine, edible vaccine, Subunit vaccine, antidiotype vaccine, live vaccine, killed vaccine etc.

Unit III
Hypersensitivity: Types of hypersensitivity, IgE-Mediated (Type I) Hypersensitivity, Antibody-Mediated Cytotoxic (Type II), Immune Complex–Mediated (Type III), Type IV or Delayed-Type Hypersensitivity (DTH) Immunity to Infection.

Unit IV
Autoimmunity, Transplantation, Tumor immunology, immunodeficiency; Active immunization, live, killed, attenuated, Sub unit vaccines;

Unit V
Recombinant DNA and protein based vaccines, plant-based vaccines; Peptide vaccines, conjugate vaccines; Passive Immunization; Antibody, Transfusion of immunocompetent cells, Stem cell therapy; Cell based vaccines.

References:

1. Medical Microbiology: Mackie and McCartney
2. Immunology by Janis Kuby
CANCER BIOLOGY

TBT 8014

Unit I
Fundamentals of Cancer Biology Regulation of Cell cycle, mutations that cause changes in signal molecules, effectson receptor, signal switches, Tumor Suppression tumour suppressor genes, modulation of cell cycle in cancer. Different forms of cancers, Diet and cancer.

Unit II

Unit III

Unit IV
Principles of Cancer Metastasis Clinical significances of invasion, heterogeneity of metastatic phenotype, Metastatic cascade, Basement Membrane disruption, Three-step theory of Invasion, Proteinases and tumour cell invasion.

Unit V

TEXT BOOKS
INDUSTRIAL BIOTECHNOLOGY

TBT 8015

Unit I

Introduction, public awareness of genetic engineering, Regulatory requirements-safety of genetically modified food, policy making, area of significant public concern. Process economics-cost estimates, process design, design exercise, capital cost estimates, operating cost estimates.

Unit II

Introduction to bioprocess technology, Isolation, preservation and improvement of industrially important organisms, Substrates for fermentation processes, Medium optimization Elements of biochemical engineering: Bioreactor design: Laboratory, pilot and large scale reactors. Plug flow reactors, enzyme reactors. Sterilization of media and air Mass transfer of oxygen: Agitation and aeration, Determination of KLa, factors affecting KLa, fluid rheology, Inoculum development, aseptic inoculation and sampling. Bioprocess kinetics: Kinetics of growth and substrate utilization in batch, fed batch and continuous systems.

Unit III


Unit IV

Classification: IUB enzyme classification, techniques used in enzyme characterization, Principle and techniques of enzymatic analysis, factors affecting enzyme activity, Extraction and purification of enzyme, separation techniques, test of purity, substrate kinetics: Equilibrium and Steady state kinetics, significance of Km, Vmax & Kcat, Pre-steady state and Relaxation kinetics, Enzyme activators, co-enzymes and co-factors in enzyme catalysis, Experimental approaches to determine enzyme mechanisms. Enzyme mechanisms: Lysozyme, Chymotrypsin, Carboxypeptidase, Restriction endonuclease, Aspartate transcarbamylase, Allosteric enzymes and sigmoidal kinetics: Protein ligand binding, Co-operativity, MWC & KNF models, Regulation of enzyme activity. Control of metabolic pathways, Isoenzymes and its physiological significance, Ribozymes and Abzymes Enzyme engineering: Chemical modification of enzymes: methods of modification of primary structure, catalytic and allosteric properties, use of group specific reagents. Enzymes in non conventional media; Enzymes sensors, Enzymes as analytical reagents.
Unit V

Reference Books:

6. Enzyme Structure and mechanism: Alan Fersht, Reading, USA.
7. Understanding Enzymes: Trevor Palmer
10. Proteins: Thomas Creighton
11. Biochemistry: Lubert Stryer
12. Biotechnology: Rehm and Reid.
13. Comprehensive biotechnology: Murray Moo Young.
LIST OF ELECTIVE II

DRUG DESIGNING

TBT 8021

Unit I
Overview of drug discovery process.
Physicochemical Properties in Relation to Biological Action – Effects of route of administration, sites of loss, Solubilities and partition coefficients (Ferguson, Hansch), Drug-receptor interactions, Steric features of drugs, The drug receptor, structure-Activity Relationships, Representatives physicochemical properties as relation to biological action

Unit II
Drug targets classification-DNA, RNA, post-translational, processing enzymes, metabolic enzymes involved in nucleic acid synthesis, G-protein coupled receptors (monomeric transmembrane proteins), small molecule receptors, neuropeptide receptors, ion channels (monomeric multi-transmembrane) proteins, ligand-gated ion channels (oligomeric transmembrane proteins), transporters (multi-transmembrane proteins, Validation Strategies

Unit III

Unit IV
Drug toxicity, tolerance, dependence, addiction, Dose Response curves

Unit V
Survey of various Drug Classes – Anaesthetics (general, local), Analgescis, Neurotransmitters (adrenergic, cholinergic effects; psychopharmacology), CNS depressants (sedative/hypnotic, major/minor tranquilizers), CNS, Stimulants, Antibiotics (especially b-lactam), Steroids-Mechanism of action and applications.
Unit I

Unit II
Different models for cellular reactions. Flexible and rigid in metabolic pathways. Metabolic regulation network at enzyme level and whole cell level- Examples of metabolic pathway manipulations.

Unit III

Unit IV

Unit V

Recommended Books:
1. “Computational Modeling of Genetic and Biochemical Networks” by James M. Bower & Hamid Bolouri.
2. “Metabolic Flux Analysis” by Valino.
NANO-BIOTECHNOLOGY
TBT 8023

Unit I

Unit II

Unit III
Fullerenes, quantum dots, Dendrimers, Properties. Method of preparation: Top down, bottom up, plasma orcing, chemical vapour deposition, sel – gel methods.

Unit IV
Self assembled monolayers, Bio molecular motors and their functions. Proteins and applications, Drug delivery systems - Nanofluidic, fluids at micro and nanometer scale, fabrication of nanoporous and nanofluidic devices, applications.

Unit V

Recommended Books:
5. Introduction to Nanotechnology- C.P. Poole & F.S. Owens.
Unit I
Host Parasite interaction in bacterial infections. Pathogenic properties of bacteria (colonization of surfaces, invasion of tissue, production of exo and endo toxins). Antimicrobial defence of the host. Protective immune response in Bacterial, Viral and Parasitic diseases;

Unit II
Biochemical disorders; Immune, Genetic and Neurological disorders; Molecular techniques for analysis of these disorders; Assays for the Diagnosis of inherited diseases; Cancer; Inappropriate Immune response; Disease pathology and clinical spectrum; Clinical diagnosis of diseases.

Unit III
Antibody based diagnosis; Monoclonal antibodies as diagnostic reagents; Production of monoclonal antibodies with potential for diagnosis; Diagnosis of bacterial, viral and parasitic diseases by using; ELISA and Western blot.

Unit IV
Isolation of DNA; purification and analysis; DNA sequencing and diagnosis; PCR and Array based techniques in diagnosis; Single nucleotide polymorphism and disease association; Two Dimensional gene scanning

Unit V
Isolation of proteins and other molecules associated with disease; Process and their profiling for diagnosis; 2D analysis of such proteins by sequencing individual spots by Mass Spectrometry; Protein Micro array; Present methods for diagnosis of Specific diseases like Tuberculosis, Malaria and AIDS; Ethics in Molecular Diagnosis

Texts/References:
BIOSENSORS AND BIOELECTRONICS

TBT 8025

Unit I
Definition, Advantages and limitations, various components of biosensors. Biocatalysis based biosensors, bioaffinity based biosensors & microorganisms based biosensors.

Unit II
Biologically active material and analyte. Types of membranes used in biosensor constructions. Various types of transducers; principles and applications - Calorimetric, optical, potentiometric / amperometric conductrometric/resistormetric.

Unit III
Piezoelectric, semiconductor, impedimetric, mechanical and molecular electronics based transducers. Chemiluminiscence - based biosensors.

Unit IV
Biosensors in clinical chemistry, medicine and health care, biosensors for veterinary, agriculture and food. Low cost- biosensor for industrial processes for online monitoring; biosensors for environmental monitoring.

Unit V
Potential advantages & Developments towards a biomolecular computer, development of molecular arrays as memory stores; molecular wires and switches; mechanisms of unit assembly.

TEXT BOOKS:

REFERENCES:
BIODIVERSITY AND CONSERVATION
TBT 805

Unit I
Definition, historical and geographical causes for diversity, Types of Biodiversity, Himalayan Biodiversity with emphasis on Uttarakhand specifically Garhwal and Kumaon region

Unit II
Germplasm, Gene pool, Genetic Erosion, Germplasm Collection, Germplasm Regeneration, Importance of germplasm in evolution

Unit III
Components of biodiversity, Plant Genetic Resources, Animal Genetics Resources, Fish Genetic Resources, Molecular taxonomy, species and population biodiversity, quantifying biodiversity

Unit IV
Maintenance of ecological biodiversity, Biodiversity and centers of origin, Biodiversity hot spots in India with emphasis to Uttarakhand, Loss of biodiversity, Biodiversity conservation of plant, animal, fish, microbial genetic resources

Unit V
Assessing, analyzing and documenting biodiversity, morphological and molecular characterization of biodiversity, vulnerability and extinction of biodiversity, introduction to biodiversity data base, Endangered animals, endemism and Red Data books, Global biodiversity Information System

REFERENCES:
Anon.1996.The Wealth of India.VolI-XI.CSIR,New Delhi,India
World Resources Institute Report ,1993