HEMCHAND YADAV VISHWAVIDYALAYA, DURG (C.G.)

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SCHEME OF EXAMINATION

&

SYLLABUS

of

M.Sc. (BIOTECHNOLOGY) Semester Exam

UNDER

FACULTY OF SCIENCE

Session 2024-25

(Approved by Board of Studies)

Effective from June 2024

SCHEME OF SEMESTER EXAMINATION FOR SESSION 2024-25					
BIOTECHNOLOGY **DURG UNIVERSITY, DURG** **M. Sc. BIOTECHNOLOGY (Semester I to IV)**					
July 2024 – December 2024					
	Paper	**Title of Paper**	**Marks**		
			(External)	**(Internal)****	**Credit**
First Semester	**1***	Cell and Development Biology	**80**	**20**	**4**
	2	Genetics	**80**	**20**	**4**
	3	Microbiology & Biosafety	**80**	**20**	**4**
	4	Bio-molecule	**80**	**20**	**4**
	LC-1	Lab Course 1 (Based on paper 1 & 2)	**80**	**20**	**2**
	LC-2	Lab Course 2 (Based on paper 3 & 4)	**80**	**20**	**2**
		Total	**600**		**20**
January 2025 – June 2025					
Second Semester	**Paper**	**Title of Paper**	**(External)**	**(Internal)**	**Credit**
	1	Biostatistics & Computer Applications in Biotechnology	**80**	**20**	**4**
	2	Molecular Biology	**80**	**20**	**4**
	3	Plant Biotechnology	**80**	**20**	**4**
	4	Macromolecules & Enzymology	**80**	**20**	**4**
	LC-1	Lab Course 1 (Based on paper 1 & 2)	**80**	**20**	**2**
	LC-2	Lab Course 2 (Based on paper 3 & 4)	**80**	**20**	**2**
		Total	**600**		**20**
July 2025 – December 2025					
Third Semester	**Paper**	**Title of Paper**	**(External)**	**(Internal)**	**Credit**
	1	Genetic Engineering	**80**	**20**	**4**
	2	Biology of Immune System	**80**	**20**	**4**
	3	Bioprocess Engineering & Bio-entrepreneurship	**80**	**20**	**4**
	4	Environmental Biotechnology	**80**	**20**	**4**
	LC-1	Lab Course 1 (Based on paper 1 & 2)	**80**	**20**	**2**
	LC-2	Lab Course 2 (Based on paper 3 & 4)	**80**	**20**	**2**
		Total	**600**		**20**
January 2026 – June 2026					
Fourth Semester	**Paper**	**Title of Paper**	**(External)**	**(Internal)**	**Credit**
	1	Basic Concept of Bioinformatics & Nanobiotechnology	**80**	**20**	**4**
	2	Advanced techniques & Research Methodology	**80**	**20**	**4**
	3	Animal Biotechnology and Bioethics	**80**	**20**	**4**
	4	Functional Genomics & Proteomics	**80**	**20**	**4**
	LC-1	Lab Course 1 (Based on paper 1 & 2)	**80**	**20**	**2**
	LC-2	Lab Course 2 (Based on paper 3 & 4)	**80**	**20**	**2**
		Total	**600**		**20**
		OR			
		Project Work***	**600**		**20**
		Dissertation	**240**	**60**	
		Seminar based on project	**160**	**40**	
		Viva-voce	**80**	**20**	
Grand total [Semester I + II + III + IV]			**2400**		**80**

***Each theory paper will have 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise.**

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1. **Each student will be evaluated continuously throughout the semester.**
2. **There will be a class test based on each theory paper. The full marks will be 10 for each paper.**
3. **There will be a poster/oral presentation based on each theory paper. The full marks will be 10 for each presentation.**
4. **Each student will be required to submit a brief write-up (not more than 20 pages) on his/her poster/oral presentation.**

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1. **A student of IV semester will have the option to opt for project work in lieu of four theory papers and two lab courses provided he/she secures at-least 65% or more marks in aggregate in semester I and II.**
2. **The project has to be carried out in recognized national laboratories or UGC recognized universities. No student will be allowed to carry out project in private laboratories/ college/ institutions, excluding the colleges recognized as research centers by the RDC of Durg university, Durg CG.**

- **M.Sc. Students of Biotechnology have to attend one excursion or visit in one academic year (within or outside Chhattisgarh)**

HEMCHANDYADAV VISHWAVIDYALAYA, DURG (C.G.)

M.Sc. (Biotechnology)

Scheme of Examination

Semester I

Paper Code	Title of Theory/Practical Paper	Marks		
		External	Internal	**Total**
1	Cell and Development Biology	80	20	100
2	Genetics	80	20	100
3	Microbial & Biosafety	80	20	100
4	Bio-molecules	80	20	100
Lab Course 1	Based on Theory papers 1, 2	80	20	100
Lab Course 2	Based on Theory papers 3, 4	80	20	100
	Total Marks			**600**

HEMCHANDYADAV VISHWAVIDYALAYA, DURG (C.G.)

Biotechnology

Semester I

Paper 1: Cell and Development Biology

M.M.80

Unit I

1. Cell Theory
2. Diversity of cell size and shape. Diversity of Prokaryotic cell and Eukaryotic cell.
3. Cellular organelles - Plasma membrane, cell wall & their structural organization; Mitochondria; Chloroplast; Nucleus; Golgi body, Endoplasmic reticulum, Lysosome.
4. Structure of Prokaryotic and Eukaryotic cells
5. Cytoskeleton, Microtubules, Microfilaments, Cell junctions - Plasmodesmata, Gap junctions, Desmosomes, Adherence junctions.

Unit II

1. Transport of nutrients, ions and macromolecules across membranes, active, passive and collateral transport.
2. Receptor mediated endocytosis
3. Cell Cycle: molecular events and model systems.
4. Apoptosis.

Unit III

1. Cellular responses to environmental signals in plants and animals - mechanisms of signal transduction.
2. Cell motility - cilia, flagella of eukaryotes and prokaryotes
3. Biology of cancer
4. Chromosome: Structure, types, banding pattern and packaging.

Unit IV

1. Spermatogenesis, oogenesis, Meiosis division, fertilization, blastocyst, development of germ lines, chorionic villi cells.
2. Morphogenesis & Organogenesis in Drosophila.

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise

Books:

1. Gerald Karp - Cell and Molecular Biology 5th Edition (2007)
2. Geoffrey M. Cooper; Robert E. Hausman - The Cell: A Molecular Approach (2009)
3. E. J. Ambrose and Dorothy M. Easty, Second Edition (1977), Book Society and Nelson.
4. C.B. Powar – Cell Biology Third Edition, reprint (2005), Himalaya Publishing House.
5. Tortora, Funke and Case – Microbiology: An introduction 6th Edition (1998), Binjamin/Cummings Publishing Co.
6. Lewis J. Klein smith and Valerie M. Kish - Principles of cell and molecular biology – Third Edition (2002)
7. P. K. Gupta – Cell and molecular biology, Second Edition (2003), Rastogi publications.
8. Lodish *et al*., Molecular cell Biology, 6th Edition, W.H. Freeman & Company, 2008.

List of Practical's:-

1. To prepare the temporary stained slide of onion bulb peel to study the structure of plant cell.
2. To prepare the temporary stained slide of cheek squamous epithelial cells of mouth of Human Beings.
3. Preparation and Study of slide of mitosis using from onion root tips squash.
4. Schedule for study of mitotic index.
5. To determine the abnormal mitotic index.
6. Preparation and study of slide for meiosis using young anthers of *Allium cepa.*
7. To determine the meiotic index in the flower bud of *Allium cepa.*

Biotechnology

Semester I

Paper 2: Genetics

M.M. 80

Unit I

1. Introduction to genetics; Beginning of genetics as a science.
2. Mendel and Genetics- Mendel's laws of genetics: Physical and chemical basis of Heredity.
3. Gene - Prokaryotic, Eukaryotic and Viral genes
4. Fine structure of gene, Eukaryotic genome organization (Structure of chromatin, coding and Non - coding sequences, satellite DNA).

Unit II

1. Gene Introduction - Interactions between the Alleles of one gene, interfering gene Interaction.
2. Mutation; Types of mutations. Changes in Chromosome number and structure - Euploidy and Aneuploidy, mutagens — Physical and chemical mutagens, Ames test; Mutational Assay System.
3. Variation - sources of variation, selection, Origin of new genes. Hardyweinberg genetic Equilibrium, genetic polymorphism and selection.

Unit III

1. Inheritance: Autosomal and sex linked inheritance, Extra chromosomal inheritance- Mitochondria & Chloroplast.
2. Genes and Quantitative traits; Genotypes and Phenotypic Distribution; Heritability of Quantitative Character; Quantifying Heritability.
3. Genetic disorder – Sickle cell anemia, haemophilia, albinism, cystic fibrosis

Unit IV

1. Bacterial Genetic system-Transformation, Conjugation. Transduction, Recombination. Bacterial Genetic map with reference to *E. coli.*
2. Viruses and their Genetic system: life cycle; RNA viruses; Retroviruses, Corona Virus.
3. Genetic system of Yeast and Neurospora.

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:-

- Genetics; Benjamin Pierce; W. H. Freeman
- Modern Genetic Analysis; Anthony J.F. Griffiths, William M. Gelbart, Richard C. Lewontin and Jeffrey H. Miller; W. H. Freeman
- Principles Of Genetics; Eldon John Gardner, Michael J. Simmons, D. Peter Snustad; Wiley India Pvt Ltd
- Principles of Gene Manipulation and Genomics; SANDY PRIMROSE and RICHARD TWYMAN; Wiley-Blackwell

Practical:

1. Experiments for Mendel's experiments-
    - Problems based on monohybrid and dihybrid cross
    - mendels law based problems
    - problems based on sex inked inheritance
    - autosomal disease based problems
    - pedigree analysis based problems
2. Studies of prokaryotic & eukaryotic cells
3. Karyo-type studies
4. Mutation in bacteria
5. Plasmid isolation

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Semester I

Paper 3: Microbiology & Biosafety

M.M. 80

Unit I

1. Microbial Growth - Growth Curve, Measurement of growth & Factor affecting microbial growth.
2. Nomenclature & Bergey's Manual
3. Microbiological Techniques -Pure culture & staining methods

Unit II

1. General Structure of bacteria, algae & fungi.
2. Cell wall of Gram Positive & Negative bacteria
3. Archae- Halophiles, Thermophiles, Psychrophiles
4. Bacteria - Purple & Green bacteria, Cyanobacteria, Gliding & Sheath bacteria, Endospore forming bacteria, Rickettsias, Chlamydia & Mycoplasma.

Unit III

1. Structure & Life Cycle of Viruses - Bacterial (Lambda) plant (TMV) & Animal Adenovirus, Pox & Herpes.
2. Microbial diseases - Tuberculosis, Typhoid, AIDS, Hepatitis.
3. Food & waterborne diseases - Cholera & Diarrhea

Unit IV

1. Biosafety - Laboratory rules, biological safety cabinets, biosafety levels, biosafety levels of pathogenic micro organisers, Biohazards, GRAS organisms.
2. Antibiotics, Mode of action of antibiotics, Antibiotics resistance, Antifungal.

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:

1. General Microbiology, Stainer, R.Y., Ingraham, J.L., Wheelis, M.L. and Painter, P.R. The Macmillanb Press Ltd.
2. Brock Biology of Microorganisms, Madigan, M.T. Martinko, J.M. and Parker, J. Prentice-Hall.
3. Microbiology, Pelczar, M.J. Jr., Chan, E.C.S. and Kreig, N.R. Tata McGraw Hill (2009)
4. Microbial Genetics, Maloy, S.R., Cronan, J.E. Jr. and Freifelder, D. Jones, Bartlett Publishers.
5. Microbiology- a Laboratory Manual, Cappuccino, J.G. and Sherman, N. Addison Wesley.
6. Microbiological Applications, (A Laboratory Manual in General Microbiology) Benson, H.J. WCB: Wm C. Brown Publishers.
7. Microbiology: Lansing Prescott, John Harley, and Donald Klein; McGraw Hil 5th Edition (2001)
8. Microbiology - Tortora, Funke and Case; 10th Edition Pearson Education Benjamin Cummings publishers

Practicals:-

1. Preparation of liquid and solid media for growth of microorganisms.
2. Isolation and maintenance of organisms by plating, streaking and serial dilution methods. Slants and stab cultures. Storage of microorganisms.
3. Isolation of pure culture from soil and water.
4. Growth; Growth curve; Measurement of bacterial population by turbidity and serial dilution methods. Effect of temperature, pH and carbon nitrogen sources on growth.
5. Microscopic examination of bacteria, yeast and molds and study of organisms by Gram stain, Acid fast stain and staining for spores.
6. Study of mutations by Ames test.
7. Assay of antibiotics and demonstration of antibiotics resistance.
8. Bacterial transformation.
9. Biochemical characterization of selected microbes.
10. One step growth curve of bacteria

Biotechnology

Semester I

Paper 4: Bio-molecule

M.M. 80

Unit I

I. Chemical foundations of Biology — Non covalent bonds, covalent bonds.
2. Principles of thermodynamics.
3. Analytical techniques in biochemistry and biophysics for small molecules and macromolecules for quantization.

Unit II

1. Amino acids and peptides — classification, chemical reactions and physical properties
2. Proteins - classification and separation, purification and end group analysis, hierarchy in structure, Ramachandran map.
3. Metabolism of proteins – Deamination and Decarboxylation of protein and urea cycle.

Unit III

1. Lipids - classification, structure and functions.
2. Metabolism of lipids – α,β & Omega fatty acids of oxidation
3. Secondary metabolites in living systems — Phenolic Compounds, Saponins, Terpenoids Alkaloids
4. Nucleic Acid- Structure, Synthesis- Denovo & Salvage pathway

Unit IV

1. Sugar – Pentose and hexose monosachharides; Oligosachharides; polysaccharides – glycogen and cellulose.
2. Metabolism of carbohydrates- glycolysis, glycogenesis, glycogenolysis, glyoxalate pathway, kreb cycle and electron transport chain.

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:

Nelson and Cox – Principles of Biochemistry, 5th Edition (2009)

Albert L. Lehninger – Biochemistry, Second Edition (2005).

Todd and Howards Mason – Text book of Biochemistry, Fourth Edition (2004).

Jeremy M. Berg, John L. Tymoczko and Lubert Stryer – Biochemistry, 6th Edition (2007)

Voet D, Voet JG & Pratt CW, Fundamentals of Biochemistry, 2nd Edition. Wiley 2006

Robert K. Murray, David A Bender, Kathleen M. Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil - Harper's Illustrated Biochemistry, 28th Edition (2007)

List of Practicals:-

1. Qualitative test for Carbohydrate. (Molisch's test)
2. Qualitative test for Carbohydrate.(Anthrone test)
3. Qualitative test for Carbohydrate.(Benedict's test)
4. Qualitative analysis of Carbohydrate by Barfoed's test.
5. Qualitative test for amino acid by Ninhydrin reaction.
6. Qualitative test for amino acid by Xanthoprotic reaction.
7. Qualitative test for Proteins using Biuret test.
8. Qualitative test for amino acid by Millon's test.

Lab. Course 1

Based on Theory Papers 1 and 2

Time: 6 hrs **Total Marks – 100**

Q.1 Experiment based on Theory paper 1 (one major & one minor)	30
Q.2 Experiment based on Theory paper 2. (one major & one minor)	30
Q.3 Spotting based on Theory paper 1 and 2	10
Q.4 Viva Voce.	10
Q.5 Sessional	20

Lab. Course 2

Based on Theory Papers 3 and 4

Time: 6 hrs **Total Marks – 100**

Q.1 Experiment based on Theory paper 3 (one major & one minor)	30
Q.2 Experiment based on Theory paper 4 (one major & one minor)	30
Q.3 Spotting based on Theory paper 3 and 4	10
Q.4 Viva Voce.	10
Q.5 Sessional	20

HEMCHANDYADAV VISHWAVIDYALAYA, DURG (C.G.)

Biotechnology

Semester II
Scheme of Examination

Paper Code	Title of Theory/Practical Paper	Marks		
		External	Internal	**Total**
1	Biostatistics & Computer Applications in Biotechnology	80	20	100
2	Molecular Biology	80	20	100
3	Plant Biotechnology	80	20	100
4	Macromolecules & Enzymology	80	20	100
Lab Course 1	Lab Course 1 (Based on paper 1 & 2)	80	20	**100**
Lab Course 2	Lab Course 2 (Based on paper 3 & 4)	80	20	**100**
	Total Marks			600

Biotechnology
Semester II
Paper 1: Biostatistics & Computer Application in Biotechnology

M.M. 80

Unit 1

1. Brief description and tabulation of data and its graphical representation,
2. Measures of central tendency and dispersion: mean, median, mode, standard deviation, types of errors and level of significance.

Unit II

1. Simple linear regression and correlation
2. Tests of significance (F & T test), chi — square test, Anova
3 Probability

Unit III

1. Introduction to digital & analog computers: Organization; low-level and high-level languages; binary number system, Concept of hardware & software.
2. Computer Application-Online Classroom, meeting, test & e-library.

Unit IV

1. Introduction to data structures and database concepts.
2. Introduction to Word processing, Spreadsheets and presentation software
3. Introduction to Image processing
4. Computer — oriented statistical techniques: Frequency table. Computation of mean, variance and standard deviation.

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:

1. Animesh K. Dutta: Basic Biostatistics and Its Application. New Central Book Agency (P) Ltd. Kolkata.
2. P.K. Banerjee: Introduction to Biostatistics. S. Chand & Company Ltd.
3. C.S.V. Murthy (2003) Bioinformatics. First Edition, Himalaya Publishing House.
4. S.C. Rastogi, Namita Mendiratta, Parag Rastogi (2003) Bioinformatics: Concepts, Skills and Applications, CBS Publishers and Distributors, New Delhi.
5. C. Subramanian (2004) A Text Book of Bioinformatics. Dominant Publishers and Distributors, New Delhi.
6. David W. Mount (2005) Bioinformatics: sequence and genome analysis. Second edition. CBS Publishers and Distributors, New Delhi, Bangalore (India).

Biostatistics

1. Calculate the mean value of given sample.
2. Calculate the median of the given sample.
3. Find out the mode value of given sample
4. To complete correlation of leaf length & breadth of a given leaf sample.
5. To perform the t-test for the given data of sample. (Leaves)
6. To perform the Chi- Square test for the given data.
7. To calculate Standard deviation from the data (Sample).
8. Experiments based on probability.

Computer Application

1. Draw Histogram, Pie, Graph, Line graph.
2. Slide preparation
3. Use of Internet.
4. To perform spreadsheet application.
5. To perform image processing.
6. Computer based statistical tools.

Biotechnology
Semester II
Paper 2: Molecular Biology

M.M.80

Unit I

1. Introduction to Molecular Biology
2. DNA Replication — Prokaryotic and eukaryotic DNA replication, Mechanism of DNA replication. Enzymes and accessory proteins involved in DNA replication.
3. Recombination-Homologous recombination- Holiday junction, gene targeting, Cre/Lox recombination, RecA and other recombinases.
4. DNA Damage & Repair – Physical & Chemical Reasons of DNA damage] Direct Base & Nucleotide excision, mismatch repair.

Unit II

1. Transcription Prokaryotic transcription, Eukaryotic transcription, RNA polymerase. General and specific transcription factors, Regulatory elements and mechanisms transcription regulation. Modification in RNA -5' – cap formation, Transcription (termination, 3' - end processing and polyadenylation, Splicing, Editing, Nuclear export mRNA, mRNA stability.

2. Translation-Prokaryotic and Eukaryotic translation, the translation machinery Mechanisms of initiation, elongation and termination, Regulation of translation, co and post — translational modifications of proteins.

Unit III

1. Protein Localization - Synthesis of secretory and membrane proteins, Import in nucleus, mitochondria, chloroplast and peroxisomes, receptor mediated endocytosis.

2. Antisense and Ribozyme technology- Molecular mechanism of Antisense molecultes, inhibition of splicing, polyadenylation and translation, disruption of RNA structure a: capping, Biochemistry of ribozyme; hammer - head, hairpin and other ribozyme strategies for designing ribozymes, Applications of Antisense and ribozyme technology

Unit IV

1. Oncogenes and Tumor Suppressor Genes -Viral and cellular Oncogenes, Tumor suppressor genes from humans, Structure, Function and mechanism of action of pRB and p53 tumor suppressor proteins.

2. Molecular Mapping of genome-Genetic and physical maps, physical mapping and Map- based cloning, Southern and fluorescence *in situ* hybridization for genome analysis.

NOTE: Each theory paper will have five questions of equal marks. First question will based on complete syllabus with no internal choice, whereas rest questions will unit-wise.

Books: Molecular Biology

- Gerald Karp - Cell and molecular biology, 5th Edition (2007)
- Lewis J. Klein smith and Valerie M. Kish - Principles of cell and molecular biology – Third Edition (2002)
- Richard M. Twyman-Advanced Molecular Biology, First South Asian Edition (1998),Viva Books Pvt. Ltd.
- Benjamin Lewin, Gene IX, 9th Edition, Jones and Barlett Publishers, 2007.
- J.D. Watson, N.H. Hopkins, J.W Roberts, J. A. Seitz & A.M. Weiner; Molecular Biology of the Gene, 6th Edition, Benjamin Cummings Publishing Company Inc, 2007.
- TA Brown – Genomes 2nd Edition; Bios Scientific Publishers 2002
- Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, Hidde Ploegh and Paul Matsudaira – Molecular Cell Biology, 6th Edition; WH Freeman 2008

List of Practical:-

1. Extraction of DNA from plant leaves by CTAB methods.
2. Estimation of plant genomic DNA by Spectrophotometer methods.
3. Separation of plant genomic DNA by Agarose gel electrophoresis.
4. Extraction of DNA from animal cells.
5. Estimation of animal genomic DNA by Spectrophotometer methods.
6. Separation of animal genomic DNA by Agarose gel electrophoresis.
7. Separation of Bacterial proteins by vertical SDS-PAGE electrophoresis.
8. Extraction of RNA from Yeast cells
9. Estimation of Yeast cellular RNA by Spectrophotometer methods

Biotechnology
Semester II
Paper 3: Plant Biotechnology

M.M. 80

Unit I

1. Introduction to cell and tissue culture, tissue culture as a technique to produce novel plants and hybrids.
2. Tissue culture media (composition and preparation)
3. Initiation and maintenance of callus and suspension culture; single cell clones.
4. Organogenesis; somatic embryogenesis; transfer and establishment of whole plants in soil
5. Shoot — tip culture: Rapid clonal propagation and production of virus free plant

Unit II

1. Embryo culture and embryo rescue
2. Anther. pollen and ovary culture for production of haploid plants and homozygous lines
3. Protoplast isolation, culture and fusion; selection of hybrid cells and Regeneration of hybrid plants; symmetric and asymmetric hybrids, cybrids.
4. Germplasm conservation — Cryopreservation and slow growth cultures

Unit Ill

1. Plant transformation technology: Basis of tumour formation, Mechanism of DNA transfer. Features of Ti and Ri plasmids, role of virulence genes, use of Ti and Ri as vectors, binary vectors, markers, use of reporter genes, 35S and other promoters, multiple gene transfers, particle bombardment, electroporation, microinjection.

2. Chloroplast Transformation: Advantages, vectors

3. Application of plant transformation for productivity and performance: Herbicide resistance, insect resistance, Bt genes, Non — Bt like protease inhibitors & amylase inhibitors, virus resistance, nucleocapsid gene, disease resistance, PR proteins, nematode resistance, abiotic stress, male sterile lines.

Unit IV

1. Metabolic Engineering and Industrial Products: plant secondary metabolites. Biodegradable plastics, therapeutic proteins, antibodies. Edible Vaccines.
2. Molecular Marker- RFLP maps, linkage analysis, RAPD markers, STS, Microsatellites. SCAR (Sequence characterized amplified regions), SSCP (Single Strand conformational polymorphism), AF LP, map based cloning, molecular marker Assisted selection.

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice whereas rest questions will be unit-wise.

Books:-

1. Razdan MK – Introduction to Plant Tissue Culture 2nd Edition; Oxford & Ibh Publishing Co. Pvt Ltd 2010
2. Vasil IK – Plant Cell and Tissue Culture; Springer 1994
3. Bhojwani SS and Razdan MK – Plant Tissue Culture; Elsevier
4. TJ Fu, G Singh and WR Curtis (Eds): Plant Cell and Tissue Culture for the production of Food Ingredient. Kluwer Academic/Plenum Press, 1999
5. J Hammond, P McGarvey & V Yusibov (Eds): Plant Biotechnology, Springer Verlag.2000.
6. H.S. Chawla: Biotechnology in Crop Improvement, International Book Distributing Company, 1998.
2. H.S. Chawla: Introduction to plant biotechnology. Oxford & IBH Publishing Co. (P) Ltd.
3. B.D. Singh, (2004) Biotechnology. Expending Horizons. First Edition. Kalyani Publishers, Ludhiana.

Practicals:

Media préparation

1. Meristem / bud culture, shoot multiplication & rooting
2. Organogenesis
3. Somatic embryogenesis
4. Plantlet acclimatization
5. Embryo culture
6. Anther culture
7. Extraction of DNA from plant
8. Estimation of plant DNA by Agarose gel electrophoresis and Spectrophotometer
9. Suspension culture
10. Qualitative analysis of secondary metabolites.
11. Production of stress tolerant plants.

Biotechnology

Semester II

Paper 4: Macromolecules and Enzymology

M.M. 80

Unit I

1. Supramolecular assembly – colloids and liposomes. Types of macromolecules in biological systems. Molecular assemblies like membranes. Ribosomes, Extracellular matrix, chromatin
2. Sequencing of proteins and nucleic acids.

Unit II

1. Protein - protein and protein - ligand interactions, physical and chemical methods of study.
2. Protein folding -biophysical and cellular aspects, Protein denaturation

Unit III

1. Enzyme catalysis in solution - kinetics and thermodynamic analysis, effects of organic solvents on enzyme catalysis and structural consequences.
2. Physical and chemical methods for immobilization of enzyme.
3. Glyco and lipoprotein - structure and function

Unit IV

1. Ribozymes and Catalytic antibodies- Functional proteins- structure and drug Targets. (Enzymes and receptors)
2. Nucleic acid hybridization - Methods, Assay & Applications.

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:

- Nelson and Cox – Principles of Biochemistry, 5th Edition (2009)
- Albert L. Lehninger – Biochemistry, Second Edition (2005).
- Todd and Howards Mason – Text book of Biochemistry, Fourth Edition (2004).
- Jeremy M. Berg, John L. Tymoczko and Lubert Stryer – Biochemistry, 6th Edition (2007)
- Voet D, Voet JG & Pratt CW, Fundamentals of Biochemistry, 2nd Edition. Wiley 2006
- Robert K. Murray, David A Bender, Kathleen M. Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil - Harper's Illustrated Biochemistry, 28th Edition (2007)

List of Practical:-

1. Qualitative assay of Protein by the Biuret method.
2. To estimation of Protein Qualitatively by Folin Lowry Method.
3. Estimation of cholesterol by the method of Crawford
4. Determine the activity of Alkaline Protease.
5. Determine the activity of neutral Protease.
6. Effect of temperature on the activity of α-amylase.
7. Determine the activity of catalase.
8. Determine the activity of urease.
9. Perform protein isolation by SDS PAGE.
10. Enzyme kinetics.
11. Qualitative analysis of Enzyme.

Lab. Course 1

Based on Theory Papers 1 and 2

Time: 6 hrs Total Marks — 100

Q.1 Experiment based on Theory paper 1 (one major & one minor)	30
Q.2 Experiment based on Theory paper 2 (one major & one minor)	30
Q.3 Spotting based on Theory papers	10
Q.4 Viva Voce.	10
Q.5 Sessional	20

Lab. Course 2

Based on Theory Papers 3 and 4

Time: 6 hrs Total Marks — 100

Q.1 Experiment based on Theory paper 3 (one major & one minor)	30
Q.2 Experiment based on Theory paper 4 (one major & one minor)	30
Q3 Spotting based on Theory papers	10
Q.4 Viva Voce.	10
Q.5 Sessional	20

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Biotechnology
Semester III
Scheme of Examination

Paper Code	Title of Theory/Practical Paper	Marks		
		External	Internal	Total
1	Genetic Engineering	80	20	100
2	Biology of Immune System	80	20	100
3	Bioprocess Engineering & Bio - entrepreneurship	80	20	100
4	Environmental Biotechnology	80	20	100
Lab Course 1	Lab Course 1 (Based on paper 1 & 2)	80	20	100
Lab Course 2	Lab Course 2 (Based on paper 3 & 4)	80	20	100
	Total Marks			600

Biotechnology
Semester III
Paper 1: Genetic Engineering

M .M. 80

Unit I

1. Scope and applications of Genetic Engineering.
2. Cloning and patenting of life forms. Genetic engineering guidelines.
3. Molecular tools and their application: Restriction enzymes, modification enzymes.
4. Nucleic acid purification, yield analysis.

Unit II

1. Gene cloning vectors: Plasmids, Bacteriophage, phagemids, cosmids, artificial chromosomes (BAC, YAC).
2. Restriction Mapping of DNA Fragments and Map Construction,
3. Gene Libraries - Genomic & cDNA Library, its construction & screening methods, chemical synthesis of Gene.
4. Cloning interacting genes -- Two and three hybrid systems.

Unit III

1. Site — directed mutagenesis and protein engineering.
2. DNA 'transfection, Primer extension. S1 mapping, RNase protection assay, and reporter assays.
3. Expression Strategies for heterologous genes: Vector engineering and codon optimization, host engineering; expression in bacteria, expression in Yeast, expression in insects and insect cells, expression in mammalian cells, expression in plants.
4. Phage display: Technique and applications

Unit 1V

1. Processing of recombinant Proteins: Purification and refolding, characterization of recombinant proteins, stabilization of proteins.
2. T DNA and transposon tagging: Role of gene tagging in gene analysis, T — DNA and transposon tagging, identification and isolation of genes through T — DNA or transposon; Targeted gene replacement.
3. Gene therapy. Strategies of gene delivery — Viral & non-viral, gene knockout, gene augmentation, gene correction, gene regulation and silencing.

NOTE: Each theory paper will have five questions of equal marks. First question will be based on the complete syllabus with no internal choice, where as rest question will be unit wise.

Books:

1. Philip M. Gilmaritin – Molecular Plant Biology Edition (2005), Oxford University Press.
2. TA Brown – Gene Cloning and DNA Analysis, 4th Edition (2005).
3. Rusell and Peter – Genetics Edition (2002), Pearson Education, Inc, San Francisco.
4. Old and Primrose –Principles of Gene Manipulation 6th Edition (2001).
5. B.D. Singh – Biotechnology: An Expanding Horizons, 1st Edition (2004).
6. W.H. Elliott and D. C. Elliott – Biochemical and Molecular Biology IInd Edition (2001).
7. Eldon John Gardner, Michael J. Simmons and Peter Snustad – Principles of Genetics Eigth Edition (1991), John Wiley and Sons, INC.
8. Benjamin Lewin – Genes IX, 9th Edition (2007) Pearson Education International.
9. HD Kumar – Modern Concepts of Biotechnology Third repring Edition (2003), Vikas Publishing House. Pvt.
10. Brown TA, Genomes, 3rd ed. Garland Science 2006
11. James D Watson, Richard M. Myers, Amy A. Caudy and Jan A. Witkowski - Recombinant DNA: Genes and Genomes 3rd Edition; WH Freeman 2007
12. Sandy Primrose and Richard Twyman - Principles of Gene Manipulation and Genomics 7th Edition; Wiley-Blackwell 2006

List of Practicals:-

1. Extraction of DNA from *E.coli.*
2. Estimation of bacterial DNA by Spectrophotometer method.
3. Separation of bacterial genomic DNA by Agarose gel electrophoresis.
4. Hot phenol method for preparation of total cellular RNA from *E.coli.*
5. Estimation of cellular RNA by Spectrophotometer methods.
6. Restriction digestion of DNA with restriction enzymes.
7. Ligation of DNA
8. Isolation of plasmid DNA from *E.coli.*
9. DNA amplification by PCR
10. Introduction of recombinant DNA to the host.
11. Transformed colony.
12. and Transformation
13. Preparation of compete cells

Biotechnology
Semester III
Paper 2: Biology of immune system

M.M. 80

Unit I

1. Introduction — Phylogeny of immune system, innate and acquired immunity.
2. Organization and structure of lymphoid organs.
3. Cells of immune system — Haematopoiesis and differentiation, Lymphocyte trafficking, B — lymphocyte, T — lymphocyte, Macrophages, Dendritic cells, Natural Killer and lymphokine activated killer cells, Eosinophils, Neutrophils and Mast cells.
4. Blood Group System & Rh Factor.

Unit II

1. Nature and biology of antigens and super antigens.
2. Antibody structure and function; antibody engineering
3. Antigen — antibody interactions.
4. Major histocompatibility complex, BCR & TCR.
5. Complement system.

Unit Ill

1. Regulation of immune response — Antigen processing and presentation, generation of humoral and cell mediated immune responses; Activation of B — and T lymphocytes; cytokines and their role in immune regulation; T — cell regulation, MHC restriction; Immunological tolerance.
2. Cell — mediated cytotoxicity: Mechanism of T cell and NK cell mediated lysis, Antibody dependent cell mediated cytotoxicity, and macrophage mediated cytotoxicity.
3. Hypersensitivity, Autoimmunity.

Unit IV

1. Transplantation: General concept and Application
2. Immunity to infectious agents (intracellular parasites, helianthus and viruses), AIDS and other immunodeficiencies.
3. Hybridoma Technology and Monoclonal antibodies.

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:-

1. J. Kuby – Immunology 5th Edition; W.H. Freeman and Company, New York 2003
2. Thomas J. Kindt, Barbara A. Osborne and Richard A. Goldsby – Immunology, 6th Edition; WH Freeman 2007
3. Peter Delves, Seamus Martin, Dennis Burton, Ivan Roitt - Roitt's Essential Immunology, 11th Edition; Wiley-Blackwell 2006
4. H.D. Kumar – Modern Concepts of Biotechnology 3rd Edition (2003), Vikas Publishing House. Pvt. Ltd.
5. K. Banerjee and N. Banerjee –Fundamental of Microbiology and Immunology, First Edition (2006). New Central Book Agency (P) Ltd. Kolkata.
6. Brostoff J, Seaddin JK, Male D, Roitt IM., Clinical Immunology, 6th Edition, Gower Medical publishing, 2002.
7. Abul K. Abbas, Andrew H. Lichtman, & Shiv Pillai; Cellular and Molecular immunology; Elsevier Inc

List of Practicals:-

1. Enumeration of WBC in blood sample.
2. Preparation of a blood smear and differential blood count.
3. To separate serum from the given blood sample.
4. To determine Albumin Globulin ratio in given serum sample.
5. Estimation of serum protein by Folin Lowry test.
6. Isolation of Immunoglobulin.
7. Separation of serum protein by SDS PAGE.
8. Detection of class specific Antibody by Double Diffusion method.
9. Observe Ag-Ab interaction by Immunoelectrophoresis.
10. Observe Ag-Ab interaction by counter current Immunoelectrophoresis.
11. Study of Agglutination reaction
12. Study of ELISA technique.
13. Immuno diffusion test.
14. Blood group determination by slide agglutination reaction.

Biotechnology
Semester III
Paper 3: Bioprocess Engineering & Bio-Entrepreneurship

M.M. 80

Unit I

1. Introduction to Bioprocess Engineering.
2. Kinetic of microbial growth and death
3. Isolation, Preservation and Maintenance of industrial Microorganisms.
4. Media for industrial fermentation
5. Air and Media Sterilization

Unit II

1. Types of fermentation processes: Bioreactors-Analysis of batch, Fed-batch and continuous bioreactors, stability of microbial reactors, analysis of mixed microbial populations, specialized reactors (Stirren Tank, fluidized, photo bioreactors).

2. Downstream processing: Introduction, Removal of microbial cells and solid matter, foam reparation, precipitation, filtration, centrifugation, cell disruption, liquid — liquid extraction, chromatography, Membrane process, Drying and crystallization, disposal of effluents.

Unit III

1. Whole cell Immobilization and their industrial applications.

2. Industrial production of chemicals: Alcohol (ethanol). Acids (citric acetic and gluconic) solvents (glycerol, acetone, butanol), Antibiotics (penicillin, streptomycin, tetracycline) Amino acids (lysine, glutamic acid). Single cell protein.

3. Introduction to food technology: Food Spoilage, Elementary idea of canning and packing, Sterilization and pasteurization, of food products, Food preservation.

Unit IV

1. Bio-Entrepreneurship - Scope in Bio-entrepreneurship, types of bio industries, establishment & operation of biofirms, Entrepreneurship development programs- MSME, DBT, BIRAC & Make in India.
2. Opportunities of bio- entrepreneurship in Biotechnology.

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:-

1. Shuler ML and Kargi F, Bioprocess Engineering: Basic concepts, 2nd Edition, Prentice Hall, Engelwood Cliffs, 2002.
2. Stanbury and Whittaker – Principles of Sterilization techniques, First Indian reprint Edition (1997). Aditya Book (P) Ltd. New Delhi
3. Michael J. Waites - Industrial microbiology: an introduction 7th Edition; Wiley-Blackwell 2008
4. Damien and Devies – Microbial Technology Edition (1994).
5. LE Casida – Industrial Microbiology Edition (1994)
6. H Patel – Industrial Microbiology 4th Edition (2003).
7. KS Bilgrami and AK Pandey – Introduction to Biotechnology Edition 2nd (1998).
8. U Satayanarayan – Biotechnology, First Edition (2005) Books and Allied (P) Ltd. Kolkata.
9. Baily JE and Ollis DF., Biochemical Engineering fundamentals, 2nd Edition, McGraw-Hill Book Co., New York, 1986.
10. Mansi EMTEL, Bryle CFA. Fermentation Microbiology and Biotechnology, 2nd Edition, Taylor & Francis Ltd, UK, 2007.
11. Shara L. Aranoff, Daniel R. Pearson, Deanna Tanner Okun, Irving A. Williamson, Dean A. Pinkert – Industrial Biotechnology; Nova Science 2009

List of Practicals:-

1. Isolation and identification of microorganisms from industrial waste water.

2. Determination of thermal death point (TDP) and thermal death time (TDT) of microorganism (Bacteria and Fungi).

4. To study the production of citric acid by *Aspergillus niger* and also qualitative and quantitative test.

5. To study the bacterial growth curve.

6. To study the fungal growth curve.

7. Bio-ethanol production

Biotechnology
Semester III
Paper 4: Environmental Biotechnology

M.M. 80

Unit I

1. Environment: Basic concepts and issues.
2. Environmental Pollution: Types of pollution, Methods for the measurement of pollution, Methodology of environmental management — the problem solving approach, limitations.
3. Air pollution and its control through Biotechnology

Unit II

1. Measurement of water pollution, waste watt collection, waste water treatment — physical, chemical and biological treatment processes
2. Microbiology of waste water treatments, aerobic process: Activated sludge, oxidation ditches, trickling filter, towers, rotating discs, rotating drums, oxidation ponds.
3. Anaerobic process: Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanket reactors.

Unit III

1. Treatment schemes for waste waters of dairy, distillery, tannery, sugar, antibiotic industries. Bioremediation
2. Xenobiotics in Environment — Ecological considerations, oil pollution, surfactant pesticides.
3. Biodegradation of Cellulose, lignin and Hydrocarbon (Superbug).
4. GMO and their Impact.

Unit IV

1. Biopesticides in integrated pest management.
2. Solid wastes: Sources and management (composting, Vormiculture and methan production).
3. Global Environmental Problems: Ozone depletion, UV — B, green house — effect and acid rain, their impact and biotechnological approaches for management.
4. IPR- Patent, Trademark copyright, GI, Breeder's Right, Trade secrets.
5. Patent Filing & Protection.

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:-

1. Gareth G. Evans, Judy Furlong - Environmental Biotechnology: Theory and Application 2nd Edition; John Wiley and Sons 2011
2. Hans-Joachim Jördening, Josef Winter - Environmental biotechnology: concepts and applications; Wiley-VCH 2005
3. Indu Shekhar Thakur – Environmental Biotechnology: Basic concepts and Applications. First Edition (2006). I. K. International Pvt. Ltd.
4. A.K. Chatterji – Introduction to Environmental Biotechnology. First Edition (2002). Prentice Hall of India Pvt. Ltd. New Delhi.
5. Manoj Tiwari, Kapil Khulbe and Archana Tiwari – Environmental Studies. First Edition (2007), I. K. International Publishing House Pvt. Ltd.
6. H.D. Kumar – Modern Concepts of Biotechnology Third repring Edition (2003), Vikas Publishing House. Pvt. Ltd.
7. B.D. Singh – Biotechnology: Expanding Horizons, 1st Edition (2004). Kalyani Publishers.
8. Alan Scragg – Environmental Biotechnology First Edition, reprinted (2005). Oxford University Press.

List of Practicals:-

1. To determine the total dissolved solids of water.(TDS)
2. Determination of Dissolved oxygen (DO) of water.
3. Determination of chemical oxygen demand (COD) of water.
4. Determination of biochemical oxygen demand (BOD) of water.
5. To screen the antagonism between two microorganisms.
6. Determination of effect of fungicide on the growth of fungi.
7. Effect of fungicide on the antagonism between two microorganisms.
8. To determine the Most Probable number (MPN) of a given water sample.

Lab. Course 1

Based on Theory Papers 1, 2
Time: 6 hrs **Total Marks – 100**

Q.1 Experiment based on Theory paper 1 (one major & one minor)	30
Q.2 Experiment based on Theory paper 2 (one major & one minor)	30
Q.3 Spotting based on Theory papers	10
Q.4 Viva Voce.	10
Q.5 Sessional	20

Lab. Course 2

Based on Theory Papers 3 and 4
Time: 6 hrs **Total Marks – 100**

Q.1 Experiment based on Theory paper 3 (one major & one minor)	30
Q.2 Experiment based on Theory paper 4 (one major & one minor)	30
Q.3 Spotting based on Theory papers	10
Q.4 Viva Voce.	10
Q.5 Sessional	20

HEMCHANDYADAV VISHWAVIDYALAYA, DURG (C.G.)

Biotechnology

Semester IV

Scheme of Examination

Paper Code	Title of Theory/Practical Paper	Marks		
		External	Internal	**Total**
1	Basic Concept of Bioinformatics & Nano-biotechnology	80	20	100
2	Advance techniques & Research Methodology	80	20	100
3	Animal Biotechnology and Bioethics	80	20	100
4	Functional Genomics & Proteomics	80	20	100
Lab Course 1	Based on paper 1 & 2	80	20	100
Lab Course 2	Based on paper 3 & 4	80	20	100
	Total Marks			600

HEMCHANDYADAV VISHWAVIDYALAYA, DURG (C.G.)

Biotechnology

Semester IV

Paper 1: Basic Concept of Bioinformatics and Nanobiotechnology

M.M. 80

Unit —1
Bioinformatics: Introduction, History, Scope of Bioinformatics, Biotechnology and Bioinformatics, BTIS network in India, Application of Bioinformatics.

Unit — II
Types of Sequences- Genomic DNA, cDNA, EST, STS, Biological database: Introduction, primary, secondary and tertiary biological database; Data Mining & Prediction.

Unit-III
Bioinformatics database software, tools - BLAST, MMDB, VAST, PDB;NCBI;EMBL; Geacbook; DDBI & Molecular docking simulation. Chemoinformatics, Pharmacogenomics, Bioinformatics in Drug discovery, Human Genome Project

Unit-IV
Nanobiotechnology : General Introduction, Nanotechnology and Nanobiotechnology; Nanoscale; Nanomicroorganisms-Nanovirus, Nanobacteria; Application of Nanobiotechnology. Nanomaterials - Synthetic Biological, Nano biosensor, Nano particles.

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:-

1. David W. Mount (2004) Bioinformatics: sequence and genome analysis; CSHL press
2. C.S.V. Murthy (2003) Bioinformatics. First Edition, Himalaya Publishing House.
3. Dov Stekel (2005) Microarray bioinformatics. Cambridge University Press.
4. S.C. Rastogi, Namita Mendiratta, Parag Rastogi (2003) Bioinformatics: Concepts, Skills and Applications, CBS Publishers and Distributors, New Delhi.
5. Andreas D. Baxebanis. B.F. Francis Ouellette (2001) Bioinformatics: A practical Guide to the Analysis of genes and proteins. Wiley Interscience.
6. C. Subramanian (2004) A Text Book of Bioinformatics. Dominant Publishers and Distributors, New Delhi.
7. Sandra J. Rosenthal, David W. Wright (2005) Nanobiotechnology Protocols. Humana Press Inc. 999 Riverview Drive, Suite, 208, Totowa, New Jersery.
8. David W. Mount (2005) Bioinformatics: sequence and genome analysis. Second edition. CBS Publishers and Distributors, New Delhi, Bangalore (India).
9. B.D. Singh, (2004) Biotechnology. Expending Horizons. First Edition. Kalyani Publishers, Ludhiana.
10. U. Satyanarayana (2005) Biotechnology. Books and Allied (P) Ltd., Kolkata.
11. PC Trivedi (2008) Nanobiotechnology; Pointer Publishers

List of Practical:

1. To extract protein / nucleotide database of phosphoprotein P of [Swine parainfluenza virus 3]
2. To find out and study the human nucleotide sequence records associated with cancer
3. To find out the location of particular target gene on human chromosome map
4. To study sequence alignment through BLAST
5. To study multiple sequence alignment
6. To find out protein modelling through MMDB.
7. To study how to develop primer (F+R) from given nucleotide sequences
8. Production of Nano particles.
9. To analyse biological data using secondary database.
10. To draw Biomolecules with the help of tools and software.

Biotechnology

Semester IV

Paper 2: Advanced techniques & Research Methodology

M.M. 80

Unit I

1. Principles and application of: Centrifugation, Chromatography (Paper, thinlayer, column) Electrophoresis.
2. Principles and application of: Colorimetry, Spectrophotometry and densitometry
3. RIA and autoradiography in biology, ELISA

Unit II

1. Principle & Application of microscopy – Confocal, Scanning and Electron] Phase Contrast & Fluorescence.
2. PCR - Principle, types and applications.
3. Principles and application of DNA micro array
4. Fluorescence spectroscopy
5. NMR and X- ray diffraction

Unit III

1. Principles and application of Cytophotometry
2. Flow cytometry
3. Southern, Northern, and Western Blotting.
4. DNA sequencer

Unit IV

1. Selection of Research Problems.
2. Literature review & collection.
3. Methodology & Research Design.
4. Report writing & Presentation.
5. Citation & Indexing- Google scholar, WOS, Scopus, H-index, Impact factor.
6. Research ethics & Plagiarism.

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:-

1. K. Wilson and J. Walker: Principle and Techniques of Biotechnology and Molecular Biotechnology.
2. Upadhya and Upadhya: Biophysical Chemistry.
3. David, L. Nelson and Michael, M. Cox: Lehniger: Principal of Biochemistry. 4th Edition. W.H. Freeman and Company, New York.
4. Anthony J.F. Griffiths, William M. Gelbart, Richard C. Lewontin and Jeffrey H. Miller; Modern Genetic Analysis; Publisher: W. H. Freeman
5. Ralf Pörtner; Animal cell biotechnology: methods and protocols; Humana Press
6. C.R. Kothari Research Methodology: Method & technique, Publisher New age International Publisher.

List of Practical:-

1. Perform various laboratory techniques-

   A. centrifugation- Normal and ultracentrifugation

   B. chromatography- paper, TLC, Ion exchange chromatography

   C. spectrophotometery,

   D. electrophoresis- agarose gel, acrylamide gel
2. Perform the advance biotechnological techniques, like – ELISA, PCR, Southern blotting, SDS PAGE etc.
3. To verify adsorption maxima.
4. Lambert Law.
5. Microscopy.

Biotechnology

Semester IV

Paper 3: Animal Biotechnology and Bioethics

M.M. 80

Unit I

1. Animal cell: Structure and organization
2. Equipment's and materials for animal cell culture
3. Primary and established cell line cultures.
4. Constituents of culture media and their application
5. Application of animal cell culture

Unit II

1. Biology and characterization of the cultured cells, measuring parameters of growth
2. Basic techniques of mammalian cell culture *in vitro*; disaggregating of tissue and primary culture; maintenance of cell culture; cell separation
3. Scaling - up of animal cell culture.
4. Cell synchronization: Cell growth stages
5. Cell transformation: Characteristics of transformed cells

Unit III

1. Stem cell cultures, embryonic stem cells and their applications.
2. Cell culture based vaccines: General introduction, Vaccines for Malaria and AIDS
3. Transgenic animals: Mice, Sheep and Fish.
4. Tissue engineering: Elementary idea of tissue engineering, Artificial skin, artificial cartilage.

Unit IV

1. Ethical Issues in Biotechnology – Gene Manipulation & Research; experiments in-Animal & Human.
2. Animal Rights; Protection of Biodiversity, biopiracy.

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:-

1. Animal Cell Culture, Practical Approach: RW Masters; Oxford University Press 2000
2. Animal cell biotechnology: Ralf Pörtner; Humana Press 2007
3. Animal Cell Culture Techniques, M Clynes.
4. Animal Cell Biotechnology methods and Protocols. Nigel Jenkins. Humana Press, Totowa, New Jersey.
5. B.D. Singh, (2004) Biotechnology. Expending Horizons. First Edition. Kalyani Publishers, Ludhiana.
6. U. Satyanarayana (2005) Biotechnology. Books and Allied (P) Ltd., Kolkata.

Practical:

1. Extraction and estimation of DNA from blood
2. Extraction and estimation of DNA from spleen
3. Extraction and estimation of DNA from muscle tissue
4. Cell viability test
5. Blood cell - smear formation and staining
6. Separation of serum and plasma from blood.
7. Preparation of Animal Tissue culture medium.
8. Inoculation and Sub culturing.

Biotechnology

Semester IV

Paper 4: Functional Genomics & Proteomics

M.M. 80

UNIT – I

- Genomics – General introduction, Types of genomics, Structural genomics, Functional genomics, Comparative genomics, Genome sequencing, Genome mapping, Future of genomics.
- Genomics in medicine: Gene medicine, Disease models, the impact of genomics on medicine.

UNIT – II

- Methods of gene sequencing: - Random shotgun sequencing. Whole genome shotgun sequencing, Genome prediction and gene counting, Single nucleotide polymorphisms (SNPs), Types of next generation sequencing.
- Comparative Genomics: Sequence comparison, Comparative genomics in bacteria, Comparative genomics in Eukaryotes & organelles

UNIT – III

- Proteomics – general concept, genes and proteins, types of proteomics – structural and functional proteomics. Analysis of protein structure, Method of study of protein – protein array, practical application of proteomics.

UNIT – IV

Future of proteomics, protein chips, synthetic biology, Protein-protein interaction. Protein database – Swiss prot and uniprot. Global analysis of protein, expression analysis and characterization of protein.

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:-

- Principles of Gene Manipulation and Genomics; by Primrose & Twyman
- Gene cloning and DNA analysis: An introduction; by TA Brown
- Genomics, Proteomics & Vaccines; by Guido Grandi
- Genomics: Application in Human biology; by Primrose & Twyman
- Introduction to molecular Genetics and Genomics; JBH Publication
- Proteomics by Timothy Palzkill
- U. Satyanarayan: Biotechnology. Books and Allied (P) Ltd. Kolkata
- P.K. Gupta: Biotechnology and Genomics. Rastogi Publication

Practical:

1. Study of whole genome of virus using database.

2. To analyze the viral evolution pattern using phylogenetic analysis.

3. Retrieve Protein structure from SWISS-PORT

4. Retrieve Human Mitochondrial Genome using Gene bank database.

5. Find out similar Protein structure using VAST^{+}.

6. Analysis of Protein imtercation using toos.

7. predicting functions domain in proteins.

8. Predicting Transcription factor binding site.

Lab. Course 1

Based on Theory Papers 1, 2

Time: 6 hrs **Total Marks – 100**

Q.1 Experiment based on Theory paper 1 (one major & one minor)	30
Q.2 Experiment based on Theory paper 2 (one major & one minor)	30
Q.3 Spotting based on Theory papers	10
Q.4 Viva Voce.	10
Q.5 Sessional	20

Lab. Course 2

Based on Theory Papers 3 and 4

Time: 6 hrs **Total Marks – 100**

Q.1 Experiment based on Theory paper 3 (one major & one minor)	30
Q.2 Experiment based on Theory paper 4 (one major & one minor)	30
Q.3 Spotting based on Theory papers	10
Q.4 Viva Voce.	10
Q.5 Sessional	20

PROJECT

Project Work	External	Internal	Total
Dissertation	240	60	300
Seminar based on project	160	40	200
Viva-voce	80	20	100
Total			**600**

1. A student of IV semester will have the option to opt for project work in lieu of four theory papers and two lab courses provided he/she secures at-least 65% or more marks in aggregate in semester I and II.

2. The project has to be carried out in recognized national laboratories or UGC recognized universities. No student will be allowed to carry out project in private laboratories/ college/ institutions, excluding the colleges recognized as research centers by the RDC of Durg university, Durg CG

3. The valuation of all the projects will be carried out by the external examiner and HoD of UTD or its nominee at the UTD Centre.

The project work should be related to the field of Biotechnology. The project report should include declaration by the candidate, certificate by the supervisor, acknowledgement, title and introduction along with the following points:

1. Introduction
2. Review of Literature
3. Materials and Methods
4. Results & Discussions
5. Summary
6. Bibliography

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