

SYLLABUS

M. Sc. Biotechnology

SEMESTER EXAMINATION



2019-20

DEPARTMENT OF Biotechnology

**GOVT. NAGARJUNA POST GRADUATE (AUTONOMOUS) COLLEGE OF SCIENCE,
RAIPUR (C.G.)**

Programme Outcome

- To understand and perform functional properties and separation techniques of carbohydrates, proteins, lipids and nucleic acids.
- To acquire knowledge about basic cell biology.
- To develop the skill for learning morphological and functional parameters of microbes.
- A detailed knowledge of structure, function and application of microorganisms. Skills in handling microorganisms in the laboratory.
- An understanding of applications of microorganisms in the industry, health-care, environmental protection, food agriculture and research.

Course Outcome

<u>M.Sc. Biotechnology I Sem</u>	
Course	Outcome
CO1- Basics of Biotechnology & Cell Biology	The course gives the life activities at cellular and molecular level and basic functions of the various cellular compartments and organelles. To impart knowledge on the process of central dogma and gene regulation in molecular biology. M.Sc. I Sem – Paper I
CO2- Bio-molecules	To give an introduction about the basic biochemistry related to the biological molecules, their diversity and biosynthesis, degradation and role in the biological systems. M.Sc. I Sem – Paper II
Labcourse I	To make the students perform qualitative analysis of biomolecules. To understand and perform functional properties and separation techniques of carbohydrates, proteins, lipids and nucleic acids. To acquire knowledge about basic cell biology. To develops the skill for learning morphological and functional parameters of microbes.
CO3- Computer Applications & Biostatistics	To apply advanced statistical methods for analyzing biological data, To draw valid inferences based on the analysis of the biological data. The students will learn to approach a research problem logically and will be able to do statistical analyses in research. M.Sc. I Sem – Paper III
CO4- Bio-techniques	To get introduced to the fields of various instruments used in biotechnology including the basic principle - application and working. To equip the students with knowledge of thermodynamics of biological system and bioenergetics. Also to give an introduction

	to the biophysical aspects of various biological physiological activities at cellular and molecular level. M.Sc. I Sem – Paper IV
Lab course II	The students will be able to analyze genetic problems and will be able to approach a research problem statistically. To acquire knowledge about basic molecular biology tools
<u>M.Sc. Biotechnology II Sem</u>	
CO5- Macromolecules & Enzymology	The structures of amino acids, their chemical properties and their organization into polypeptides and proteins. Enzymes and how they catalyze reactions as well as enzyme kinetics. Basic function of nucleotides structure of different classes of lipids and their roles in biological systems. The interrelation of each of these metabolic pathways and their contribution in various metabolic disorders are also explained in detail. M.Sc. II Sem – Paper I
CO6- Molecular Biology	The student will get an idea about the principles behind molecular biology which makes students to understand the basic molecular tools and its application in basic research and applied research in various fields of life sciences. M.Sc. II Sem – Paper II
Lab course I	The students will be made proficient in basic molecular biology skills and molecular biology laboratory techniques To develop the skills in isolating and identifying the challenges in molecular biology related tools.
CO7- Microbial morphology & Physiology	To give an introduction about the microbial world- their distribution- morphology and reproduction and about the role of microorganism in various fields of human life and Industry. The students get trained in all aspects of microbiology as it is required for Biotechnology.
CO8- Biology of Immune system	This course is designed to impart the students the importance of immunology and its theoretical aspects and on the principles of immunology and immunotechnology.
Lab course II	Molecular Biology techniques, microbial production of chemicals, antibiotics & enzymes A detailed knowledge of structure, function and application of microorganisms. Skills in handling microorganisms in the laboratory. •An understanding of applications of microorganisms in the industry, health-care, environmental protection, food agriculture and research.

M.Sc. Biotechnology III Sem	
Course	Outcome
CO1-Environmental biotechnology	This course presents the basic understanding of various types of pollution & their remedial measures. It also include waste management. The emphasis is laid on role of biotechnology in conservation of environment. M.Sc. III Sem – Paper I
CO2- Plant Biotechnology	This course includes plant tissue culture techniques , plant transformation technology & its applications. M.Sc. III Sem – Paper II
Lab course I	Environmental analytical techniques, Plant tissue culture
CO3-Animal Biotechnology	This course presents various techniques & methodology of animal tissue culture M.Sc. III Sem – Paper III
CO4-Microbial Genetics	In this course, different gene transfer mechanisms & cellular genetics of micro-organisms is discussed.It also includes role of micro-organisms in genetic engineering.
Lab course II	DNA & RNA isolation & estimation, isolation & cultivation of Micro-organisms & their biochemical activity
M.Sc. Biotechnology IV Sem	
CO5- Genetic Engineering	This course includes genetic manipulation techniques, vectors & methods of gene cloning. It also deals with protein engineering, gene therapy & its applications. M.Sc. IV Sem – Paper I
CO6- Bioprocess engineering	This course presents various industrial biotechnological processes & role of micro-organisms in industrial biotechnology. It also includes industrial production of various chemicals, antibiotics & solvents. M.Sc. IV Sem – Paper II
Lab course I	Molecular Biology techniques, microbial production of chemicals, antibiotics & enzymes
Project	Three months dissertation work for developing skills in biotechnology through hands on training.

DEPARTMENT OF BIOTECHNOLOGY
GOVT. N. P. G. COLLEGE OF SCIENCE, RAIPUR
M. Sc. BIOTECHNOLOGY
 (Under self financing scheme)

FIRST 2019-20	Paper No.	Title of paper	Marks
	I	Basics of Biotechnology & Cell Biology	80+20
	II	Bio-molecules	80+20
	III	Computer Applications & Biostatistics	80+20
	IV	Bio-techniques	80+20
	LC-I	Lab Course I (Based on Paper I & Paper II)	100
	LC-II	Lab Course II (Based on Paper III & Paper IV)	100
	Unit Test	Average of two in each paper	20 in each
	Total		600

SECOND 2019-20	Paper No.	Title of paper	Marks
	I	Macromolecules & Enzymology	80+20
	II	Molecular Biology	80+20
	III	Microbial morphology & Physiology	80+20
	IV	Biology of Immune system	80+20
	LC-I	Lab Course I (Based on Paper I & Paper II)	100
	LC-II	Lab Course II (Based on Paper III & Paper IV)	100
	Unit Test	One Seminar in each paper	20 in each
	Total		600

THIRD 2019-20	Paper No.	Title of paper	Marks
	I	Environmental Biotechnology	80+20
	II	Plant Biotechnology	80+20
	III	Animal Biotechnology	80+20
	IV	Microbial Genetics	80+20
	LC-I	Lab Course I (Based on Paper I & Paper II)	100
	LC-II	Lab Course II (Based on Paper III & Paper IV)	100
	Unit Test	Average of two in each paper	20 in each
	Total		600

FOURTH 2019-20	Paper No.	Title of Paper	Marks
	I	Genetic Engineering	80+20
	II	Bioprocess Engineering & Technology	80+20
	LC I	Lab Course I (Based on Paper I & Paper II)	100
		Seminar in each paper	20 in each
		Project report with presentation	300
	Total		600
	Grand Total		2400

M.Sc. students of Biotechnology have to attend excursion tour or visit an industry/laboratory in first or second academic year (with or without C.G.) depending upon the availability of fund.

DEPARTMENT OF BIOTECHNOLOGY
GOVT. N.P.G. COLLEGE OF SCIENCE, RAIPUR
M. Sc. I Semester BIOTECHNOLOGY
(Under self financing scheme)

FIRST	Paper No.	Title of paper	Marks
2019-20	I	Basics of Biotechnology & Cell Biology	80+20
	II	Bio-molecules	80+20
	III	Computer Applications & Biostatistics	80+20
	IV	Bio-techniques	80+20
	LC-I	Lab Course I (Based on Paper I & Paper II)	100
	LC-II	Lab Course II (Based on Paper III & Paper IV)	100
	Unit Test	Average of two in each paper	20 in each
	Total		600

M.Sc. BIOTECHNOLOGY

I Semester

Paper I- Basic Biotechnology & Cell Biology

Unit-1

General biotechnology – What is the biotechnology, history, overview, Aspects Prospects and General lab safety on lab of BT include the recommended apparatus about the practice of Biotech.

Unit-II

Diversity of cell size and shape, Cell theory, Structure of Prokaryotic and Eukaryotic cell, Molecular composition, models and function of Plasma membrane, Vesicular transport.

Structure and function of Endoplasmic Reticulum. Structure and function of Mitochondria, Golgi complex, Lysosome, Ribosome, Structure and function of Nucleus, Nucleolus.

Unit-III

Chromosomes- structure, function and types, Cytoskeleton. Cell division- types and different stages & Cell cycle- check points, Cyclic dependent and its Regulation. Apoptosis. Aging of cell & tissue.

Unit-IV

Central dogma, Mechanism & regulation of protein synthesis in Prokaryotes & Eukaryotes, Cell signaling, Gametogenesis and Fertilization.

Books recommended

Molecular biology of cell – Lodish et al.

Genes VIII- B. Lewin.

Molecular biology of Genes – Watson et al.

Principle of Genetics – Gardner.

Molecular biology of cell – B. Albert's et al.

Molecular cell Biology – J. Darnell et al.

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M.Sc. BIOTECHNOLOGY

I Semester

Paper II- Biomolecules

Unit I

Chemical foundation of biology (Water, pH, pK, acids, bases, buffers, weak bonds, covalent bond). Principles of thermodynamics, free energy, hydrolysis of ATP and other phosphorylated compound (organophosphate), Xenobiotics (structure and metabolism).

Unit II

Carbohydrates- Classification, composition of monosaccharides, disaccharides & polysaccharides. Metabolism of carbohydrates (glycolysis, citric acid cycle, gluconeogenesis, glycogenesis glycogenolysis, HMP pathway). Regulation of blood glucose.

Unit III

Lipids classification, structure & function of lipids, saturated & unsaturated fatty acids, biosynthesis of lipids (triglycerides, phospholipids, eicosanoids) and metabolism of lipid (cholesterol & triglycerides).

Unit IV

Biosynthesis and catabolism of purines and pyrimidines. Nucleoproteins. Vitamins (structure & function of water and fat soluble vitamins).

Books Recommended:

Biochemistry- D. Voet and J.G. Voet

Physical Biochemistry- D. Friefelder

Tools of Biochemistry- T.G. Cooper

Lehninger's Biochemistry- Nelson & Cox

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M.Sc. BIOTECHNOLOGY

I Semester

Paper III- Computer Applications and Biostatistics

Unit- 1 Computer application

Introduction to digital computer- basic knowledge of hard ware & soft ware, CPU, Input and Output devices, Auxiliary storage system, Operating system & Binary number system, Flow chart and Programming technique - Simple computational and elementary knowledge of flow chart, Introduction to programming in BASIC.

Unit- II: Computer application

Introduction to MS Office-Word, excel, Power point Window, Introduction to programming 'C'- Elementary idea , C character and constant, variable key word. Decision and control system, loop control structure, data type. Data analysis , COSTAT, SPSS.

Unit- III: Biostatistics

Measurement of central tendency- Arithmetic Mean, Median,& Mode. Measurement of Dispersion- Standard deviation, standard error, Presentation of data- Tables (Simple, double and manifold rules for making tables), Use of table, graph, lines, bar and pie diagram, Use and rules for making diagram.

Unit-IV: Biostatistics

Probability- normal and binomial distribution, correlation and regression –kinds, significance and application, Test of significance- t- test and Chi square test. Analysis of Variance (one and two way ANOVA).

Books recommended

Programming in BASIC – E .Balagurusamy
How computer work – J.H Zar
Computer: concept & uses –A.C .Wardlaw
Statistics for Bilogists- R.C. Campbell
Statistical Method- R.R. Sokal & F.J. Rolf
Introduction to Biostatistics- M. Summer
Biostatistics- E. Padmini

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M. Sc BIOTECHNOLOGY

I Semester

Paper IV: Bio-techniques

Unit I

Principle & application of pH meter, colorimeter, spectrophotometer (UV, visible & infra red spectrophotometer, spectrofluorimeter, (NMR , ESR), Densitometer.

Unit II

Light, Electron, fluorescence and Phase contrast Microscopy. Introduction, objective, evolution and history of Bioinformatics, Major informatics data bases, tool of bioinformatics BLAST, FAST, SPSS. Applications of bioinformatics.

Unit III

Radioisotopes techniques- radioactive decay, sample preparation for radioactive counting, Radioactive counter, Autoradiography, Magnetic resonance Imaging (MRI)

Unit IV

Centrifugation- Principle, techniques and types,

Chromatography – Principle , techniques and , Electrophoresis – Principle, techniques and type

(Especially paper and gel)

Books recommended

Introduction to Instrument analysis –Robert Braun

Principles of Instrumentation- B.K. Sharma

Principles of Instrumentation- Upadhyay & Upadhyay

Principles of Instrumentation- Chatwal & Chatwal

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M. Sc. BIOTECHNOLOGY

I Semester

Lab course I (Based on paper I & II)

Duration - 6 hrs.

M.M-100

Practical based on paper-I

35

Study of types of cells Pro & Eukaryotic.

Study of permanent slide of cell organelles & cell division.

Preparation of slide of cell division by squash preparation.

Preparation of slide of polytene chromosomes.

Cell fractionation.

Preparation of slide of mitochondria and bar bodies by vital staining.

Experiment showing apoptosis.

Practical based on paper-II

35

Color reaction of carbohydrate.

Determination of total carbohydrate by anthrone method.

Estimation of starch using anthrone method.

Isolation and assay of glycogen from the liver and skeleton muscles.

Qualitative test of lipid.

Estimation of oil in oil seed.

Estimation of blood cholesterol.

Saponification value.

Determination of iodine value of oil.

Determination of acid value of a fat.

Viva-Voce

10

Sessional

20

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M.Sc. BIOTECHNOLOGY

I Semester

Lab Course II (Based on paper III & IV)

Duration - 6 hrs.

Max. Marks 100

Practical based on paper – III

35

Exercises for computation of mean, mode, median, SD, SE, and regression.

Exercises for data presentation

Data analysis by ANOVA

Hypothesis testing by t-test, Chi-square test

Computation of diversity indices

Study of different components of a computer system

Graphical presentation of data by a suitable package

Statistical analysis of a data by a suitable package

Preparation of a document/non-document by using a suitable word processor

Study of BASIC commands and statements

Study of flowchart symbols and construction of a flowchart for a given problem

Programming in BASIC for computing.

Practical Based on paper –IV

35

Determination of pH of different soil & water samples.

Determination of maximum absorption.

Exercise to calculate/demonstrate the Beer's Law.

Exercise based on microscopy.

Exercise of carbohydrate, protein, and amino acids from tissue,

Separation of amino acid by paper and thin layer chromatography,

Paper / gel Electrophoresis.

Viva-voce

10

Sessional

20

Members of board of studies in biotechnology

DEPARTMENT OF BIOTECHNOLOGY
GOVT. N.P.G. COLLEGE OF SCIENCE, RAIPUR
M. Sc. II Semester BIOTECHNOLOGY
(Under self financing scheme)

SECOND	Paper No.	Title of paper	Marks
2019-20	I	Macromolecules & Enzymology	80+20
	II	Molecular Biology	80+20
	III	Microbial morphology & Physiology	80+20
	IV	Biology of Immune system	80+20
	LC-I	Lab Course I (Based on Paper I & Paper II)	100
	LC-II	Lab Course II (Based on Paper III & Paper IV)	100
	Unit Test	One Seminar in each paper	20 in each
	Total		600

M.Sc. BIOTECHNOLOGY

II Semester

Paper-I: Macromolecules & Enzymology

Unit-I

Structure, classification & properties of amino acid, Peptides, Biosynthesis of serine, cysteine, histidine, Catabolism of histidine, methionine, and glycine, Fate of amino acids.

Unit-II

Proteins- structure and classification. Metabolism of protein, Structure and function of Glycoprotein and Lipoprotein, Protein denaturation.

Unit-III

Classification & nomenclature of enzyme. Mechanism of enzyme action. Enzyme kinetics. Michaelis-Menten hypothesis. Competitive & non competitive inhibition. Coenzyme, Lysozyme, Isozyme, Ribozyme and Allosteric enzyme.

Unit-IV

Protein and nucleic acid sequencing, Drug designing, Nano particles, Protein folding, Protein-protein and protein-ligand interaction, Physical and chemical methods for immobilization of small and macromolecules, protein purification.

Books recommended:

Principles of Biochemistry- Nelson & Cox

Biochemistry- A.L. Lehninger

Text Book of Biochemistry- T. Odell & Howard Mason

Biochemistry- L. Stryer & Berg

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M.Sc. BIOTECHNOLOGY

II Semester

Paper II- Molecular Biology

Unit-I

Structure, type and replication of DNA & RNA, DNA repair and mobile DNA, DNA hybridization, nucleosome.

Unit-II

Mechanism of prokaryotic & eukaryotic transcription, transcription factors, transcriptional & post transcriptional gene silencing. Modification in RNA-5, cap formation transcription, termination, endoprocessing, polyadenylation, splicing, self splicing of RNA, editing and ribozyme technology.

Unit-III

Mechanism and types (Eukaryotic & prokaryotic) of translation. Translational machinery, mechanism of initiation, elongation and termination, regulation of translation. Protein localization- synthesis of secretory and membrane protein. Import of protein into mitochondria, nucleus and peroxisomes.

Unit-IV

Cancer biology, oncogene and tumor suppressor gene, rDNA technology, genomic library, DNA chip, Molecular techniques in genetics- physical and genetic map, RFLP, RAPD, YAC, AFLP, BAC library, DNA finger printing and Blotting techniques.

Books recommended

Molecular Biology of Cell- Lodish et al.

Gene VIII- B. Lewin

Molecular Biology of Genes-Watson & other

Principle of Genetics- Gardner

Molecular Biology of cell- B. Albert's & other

Molecular Cell Biology- J. Darnell & other

Members of Board of Studies in Biotechnology

M.Sc. BIOTECHNOLOGY

II Semester

Paper-III: Microbial morphology & Physiology

Unit- I

Microbial evolution, Systematic, taxonomy and nomenclature of Microorganism, sterilization technique, pure culture technique. Ultra structure of Bacteria, Bacterial types- Purple & Green bacteria, Cyanobacteria, Budding & Appendages bacteria, Spirilla, Spirochaetes, Gliding & Sheathed bacteria, Endospore forming Rods Cocci, Mycobacterium, Mycoplasma.

Unit- II

Microbial growth- mathematical expression of growth and growth curve, measurement of growth and growth yields, synchronous growth, continuous culture, environmental growth factors. Viruses- Classification, size, shape and ultra structure. General account of different viruses- Plant (TMV), Animal (Retroviruses, Adenoviruses & Pox virus) virus.

Unit- III

Microbial nutrition types (autotroph, heterotrophy, chemotroph), metabolic pathways (Glycolysis, Pentose phosphate pathway, Entner- Doudoroff pathway, Glyoxlate- pathway), Chemolithotrophy (Hydrogen- Ion, nitrite- oxidizing bacteria, Nitrite and sulphate reduction), Methogenesis and acetogenesis, fermentation (Lactic acid, ethanol, acetic acid, butanol) Nitrogen metabolism (Nitrogen fixation & transformation), Microbial photosynthesis- role of chlorophyll. Carotenoids, phycobillins and Calvin cycle.

Unit- IV

Soil microbiology (physiochemical properties of soil, soil microbes and biogeochemical cycles- carbon, nitrogen, phosphorus and sulphur), Water microbiology (Fresh water & Marine), Air microbiology (air microflora- hospital, house, pharmacy, Aero- allergens & Aero- allergy).

Books recommended:

Microbiology: L.M. Prescott, J.P. Harley and D.A. Klein

General Microbiology: R.M. Stanier, J.L. Ingraham, M.L. Wheelies and P.R. Painter

Principle of Microbiology: R.M. Atlas

Microbiology: M.J. Peleczar, E.C.S. Chan & N.R. Krieg

Microbial Genetics- S.R. Maloy, J.E. Cronan & D. Freifelder

General Virology: Luria, Darnell, Baltimore and Campell

Brock Biology of Microbiology- M.T. Madigan et al.

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M.Sc. BIOTECHNOLOGY

II Semester

Paper-IV: Biology of Immune System

Unit- I

Principle of Immune System: Innate Immunity (Anatomical, Phagocyte, Inflammatory, physiological barriers), Adaptive Immunity.

Cell involved in immune system: Structure & function of B & T lymphocytes, NK cell, APCs, Eosinophil, Neutrophil, Basophil, Mast cell, Macrophages, Platelets.

Organization & Structure of primary and secondary lymphoid organ.

Unit- II

Nature & Biology of Antigen. APC, Antigen receptors molecules- BCR, TCR. Antibody Structure & functions, Ag-Ab-R & Application.

Unit- III

MHC, HLA, Complement System, CMI, Cytokines.

Unit- IV

Hypersensitivity reaction and types, Immunodeficiency disease, Vaccines, Autoimmunity, Immunodiagnostic technology.

Books recommended

Kubey's Immunology: R.A. Goldsby, Thomas J Kindt and Barbara A. Osborne
Immunology: A short Course: E. Benjamini, R. Coico and G. Sunshine
Immunology: Roitt *et al.*
Fundamentals of Immunology: William Paul
Understanding Immune System: Elgert
Immunology: Abbas *et al.*
Immunology: Tizard
Immunology: Pinchuk, G.
Immunology: Fatima *et al.*

Members of Board of Studied in Biotechnology

M.Sc. BIOTECHNOLOGY

II Semester

Lab Course I (Based on Paper I & II)

Duration 6 hrs.

Max. Marks 100

Practical based on paper- I

35

Estimation of protein by Biurate & folin lowery method.

Determination of the activity of alkaline and neutral proteases.

Determination of the activity of catalase.

Determination of the activity of urease.

Effect of temperature, pH, Concentration on the activity of amylase.

Qualitative test for amino acid by ninhydrin reaction.

Practical based on paper- II

35

Histochemical preparation of Protein, Carbohydrates, Lipid.

Biochemical estimation of DNA.

Isolation and electrophoresis of DNA.

Problem based on molecular genetics.

Histochemical localization of DNA/RNA.

Isolation of DNA by C-tab method.

Viva-Voce

10

Sessional

20

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M.Sc. BIOTECHNOLOGY

II Semester

Lab Course II (Based on Paper III & IV)

Duration 6 hrs.

Max. Marks 100

Practical based on paper- I

35

Micrometry.

Preparation of media.

Counting of cell/spore, pollen grain.

Study of microbial growth, microorganism growth rate.

Effect of pH, Temp, strain, reagent & media on growth of a microorganism.

Study of permanent slides of bacteria, fungi & parasite and free living protozoa's.

Practical based on paper- II

35

TLC, DLC & Agglutination reaction.

Study of Histology of lymphoid organs.

Double and radial immune-diffusion.

ELISA

Isolation & Estimation of IgG.

Estimation of serum proteins.

Determination of albumin, globulin ration in serum.

Immunoelectrophoresis.

Rocket.immuno-electrophoresis & other available facilities about I.

Viva-Voce

10

Sessional

20

Members of Board of Studied in Biotechnology

DEPARTMENT OF BIOTECHNOLOGY
GOVT. N.P.G. COLLEGE OF SCIENCE, RAIPUR
M. Sc. III Semester BIOTECHNOLOGY
(Under self financing scheme)

	Paper	Title of Paper	Marks
THIRD 2019-20	I	Environmental Biotechnology	80 + 20
	II	Plant Biotechnology	80 + 20
	III	Animal Biotechnology	80 + 20
	IV	Microbial Genetics	80 + 20
	LC- I	Lab Course I (Based on Paper I & II)	100
	LC- II	Lab Course I (Based on Paper III & IV)	100
	Unit test	Best of two in each paper	20 in each

M. Sc. BIOTECHNOLOGY

III Semester

Paper I- Environmental Biotechnology

Unit I

Environmental pollution: types of pollution, methods for the measurement of the pollution. Air pollution and its control through biotechnology. Water pollution and its control through biotechnology: need for the water management, measurement of the water pollution, source of water pollution, waste water collection. Water quality parameters.

Unit II

Waste water treatment: physical and chemical, microbiology of waste water treatment. Aerobic process- activated sludge, oxidation ditches, trickling filter, towers, rotating discs, rotating drums, oxidation ponds. Anaerobic processes- anaerobic digestion, anaerobic filters, up flow anaerobic sludge blanket reactors. Treatment schemes for waste water of dairy, distillery, tannery, sugar, antibiotic industries.

Unit III

Bioremediation of contaminated soils and waste lands, Microbiology of degradation of xenobiotics in environment. Hydrocarbons, Pesticides, Herbicides, Insecticides, Heavy metals, Degradative plastics, Oil pollution, Oil recovery, Biofuels, Biopesticides in integrated pest management.

Unit IV

Solid wastes- Source and management (Composting, wormiculture and methane production), Global environment problem- ozone depletion, UV- B, green house effect and acid rain, their impact and biotechnological approaches for management, Role of National organization in biotechnology.

Books recommended:

Environmental Biotechnology- A. Scragg

Environmental Studies- M. Tiwari, K. Khulbe and A. Tiwari

Introduction to Environmental Biotechnology- A. K. Chatterji

Environmental Biotechnology- Basic Concept and Application- I. S. Thakur

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M. Sc. BIOTECHNOLOGY

III Semester

Paper II- PLANT BIOTECHNOLOGY

Unit I

Introduction to cell and tissue culture. 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, embryo culture and embryo rescue.

Unit II

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. Cryopreservation, slow growth, DNA banking for germplasm conservation. Chloroplast and mitochondrial transformation.

Unit III

Plant transformation technology (*Agrobacterium* mediated), features of *Ti* and *Ri* plasmids, mechanism, of DNA transfer, role of virulence genes, use of *Ti* and *Ri* as vectors, methods of nuclear transformation. Binary vectors, Viral vectors and their application. Multiple gene transfer, vectorless or direct DNA transfer, transgene stability and gene silencing.

Unit IV

Application of plant transformation for productivity and performance: herbicide resistance, insect resistance, *Bt* genes, virus resistance, disease resistance, PR proteins, nematode resistance. Metabolic engineering and industrial products- plant secondary metabolites, alkaloids, industrial enzymes, biodegradable plastics, therapeutic proteins, antibiotics, edible vaccines. Molecular marker- RFLP maps, linkage analysis, RAPD markers, STS, microsatellites, SCAR (Sequence Characterized Amplified Region), SSCP (Single Strand Conformational Polymorphism). Green house and green home technology.

Books recommended

Introduction to Plant Biotechnology- H. S. Chawala

Introduction to Plant Biotechnology- T. J. Fu

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M. Sc. BIOTECHNOLOGY

III Semester

Paper III- ANIMAL BIOTECHNOLOGY

Unit I

History, scope, advantages and disadvantages of animal cell and tissue culture. Structure and organization of animal cell. Laboratory facilities for tissue culture. Culture media for cell and tissue culture (Natural and defined media). Substrate on which cell grow. Gas phase for tissue culture.

Unit II

Disaggregation of tissues and primary culture- enzymatic and mechanical. Separation of viable and non viable cell. Cultured cell and evolution of continues cell lines. Large scale culture of cell lines. Cell banking and scaling of cell culture.

Unit III

Somatic cell fusion. Cell cultured vaccines. Properties and analysis of cultured somatic cell, inter and intra specific somatic cell genetics. Hybridoma technology- techniques of cell and tissue culture, production of monoclonal antibodies.

Unit IV

Organ and whole embryo culture. Animal cloning. Superovulation, IVF, IVET in human and cattle. Tissue engineering. Transfection methods and transgenic animals- mice, sheep, pig, goat, cow and fish.

Books recommended

Animal Cell Culture Techniques- M. Clynes

Animal Cell Culture- Practical Approaches- R. W. Masters

Animal Cell Culture- Freshney

Biotechnology- U. Satyanarayana

Biotechnology- B. D. Singh

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M. Sc. BIOTECHNOLOGY

III Semester

Paper IV- MICROBIAL GENETICS

Unit I

Gene transfer mechanisms (transformation, transduction, conjugation, and transfection). Gene mapping with reference to *E. coli*, transposones, plasmid (types, replication of plasmid).

Unit II

Cellular genetics: Mutation (Types, mutagens, test for mutagens, mechanism of mutation), Virus genetic system (Phase I and its cycle- lytic and lysogenic life cycle, retrovirus- genome and its application), genetic system of yeast.

Unit III

Cellular genetics of microbes, genetic regulation of cell cycle in *S. pombe*. Genetic regulation of cell cycle in *S. cerevisiae*.

Unit IV

Molecular and basic techniques about the role of microbes in genetic engineering, ISH, FISH, Role of microbes as vectors in or cDNA technology.

Books recommended

Manual of Microbes- Cell and Molecular Biology- Ajoy Paul

DNA Technology- Watson *et al.*

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M. Sc. BIOTECHNOLOGY

III Semester

LAB COURSE I (Based on Paper I & II)

Duration: 6hrs

Max Marks 100

Practical based on Paper I

35

Preparation of media

Surface sterilization

Callus propagation

Organ culture- Anther, ovary, shoot, auxiliary bud culture

Practical based on Paper II

35

Measurement of hardness of water

Determination of total dissolved solids of water

Determination of total alkalinity of water samples

Determination of biological oxygen demand (BOD) of water

Determination of chemical oxygen demand (COD) of water

Bacteriological examination of water by coliform test

Viva Voice

10

Sessional

20

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M. Sc. BIOTECHNOLOGY

III Semester

LAB COURSE II (Based On Paper III & IV)

Duration: 6hrs

Max Marks 100

Practical based on Paper III

35

Isolation of DNA from animal cell

Quantitative estimation of DNA by diphenylamine reagent

Quantitative estimation of RNA by orcinol reagent

Isolation of RNA from yeast

Isolation of DNA from blood (whole blood extraction)

Electrophoresis of DNA

Demonstration of restriction and ligation

PCR, Southern blotting, RFLP, RAPD

Practical based on Paper IV

35

Cultivation techniques- Isolation of microorganism from air, water and soil

Purification, maintenance and preservation of microorganism

Biochemical activity of microorganism- production of amylase, cellulose and catalase

Antibiotic sensitivity test, screening of antagonism, production of penicillin

Isolation of plasmid

Determination of thermal death point and death time

Lethal effect of UV rays

Viva Voce

10

Sessional

20

Members of Board of Studied in Biotechnology

DEPARTMENT OF BIOTECHNOLOGY
GOVT. N.P.G. COLLEGE OF SCIENCE, RAIPUR
M. Sc. IV Semester BIOTECHNOLOGY
(Under self financing scheme)

FOURTH	Paper No.	Title of Paper	Marks
2019-20	I	Genetic Engineering	80+20
	II	Bioprocess Engineering & Technology	80+20
	LC I	Lab Course I (Based on Paper I & Paper II)	100
		Seminar in each paper	20 in each
		Project report with presentation	300
	Total		600

M.Sc. BIOTECHNOLOGY

IV Semester

Paper I- Genetic Engineering

Unit I

Genetic engineering and its advantage & disadvantage of prokaryote- E.coli, Saccharomyces cerevisiae and mammalian cell. Enzymes used in manipulation of DNA & RNA. Action of enzyme- SI nuclease, DNA ligase, Methylases, Terminal nucleotidyl transferase, DNA polymerase, Reverse transcriptase and Calf intestinal phosphatase(CIP). Restriction enzymes- Types of restriction endonuclease.

Unit II

Vector and its types- plasmid, cosmid, bacteriophages, phagemid, YAC, animal cell vectors (SV-40, adenovirus, pox viral vector). DNA synthesis- phosphoramadite method, synthesis of gene, design of gene & synthetic gene application of chemically synthesized gene. PCR, Microarray.

Unit III

Mechanism of gene cloning, Methods of screening of recombination, Nucleic acid hybridization, plus & minus screening, SRT, XART, HRT, HART and use of mini & maxi cell. DNA protein interaction- type of assay (filter binding, gel retardation, foot printing, endonuclease analysis). Nucleic acid labeling. Types, preparation & uses of molecular probe.

Unit IV

Protein engineering, Methods of gene transfer technology, Gene therapy- Vector engineering, strategies of gene delivery, gene replacement, gene correction, gene regulation and Human Genome Project (HGP). Colony hybridization.

Books recommended

Gene cloning and DNA analysis- T.A. Brown

Textbook of Biotechnology rDNA technology- J.D. Watson et.al.

Biotechnology- S.S. Purohit

Biotechnology- S.N. Jogdand

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M.Sc. BIOTECHNOLOGY

IV Semester

Paper II- Bioprocess Engineering and Technology

Unit I

Isolation, preservation and maintenance of industrial microorganism, Media for industrial fermentation, Air and media sterilization, Strain improvement, Types of fermentation process. Bioreactors- analysis of batch, fed batch and continuous bioreactors, stability of bioreactors. Specialized bioreactors (pulsed, fluidized, photo bioreactors, airlift, column, bubble bioreactors).

Unit II

Measurement and control of bioprocess parameters. Downstream processing- introduction, removal of microbial cells and solid matters, foam separation, precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, membrane process, drying & crystallization. Effluent treatment- DOC and COD treatment and disposal of effluents. Whole cell immobilization and their industrial application. Enzyme engineering.

Unit III

Industrial production of chemicals- alcohol (ethanol), acids (citric, acetic and gluconic), solvents (glycerol, butanol, acetone), antibiotics (penicillin, streptomycin, tetracycline), amino acids (lysine), Single cell protein, use of microbes in minerals beneficiation & oil recovery.

Unit IV

Food preservation- elementary idea of canning and packing, sterilization and pasteurization of food products, Technology of typical food/food products (bread, cheese, idly), milk and milk products. Food spoilage examination. Microbial flora of food.

Books recommended

Industrial microbiology- L.E. Casida

Industrial microbiology- A.H. Patel

Industrial microbiology- Demien & Devices.

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M.Sc. BIOTECHNOLOGY

IV Semester

(Lab course based on Paper I & Paper II)

Time: 06 hrs.

Max. Marks: 100

Practical based on paper I

35

Isolation of DNA from animal cell

Quantitative estimation of DNA by DPA reagent

Quantitative estimation of RNA by orcinol

Isolation of RNA from yeast

Isolation of DNA from blood (whole blood extraction)

Electrophoresis of DNA

Exercises' based on demonstration of ligation.

PCR, Southern blotting, RFLP, RAPD

Practical based on paper II

35

Isolation of industrially important microorganisms

Exercise on microbial production of citric acid by using *Aspergillus*

Exercise on microbial production antibiotics (penicillin)

Exercise on microbial production of amylase

Carbohydrate catabolism by microorganisms (oxidation and fermentation of glucose)

Fermentation of carbohydrate

Test of quality of milk sample by methylene blue reduction test

Viva-voice

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Sessional

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FORMAT FOR PROJECT WRITING

1. Style:

- (a) Times New Roman
- (b) Font Size- main title/heading-16
Sub-title- 14
Content- 12
- (c) Paragraph space- 1.5
- (d) No border
- (e) Page No.- Bottom-Centre
- (f) Main title- Centre
Other- Justify

2. List:

- a. Front page
- b. Certificates
- c. Acknowledgement
- d. Declaration
- e. Content- Write page No.
- f. List of Figures- Write figure No. with Page No.
- g. List of Tables- Write figure No. with Page No.
- h. List of Graphs- Write figure No. with Page No.
- i. Abbreviation

3. Arrangement of topics

- a. **Introduction**- 5-10 Pages
- b. **Aim & Objective**- 1 Page
- c. **Review of Literature** (Add latest review)- 30-50 Pages
eg.- Verma et al, 2009 (if no. of Scientist is more than 2)
eg.- Kumar and Soni, 2009 (if no. of Scientist two)
- d. **Material and Method**
- e. **Result**
- f. **Discussion**- (Add latest review and Minimum no. of review- 05)

g. Summary

h. References

eg.: Verma N., Koche V., Tiwari K.L. and Mishra S.K.(2009). RAPD analysis of *trichoderma indicum*. African journal of Biotechnology, 9(28): 4322-4325.

eg. : Verma N., and Mishra S.K.(2009). Micropropagation of medicinal plant-*trichoderma indicum*. African journal of Biotechnology, August 13-18 (145).

Departmental Internal Distribution of Marks

Total Marks	300
Thesis Writing	150
Work done	50
Discussion & Viva	100
Total Marks	300