BACHELOR OF SCIENCE

6th SEMESTER

DISCIPLINE SPECIFIC ELECTIVES (DSEs)

BT620DA: BIO-TECHNOLOGY: ELEMENTARY BIOSTATISTICS AND BIOINFORMATICS

CREDITS: THEORY - 4, PRACTICAL – 2 (4+2)

OPTION-I

THEORY (4 CREDITS: 60 HOURS) **MAXIMUM MARKS: 60, MINIMUM MARKS: 24**

Objective: This course introduces students to basic statistical concepts involved in biology and illustrates the power of computing in modern biology.

Unit-1 (15 HOURS)

Introduction to statistics; Understanding of data & variables (with their types and categories);
Data production - experiments vs sample surveys, principles & types of experimental design, idea of randomization, detailed account of sampling designs; Graphical representation of data (bar graph, pie chart, stem plot, histogram).

Unit - 2 (15 Hours)

Measures of central tendency (mean, median, mode) & dispersion (quartiles, standard deviation) with their properties and comparison; Understanding of correlation, least-squares regression & scatterplots; Overview of probability & probability rules, statistical inference with emphasis on confidence intervals and p-values.

Unit - 3 (15 Hours)

Introduction to bioinformatics; Scope and application of bioinformatics; Introduction to biological databases (types-sequence, structure & pathway), Nucleic acid databases (NCBI, GenBank, EMBL), Protein databases (PIR, Swiss-Prot, PDB); Introduction to PubMed.

Unit - 4 (15 Hours)

Sequence similarity and alignment - local & global alignment, pairwise & multiple sequence alignments, BLAST, FASTA & CLUSTALW; Basic idea of phylogenetic tree; Protein structure analysis - levels of protein structure, primary structure analysis (protparam), secondary structure predictions (ExPASy, JPred), tertiary structure prediction methods (homology, threading).

PRACTICALS (2 CREDITS: 60 HOURS) MAXIMUM MARKS: 30, MINIMUM MARKS: 12

1. Use of excel for calculating: Mean, Mode, Median.
2. Use of excel for drawing, histogram, bar-chart &piechart.
3. Use of NCBI, GenBank, EMBL, SwissProt, PDB, TREMBL.
4. Pairwise and multiple sequence alignment (BLAST and ClustalW)
5. Use of protparam, Expasy and JPred.

BOOKS RECOMMENDED

1. *Basic Biostatistics:* Bert Gurtsman
2. *Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery*, - Rastogi, Prentice Hall India Learning Private Limited.
3. *Essential Bioinformatics*, Jin Xiong, - Cambridge University Press.
4. *Bioinformatics - Principles and Applications, Ghosh, Z.* and Mallick, B.,-Oxford University Press (India).

Expected Learning Outcomes:

1. *Understanding of basic statistical methods as applied to biological sciences.*
2. *Concept of Bioinformatics, types of data and databases.*
3. *Understanding of tools used for data analysis and prediction of different levels of protein structure.*

BACHELOR OF SCIENCE

6th SEMESTER

DISCIPLINE SPECIFIC ELECTIVES (DSEs)

BT620DB: BIO-TECHNOLOGY: ENVIRONMENTAL BIOTECHNOLOGY

CREDITS: THEORY - 4, PRACTICAL – 2 (4+2)

OPTION-II

THEORY (4 CREDITS: 60 HOURS) **MAXIMUM MARKS: 60, MINIMUM MARKS: 24**

Objective: The objective of this course is to familiarize the students with various problems concerning environment and their possible solutions employing the biotechnological approaches.

Unit-1 (15 HOURS)

Environment- basic concepts and issues; Pollution - types of pollutants, air, water and soil pollution; Global environmental problems - Greenhouse effect, acid rain, ozone depletion, deforestation, desertification, salination, biodiversity loss.

Unit- 2(15 HOURS)

Water as a scarce natural resource; Sources and measurement of water pollution; Waste water treatment-physical, chemical and biological treatment processes; Microbiology of waste water treatments: Aerobic processes - activated sludge, oxidation ponds and ditches, trickling filter, towers, rotating discs and drums; Anaerobic processes - anaerobic digestion, anaerobic filters

Unit- 3(15 HOURS)

Solid waste and soil pollution management; Treatment and disposal of solid waste - Aerobic (Composting and Vermiculture), Anaerobic treatment of solid waste and biogas generation.

Unit- 4(15 HOURS)

Bioremediation - principle and process; Bioremediation of contaminated soils, water and waste land, spilled hydrocarbons; Biodegradation of organic pollutants, pesticides and xenobiotics; Biopesticides; Bio-pollution; Macro-plastics; Bio-mining.

PRACTICALS (2 CREDITS: 60 HOURS) MAXIMUM MARKS: 30, MINIMUM MARKS: 12

1. Collection, processing and storage of effluent samples
2. Determination of BOD/COD in waste water samples
3. Determination of dissolved oxygen/ total dissolved solids in waste water samples
4. Analysis of total hardness/temporary hardness of waste water samples.
5. Analysis of waste water/sludge for heavy metals.

BOOKS RECOMMENDED

1. *Wastewater Engineering - Treatment, Disposal and Reuse,* Tchobanoglous, G., Franklin, B. and Stensel, H. D- Tata McGraw Hill, New Delhi
2. *Comprehensive Biotechnology,* M. Moo-Young -Pergamon Press, Oxford
3. *Environmental Chemistry* De, A. K. - Wiley Eastern Ltd., New Delhi
4. *Environmental Biotechnology*, Kumar, A. -Daya publishing house.
5. *Advances in industrial waste water treatment*, Goel, P.K. - ABD Publishers.
6. *Environmental risks and Hazards*, Cutter, S. L. - Prentice Hall.
7. *Biotechnology in Environmental Management,* Pathade, G. R. and Goel, P.K - BDPublications.

Expected Learning Outcomes:

1. *Basic concept of Environmental pollution, its types, causes and treatment.*
2. *Understanding of global environmental issues and their mitigation.*
3. *Brief idea of bioremediation and biodegradation of organic pollutants.*

BACHELOR OF SCIENCE

6th SEMESTER

DISCIPLINE SPECIFIC ELECTIVES (DSEs)

BT620DC: BIO-TECHNOLOGY: CELL CYCLE, SIGNALING AND CANCER

CREDITS: THEORY - 4, PRACTICAL – 2 (4+2)

OPTION-III

THEORY (4 CREDITS: 60 HOURS) **MAXIMUM MARKS: 60, MINIMUM MARKS: 24**

Objectives: This course acquaints the students with coordination and communication at cellular level.

Unit-1 (15 HOURS)

Cell cycle: stages of cell cycle, cell cycle regulation - cyclin, CDKs, check points in cell cycle (G1 and G2), DNA damage check points.

Unit- 2(15 HOURS)

Types of mutations - base substitution, mis-sense, non-sense, deletion, insertion, frameshift, silent mutations, spontaneous and induced mutations; Chemical and physical mutagens; Reversion (brief idea); Overview of recombination (homologous recombination); DNA Repair - mismatch repair system, excision repair, specialized repair systems, photo reactivation, recombination repair, SOS repair, double stranded repair in eukaryotes.

Unit- 3(15 HOURS)

Signaling - autocrine, paracrine and endocrine signaling; Types of receptors and action (steroid 2_) _and peptide); GPCR signaling; Second Messengers - cAMP, cGMP, Ca^{2+}, NO (importance and role in signaling and signal transduction); Receptor tyrosine kinases.

Unit- 4(15 HOURS)

Characteristic of tumour cells; Use of cell culture in cancer research; Cancer- causes, types and stages; Role of tumor suppressor genes and (proto)-oncogenes; Cancer treatment- molecular approach; Apoptosis vs necrosis; Autophagy.

PRACTICALS (2 CREDITS: 60 HOURS) MAXIMUM MARKS: 30, MINIMUM MARKS: 12

1. Study of different stages of cell cycle.
2. Study of different stages of mitosis and meiosis.
3. DNA fragmentation assay.
4. Permanent slides for different types of cancer.

BOOKS RECOMMENDED

1. *Cell and Molecular Biology: Concepts and Experiments,* Karp G. - John Wiley & Sons. Inc.
2. *The Cell: A Molecular Approach.* Cooper, G.M. and Hausman, R.E. - ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
3. *Genomes 3*, TA Brown, - Garland Science
4. *Genetics: A Conceptual Approach*, Benjamin Pierce, - WH Freeman

Expected Learning Outcomes:

1. *Understanding of the process of cell cycle, cell division and its control.*
2. *Understanding different types of mutations, mutagens and the mechanism of repair.*
3. *Basic concept of cell signaling and cancer.*