

# ATAL BIHARI VAJPAYEE VISHWAVIDALAY, BILASPUR (C.G.)



Scheme and Courses of Studies for M. Sc. w.e.f. – 2019 –20

## BIOTECHNOLOGY

SEM.	COURSES & EXAMINATION PATTERN			MARKS		
	PAPER		Title of the Paper	Distribution of Marks/Paper		
	Paper	Code		Internal	External	Total
First	First	BT 101	General Microbiology	20	80	100
	Second	BT 102	Cell Biology	20	80	100
	Third	BT 103	Genetics & Cytogenetics	20	80	100
	Fourth	BT 104	Biochemistry	20	80	100
	Practical-I	LC 001	Concern with paper - I & II	20	80	100
	Practical-II	LC 002	Concern with paper - III & IV	20	80	100
Second	First	BT 201	Biostatistics and Computer basics & Application	20	80	100
	Second	BT 202	Molecular Biology	20	80	100
	Third	BT 203	Plant Biotechnology	20	80	100
	Fourth	BT 204	Macromolecules and Enzymology	20	80	100
	Practical-I	LC 003	Concern with paper - I & II	20	80	100
	Practical-II	LC 004	Concern with paper - III & IV	20	80	100
Third	First	BT 301	Immunology	20	80	100
	Second	BT 302	Genetic Engineering	20	80	100
	Third	BT 303	Industrial Biotechnology	20	80	100
	Fourth	BT 304	Environmental Biotechnology	20	80	100
	Practical-I	LC 005	Concern with paper - I & II	20	80	100
	Practical-II	LC 006	Concern with paper - III & IV	20	80	100
Fourth	First	BT 401	Bioinformatics, Genomics and Proteomics	20	80	100
	Second	BT 402	Animal Biotechnology	20	80	100
	Third	BT 403	Advanced Bio-techniques and Nanotechnology	20	80	100
	Fourth	BT 404	Research Methodology, Bioethics and IPR	20	80	100
	Practical-I	LC 007	Concern with paper - I, II & III	20	80	100
	PROJECT	PW 01	Project work, Minor (INTERNAL PROJECT)**	VV-20, PT-20, DT-60		100
<b>OR (EXTERNAL PROJECT FOR FOURTH SEMESTER)</b>						
		Dissertation / Thesis / Project Report		60	240	300
		Presentation		40	160	200
		Viva-voce		20	80	100
<b>TOTAL</b>						<b>2400</b>
*As per guideline 20% of theory marks i.e. 20 marks is allotted for internal assessment per paper, which will be divided into test and seminar of 10 marks for each.						
**At recognised research centre / laboratory or Industry; VV- Viva-voce, PT - Presentation; DT - Dissertation						
<b>Question pattern in each Theory paper:</b>						
Section - A will be Compulsory containing 10 objective questions of 01 marks for each and 05 short answer type questions of 02 marks for each.						
Section-B will contain 08 descriptive type questions with internal choice, carrying equal marks						

Papers of respective semester may be allotted code such as semester- I =BT: 101, BT: 102 etc; Semester -II =BT: 201, BT: 202 etc. And similarly Semester- III =BT: 301, BT: 302, BT: 303 etc.....;



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**M.Sc. FIRST SEMESTER  
BIOTECHNOLOGY  
PAPER – I  
(General Microbiology)**

Total Marks: 100  
Internal assessment Marks: 20  
Term end Exam Marks: 80  
Minimum marks: 36

**Unit I:** Microbial Evolution. Viruses: Discovery, classification, Structure and lifecycle of Bacterial, Plant and Animal viruses; Examples of few viruses- Herpes Pox, Adenoviruses, Retroviruses, Viroids and Prions. New approaches to bacterial taxonomy: classification including ribotyping; Characteristics of primary domains; Nomenclature and Bergey's Manual. Prokaryotic cells: Structure and function — Cell wall of eubacteria (peptidoglycan) and related molecules: Cell wall and cell membrane.

(Teaching 20 Hrs.)

**Unit II:** Archae: Archaea as earliest lifeforms; Halophiles; Methanogens; Hyperthermophilic Archae: Thermoplasma. Bacteria: Purple and green bacteria; Cyanobacteria: Homoacetogenic bacteria; Acetic acid bacteria; Budding and appendaged bacteria; Spirilla: Spirochaetes; Gliding and sheathed bacteria; Pseudomonads; Lactic and propionic acid bacteria: Endospore forming rods and cocci; Mycoplasma, Mycobacteria; Rickettsias. Chlamydia and Actinomycetes.

(Teaching 20 Hrs.)

**Unit III:** Microbial Growth — The definition of growth, mathematical expression of growth, growth curve, measurement of growth and growth yields; Synchronous growth; Continuous culture; Growth as affected by environmental factors -temperature, acidity, alkalinity water availability and oxygen. Metabolic Diversity among Microorganisms - Photosynthesis in microorganisms; Role of Chlorophylls, carotenoids and phycobillins; Chemolithotrophy - Hydrogen iron - nitrite- oxidizing bacteria; Nitrate and sulphate reduction; Methanogenesis and acetogenesis; Fermentation diversity, syntrophy. Nitrogen metabolism; Nitrogen fixation.

(Teaching 20 Hrs.)

**Unit IV:** 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). Food and water borne diseases. Host — Parasite Relationships – Normal micro flora of Skin, Oral cavity, Gastrointestinal tract; Virulence Pathogenesis. Disease control - Chemotherapy / Antibiotics, Antibiotics and Antimicrobial agents; Mode of action Resistance to antibiotics.

(Teaching 20 Hrs.)

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**TEXT BOOKS:-**

1. General Microbiology, Stainer, R.Y., Ingraham, J.L., Wheelis, M.L. and Painter, P.R. 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 Lab. Manual in General Microbiology) Benson, H.J.WCB: Wm C.Brown Pub.
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

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**M.Sc. FIRST SEMESTER**  
**BIOTECHNOLOGY**  
**PAPER – II**  
**(Cell Biology)**

Total Marks: 100  
Internal assessment Marks: 20  
Term end Exam Marks: 80  
Minimum marks: 36

**Unit I:** Cell Theory; Structure and diversity of Prokaryotic and Eukaryotic cells; diversity of cell size and shape. Cellular organelles - Plasma membrane, cell wall & their structural organization; Mitochondria; Chloroplast; Other organelles and their organization. Cytoskeleton, Microtubules, Microfilaments, Cell junctions - Plasmodesmata, Gap junctions, Desmosomes, Adherence junctions.  
(Teaching 20 Hrs.)

**Unit II:** Nucleus; Nuclear Envelop and Nuclear pore. Chromatin concept - Euchromatin and heterochromatin, Histones, Nucleosome concept, Chromosome: Structure, types, staining, banding pattern and packaging of DNA. Cell Cycle: molecular events and model systems. Mitosis and Meiosis - Events and abnormalities; Biology of cancer; Programmed Cell Death - Apoptosis.  
(Teaching 20 Hrs.)

**Unit III:** Transport of nutrients, ions and macromolecules across membranes, active, passive and collateral transport. Receptor mediated Endocytosis. Cellular responses to environmental signals in plants and animals - mechanisms of signal transduction. Cell motility - cilia, flagella of eukaryotes and prokaryotes. Isolation of cells, microscopic techniques for study of cells.  
(Teaching 20 Hrs.)

**Unit IV:** Nucleic Acid: DNA - structure, different forms, coiling & super coiling; Replication of DNA - Nature, mechanism, process and experimental evidences. RNA - types structure, function and biosynthesis. Cellular basis of differentiation and development - mitosis, gametogenesis and fertilization. Development in Drosophila and Arabidopsis; Spatial and temporal regulation of Gene Expression.  
(Teaching 20 Hrs.)

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**TEXT BOOKS:-**

1. Gerald Karp - Cell and Molecular Biology 5<sup>th</sup> 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 6<sup>th</sup> Edition, Benjamin/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.

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**M.Sc. FIRST SEMESTER**  
**BIOTECHNOLOGY**  
**PAPER – III**  
**(Genetics & Cytogenetics)**

Total Marks: 100  
Internal assessment Marks: 20  
Term end Exam Marks: 80  
Minimum marks: 36

**Unit I:** Introduction to Genetics; Early studies involving genetics. Mendelian Genetics - Mendel's laws of inheritance. Back/Test Cross, Punnett square, Mono, Di & Trihybrid cross. Physical and chemical basis of Heredity, Genetic variation: Linkage - types, concept of coupling and repulsion. Interaction of gene - Complementary, Supplementary, Inhibitory & Duplicate gene; Epitaxis; Co dominance, Pseudo dominance & incomplete dominance; Inheritance: Autosomal and sex linked inheritance Plasmogene; Extra nuclear Inheritance, Concept of gene; Oligogenic & Polygenic dominance; multiple allele and quantitative inheritance. **(Teaching- 20 Hrs.)**

**Unit II:** Genetic variation: Chromosomal aberrations - deletion /deficiency, duplication, translocation and inversion - its origin, cytology, genetics and role in evolution. Complex translocation; Robertsonian & B-translocation. Aneuploidy and Euploidy - types, origin, interrelation; cytology and genetics of trisomy and polyploidy. Monoploidy & Haploidy; Role of polyploidy in evolution and crop improvement; Genetic disorder and Syndromes in human. Heterosis and Hybrid vigor. **(Teaching- 20 Hrs.)**

**Unit III:** Mutation; Types of mutations. Molecular basis of mutations; base pair substitution and frame shift mutations; Mutagens — Physical and chemical mutagens, Ames test; complementation test, Mutational Assay System. Mutation frequency; Role of mutation in evolution, diseases in human; DNA damage and repair mechanism. Population genetics; origin of new genes and species. Process of Speciation, Hardy-weinberg law / genetic equilibrium, genetic polymorphism and selection of mutants. **(Teaching- 20 Hrs.)**

**Unit IV:** Concept of Genome: Bacterial and viral genome. Bacterial Genetic system: Genetic recombination -Mechanism of Transformation, Conjugation, Transduction, Sexduction. Plasmids and Transposons, Retroposon & Retrotransposon. Genetic mapping- Phage genome, Bacterial genome map with reference to *E. coli*. Viruses and their Genetic system: Phage I and its life cycle; RNA phases; RNA viruses; Retroviruses, Genetic system of Yeast and Neurospora. **(Teaching- 20 Hrs.)**

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**TEXT BOOKS:-**

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

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**M.Sc. FIRST SEMESTER**  
**BIOTECHNOLOGY**  
**PAPER – IV**  
**(Biochemistry)**

Total Marks: 100  
Internal assessment Marks: 20  
Term end Exam Marks: 80  
Minimum marks: 36

**Unit I:** Scope and importance of Biochemistry, General concept of Bio molecules, chemical bonds (covalent & non covalent bonds), Chemical properties water molecules, stabilizing interaction (Vanderwaals, electrostatic, hydrogen bonding , hydrophobic interaction), essential microelements. Chemical foundations of Biology — pH, pKa, acids & bases, buffers. Principles of thermodynamics. Analytical techniques in biochemistry and biophysics for small molecules and macromolecules for quantization. **(Teaching- 20 Hrs.)**

**Unit II:** Carbohydrates: structure and classification; Monosaccharide, Disaccharide, Oligosaccharide and Polysaccharides — types, structural features, methods for compositional analysis. Metabolism (anabolism and catabolism) of carbohydrates- Calvin cycle, glycolysis, glycogenesis, gluconeogenesis, glycogenolysis, glyoxalate pathway, kreb cycle and electron transport chain. **(Teaching- 20 Hrs.)**

**Unit III:** Amino acids and peptides — classification, chemical reactions and physical properties and bio-synthesis of amino acids. Proteins - structure, classification and separation, purification and criteria of homogeneity, end group analysis, hierarchy in structure, primary, secondary tertiary and quaternary structure of protein. Ramachandran plot / map. Metabolism of proteins; Proteins of bio-membrane and nucleoprotein. **(Teaching 20 Hrs.)**

**Unit IV:** Fatty acids - types and properties, biosynthesis of fatty acids.. Lipids - classification, structure and functions. Metabolism of lipids: Synthesis of fats and oxidation of fats. Heterocyclic compounds and secondary metabolites in living systems — nucleotide: pigments, toxins, antibiotics. Vitamins - structure and function- types and its application. **(Teaching - 20 Hrs.)**

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**TEXT BOOKS:-**

1. Nelson and Cox – Principles of Biochemistry, 5th Edition (2009) Albert L. Lehninger – Biochemistry, Second Edition (2005).
2. Todd and Howards Mason – Text book of Biochemistry, Fourth Edition (2004).
3. 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
4. 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)

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M. Sc. FIRST SEMESTER

BIOTECHNOLOGY

PRACTICAL PAPER-I

(MICROBIOLOGY AND CELL BIOLOGY)

Total Marks: 100

Internal assessment Marks: 20

Term end Exam Marks: 80

1. Preparation of liquid and solid media for growth of microorganisms.
2. Isolation and maintenance of organisms by plating, streaking and serial dilution methods. Slants and stab cultures. Storage of microorganisms.
3. Isolation of pure culture from soil and water.
4. Growth; Growth curve; Measurement of bacterial population by turbidity and serial dilution methods. Effect of temperature, pH and carbon nitrogen sources on growth.
5. Microscopic examination of bacteria, yeast and molds and study of organisms by Gram stain, Acid fast stain and staining for spores.
6. Study of mutations by Ames test.
7. Assay of antibiotics and demonstration of antibiotics resistance.
8. Bacterial transformation.
9. Biochemical characterization of selected microbes.
10. One step growth curve of bacteria
11. To prepare the temporary stained slide of onion bulb peel to study the structure of plant cell.
12. To prepare the temporary stained slide of cheek squamous epithelial cells of mouth of Human Beings.
13. Preparation and Study of slide of mitosis using from onion root tips squash.
14. Schedule for study of mitotic index.
15. To determine the abnormal mitotic index.
16. Preparation and study of slide for meiosis using young anthers of *Allium cepa*.
17. To determine the meiotic index in the flower bud of *Allium cepa*.

Scheme of examination:

Lab performances	60 marks
Spotting	20 marks
Oral evaluation	10 marks
Sessional	10 marks

Total 100 marks

Provided period- 06 hr.

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**BIOTECHNOLOGY  
PRACTICAL PAPER-II  
(GENETICS, CYTOGENETICS AND BIOCHEMISRY)**

Total Marks: 100  
Internal assessment Marks: 20  
Term end Exam Marks: 80

1. Experiments for Mendel's experiments-

- Problems based on monohybrid and dihybrid cross
- mendel's law based problems
- problems based on sex linked 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

6. Qualitative test for Carbohydrate. (Molisch's test)

7. Qualitative test for Carbohydrate. (Anthrone test)

8. Qualitative test for Carbohydrate. (Benedict's test)

9. Qualitative analysis of Carbohydrate by Barfoed's test.

10. Qualitative test for amino acid by Ninhydrin reaction.

11. Qualitative test for amino acid by Xanthoprotic reaction.

12. Qualitative test for Proteins using Biuret test.

13. Qualitative test for amino acid by Millon's test.

**Scheme of Examination:**

Lab performances	60 marks
Spotting	20 marks
Oral evaluation	10 marks
Sessional	10 marks

Total

100 marks

Provided period- 06 hrs

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**M. Sc. SECOND SEMESTER  
BIOTECHNOLOGY  
PAPER – I  
(Biostatistics and Computer Basics & Application)**

Total Marks: 100  
Internal assessment Marks: 20  
Term end Exam Marks: 80  
Minimum marks: 36

**Unit I:** Concept and scope of Biostatistics. Statistical term, Sampling, data collection and presentation, Frequency distribution- central tendency (mean, median and mode), standard deviation, standard error. ANOVA, Concepts of Probability, Test of significance, Chi square-test, T-test Correlation and Regression.

(Teaching- 20 Hrs.)

**Unit II:** Basic concept of computer organization. Components of computer system; central processing unit, VDU, keyboard and mouse, input and output devices, computer memory. Generations of computer, concepts of hardware and software, Concept of file, folder and directories, commonly used command, flow chart and basic of operating system (windows, unix), Classification of computers and computer language. Flow charts and programming techniques

(Teaching- 20 Hrs.)

**Unit III:** Introduction to digital computers: Organization; low-level and high-level languages; binary number system. Word processing, Spreadsheets and presentation software. Introduction to software, MS-office (MS-word, Power point, Excel). Introduction to computer languages, basic ideas of internet, importance and requirement of internet. LAN, WAN, www. Electronic mailing, Chatting, Search engines, Websites and Web pages.

(Teaching- 20 Hrs.)

**Unit IV:** Application of Computers. Introduction to data structures and database concepts. Computer oriented statistical techniques: Frequency table of single discrete variable, Bubble sort. Computation of mean, variance and standard deviation. Applications of computers in the field of Biology; Protein structure prediction, drug designing, evaluation by ramachandran plot, domain and motifs. Cluster analysis; phylogenetic clustering by simple matching coefficient, sequence comparison

(Teaching- 20 Hrs.)

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**TEXT 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).

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**M. Sc. SECOND SEMESTER**  
**BIOTECHNOLOGY**  
**PAPER – II**  
**(Molecular Biology)**

Total Marks: 100  
Internal assessment Marks: 20  
Term end Exam Marks: 80  
Minimum marks: 36

**Unit I:** Introduction to Molecular Biology. DNA Replication — Prokaryotic and eukaryotic DNA replication, Mechanism of DNA replication. Enzymes and accessory proteins involved in DNA replication. DNA Repair and Recombination. Homologous recombination- Holiday junction, gel targeting, RecA and other recombinases. Transcription in Prokaryotic and Eukaryotes - RNA polymerase and transcription factors, Regulatory elements and mechanisms transcription regulation and inhibition. Modification in RNA, Splicing, Editing, Nuclear export mRNA, mRNA stability  
**(Teaching- 20 Hrs.)**

**Unit II:** Concept of Gene - Gene fine structure. Genetic code: Code deciphering, Code dictionary, Characteristic of genetic code. Translation - Prokaryotic and Eukaryotic translation, the translation machinery. Mechanisms of initiation, elongation and termination, Regulation of translation, co - and post - translational modifications of proteins. Protein Localization - Synthesis of secretory and membrane proteins, Import in nucleus, mitochondria, chloroplast and peroxisomes, receptor mediated endocytosis.  
**(Teaching- 20 Hrs.)**

**Unit III:** Regulation of gene expression, Operon concept, Positive and Negative regulation. Oncogenes and Tumor Suppressor Genes -Viral and cellular Oncogenes, suppressor genes from humans. Structure, function and mechanism of action of pRB and p53 tumor suppressor proteins. Antisense and Ribozyme technology- Molecular mechanism of Antisense molecules, inhibition of splicing, polyadenylation and translation, disruption of RNA structure a: capping, Biochemistry of ribozyme; hammer - head, hairpin and other ribozyme strategies for designing ribozymes, Applications of Antisense and ribozyme technology  
**(Teaching- 20 Hrs.)**

**Unit IV:** 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. Molecular markers in genome analysis: RFLP. RAPD and AFLP analysis, molecules markers linked to disease resistance genes, Application of RFLP in Forensic, disease prognosis, genetic counseling, Pedigree, varietal etc.  
**(Teaching- 20 Hrs.)**

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**TEXT BOOKS:-**

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

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**M. Sc. SECOND SEMESTER  
BIOTECHNOLOGY  
PAPER – III  
(Plant Biotechnology)**

Total Marks: 100  
Internal assessment Marks: 20  
Term end Exam Marks: 80  
Minimum marks: 36

**Unit I:** Introduction to cell and tissue culture, tissue culture as a technique to produce novel plants and hybrids. Tissue culture media (composition and preparation). Initiation and maintenance of callus and suspension culture; single cell clones. Organogenesis; somatic embryogenesis; transfer and establishment of whole plants in soil. Shoot — tip culture: Rapid clonal propagation and production of virus free plant. **(Teaching- 20 Hrs.)**

**Unit II:** Embryo culture and embryo rescue; Anther. pollen and ovary culture for production of haploid plants and homozygous lines; Protoplast isolation, culture and fusion; selection of hybrid cells and Regeneration of hybrid plants; symmetric and asymmetric hybrids, cybrids. Germplasm - collection, conservation — Cryopreservation and slow growth cultures. Centre of Germplasm conservation. Artificial seeds; Somatic hybridization. Micro-propagation. **(Teaching- 20 Hrs.)**

**Unit III:** Plant transformation technology: Basis of tumour formation, Mechanism of DNA transfer. Features of Ti and Ri plasmids, role of virulence genes, use of Ti and Ri as vectors, binary vectors, markers, use of reporter genes, 35S and other promoters, multiple gene transfers, particle bombardment, electroporation, microinjection. Chloroplast Transformation: vectors, advantages, limitations. 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. **(Teaching- 20 Hrs.)**

**Unit IV:** 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. DNA microarray. Labelling and detection of nucleic acid sequences: End-Labeling (3'- and 5'-), Random priming and Nick translation using radioactive non-radioactive labeling techniques. Biodegradable plastics, therapeutic proteins, antibodies. Edible Vaccines. Transgenic plants; genetically modified crops. **(Teaching- 20 Hrs.)**

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**TEXT BOOKS:-**

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

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**M. Sc. SECOND SEMESTER**  
**BIOTECHNOLOGY**  
**PAPER – IV**  
**(Macromolecules and Enzymology)**

Total Marks: 100  
Internal assessment Marks: 20  
Term end Exam Marks: 80  
Minimum marks: 36

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**Unit I:** Macromolecules and supra molecules assemblies Types of macromolecules in biological systems. Molecular assemblies like membranes. Ribosomes, Extracellular matrix, chromatin. Sequencing of proteins and nucleic acids. Conformational properties of polynucleotide and polysaccharides - secondary and tertiary structural features and their analysis - theoretical and experimental.

**(Teaching- 20 Hrs.)**

**Unit II:** Protein: protein and protein - ligand interactions, physical and chemical methods of study. Protein folding - biophysical and cellular aspects, Protein denaturation. Nucleic acid hybridization-structural and biological study. Nomenclature, classification, methods for determination of enzyme activity. Isolation and purification of enzymes. Enzyme kinetics: Michaelis - Menten equation, effect of pH, substrate concentration, temperature and inhibitors.

**(Teaching- 20 Hrs.)**

**Unit III:** Isoenzymes and allosteric enzymes. Enzyme inhibition- competitive and non-competitive inhibition. Enzyme catalysis in solution - kinetics and thermodynamic analysis, effects of organic solvents on enzyme catalysis and structural consequences. Physical and chemical methods for immobilization of enzyme. Glyco and lipoprotein - structure and function.

**(Teaching- 20 Hrs.)**

**Unit IV:** Action of ribonuclease, chymotrypsin, and trypsin. Coenzyme catalysis. Mechanism of action of thiamine pyrophosphate enzyme. Control and regulation of enzyme activity and feedback mechanisms. Metabolic compartmentalization in relation to enzyme, enzymes and secondary metabolites. Ribozymes and Catalytic antibodies- Functional proteins- structure and drug Targets. (Enzymes and receptors). Nucleic acid hybridization - structural and biological study.

**(Teaching- 20 Hrs.)**

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**TEXT BOOKS:-**

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

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M. Sc. SECOND SEMESTER

BIOTECHNOLOGY

PRACTICAL PAPER-I

(BIOSTATISTICS, COMPUTER BASICS & APPLICATION AND MOLECULAR BIOLOGY)

Total Marks: 100  
Internal assessment Marks: 20  
Term end Exam Marks: 80

1. Draw Histogram, Pie, Graph, Line graph.
2. Slide preparation
3. Use of Internet.
4. To perform spreadsheet application.
5. To perform image processing.
6. Computer based statistical tools.
7. Calculate the mean value of given sample.
8. Calculate the median of the given sample.
9. Find out the mode value of given sample
10. To complete correlation of leaf length & breadth of a given leaf sample.
11. To perform the t-test for the given data of sample. (Leaves)
12. To perform the Chi- Square test for the given data.
13. To calculate Standard deviation from the data (Sample).
14. Experiments based on probability.
15. Extraction of DNA from plant leaves by CTAB methods.
16. Estimation of plant genomic DNA by Spectrophotometer methods.
17. Separation of plant genomic DNA by Agarose gel electrophoresis.
18. Extraction of DNA from animal cells.
19. Estimation of animal genomic DNA by Spectrophotometer methods.
20. Separation of animal genomic DNA by Agarose gel electrophoresis.
21. Separation of Bacterial proteins by vertical SDS-PAGE electrophoresis.
22. Extraction of RNA from Yeast cells
23. Estimation of Yeast cellular RNA by Spectrophotometer methods

Scheme of examination:

Lab performances	60 marks
Spotting	20 marks
Oral evaluation	10 marks
Sessional	10 marks

Total 100 marks

Provided period- 06 hr.

Signature: Members of BOS

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M. Sc. SECOND SEMESTER

BIOTECHNOLOGY  
PRACTICAL PAPER-II

(PLANT BIOTECHNOLOGY AND MACROMOLECULES & ENZYMOLOGY)

Total Marks: 100  
Internal assessment Marks: 20  
Term end Exam Marks: 80

**Media preparation**

1. Meristem / bud culture, shoot multiplication & rooting
2. Organogenesis
3. Somatic embryogenesis
4. Plantlet acclimatization
5. Embryo culture
6. Anther culture
7. Extraction of DNA from plant
8. Estimation of plant DNA by Agarose gel electrophoresis and Spectrophotometer
9. Qualitative assay of Protein by the Biuret method.
10. To estimation of Protein Qualitatively by Folin Lowry Method.
11. Estimation of cholesterol by the method of Crawford
12. Determine the activity of Alkaline Protease.
13. Determine the activity of neutral Protease.
14. Effect of temperature on the activity of  $\alpha$ -amylase.
15. Determine the activity of catalase.
16. Determine the activity of urease.
17. Perform protein isolation by SDS PAGE.
18. Enzyme kinetics

**Scheme of Examination:**

Lab performances	60 marks
Spotting	20 marks
Oral evaluation	10 marks
Sessional	10 marks

Total 100 marks Provided period- 06 hrs

**Signature: Members of BOS**

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**M. Sc. THIRD SEMESTER**  
**BIOTECHNOLOGY**  
**PAPER – I**  
**(Immunology)**

Total Marks: 100  
Internal assessment Marks: 20  
Term end Exam Marks: 80  
Minimum marks: 36

**Unit I:** Introduction — Phylogeny of immune system, innate and acquired immunity, Clonal nature of immune response. Organization and structure of lymphoid organs. Cells of immune system — Haematopoiesis and differentiation, Lymphocyte trafficking, B — lymphocyte, T — lymphocyte, Macrophages, Dendritic cells, Natural Killer and lymphokine activated killer cells, Eosinophils, Neutrophils and Mast cells.

**(Teaching- 20 Hrs.)**

**Unit II:** Nature and biology of antigens and super antigens. Antibody structure and function; antibody engineering. Antigen — antibody interactions. Immunoglobulin - structure, heterogeneity, types and sub-types, properties (physico-chemical and biological); Immunoglobulin gene arrangement. Theories of antibody formation; monoclonal antibodies and their applications. Major histocompatibility complex, BCR & TCR. Complement system.

**(Teaching- 20 Hrs.)**

**Unit III:** 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. Cell-mediated cytotoxicity: Mechanism of T cell and NK cell mediated lysis, Antibody dependent cell mediated cytotoxicity, and macrophage mediated cytotoxicity. Hypersensitivity, Autoimmunity

**(Teaching 20 Hrs.)**

**Unit IV:** Transplantation: General concept and Application. Immunity to infectious agents (intracellular parasites, helminths and viruses), AIDS and other immune-deficiencies. Hybridoma Technology and Monoclonal antibodies. Immunological methods for their diagnosis. Complement components, pathways and complement deficiencies. ELISA and radio-immune assay. *In vivo* technique: skin tests and immune complex demonstration

**(Teaching 20 Hrs.)**

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**TEXT BOOKS:-**

1. J. Kuby – Immunology 5<sup>th</sup> Edition; W.H. Freeman and Company, New York 2003
2. Thomas J. Kindt, Barbara A. Osborne and Richard A. Goldsby – Immunology, 6<sup>th</sup> Edition; WH Freeman 2007
3. Peter Delves, Seamus Martin, Dennis Burton, Ivan Roitt - Roitt's Essential Immunology, 11<sup>th</sup> Edition; Wiley-Blackwell 2006
4. H.D. Kumar – Modern Concepts of Biotechnology 3<sup>rd</sup> 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

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**M.Sc. THIRD SEMESTER  
BIOTECHNOLOGY  
PAPER – II  
(Genetic Engineering)**

Total Marks: 100  
Internal assessment Marks: 20  
Term end Exam Marks: 80  
Minimum marks: 36

- Unit I:** Scope and applications of Genetic Engineering. Cloning and patenting of life forms. Genetic engineering guidelines. Molecular tools and their application: Restriction enzymes, modification enzymes. Molecular markers. Nucleic acid purification, yield analysis. Nucleic acid amplification and its applications - PCR and Cloning. **(Teaching - 20 Hrs.)**
- Unit II:** Gene cloning vectors: Plasmids, Bacteriophage, phagemids, cosmids, Artificial chromosomes (BAC, YAC). Restriction Mapping of DNA Fragments and Map Construction, cDNA synthesis and cloning: mRNA enrichment, reverse transcription. DNA primers, linkers, adaptors and their chemical synthesis, Library construction and screening. Alternative strategies of gene cloning: Cloning interacting genes -- Two and three hybrid systems. Nucleic acid, micro array assay. **(Teaching 20 Hrs.)**
- Unit III:** Site-directed mutagenesis and protein engineering. DNA 'transfection, Southern blot, Northern blot, Western blot, Primer extension. Si mapping, RNase protection assay, and reporter assays. Expression Strategies for heterologous genes: Vector engineering and codon optimization, host engineering; expression in bacteria, expression in Yeast, expression in insects and insect cells, expression in mammalian cells, expression in plants. Phage display: Technique and applications. **(Teaching- 20 Hrs.)**
- Unit IV:** Processing of recombinant Proteins: Purification and refolding, characterization of recombinant proteins, stabilization of proteins. T-DNA and transposon tagging: Role of gene tagging in gene analysis, identification and isolation of genes through T -DNA or transposon/t-element; Targeted gene replacement. Chromosome engineering. Gene therapy: Vector engineering. Strategies of gene delivery - Viral & non-viral, gene knockout, gene augmentation, gene correction / gene editing, gene regulation and silencing. **(Teaching- 20 Hrs.)**

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**TEXT BOOKS:-**

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

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**M.Sc. THIRD SEMESTER  
BIOTECHNOLOGY  
PAPER – III  
(Industrial Biotechnology)**

Total Marks: 100  
Internal assessment Marks: 20  
Term end Exam Marks: 80  
Minimum marks: 36

- Unit I:** Introduction to Industrial Biotechnology, Fermentation technology Bioprocess Engineering. Kinetic of microbial growth and death Isolation, Microorganisms of industrial importance. Strategies for selection, improvement & maintenance .Large-scale production using recombinant microorganisms. Preservation and Maintenance of industrial Microorganisms. Media for industrial fermentation. Methods of sterilization. Air and Media Sterilization. **(Teaching- 20 Hrs.)**
- Unit II:** 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). Measurement and control of bioprocess parameters. Batch kinetics – Monod’s model (single substrate), substrate inhibition, toxic inhibition. Fed-batch kinetics – fixed volume, variable volume and cyclic fed-batch and its applications with examples. **(Teaching 20 Hrs.)**
- Unit III:** 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, Mitten treatment: D.O.C. and C.O.D. treatment and disposal of effluents. Whole cell Immobilization and their industrial applications. **(Teaching- 20 Hrs.)**
- Unit IV:** 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. Introduction to food technology: Elementary idea of canning and packing, Sterilization and pasteurization, of food products, technology of typical food products (bread, cheese. idli), Food preservation. **(Teaching- 20 Hrs.)**

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**TEXT 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 7<sup>th</sup> Edition; Wiley-Blackwell 2008
4. Damien and Devies – Microbial Technology Edition (1994).
5. LE Casida – Industrial Microbiology Edition (1994)
6. H Patel – Industrial Microbiology 4<sup>th</sup> Edition (2003).
7. KS Bilgrami and AK Pandey – Introduction to Biotechnology Edition 2<sup>nd</sup> (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

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**M.Sc. THIRD SEMESTER  
BIOTECHNOLOGY  
PAPER – IV  
(ENVIRONMENTAL BIOTECHNOLOGY)**

Total Marks: 100  
Internal assessment Marks: 20  
Term end Exam Marks: 80  
Minimum marks: 36

- Unit I:** Environment: Basic concepts and issues. Environmental Pollution: Types of pollution, Methods for the measurement of pollution, Methodology of environmental management - the problem solving approach, limitations. Air & Sound pollution and its control through Biotechnology. Role of Biotechnology in Environmental monitoring, pollution detection & control and environment protection. **(Teaching 20 Hrs.)**
- Unit II:** 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. Microbiology of waste water treatments, aerobic process: Activated sludge, oxidation ditches, trickling filter, towers, rotating discs, rotating drums, oxidation ponds. Anaerobic process: Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanket reactors. **(Teaching 20 Hrs.)**
- Unit III:** Treatment schemes for waste waters of dairy, distillery, tannery, sugar, antibiotic industries. Bioremediation. Xenobiotics in Environment — Ecological considerations, oil pollution, surfactant pesticides. Biodegradation of Cellulose, lignin and Hydrocarbon (Superbug). Biodeterioration of petroleum products and Jet fuel oil. GMO and their Impact. **(Teaching 20 Hrs.)**
- Unit IV:** Biopesticides in integrated pest management. Solid wastes: Sources and management (composting, wormi-culture and methar production). Global Environmental Problems: Ozone depletion, UV- B, Green house effect and acid rain, their impact and biotechnological approaches for management. Role of National organization in Biotechnology. IPR- Patent, Trademark copyright, GI, Breeder's Right, Trade secrets . **(Teaching 20 Hrs.)**

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**TEXT BOOKS:-**

1. Gareth G. Evans, Judy Furlong - Environmental Biotechnology: Theory and Application 2<sup>nd</sup> 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 reprinting Edition (2003), Vikas Publishing House. Pvt. Ltd.
7. B.D. Singh – Biotechnology: Expanding Horizons, 1<sup>st</sup> Edition (2004). Kalyani Publishers.
8. Alan Scragg – Environmental Biotechnology First Edition, reprinted (2005). Oxford University Press.

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M. Sc. THIRD SEMESTER

BIOTECHNOLOGY

PRACTICAL PAPER-I

(IMMUNOLOGY AND GENETIC ENGINEERING)



Total Marks: 100

Internal assessment Marks: 20

Term end Exam Marks: 80

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 Immuno-electrophoresis.
10. Observe Ag-Ab interaction by counter current Immuno-electrophoresis.
11. Study of Agglutination reaction
12. Study of ELISA technique.
13. Immuno-diffusion test.
14. Blood group determination by slide agglutination reaction.
15. Extraction of DNA from *E.coli*.
16. Estimation of bacterial DNA by Spectrophotometer method.
17. Separation of bacterial genomic DNA by Agarose gel electrophoresis.
18. Hot phenol method for preparation of total cellular RNA from *E.coli*.
19. Estimation of cellular RNA by Spectrophotometer methods.
20. Restriction digestion of DNA with restriction enzymes.
21. Ligation of DNA
22. Isolation of plasmid DNA from *E.coli*.
23. DNA amplification by PCR
24. Introduction of recombinant DNA to the host.
25. Screening of transformed colony.

Scheme of examination:

Lab performances	60 marks
Spotting	20 marks
Oral evaluation	10 marks
Sessional	10 marks

Total 100 marks

Provided period- 06 hr.

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M. Sc. THIRD SEMESTER

BIOTECHNOLOGY  
PRACTICAL PAPER-II  
(INDUSTRIAL BIOTECHNOLOGY AND ENVIRONMENTAL BIOTECHNOLOGY)

Total Marks: 100  
Internal assessment Marks: 20  
Term end Exam Marks: 80

1. To determine the total dissolved solids of water.(TDS)
2. Determination of Dissolved oxygen (DO) of water.
3. Determination of chemical oxygen demand (COD) of water.
4. Determination of biochemical oxygen demand (BOD) of water.
5. To screen the antagonism between two microorganisms.
6. Determination of effect of fungicide on the growth of fungi.
7. Effect of fungicide on the antagonism between two microorganisms.
8. To determine the Most Probable number (MPN) of a given water sample.
9. Isolation and identification of microorganisms from industrial waste water.
10. Determination of thermal death point (TDP) and thermal death time (TDT) of microorganism (Bacteria and Fungi).
11. To study the production of citric acid by *Aspergillus niger* and also qualitative and quantitative test.
12. To study the bacterial growth curve.
13. To study the fungal growth curve.
14. Bio-ethanol production

Scheme of Examination:

Lab performances	60 marks	
Spotting	20 marks	
Oral evaluation	10 marks	
Sessional	10 marks	
Total	100 marks	Provided period- 06 hrs

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**M. Sc. FOURTH SEMESTER**  
**BIOTECHNOLOGY**  
**PAPER – I**  
**(Bioinformatics, Genomics and Proteomics)**

Total Marks: 100  
Internal assessment Marks: 20  
Term end Exam Marks: 80  
Minimum marks: 36

**Unit I:** Bioinformatics: Introduction, History, Scope of Bioinformatics, Biotechnology and Bioinformatics, BTIS network in India, Sequence and Nomenclature, Application of Bioinformatics. 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. **(Teaching- 20 Hrs.)**

**Unit II:** Bioinformatics software tools- BLAST, MMDB, VAST, PDB Chemo-informatics, Pharmacogenomics, Genomic mapping, Microarray technology, Bioinformatics in Drug discovery, Human Genome Project Methods of gene sequencing: - Random shotgun sequencing, EST. Whole genome shotgun sequencing, Genome prediction and gene counting, Single nucleotide polymorphisms (SNPs). **(Teaching 20 Hrs.)**

**Unit III:** 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, The impact of genomics on medicine. Comparative Genomics: Sequence comparison, Comparative genomics in bacteria, Comparative genomics in Eukaryotes & organelles. **(Teaching 20 Hrs.)**

**Unit IV:** Proteomics – General concept, Gene and Protein, Types of proteomics, Structural proteomics and Functional proteomics. Methods of study the protein, Protein arrays, protein chips, System biology, Practical application of proteomics. Future of proteomics, Analysis of protein structure, Protein-Protein interactions, Protein database, Global analysis of protein, Expression analysis and characterization of protein **(Teaching 20 Hrs.)**

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

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M.Sc. FOURTH SEMESTER  
BIOTECHNOLOGY  
PAPER – II  
(Animal Biotechnology)

Total Marks: 100  
Internal assessment Marks: 20  
Term end Exam Marks: 80  
Minimum marks: 36

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**Unit I:** Scope of animal biotechnology, Methods of transferring genes- physical, chemical and biological methods. Animal cell: Structure and organization. Equipments and materials for animal cell culture. Primary and established cell line cultures. Constituents of culture media and their application. Application of animal cell culture  
(Teaching- 20 Hrs.)

**Unit II:** Biology and characterization of the cultured cells, measuring parameters of growth. Basic techniques of mammalian cell culture *in vitro*; disaggregating of tissue and primary culture; maintenance of cell culture; cell separation Scaling - up of animal cell culture. Cell synchronization: Cell growth stages; Cell cloning: Basic techniques for cell cloning; Cell transformation: Characteristics of transformed cells  
(Teaching 20 Hrs.)

**Unit III:** History of stem cells. Preparation and applications of embryonic, adult and umbilical cord blood stem cells. Stem cell differentiation and transplantation. 3D tissue culture and their application. Stem cell cultures, embryonic stem cells and their applications. Bioethics and stem cell research. Cell culture based vaccines: General introduction, Vaccines for Malaria and AIDS. Somatic cell genetics.  
(Teaching 20 Hrs.)

**Unit IV:** Transgenic animals: Mice, Sheep, Birds and Fish; Apoptosis. Tissue engineering: Elementary idea of tissue engineering, Artificial skin, artificial cartilage. Transgenic animals as models for neurodegenerative disorders, carcinogenesis and hypertension. Assisted reproduction biotechnology: Artificial insemination and embryo transfer. Ethical issues in relation to animal biotechnology  
(Teaching 20 Hrs.)

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**TEXT 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. Expanding Horizons. First Edition. Kalyani Publishers, Ludhiana.
6. U. Satyanarayana (2005) Biotechnology. Books and Allied (P) Ltd., Kolkata.

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## M.Sc. FOURTH SEMESTER

### BIOTECHNOLOGY

### PAPER – III

#### (Advanced Bio-techniques and Nanotechnology)

Total Marks: 100  
Internal assessment Marks: 20  
Term end Exam Marks: 80  
Minimum marks: 36

**Unit I:** Principles and application of: Microscopy, Centrifugation, Chromatography, Electrophoresis, HPLC. RIA and autoradiography in biology, ELISA; 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, chemoheterotrophs and photosynthetic microorganisms.

(Teaching 20 Hrs.)

**Unit II:** Principles and application of: Colorimetry, Spectrophotometry and densitometry; Principles and application of DNA microarray; Fluorescence spectroscopy; NMR and X-ray diffraction; Principles and application of Thermo-cycler. Principles and application of Cytophotometry; Flow cytometry; Southern, Northern, and Western Blotting. DNA sequencer

(Teaching 20 Hrs.)

**Unit III:** Diagnosis of inherited diseases- Karyotyping, DNA based diagnosis - PCR, protein and enzyme markers. Prenatal diagnosis of genetic diseases - Amniocentesis, Chorionic villus sampling, Fetoscopy, Percutaneous umbilical cord blood sampling. Population screening, carrier detection and genetic counselling, consanguinity in human population. Application of biotechnology in healthcare.

(Teaching 20 Hrs.)

**Unit IV:** Nanobiotechnology: General Introduction, Nanotechnology and Nanobiotechnology; Nanoscale; Nano-microorganisms-Nanovirus, Nanobacteria; Application of Nanobiotechnology -in the field of Nanomedicine; Bionanotechnology; Industry and Agriculture.

(Teaching 20 Hrs.)

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#### TEXT BOOKS:-

1. K. Wilson and J. Walker: Principle and Techniques of Biotechnology and Molecular Biotechnology.
2. Upadhyaya and Upadhyaya: Biophysical Chemistry.
3. David, L. Nelson and Michael, M. Cox: Lehninger: Principles 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. Sandra J. Rosenthal, David W. Wright (2005) Nanobiotechnology Protocols. Humana Press Inc. 999 Riverview Drive, Suite, 208, Totowa, New Jersey.
7. PC Trivedi (2008) Nanobiotechnology; Pointer Publishers

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**M.Sc. FOURTH SEMESTER  
BIOTECHNOLOGY  
PAPER – IV  
(Research Methodology, Bioethics and IPR)**

Total Marks: 100  
Internal assessment Marks: 20  
Term end Exam Marks: 80  
Minimum marks: 36

**Unit -I: Computer application and Biostatistics in Research:**

Using formulas and functions, Data storing, Features for Statistical data analysis, Generating charts / graph and other features, Tools – Microsoft Excel and Power Point. Use of Internet, WWW; Use of search engines, Biological data bases. Data collection & Tabulation, Presentation - graph, bar diagram and pie diagram. Measures of Central tendency and Dispersion. Probability distribution. Use of Statistics in Biosciences, Use of Computers in Quantitative analysis.

**(Teaching 20 Hrs.)**

**Unit- II: Scientific Writing::**

An Insight into Research: Definition and basic concepts, objectives, significance and techniques of research, finding research materials – literature survey, compiling records. Definition and kinds of scientific documents – research paper, review paper, book reviews, theses, conference and project reports (for the scientific community and for funding agencies). Components of a research paper– the IMRAD system, title, authors and addresses, abstract, acknowledgements, references, tables and illustrations.

**(Teaching- 20 Hrs.)**

**Unit-III:** Introduction. Definitions. General Agreement on Trade and Tariff (GATT) and World Trade Organizations. Establishment and functions of GATT, WTO and WIPO. WTO Guidelines and Summits. Physical and Intellectual Property. Roles of IBSC, RCGM and GEAC. TRIPS. Different types of intellectual property rights (IPR) - Patents, Trade mark, Trade secret, Copy right with Biotechnological examples and Geographical Indications. Requirement of patentability. Compulsory licences.

**(Teaching- 20Hrs.)**

**Unit-IV:** Bioethics-Introduction. Animal Rights. General issues related to environmental release of transgenic plants, animals and microorganisms. Ethical issues related to research in embryonic stem cell cloning. Ethical, Legal and Social Implications (ELSI) of Human Genome Project. Different levels of Biosafety. Guidelines for rDNA research activities. General guidelines for research in transgenic plants, Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).

**(Teaching 22 Hrs.)**

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**SUGGESTED BOOK:**

1. Biostatistics : A foundation for Analysis in the Health Sciences 7/E Wayne W.Daniel, Wiley Series in Probability and Statistics.
2. Introductory Statistics. Fifth Edition.(2004) Prem S. Mann.John Wiley and Sons(ASIA) Pvt. Ltd.
3. Bioinformatics Methods and Applications Genomics, Proteomics, and DrugDiscovery (S. C. Rastogi, N. Mendiratta, and P. Rastogi).
4. Introduction to Bioinformatics, (Atwood, T. K. and Parry-Smith, D. J).
5. Deepa Goel and Shomini Parashar, IPR, Biosafety and Bioethics (2013), 1st Edition, Pearson Education, India
6. Research Methodology

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# M. Sc. FOURTH SEMESTER

## BIOTECHNOLOGY

### PRACTICAL PAPER-I

(BIOINFORMATICS, GENOMICS AND PROTEOMICS, ANIMAL BIOTECHNOLOGY AND  
ADVANCED BIO-TECHNIQUES AND NANOTECHNOLOGY)

Total Marks: 100  
Internal assessment Marks: 20  
Term end Exam Marks: 80

1. To extract protein / nucleotide database of phosphoprotein P of [Swine parainfluenza virus 3]
2. To find out and study the human nucleotide sequence records associated with cancer
3. To find out the location of particular target gene on human chromosome map
4. To study sequence alignment through BLAST
5. To study multiple sequence alignment
6. To find out protein modelling through MMDB.
7. To study how to develop primer (F+R) from given nucleotide sequences
8. Study of whole genome of virus using database.
9. Comparative study of gene in different organism to find orthologue or paralogue.
10. Study of structure of protein (XRD, NMR) using databases.
11. Study of EST, SNP, UTR, ORF.
12. Extraction and estimation of DNA from blood
13. Extraction and estimation of DNA from spleen
14. Extraction and estimation of DNA from muscle tissue
15. Cell viability test
16. Blood cell - smear formation and staining
17. Separation of serum and plasma from blood.
18. Preparation of different culture media for culture of various microorganisms, like – Bacteria, Fungi, Yeast.
19. Perform the various culture techniques for microbial culture
20. Perform various laboratory techniques-
21. centrifugation- Normal and ultracentrifugation
22. chromatography- paper, TLC, Ion exchange chromatography
23. spectrophotometry,
24. electrophoresis- agarose gel, acrylamide gel
25. Pure culture techniques of microbes from various sources
26. Perform the advance biotechnological techniques, like –ELISA, PCR, Southern blotting, SDS PAGE etc.

*Note: Experimental task may be shorted by the department accordingly*

#### Scheme of examination:

Lab performances	60 marks
Spotting	20 marks
Oral evaluation	10 marks
Sessional	10 marks
Total	100 marks

Provided period- 06 hr.

Signature: Members of BOS

*Rashmi* *[Signature]* *[Signature]* *[Signature]*