### Uttarakhand Technical University

**B.TECH (BIOTECHNOLOGY)**

**II YEAR, SEMESTER III**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Subject Code</th>
<th>Subject Title</th>
<th>Contact Hours / Week</th>
<th>Evaluation Scheme</th>
<th>Subject Total Marks</th>
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<td>General Proficiency</td>
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(* These marks will be awarded at the end of semester IV based upon the performances in both semester III & IV.)

CT- Cumulative Test  
TA - Teacher Assessment  
ESE- End Semester Examination
3rd Semester

COMPUTER BASED NUMERICAL AND STATISTICAL TECHNIQUES

TCS 302

Unit-I


Unit-II

Simultaneous Linear Equations: Solutions of system of Linear equations, Gauss Elimination direct method and pivoting, Ill Conditioned system of equations, Refinement of solution. Gauss Seidal iterative method, Rate of Convergence. Interpolation and approximation: Finite Differences, Difference tables, Polynomial Interpolation: Newton’s forward and backward formula, Central Difference Formulae: Gauss forward and backward formula, Stirling’s, Bessel’s, Everett’s formula. Interpolation with unequal intervals: Langrange’s Interpolation, Newton Divided difference formula, Hermite’s Interpolation, Approximation of function by Taylor’s series and Chebyshev polynomial.

Unit-III


Unit-IV

Curve fitting, Cubic Spline and Approximation: Method of least squares, fitting of straight lines, polynomials, exponential curves etc. Frequency Chart: Different frequency chart like Histogram, Frequency curve, Pi chart. Regression analysis: Linear and Non linear regression, multiple regressions.

References:
Unit I
Cell: An introduction, classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation.

Unit II
Cell membrane and permeability: Chemical components of biological membranes, organization and fluidity of membrane components, the membrane as a dynamic entity, cell recognition and membrane transport.

Unit III
Organization of transport activity in cell; Signal Transduction. Cell signaling: Types of signaling, Cell surface receptor mediated signaling (RTK, pathway, JAK-STAT pathway), G-proteins and G- protein coupled receptors, Secondary messengers and intracellular communication, Target cell adaptation.

Unit IV

Unit V
Nucleus: Structure, cell-cycle (interphase and M phases), regulation of cell cycle. Extracellular matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extracellular matrix macromolecules, regulation of receptor expression and function.

Text/ References Books:
2. Cell Biology- Smith and Wood by Chapman and Hall.
CELL BIOLOGY / BIOINFORMATICS LAB

Practical

PBT301

1. Study of microscopy
2. Study of general methods for cytological preparation
3. Study of cell ultrastructure
4. Study of general methods for cytological preparation
5. Study of mitotic chromosome in Plant Material
6. Study of mitotic chromosome in Bone-marrow cells of RAT/GUINEA PIG
7. Study of mitosis
8. Study of meiosis
9. Construction of database for specific class of proteins/enzymes, genes/ ORF/ EST/Promoter sequences/ DNA motifs or protein motifs using oracle.
10. Access and use of different online protein and gene alignment softwares
11. Gene finding related search for a given nucleotide sequence in order to predict the gene
12. ORF prediction for different proteins out of some given nucleotide sequences.
13. Exon identification using available softwares for a given nucleotide sequences
14. Secondary structure prediction for amino acid sequences of a given protein.
BIOCHEMISTRY
TBT 302

Unit I

Unit II

Unit III

Unit IV

Unit V

Recommended Books:
2. Biochemistry: Voet and Voet, John Wiley and Sons, Inc. USA.
4. Biochemistry: Zubey, WCB.
Biochemistry / BIOANALYTICAL LAB
Practicals

PBT 302

- Qualitative analysis of proteins, carbohydrates and lipids.
- Preparation and purification of casein from buffalo milk.
- Determination of acid value of fat/oil
- Determination of Iodine number of fat/oil
- Determination of Logic properties (pH value of Lysine by titration).
- To find lambda max for proteins.
- Demonstration of mitotic cell using microscopy
- Verification of Lambert Beers Law by UV Vis Spectrophotometer.
- Estimation of Different macromolecules by visible spectrophotometer.
- Estimation of pH of Different solutions and buffers by digital pH Meter
- Estimation of proteins and nucleic acids by UV method
- Separation of different macromolecules by paper and Thin Layer Chromatography.
- Membrane separation- dialysis and ultrafilteration.
- To study different cell lysis methods.
MICROBIAL BIOTECHNOLOGY
TBT 303

Unit I

Unit II

Unit III
Structure and function of flagella, cilia, pili, gas vesicles, chromosomes, carboxysomes, magnetosomes and phycobilisomes, nucleoid, cell division. Spores, reserve food materials polyhydroxybutyrate, phosphate granules. Oil droplets, cyanophycin granules and sulfur inclusions.

Unit IV

Unit V

Recommended Books
2. Text book of Microbiology: Annathnarayan and Panicer
3. Microbiology ; Prescott
4. Practical Microbiology: Dubey and D.K.Maheshwari
MICROBIAL BIOTECHNOLOGY
Lab
PBT 303

1. To study the working and principle of instrument used in the microbiology lab
2. Wrapping of glassware.
3. To stain the bacteria by simple staining using monochrome stain
4. To study the morphology of bacteria by Negative staining
5. To perform the gram staining to know the bacteria is gram positive or gram negative
6. Perform the spore staining to know the bacteria is spore former or not
7. Perform the fungal staining by lactophenol cotton blue.
8. To study the motility of bacteria by hanging drop method.
BIOANALYTICAL TECHNIQUES
TBT-304

Unit I: Introduction
Types of Analytical Methods, Instrument for analysis, Uncertainties in Instrumental measurements –Sensitivity and detection limit for instruments, pH meter, dissolved oxygen, agitation, sensors and their operation.

Unit II Microscopy
Bright field, Dark field, Fluorescent, Phase contrast, Confocal microscopy, SEM and TEM microscopy, Flow cytometry.

Unit III Centrifugation
General principles, Ultracentrifugation, Velocity Sedimentation and Measurements, Equilibrium Ultracentrifugation- Density Gradient Centrifugation.

Unit IV Spectroscopy

Unit V Separation Equipments-Principle and Operation
HPLC, Gas Chromatography, Ion Exchange Chromatography, Gel Filtration Chromatography, Affinity Chromatography, Membrane separation, Ultrafiltration, Reverse Osmosis.

Text Books
4. Ewing, Instrumental Method of analysis, 1992
Bioinformatics I

TBT 305

Unit I
Primary and secondary databases. Specialized sequence databases of EST, TFB Sites, SNP’s, gene expression. Pfam, PROSITE, BLOCK( Secondary databases). Data retrieval with ENTREZ, SRS, DBGET

Unit II
Principles of DNA sequencing (chemical chain termination, Dideoxy chain termination method, Automatic sequencer). RNA sequencing . Protein sequencing ( Edmand degradation method)

Unit III
Sequence alignment ( pairwise and multiple, global and local). Sequence alignment algorithm (FAST , BLAST, Needleman and Wunsch, Smith Waterman ). Database similarity searches (BLAST, FASTA and PSI BLAST). Amino acid substitution matrices ( PAM BLOSUM)

Unit IV
Protein structure prediction ( Chou Fasman method) : Secondary and tertiary structures. Homology Modelling, ORF prediction, Gene prediction, Micro array data analysis. Profiles and motifs.

Unit V

Recommended books:

1. Bioinformatics : Principles and applications by Ghosh and Mallick (oxford) university press)
2. Bioinformatics by Andreas D Boxevanis (Wiley Interscience)
3. Fundamental concept of bioinformatics by Dan e. krane
4. Introduction to bioinformatics by Attwood and Parry Smith ( Pierson education Publication
**Uttarakhand Technical University**  
**B.TECH (BIOTECHNOLOGY)**  
**II YEAR, SEMESTER IV**

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<td>TBT403</td>
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**CT** - Cumulative Test  
**TA** - Teacher Assessment  
**ESE** - End Semester Examination
Unit I: Introduction to Environment
Environment and its segments.
Atmospheric Structure
Environmental Pollution

Unit II: Water pollution
Water pollution
Wastewater and its treatment
Water quality standards, water treatment;
Sludge treatment and disposal.

Unit III: Air pollution
Criteria Pollutants
Sources and effects of air pollution,
Air pollution and Meteorology,
Treatment of emissions,

Unit III: Solid and hazardous waste management.
Solid waste and its classification
Solid waste management,
Energy from waste.

Unit IV: Global atmospheric change
Global warming and its impact,
Ozone layer depletion.

Unit V: Brief introduction about environmental legislation and environmental audit.

Books Recommended:
1) Introduction to Environmental Engineering and Science by G.M. Masters, Prentice Hall India Pvt. Ltd.
2) Environmental Science and Engineering by Wright, Pearson Publication.
3) Environmental Engineering by Vasilind, Cengage Learning, New Delhi.
GENETICS
TBT-401

Unit I
Heredity, Historical Perspectives: Definition of genetics; Origin of life; spontaneous generation; Performationism; Inheritance of acquired characters; Pangenesis; Germplasm theory; Early Ideas on reproduction; Molecular theory on origin of life.

Unit II

Unit III
Molecular organization of chromosomes: Genome size and evolutionary complexity, supercoiling of DNA, structure of bacterial chromosome, structure of eukaryotic chromosome. Gene Mutation and DNA Repair: Classification of mutations, spontaneous mutations, induced mutations, application of induced mutations, detection of mutations, site-directed mutagenesis, mechanisms of DNA repair.

Unit IV
Gene Linkage and Chromosome Mapping: Linkage and recombination of genes in a chromosome, crossing over and genetic mapping, gene mapping by 2-point and three point test crosses. Somatic Cell Genetics: Somatic cell hybrids production and gene mapping.

Unit V

Quantitative Genetics: Quantitative inheritance, causes of variation.

Text/Reference Books:
5. A text Book of animal Geneitics. P.Kanakraj, IBDC, New Delhi
GENETICS EXPERIMENTS

PBT-401

1. Study of simple and compound microscope
2. Study of Cell structure
3. Study of dihybrid cross
4. Study of epistasis
5. Study of polytene chromosome
6. Study of meiotic studies in animals
7. Study of behavior of chromosome during meiosis in Pollen Mother cells.
8. Study of Chi-Square Test
MOLECULAR BIOLOGY
TBT-402

Unit I
Structure and properties of Nucleic acid: Models of DNA structure; RNA structure, physical, chemical and Spectroscopic properties.

Unit II
Chromosome and gene organisation: Histones, Non Histones, Nucleosome, chromatin, chromosome structure in prokaryotes and eucaryotes, spilited genes, overlapping genes, Transposons and Retrotransposon, Gene cluster.

Unit III
DNA replication: Models of DNA replication, Enzymology of DNA replication, the replication process, initiation, Elongation and termination of replication; Telomeres.

Unit IV
Transcription, mRNA processing and Translation: Components of transcriptional machinery in prokaryotes and eucaryotes; Initiation, elongation and termination of transcription; capping, polyadenylation, splicing, mRNA stability. The genetic code; tRNA and Aminoacyl synthetases, ribosomes, translation process, initiation, elongation and termination of transcription; capping, polyadenylation, splicing, mRNA stability.

Unit V
Regulation of gene expression: General aspects of regulation prokaryotes and eucaryotes; Operon model, Lac and Trp operon; DNA methylation; Tissue specific and developmental stage specific expression of genes.

Text Book
1. Gene IX by B. Lewin
2. Essential of Molecular Biology, Malacinski and Freifelder. Jones and Bartlet Publisher
3. Genomes. T.A.Brown, John Wiley and Sons PTE Ltd.
5. The Cells- A molecular Approach, G M Cooper, ASM Press.
List of Experiment

1. Extraction and estimation of RNA
2. Extraction and estimation of DNA
3. To find Lambda max for nucleic acid
5. Isolation of plasmid DNA from E. coli (miniprep).
6. Electrophoretic separation of plasmid DNA
7. To determine the melting curve of DNA
8. Determination of base composition of DNA
9. Amplification of a gene fragment using PCR
IMMUNOTECHNOLOGY
TBT 403

Unit I
Introduction to Immunotechnology: Kinetics of immune response, memory; Principles of Immunization; Techniques for analysis of Immune response

Unit II

Unit III
Immuno-chemistry of Antigens - Immunogeneity, Antigenecity, haptons, Toxins-Toxiods, Hapten-carrier system; Genetic bases of immune response – Heterogeneity; Role and properties of adjuvants, Immune modulators; B cell epitopes; Hybridoma Rabbit, human;

Unit IV
Antigen – Antibody interaction, affinity, cross reactivity, specificity, epitope mapping; Immuno assays RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence, Agglutination and Precipitation reaction.

Unit V
CD nomenclature, Identification of immune Cells; Principle of Immunofluorescence Microscopy, Flurochromes; Staining techniques for live cell imaging and fixed cells; Flow cytometry, Instrumentation, Applications;

Unit 5
Hypersensitivity reaction: Antibody- mediated- Type- 1. Anaphylaxis – Type-II. Antibody dependent cell cytotoxicity. Type III. Immune complex mediated reactions. Type IV cell mediated hypersensitivity reactions. Defects in immune system

Recommended Book
1. Immunology by Janis Kubey
2. Immunology by Roiet and Roiet
3. Test book of Microbiology by Annanthnarayan and Panicer
IMMUNOTECHNOLOGY
PBT 403

List of Experiment

1. Perform experiment to isolated serum from blood sample
2. Perform experiment to isolated serum from blood sample
3. Perform Widal test by slide agglutination
4. Perform Widal test by using tube agglutination method
5. Perform ELISA for diagnosis of disease.
6. Perform Rocket electrophoresis to quantitate antigen concentration.
7. Perform slide agglutination for detection of RA factor
8. Perform slide agglutination for detection of Syphilis.
Unit I
Presentation of Data: Frequency distribution, graphical presentation of data by histogram, frequency curve and cumulative frequency curves. Measure of Location and Dispersion: Mean, Medium, Mode and their simple properties. (without derivation) and calculation of median by graphs: range, mean deviation, Standard deviation, Coefficient of variation.

Unit II
Probability and Distribution: Random distributions, events-exhaustive, mutually exclusive and equally likely, definition of probability (with simple exercises), definition of binomial, Poisson and normal distributions and their inter-relations, Simple properties of the above distributions (without derivation).

Unit III
Correlation and Regression: Bivariate data – simple correlation and regression coefficients and their relation, Limits of correlation coefficient, Effect of change of origin and scale on correlation coefficient, Linear regression and equations of line of regression, Association and independence of attributes.

Unit IV
Sampling: Concept of population and sample, Random sample, Methods of taking a simple random sample. Tests of Significance: Sampling distribution of mean and standard error, Large sample tests (test for an assumed mean and equality of two population means with known S.D.); small sample tests (t-test for an assumed mean and equality of means of two populations when sample observations are independent, Paired and unpaired t-test for correlation and regression coefficients, T-test for comparison of variances of two populations, Chi-square test for independence of attributes, Goodness of fit and homogeneity of samples.

Unit V
Experimental Designs: Principles of experimental designs, Completely randomized, Randomized block and latin square designs, Simple factorial experiments of 22, 23, 24 and 32 types, Confounding in factorial experiments (mathematical derivations not required); Analysis of variance (ANOVA) and its use in the analysis of RBD.

Reference:
Unit I

Unit II

Unit III
Overview of key computational simulation techniques: differential equation simulators, parameter estimation, and sensitivity analysis. Overview of key techniques for the management of large document collections and the biological literature: information retrieval, document clustering, and natural language information extraction.

Unit IV
Advanced topics in bioinformatics. This course will address recent developments in bioinformatics and focus on advanced issues in specific areas including (but not limited to), information extraction from biomedical literature, inference of biochemical networks from high throughput data, and prediction of protein function.

Text Books & References
1. Problems based on Biostatistics

2. In silico gene identification/characterization in a prokaryotic organism using suitable annotation tools.

3. 2. Secondary structure determination of a protein molecule using various tools.


5. Development of a gene finding program using statistical significance and C++/C/Perl etc.

Establishments of methods for gene an