



Bharatiya Vidya
Bhavan

BHAVAN'S VIVEKANANDA COLLEGE OF SCIENCE, HUMANITIES AND COMMERCE
Autonomous College, Affiliated to OSMANIA UNIVERSITY, Hyderabad.
(Accredited with 'A' grade by NAAC)
Department of Genetics & Biotechnology; Subject: Biotechnology

YEAR	SEMESTER	TITLE OF PAPER	CLASSES PER WEEK		CREDITS	MAX MARKS			
			Theory	Practicals		CIA	SEE	Practicals	Total
I	I	DSC 1A: Cell Biology and Genetics	4	2	5	30	70	50	150
	II	DSC 1B: Nucleic Acids, Biostatistics and Bioinformatics	4	2	5	30	70	50	150
II	III	DSC 1C: Biochemistry	4	2	5	30	70	50	150
	IV	DSC 1D: Microbiology and Biophysical Techniques	4	2	5	30	70	50	150
III	V	DSC 1E: Molecular Biology	3	2	4	30	70	50	150
		DSE 1E: A: Animal & Plant Biotechnology/ B: Medical Microbiology	3	2	4	30	70	50	150
		Generic elective	2	-	2				
	VI	DSC 1F: Genetic Engineering and Immunology	3	2	4	30	70	50	150
		DSE 1F: A: Industrial & Environmental Biotechnology/ B: Enzyme Technology & Medical Biotechnology	3	2	4	30	70	50	150
		Generic elective	2	-	2				
Total			32	16	40	240	560	400	1200

Jadhava

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Sainikpuri, Secunderabad - 500 094.

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**BHAVAN'S VIVEKANANDA COLLEGE OF SCIENCE, HUMANITIES AND
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Department of Genetics, Biotechnology and Botany

PROGRAM NAME: B.Sc BtGC (w.e.f 2019-20)

COURSE NAME: CELL BIOLOGY AND GENETICS

Paper Code: BT 133

No of Hours: 60

YEAR/SEMESTER: I/I

Credits: 4

COURSE OBJECTIVE: To Familiarize the students with the concepts and principles of cell biology and genetics

UNIT-WISE COURSE OBJECTIVES:

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

Cob 2 To analyze Chromosome organisation and cell division.

Cob 3 To interpret Mendelian Laws and Mechanism of inheritance.

Cob 4 To develop the fundamentals of recombination, linkage and sex determination.

Unit I: Cell Structure and Function.

16 hours

1. Cells as basic units of living organisms- Prokaryotic- Viral, bacterial (2)
2. Structure of fungal cell (1)
3. Structure of Plant and Animal cells. (2)
4. Ultra structure of prokaryotic cell (capsule, cell wall, pili, flagella, cell membrane, nucleoid, ribosomes) (2)
5. Ultra structure of eukaryotic cell (Cell wall, cell membrane, endoplasmic reticulum, Golgi apparatus, vacuoles, ribosomes).(6)
6. Structure and function of mitochondria and chloroplast. (3)

Unit II: Chromosome organization and Cell Division.

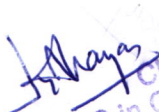
14 hours

1. Chromosome organization in Prokaryotes and Eukaryotes (3)
2. Structure of chromosomes – Heterochromatin, Euchromatin (2)
3. Cell Division – Mitosis and its significance (1)
4. Meiosis – Stages of meiosis I and II, significance of meiosis (2)
5. Synaptonemal complex, kinetochores; difference between anaphase I and II; (2)
6. Cell Cycle- Phases of cell cycle G₀, G₁, S, G₂- genes that determine the cell cycle – cyclins, CDK proteins (2)
7. Necrosis, senescence & apoptosis - Mechanism of apoptosis. (2)

Unit III: Mendel's Laws 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 (1)
3. Law of Independent assortment – Dihybrids, Trihybrids (2)
4. Deviation from Mendel's Laws - incomplete dominance, co-dominance (2)
5. Penetrance and expressivity, Pleiotropism (3)
6. Epistatic gene interaction – Modified dihybrid ratios (4)
(12:3:1; 9:7; 15:1; 9:3:4 9:6:1; 13:3)
7. Genes and environment – Temperature (*Drosophila shibire* mutant), Nutritional (*Neurospora*), Effect on human genes (PKU, Pattern baldness) (1)
8. Phenocopies – Microcephaly, Cleft lip and palate (1)


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Unit IV: Linkage, Recombination and Sex Determination

15 hours

1. Discovery of linkage, cytological proof of crossing over in maize and *Drosophila* (3)
2. Recombination frequency and map distance-2-point, 3-point test crosses; Interference and coincidence; (3)
3. Mitotic crossing over in *Drosophila* (1)
4. Sex determination- genic balance theory – *Drosophila* (3)
5. Homogametic and Heterogametic theory - Human, Birds (3)
6. Sex determination in *Bonellia* (1)
7. X – linked inheritance (egs: Haemophilia, Color blindness) (1)

Paper I- Practicals

Paper Code: BT 133 P

30 hrs (2 hrs/ week)

Credits: 1

1. Identification of bacterial, fungal, plant and animal cell.
2. Preparation of different stages of Mitosis.
3. Permanent Slide preparation of plant and animal cells.
4. Problems on Monohybrid ratio in *Drosophila*/maize.
5. Problems on Dihybrid ratio in *Drosophila*/maize.
6. Problems on Epistasis.

REFERENCES/ SUGGESTED READING

1. Cell Biology - By S.C. Rastogi (New Age International (P) Ltd)
2. Cell and Molecular Biology - By De Robertis
3. Cell and Molecular Biology - By Lodish
4. The World of the Cell - By Becker (Pearson Education)
5. Cell Biology and Genetics - By P.K. Gupta
6. Biotechnology - By K. Trehan
7. Genetics - By Gardner (Macmillan Press)
8. An introduction to Genetic Analysis - By Griffith and others – Freeman and Company
9. Concepts of Genetics - By Klug (Pearson Education)
10. Genetics - By Strickberger (Pearson Education)
11. Fundamentals of Genetics - By B.D. Singh, N. Pratibha, P.H. Rao and P.B. Kavi Kishor
12. Genetics - By B.D. Singh
13. Genetics - By Mohan P. Arora, Gurdarshan and S. Sandhu
14. Theory and Problems in Genetics - By Stransfield

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 Identify Chromosome organisation and cell division.

Bt133 CO3 Solve problems based on Mendelian Laws and Mechanism of inheritance.

Bt133 CO1 Interpret the fundamentals of recombination, linkage and sex determination.

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Department of Genetics, Biotechnology and Botany
PROGRAM NAME: B.Sc BtGC (w.e.f 2019-20)

COURSE NAME: NUCLEIC ACIDS, CELL CULTURE AND BIOINFORMATICS

Paper Code: BT 233

No of Hours: 60

YEAR/SEMESTER: I/II

Credits: 4

COURSE OBJECTIVE: To Familiarize the students with the concepts and principles of nucleic acids, cell culture and bioinformatics

Objectives:

- Cob 1 To analyze the structure and function of Nucleic acids**
- Cob 2 To compare the different models of DNA replication.**
- Cob 3 To value the concepts of cell culture.**
- Cob 4 To develop the concepts of Bioinformatics.**

Unit I: Structure and Function of nucleic acids. 15 hours

- 1. DNA as the genetic material – Griffiths experiments on transformation in *Streptococcus pneumoniae*; Avery, Mc Cleod and Mc Carty's experiments; Hershey – Chase experiments with radio- labelled T₂ bacteriophage (3)**
- 2. Structure of DNA – Watson and Crick Model (2)**
- 3. Forms of DNA – A, B and Z forms of DNA (2)**
- 4. Super coiled and relaxed DNA – Role of topoisomerases (2)**
- 5. RNA as genetic material – Tobacco Mosaic Virus (2)**
- 6. Structures and types of RNA - mRNA, t-RNA, r-RNA (4)**

Unit II: DNA replication 15 hours

- 1. Models of DNA replication - Semi-conservative, Non-conservative models (1)**
- 2. Meselson and Stahl's experiment (3)**
- 3. DNA Replication in prokaryotes – initiation, elongation and termination. (3)**
- 4. Circular mechanisms of DNA replication – Rolling circle, theta mechanism (3)**
- 5. DNA Replication in eukaryotes (3)**
- 6. Enzymes involved in DNA Replication (2)**

Unit III: Fundamentals of cell culture 15 hours

- 1. Principles of cell culture and types of cell cultures (Monolayer culture and Suspension cultures) (2)**
- 2. Cell culture vessels- monolayer (Roux bottle, roller bottles, multi tray unit, synthetic hollow fiber cartridge, optical culture system) (2)**
- 3. Suspension culture vessels (spinner flask, stirred tank bioreactors, continuous flow culture) (2)**
- 3. Cell culture media – natural and artificial (3)**
- 4. Explants and cell disaggregation- mechanical and enzymatic. (2)**
- 5. Establishment and preservation of cell lines. (3)**

Unit IV: Concepts of Bioinformatics 15 hours

- 1. Classification of Biological Databases (1)**

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2. Nucleotide sequence database: GenBank, EMBL, DDBJ (3)
3. Protein databases: PDB, Swiss-PROT, Uni-PROT. (2)
4. Data Retrieval Tools- BLAST, ENTREZ, OMIM, PubMed, PROSITE. (4)
5. Storage of biological data in databanks, Data retrieval from databases and their utilization (1)
6. Sequence alignment - Pairwise and multiple. (4)

Paper II- Practicals

Paper Code: BT 233 P

20 hrs (2 hrs/ week)

Credits: 1

1. Estimation of DNA by diphenylamine method
2. Estimation of RNA by Orcinol method
3. Preparation of media and culturing of cells
4. Viability tests of cells/bacteria (Evans blue test or Trypan blue test)
5. Acquaintance with the Biological databases through Internet.
6. Sequence homology search using the BLAST program

REFERENCES/SUGGESTED READINGS:

1. Genetics - By Gardner (Macmillan Press)
2. An introduction to Genetic Analysis - By Griffith and others – Freeman and Company
3. Concepts of Genetics - By Klug (Pearson Education)
4. Genetics - By Strickberger (Pearson Education)
5. Cell and Molecular Biology - By Lodish
6. Cell Biology and Genetics - By P.K. Gupta
7. Biometry - By Sokal and Rohlf W.H. Freeman
8. Fundamentals of Biometry - By L.N. Balaram (George Allen and Unwin Ltd, London(1972)
9. Biostatistics - By N.T.J. Bailey
10. Biostatistics- Manual of biostatistical methods for use in health, nutrition and Anthropology - By K. Visweshwar Rao (Jaypee Publications).
11. Bioinformatics and Bioprogramming in C - By L.N. Chavali
12. Introduction to Bioinformatics - By V. Kothekar
13. Introduction to Bioinformatics - By Arthur M. Lesk
14. Introduction to Bioinformatics - By T.K. Attwood, D.J. Parry-Smith, Samiron Phukan (Pearson Education)
15. Discovering Genomics, Proteomics and Bioinformatics - By A.M. Campbell and L.J. Heyer (Pearson Education)
16. Fundamental Concepts of Bioinformatics - By Krane (Pearson Education)
17. Fundamentals of Biostatistics - By Khan and Khanum (Ukaaz Publications)
18. Basic Concepts of Bioinformatics - By Irfan Ali Khan and Atiya Khanum (Ukaaz Publications)

COURSE OUTCOMES:

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

Bt233 CO1 Compare the structure and function of Nucleic acids in prokaryotes and eukaryotes

Bt233 CO2 Differentiate the different models of DNA replication.

Bt233 CO3 Interpret the fundamentals of cell culture

Bt233 CO4 Construct homology using BLAST program based on concepts of Bioinformatics.

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Department of Genetics, Biotechnology and Botany

Subject: Biotechnology (Optional)

(BSc. Life Sciences)

Semester –III CBCS

Paper III - Theory

Title–Biochemistry

Effective from 2016-17 onwards

Credits: 4

Paper Code: BT 333

No of Hours: 60

Objectives:

- The concepts of biochemistry are introduced to the students like biomolecules, enzymes, vitamins and minerals
- They learn about different biomolecules like carbohydrates, proteins and lipids including their building blocks and structures
- Various metabolic pathways like glycolysis, citric acid cycle, gluconeogenesis, beta oxidation is explained in detail.
- A sound knowledge about vitamins and minerals helps them to understand their importance in balanced diet.
- Students are taught about metabolic disorders like phenylketoneuria and albinism

Unit I: Carbohydrates and Proteins

15 hours

1. Carbohydrates: Importance, classification and properties. (2)
2. Monosaccharides - Structures and biochemical importance of glucose and fructose. (1)
3. Disaccharides - Structures and biochemical importance of sucrose, lactose, trehalose, maltose. Physiologically important glycosides (streptomycin, cardiac glycosides, ouabain). (2)
4. Polysaccharides - Structure and function of homopolysaccharides – starch, inulin, cellulose and glycogen ; heteropolysaccharides – Hyaluronic acid, peptidoglycan (4)
5. Proteins: Classification, structure and properties of amino acids, Peptide bond – Synthesis and characters. (3)
6. Structures of proteins- Primary, secondary, tertiary and quaternary; Ramachandran plot. (3)

Unit II: Lipids, Enzymes, Vitamins and Minerals

15 hours

1. Lipids : Fatty acids - Saturated and unsaturated. (1)

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2. Triacylglycerols, Sphingolipids, Sterols, Phospholipids (phosphatidic acid, phosphatidylcholine). (2)
 3. Enzymes: Classification and nomenclature of enzymes, kinetics of enzyme catalyzed reactions. (3)
 4. Factors influencing enzymatic reactions: (a) pH (b) Temperature (c) Substrate concentration (d) Enzyme concentration. (1)
 5. Enzyme Inhibition – Competitive and non-competitive. (2)
 6. Vitamins: Definition, classification - Fat soluble vitamins, water soluble vitamins; Minerals: sources and functions. (3)

Unit III: Intermediary Metabolism of Carbohydrates and Lipids

15 hours

1. Glycolysis. (2)
2. Citric acid cycle. (3)
3. Gluconeogenesis and its significance. (2)
4. Mitochondrial electron transport, Chemiosmotic theory of ATP synthesis. (4)
5. Alcoholic fermentation (1)
6. β -Oxidation of fatty acid. (3)

Unit IV: Intermediary Metabolism of Proteins and Photosynthesis

15 hours

1. Deamination, decarboxylation and transamination reactions of amino acids. (3)
2. Catabolism of phenyl alanine -Phenylketonuria. (2)
3. Catabolism of tyrosine – albinism (2)
4. Photosynthesis – Light reaction (3)
5. Photo phosphorylation. (1)
6. Carbon assimilation. (4)

Outcomes:

- Understanding of biochemistry develops in them an instinct to take up research in biochemistry as biochemists in various labs across the world
- Biophysical techniques help students to carry out research in biochemistry on biomolecules
- Knowledge acquired on various biochemical pathways opens great avenues for them to join for research in various labs across the country
- A sound knowledge gained on the importance of vitamins and minerals makes them understand the importance of balanced diet supplemented with proper recommended dosage.
- Nutritional significance of vitamins and minerals helps them give some valuable inputs into many of the programs taken up by different organizations both at national and international level on the importance of balanced diet like WHO.

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Biotechnology
II Year B.Sc Syllabus
Semester –III; CBCS
Paper III- Practicals
Title– Biochemistry

Credits: 1

Paper Code: BT 333 P

30hrs (2 hrs/ week)

Objective: Students are introduced to the various qualitative analysis of sugars, lipids and amino acids along with the estimation of sugars and proteins

1. Preparation of Normal, Molar and Molal solutions
2. Preparation of Buffers (Acidic, Neutral and Alkaline Buffers)
3. Qualitative tests of sugars
4. Qualitative tests of amino acids.
5. Qualitative tests of lipids
6. Estimation of total sugars by anthrone method.
7. Estimations of protein by Biuret method.

Outcome: Expertise gained by students on qualitative and quantitative analysis of biomolecules helps them get research opportunities and jobs in various labs both at national and international level.

1. Biochemistry - By Conn and Stumpf
2. Biochemistry - By Lehninger
3. Biochemistry - By K. Trehan
4. Biochemical Methods - By S. Sadasivam and A. Manickam
7. An introduction to Practical Biochemistry - By T. Plummer
8. Text Book of Microbiology - By Ananthanarayan and Paniker
9. Microbiology - By Cappuccino (Pearson Education)
10. Microbiology - By Tortora (Pearson Education)
11. Microbiology - B.J. Pelczar, E.S.N. Cfan and N.R. Kreig, McGraw Hill Publ.
12. General Microbiology & P.R. - By Stanier, R.Y, J.L. Ingrahm, M.L. Wheel is
Painter
13. General Microbiology - By Powar (Vol. I and Vol. II).
14. Practical Microbiology - By Aneja.

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Department of Genetics, Biotechnology and Botany

Subject: Biotechnology (Optional)

(BSc. Life Sciences)

Semester –IV CBCS

Paper IV - Theory

Title–Microbiology and Biophysical Techniques

Effective from 2016-17 onwards

Credits: 4

Paper Code: BT 433

No of Hours: 60

Objectives:

- To introduce concepts of microbiology and various sterilization techniques employed to get pathogen free atmosphere are introduced to the students
- Different methods like pour plate, streak plate, spread plate, serial dilutions along with single cell isolation, enrichment, selective, differential media methods employed to obtain pure cultures is taught to students.
- A brief account of microbial pathogenesis especially pertaining to diseases like typhoid and HIV is introduced to the students.
- They are exposed to various biophysical techniques like spectroscopy, chromatography and electrophoresis

Unit I: - Identification of Microorganisms and Sterilization methods 15 hours

1. Classification of microorganisms. (2)
2. Structure and general characters of Micro Algae. Eg: *Chroococcus* (blue green algae), *Chlorella* (green algae) (2)
3. Isolation, identification and preservation (refrigerator cold room storage, mineral oil, -40 °C in glycerol, lyophilisation and liquid nitrogen method) of Bacteria (3)
4. Identification methods of Fungi- colony morphology, hyphae spores and reproductive bodies. (2)
5. Identification methods of useful Micro Algae – colony, thallus, pigments, reproductive bodies. (2)
6. Methods of sterilization-Physical (dry heat, moist air), chemical, filtration and radiation. (2)
7. Pure cultures - common method (pour plate, streak plate, spread plate, serial dilutions), special methods (single cell isolation, enrichment, selective, differential media methods); cultural characteristics. (2)

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Unit II: Bacterial Reproduction and Disease causing microorganisms **15 hours**

1. Bacterial reproduction – Binary fission, Conjugation, transformation and transduction. (3)
2. Growth kinetics – growth curve- Batch cultures (3)
3. Growth kinetics - continuous culture – chemostat, turbidostat (1)
4. Production of single cell proteins - Bacterial (2)
5. Production of single cell proteins – Algal (2)
6. Disease causing pathogen and symptoms - Typhoid (2)
7. Structure of HIV- AIDS disease and symptoms (2)

Unit III: Photometry and Microscopy

15 hours

1. Colorimetry – Beer - Lambert's Law. (2)
2. UV-VIS Spectrophotometry. (3)
3. Infrared Spectroscopy. (2)
4. X-ray diffraction - Braggs Law (2)
5. NMR- principle and applications. (2)
6. Microscopy – Light, Inverted, Fluorescent, Electron, Phase contrast microscopy. (4)

Unit IV: Biophysical Techniques

15 hours

1. Chromatography: (a) Paper (b) Thin Layer (c) Ion-exchange (d) Gel-filtration & (e) HPLC. (5)
2. Electrophoresis – Native gels and SDS-PAGE, Agarose. (4)
3. Centrifugation and filtration – Basic Principles (2)
4. Dialysis (1)
5. Lyophilization. (1)
6. Radio isotopes and their uses in biology, Autoradiography. (2)

Outcomes:

- An understanding of microbiology will help them in building a healthy nation which is pathogen free and away from dreadful diseases both at regional level and national level
- Pure culture isolation techniques help them look for rare isolates which can be of significance either at industrial level or bioremediation
- Even a brief account of microbial pathogenesis especially pertaining to diseases like typhoid and HIV is introduced to the students which helps in preventing the pathogenicity of the disease thereby building a healthy nation.
- They are exposed to various biophysical techniques like spectroscopy, chromatography and electrophoresis which will make them build their skills to carry out advanced research and contribute in nation's progress.

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Biotechnology
II Year B.Sc Syllabus
Semester –IV; CBCS
Paper IV- Practicals

Title– Microbiology and Biophysical Techniques

Credits: 1

Paper Code: BT 433 P

30 hrs (2 hrs/ week)

Objective: The students are introduced to microbial techniques of preparing media growing bacteria and staining them along with electrophoretic analysis of proteins and chromatographic separation of aminoacids.

1. Preparation of routine microbiological media.
2. Isolation of common non-pathogenic bacteria from air, soil.
3. Staining and identification of bacteria – *E.coli*, *Pseudomonas*, *Bacillus* and *Staphylococcus*
4. Enzyme assay – Catalase or Invertase (or any other enzyme)
5. Technique of Micrometry (Stage and ocular)
6. Electrophoretic separation of proteins (SDS-PAGE)
7. Separation of amino acids by paper chromatography

Outcome: Students expertise in growing bacteria and explore electrophoretic analysis of proteins along with paper chromatography.

Recommended Books

- | | |
|---|---|
| 1. Biochemistry | - By Dr. U. Satyanarayana, U. Chakrapani |
| 2. Biochemistry | - By J.L. Jain |
| 3. Biochemistry | - By Conn and Stumpf |
| 4. Biochemistry | - By Lehninger |
| 5. Textbook of Medical Biochemistry | - By S. Ramakrishnan, R. Rajan, and K.G. Prasannan (Orient Longman) |
| 6. Biochemistry | - By Stryer |
| 7. Biochemistry | - By Voet and Voet |
| 8. Biochemistry (Jaypee) | - By Vasudevan |
| 9. Biochemistry | - By David Rawn |
| 10. General Biochemistry | - By J.H. Well |
| 11. Biochemistry | - By K. Trehan |
| 12. Biochemical Methods | - By S. Sadasivam and A. Manickam |
| 13. An introduction to Practical Biochemistry | - By T. Plummer |
| 14. Experimental Biochemistry | - A Student Companion - By V. Deshpande and B. Sas Rao |
| 15. Practical Biochemistry | - By Upadhayay, Wilson and Wilson, Wilson & Walker |
| 16. Biochemistry | - Viva Series |

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