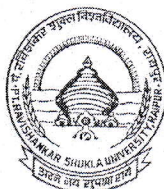


SCHOOL OF STUDIES IN BIOTECHNOLOGY

Pt. Ravishankar Shukla University
Raipur 492 010, Chhattisgarh



Syllabus

BIOTECHNOLOGY

M. Sc.
(Semester System)

Session

2019-2020

2020-2021

Meetalika
28/12/18

P. Prakash
28/12/18

S. S. Sanyal
28/12/18

Devsingh
28/12/18

M. M. Mishra
28/12/18

A. Mukherjee
28/12/18

SCHEME OF EXAMINATION FOR SESSION 2019-2021				
SCHOOL OF STUDIES IN BIOTECHNOLOGY				
PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR				
M. Sc. BIOTECHNOLOGY (Semester I to IV)				
July 2019 – December 2019				
First Semester	Paper	Title of Paper	Marks	
			(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 2020 – June 2020				
Second Semester	Paper	Title of Paper	(External)	(Internal)
	5	Biostatistics, Bioinformatics & Computers 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 2020 – December 2020				
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 2021 – June 2021				
Fourth Semester	Paper	Title of Paper	(External)	(Internal)
	13	IPR, Biosafety, Bioethics and Nanobiotechnology	80	20
	14	Advanced techniques in Biotechnology	80	20
	15	Animal Biotechnology	80	20
	16	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	

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*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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School of Studies in 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

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School of Studies in Biotechnology

Semester I

Paper 1: Cell Biology

M.M.80

Unit-I

1. Cell theory
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; Cell inclusions like endospores, gas vesicles.
3. Diversity of cell size and shape; diversity in prokaryotic and eukaryotic cells.

Unit-II

1. Eukaryotic cells: cell wall; plasma membrane; endoplasmic reticulum; golgi apparatus; lysosome; peroxisome; ribosome; mitochondria; chloroplast; nucleus; nucleolus; chromosome.
2. Transport of nutrients and macromolecules: osmosis; ion channels; ion pumps; active transport; protein diffusion, nuclear transport; transport across membranes; molecular mechanisms of transport; regulation of intracellular transport; intracellular vesicular trafficking.

Unit-III

1. Mitosis, meiosis and their regulation; steps in cell cycle; regulation of cell cycle; cell-cell interactions.
2. Cell signalling: cellular receptors; signalling through G-protein coupled receptors; signal transduction pathways; second messengers; regulation of signalling pathways.
3. Cell motility: cilia and flagella of eukaryotes and prokaryotes.

Unit-IV

1. Production of gametes; cell surface molecules in sperm-egg interaction in animals; molecular events during fertilization in animals, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis.
2. Development in *Drosophila* and *Arabidopsis*; gene expression and its regulation. 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 (2007) Cell and Molecular Biology. Fifth Edition.
2. Geoffrey M. Cooper; Robert E. Hausman (2009) The Cell: A Molecular Approach.
3. E. J. Ambrose and Dorothy M. Easty (1977) Cell Biology. Second Edition
4. C.B. Powar (2005) Cell Biology. Third Edition.
5. Tortora, Funke and Case (1998) Microbiology: An introduction. Sixth Edition
Benjamin/Cummings Publishing Co.
6. Lewis J. Klein smith and Valerie M. Kish (2002) Principles of cell and molecular biology.
Third Edition.
7. P. K. Gupta (2003) Cell and molecular biology. Second Edition, Rastogi publications.
8. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2008). Molecular
Biology of the Cell (5th Ed.). New York: Garland Science.
9. Lodish, H. F. (2016). Molecular Cell Biology (8th Ed.). New York: W.H. Freeman.
10. Cooper, G. M., & Hausman, R. E. (2013). The Cell: a Molecular Approach (6th Ed.).
Washington: ASM ; Sunderland.
11. Watson, J. D. (2008). Molecular Biology of the Gene (5th ed.). Menlo Park, CA:
Benjamin/Cummings.

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 to Phenotype – Interactions between the Alleles of one gene, interfering gene interaction.
4. 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. Mutation; Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. Changes in Chromosome number and structure - Euploidy and Aneuploidy, mutagens – UV and chemical mutagens, Ames test; Dosage compensation; Mutational Assay System.
3. 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; Polygenic inheritance, Locating genes, QTL mapping
3. Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.

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.
4. Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants.

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. Benjamin Pierce (2017) Genetics: A Conceptual Approach. Sixth Edition, W. H. Freeman
2. Griffiths, William M. Gelbart, Jeffrey H. Miller, Richard C. Lewontin and Anthony J.F. Griffiths (2009) Modern Genetic Analysis. W. H. Freeman
3. D. Peter Snustad, Michael J. Simmons (2007) Principles of Genetics. Wiley India Pvt Ltd.
4. Sandy Primrose and Richard Twyman (2016) Principles of Gene Manipulation and Genomics. Wiley-Blackwell

List of Practical's:-

1. Experiments for Mendel's experiments.
2. Studies of prokaryotic & eukaryotic cells.
3. Karyo-type studies.
4. To Performance and study of Mutation in bacteria.
5. To study polyploidy in onion root tips after treatment with colchicine.
6. To demonstrate Barr body in neutrophils by staining human blood smear.
7. Isolation of genetic material from Bacteria.

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School of Studies in Biotechnology

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. 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.

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, chemoheterotrophs and photosynthetic microorganisms.
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; Spirilla; Spirochaetes; Pseudomonads; Lactic and propionic acid bacteria; Endospore forming rods and cocci; Mycobacteria; Chlamydia's and Mycoplasmas.
2. Archaea: Archaea as earliest life forms; Halophiles; Methanogens; Hyperthermophilic Archaea; Thermoplasma.
3. Algae, Fungi, Slime moulds and Protozoa. Viruses: Bacterial, Plant and Animal viruses; Discovery, classification and structure of viruses; Lysogeny; DNA viruses; RNA viruses; Examples of Herpes, Pox, Adenoviruses, Retroviruses.

Unit IV

1. Microbial diseases –Infectious disease transmission; Sexually transmitted diseases including AIDS; Diseases transmitted by animals (rabies, plague), insects and ticks (Rickettsias, Lyme disease)
2. Host – Parasite Relationships – Normal microflora of Skin, Oral cavity, Gastrointestinal tract; Types of toxins (Exo -, Endo -, Entero -); 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.

Books:

1. Roger Y. Stanier, John L Ingraham, Mark L Wheelis, Rage R Painter (1992) General Microbiology. Fifth edition. The Macmillan Press Ltd.
2. Michael T. Madigan, John Martinko, Jack Parker Brock Biology of Microorganisms. Tenth edition, Prentice-Hall.
3. Pelczar, M.J. Jr., Chan, E.C.S. and Kreig, N.R. (2009) Microbiology. Tata McGraw Hill
4. Maloy, S.R., Cronan, J.E. Jr. and Freifelder, D. Jones (1994) Microbial Genetics. Second edition, Bartlett Publishers.
5. James G. Cappuccino, Natalie Sherman (1996) Microbiology: A Laboratory Manual. Benjamin-Cummings Pub Co.
6. Lansing Prescott, John Harley, and Donald Klein (2001) Microbiology. Fifth edition. McGraw Hill
7. Tortora, Funke and Case (2016) Microbiology. Tenth Edition, Pearson Education.
8. L Y Kun (2003) Microbial Biotechnology: Principles and applications, Microbiology and Environmental Toxicology, Sharad Saxenda, Published by Manglam Publications.
9. Willey, J. M., Sherwood, L., Woolverton, C. J., Prescott, L. M., & Willey, J. M. (2011). Prescott's Microbiology. New York: McGraw-Hill.
10. Matthai, W., Berg, C. Y., & Black, J. G. (2005). Microbiology, Principles and Explorations. Boston, MA: John Wiley & Sons.
11. Lee, Y. K. (2013). Microbial Biotechnology: Principles and Applications. Hackensack, NJ: World Scientific.

List of Practical's:-

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, staining for spores and lactophenol cotton blue mount.
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 and living system.

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.

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. Nelson and Cox (2009) Principles of Biochemistry. Fifth Edition.
2. Albert L. Lehninger (2005) Biochemistry. Second Edition.
3. Todd and Howards Mason (2004) Text book of Biochemistry. Fourth Edition.
4. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer (2007) Biochemistry, Sixth Edition
5. Voet D, Voet JG & Pratt CW (2006) Fundamentals of Biochemistry Second Edition. Wiley.
6. Robert K. Murray, David A Bender, Kathleen M. Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil (2007) Harper's Illustrated Biochemistry, 28th Edition.
7. Buchanan, Grissemen & Jones (2015) Biochemistry & Molecular Biology of Plant, 2nd edition.
8. M. Debnath (2011) Tools and Techniques in Biotechnology.

List of Practical's:-

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

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Lab. Course 1

Based on Theory Papers 1 and 2

Time: 6 hrs.

Total Marks – 100

Q.1 Experiment based on Theory paper 1 (one major & one minor)	30
Q.2 Experiment based on Theory paper 2. (One major & one minor)	30
Q.3 Spotting based on Theory paper 1 and 2	10
Q.4 <i>Viva Voce.</i>	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 <i>Viva Voce.</i>	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, Bioinformatics & Computers 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, Bioinformatics & Computers 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 tests), chi – square test.

Unit III

1. Introduction to Word processing, Spreadsheets and Presentation software.
2. Computer – Oriented statistical techniques: Frequency table of single discrete variable, Bubble sort, Computation of mean, variance and standard deviation.

Unit IV

1. Bioinformatics basics: Computers in biology and medicine.
2. Protein and nucleic acid databases; Biological background for sequence analysis.
3. Identification of protein sequence from DNA sequence; searching of databases similar sequence; NCBI; publicly available tools; database mining tools.
4. BTIS network in India.

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. Animesh K. Dutta (2007) Basic Biostatistics and Its Application. New Central Book Agency (P) Ltd. Kolkata.
2. P.K. Banerjee (2006) Introduction to Biostatistics. 3rd edition. 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).
7. David W. Mount (2004) Bioinformatics: sequence and genome analysis; CSHL press
8. C.S.V. Murthy (2003) Bioinformatics. First Edition, Himalaya Publishing House.
9. Johnathan Pevsner (2015) Bioinformatics and Functional, 3rd edition.
10. Rosner, B. (2000). Fundamentals of Biostatistics. Boston, MA: Duxbury Press.
11. Lesk, A. M. (2002). Introduction to Bioinformatics. Oxford: Oxford University Press.
12. Mount, D. W. (2001). Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
13. Baxevanis, A. D., & Ouellette, B. F. (2001). Bioinformatics: a Practical Guide to the Analysis of Genes and Proteins. New York: Wiley-Interscience.
14. Pevsner, J. (2015). Bioinformatics and Functional Genomics. Hoboken, NJ.: Wiley-Blackwell.
15. Bourne, P. E., & Gu, J. (2009). Structural Bioinformatics. Hoboken, NJ: Wiley-Liss.

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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. Draw Histogram, Pie, Graph, Line graph.
2. Slide preparation.
3. Use of Internet in Research.
4. Perform spreadsheet application.
5. Compute statistical tools.

Bioinformatics

1. Search nucleotide sequence of a target gene on NCBI website and BLAST it.
2. Find out amino acid sequence of a particular protein from protein database available on public domain and compare it with other proteins.

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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.

Unit II

1. Transcription – Prokaryotic transcription: RNA polymerase, Regulatory elements and mechanisms of transcription regulation, Transcription termination.
2. 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 III

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 IV

1. Oncogenes and Tumor Suppressor Genes – Viral and cellular Oncogenes, tumor suppressor genes from humans, Structure, Function and mechanism of action of pRB and p53 tumor suppressor proteins.
2. 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.
3. 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.

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 (2007) Cell and molecular biology, 5th Edition.
2. Lewis J. Klein smith and Valerie M. Kish (2002) Principles of cell and molecular biology, Third Edition.
3. Richard M. Twyman (1998) Advanced Molecular Biology, First South Asian Edition, Viva Books Pvt. Ltd.
4. Benjamin Lewin (2007) Gene IX, 9th Edition, Jones and Barlett Publishers.
5. J.D. Watson, N.H. Hopkins, J.W Roberts, J. A. Seitz & A.M. Weiner (2007) Molecular Biology of the Gene, 6th Edition, Benjamin Cummings Publishing Company Inc.
6. TA Brown (2002) Genomes 2nd Edition; Bios Scientific Publishers.
7. Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, Hidde Ploegh and Paul Matsudaira (2008) Molecular Cell Biology, 6th Edition; WH Freeman.
8. Buchanan, Gruissemen & Jones (2015) Biochemistry & Molecular Biology of Plant, 2nd edition.
9. M. Debnath (2011) Tools and Techniques in Biotechnology.
10. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2008). Molecular Biology of the Cell (5th Ed.). New York: Garland Science.
11. Lodish, H. F. (2016). Molecular Cell Biology (8th Ed.). New York: W.H. Freeman.
12. Cooper, G. M., & Hausman, R. E. (2013). The Cell: a Molecular Approach (6th Ed.). Washington: ASM ; Sunderland.

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, long shelf-life of fruits and flowers, male sterile lines, bar and barnase systems.

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.

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Books:-

1. Razdan MK (2010) Introduction to Plant Tissue Culture 2nd Edition; Oxford & Ibh Publishing Co. Pvt Ltd.
2. Vasil IK (1994) Plant Cell and Tissue Culture; Springer.
3. Bhojwani SS and Razdan MK(1996) Plant Tissue Culture; Elsevier.
4. TJ Fu, G Singh and WR Curtis (Eds) (1999) Plant Cell and Tissue Culture for the production of Food Ingredient. Kluwer Academic/Plenum Press.
5. J Hammond, P McGarvey & V Yusibov (Eds)(2000) Plant Biotechnology, Springer Verlag.
6. H.S. Chawla (1998) Biotechnology in Crop Improvement, International Book Distributing Company.
7. H.S. Chawla (2000) 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
11. Slater, A., Scott, N. W., & Fowler, M. R. (2008). Plant Biotechnology: an Introduction to Genetic Engineering. Oxford: Oxford University Press.
12. Glick, B. R., & Pasternak, J. J. (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA. Washington, D.C.: ASM Press.
13. Brown, T. A. (2006). Gene Cloning and DNA Analysis: an Introduction. Oxford: Blackwell Pub.
14. Primrose, S. B., & Twyman, R. M. (2006). Principles of Gene Manipulation and Genomics. Malden, MA: Blackwell Pub.

List of Practical's:-

1. Media preparation
2. Meristem / bud culture, shoot multiplication & rooting
3. Callus culture
4. Organogenesis
5. Somatic embryogenesis
6. Plantlet acclimatization
7. Embryo culture
8. Extraction of DNA from plant
9. Estimation of plant DNA by Agarose gel electrophoresis and Spectrophotometer
10. Study of molecular markers

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School of Studies in Biotechnology

Semester II

Paper 8: Macromolecules and Enzymology

M.M. 80

Unit I

1. Macromolecules and supra molecules assemblies – Types of macromolecules in biological systems,
2. Molecular assemblies like membranes, ribosomes, extracellular matrix, chromatin
3. 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 polynucleotides 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. Protein denaturation
2. Ribozymes and Catalytic antibodies – Functional proteins – structure and drug targets (enzymes and receptors)
3. Nucleic acid hybridization – structural analysis and biological study.

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. Nelson and Cox (2009) Principles of Biochemistry, 5th Edition.
2. Albert L. Lehninger(2005) Biochemistry, Second Edition.
3. Todd and Howards Mason (2004) Text book of Biochemistry, Fourth Edition.
4. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer (2007) Biochemistry, 6th Edition.
5. Voet D, Voet JG & Pratt CW (2006) Fundamentals of Biochemistry, 2nd Edition. Wiley
6. Robert K. Murray, David A Bender, Kathleen M. Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil (2007) Harper's Illustrated Biochemistry, 28th Edition
7. M. Debnath (2011) Tools and Techniques in Biotechnology.

List of Practical's:-

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

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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 <i>Viva Voce</i> .	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 <i>Viva Voce</i> .	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

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School of Studies in Biotechnology

Semester III

Paper 9: Genetic Engineering

M.M. 80

Unit I

1. Scope of Genetic Engineering.
2. 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, bacteriophages, 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. 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 heterologous genes: Vector engineering and codon optimization, host engineering; expression in bacteria, expression in Yeast, expression in insects and insect cells, expression in mammalian cells, expression in plants
4. Phage display: Technique and applications

Unit 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. Cisgenesis, intragenesis and genome editing by CRISPR-CAS
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 (2005) Molecular Plant Biology. Edition Oxford University Press.
2. TA Brown (2005) Gene Cloning and DNA Analysis. 4th Edition.
3. Rusell and Peter (2002) Genetics Edition. Pearson Education, Inc, San Francisco.
4. Old and Primrose (2001) Principles of Gene Manipulation. 6th Edition.
5. B.D. Singh (2004) Biotechnology: An Expanding Horizons, 1st Edition.
6. W:H. Elliott and D. C. Elliott (2001) Biochemical and Molecular Biology. 2nd Edition.
7. Eldon John Gardner, Michael J. Simmons and Peter Snustad (1991) Principles of Genetics. Eighth Edition, John Wiley and Sons, INC.
8. Benjamin Lewin (2007) Genes IX. 9th Edition Pearson Education International.
9. HD Kumar (2003) Modern Concepts of Biotechnology. Third reprint Edition, Vikas Publishing House. Pvt. Ltd.
10. Brown TA (2006) Genomes, 3rd ed. Garland Science.
11. James D Watson, Richard M. Myers, Amy A. Caudy and Jan A. Witkowski (2007) Recombinant DNA: Genes and Genomes 3rd Edition; WH Freeman.
12. Sandy Primrose and Richard Twyman (2006) Principles of Gene Manipulation and Genomics 7th Edition; Wiley-Blackwell.
13. Buchanan, Gruissemen & Jones (2015) Biochemistry & Molecular Biology of Plant, 2nd edition.
14. Choudhuri, S and DB Carlson (2008) Genomics: Fundamentals and applications, 1st edition.
15. M. Debnath (2011) Tools and Techniques in Biotechnology.
16. Green, M. R., & Sambrook, J. (2012). Molecular Cloning: a Laboratory Manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

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 (malaria), helminthes, bacterial (tuberculosis), viruses, (AIDS) infections and other congenital and acquired immunodeficiencies, vaccines.
3. Hybridoma Technology and Monoclonal antibodies

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. Thomas J. Kindt, Barbara A. Osborne and Richard A. Goldsby (2007) Immunology, 6th Edition; WH Freeman.
2. Peter Delves, Seamus Martin, Dennis Burton, Ivan Roitt (2006) Roitt's Essential Immunology, 11th Edition; Wiley-Blackwell.
3. H.D. Kumar (2003) Modern Concepts of Biotechnology 3rd Edition, Vikas Publishing House. Pvt. Ltd.
4. K. Banerjee and N. Banerjee (2006) Fundamental of Microbiology and Immunology, First Edition. New Central Book Agency (P) Ltd. Kolkata.
5. Bröstoff J, Seaddin JK, Male D, Roitt IM.(2002) Clinical Immunology, 6th Edition, Gower Medical publishing.
6. Abul K. Abbas, Andrew H. Lichtman, & Shiv Pillai (2007) Cellular and Molecular immunology; Elsevier Inc
7. M. Debnath (2011) Tools and Techniques in Biotechnology.
8. Kindt, T. J., Goldsby, R. A., Osborne, B. A., & Kubly, J. (2006). Kubly Immunology. New York: W.H. Freeman.
9. Murphy, K., Travers, P., Walport, M., & Janeway, C. (2012). Janeway's Immunobiology. New York: Garland Science.
10. Paul, W. E. (2012). Fundamental Immunology. New York: Raven Press.

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 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.

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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.

Books:-

1. Shuler ML and Kargi F (2002) Bioprocess Engineering: Basic concepts. 2nd Edition, Prentice Hall, Engelwood Cliffs.
2. Stanbury and Whittaker (1997) Principles of Sterilization techniques, First Indian reprint Edition. Aditya Book (P) Ltd. New Delhi.
3. Michael J. Waites (2008) Industrial microbiology: an introduction 7th Edition; Wiley-Blackwell.
4. Damien and Devies (1994) Microbial Technology.
5. LE Casida (1994) Industrial Microbiology
6. H Patel (2003) Industrial Microbiology. 4th Edition.
7. KS Bilgrami and AK Pandey (1998) Introduction to Biotechnology. Edition 2nd.
8. U Satayanarayan (2005) Biotechnology. First Edition Books and Allied (P) Ltd. Kolkata.
9. Baily JE and Ollis DF. (1986) Biochemical Engineering fundamentals, 2nd Edition, McGraw-Hill Book Co., New York.
10. Mansi EMTEL, Bryle CFA (2007) Fermentation Microbiology and Biotechnology. 2nd Edition, Taylor & Francis Ltd, UK,
11. Shara L. Aranoff, Daniel R. Pearson, Deanna Tanner Okun, Irving A. Williamson, Dean A. Pinkert (2009) Industrial Biotechnology; Nova Science.
12. M. Debnath (2011) Tools and Techniques in Biotechnology.
13. Stanbury, P. F., & Whitaker, A. (2010). Principles of Fermentation Technology. Oxford: Pergamon Press.
14. El-Mansi, M., & Bryce, C. F. (2007). Fermentation Microbiology and Biotechnology. Boca Raton: CRC/Taylor & Francis.
15. Lee, Y. K. (2013). Microbial Biotechnology: Principles and Applications. Hackensack, NJ: World Scientific.

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).
3. To study the production of citric acid by *Aspergillus niger* and also qualitative and quantitative test.
4. To study the bacterial growth curve.
5. To study the fungal growth curve.
6. Enzyme kinetics.
7. 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.

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 (2011) Environmental Biotechnology: Theory and Application. 2nd Edition; John Wiley and Sons
2. Hans-Joachim Jördening, Josef Winter (2005) Environmental biotechnology: concepts and applications; Wiley-VCH.
3. Indu Shekhar Thakur (2006) Environmental Biotechnology: Basic concepts and Applications. First Edition. I. K. International Pvt. Ltd.
4. A.K. Chatterji (2002) Introduction to Environmental Biotechnology. First Edition. Prentice Hall of India Pvt. Ltd. New Delhi.
5. Manoj Tiwari, Kapil Khulbe and Archana Tiwari (2007) Environmental Studies. First Edition, I. K. International Publishing House Pvt. Ltd.
6. H.D. Kumar (2003) Modern Concepts of Biotechnology. Third reprint Edition, Vikas Publishing House. Pvt. Ltd.
7. B.D. Singh (2004) Biotechnology: Expanding Horizons, 1st Edition. Kalyani Publishers.
8. Alan Scragg (2005) Environmental Biotechnology First Edition, reprinted. Oxford University Press.
9. L Y Kun(2003)Microbial Biotechnology: Principles and applications.
10. M. Debnath (2011)Tools and Techniques in Biotechnology.
11. B. Ritmann and P. L. McCarty, (2000), Environmental Biotechnology: Principle & Applications, 2nd Ed., McGraw Hill Science.

List of Practical's:-

1. To determine the total suspended solids of water.(TSS)
2. To determine the total dissolved solids of water.(TDS)
3. Determination of Dissolved oxygen (DO) of water.
4. Determination of chemical oxygen demand (COD) of water.
5. Determination of biochemical oxygen demand (BOD) of water.
6. To screen the antagonism between *Trichoderma* sp. and *Curvularia* sp.
7. Determination of effect of fungicide on the growth of fungi (*Trichoderma* sp.).
8. Effect of fungicide on the antagonism between *Trichoderma* sp. and *Curvularia* sp.
9. 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 <i>Viva Voce.</i>	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 <i>Viva Voce.</i>	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	IPR, Biosafety, Bioethics and Nanobiotechnology	80	20	100
14	Advanced techniques in Biotechnology	80	20	100
15	Animal Biotechnology	80	20	100
16	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: IPR, Biosafety, Bioethics and Nanobiotechnology

M.M. 80

Unit – I

1. **IPR** : Introduction to intellectual property; types of IP: patents, trademarks, copyright & related rights, plagiarism, industrial design, traditional knowledge, geographical indications, protection of new GMOs; International framework for the protection of IP; IP as a factor in R&D.
2. **Entrepreneurship in bio-business** : Introduction and scope in Bio-entrepreneurship, Types of bio-industries Strategy and operations of bio-sector firms; Entrepreneurship development program of public and private agencies (MSME, DBT, BIRAC, Make In India).

Unit II

1. **Biosafety** - introduction; historical background; introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; GRAS organisms, biosafety levels of pathogenic microorganisms; definition of GMOs; principles of environmental risk assessment and food and feed safety assessment
2. **Bioethics** – cloning and stem cell research, Human, plants, microbes and animal experimentation, animal rights/welfare, Agricultural biotechnology – Genetically engineered food, Protection of environment and biodiversity – biopiracy.

Unit – III

1. **Nanobiotechnology** Introduction to Nanobiotechnology: Concepts, historical perspective; Different formats of nanomaterials and applications;
2. Cellular Nanostructures; Nanopores; Bimolecular motors; Synthesis and characterization of different nanomaterials.

Unit – IV,

1. Nanoparticles for diagnostics; concepts of smart stimuli responsive nanoparticles, implications in cancer therapy,
2. Nanodevices for biosensor development
3. Thin films: synthesis and applications.

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. Onetti, A., & Zucchella, A. Business Modeling for Life Science and Biotech Companies: Creating Value and Competitive Advantage with the Milestone Bridge. Routledge.
2. Jordan, J. F. (2014). Innovation, Commercialization, and Start-Ups in Life Sciences. London: CRC Press.
3. Desai, V. (2009). The Dynamics of Entrepreneurial Development and Management. New Delhi: Himalaya Pub. House.
4. Ganguli, P. (2001). Intellectual Property Rights: Unleashing the Knowledge Economy. New Delhi: Tata McGraw-Hill Pub.
5. National IPR Policy, Department of Industrial Policy & Promotion, Ministry of Commerce, GoI
6. National Portal of India. <http://www.archive.india.gov.in>
7. National Biodiversity Authority. <http://www.nbaindia.org>
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<http://www.envfor.nic.in/divisions/csurv/geac/annex-5.pdf>
9. Recombinant DNA Safety Guidelines, 1990 Department of Biotechnology, Ministry of Science and Technology, Govt. of India. Retrieved from-
<http://www.envfor.nic.in/divisions/csurv/geac/annex-5.pdf>
10. Wolt, J. D., Keese, P., Raybould, A., Fitzpatrick, J. W., Burachik, M., Gray, A., Wu, F. (2009) Problem Formulation in the Environmental Risk Assessment for Genetically Modified Plants. Transgenic Research, 19(3), 425-436. doi:10.1007/s11248-009-9321-9
11. Craig, W., Tepfer, M., Degrassi, G., & Ripandelli, D. (2008) An Overview of General Features of Risk Assessments of Genetically Modified Crops. Euphytica, 164(3), 853-880. doi:10.1007/s10681-007-9643-8
12. Guidelines for Safety Assessment of Foods Derived from Genetically Engineered Plants. 2008.
13. Guidelines and Standard Operating Procedures for Confined Field Trials of Regulated Genetically Engineered Plants. 2008. Retrieved from
<http://www.igmoris.nic.in/guidelines1.asp>
14. Alonso, G. M. (2013). Safety Assessment of Food and Feed Derived from GM Crops: Using Problem Formulation to Ensure "Fit for Purpose" Risk Assessments. Retrieved from
<http://biosafety.icgeb.org/inhousepublicationscollectionbiosafetyreviews>
15. Sandra J. Rosenthal, David W. Wright (2005) Nanobiotechnology Protocols. Humana Press Inc. 999 Riverview Drive, Suite, 208, Totowa, New Jersey.
16. PC Trivedi (2008) Nanobiotechnology. Pointer Publishers.
17. GŁ Hornyak, HF Tibbals, and J Dutta (2008) Fundamentals of Nanotechnology.
18. Rita Khare (2013) Concepts in Nano Biotechnology.
19. Shimasaki, C. D. (2014). Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Amsterdam: Elsevier. Academic Press is an imprint of Elsevier.
20. Complete Reference to Intellectual Property Rights Laws. (2007). Snow White Publication Oct.
21. Kuhse, H. (2010). Bioethics: an Anthology. Malden, MA: Blackwell.
22. World Intellectual Property Organisation. <http://www.wipo.int>
23. David S. Goodsell, (2004); Bionanotechnology: Lessons from Nature; Wiley-Liss.

List of Practical's:-

1. Synthesis of Nanomaterials.
2. Characterization of Nanomaterials.
3. Plagiarism detection by using different online plagiarism-tools.
4. Write-down guidelines for GMO.
5. Find and list-out bio-safety rules for food & beverage.
6. List out IPR of a researcher.
7. Find and list-out different bio-safety rules to be followed in the laboratories.
8. Find and list-out different bio-safety rules to be considered during management of biohazard materials.

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BoS Approved Syllabus for M.Sc. Biotechnology (Academic session 2019-20 and 2020-21)

School of Studies in Biotechnology

Semester IV

Paper 14: Advanced techniques in Biotechnology

M.M. 80

Unit I

1. Principles and application of: Centrifugation, Chromatography (Paper, Thin layer, gas and liquid chromatography, LCMS), Electrophoresis.
2. RIA and autoradiography in biology, ELISA.

Unit II

1. Principles and application of Thermocycler
2. Microscopy: Light and compound microscopes, Confocal microscopy, Scanning & Electron microscopy, Phase Contrast and fluorescence microscopy.

Unit III

1. Principles and application of DNA micro array
2. Principles and application of: Colorimetry, Spectrophotometry, densitometry, Fluorescence spectrophotometry.
3. Molecular structure determination using 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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Books:-

1. K. Wilson and J. Walker (2018) Principle and Techniques of Biotechnology and Molecular Biotechnology. Cambridge University Press.
2. Upadhyaya and Upadhyaya(2009) Biophysical Chemistry. Mumbai : Himalaya Pub. House.
3. David, L. Nelson and Michael, M. Cox Lehniger (2008) Principal of Biochemistry. 5th Edition. W.H. Freeman and Company, New York.
4. Anthony J.F. Griffiths, William M. Gelbart, Richard C. Lewontin and Jeffrey H. Miller; (1999)Modern Genetic Analysis. Publisher W. H. Freeman.
5. Ralf Pörtner (2013) Animal cell biotechnology: methods and protocols. Humana Press.
6. M. Debnath (2011) Tools and Techniques in Biotechnology.
7. Campbell, I. D. (2012). Biophysical Techniques. Oxford: Oxford University Press.
8. Serdyuk, I. N., Zaccai, N. R., & Zaccai, G. (2007). Methods in Molecular Biophysics: Structure, Dynamics, Function. Cambridge: Cambridge University Press.
9. Rajagopal Vadivambal, Digvir S. Jayas. (2015). Bio-Imaging: Principles, Techniques, and Applications. ISBN 9781466593671 - CAT# K20618.
10. Alberto Diaspro, Marc A. M. J. van Zandvoort. (2016). Super-Resolution Imaging in Biomedicine. ISBN 9781482244342 - CAT# K23483.

List of Practical's:-

Perform various advance laboratory techniques, like –

1. Centrifugation.
2. Chromatography.
3. Spectrophotometry.
4. Electrophoresis.
5. Perform the advance biotechnological techniques, like – ELISA, PCR, Southern blotting, etc.

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. RW Masters (2000) Animal Cell Culture Practical Approach: Oxford University Press.
2. Ralf Pörtner (2007) Animal cell biotechnology. Humana Press.
3. M Clynes (2012) Animal Cell Culture Techniques.
4. Nigel Jenkins (1999) Animal Cell Biotechnology methods and Protocols. Humana Press, Totowa, New Jersey.
5. B.D. Singh Biotechnology (2004) Expanding Horizons. First Edition. Kalyani Publishers, Ludhiana.
6. U Satyanarayana (2005) Biotechnology. Books and Allied (P) Ltd., Kolkata.

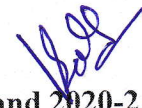

List of Practical's:-

1. Extraction, estimation and separation of DNA from blood
2. Extraction, estimation and separation of DNA from spleen
3. Extraction, estimation and separation 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: 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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Books:-

1. Primrose & Twyman (2013) Principles of Gene Manipulation and Genomics.
2. TA Brown (2015) Gene cloning and DNA analysis: An introduction.
3. Guido Grandi (2004) Genomics, Proteomics & Vaccines.
4. Primrose & Twyman (2008) Genomics: Application in Human biology.
5. Introduction to molecular Genetics and Genomics; JBH Publication
6. Timothy Palzkill (2002) Proteomics.
7. U Satyanarayana (2005) Biotechnology. Books and Allied (P) Ltd., Kolkata.
8. P.K. Gupta (2004) 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.

List of Practical's:-

1. Find out and study the sequence similarity 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. Shui Qing Ye (2007) Bioinformatics: A Practical Approach. Chapman & Hall Taylor & Francis Gen.
2. Mount D. W (2005) Bioinformatics – Sequence & Genome Analysis. CBS Publishers & Distributors (Pvt) Ltd.
3. Bela Tiwari (2007) Introductory Bioinformatics For Users: The Practicals.
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.

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Lab. Course 7

Based on Theory Papers 13, 14

Time: 6 hrs.

Total Marks – 100

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

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28/12/18

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Project

Project Work	External	Internal	Total
Dissertation	240	60	300
Seminar based on project	160	40	200
<i>Viva-voce</i>	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

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