SCHEME OF SEMESTER EXAMINATION FOR SESSION 2025-26				
Department of Biotechnology, Govt. Digvijay P. G. College Rajnandgaon, (C.G.) **M. Sc. BIOTECHNOLOGY (Semester I to IV)**				
First Semester	**Paper**	**Title of Paper**	**Marks**	
			(External)	**(Internal)****
	1*	Cell Biology	**80**	**20**
	2	Genetics	**80**	**20**
	3	Microbiology, Biosafety and IKS	**80**	**20**
	4	Bio-molecules	**80**	**20**
	LC-1	Lab Course 1 (Based on paper 1 & 2)	**80**	**20**
	LC-2	Lab Course 2 (Based on paper 3 & 4)	**80**	**20**
		Total	**600**	
Second Semester	**Paper**	**Title of Paper**	**(External)**	**(Internal)**
	5	Biostatistics & Computer Applications in Biotechnology	**80**	**20**
	6	Molecular Biology	**80**	**20**
	7	Plant Biotechnology	**80**	**20**
	8	Macromolecules & Enzymology	**80**	**20**
	LC-3	Lab Course 3 (Based on paper 5 & 6)	**80**	**20**
	LC-4	Lab Course 4 (Based on paper 7 & 8)	**80**	**20**
		Total	**600**	
Third Semester	**Paper**	**Title of Paper**	**(External)**	**(Internal)**
	9	Genetic Engineering	**80**	**20**
	10	Biology of Immune System	**80**	**20**
	11	Bioprocess Engineering & Bio-Entrepreneurship	**80**	**20**
	12	Environmental Biotechnology	**80**	**20**
	LC-5	Lab Course 5 (Based on paper 9 & 10)	**80**	**20**
	LC-6	Lab Course 6 (Based on paper 11 & 12)	**80**	**20**
		Total	**600**	
Fourth Semester	**Paper**	**Title of Paper**	**(External)**	**(Internal)**
	13	Basic Concept of Bioinformatics & Nanobiotechnology	**80**	**20**
	14	Advanced techniques & Research Methodology	**80**	**20**
	15	Animal Biotechnology & Bio-ethics	**80**	**20**
	16	Functional Genomics & Proteomics	**80**	**20**
	LC-7	Lab Course 7 (Based on paper 13 & 14)	**80**	**20**
	LC-8	Lab Course 8 (Based on paper 15 & 16)	**80**	**20**
		Total	**600**	
		OR		
	Paper	**Title of Paper**	**(External)**	**(Internal)**
	13	Basic Concept of Bioinformatics & Nanobiotechnology	**80**	**20**
	14	Advanced techniques & Research Methodology	**80**	**20**
	LC-7	Lab Course 7 (Based on paper 13 & 14)	**80**	**20**
		And		
		Project Work***	**300**	
		Dissertation	**120**	**30**
		Seminar based on project	**80**	**20**
		Viva-voce	**40**	**10**
		Grand total [Semester I + II + III + IV]	**2400**	

*Each theory paper will have four units but the external evaluation of each paper (80 Marks) will be done in **three parts (A, B and C)**.

Part A : This part contain **one** very short questions from each four unit. All questions are compulsory to attempt. All questions carry **03** marks (03x04=**12** marks)
Part B : This part contain **two** short questions from each unit. One question is compulsory to attempt. All question carry **05** marks (05x04=**20** marks).
Part C : This part contain **two** long questions from each unit. One question is compulsory to attempt. All questions carry **12** marks (12x04=**48**).

**1.Each student will be evaluated continuously throughout the semester.
2. The internal examination will be based on Unit test and Seminar and any modification made by the autonomous cell of the college should be adopted.
3. The seminar will be based on oral presentation. Each student will be required to submit a brief write-up (both hard and soft copy) on his/her oral presentation.

*** 1. A student of IV semester will have the option to opt for project work in lieu of two theory papers and one lab courses.
2. The project has to be carried out in recognized national laboratories or UGC recognized universities or any other organization of public or privet concern. The duration of project will be 90 days.
3. The department also gives opportunity to do project work in department maximum 02 students per faculty based on merit marks obtained in Sem I and II.
4. The valuation of all the projects will be carried out by the external examiner.

Approval of the Board of Studies

Date: 14/05/25

Name	Prof. S. K. Jadhav	Sabiha Naz	Dr. Shubha Diwan	Shri Sanjay Bhagwat	Ku. Varsha Meshram	Dr. Pramod Kumar Mahish
Designation	VC Nominee	Subject Expert	Subject Expert	Employment/ Industrial Member	Merit Alumni	Chairman/ HOD
Signature			Joined online	Joined online		

M.Sc. in Biotechnology – Semester Examination
Based on Credit System
2025-26

M.Sc. Biotechnology divided in four Semester and each semester contains four papers. This is treated as 16 paper course structure. So, there will be 16 papers in each post graduate examination in Biotechnology containing 80 credits. In I, II, III and IV semester, each paper shall carry 100 marks (80 marks for External and 20 for Internal). All four Semester Including 2 Practical's, each practical's containing 100 marks. There shall be 2400 marks. Candidate shall have the secure 36 marks in aggregate of all papers in order to pass the examination.

First Semester	Paper	Title of Paper	Credit
	1	Cell Biology	4
	2	Genetics	4
	3	Microbiology, Biosafety and IKS	4
	4	Bio-molecules	4
	LC-1	Lab Course 1 (Based on paper 1 & 2)	2
	LC-2	Lab Course 2 (Based on paper 3 & 4)	2
			Total 20
Second Semester	**5**	Biostatistics & Computer Applications in Biotechnology	4
	6	Molecular Biology	4
	7	Plant Biotechnology	4
	8	Macromolecules & Enzymology	4
	LC-3	Lab Course 3 (Based on paper 5 & 6)	2
	LC-4	Lab Course 4 (Based on paper 7 & 8)	2
			Total 20
Third Semester	**Paper**	**Title of Paper**	4
	9	Genetic Engineering	4
	10	Biology of Immune System	4
	11	Bioprocess Engineering & Bio-Entrepreneurship	4
	12	Environmental Biotechnology	4
	LC-5	Lab Course 5 (Based on paper 9 & 10)	2
	LC-6	Lab Course 6 (Based on paper 11 & 12)	2
			Total 20
Fourth Semester	**13**	Basic Concept of Bioinformatics & Nanobiotechnology	4
	14	Advanced techniques & Research Methodology	4
	15	Animal Biotechnology & Bio-ethics	4
	16	Functional Genomics & Proteomics	4
	LC-7	Lab Course 7 (Based on paper 13 & 14)	2
	LC-8	Lab Course 8 (Based on paper 15 & 16)	2
			Total 20
	Or		
	13	Basic Concept of Bioinformatics & Nanobiotechnology	4
	14	Advanced techniques & Research Methodology	4
	LC-7	Lab Course 7 (Based on paper 13 & 14)	2
		and	
		Project Work	10
		Grand Total	**80**

Scheme of M.Sc. (Biotechnology)

Scheme of Examination

Semester I

Paper Code	Title of Theory/Practical Paper	Marks		
		External	Internal	**Total**
1	Cell Biology	80	20	100
2	Genetics	80	20	100
3	Microbiology, Biosafety and IKS	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**

Approval of the Board of Studies

Date: 14/05/25

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Department of Biotechnology

Semester I

Paper 1: Cell Biology

RATIONALE

This paper is designed to enable students to acquire knowledge on the structure, behavior and functioning of cell constituents and outer cover. Cellular transport and division are added to understand the concept.

EVALUATION SCHEME

External evaluation of each paper (80 Marks) will be done in **three parts (A, B and C)**.

Part A : This part contain **one** very short type questions from each four unit. All questions are compulsory to attempt. All questions carry **03** marks (03x04=**12** marks)

Part B : This part contain **two** short type questions from each unit. One question is compulsory to attempt. All question carry **05** marks (05x04=**20** marks).

Part C : This part contain **two** long type questions from each unit. One question is compulsory to attempt. All questions carry **12** marks (12x04=**48**).

M.M. 80

Unit I

1. Cell discovery
2. Cell Theory, Modern interpretation of Cell Theory
3. Characteristics of prokaryotic and eukaryotic cells
4. Cell cycle – molecular events and checkpoints

Unit II

5. Plasma membrane – lipid bilayer, proteins, structure model and applications
6. Cell wall
7. Cell organelle Mitochondria; Chloroplast; Nucleus and other organelles and their organization.
8. Cytoskeleton – Microtubules, microfilaments

Unit III

1. Cell motility – cilia, flagella of eukaryotes and prokaryotes
2. Extracellular matrix – Polysaccharides and Proteins
3. Transport of nutrients, ions and macromolecules across membranes - active and passive transport

Unit IV

1. Cellular responses to environmental signals in plants and animals – mechanisms of signal transduction.
2. Biology of cancer
3. Cellular basis of differentiation and development – gametogenesis and fertilization.

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 Practicals:-

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.*

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Department of Biotechnology

Semester I

Paper 2: Genetics

RATIONALE

This paper is designed to understand students to acquire knowledge on mendelian inheritance, mutation, chromosomal change and genetic system of some organisms.

EVALUATION SCHEME

External evaluation of each paper (80 Marks) will be done in **three parts (A, B and C)**.

Part A : This part contain **one** very short type questions from each four unit. All questions are compulsory to attempt. All questions carry **03** marks (03x04=**12** marks)

Part B : This part contain **two** short type questions from each unit. One question is compulsory to attempt. All question carry **05** marks (05x04=**20** marks).

Part C : This part contain **two** long type questions from each unit. One question is compulsory to attempt. All questions carry **12** marks (12x04=**48**).

M.M. 80

Unit I

1. Introduction to genetics
2. Mendel and genetics; Mendelian principle, Extension of Mendelian principle.
3. Gene - Types of genes, Prokaryotic, Eukaryotic and Viral genes
4. Fine structure of gene, Eukaryotic genome organization - Structure of chromatin

Unit II

1. Regulation of gene expression in Prokaryotes – Operon,
2. Eukaryotic gene regulation – RNA silencing
3. Mutation; Mutagens, Types of mutations,Changes in Chromosome number and structure - Euploidy and Aneuploidy, mutant types; lethal, conditional and insertional mutagenesis, Ames test.
4. DNA damage and repair

Unit III

1. Inheritance: Autosomal and sex linked inheritance, Extrachromosomal inheritance, Inheritance of organelle genes.
2. Cancer genetics
3. Genetic disorder and syndromes.
4. Sickle cell anemia in Chhattisgarh

Unit IV

1. Bacterial Genetic system: Transformation, Conjugation, Transduction, Recombination,
2. Plasmids
3. Viruses and their Genetic system: Phage I and its life cycle; RNA phases; RNA viruses; Retroviruses
4. Transposons.

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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Department of Biotechnology

Semester I

Paper 3: Microbiology, Biosafety and IKS

RATIONALE

This paper is designed to enable students to acquire knowledge on the microbial classification, structure, metabolism, reproduction and disease caused by pathogens.

EVALUATION SCHEME

External evaluation of each paper (80 Marks) will be done in **three parts (A, B and C)**.

Part A : This part contain **one** very short type questions from each four unit. All questions are compulsory to attempt. All questions carry **03** marks (03x04=**12** marks)

Part B : This part contain **two** short type questions from each unit. One question is compulsory to attempt. All question carry **05** marks (05x04=**20** marks).

Part C : This part contain **two** long type questions from each unit. One question is compulsory to attempt. All questions carry **12** marks (12x04=**48**).

M.M. 80

Unit I

1. Systematics and Taxonomy: ribotyping; Bergey's Manual.
2. Prokaryotic cells: Structure and function – Cell walls of Gram positive bacteria, peptidoglycan and related molecules
3. Cell wall of - Gram negative bacteria;
4. Microbial Growth: Growth curve, measurement of growth; Growth as affected by environmental factors.

Unit II

1. Photosynthetic microorganisms
2. Chemolithotrophy
3. Special characteristic microbes - Gliding and sheathed bacteria; Endospore forming bacteria, Rickettsias, Chlamydia and Mycoplasma.
4. Viruses – classification, structure and life cycle
5. Microbial diseases - Tuberculosis, typhoid, AIDS, Hepatitis, Malaria, Candidiasis

Unit III

1. Biosafety – Laboratory rules, biosafety cabinets, biosafety levels and related pathogens
2. Biohazards and GRAS organisms
3. Antibiotics -Mode of action and Resistance
4. Antifungals

Unit IV

1. What is Indian knowledge system?
2. Knowledge framework and classification of IKS.
3. Ancient Indian scientist - Charak, Sushruta, Aristotle, Aryabhatta.
4. IKS in health sciences - Ayurveda, Siddha, Unani
5. IKS in food, agriculture and biodiversity conservation

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. Prayogatmak Jaivprodyogiki awam Kukshmjiv vigyan - S. K. Jadhav and Pramod Kumar Mahish, Chhattisgarh Hindi Granth Acadmy.
9. Microbiology - Tortora, Funke and Case; 10th Edition Pearson Education Benjamin Cummings publishers

Practicals:-

1. General laboratory safety measures.
2. Preparation of liquid and solid media for growth of microorganisms.
3. Isolation and maintenance of organisms by plating, streaking and serial dilution methods. Slants and stab cultures. Storage of microorganisms.
4. Isolation of pure culture from soil and water.
5. Growth; Growth curve; Measurement of bacterial population by turbidity and serial dilution methods.
6. Microscopic examination of bacteria, yeast and molds and study of organisms by Gram stain, Acid fast stain and staining for spores.
7. Assay of antibiotics and demonstration of antibiotics resistance.
8. Biochemical characterization of selected microbes.
9. One step growth curve of bacteria

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Department of Biotechnology

Semester I

Paper 4: Bio-molecule

RATIONALE

This paper is design to gather knowledge on classification, structure and properties of biomolecules. Biochemical pathways based on the molecules are also included in the paper.

EVALUATION SCHEME

External evaluation of paper (80 Marks) will be done in **three parts (A, B and C)**.

Part A : This part contain **one** very short type questions from each four unit. All questions are compulsory to attempt. All questions carry **03** marks (03x04=**12** marks)

Part B : This part contain **two** short type questions from each unit. One question is compulsory to attempt. All question carry **05** marks (05x04=**20** marks).

Part C : This part contain **two** long type questions from each unit. One question is compulsory to attempt. All questions carry **12** marks (12x04=**48**).

M.M. 80

Unit I

1. Basics of Biomolecules- Structure of atom, molecules, chemical bonds.
2. Biochemistry of water
3. Chemical foundations of Biology – pH, pK, acids, bases, buffers,
4. Principles of thermodynamics.

Unit II

1. Carbohydrates- Types, structural features and classification,.
2. Lipids - classification, structure and functions.
3. Amino acids and peptides-Classification, chemical and physical properties.
4. Proteins - classification and hierarchy in structure. Higher order structure of proteins – Myoglobin and Hemoglobin
5. Conformation of protein (Ramachandran plot, Secondary structures- Domain, Motif and Folds). Separation & Purification, End group analysis,

Unit III

1. Heterocyclic compounds and secondary metabolites in living systems- nucleotide: pigments, isoprenoids.
2. Vitamins and its essential functions.
3. Cholesterol and its physiological importance

Unit IV

1. Bioenergetics- glycolysis, oxidative phosphorylation, coupled reaction, Metabolism of carbohydrates-glycogenesis, glycogenolysis, kreb cycle and electron transport chain.
2. Methods for compositional analysis of carbohydrates.
3. Metabolism of lipids.
4. Metabolism of proteins.

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:-

- Qualitative test for Carbohydrate. (Molisch's test)
- Qualitative test for Carbohydrate.(Anthrone test)
- Qualitative test for Carbohydrate.(Benedict's test)
- Qualitative analysis of Carbohydrate by Barfoed's test.
- Qualitative test for amino acid by Ninhydrin reaction.
- Qualitative test for amino acid by Xanthoprotic reaction.
- Qualitative test for Proteins using Biuret test.
- Qualitative test for amino acid by Millon's test.

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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

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Department of Biotechnology
Semester II

Scheme of Examination

Paper Code	Title of Theory/Practical Paper	Marks		
		External	Internal	**Total**
5	Biostatistics & Computer Applications in Biotechnology	80	20	100
6	Molecular Biology	80	20	100
7	Plant Biotechnology	80	20	100
8	Macromolecules & Enzymology	80	20	100
Lab Course 3	Lab Course 3 (Based on paper 5 & 6)	80	20	100
Lab Course 4	Lab Course 4 (Based on paper 7 & 8)	80	20	100
	Total Marks			**600**

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Department of Biotechnology

Semester II

Paper 5: Biostatistics & Computer Application in Biotechnology

RATIONALE

This paper is centered to the basic knowledge on biostatistical analysis of data, tabular and graphical presentation and computer applications.

EVALUATION SCHEME

External evaluation of paper (80 Marks) will be done in **three parts (A, B and C)**.

Part A : This part contain **one** very short type questions from each four unit. All questions are compulsory to attempt. All questions carry **03** marks (03x04=**12** marks)

Part B : This part contain **two** short type questions from each unit. One question is compulsory to attempt. All question carry **05** marks (05x04=**20** marks).

Part C : This part contain **two** long type questions from each unit. One question is compulsory to attempt. All questions carry **12** marks (12x04=**48**).

M.M. 80

Unit I

1. Brief description and tabulation of data and its graphical representation.
2. Measures of central tendency and dispersion: mean, median, mode
3. Dispersion – Standard deviation and standard error

Unit II

1. Simple linear regression
2. Correlation – types and measurement
3. Probability – addition and multiplication rules
4. Student ‘t’ test
5. Chi-square test
6. ANOVA

Unit III

1. Introduction to digital computers: Organization; low – level and high – level languages;
2. Concept of hardware and software. Coding and software development
3. Introduction to Internet and its application.
4. Computer – oriented statistical techniques: Computation of mean and standard deviation.

Unit IV

1. Introduction to Word processing, Spreadsheets and presentation software
2. Introduction to Image processing
3. Application development
4. Artificial intelligence in Biotechnology

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).

List of Practicals:-

Biostatistics

1. Calculate the mean value of given 20 leaves.
2. Calculate the median of the given sample of 20 leaves.
3. Find out the mode value of given 20 leaves.
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- Squre test for the given data.
7. To calculate Standard deviation from the data (Sample).

Computer Application

1. Formulation of Basic Programs on Q basic
2. Writing basic programs on C
3. Draw Histogram, Pie, Graph, Line graph.
4. Data management
5. Slide preparation
6. Use of Internet.
7. To perform spreadsheet application.

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Semester II

Paper 6: Molecular Biology

RATIONALE

This paper is design to know the depths of central dogma, diagnosis of DNA, molecular mapping and genome analysis.

EVALUATION SCHEME

External evaluation of paper (80 Marks) will be done in **three parts (A, B and C)**.

Part A : This part contain **one** very short type questions from each four unit. All questions are compulsory to attempt. All questions carry **03** marks (03x04=**12** marks)

Part B : This part contain **two** short type questions from each unit. One question is compulsory to attempt. All question carry **05** marks (05x04=**20** marks).

Part C : This part contain **two** long type questions from each unit. One question is compulsory to attempt. All questions carry **12** marks (12x04=**48**).

M.M.80

Unit I

1. Introduction to Molecular Biology
2. DNA Replication – Mechanics of DNA replication. Enzymes and accessory proteins involved in DNA replication.
3. Recombination. Homologous recombination – Holiday junction,

Unit II

1. Transcription – Initiation in prokaryotes and eukaryotes, RNA polymerase, General and specific transcription factors, transcription process and termination
2. Modification in RNA - 5' – cap formation, 3' – end polyadenylation, Splicing.
3. Translation – Prokaryotic and Eukaryotic translation, Mechanisms of initiation, elongation and termination,

Unit III

1. Regulation of translation, co – and post – translational modifications of proteins.
2. Protein Localization – Synthesis of secretory and membrane proteins,
3. Import into nucleus, mitochondria, chloroplast and peroxisomes

Unit IV

1. Antisense and Ribozyme technology – mechanisms and applications
2. Molecular Mapping of genome – Genetic and physical maps
3. Diagnosis of DNA – dot blot, DNA chip, sequence specific primer, hybridization probe,
4. Southern and fluorescence *in situ* hybridization for genome analysis

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. Separation of plant genomic DNA by Agarose gel electrophoresis.
3. Extraction of DNA from animal cells.
4. Separation of animal genomic DNA by Agarose gel electrophoresis.
5. Separation of Bacterial proteins by vertical SDS-PAGE electrophoresis.
6. Extraction of RNA from Yeast cells.

Approval of the Board of Studies

Date: 14/05/25

Name	Prof. S. K. Jadhav	Sabiha Naz	Dr. Shubha Diwan	Shri Sanjay Bhagwat	Ku. Varsha Meshram	Dr. Pramod Kumar Mahish
Designation	VC Nominee	Subject Expert	Subject Expert	Employment/ Industrial Member	Merit Alumni	Chairman/ HOD
Signature			Joined online	Joined online		

Department of Biotechnology

Semester II

Paper 7: Plant Biotechnology

RATIONALE

This paper is focused to provide knowledge on principle of plant tissue culture, different techniques and its applications.

EVALUATION SCHEME

External evaluation of paper (80 Marks) will be done in **three parts (A, B and C)**.

Part A : This part contain **one** very short type questions from each four unit. All questions are compulsory to attempt. All questions carry **03** marks (03x04=**12** marks)

Part B : This part contain **two** short type questions from each unit. One question is compulsory to attempt. All question carry **05** marks (05x04=**20** marks).

Part C : This part contain **two** long type questions from each unit. One question is compulsory to attempt. All questions carry **12** marks (12x04=**48**).

M.M. 80

Unit I

1. Introduction to cell and tissue culture
2. Tissue culture media (composition and preparation)
3. Callus and suspension culture
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
4. Germplasm conservation; Cryopreservation and slow growth cultures

Unit III

1. Plant transformation technology: Mechanism of DNA transfer; Features of TI and RI plasmids, use of Ti and Ri as vectors, particle bombardment, electroporation, microinjection.
2. Application of plant transformation for productivity and performance: herbicide resistance, insect resistance, virus resistance, nematode resistance, male sterile lines.

Unit IV

1. Metabolic Engineering and Industrial Products: plant secondary metabolites, biodegradable plastics, edible vaccines.
2. Molecular Marker –RFLP maps, RAPD markers, microsatellites, SCAR (Sequence characterized amplified regions), SSCP (Single strand conformational polymorphism), AFLP
3. Status of Transgenic Research in India.

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.

4. H.S. Chawla: Introduction to plant biotechnology. Oxford & IBH Publishing Co. (P) Ltd.

5. B.D. Singh, (2004) Biotechnology. Expending Horizons. First Edition. Kalyani Publishers, Ludhiana.

Practicals:

1. Media preparation
2. Meristem / bud culture, shoot multiplication & rooting
3. Organogenesis
4. Somatic embryogenesis
5. Plantlet acclimatization
6. Embryo culture
7. Anther culture
8. To extract Phytochemical from plants
9. Study of molecular markers
10. Extraction of DNA from plant

Date: 14/05/25	Approval of the Board of Studies					
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Designation	VC Nominee	Subject Expert	Subject Expert	Employment/ Industrial Member	Merit Alumni	Chairman/ HOD
Signature			Joined online	Joined online		

Department of Biotechnology
Semester II
Paper 8: Macromolecules and Enzymology

RATIONALE

This paper is design to know about the role of macromolecules and enzymes in biological system.

EVALUATION SCHEME

External evaluation of paper (80 Marks) will be done in **three parts (A, B and C)**.

Part A : This part contain **one** very short type questions from each four unit. All questions are compulsory to attempt. All questions carry **03** marks (03x04=**12** marks)

Part B : This part contain **two** short type questions from each unit. One question is compulsory to attempt. All question carry **05** marks (05x04=**20** marks).

Part C : This part contain **two** long type questions from each unit. One question is compulsory to attempt. All questions carry **12** marks (12x04=**48**).

M.M. 80

Unit I

1. Types of macromolecules in biological systems
2. Molecular assemblies like membranes, ribosomes, extracellular matrix and chromatin.
3. Protein – protein and protein – ligand interactions

Unit II

1. Polynuleotides
2. Serve storage polysaccharides – Starch, Glycogen
3. Structure Polysaccharides – Cellulose, Chitin
4. Higher order structure of proteins – Myoglobin and Hemoglobin
5. Cholesterol and its physiological importance

Unit III

1. Types of Enzymes, co-enzymes
2. Enzyme kinetics
3. Seperation and purification of enzyme
4. Physical and chemical methods for immobilization of enzyme.

Unit IV

1. Biological source of enzymes, enzyme production
2. Industrial application of enzymes
3. Ribozymes and Catalytic antibodies

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:-

- Qualitative assay of Protein by the Biuret method.
- To estimation of Protein Qualitatively by Folin Lowry Method.
- Estimation of cholesterol by the method of Crawford
- Determine the activity of Alkalie Protease.
- Determine the activity of neutral Protease.
- Effect of temperature on the activity of α-amylase.
- Determine the activity of catalase.
- Determine the activity of urease.
- Perform protein isolation by SDS PAGE.
- Separation of molecules using column chromatography
- Enzyme kinetics
- Production of enzymes
- Immobilization techniques of enzyme

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Lab. Course 3

Based on Theory Papers 5, 6

Time: 6 hrs **Total Marks – 100**

Q.1 Experiment based on Theory paper 5 (one major & one minor)	30
Q.2 Experiment based on Theory paper 6 (one major & one minor)	30
Q.3 Spotting based on Theory papers	10
Q.4 Viva Voce.	10
Q.5 Sessional	20

Lab. Course 4

Based on Theory Papers 7 and 8

Time: 6 hrs **Total Marks – 100**

Q.1 Experiment based on Theory paper 7 (one major & one minor)	30
Q.2 Experiment based on Theory paper 8 (one major & one minor)	30
Q.3 Spotting based on Theory papers	10
Q.4 Viva Voce.	10
Q.5 Sessional	20

Approval of the Board of Studies

Date: 14/05/25

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Department of Biotechnology

Semester III

Scheme of Examination

Paper Code	Title of Theory/Practical Paper	Marks		
		External	Internal	**Total**
9	Genetic Engineering	80	20	100
10	Biology of Immune System	80	20	100
11	Bioprocess Engineering & Bio-Entrepreneurship	80	20	100
12	Environmental Biotechnology	80	20	100
Lab Course 5	Lab Course 5 (Based on paper 9 & 10)	80	20	100
Lab Course 6	Lab Course 6 (Based on paper 11 & 12)	80	20	100
	Total Marks			**600**

Approval of the Board of Studies

Date: 14/05/25

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Department of Biotechnology

Semester III

Paper 9: Genetic Engineering

RATIONALE

This paper is design to know about the principle and process and genetic engineering. The paper also contains applications of genetic engineering in different areas.

EVALUATION SCHEME

External evaluation of paper (80 Marks) will be done in **three parts (A, B and C)**.

Part A : This part contain **one** very short type questions from each four unit. All questions are compulsory to attempt. All questions carry **03** marks (03x04=**12** marks)

Part B : This part contain **two** short type questions from each unit. One question is compulsory to attempt. All question carry **05** marks (05x04=**20** marks).

Part C : This part contain **two** long type questions from each unit. One question is compulsory to attempt. All questions carry **12** marks (12x04=**48**).

M.M. 80

Unit I

1. Scope of Genetic Engineering, Introduction of Gene cloning.
2. Molecular tools and their application: modification enzymes, Restriction enzymes-Nomenclature, type and pattern of cutting.
3. Techniques in gene manipulation - Cutting and joining of DNA,
4. Ligation-DNA ligase, advance technique for gene transfer
5. Linker, Adaptor, Homopolymor tailing,

Unit II

1. Gene cloning vectors: Plasmids, bacteriophages, phagemids, Cosmides,
2. Animal vectors- Artificial chromosomes, Yeast vector - Yeast Artificial Chromosome
3. Isolation and preparation of desire DNA
4. Gene libraries - cDNA and Genomics, its construction and screening
5. Selection of suitable host, its properties, identification of Recombinants

Unit III

1. Gene Cloning strategies - Construction – Genomic, rDNA libraries, Probe construction, methods of labeling gene probes - recombinant selection and screening, Molecular cloning. Strategies for identifying recombinant clones – gene mapping technique
2. Site – directed mutagenesis and protein engineering.
3. CRISPR/Cas 9
4. T-DNA and transposon tagging
5. Phage display: Technique and applications

Unit IV

1. Gene transfer method - Transformation, Transduction, Particle bombardment, Electroporation, Liposome mediated gene transfer, Microinjection. Agrobacterium mediated gene transfer.
2. Analysis of cloned genes - DNA amplification, blotting, colony & plague hybridization and reporter Gene. DNA Transfection, Southern blot, Northern blot, Western blot
3. Application of r-DNA technology- Edible vaccines, Production of recombinant Proteins,
4. Application of genetic engineering in human welfare
5. Gene therapy: Vector engineering

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. Ltd.
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.* Bacteria.
2. Estimation of bacterial DNA by Spectrophotometer methods.
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.*

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Department of Biotechnology

Semester III

Paper 10: Biology of immune system

RATIONALE

This paper is design to understand immune cells and its work, antigen antibody reactions, immunity against diseased etc.

EVALUATION SCHEME

External evaluation of paper (80 Marks) will be done in **three parts (A, B and C)**.

Part A : This part contain **one** very short type questions from each four unit. All questions are compulsory to attempt. All questions carry **03** marks (03x04=**12** marks)

Part B : This part contain **two** short type questions from each unit. One question is compulsory to attempt. All question carry **05** marks (05x04=**20** marks).

Part C : This part contain **two** long type questions from each unit. One question is compulsory to attempt. All questions carry **12** marks (12x04=**48**).

M.M. 80

Unit I

1. Introduction – Phylogeny of immune system, innate and acquired immunity,
2. Organization and structure of lymphoid organs.
3. Antigen, antibody binding site
4. Antibody structure and function
5. Antigen – antibody interactions

Unit II

1. Major histocompatibility complex
2. Complement system.
3. Cells of immune system – Hematopoiesis and differentiation, B – lymphocyte, T – lymphocyte, Macrophages, Dendritic cells, Natural Killer and Eosinophils, Neutrophils and Mast cells.

Unit III

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

Unit IV

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

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.

Approval of the Board of Studies

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Department of Biotechnology

Semester III

Paper 11: Bioprocess Engineering & Bio-Entrepreneurship

RATIONALE

This paper is design to provide knowledge on principle of bioprocess engineering. It includes the media, potential microbes and bioreactors for production of metabolites. Downstream processing and ideology of production of some important products is also included in the paper.

EVALUATION SCHEME

External evaluation of paper (80 Marks) will be done in **three parts (A, B and C)**.

Part A : This part contain **one** very short type questions from each four unit. All questions are compulsory to attempt. All questions carry **03** marks (03x04=**12** marks)

Part B : This part contain **two** short type questions from each unit. One question is compulsory to attempt. All question carry **05** marks (05x04=**20** marks).

Part C : This part contain **two** long type questions from each unit. One question is compulsory to attempt. All questions carry **12** marks (12x04=**48**).

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: batch, Fed-batch and continuous fermentation, specialized reactors (Stirrer tank, fluidized, photo bioreactors).
2. Downstream processing: Removal of microbial cells and solid matter, cell disruption, chromatography
3. Industrial fermentation of ethanol, citric acid, streptomycin, single cell protein and amino acids

Unit III

1. Applications of industrial fermentation in – bioenergy and waste management
2. Introduction to food technology: Food Spoilage, Elementary idea of canning and packing, Sterilization and pasteurization, of food products, Food preservation.

Unit IV

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

3. Opportunities of bio- entrepreneurship in Biotechnology.

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. Enzyme kinetics
8. Bio-ethanol production
9. Production of enzymes from microbial source
10. Solid state fermentation

Approval of the Board of Studies

Date: 14/05/25

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Department of Biotechnology

Semester III

Paper 12: Environmental Biotechnology

RATIONALE

This paper is design to provide knowledge on environmental pollution and its control. The paper meets global environmental issues and its adverse effects.

EVALUATION SCHEME

External evaluation of paper (80 Marks) will be done in **three parts (A, B and C)**.

Part A : This part contain **one** very short type questions from each four unit. All questions are compulsory to attempt. All questions carry **03** marks (03x04=**12** marks)

Part B : This part contain **two** short type questions from each unit. One question is compulsory to attempt. All question carry **05** marks (05x04=**20** marks).

Part C : This part contain **two** long type questions from each unit. One question is compulsory to attempt. All questions carry **12** marks (12x04=**48**).

M.M. 80

Unit I

1. Environment: Basic concepts and issues.
2. Environmental Pollution: Types of pollution, Methods for the measurement of pollution.
3. Air pollution and its control through Biotechnology

Unit II

1. Water pollution and its control: sources of water pollution, Measurement of water pollution, waste water treatment; physical, chemical and biological treatment processes, sludge treatment.
2. Microbiology of waste water treatments, aerobic process: Activated sludge, oxidation ditches, trickling filter, rotating drums, oxidation ponds.
3. Anaerobic process: Anaerobic digestion, anaerobic filters, anaerobic sludge.

Unit III

1. Treatment schemes for waste waters of dairy, distillery, tannery, sugar, antibiotic industries.
2. Bioremediation
3. Xenobiotics in Environment; Ecological considerations, oil pollution, surfactants, pesticides, natural resources recovery.
4. Electronic waste (e-waste)
5. Arsenic and Fluoride pollution in Rajnandgaon district

Unit IV

1. Biopesticides in integrated pest management.
2. Solid wastes: Sources and management(composting, wormiculture and methane production), phytotechnology.
3. IPR – Patent, Copyright, Trademark, GI
4. Patent filing and protection

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. S. K. Jadhav and Pramod Kumar Mahish, Prayogatmak Jaivprodiki awam suksmjiv vigyan, Chhattisgarh Hindi Granth acadmi
9. Alan Scragg – Environmental Biotechnology First Edition, reprinted (2005). Oxford University Press.

List of Practicals:-

- To determine the total dissolved solids of water.(TDS)
- Determination of Dissolved oxygen (DO) of water.
- Determination of chemical oxygen demand (COD) of water.
- Determination of biochemical oxygen demand (BOD) of water.
- To screen the antagonism between *Trichoderma* sp. and *Curvularia* sp.
- Determination of effect of fungicide on the growth of fungi (*Trichoderma* sp.).
- Effect of fungicide on the antagonism between *Trichoderma* sp. and *Curvularia* sp.
- To determine the Most Probable number (MPN) of a given water sample.
- Microbial tolerance of heavy metals
- Effect of xenobiotics on growth of microorganisms.

Approval of the Board of Studies

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Lab. Course 5

Based on Theory Papers 9, 10

Time: 6 hrs **Total Marks – 100**

Q.1 Experiment based on Theory paper 9 (one major & one minor)	30
Q.2 Experiment based on Theory paper 10 (one major & one minor)	30
Q.3 Spotting based on Theory papers	10
Q.4 Viva Voce.	10
Q.5 Sessional	20

Lab. Course 6

Based on Theory Papers 11 and 12

Time: 6 hrs **Total Marks – 100**

Q.1 Experiment based on Theory paper 11 (one major & one minor)	30
Q.2 Experiment based on Theory paper 12 (one major & one minor)	30
Q.3 Spotting based on Theory papers	10
Q.4 Viva Voce.	10
Q.5 Sessional	20

Approval of the Board of Studies

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Department of Biotechnology

Semester IV

Scheme of Examination

Paper Code	Title of Theory/Practical Paper	Marks		
		External	Internal	**Total**
13	Basic Concept of Bioinformatics & Nano-biotechnology	80	20	100
14	Advanced techniques & Research Methodology	80	20	100
15	Animal Biotechnology & Bio-ethics	80	20	100
16	Functional Genomics & Proteomics	80	20	100
Lab Course 7	Based on paper 13 & 14	80	20	100
Lab Course 8	Based on paper 15 & 16	80	20	100
	Total Marks			**600**

Approval of the Board of Studies

Date: 14/05/25

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Signature			Joined online	Joined online		

Department of Biotechnology

Semester IV

Paper 13: Basic Concept of Bioinformatics and Nanobiotechnology

RATIONALE

This paper is focused with the biological data, its centre sources and application in different areas. The paper also aims to provide information about Nanobiotechnology.

EVALUATION SCHEME

External evaluation of paper (80 Marks) will be done in **three parts (A, B and C)**.

Part A : This part contain **one** very short type questions from each four unit. All questions are compulsory to attempt. All questions carry **03** marks (03x04=**12** marks)

Part B : This part contain **two** short type questions from each unit. One question is compulsory to attempt. All question carry **05** marks (05x04=**20** marks).

Part C : This part contain **two** long type questions from each unit. One question is compulsory to attempt. All questions carry **12** marks (12x04=**48**).

M.M. 80

Unit – I

Bioinformatics: Introduction, History, Scope of Bioinformatics, Biotechnology and Bioinformatics

BTIS network in India, Bioinformatics tools, Sequence and Nomenclature,

Application of Bioinformatics

Unit – II

Types of Sequences - Genomic DNA, cDNA, Organelle's DNA;

Biological database: Introduction, primary, secondary and tertiary biological database

Information sources with special reference to NCBI, EMBL, DDBJ, Gene bank

Unit-III

Cheminformatics, Pharmacogenomics,

Molecular modeling databases, Taxonomy databases

Human Genome Project, Sanjeevini Module; A complete drug design suite

Unit-IV

Nanobiotechnology: General Introduction, Nanotechnology and Nanobiotechnology;

Nanoscale; Nanomicroorganisms – Nanovirus, Nanobacteria;

Nanomolecules, its synthesis and use in antimicrobial activity

Application of Nanobiotechnology

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 from NCBI
2. To study the future and scope of BLAST in Biotechnology researc
3. To study how to develop primer (F+R) from given nucleotide sequences
4. 3D molecular modeling of proteins
5. To study the whole genome of any microorganisms
6. To study the protein structure using protein data bank (PDB)
7. To perform synthesis of silver nanoparticles
8. To perform the antimicrobial activity of nanoparticles
9. To study the active site prediction form Sanjeevini Module

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Designation	VC Nominee	Subject Expert	Subject Expert	Employment/ Industrial Member	Merit Alumni	Chairman/ HOD
Signature			Joined online	Joined online		

Department of Biotechnology

Semester IV

Paper 14: Advanced techniques & Research Methodology

RATIONALE

This paper aims to provide information about advance tools and technique useful to perfume different biotechnological experiments.

EVALUATION SCHEME

External evaluation of paper (80 Marks) will be done in **three parts (A, B and C)**.

Part A : This part contain **one** very short type questions from each four unit. All questions are compulsory to attempt. All questions carry **03** marks (03x04=**12** marks)

Part B : This part contain **two** short type questions from each unit. One question is compulsory to attempt. All question carry **05** marks (05x04=**20** marks).

Part C : This part contain **two** long type questions from each unit. One question is compulsory to attempt. All questions carry **12** marks (12x04=**48**).

M.M. 80

Unit I

1. Principles and application of Electrophoresis
2. Principles and application of Spectrophotometry – AAS and FT-IR
3. RIA and autoradiography in biology
4. ELISA types and applications

Unit II

1. Advanced Microscope – Confocal and SEM/TEM
2. DNA sequencer, component, types and applications
3. Chromatography - HPLC/HPTLC, GC-MS/LC-MS
4. Principles, types and application of Thermocycler
5. NMR and X- ray diffraction

Unit III

1. Principles and application of DNA micro array
2. Flow cytometer
3. Southern, Northern & Western Blotting.
4. Biosensor – types and application

Unit IV

1. Research plan – conceptualization, stamen of problem, finding research gap
2. Literature collection and review
3. Research design – methodology, timelines, resources
4. Report writing and presentation
5. Indexing – WOS, Scopus
6. Citation – Google scholar, H-index, Impact factor
7. Research ethics and Plagiarism

Reference 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

List of Practical:-

1. Preparation of different culture media for culture of various microorganisms, like – Bacteria, Fungi, Yeast, Actinomycetes, Algae, etc
2. Perform the various culture techniques for microbial culture
3. Perform various laboratory techniques, like – centrifugation, chromatography, spectrophotometery, electrophoresis, etc.
4. Pure culture techniques of microbes from various sources
5. Perform the advance biotechnological techniques, like – ELISA, PCR, Southern blotting, etc.
6. H index calculation
7. Impact factor calculation
8. Google scholar indexing
9. Plagiarism software
10. Literature finding in Scopus and WoS database

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Semester IV

Paper 15: Animal Biotechnology & Bio-ethics

RATIONALE

This paper is design to provide knowledge on basic principles of animal tissue culture and its broad applications.

EVALUATION SCHEME

External evaluation of paper (80 Marks) will be done in **three parts (A, B and C)**.

Part A : This part contain **one** very short type questions from each four unit. All questions are compulsory to attempt. All questions carry **03** marks (03x04=**12** marks)

Part B : This part contain **two** short type questions from each unit. One question is compulsory to attempt. All question carry **05** marks (05x04=**20** marks).

Part C : This part contain **two** long type questions from each unit. One question is compulsory to attempt. All questions carry **12** marks (12x04=**48**).

M.M. 80

Unit I

1. Basic principle of animal tissue culture
2. Laboratory requirement - Equipment- Essential, beneficial and useful equipments, consumable items.
3. Different types of culture medium for animal tissue culture
4. Application of animal cell culture

Unit II

1. Primary and established cell line
2. Disaggregation – mechanical and enzymatic
3. Suspension culture. Cell lines: Definition, Evolution of cell lines, continuous cell lines.
4. Biology of cultured cells- Culture environment, cell adhesion, cell proliferation, differentiation, Initiation of culture, cell senescence, continuous cell lines.
5. Contamination- Source and types of contamination
6. Cell line banking, cryopreservation, cell viability assays

Unit III

1. Stem cells – types, culture and its applications
2. Transgenic animals – mechanism of production and applications
3. Hybridoma technology, Production of Monoclonal antibodies
4. Cell culture based vaccines – human and veterinary
5. Tissue engineering and its applications

Unit IV

1. Ethical issues in biotechnology – Gene manipulation, experiments in animals and humans
2. Animal rights, protection of biodiversity
3. Biopiracy
4. Animal models for biotechnology research

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.

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Semester IV

Paper 16: Functional Genomics & Proteomics

RATIONALE

This paper is design to provide knowledge on genome mapping, sequencing and comparative analysis of genome of different organisms. The paper also includes advance tools techniques for analysis proteins.

EVALUATION SCHEME

External evaluation of paper (80 Marks) will be done in **three parts (A, B and C)**.

Part A : This part contain **one** very short type questions from each four unit. All questions are compulsory to attempt. All questions carry **03** marks (03x04=**12** marks)

Part B : This part contain **two** short type questions from each unit. One question is compulsory to attempt. All question carry **05** marks (05x04=**20** marks).

Part C : This part contain **two** long type questions from each unit. One question is compulsory to attempt. All questions carry **12** marks (12x04=**48**).

M.M. 80

UNIT – I

- Genomics – General introduction, Types of genomics; Structural genomics, Functional genomics, Comparative genomics, Genome sequencing, Genome mapping, Future of genomics
- Plant Genomics
- Genomics in medicine; Gene medicine, Disease models

UNIT – II

- Genome project; the human genome project, the ENCODE project.
- Methods of gene sequencing: - Random shotgun sequencing, EST. Whole genome shotgun sequencing, Single nucleotide polymorphisms (SNPs)
- Comparative Genomics: Sequence comparison, Comparative genomics in bacteria, Comparative genomics in Eukaryotes & organelles

UNIT – III

- Proteomics – General concept, Gene and Protein, Methods of study the protein,
- Types of proteomics, Structural proteomics, Analysis of protein structure, Ab-initio and Homology modeling of Protein Structure.

UNIT – IV

- Functional proteomics, Protein-Protein interactions, Protein arrays, protein chips, Expression analysis of protein
- Global analysis of protein, and characterization of protein
- System biology, Practical application of proteomics, Future of proteomics

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 a organism.
2. Retrive protein sequence from NCBI database.
3. Retrive protein structure from ptotein databank
4. Obtain mass spectrophotometric structure of any protein from protein databank

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Lab Course 7 Based on Theory Papers 13, 14

Time: 6 hrs **Total Marks – 100**

Q.1 Experiment based on Theory paper 13 (one major & one minor)	30
Q.2 Experiment based on Theory paper 14 (one major & one minor)	30
Q.3 Spotting based on Theory papers	10
Q.4 Viva Voce.	10
Q.5 Sessional	20

Lab. Course 8

Based on Theory Papers 15 and 16

Time: 6 hrs **Total Marks – 100**

Q.1 Experiment based on Theory paper 15 (one major & one minor)	30
Q.2 Experiment based on Theory paper 16 (one major & one minor)	30
Q.3 Spotting based on Theory papers	10
Q.4 Viva Voce.	10
Q.5 Sessional	20

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Project

Project Work	External	Internal	Total
Dissertation	120	30	150
Seminar based on project	80	20	100
Viva-voce	40	10	50
Total			**300**

1. A student of IV semester will have the option to opt for project work in lieu of two theory papers and one lab courses.
2. The project has to be carried out in recognized national laboratories or UGC recognized universities or any other organization of public or privet concern. The duration of project will be 90 days.
3. The department also gives opportunity to do project work maximum 02 students per faculty based on merit marks obtained in Semester I and II.
4. The valuation of all the projects will be carried out by the external examiner.

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 & Discussion
5. Summary
6. Bibliography

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