SCHOOL OF STUDIES IN BIOTECHNOLOGY

Pt. Ravishankar Shukla University
Raipur-492 010

Syllabus

BIOTECHNOLOGY

M. Sc.
(Semester System)

Session
2018-2019
2019-2020

SCHEME OF SEMESTER EXAMINATION FOR SESSION 2018-2020

SCHOOL OF STUDIES IN BIOTECHNOLOGY
PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR
M. Sc. BIOTECHNOLOGY (Semester I to IV)

July 2018 – December 2018

			Marks	
First Semester	Paper	Title of Paper	(External)	(Internal)**
	1*	Cell Biology	80	20
	2	Genetics	80	20
	3	Microbial Physiology	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	

January 2019 – June 2019

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	

July 2019 – December 2019

Third Semester	Paper	Title of Paper	(External)	(Internal)
	9	Genetic Engineering	80	20
	10	Biology of Immune System	80	20
	11	Bioprocess Engineering & Technology	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	

January 2020 – June 2020

Fourth Semester	Paper	Title of Paper	(External)	(Internal)
	13	Basic Concept of Bioinformatics & Nanobiotechnology	80	20
	14	Advanced techniques in Biotechnology	80	20
	15	Animal Biotechnology	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		
		Project Work***	600	
		Dissertation	240	60
		Seminar based on project	160	40
		Viva-voce	80	20
		Grand total [Semester I + II + III + IV]	2400	

*Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) -type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

**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.

*** 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 Pt. Ravishankar Shukla University, Raipur.
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.

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

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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	Microbial Physiology	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**

School of Studies in Biotechnology

Semester I

Paper 1: Cell Biology

M.M.80

Unit I

1. Cell Theory
2. Structure of Prokaryotic and Eukaryotic cells
3. Diversity of cell size and shape. Diversity of Prokaryotic cell and Eukaryotic cell.

Unit II

1. Cellular organelles – Plasma membrane, cell wall, their structural organization; Mitochondria; Chloroplast; Nucleus and other organelles and their organization.
2. Transport of nutrients, ions and macromolecules across membranes.
3. Cell cycle – molecular events and model systems

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

Unit IV

1. Biosynthesis of proteins in Eukaryotic cell, Co – and post – translational modifications, intracellular protein traffic.
2. Cellular basis of differentiation and development – mitosis, gametogenesis and fertilization. Development in Drosophila and Arabidopsis; Spatial and temporal regulation of Gene Expression

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

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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.*

School of Studies in Biotechnology

Semester I
Paper 2: Genetics

M.M. 80

Unit I

1. Introduction to genetics; Beginning of genetics as a science. Early studies involving genetics
2. Mendel and genetics; Mendel's laws of genetics; Physical and chemical basis of Heredity. Genetic variation.
3. Gene - Types of genes, Prokaryotic, Eukaryotic and Viral genes
4. Genetics and human affairs.
5. Fine structure of gene, Eukaryotic genome organization (Structure of chromatin, coding and non – coding sequences, satellite DNA); rearrangement in DNA. Central dogma

Unit II

1. Regulation of gene expression in Prokaryotes and Eukaryotes; Attenuation and antitermination; Operon concept; DNA methylation.
2. Gene to Phenotype – Interactions between the Alleles of one gene, interfering gene interaction.
3. Mutation; Types of mutations, Changes in Chromosome number and structure - Euploidy and Aneuploidy, mutagens – UV and chemical mutagens, Ames test; Dosage compensation; Mutational Assay System.
4. Inheritance: Autosomal and sex linked inheritance, Extrachromosomal inheritance, Inheritance pattern. Inheritance of Organelle genes.

Unit III

1. Variation; sources of variation; selection; Heritability of variation, Process of speciation; Origin of new genes. Hardyweinberg genetic equilibrium, genetic polymorphism and selection.
2. Genes and Quantitative traits; Genotypes and Phenotypic Distribution; Heritability of Quantitative Character; Quantifying Heritability; Locating genes.
3. Genetic disorder and syndromes.

Unit IV

1. Bacterial Genetic system: Transformation, Conjugation, Transduction, Recombination, Plasmids and Transposons. Bacterial Genetic map with reference to *E.coli*.
2. Viruses and their Genetic system: Phage I and its life cycle; RNA phases; RNA viruses; Retroviruses
3. Genetic system of Yeast and Neurospora.

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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:

- Experiments for Mendel's experiments
- Studies of prokaryotic & eukaryotic cells
- Karyo-type studies
- Mutation in bacteria
- Plasmid isolation

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Semester I

Paper 3: Microbial Physiology

M.M. 80

Unit I

1. Microbial Evolution, Systematics and Taxonomy –New approaches to bacterial taxonomy classification including ribotyping; Ribosomal RNA sequencing; Characteristics of primary domains; Nomenclature and Bergey's Manual.
2. Prokaryotic cells: Structure and function – Cell walls of eubacteria (peptidoglycan) and related molecules: Outer – membrane of Gram negative bacteria; Cell wall and cell membrane synthesis; Flagella and motility; Cell inclusions like endospores, gas vesicles.

Unit II

1. Microbial Growth – growth curve, measurement of growth and growth yields; Synchronous growth; Continuous culture; Growth as affected by environmental factors like temperature, acidity, alkalinity, water availability and oxygen.
2. Metabolic Diversity among Microorganisms – Photosynthesis in microorganisms; Calvin cycle; Chemolithotrophy; oxidizing and reducing bacteria; Methanogenesis and acetogenesis, syntrophy, Nitrogen metabolism; Nitrogen fixation.

Unit III

1. Bacteria: Purple and green bacteria; Cyanobacteria; Homoacetogenic bacteria; Acetic acid bacteria; Budding and appendage bacteria; Spirilla; Spirochaetes; Gliding and sheathed bacteria; Pseudomonads; Lactic and propionic acid bacteria; Endospore forming rods and cocci; Mycobacteria; Rickettsia's, Chlamydia's and Mycoplasmas.
2. Archaea: Archaea as earliest life forms; Halophiles; Methonogens; Hyperthermophilic Archaea; Thermoplasma.
3. Algae, Fungi, Slime moulds and Protozoa. Viruses: Bacterial, Plant, Animal and tumor viruses; Discovery, classification and structure of viruses; Lysogeny; DNA viruses; RNA viruses; Replication; Examples of Herpes, Pox, Adenoviruses, Retroviruses.

Unit IV

1. Microbial diseases –Infectious disease transmission; Respiratory infections caused by bacteria and viruses; Tuberculosis; Sexually transmitted diseases including AIDS; Diseases transmitted by animals (rabies, plague), insects and ticks (Rickettsias, Lime disease, malaria)
2. Host – Parasite Relationships – Normal microflora of Skin, Oral cavity, Gastrointestinal tract; Types of toxins (Exo –, Endo -, Entero -) and their structure; Virulence and Pathogenesis.
3. Chemotherapy/Antibiotics – Antibiotics and Antimicrobial agents; Broad-spectrum antibiotics; Antibiotics from prokaryotes; Antifungal antibiotics; Mode of action; Resistance to antibiotics.

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

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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
9. Microbial Biotechnology: Principles and applications, L Y Kun (2003)
10. Microbiology and Environmental Toxicology, Sharad Saxenda,Published by Manglam Publications.
11. Food Microbiology, Veena Kumari (2012)

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. Analysis of water for portability and determination of MPN.
9. Bacterial transformation.
10. Biochemical characterization of selected microbes.
11. Transduction
12. One step growth curve of bacteria

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School of Studies in Biotechnology

Semester I

Paper 4: Bio-molecule

M.M. 80

Unit I

1. Chemical foundations of Biology – pH, pK, acids, bases, buffers, weak bonds, covalent bonds.
2. Principles of thermodynamics.

Unit II

1. **Amino acids and peptides** – classification, chemical reactions and physical properties
2. **Sugars** – classification and reactions
3. Heterocyclic compounds and secondary metabolites in living systems – nucleotides, pigments, isoprenoids.

Unit III

1. **Lipids** – classification, structure and functions.
2. **Proteins** – classification and separation, purification and criteria of homogeneity, end group analysis, hierarchy in structure, Ramachandran map.

Unit IV

1. **Polysaccharides** – types, structural features, methods for compositional analysis
2. Analytical techniques in biochemistry and biophysics for small molecules and macromolecules for quantization.

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Books:

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

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

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

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

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

f) 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).

g) Buchanan, Gruissemen & Jones (2015) Biochemistry & Molecular Biology of Plant, 2nd edition.

h) M. Debnath (2011) Tools and Techniques in Biotechnology

List of Practical's:-

- 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.

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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School of Studies in 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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School of Studies in Biotechnology

Semester II

Paper 5: Biostatistics & Computer Application in Biotechnology

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, range, standard deviation, variance. Idea of two 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.

Unit III

1. Introduction to digital computers: Organization; low – level and high – level languages; binary number system
2. Flow charts and programming techniques

Unit IV

1. Introduction to programming in Q Basic and C.
2. Introduction to data structures and database concepts, introduction to Internet and its application.
3. Introduction to Word processing, Spreadsheets and presentation software
4. Introduction to Image processing
5. Computer – oriented statistical techniques: Frequency table of single discrete variable, Bubble sort, Computation of mean, variance and standard deviation.
6. Bioinformatics and Biotechnology – An overview.

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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 Practical's:-

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- Square 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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School of Studies in Biotechnology

Semester II

Paper 6: Molecular Biology

M.M.80

Unit I

1. Introduction to Molecular Biology
2. DNA Replication – Prokaryotic and eukaryotic DNA replication, Mechanics of DNA replication. Enzymes and accessory proteins involved in DNA replication.
3. DNA Repair and Recombination. Homologous recombination – Holiday junction, gene targeting, FLP/FRT and Cre/Lox recombination, RecA and other recombinases.
4. Transcription – Prokaryotic transcription, Eukaryotic transcription, RNA polymerase, General and specific transcription factors, Regulatory elements and mechanisms of transcription regulation. Modification in RNA - 5' – cap formation, Transcription termination, 3' – end processing and polyadenylation, Splicing, Editing, Nuclear export of mRNA, mRNA stability

Unit II

1. Translation – Prokaryotic and Eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation, co – and post – translational modifications of proteins.
2. Protein Localization – Synthesis of secretory and membrane proteins, Import into nucleus, mitochondria, chloroplast and peroxisomes, receptor mediated endocytosis.

Unit III

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. Antisense and Ribozyme technology – Molecular mechanism of Antisense molecules, inhibition of splicing, polyadenylation and translation, disruption of RNA structure and capping, Biochemistry of ribozyme; hammer – head, hairpin and other ribozymes, strategies for designing ribozymes, Applications of Antisense and ribozyme technologies.

Unit IV

1. Molecular Mapping of genome – Genetic and physical maps, physical mapping and map – based cloning, Southern and fluorescence *in situ* hybridization for genome analysis, Chromosome micro dissection and micro cloning.
2. Molecular markers in genome analysis: RFLP, RAPD and AFLP analysis, molecular markers linked to disease resistance genes, Application of RFLP in forensic, disease prognosis, genetic counseling, Pedigree, varietal etc.

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Books:

- 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.
- Buchanan, Gruissemen & Jones (2015) Biochemistry & Molecular Biology of Plant, 2nd edition.
- M. Debnath (2011) Tools and Techniques in Biotechnology

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.

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School of Studies in Biotechnology

Semester II

Paper 7: 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 III

1. Plant transformation technology: Basis of tumor 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, control mechanisms and manipulation of phenylpropanoid pathway, shikimate pathway, 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), AFLP, map based cloning, molecular marker assisted selection.

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

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.
7. H.S. Chawla: Introduction to plant biotechnology. Oxford & IBH Publishing Co. (P) Ltd.
8. B.D. Singh, (2004) Biotechnology. Expending Horizons. First Edition. Kalyani Publishers, Ludhiana.
9. Buchanan, Gruissemen & Jones (2015) Biochemistry & Molecular Biology of Plant, 2nd edition.
10. M. Debnath (2011) Tools and Techniques in Biotechnology

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. Study of molecular markers
9. Extraction of DNA from plant
10. Estimation of plant DNA by Agarose gel electrophoresis and Spectrophotometer.

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Semester II

Paper 8: Macromolecules and Enzymology

M.M. 80

Unit I

1. Macromolecules and supra molecules assemblies – Types of macromolecules in biological systems, molecular assemblies like membranes, ribosomes, extracellular matrix.

2. Sequencing of proteins and nucleic acids.

Unit II

1. Protein – protein and protein – ligand interactions, physical and chemical methods of study.

2. Conformational properties of polynuleotides and polysaccharides – secondary and tertiary structural features and their analysis – theoretical and experimental; protein folding – biophysical and cellular aspects

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 lipoproteins – structure and function

Unit IV

1. Organization of macromolecular complexes – chromatin and ribosomes; Protein denaturation

2. Ribozymes and Catalytic antibodies – Functional proteins – structure and drug targets (enzymes and receptors)

3. Nucleic acid hybridization – structural and biological study.

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NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

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)
- M. Debnath (2011) Tools and Techniques in Biotechnology

List of Practical`s:-

- 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.
- Enzyme kinetics

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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

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School of Studies in 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 & Technology	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**

School of Studies in Biotechnology

Semester III

Paper 9: Genetic Engineering

M.M. 80

Unit I

1. Scope of Genetic Engineering.
2. Milestones in Genetic Engineering: Isolation of restriction enzymes, DNA sequencing, gene synthesis and mutation, detection and separation, cloning, gene expression. Cloning and patenting of life forms. Genetic engineering guidelines.
3. Molecular tools and their application: Restriction enzymes, modification enzymes, molecular markers.
4. Nucleic acid purification, yield analysis
5. Nucleic acid amplification and its applications

Unit II

1. Gene cloning vectors: Plasmids, bacteriphages, phagemids, cosmids, Artificial chromosomes
2. Restriction Mapping of DNA Fragments and Map Construction, Nucleic acid sequencing.
3. cDNA synthesis and cloning: mRNA enrichment, reverse transcription, DNA primers, linkers, adaptors and their chemical synthesis, Library construction and screening.
4. Alternative strategies of gene cloning: Cloning interacting genes – Two and three hybrid systems. Nucleic acid micro array assay.

Unit III

1. Site – directed mutagenesis and protein engineering.
2. DNA Transfection, Southern blot, Northern blot, Western blot, Primer extension, S1 mapping, RNase protection assay, and reporter assays.
3. Expression Strategies for hetrologous 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 IV

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, Chromosome engineering.
3. Gene therapy: Vector engineering. Strategies of gene delivery – Viral & non-viral, gene knockout, gene augmentation, gene correction / gene editing, gene regulation and silencing

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

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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
13. Buchanan, Gruissemen & Jones (2015) Biochemistry & Molecular Biology of Plant, 2nd edition
14. S Choudhuri, and DB Carlson (2008) Genomics: Fundamentals and applications, 1st edition
15. M. Debnath (2011) Tools and Techniques in Biotechnology

List of Practical's:-

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.*
9. DNA amplification by PCR

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School of Studies in Biotechnology

Semester III

Paper 10: Biology of immune system

M.M. 80

Unit I

1. Introduction – Phylogeny of immune system, innate and acquired immunity, Clonal nature of immune response.
2. Organization and structure of lymphoid organs.
3. Nature and biology of antigens and super antigens.
4. Antibody structure and function; antibody engineering
5. Antigen – antibody interactions

Unit II

1. Major histocompatibility complex
2. BCR & TCR, generation of diversity.
3. Complement system.
4. Cells of immune system – Hematopoiesis and differentiation, Lymphocyte trafficking, B – lymphocyte, T – lymphocyte, Macrophages, Dendritic cells, Natural Killer and lymphokine activated killer cells, Eosinophils, Neutrophils and Mast cells.

Unit III

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, helminthes and viruses), AIDS and other immunodeficiencies.
3. Hybridoma Technology and Monoclonal antibodies

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NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

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
8. M. Debnath (2011) Tools and Techniques in Biotechnology

List of Practical's:-

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.

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School of Studies in Biotechnology

Semester III

Paper 11: Bioprocess Engineering & Technology

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 (pulsed, fluidized, photo bioreactors).
2. Measurement and control of bioprocess parameters.

Unit III

1. 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, Effluent treatment: D.O.C. and C.O.D. treatment and disposal of effluents.
2. Whole cell Immobilization and their industrial applications.

Unit IV

1. 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. Use of microbes in mineral beneficiation and oil recovery.
2. Introduction to food technology: Elementary idea of canning and packing, Sterilization and pasteurization, of food products, technology of typical food/food products (bread, cheese, idli), Food preservation.

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

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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
12. I. Y Kun, Microbial Biotechnology: Principles and applications,2003
13. M. Debnath () Tools and Techniques in Biotechnology, 2011

List of Practical's:-

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

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School of Studies in Biotechnology

Semester III

Paper 12: 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, its limitations.
3. Air pollution and its control through Biotechnology

Unit II

1. Water pollution and its control: Water as a scarce natural resource, sources of water pollution, Need for water management, Measurement of water pollution, waste water 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, surfactants, pesticides.

Unit IV

1. Biopesticides in integrated pest management.
2. Solid wastes: Sources and management (composting, wormiculture and methane production).
3. Global Environmental Problems: Ozone depletion, UV – B, green house – effect and acid rain, their impact and biotechnological approaches for management.
4. Role of National organization in Biotechnology.
5. IPR.

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

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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.
9. L Y Kun-Microbial Biotechnology: Principles and applications, (2003).
10. Sharad Saxenda-Microbiology and Environmental Toxicology, Published by Manglam Publications.
11. M. Debnath -Tools and Techniques in Biotechnology, (2011).

List of Practical's:-

- 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.

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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

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School of Studies in 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	Advance techniques in Biotechnology	80	20	100
15	Animal Biotechnology	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**

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School of Studies in Biotechnology

Semester IV

Paper 13: Basic Concept of Bioinformatics and Nanobiotechnology

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, ESTS, GSTS, Organelle's DNA; Biological database.
Biological database: Introduction, primary, secondary and tertiary biological database;
Information sources with special reference to NCBI, EMBL, DDBJ,
Gene bank

Unit-III

Cheminformatics,
Pharmacogenomics,
Genomic mapping,
Microarray technology,
Bioinformatics in Drug discovery,
Human Genome Project

Unit-IV

Nanobiotechnology: General Introduction, Nanotechnology and Nanobiotechnology;
Nanoscale:
Nanomicrooganisms – Nano virus, Nanobacteria;
Application of Nanobiotechnology

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

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.
12. GL Hornyak, HF Tibbals, and J Dutta (2008) Fundamentals of Nanotechnology
13. S Choudhuri, and DB Carlson (2008) Genomics: Fundamentals and applications, 1st edition
14. Rita Khare (2013) Concepts in Nano Biotechnology
15. Johnathan Pevsner (2015) Bioinformatics and Functional, 3nd edition.

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 the future and scope of BLAST in Biotechnology research
5. To study how to develop primer (F+R) from given nucleotide sequences

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School of Studies in Biotechnology

Semester IV

Paper 14: Advanced techniques in Biotechnology

M.M. 80

Unit I

1. Principles and application of: Microscopy, Centrifugation, Chromatography, Electrophoresis, HPLC.
2. Principles and application of: Colorimetry, Spectrophotometry and densitometry
3. RIA and autoradiography in biology, ELISA

Unit II

1. Methods in Microbiology – Pure culture techniques; Theory and practice of sterilization; Principles of microbial nutrition; Types of culture media: defined and undefined media, selective and differential media, minimal and enrichment media; Enrichment culture techniques for isolation of chemoautotrophs, chemohetrotrophs and photosynthetic microorganisms.
2. Principles and application of Thermocycler

Unit III

1. Principles and application of DNA micro array
2. Fluorescence spectroscopy
3. NMR and X- ray diffraction

Unit IV

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

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

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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
6. M. Debnath (2011) Tools and Techniques in Biotechnology

List of Practical's:-

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, spectrophotometry, electrophoresis, etc.
4. Pure culture techniques of microbes from various sources
5. Perform the advance biotechnological techniques, like – ELISA, PCR, Southern blotting, etc.

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School of Studies in Biotechnology

Semester IV

Paper 15: Animal Biotechnology

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 cloning: Basic techniques for cell cloning
6. 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. Somatic cell genetics.
4. Ethical issues in relation to animal biotechnology

Unit IV

1. Transgenic animals: Mice, Sheep, Birds and Fish
2. Apoptosis.
3. Tissue engineering: Elementary idea of tissue engineering, Artificial skin, artificial cartilage

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

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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. Biotechnology. Expending Horizons. First Edition. Kalyani Publishers, Ludhiana. B.D. Singh. (2004)
6. Biotechnology. Books and Allied (P) Ltd., Kolkata. U Satyanarayana (2005)

Practical's:

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. To perform mechanical disaggregation of soft tissues of chick, for recovery of cells.
5. To perform enzymatic disaggregation of tissue, for recovery of cells.

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School of Studies in Biotechnology

Semester IV

Paper 16: Functional Genomics & Proteomics

M.M. 80

UNIT – I

1. Genomics – General introduction, Types of genomics, Structural genomics, Functional genomics, Comparative genomics, Genome sequencing, Genome mapping, Future of genomics
2. Plant Genomics
3. Genomics in medicine: Gene medicine, Disease models, The impact of genomics on medicine

UNIT – II

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

UNIT – III

1. Proteomics – General concept, Gene and Protein, Types of proteomics, Structural proteomics and Functional proteomics
2. Methods of study the protein, Protein arrays, protein chips, System biology, Practical application of proteomics

UNIT – IV

1. Future of proteomics, Analysis of protein structure,
2. Protein-Protein interactions, Protein database, Global analysis of protein, Expression analysis and characterization of protein

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

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Practical's:-

1. To find out and study the sequence similarity search by BLAST & FASTA.
2. To study the genome map from NCBI resource.
3. To study the basic functionality of genome by genome browser.
4. Study the whole genome of Hepatitis B virus and Human Mitochondrial Genome using genome databases of Gene Bank.
5. Study the single nucleotide polymorphism (SNP) of human genome using SNP databases of NCBI (Example: MTHFR gene)
6. Study the Sequence comparison in bacterial genome using Gene Bank (16S Ribosomal DNA sequence of *Rickettsia* sp.)
7. To study the Multiple Alignment Sequence by using CLUSTAL OMEGA tools.
8. To determine the sequence of database of RNA families by using Rfam.
9. To retrieve the protein sequence by Swiss Prot database
10. Study the Protein protein and Protein nucleotide interaction using Gene Bank databases (Example : Human 40S ribosome)

Practical References:-

1. Bioinformatics: A Practical Approach Chapman & Hall Taylor & Francis Gen.
2. Bioinformatics – Sequence & Genome Analysis, David W-Mount CBS Publishers & Distributors (Pvt) Ltd.
3. Introductory Bioinformatics For Users: The Practicals Bela Tiwari October 29, 2007.
4. Griffiths-Jones S, Bateman A, Marshall M, Khanna A, Eddy SR (2003). "Rfam: an RNA family database". Nucleic Acids Res. 31 (1): 439–41.

Books:-

1. Principles of Gene Manipulation and Genomics; by Primrose & Twyman
2. Gene cloning and DNA analysis: An introduction; by TA Brown
3. Genomics, Proteomics & Vaccines; by Guido Grandi
4. Genomics: Application in Human biology; by Primrose & Twyman
5. Introduction to molecular Genetics and Genomics; JBH Publication
6. Proteomics by Timothy Palzkill
7. U. Satyanarayan: Biotechnology. Books and Allied (P) Ltd. Kolkata
8. P.K. Gupta: Biotechnology and Genomics. Rastogi Publication
9. S Choudhuri, and DB Carlson (2008) Genomics: Fundamentals and applications, 1st edition
10. Johathan Pevsnev (2015) Bioinformatics and Functional, 3rd edition.

23/12/17

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

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 Pt. Ravishankar Shukla University, Raipur.

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 & Discussion
5. Summary
6. Bibliography

28/2/2017