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Autonomous College
Affiliated to Osmania University, Hyderabad.
(Accredited with 'A' grade by NAAC)
Department of Genetics and Biotechnology
Program name: B.Sc BtGC & BtMbC (w.e.f. 2023- '24)
Biotechnology (Optional)

Course Name: Cell Biology and Genetics

Paper Code: BT133 **No of Classes: 60**
Year/Semester: I/I **No of Credits: 4**

Skill Development: Knowledge of cell structure, cell division, Mendelian inheritance, recombination, linkage will lay a strong foundation in the field of Cell biology and Genetics.

Course Objective: To evaluate the basic concepts of cell and apply the principles of genetics.

Unit wise Course Objectives:

Cob 1: To distinguish the cell structure and function of prokaryotic and eukaryotic cells.

Cob 2: To analyze all the stages of cell cycle and cell division.

Cob 3: To interpret Mendelian laws and mechanism of inheritance.

Cob 4: To evaluate the fundamentals of recombination, linkage and extensions to Mendelian inheritance.

Unit I: Cell structure and Function **16 hours**

1. Cells as basic units of living organisms- Bacterial, Fungal, Plant and Animal cells. **(2)**
2. Ultra structure of Prokaryotic cell (cell wall, cell membrane, plasmids, Nucleoid). **(1)**
3. Ultrastructure of eukaryotic cell (Cell wall, cell membrane, Nucleus, Mitochondria, Chloroplast, Endoplasmic reticulum, Golgi complex, vacuoles). **(5)**
4. Fluid mosaic model, Sandwich model, Cell membrane permeability **(3)**

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5. Structure of chromosome-morphology, components of chromosomes (histones and non-histones) Packing of DNA into chromatin, nucleosome, and higher order organization (3)

6. Specialized chromosomes (Polytene and Lampbrush). (2)

Unit II: Cell Division and Cell cycle **14 Hours**

1. Bacterial cell division (2)
2. Eukaryotic cell cycle - phases (2)
3. Mitosis-Stages (spindle assembly) - Significance (2)
4. Meiosis- Stages (synaptonemal complex) - Significance (4)
5. Senescence and necrosis: characteristics & mechanisms. (2)
6. Apoptosis: extrinsic & intrinsic pathways & significance. (2)

Unit III: Principles and mechanism of inheritance **15 Hours**

1. Mendel's experiments - Factors contributing to success of Mendel's experiments (1)
2. Law of segregation - Monohybrid ratio; Law of Independent assortment - Dihybrid Ratio, Trihybrid Ratio. (2)
3. Deviation from Mendel's Laws - Incomplete dominance (Flower color in Mirabilis jalapa), Co-dominance (MN Blood groups), Non allelic interactions-types of epistasis (4)
4. Penetrance and expressivity (Polydactyly), Pleiotropism (Sickle cell anemia), Phenocopy (microcephaly & cleft lip), Multiple alleles (ABO blood groups). (4)
5. Genes and environment – Temperature (Drosophila shibire mutant), Nutrional (Neurospora), Effect on human genes (PKU & Pattern baldness). (1)
6. X-Y chromosomes- Sex determination in Drosophila, Man, X- linked inheritance - Hemophilia & Color blindness, X- inactivation (3)

Unit IV: Linkage, Recombination and extension to Mendel's laws **15 Hours**

1. Linkage and recombination- cytological proof of crossing, phases of linkage, recombination frequency, gene mapping and map distance. (4)

2. Non-Mendelian inheritance- Maternal effect (Shell coiling in snail), Maternal inheritance (Variegation in leaves of Mirabilis jalapa) (4)

3. Cytoplasmic male sterility in maize. (1)

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4. Mitochondrial inheritance in Human (LHON) & Poky in Neurospora crassa (3)

5. Chloroplast inheritance in Chlamydomonas (2)

6. Hardy- Weinberg Equilibrium (1)

Course Outcomes:

By the end of this course, student will be able to

BT133. CO1: Compare the cell structure and function of prokaryotic and eukaryotic cells.

BT133. CO2: Relate the stages of cell cycle and cell division.

BT133. CO3: Solve problems based on Mendelian laws and mechanism of inheritance.

BT133. CO4: Interpret the fundamentals of recombination, linkage and extensions to Mendelian inheritance.

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Paper I- Practicals

Paper Code: BT133P **30 hrs(2 hrs/ week)**
Credits: 1

Skill Development: To comprehend and develop skills in maintaining and handling drosophila and problem solving skills.

Objective: To acquire basic skills like handling the microscope, preparation of slides for microscopic observation and problem solving using Mendelian laws.

1. Microscopic observation of cells: bacterial, fungal, plant and animal cell.
2. Preparation of different stages of Mitosis (garlic root tips).
3. Preparation of different stages of Meiosis (grasshopper testis)
4. Preparation of Polytene chromosomes from drosophila salivary gland
5. Problems on monohybrid and Dihybrid ratio in *Drosophila*/maize.
6. Problems on co-dominance, Epistasis, two-point and three-point test cross, gene mapping.
7. Statistical applications of Hardy-Weinberg Equilibrium.

Outcome: Students evaluate the microscopic handling techniques and develop analytical skills for problem-solving in genetics.

Spotters:

1. Prokaryotic Cell (Bacteria).
2. Mitochondria.
3. Chloroplast.
4. Polytene Chromosomes.
5. Test Cross.
6. Blood Grouping.
7. Hemophilia Pedigree.

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8. Crossing Over.

9. Synaptonemal Complex.

10. Nucleosome Model.

Reference Books:

1. Cell & Molecular Biology. E. D. D De Robertis & E. M. F De Robertis, Waverly publication

2. An Introduction to Genetic Analysis by Anthony, J.F. J.A. Miller, D.T. Suzuki, R.C. Richard Lewontin, W.M-Gilbert, W.H. Freeman publication

3. Principles of Genetics by E. J. Gardner and D. P. Snusted. John Wiley & Sons, New York

4. The science of Genetics, by A. G. Atherly J. R. Girton, J. F. Mcdonald, Saundern College publication.

5. Principles of Genetics by R. H. Tamarin McGrawhill.

6. Theory & problems in Genetics by Stansfield, Schaum out line series McGrawhill.

7. Molecular Cell Biology Lodish, H., Baltimore, D; fesk, A., Zipursky S. L., Matsudaride, P. and Darnel. American Scientific Books. W. H. Freeman, New York.

8. The cell: A molecular approach. Geoffrey M Cooper, Robert E Hausman, ASM press.

9. Cell and Molecular Biology, Concepts and Experiments – Gerald Karp, John Wiley & Sons, Inc.

10. Cell Biology and Genetics by P. K. GUPTA.

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Department of Genetics and Biotechnology
Program name: B.Sc BtGC & BtMbC (w.e.f. 2023- '24)
Biotechnology (Optional)

Course Name: Biological Chemistry and Microbiology

Paper Code: BT233 **No of Classes: 60**
Year/Semester: I/II **No of Credits: 4**

Skill Development: Fundamental concepts of biomolecules and their intermediary metabolism will lay a strong foundation in the field of Biochemistry and the basics of Microbiology will help in understanding and comparing microorganisms.

Course Objective: To analyze biological chemistry and understand microbiology.

Unit wise Course Objectives:

Cob 1: To distinguish biomolecules and analyze their structures including enzymes and enzyme action.

Cob 2: To value Intermediary Metabolism of biomolecules.

Cob 3: To understand microbial diversity and disease-causing microorganisms.

Cob 4: To interpret sterilization techniques, isolate microbes in pure form and understand pure culture characteristics.

Unit I: Biomolecules **16 Hours**

1. Carbohydrates- Importance, classification, structure and functions of monosaccharides (glucose and fructose), disaccharides (sucrose, lactose and maltose) and polysaccharides - Homo (starch, glycogen, inulin) and hetero polysaccharides (hyaluronic acid and peptidoglycan). **(4)**
2. Amino acids- Importance, classification, structure, physical and chemical properties of amino acids, peptide bond formation. **(2)**
3. Proteins-importance, structure of proteins- primary, secondary, tertiary, and quaternary. **(2)**
4. Lipids- importance, classification-simple lipids (triacylglycerides and waxes), complex lipids

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(phospholipids and glycolipids), derived lipids (steroids, terpenes, and carotenoids). (2)

5. Nucleic acids: structure and Chemistry of DNA (Watson and Crick Model), forms of DNA (A, B and Z) and RNA (t-RNA) structure. (3)

6. Enzymes – Importance, classification, and nomenclature, Michaelis- Menton Equation, factors influencing the enzyme reactions, enzyme inhibition (competitive, uncompetitive and mixed), co-enzymes (3)

Unit II: Bioenergetics **14 Hours**

1. Glycolysis, Tricarboxylic Acid (TCA) Cycle. (3)
2. Electron Transport, Oxidative Phosphorylation (2)
3. Gluconeogenesis and its significance (2)
4. Transamination and Oxidative deamination reactions of amino acids (3)
5. B-oxidation of Fatty acids (2)
6. Glyoxylate cycle. (2)

Unit III: Fundamentals of Microbiology **15 Hours**

1. Historical development of microbiology and contributors of microbiology (1)
2. Microscopy: Bright field microscopy, Dark field microscopy, Phase contrast microscopy, Fluorescent microscopy, Scanning and Transmission electron microscopy. (4)
3. Outlines of Classification of microorganisms-Whittaker classification. (2)
4. Structure and general characteristics of bacteria and virus. (3)
5. Disease causing pathogens and symptoms (Mycobacterium, Hepatitis). (2)
6. Structure and general characteristics of micro-algae and fungi. (3)

Unit IV: Culture and Identification of microorganisms **15 Hours**

1. Methods of sterilization-Physical and chemical methods (2)
2. Bacterial nutrition: nutritional types of bacteria, essential macro and micro nutrients and growth factors (3)
3. Bacterial growth curve– batch and continuous cultures, synchronous cultures, measurement of bacterial growth - measurement of cell number and cell mass. (3)
4. Factors affecting bacterial growth (2)

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5. Culturing of anaerobic bacteria and viruses (3)

6. Pure cultures – characteristics and techniques (2)

Course Outcomes:

By the end of this course, student will be able to

BT233. CO1: To appreciate the structural and functional aspects of various biomolecules including enzymes.

BT233. CO2: To evaluate various biochemical pathways.

BT233. CO3: To interpret microorganism's structure and analyze microbial pathogenesis

BT233. CO4: To identify techniques to isolate them in pure forms and value the pure culture characteristics.

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Paper II- Practicals

Paper Code: BT233P 30 hrs(2 hrs/ week)
Credits: 1

Skill development: To acquire skills in biochemical and microbiology techniques.

Objective: To provide hands on training in qualitative and quantitative assays of biomolecules and basic microbiological techniques.

1. Preparation of Normal, Molar and Molal solutions
2. Preparation of Buffers (Acidic, Neutral and Alkaline Buffers)
3. Qualitative tests of sugars, amino acids and lipids.
4. Estimation of total sugars by Anthrone method.
5. Separation of amino acids by paper chromatography
6. Estimation of protein by Biuret method.
7. Sterilization methods
8. Preparation of microbiological media (Bacterial, algal and fungal)
9. Isolation of bacteria by streak, spread and pour plate methods
10. Isolation of bacteria from soil.
11. Simple staining and differential staining (gram staining).
12. Bacterial growth curve.
13. Technique of micrometry (Ocular and stage).

Outcome: Expertise in qualitative and quantitative analysis of biomolecules and also in isolation and staining of bacteria.

Spotters:
1. Osazone
2. Globular protein
3. Lock and key model
4. Competitive inhibition

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5. ATP synthase

6. Autoclave

7. Laminar air flow

8. Tyndallisation

9. Bacterial growth curve

10. Hot air oven

12. Serial dilution technique

Reference books:

1. Principles of Biochemistry by David L, Nelson and Cox

2. Biochemistry by Rex Montgomery

3. Harper's Biochemistry by Robert K. Murray

4. Enzymes by Trevor Palmer

5. Enzyme structure and mechanism by Alan Fersht

6. Principles of Biochemistry by Donald J. Voet, Judith G.Voet, Charlotte W.Pratt

7. Analytical Biochemistry by Cooper

8. Principles and techniques of Biochemistry and Molecular Biology Edited by Keith Wilson and John Walker

9. Practical Biochemistry by Plummer

10. Biology of Microorganisms by Brock, T.D. and Madigan, M.T.

11. Microbiology by Prescott, L.M., Harley, J.P. Klein,D.A.

12. Microbiology by Pelczar, M.J, Chan, E.C.S., Ereig, N.R.

13. Microbiological applications by Benson

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Department of Genetics and Biotechnology
Program name: B.Sc BtGC & BtMbC (w.e.f. 2023- '24)
Biotechnology (Optional)

Course Name: Molecular Biology and Recombinant DNA Technology

Paper Code: BT333 **No of Classes: 60**
Year/Semester: II/III **No of Credits: 4**

Skill development: The theoretical and practical application of Molecular biology and recombinant DNA technology help students to acquire skills in understanding and analyzing genomics, proteomics, genetic manipulation of microbes and their protein expression.

Course Objective: To compare the structure of nucleic acids, mechanism of gene expression and regulation in Prokaryotes and Eukaryotes, methods of recombinant DNA technology.

Unit wise Course objectives:

Cob 1: To analyze genome organization and understand DNA replication.

Cob2: To understand Gene expression in Prokaryotes and Eukaryotes.

Cob 3: To analyze Gene regulation in Prokaryotes and Eukaryotes.

Cob 4: To evaluate the tools used to formulate cloning strategies and recombinant DNA Technology.

Unit 1- Genome organization and DNA Replication **15 Hours**

1. DNA as the genetic material- Griffiths transformation experiment, Avery, Macleod and McCarty's experiment and Hershey and Chase – labeling experiment, RNA as genetic material- Tobacco Mosaic virus. (3)

2. Organization of prokaryotic genome and eukaryotic nuclear genome. (2)

3. Organization of Mitochondrial and chloroplast genome. (2)

4. DNA Replication –enzymes involved in the replication of DNA, origin of replication fork. (3)

5. Replication of prokaryotic genome and nuclear genome of eukaryotes. (3)

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6. Mutations –types of mutations, spontaneous mutations and induced mutations. (2)

Unit 2: Gene expression in Prokaryotes and Eukaryotes **15 Hours**

1. Structure of prokaryotic gene, structure of eukaryotic gene, structure and functions of prokaryotic RNA –polymerase-subunits. (3)

2. Transcriptional machinery in eukaryotes (RNA polymerase) and their structural and functional features. (2)

3. Genetic code-properties, deciphering of genetic code, wobble hypothesis. (2)

4. Transcription mechanism in prokaryotes-initiation, elongation and proof reading, termination (rho independent and rho dependent). (3)

5. Transcription in eukaryotes- initiation, elongation and termination. (2)

6. Translation mechanism-initiation, elongation and termination. (3)

Unit 3 - Gene regulation in Prokaryotes and Eukaryotes **15 Hours**

1. Prokaryotic transcriptional regulation (inducible system)-operon concept, lac operon and glucose effect. (4)

2. Prokaryotic transcriptional regulation (repressible system) -tryptophan operon. (2)

3. Post transcriptional modification – capping, poly–adenylation. (2)

4. Splicing and alternate splicing. (2)

5. Post translational modifications -glycosylation, acetylation and ubiquitination. (3)

6. Gal regulation in yeast – mating type gene switching. (2)

Unit 4- Recombinant DNA technology **15 Hours**

1. Enzymes used in molecular cloning restriction endonuclease, DNA ligases, polynucleotide kinase, klenow enzyme and DNA polymerase. (3)

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2. Cloning vectors PBR 322, bacteriophage vectors, Cosmid, Phagemid, Shuttle vectors. (3)

3. Vectors for library preparation (lambda phage vectors, cosmids, BAC and YAC). (2)

4. Gene transfer techniques: physical chemical and biological methods. (2)

5. Selection of recombinant clones-colony hybridization and library screening. (2)

6. CRISPR- Introduction, History, Mechanism and Applications (2)

7. Application of recombinant DNA technologies-agriculture, diagnostics, industrial, pharmaceutics and medicine. (1)

Course Outcomes:

By the end of this course students will be able to

BT333. CO1: To understand and demonstrate the various levels of genomic organization and DNA replication.

BT333. CO2: To relate and interpret gene expression in prokaryotes and Eukaryotes.

BT333. CO3: To formulate new strategies applicable to state the function of various genes.

BT333. CO4: To interpret the concepts, techniques and applications of recombinant DNA technology

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Paper III- Practicals

Paper Code: BT333P 30 hrs(2 hrs/ week)
Credits: 1

Skill development: To acquire technical skills in Molecular biology and recombinant DNA technology.

Objective: To provide hands on experience in molecular biology and recombinant DNA technology.

1. Isolation of DNA from bacterial cells.
2. Isolation of Plasmid DNA.
3. Agarose electrophoresis of DNA.
4. Quantification of DNA by Spectrophotometer.
5. Separation of proteins by SDS-PAGE.
6. Polymerase Chain reaction.
7. Restriction digestion of DNA.
8. Bacterial transformation.

Outcome: Students understand the principles involved in isolation of DNA, basic techniques used in Molecular biology and recombinant DNA Technology.

Spotters:

1. PCR
2. RNA Polymerase
3. Okazaki fragments
4. Plasmid vector Map
5. Prokaryotic gene
6. Eukaryotic gene
7. Splicing
8. Post transcriptional modification
9. Point mutations

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10 .Lac operon

11. Tryptophan operon

12. Post translational modifications (PTMS)

Reference Books:

1. Molecular Biology of the gene- Watson, Hopkins, Roberts, Steitz and Weiner
2. Genes- Benjamin Levin
3. General virology- Luria, Darnell, Baltimore and Campbell
4. Molecular Biology- David Frefielder
5. Practical Microbiology- Aneja
6. Microbial Genetics ByMaloy, Freifelder
7. Molecular Genetics By Gunther and Stent
8. Genetic Analysis By Griffith, Suzuki and others
9. Gene cloning and DNA analysis: an introduction - T.A. Brown
10. Principles of Genetics- Irwin Herscowitz

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Department of Genetics and Biotechnology

Skill Enhancement Course- Credits 2

Effective from 2023-'24 onwards

Title: Integrated Pest Management -SE333

Skill Development: Gain expertise in identifying the pests infesting the crop plants. Manage to incorporate IPM program in controlling the pest infestation.

Course Objectives:

Cob 1: Gain basic knowledge of various pests and Pest control strategies of IPM.

Cob 2: Students understand the side effects of chemical pesticides.

UNIT 1: Theory (15 hours)

1. Basic concepts of pest. (1)
2. Types of pest based on occurrence and nature of damage. (2)
3. Concept of Pest Management. (1)
4. Principles of insect pest management. (2)
5. Tools of Integrated pest management. (2)
6. Chemical pest management (Insecticides- Advantages and disadvantages). (2)
7. Role of soil nutrients in pest control. (1)
8. Biopesticides- success stories and limitations. (2)
9. Bioremediation of Industrial pollutants by insects. (2)

Unit II 15 hours

Project work/survey on

1. Collection and preservation of mature and immature insects.
2. Collection of information on chemical insecticides available in local markets.
3. Collection of information on Biopesticides available in local market.
4. Visit to IPM fields.
5. Neem Extract-Application to plants.

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Break up for classes
Survey and field work (10)
Analysis and compilation of Data (5)

Course Outcomes:

CO1: Students expertise in tackling the pests in an eco-friendly way

CO2: Students are motivated to go for biological pesticides and employ IPM strategies for pest control

Reference Books:

1. Metcalf R L, Introduction to Insect pest management. 3'd Edition New York: A Wiley Interscience publication, c1994

2. Shagufta, Integrated Pest Management APH Publishing corporation, 2012

3. G. S. Dhaliwal and R Arora, Integrated pest management, Concepts and Approaches.

4. D, Prasad, Crop Protection: Management strategies.

5. Awasthi V B, Agricultural Insect Pests and their control'

6. Arora R, Theory and Practice of integrated Pest Management

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Program name: B.Sc BtGC & BtMbC (w.e.f. 2023- '24)
Biotechnology (Optional)

Course Name: Bioinformatics and Biostatistics

Paper Code: BT433 No of Classes: 60
Year/Semester: II/IV No of Credits: 4

Skill development: To acquire knowledge in data retrieval and integration in bioinformatics, problem solving and analytical skills in biostatistics.

Course objective: To analyze biological data digitally and to apply and interpret statistical methods correctly.

Unit wise course objectives:

Cob 1: To retrieve and interpret the biological data from bioinformatics database.

Cob2: To organize, process and analyze biological data

Cob 3: To evaluate statistical tools and its application to problems of human health and disease, with the ultimate goal of advancing statistics.

Cob 4: To apply statistical tests for testing of hypothesis and analysis of variance and interpret statistical results correctly, effectively, and in context.

Unit 1 – Introduction to bioinformatics and biological databases **15 Hours**

1. Bioinformatics definition, history, scope and applications. (4)
2. Bioinformatics tools and resources – Internet basics, role of internet, free online tools, downloadable free tools. (3)
3. Bioinformatics web portals –NCBI, EBI, ExPASy. (3)
4. Biological databases –DNA sequence databases (ENA &DDBJ). (3)

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5. Protein sequence databases (Swissprot & PROSITE). (2)

6. Introduction to homology modeling (1)

Unit 2- Sequence alignment **15 Hours**

1. Basics of sequence alignment –match, mismatch, gaps, gap penalties, scoring alignment. (3)

2. Types of sequence alignment –pairwise and multiple alignment, local and global alignment.(3)

3. Dot matrix comparison of sequences. (2)

4. Scoring matrices-PAM and BLOSUM. (2)

5. Pairwise sequence similarity search by BLAST and FASTA. (2)

6. Concepts of Phylogeny – distance based (NJ method and character base (ML method) tree construction methods (3)

Unit 3- Descriptive Biostatistics and probability **15 Hours**

1. Introduction to biostatistics, kinds of data and variables –based on nature (numerical –discrete and continuous: categorical – ordinal and nominal – based on source (primary and secondary data): sample size, sampling methods and sampling errors. (3)

2. Data tabulation and representation methods: graphical methods –stem and leaf plot, line diagram, bar graph, histogram, frequency polygon, frequency curves; diagrammatic method-pie diagram. (3)

3. Measures of central tendency- mean, median, mode; merits and demerits. (2)

4. Measures of dispersion - range, variance, standard deviation, standard error and coefficient of variation; merits and demerits. (2)

5. Concepts of probability-random experiments, events, probability of event, probability rules (addition and multiplication) use of permutations and combinations, random variables (discrete and continuous). (3)

6. Probability distributions: Binomial and Poisson distributions for discrete variables, Normal

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distribution for continuous variables. (2)

Unit 4 – Application of biostatistics **15 Hours**

1. Hypothesis testing –steps in testing for statistical hypothesis, null and alternative hypothesis, level of significance-type 1 and type 2 errors. (3)

2. Test of significance for small samples –student's t-test (one sample and two samples). (2)

3. Test of significance for large samples –Z – test for means and proportions. (3)

4. Chi-square test and its applications- goodness of fit, test of independence. (2)

5. Analysis of variance (ANOVA) – one way analysis. (2)

6. Correlation – definition, simple and linear analysis, Karl Pearson's correlation coefficient. (3)

Course outcomes:

By the end of this course students will be able to

BT 433 CO 1: To apply bioinformatics tools to guide data analysis and interpretation.

BT 433 CO 2: To provide a basic outline of the processes used for sequence alignment.

BT 433 CO 3: To understand the principal concepts about biostatistics and recognize it's importance with the other sciences.

BT 433 CO 4: Implement statistical tests for testing of hypothesis and analysis of variance and to enhance their knowledge in new spheres of Biostatistics.

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Paper IV- Practicals

Paper Code: BT333P 30 hrs(2 hrs/ week)
Credits: 1

Skill development: To acquire the skills to use the basic tools in bioinformatics and interpret the concepts of biostatistics.

Objectives: Students understand the concepts of biostatistics along with hands on expertise in bioinformatics.

1. Omics -Basics
2. Exploring web portals NCBI, EBI & ExPASY.
3. Literature search through Pubmed and Pubmed Central.
4. Sequence retrieval from Genbank, ENA, Swissprot.
5. Pairwise homology search by BLAST and FASTA.
6. Calculation of mean, median, mode, standard deviation, variance, standard coefficient of variation.
7. Construction of bar diagram, Pie diagram, Line diagram, Histogram.
8. Problems on Hypothesis testing using Z- test, t-test and Chi- square test.
9. Problems on probability and probability distributions.

Outcomes: Students expertise Biostatistics and also in analysis of biological data using bioinformatics tools.

Spotters:

1. Line diagram, Bar diagram and pie diagram.
2. Histogram, frequency polygon and frequency curve
3. Normal Probable curve.
4. GenBank
5. DDBJ
6. SWISS-PROT
7. PROSITE
8. PIR

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9. BLAST

10. Pairwise alignment.

11. Multiple sequence alignment

12. PAM, BLOSUM

13. Phylogentic Tree

Reference books:

1. Khan & Khanum (2004), Fundamentals of Biostatistics, II Revised Edition. Ukaaz Publication

2. Bailey, N.T.J, Statistical methods in Biology, Cambridge Univ. Press

3. Fundamentals of Biostatistics, P Hanumantha Rao and K.Janardhan

4. Danial, W. W. Biostatistics, Wiley

5. Introduction to Bioinformatics by Aurther M lesk

6. Developing Bioinformatics Computer Skills By: Cynthia

7. Bioinformatics second edition By David M mount

8. Essential Bioinformatics by Jin Xiong

9. Bioinformatics Computing By Bryan Bergeron

10. Bioinformatics: Concepts, Skills & Applications by R.S. Rastogi

11. Queen. J. P.. Quinn, G. P., & Keough. M. J. (2002). Experimental design and data analysis for biologists Cambridge University Press.

12. Mahajan. B. K. (2002). Methods in biostatistics Jaypee Brothers Publishers.

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Autonomous College
Affiliated to Osmania University, Hyderabad.
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Department of Genetics and Biotechnology
Skill Enhancement Course- Credits 2
Effective from 2023-'24 onwards
Title: Food Preservation and adulteration –SE433

Skill Development: Students learn about different processes to preserve food and they also learn to identify the key adulterants in various foods in the market.

Course objectives:

COb 1: Students get an insight into the process of microbial degradation of food.

COb 2: Students get the basic knowledge of the different types of food adulteration added to foods and evaluation of milk by MBRT.

UNIT 1	**(15 hours)**
1. History of Food preservation -evolution of cooking process.	(1)
2. Food fermentation process and preservation process.	(3)
3. Food additives- Preservative,Antioxidants, supplements , emulsifiers and thickening agents.	(4)
4. Food additives -Taste and Flavour Enhancers (Sweeteners,Bleaching and Maturing agents, Colouring and Flavouring agents.	(3)
5. Food adulterants -Types of adulterants (Intentional and Incidental).	(3)
6. Health hazards and Risks.	(1)

Unit II	**(15 hours)**
1.Report writing on "Food adulterants in coffee,Turmeric, Edible oils, Ghee,Honey ,Milk	(4)
2. Microbial Analysis of Foods	(3)
3. Determination of quality of Milk by MBRT	(6)
4. Preparation of Fruit Squash/Mayonnaise	(2)

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Course outcomes:

CO1: Students learn the basic methods of food preservation.

CO2: Students interpret the health risks with different adulterants present in food.

Reference books:

1. Hand book of Analysis and Quality control for fruits and Vegetable products by Ranganna S.

2. Food Microbiology by William G, Frazier

3. Fruit and Vegetable Preservation- Principles and Practice by Srivastava R. P

4. Food Science Experiments and Applications by Mohini Sethi.

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Department of Genetics and Biotechnology
Program name: B.Sc BtGC & BtMbC (w.e.f. 2023- '24)
Biotechnology Paper VA Theory

Course Name: Plant Biotechnology

Paper Code: BT533A **No of Classes: 60**
Year/Semester: III/V **No of Credits: 4**

Employability: In-depth knowledge and understanding in Principles of plant tissue culture helps students procure jobs in various labs involved in plant tissue culture or even start their own startup.

Course objective: To analyze the basic concepts of Plant tissue culture and transgenic plants along with its applications.

Unit wise Course Objective:

Cob1: To discuss the basics of plant tissue culture, media preparation and techniques involved in callus cultures, suspension cultures, organogenesis and somatic embryogenesis.

Cob2: To identify the different techniques involved in plant tissue culture and interpret its applications.

Cob3: To differentiate the methods involved in production of transgenic plants.

Cob4: To appraise the achievements of transgenic plants and its emergence as bioreactors for edible vaccines, antibody production.

Unit 1: Fundamentals of Plant Tissue Culture **15 Hours**

1.1: Introduction to Plant tissue culture, totipotency of plant cells (dedifferentiation, redifferentiation and regeneration). **(3)**

1.2: Nutritional requirements for plant tissue culture, nutrient media-macronutrients and micronutrients, media additives (carbon source,vitamins, amino acids); types of media. **(2)**

1.3: Plant growth regulators-auxins, cytokinins and gibberellins. **(2)**

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1.4: Preparation of media, sterilization, selection & surface sterilization of explant, inoculation of callus cultures and cell suspension cultures. (3)

1.5: Induction of callus cultures and cell suspension cultures. (3)

1.6: Organogenesis and somatic embryogenesis. (2)

Unit 2: Application of plant Tissue culture **15 Hours**

2.1: Meristem culture, micropropagation and their applications . (2)

2.2: Encapsulation and production of synthetics seeds and their applications. (2)

2.3: Cell suspension cultures (batch and continuous cultures) and application. (2)

2.4: Protoplast isolation, culture and fusion- development of somatic hybrids & cybrids and their applications. (3)

2.5: Somaclonal variation and its applications. (2)

2.6: Anther and pollen culture for production of haploids & their applications. (2)

2.7: Cryopreservation - conservation of plant germplasm. (2)

Unit 3: Production of Transgenic Plants **15 Hours**

3.1: Direct gene transfer techniques - physical methods: microinjection, particle bombardment gene gun) and electroporation & Chemical methods. (3)

3.2: Molecular mechanism of Agrobacterium infection and features of Ti plasmid. (2)

3.3: Agrobacterium mediated gene transfer using binary and co - integrate vectors. (3)

3.4: Viral vectors for gene transfer into plants. (2)

3.5: Selection of transgenic plants using reporter and selection marker genes. (3)

3.6: Genome editing - CRISPR CAS 9 Technology. (2)

Unit 4: Applications of Transgenic Plants **15 hours**

4.1: Herbicide resistance in transgenic plants- glyphosate tolerance. (2)

4.2: Insect resistance transgenic plants: Bt cotton, proteinase inhibitors, lectins. (3)

4.3: Virus , bacterial and fungal resistant transgenic plants. (3)

4.4: Abiotic stress tolerance : drought , heat and salinity stress tolerant plants. (2)

4.5: Transgenic plants with enhanced nutritional value vitamin A, oil, amino acids. (2)

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4.6: Transgenic plants as bioreactors:edible vaccines,antibody production, biodegradable plastics. (3)

Course outcomes:

By the end of this course, students will be able

BT533A CO1: To understand the principles and techniques of plant tissue culture.

BT533A CO2: To appraise the achievements of plant tissue culture techniques and their benefit to society .

BT533A CO3: To determine the different methods involved in gene transfer techniques and CRISPR CAS 9 Technology.

BT533A CO4: To describe the uses of evolving transgenic plants for the resistance to herbicides, insects, virus, bacteria fungi and abiotic stress. They will also be able to determine its role in enhanced nutritional value and as bioreactors.

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Paper VA- Practicals

Paper Code: BT533A P **30 hrs(2 hrs/ week)**
Credits: 1

Skill Development: Students learn media preparation, callus induction, micropropagation , transformation and encapsulation techniques.

Objective: To demonstrate the basic procedures used in plant tissue cultures.

1. Preparation of media for plant tissue culture.
2. Sterilization methods of explants (seed, leaf, internode & root) and inoculation.
3. Establishment of callus culture - from carrot/rice.
4. Preparation of synthetic seeds.
5. Meristem culture.
6. Cell suspension cultures.
7. Protoplast isolation and culture.
8. Agrobacterium mediated transformation.
9. Field visit

Outcomes: Students expertise in media preparation, sterilization methods, different culture techniques, synthetic seeds preparation.

Spotters:

1. Callus cultures
2. Sterilization techniques autoclave and hot air oven
3. Somatic embryo
4. Synthetic seeds
5. Meristem culture
6. Plant regeneration
7. Cell suspension cultures
8. Isolation of Protoplast
9. Particle bombardment (gene gun)
10. Binary or co-integrate vectors

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12. Golden Rice

Recommended books:

1. Plant Tissue culture and its Biotechnological Application by W.Barz, E. Reinhard, M.H.Zenk.

2. Plant Tissue Culture by Akio Fujiwara

3. Frontiers of Plant Tissue Culture by Trevor A. Thorpe

4. In vitro Haploid Production in Higher Plants by S.Mohan Jain, S.K Sopory, R.E. Veilleux

5. Plant Tissue Culture Theory and Practice by S.S Bhojwan and Razdan

6. Plant Cell, Tissue and Organ culture , Applied and Fundamental Aspects by Y.P.S Bajajand A.Reinhard

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Department of Genetics and Biotechnology
Program name: B.Sc BtGC & BtMbC (w.e.f. 2023- '24)
Biotechnology paper VB Theory

Course Name: Medical Biotechnology

Paper Code: BT533B **No of Classes: 60**
Year/Semester: III/V **No of**
Credits: 4

Employability: Theoretical knowledge and practical skills gained on karyotyping helps students to procure jobs in hospitals and institutes as genetic counselors.

Course Objective: To analyze the concepts of Inheritance of Human diseases, its genetic basis and to interpret the techniques for its diagnosis and therapeutic approaches.

Unit wise course objective:

Cob1: To understand the inheritance of human diseases and karyotyping including chromosomal staining.

Cob2: To analyze the genetic basis of Human disorders.

Cob3: To examine the techniques for diagnosis of human diseases.

Cob4: To interpret the Therapeutic approaches for human diseases.

Unit 1: Inheritance of human diseases and karyotyping	**15 Hours**
1.1: Inheritance patterns- pedigree analysis of autosomal traits	(3)
1.2: Inheritance patterns – pedigree analysis of allosomal traits	(3)
1.3: Factors affecting pedigree pattern – penetrance, expressivity	(2)
1.4: Genetic heterogeneity-allele and locus heterogeneity	(2)
1.5: karyotyping of Human chromosomes	(2)
1.6: Chromosomal staining – G.Q, R and C banding techniques.	(3)

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Unit 2: Genetic basis of Human disorders **15 Hours**

2.1: Chromosomal disorders caused due to structural chromosomal abnormalities (deletions, duplications, translocations and inversions) (3)

2.2: Chromosomal disorders caused due to numerical chromosomal abnormalities (euploidy, aneuploidy, autosomal and allosomal) (3)

2.3: Monogenic disorders (autosomal and X- linked diseases) (2)

2.4: Mitochondrial diseases-LHON, MERRF (2)

2.5: Multifactorial disorders – diabetes and hypertension (2)

2.6: Cancer – types of cancer, genetic basis of cancer (Oncogenes, tumor suppressor genes) (2)

2.7: Introduction to communicable and non- communicable diseases (1)

Unit 3: Techniques for diagnosis of human diseases. **15 Hours**

3.1: Prenatal; diagnosis -invasive techniques -amniocentesis, chorionic villi sampling (3)

3.2: Diagnosis using enzyme markers -Guthrie test (phenylketonuria) (2)

3.3: Diagnosis using monoclonal antibodies-ELISA (HIV) (2)

3.4: DNA /RNA based diagnosis-HBV (3)

3.5: PCR based genotyping techniques for diagnosis-RFLP (MTHFR C677T mutation) (3)

3.6: Chip bases diagnosis and applications- colon cancer (2)

Unit 4: Therapeutic approaches for human diseases **15 Hours**

4.1: Recombinant proteins-human growth hormone, insulin (2)

4.2: Gene therapy -ex vivo and in vivo gene therapy (2)

4.3: Stem cells -potency definitions; embryonic and adult stem cells (2)

4.4: Applications of stem cell-based therapies and regenerative medicine (3)

4.5: Vaccines, different Types and their Applications -(herpes simplex virus, Cholera, Covid) (3)

4.6: Industrial production and Applications of monoclonal antibodies (3)

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Paper VB- Practicals

Paper Code: BT533B P **30 hrs(2 hrs/ week)**
Credits: 1

Skill Development: Students learn the method of karyotyping, identification of the mode of inheritance from pedigrees and DOT ELISA.

Objective: To demonstrate the role of karyotyping in identification of chromosomal disorders, to help students to identify the mode of inheritance by pedigree analysis, DOT ELIZA and Chromosome banding.

1. Karyotyping of normal human chromosome set
2. Karyotyping of autosomal abnormality (Down's syndrome)
3. Karyotyping of allosomal abnormality (Klinefelter syndrome)
4. Chromosome banding -G Banding
5. Human pedigree analysis of autosomal disorder
6. Human pedigree analysis of allosomal disorder
7. Estimation of C-reactive protein
8. DOT ELISA
9. Field visit

Outcome: Students evaluate karyotyping procedures, Chromosome banding, different modes of inheritance of traits, and expertise in DOT ELISA

Spotters:

1. Identify the karyotype (Down's syndrome)
2. Identify the karyotype (Klinefelter syndrome)
3. Chromosomal banding techniques)
4. Identify the inheritance pattern of pedigree (autosomal disorder)

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Course outcomes:

By the end of this course, students will be able

BT533B CO1: To compare the pedigree analysis of autosomal and allosomal traits and the theory behind karyotyping and chromosomal staining of human chromosomes.

BT533B CO2: To distinguish chromosomal disorders, monogenic disorders, multi-functional disorders, mitochondrial disease and cancer.

BT533B CO3: To recognize the principles and applications involved in the techniques involved in the diagnosis of human diseases like Phenylketonuria, HIV, colon cancer.

BT533B CO4: To formulate therapeutic approaches for human diseases which involves recombinant proteins, gene therapy, stem cells, DNA based vaccines, monoclonal antibodies.

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6. Prenatal diagnosis – invasive technique

7. Prenatal diagnosis- noninvasive techniques

8. Identify the type of gene therapy -ex vivo in vivo

9. Recombinant vaccine

10. ELISA technique

11. Identify the SNP genotype of different samples after performing PCR-RFLP

12. Count the viable cells on Neubauer chamber (hemocytometer)

Recommended Books:

1. Medical Biotechnology by Pratibha Nallari. V Venugopal Rao- Oxford Press
2. Introduction to Human Molecular Genetics by JJ Pasternak- John Wiley Publishers.
3. Human Molecular Genetics by Tom Strachen and AP Read Bios Scientific Publishers
4. Human Genetics Molecular Evolution by McConkey
5. Recombinant DNA Technology by AEH Emery
6. Principles and Practice of Medical Genetics - 1 II III Volumes by AEH Emery
7. Molecular Biotechnology by Glick and Pasternak

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Department of Genetics and Biotechnology
Program name: B.Sc BtGC & BtMbC (w.e.f. 2023- '24)
Biotechnology (General Elective)

Course Name: Basics in Biotechnology

Paper Code: GE 533 **No of Classes: 60**
Year/Semester: III/V **No of Credits: 4**

Employability: Acquiring knowledge on the concepts of Basic biotechnology will procure jobs in agricultural, microbial and industrial, animal and medical and bioinformatics sectors.

Course objectives:

To analyze the concepts of Basic biotechnology with reference to Agricultural, Microbial and Industrial, animal and medical sectors including computer applications .

Unit Wise Course objectives:

Cob1: To distinguish the different techniques involved in agricultural biotechnology along with its applications .

Cob2: To interpret the methods involved to characterize and preserve microorganisms, its strain improvement and development along with its application.

Cob3: To discuss the concepts involved in Animal and Medical Biotechnology.

Cob4: To evaluate computer applications in Biotechnology.

Unit I: Agricultural Biotechnology **15 Hours**

1.1: Plant tissue culture- media, sterilization, culture types. (3)

1.2: Micro-propagation, Synthetic seeds, Somatic hybrids and haploid plants. (3)

1.3: Transgenic plants- direct & indirect methods of gene transfer. (3)

1.4: Applications of transgenic plants- improving productivity & Nutritional quality. (2)

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1.5: Applications of transgenic plants-stress tolerant plants & molecular farming. (2)

1.6: Biofertilizers and biopesticides . (2)

Unit 2: Microbial and Industrial Biotechnology **15 Hours**

2.1: Exploitation of micro-organism and their products. (2)

2.2: Isolation, screening and selection of microorganisms for industrial products. (3)

2.3: Preservation of microorganisms. (2)

2.4: Strain development and improvement, strategies of strain improvement selection and recombination. (2)

2.5: Production of recombinant DNA vaccine, amino acids, vitamins. (3)

2.6: Single cell protein, dairy products, penicillin and streptomycin production. (3)

Unit 3: Animal and Medical Biotechnology **15 Hours**

3.1: Cell culture technique and its applications. (3)

3.2: Animal breeding (Selective breeding and cross breeding) and its limitations. (3)

3.3: In vitro techniques in animal improvement: in vitro fertilization & microinjection. (2)

3.4: Genetically modified animals: transgenic & knock – outs. (3)

3.5: Mouse models of disease: cancer and diabetes. (2)

3.6: Biotechniques: gel electrophoresis and PCR. (2)

Unit 4: Computer applications in Biotechnology **15 Hours**

4.1: Scope of computer applications in Biotechnology. (2)

4.2: Biotechnology tools and resources -role of the internet, free online tools, downloadable free software. (3)

4.3: Biotechnology web portals- NCBI, EBI, ExPASY. (3)

4.4: Biological databases: Classification of databases – the primary (GenBank), secondary (PIR) databases. (3)

4.5: Sequence databases – DNA sequence databases (ENA & DDBJ). (2)

4.6: Protein sequence databases (Swissprot & PROSITE). (2)

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Course Outcomes:

At the end of this course, students will be able

CO1: To interpret the different techniques involved in Plant tissue culture, Micropropagation , Gene transfer and the production of biofertilizers and biopesticides.

CO2: To evaluate the concepts and applications of Microbial and Industrial Biotechnology

CO3: To differentiate cell culture and animal breeding techniques,and also to value the role of mouse models of diseases and transgenic animals.

CO4: To identify the tools and resources of computer applications in Biotechnology which will pave a way to acquire a comprehensive knowledge on different kinds of Web portals and databases.

Recommended books:

1. Plant Tissue culture and its Biotechnological Application by W.Barz, E. Reinhard, M.H.Zenk.

2. Plant Cell, Tissue and Organ culture , Applied and Fundamental Aspects by Y.P.S Bajajand A.Reinhard

3. Essentials of Biotechnology for Students by Satya N.Das

4. TextBook of Biotechnology by H.K Das (Wiley publication)

5. Biotechnology by H. J. Rehm and G. Reed VIH Publications, Germany

6. Biogas Technology by T. Nijaguna

7. Biotechnology by K.Trehan

8. Industrial Microbiology by L.E. Casida

9. Essentials of Biotechnology for Students by Satya N.Das

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Department of Genetics and Biotechnology
Program name: B.Sc BtGC & BtMbC (w.e.f. 2023- '24)
Biotechnology Paper VIA Theory

Course Name: Animal Biotechnology

Paper Code: BT633A **No of Classes: 60**
Year/Semester: III/VI **No of Credits: 4**

Employability: In-depth Knowledge and understanding of applications of biotechnological tools and principles helps students to develop skills in cell and tissue culture helping them to procure jobs in various institutions and companies carrying out production of animal cell cultures.

Course objectives: To analyze the principles and applications of animal cell culture and to examine the techniques involved in the in vitro animal improvement ,animal genetics and genetically modified organisms.

Unit Wise Course objectives:

Cob1: To describe the principles and applications of animal cell culture techniques.

Cob2: To distinguish the methods pertaining to animal breeding, superovulation, in vitro fertilization, somatic cell nuclear transfer and their applications.

Cob3: To interpret molecular markers in animal genetics.

Cob4: To appraise the significance of genetically modified organisms and their applications in the field of disease biology and drug development.

Unit 1: Animal cell culture: principles and applications **15 hours**

1.1: Cell culture technique: cell culture media, sterilization techniques. **(2)**

1.2: Characteristic features of cell lines and cell line maintenance. **(2)**

1.3: Methods of isolation and separation of various cell types and establishment of cell lines. **(3)**

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1.4: Properties and types of stem cells, culturing of embryonic stem cells and adult stem cells and adult stem cells. (3)

1.5: Manipulation of cells: electroporation, transfection, transduction and microinjection. (3)

1.6: Application of cell culture : manufacturing , toxicity testing and tissue engineering. (2)

Unit 2: In vitro techniques in animal improvement **15 hours**

2.1: Principles of animal breeding , selective breeding, cross breeding and their limitations. (3)

2.2: Superovulation , collection of semen and ova. (2)

2.3: In vitro maturation of oocytes, artificial insemination. (2)

2.4: In vitro fertilization, embryo collection and embryo sexing. (3)

2.5: Somatic cell nuclear transfer, cloning of animals (example: Dolly). (3)

2.6: Applications of in vitro techniques in animal improvement. (2)

Unit 3: Molecular markers in animal genetics **15 hours**

3.1 Development in livestock genomes (Estimated Breeding Value-EBV). (3)

3.2: Molecular markers: types and characteristics. (3)

3.3: RFLP and RAPD. (3)

3.4: SNPs and their application in genotyping. (2)

3.5: Identification and isolation of desired genes of interest. (2)

3.6: Marker- assisted selection. (2)

Unit 4: Genetically modified organisms **15 hours**

4.1: Animal models and their significance in scientific research. (3)

4.2: Mouse models for cancer. (2)

4.3: Generation of transgenic mouse. (2)

4.4: Generation of Gene knock-out mouse. (2)

4.5: Genetically modified mice as disease models. (3)

4.6: Applications of genetically modified animals in understanding disease biology

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and drug development. (3)

Course outcomes:

By the end of this course students will be able to

BT633A CO1: To interpret the cell culture techniques, cell lines characteristics, stem cell properties and methods of cell manipulation.

BT633A CO2: To evaluate the methods of invitro techniques involved in animal improvement.

BT633A CO3: To identify the significance of molecular markers and their role in RAPD, RFLP and in animal genetics.

BT633A CO3: To value the role of genetically modified animals in scientific research.

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Paper VIA- Practicals

Paper Code: BT633A P **30 hrs(2 hrs/ week)**
Credits: 1

Skill development: Students will get hands-on experience to prepare and sterilize animal culture media, establish primary cell culture, suspension cells, adherent cells and to prepare metaphase chromosomes.

Objectives: To demonstrate preparation and sterilization of animal culture media, cell counting, Culturing of suspension and adherent cells and preparation of metaphase chromosomes.

1. Preparation of animal cell culture media
2. Sterilization of cell culture media
3. Cell counting by microscopy
4. Isolation of cells from chicken liver
5. Establishment of primary cell culture: Liver/Spleen
6. Preparation of metaphase chromosomes
7. Culturing suspension cells
8. Culturing adherent cells
9. Field visit.

Outcomes: To expertise in preparing animal culture media,metaphase chromosomes,establishing the primary cell culture procedure which will pave a way for students to seek employability in research laboratories .

Spotters:

1. Microscope
2. CO2 incubator
3. Biosafety cabinet/Laminar air flow
4. Trypan blue stained cells
5. Cell culture flasks and dishes
6. Metaphase slide

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8. Centrifuge

9. Example of an RFLP

10. Microinjection into egg cells

Recommended Books:

1. Text book of Animal Biotechnology by B Singh. The Energy and Resources Institute (teri)

2. Genetics for Animal Sciences by WH Freeman Van Vleck LD, Pollak EJ & Bltenacu EAB.1987

3. Cancer Cell Culture Methods and Protocols 731 (Methods in Molecular Biology) Human; 2nd 2011 edition (28 April 2011).

4. Genetic Engineering by VK Agarwal and P.S. Varma. S. Chand & Company Ltd, 2009

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Autonomous College
Affiliated to Osmania University, Hyderabad.
(Accredited with 'A' grade by NAAC)
Department of Genetics and Biotechnology
Program name: B.Sc BtGC & BtMbC (w.e.f. 2023- '24)
Biotechnology Paper VIB Theory

Course Name: Environmental Biotechnology

Paper Code: BT633B
Year/Semester: III/VI

No of Classes: 60
No of Credits: 4

Employability: A profound knowledge gained from bioremediation helps students procure jobs in organizations dealing with bioremediation like sewage treatment.

Course objectives: To acquire knowledge on pollution and sources and understand the importance of Biomass, Biofuels, Biofertilizers, Biopesticides and Bioremediation.

Unit Wise course objectives:

Cob1: To discuss the different types of pollution and its sources.

Cob2: To appraise the different sources of Biomass and Biofuels.

Cob3: To distinguish the different concepts and types of Biofertilizers and biopesticides.

Cob4: To analyze the different methods of bioremediation of environmental pollution.

Unit 1: Environmental pollution **15 Hours**

1.1: Introduction to environment and pollution. (2)

1.2: Types of pollution -air, water and soil pollution. (3)

1.3: Types of pollution-inorganic, organic and biotic. (3)

1.4: Sources of pollution -domestic waste, agricultural waste, industrial effluents and municipal waste. (3)

1.5 Greenhouse gases, global warming and climate change. (2)

1.6: Measurement methods of environmental pollution -BOD & COD. (2)

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Unit 2: Biomass and Biofuels 15 Hours

2.1: Renewable and non- renewable energy resources. (2)

2.2: Fossil fuels energy source and their impact on the environment. (3)

2.3: Biomass as source of energy (Bioenergy). (3)

2.4: Types of biomass -plant, animal and microbial biomass. (3)

2.5: Production of biofuels: bioethanol and biodiesel. (2)

2.6: Production of biohydrogen and biomethane. (2)

Unit 3: Biofertilizers and Biopesticides 15 hours

3.1: Chemical fertilizers and their impact on the environment (eutrophication). (3)

3.2: Concepts of biofertilizers. (2)

3.3: Types of biofertilizers – bacterial, fungal and algal fertilizers. (3)

3.4: Pesticides and their impact on the environment. (2)

3.5: Concepts of biopesticides, types of biopesticides. (3)

3.6: Uses of biofertilizers and biopesticides. (2)

Unit 4: Bioremediation of Environmental Pollutants 15 hours

4.1: Waste water treatment – sewage and industrial effluents (aerobic and anaerobic methods). (3)

4.2: Bioremediation -concepts and types (in-situ and ex-situ bioremediation). (3)

4.3: Bioremediation of toxic metal ions-biosorption and bioaccumulation. (3)

4.4: Composting of organic wastes. (2)

4.5: Microbial remediation of pesticides and xenobiotic compounds. (2)

4.6: Phytoremediation- concepts and applications. (2)

Course outcomes:

By the end of this course students will be able to

BT633B CO1: To interpret the different types of Pollution and its sources ,its effect on the globe along with the measurement methods.

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BT633B CO2: To evaluate the different types of biomass and biofuels used and its importance to the maintenance of the environment.

BT633B CO3: To explore the sources of energy that are eco-friendly like bio-fuels and biofertilizers and to motivate the students to pursue research in the same field for the betterment of the society.

BT633B CO4: To analyze the importance of bioremediation to the environment and to identify its methods.

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Paper VI B- Practicals

Paper Code: BT633B P **30 hrs(2 hrs/ week)**

Credits: 1

Skill development: Students will obtain skills to analyze polluted samples, produce biogas and biofertilizers.

Objective: To demonstrate the techniques involved to evaluate polluted water samples and to help students understand the microbial flora present in it.

1. Estimation of BOD in polluted water samples.
2. Estimation of COD in polluted water samples.
3. Estimation of total dissolved solid in wastewater samples.
4. Determination of quality of water sample (Coliform test).
5. Isolation of microorganisms from polluted soil/ industrial effluents.
6. Production of hydrogen or biogas.
7. Identification and characterization of bioremediation microorganisms.
8. Production of microbial biofertilizers.
9. Field Visit

Outcome: The students estimate BOD, COD of polluted water samples, isolate and characterize the microorganisms from different sources and analyze the techniques in the production of biofertilizers and biogas.

Spotters:

1. Air/water /soil pollution
2. Municipal waste
3. Industrial effluents
4. Algal blooms
5. Greenhouse effect
6. Plant biomass
7. Waste water treatment plant

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9. Biogas plant

10.Xenobiotic degrading bacteria

11. Phytoremediation

12. Microbial biofertilizers.

Recommended books:

1. TextBook of Biotechnology by H.K Das (Wiley publication)
2. Biotechnology by H. J. Rehm and G. Reed VIH Publications, Germany
3. Biogas Technology by T. Nijaguna
4. Biotechnology by K.Trehan
5. Industrial Microbiology by L.E. Casida
6. Food Microbiology by P.K.Gupta
7. Essentials of Biotechnology for Students by Satya N.Das
8. Bioethics – Readings and Cases by B.A Brody and h.t Engelhardt.Jr.(Pearson education)
9. Biotechnology. IPRS and biodiversity by M.B.Rao and Manjula Guru (Pearson education)

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Department of Genetics and Biotechnology
Program name: B.Sc BtGC & BtMbC (w.e.f. 2023- '24)
Biotechnology (Optional)

Course Name: IPR, Biosafety and Entrepreneurship

Paper Code: BT633_O | **No of Classes: 60**
Year/Semester: III/VI | **No of Credits: 4**

Employability: Students can establish their own start-ups and create employability which means from being an employee they become employers. They can also procure jobs in labs as quality control and quality assurance analysts. They can be employed as patent analysts for companies with an advanced course in IPR in reputed universities like Nalsar Law University.

Course objectives: To introduce the basic concepts of ethics and safety that are essential for the different disciplines of science and procedures involved in the protection of intellectual property and related rights.

Unit wise course objectives:

Cob1: To introduce the basics of Intellectual property rights, copyrights ,trademarks and patents.

Cob2: To understand the value and purpose of patents.

Cob3: To discuss the basics of laboratory management and safety.

Cob4: To appraise the fundamental concepts of Entrepreneurship.

Unit 1: Intellectual Property Rights **15 hours**

1.1: Intellectual Property - meaning, nature. (2)

1.2: Significance and need of protection of intellectual property. (2)

1.3: Types of intellectual property rights: patent, trademarks, copyright, design registration,

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trade secret, geographical indicators, plant variety protection. (3)

1.4: Copyright: meaning, nature, historical evolution and significance. (2)

1.5: Ownership of copyrights-rights of author and owners, trademarks. (3)

1.6: Plant varieties protection and plant breeding rights. (3)

Unit 2: Patents laws **15 hours**

2.1: Patents-concepts of patents- historical overview of the patent law in India. (3)

2.2: Kinds of patents - procedure for obtaining patent in India and other countries. (3)

2.3: Patenting microbes and organisms- novelty, International Depository Authorities(IDAs),submitting details of the deposit. (3)

2.4 Patenting genes-pros and cons, Bioethics: examples. (2)

2.5: Patenting markers and variants -examples. (2)

2.6: Product vs process patent - product life cycle and process design. (2)

Unit3: Laboratory management and safety **15 hours**

3.1: Administration of laboratories, laboratory design, laboratory information management system. (3)

3.2: Laboratory safety-good laboratory practice (GLP), good manufacturing practices (GMP), biosafety levels. (2)

3.3: Basic principles of quality control (QC) and quality Assurance (QA). (2)

3.4: Handling of hazardous compounds - chemicals, solvents, poisons, isotopes,explosives and biological strains. (3)

3.5: Storage of hazardous material. (3)

3.6: Disposal of biological and radioisotope wastes. (2)

Unit 4: Entrepreneurship **15 hours**

4.1: Concept, definition structure and theories of entrepreneurship. (3)

4.2: Types of start -ups with examples. (2)

4.3: Types of entrepreneurship, environment , process of entrepreneurial development. (3)

4.4: Entrepreneurial culture, entrepreneurial leadership. (2)

4.5: Product planning and development - project management, search for business ideas, concept of projects , project identification. (3)

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4.6: Promoting bio-entrepreneurship. (3)

Course Outcomes:

By the end of this course students will be able to

BT633_O CO1: Distinguish and explain various forms of IPRs and analyze the rights and responsibilities of holders of Patent, Copyright, Trademark, design registration and trade secret.

BT633_O CO2: To analyze the significance of patent laws and its role in innovation and economic performance.

BT633_O CO3: To understand the legal framework of health and safety.

BT633_O CO4: To demonstrate an ability to engage in critical thinking by analyzing situations and constructing and selecting viable solutions to solve problems.

Recommended Books:

1. Law Relating to Intellectual Property Right by V K Ahuja.
2. Intellectual Property Rights by Neeraj Pandey and Khushdeep Dharni.
3. Text Book of Intellectual Property Rights by N K Acharya.
4. Principles of Entrepreneurship development by prof.Dr.C.karthikeyan and Dr.P.Lalitha.
5. Patent Law principles and strategies by Jeffrey I. Auerbach, Ph.D., J.D.

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Department of Genetics and Biotechnology

Subject: Biotechnology

B.Sc Life Sciences

Semester–VI

CBCS

W.e.f 2023-24 onwards

PROJECT WORK

Credits: 4

Paper Code: BT632_PW
No of Hours: 60 (4hr/wk)

1. **Basic concepts of Project planning**

    a) **Selection of Project topic and defining objectives**
    b) **Planning of methods/approaches**

2. **Guidelines for Project writing**

- **Title of the project:**
- **Title page- Name of the Project, Name of the Student & the Supervisor**
- **Declaration by Student**
- **Declaration by Supervisor**
- **Introduction**
- **Objectives**
- **Review of Literature**
- **Methodology**
- **Results and Discussion**
- **Conclusion**
- **References**

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Course Objectives:

Cob 1: To develop practical and project writing skills.

Cob 2: To select a topic and execute the planned work using scientific analysis and logic.

1. **Project work will involve experimental work/data collection and it has to be completed in the stipulated time by the student.**

- Students will be asked their choice for Project work at the beginning of Semester VI and all formalities of topic and mentor selection will be completed. Project work will be offered as per the expertise and infrastructural facilities available in the department.

- Project work may be allotted to students as individual or as group project (not exceeding 4-5 students per group).

- The completed work and compiled data would be presented in the form of results and submitted in the form of a dissertation/project report.

- Final evaluation of the project work will be through a panel consisting of internal and external examiners.

- Guidelines provided for execution and evaluation of project work will be strictly adhered.

- The grading would be based on evaluation of punctuality, experimental work, record keeping, academic inputs, data presentation, interpretation etc.

Course Outcome:
At the end of the course, students will be able to
CO1: Plan and execute a project effectively in the stipulated time.
CO2: They develop analytical skills, statistical data handling skills, paper writing and oral presentation skills.

PROJECT WORK EVALUATION SCHEME

Presentation of Thesis Dissertation to External Examiner	-	**70 Marks (50 Presentation + 20 Dissertation)**
Continuous Evaluation by the Internal Examiner	-	**30 Marks**
Total	-	**100 Marks**

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