Shri Rawatpura Sarkar University,

Raipur

Examination Scheme & Syllabus as per Outcome Based Education (OBE) and Choice Based Credit System (CBCS) for MASTER OF SCIENCE IN BIOTECHNOLOGY

(Effective from the session: 2022-23)

PROGRAMME OUTCOMES OF MSC DEGREE IN BIOTECHNOLOGY

PO1: This program explores the molecular basis for the changes occurring in living cells. It usesthe methods of chemistry, physics, molecular biology and immunology to study the structure and behaviour of the complex molecules found in biological material and the ways these molecules interact and communicate within and between cells and organs.

PO2: The program focuses on techniques used in industry for production of microbial products thus it enables develop an understanding of an applied aspect of microbes in industry.

PO3: To train the students in all the fundamentals of the subject of Biotechnology, progressively giving way to all essentials of the subject with good practical training and exposure to most modern concepts.

PO4: The curriculum carries multiple options in terms of electives for incorporating innovative ideas generated in this field.

PO5: To help the students to mold themselves as competent enough in an international pursuit of knowledge.

PO6: To provide ample opportunity for the students to gain sufficient practical knowledge in the subject with properly designed experiments.

PO7: Explore new areas of research in all the branches of biotechnology in addition to interdisciplinary fields.

PO8: The interdisciplinary nature of the subject is to be incorporated to have option for employment and higher studies.

PO9: To carry out professional responsibilities such as teaching and research in allied subjects.

PO10: To equip the students for seeking suitable careers in various disciplines of Life sciences.

PROGRAMME SPECIFIC OUTCOMES (PSO's) OF MSC DEGREE IN BIOTECHNOLOGY

Students who graduate with MSc. Biotechnology will,

PSO1: Have significant knowledge on various aspects of Biotechnology with special reference to microbes and their products.

PSO2: Expertise in laboratory techniques of basic microbiology, especially with regard to isolation, characterization of industrially important microbes.

PSO3: Understand the fundamental concepts in core (plant, animal, industrial biotechnology, molecular biology, genetic engineering and genetics) and allied (microbiology, immunology and physiology).

PSO4: Get exposure to various research fields and thrust area of the core and interdisciplinary subjects.

PSO5: Acquire technical skills especially in regard to industrially important metabolites and their production.

PSO6: Have ability to plan and execute experiments as well as to analyze & interpret data for any research.

Shri Rawatpura Sarkar University, Raipur

Faculty of Science

Two Years M. Sc. Programme

Scheme of Teaching and Examination

M. Sc. First Semester Biotechnology

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the Academic Year 2022-2023)

SN	Course Code	Course Title	Hours/Week			Credits	Maximum Marks			Sem End Exam Duration (Hrs.)
			L	**T**	**P**		Continuous Evaluation	Sem. End Exam	Total	
1.	SMS02101T	Biotechnology I: Cell and Molecular Biology	4	-	-	4	30	70	100	3
2.	SMS02102T	Biotechnology II: Microbiology	4	-	-	4	30	70	100	3
3.	SMS02103T	Biotechnology III: Biochemistry & Biophysics	4	-	-	4	30	70	100	3
4.	SMS02104T	Biotechnology IV: Bioanalytical Techniques	4	-	-	4	30	70	100	3
5.	SMS02191P	Lab course: I (Combining Biotechnology I and II)	-	-	4	2	15	35	50	5
6.	SMS02192P	Lab Course: II (Combining Biotechnology III and IV)	-	-	4	2	15	35	50	5
7.	SMS02121P	Computer Application and Bioinformatics	-	-	2	2	15	35	50	2
TOTAL						**22**			**550**	

Course Title	**Biotechnology I: Cell and Molecular Biology**				
Course Code	**SMS02101T**				
Course Credits	**L**	**T**	**P**	**LC**	
	4			**4**	
Prerequisites	**NIL**				
Course objectives	To understand the basics of Cell Biology and Molecular Biology				
Course Contents	**Unit: 1** Structural organization of the cell: specialized plant cell types, structure and function of cell wall, biogenesis, growth. Cytoskeleton: organization and role of Microtubules and Microfilaments, motor movements. Plasma membrane: structure, models and functions, sites for ATPases, structure of Plasmodesmata and role in the movement of molecules. **Unit: 2** Chloroplast: structure, genome organization and expression, functions, nucleo-chloroplastic interactions. Mitochondria: structure, genome organization, biogenesis, functions. Plant Vacuoles: as storage organelle, Tonoplast membrane, ATPases, as transporters. Golgi apparatus. Lysosomes, Endoplasmic Reticulum. **Unit: 3** Structure and functions of Nucleus: The nuclear envelope, structure of the Nuclear pore complex (NPC) and its role in Nucleo - cytoplasmic exchange. The concept of a gene as a unit of inheritance. The chemical nature of the gene, Structure of DNA: A, B, and Z forms, Watson- Crick model, DNA supercoiling, Organization of the genome. **Unit: 4** Functions of Nucleic Acids: DNA Replication in prokaryotes and eukaryotes: basic features of DNA replication in vivo and in vitro, role of DNA polymerases and other enzymes, the complex replication apparatus. Transcription in prokaryotes and eukaryotes. RNA Processing in eukaryotes, RNA splicing. Promoters and transcription factors. Types of RNA molecules. Interrupted genes in eukaryotes: exons and introns. **Unit: 5** Translation and the Genetic code: synthesis of protein, mechanism of translation- initiation, elongation and termination. Genetic code- properties, codon assignment and Wobble hypothesis. Structure and role of tRNA, Protein sorting, targeting of proteins to organelles. Gene expression: Regulation of gene expression in prokaryotes (operon and other models) and in eukaryotes.				
Course outcomes	1. Students will aware about basic concepts of cell, cell structure and genome organization of eukaryotic cell (plant cell). 2. Students will know the Genome structure and mechanism of transport in Chloroplast, Golgi complex, other organelles and trafficking between nucleus				

	and cytoplasm. 3. Students will attentive about the structure of nucleus and importance of nucleic acids, gene and genome the role of different manipulative enzymes in DNA functions 4. Students will acquaint with the knowledge of DNA replication and Transcription 5. Students will know the mechanism of Genetic code in translation and regulation of gene expresssion in prokaryotes and eukaryotes and its applications.
Text and References	1. Molecular Biology of the Gene (1987) Watson J. D., Hopking N.,Robast J. and Steiz, J. 2. Gene IX: Lewine Benjamin. 3. The Biochemistry of the nucleic acid (1996) Adams et al 4. Microbial Genetics: David Fridflelder. 5. Molecular cell Biology (1999) Lodish, H., Baltimore, D., Berk, A, Zipursky SL, Paul M and Darnell J. 6. Cell and Molecular Biology (1996) Gerald Karp.

Course Title	**Biotechnology II: Microbiology**				
Course Code	**SMS02102**				
Course Credits	**L**	**T**	**P**	**LC**	
	4			**4**	
Prerequisites	**NIL**				
Course objectives	To acquaint the students with various aspects of basic and applied Micrbiology				
Course Contents	**UNIT –I** History of Microbiology, Discovery of the microbial world. Isolation of micro-organisms from various sources (air, soil, water etc.), Inoculation technique, pure culture techniques, Culture, collection and maintenance of pure culture. Methods of sterilization and Enrichment culture techniques. **UNIT- II** Bacterial identification, nomenclature and classification, New approaches to bacterial taxonomy /classification including ribotyping and ribosomal RNA sequencing. General structure and brief account of bacteria and cyanobacteria, Rickettsia's, Chlamydia's and Mycoplasmas, Archaea; Archaebacteria and extremophilic microbes – their biotechnological potentials. **UNIT -III** The definition of growth, growth curve, measurement of growth and growth yields, collection and maintenance of cultures. Different modes of nutrition in bacteria, Sulfate reduction, Nitrogen metabolism – nitrate reduction, nitrifying and denitrifying bacteria, Nitrogen fixation and Microbes used as biofertilizer.				

	UNIT -IV Viruses: General introduction, morphology and composition, ultastructure and classification. General account of Plant viruses (TMV, Gemini Virus), Animal viruses (baculoviruses), Bacteriophages: Lambda, φX 174, cyanophages, Lytic cycle in T even phages and its regulation; lysogeny and its regulation in lambda phage; **UNIT -V** Viroid's and Prions. Basic design of a fermenter; biosensors; bioremediation.
Course outcomes	CO 1. Familiar in the microbial ecology and role of microbes in nutrient cycles. CO 2. Evaluate methods of microbial control and apply the proper methods necessary in a given scenario. CO 3. Knowledge in microbial organisms and their relevance of infectiousdiseases. CO 4. Intellectual literacy in the applications of microbiology in various industries. CO 5. Knowledge about the medical and practical uses for microorganisms CO 6. Knowledge in Disease transmission and control of nosocomial infections
Text and References	1. Pelczar et al., (1998): Microbiology. Tata McGraw-Hill, New Delhi 2. Prescott et al., (1996): Microbiology (WMC Brown Publishers, USA) 3. Tortora GJ, Funke BR, Case CL. Microbiology: An introduction 8th Edition. San Francisco: Pearson Publishers, 2004.

Course Title	**Biotechnology III: Biochemistry**				
Course Code	**SMS02103T**				
Course Credits	**L**	**T**	**P**	**LC**	
	4			**4**	
Prerequisites	**NIL**				
Course objectives	The students will understand the significance of biochemistry and chemistry of various macromolecules that interact to maintain and perpetuate the living systems.				
Course Contents	**UNIT-I** Introduction: Biochemical basis of life. Significance of macromolecules Carbohydrates, proteins, lipids and nucleic acids. **UNIT II** Chemistry and Metabolism of Carbohydrates - Structure and function of monosaccharides, Oligosaccharides and Polysaccharides Metabolism of carbohydrates Glycolysis, Citric acid cycle, HMP pathway and Glycogenolysis. **UNIT III** Classification and chemistry Lipids: Structure and functions of triglycerides, phospholipids, glycolipids, Significance of PUFA, Cholesterol and its derivatives. Metabolism of fatty acids oxidation, fatty acid biosynthesis, endogenous synthesis of triacylglycerols, phospholipids cerebrosides, gangliosides, cholesterol. **UNIT IV** Classification of Proteins and their functions: Essential and nonessential Aminoacids structure and properties of amino acids, general degradation of amino acids transamination, oxidative deamination, decarboxylation, disposal of ammonia Urea cycle,				

	structure of proteins primary secondary and tertiary structures. Biocatalysts: Enzymes classification, Mechanism of action / allosteric enzymes / Isoenzymes / Coenzymes and cofactors. **UNIT V** Nucleic acids: Structure and function of DNA and RNA Purine and Pyrimidine bases structure, degradation and synthesis, inborn errors of nucleotide metabolism.
Course outcomes	CO 1. Knowledge about the molecular biology of life CO 2. Understanding the enzymes and how they catalyze reactions as well as enzyme kinetics CO 3. Intellectual about the structures of amino acids, their chemical properties and their organization into polypeptides and proteins. CO 4. Review about the structure of fundamental monosaccharides and polysaccharides. CO 5. Knowledge about the structure and biological function of nucleotides and lipids. CO 6. Understanding the synthesis of biomolecules and their role in metabolic pathways along with their regulation CO 7. Understanding scientific basics of the life processes at the molecular level. CO 8. Explain and provide the inter-relationships of biomolecules and their consequences for interpreting & solving clinical problems.
Text and References	1. Lehninger, A. L. et al., 1993. Principles of Biochemistry, Worth Publishers. Inc. USA. 2. Stryer, I., 1988. Biochemistry (2nd Edition), W.H. Freeman & Co., New York. 3. Murray, R.K., Granner, B.K., Mayes. P.A., Rodwell, V.W., Harper's Biochemistry Prentice Hall International, 29th edition, 2012.

Course Title	**Biotechnology IV: Bioanalytical Techniques**				
Course Code	**SMS02104T**				
Course Credits	**L**	**T**	**P**	**Details**	
	4			**4**	
Prerequisites	**NIL**				
Course objectives	To develop the skills of the applications of basic and advanced techniques employed in quantitative and qualitative analysis of biomolecules.				
Course Contents	**Unit-I** Principles and applications, simple, compound, phase-contrast and fluorescent microscopes. Electron microscopy: SEM and TEM. Centrifugation Techniques: Principles, type of centrifuges, density gradient centrifugation in isolation of cells, cell organelles and biomolecules. **Unit-II** Electromagnetic spectrum, Beer Lambert's Law. Photometry, UV/VIS Spectrophotometry, Infrared spectroscopy, Atomic absorption spectroscopy, ESR and NMR spectroscopy. Mass spectroscopy (LC-MS, GC-MS). Fluorescent spectroscopy. Applications of different Spectroscopic techniques in Biology. **Unit-III** Introduction and types of chromatography, paper, thin layer, gas, Gel permeation, ion-exchange, HPLC, FPLC and affinity chromatography and instrumental details of each. Applications of Chromatographic techniques in Biology.				

	Unit-IV Paper and gel electrophoresis, Polyacrylamide gel electrophoresis (native and SDS), Agarose gel electrophoresis, Blotting- Southern, Western and Northern blotting, Immunoblotting, Immunoelectrophoresis, DNA finger printing and ELISA. **Unit-V** Nature and types of radiations, preparation of labelled biological samples. Detection and measurement of radioactivity, GM counter, Scintillation counter, Autoradiography, Flow cytometry. Safety measures in handling radioisotopes. RIA, non radiolabelling.
Course outcomes	CO 1. Beneficial to various scientific areas including life sciences, chemical sciences, material sciences and environmental science. CO 2. Provide scientific understanding of analytical techniques and detail interpretation of results. CO 3. Understand the working principles, construction and applications of the instruments often used in the studies related to various disciplines of Biological Sciences.
Text and References	1. Nuclear Magnetic Resonance: Williams 2. Biochemical Techniques theory and practice : White R 3. Analytical Chemistry: Christion G. D. 4. A Biologist Guide to Principle and Techniques: Willson K. and Gounding K.H. 5. An Introduction to Practical Biochemistry: Plummer D. T.

Course Title	**Lab course: I (Combining Biotechnology I and II)**				
Course Code	**SMS02191P**				
Course Credits	**L**	**T**	**P**	**LC**	
			2	**2**	
Prerequisites	**NIL**				
Course objectives	To understand the practical approach of basics of Cell Biology, Molecular Biology and Microbiology				
Course Contents	1. Different media composition and preparation used in Microbiology 2. Preparation of Slants and Plate Culture. 3. Different inoculation techniques. 4. Isolation and enumeration of microbes from air, water, soil and sewage. 5. Staining of microbes: Gram staining, Acid-fast staining, Cotton blue staining. 6. Hanging drop technique for motility of bacteria. 7. Study of Mitosis and Meiosis. 8. Effect of pH, temperature, light and nutrient source on the growth of microorganisms. 9. Bacterial growth curve by measuring the turbidity.				
Course outcomes	CO1 An understanding between different stages of cell cycle. CO2 The safe methods for isolation, subculture, and maintenance of bacterial and fungal specimens. CO3 An understanding of fundamental stains, basic staining techniques, and related bacterial and fungal physiology. CO4 An understanding of the uses of various media and testing protocols				

Text and References	1. Practical Biochemistry by Plumer 2. Biotechnology: Labrotary Techniques by Aneja

Course Title	**Lab Course: II (Combining Biotechnology III and IV)**				
Course Code	**SMS02192P**				
Course Credits	**L**	**T**	**P**	**LC**	
			2	**2**	
Prerequisites	**NIL**				
Course objectives	To impart knowledge of methods and techniques for biomolecules separation, quantification and purification.				
Course Contents	1. Carbohydrates: Qualitative analysis, quantitation of glucose and ribose. 2. Amino acids and proteins: Qualitative analysis, quantitation of proteins and amino acids. 3. Quantitation of free and bound phosphate. 4. Quantitation of vitamin C. 5. Fats: Acid number, saponification and iodine values. 6. Paper chromatography of Amino acids. 7. Verification of Lambert Beer's Law. 8. Gel chromatography for separation of a mixture of molecules.				
Course outcomes	CO1: Able to do qualitative and quantitative test for carbohydrates, amino acids, proteins and vitamin C. CO2: Able to determine fat values. CO3: Students will perform Paper chromatography and Thin layer chromatography. CO4:Explain the basic principle of spectrophotometer used to analyze the concentration of unknown solution				
Text and References	1. Practical Biochemistry by Plumer 2. Biotechnology: Labrotary Techniques by Aneja				

Course Title	**Computer Application and Bioinformatics**				
Course Code	**SMS02121P**				
Course Credits	**L**	**T**	**P**	**LC**	
			2	**2**	
Prerequisites	**NIL**				
Course objectives	The basic objective is to give students an introduction to the basic practical knowledge of computer and techniques of bioinformatics.				
Course Contents	**Unit I:** Computer Basics, Introduction to computer networks, LAN, MAN, WAN & Internet, Internet applications. Introduction to MS office, working with documents,				

	worksheets and presentations. **Unit II:** Concepts of Programming languages, Introduction to 'C' language, flowcharts and algorithms, introduction to data structure and database concepts, Object oriented concepts. **Unit III:** Database concepts: Introduction, Key features, History; Database management systems, Types of database management systems, Structured Query language; Index: Introduction and forms; Biological Database: Introduction and Types. **Unit IV:** Bioinformatics: Introduction, Bioinformatics databases, Importance of Bioinformatics; Analytical approaches, Components of Bioinformatics, Useful sites for researchers, Commercial use of bioinformatics; Bioinformatics in Life Sciences, Biocomputing, Bioinformatics in the area of genomics, Technical and legal issues, Role of Bioinformatician. **Unit V:** DNA sequence analysis: Gene structure and DNA sequences, Features of DNA structure analysis, DNA libraries and ESTs, Effect of EST data on DNA databases; Pair wise and multiple sequence alignment techniques; Phylogenetics; Analysis of Gene expression: Overview of microarray analysis, Micro arrays as tools for Gene expression analysis
Course outcomes	CO 1. To give students knowledge of and competence in use of bioinformatical methods central to conduction of molecular biological research projects. CO 2. Emphasis on bioinformatics related to exploration of proteins and includes analyses of sequences, database searches, sequence comparison, visualization and analysis of protein structures, and introduction to phylogenetic analyses. CO 3. Give an introduction to analysis of DNA sequences, genes and genomes, gene expression and systems biology. CO 4. To give students a basic competences in the use of bioinformatical tools. CO 5. Emphasizes the learning of bioinformatical tools in light of the student's knowledge of molecular biology. CO 6. Study the meaning and structure of biological information available in the existing databases.
Text and References	1. Arthur M Lesk. 2005. Introduction to Bioinformatics(Ed:2). Oxford university press, New York. 2. Attwood, T.K. and Parrysmith, D.J. 2001. Introduction to Bioinformatics. Pearson Education (Singapore) Pvt. Ltd., New Delhi. 1. Andreas D. Baxevanis and B. F. Francis Ouellette. 2005. Bioinformatics - A Practical guide to the analysis of Genes and Proteins (Ed:3). John Wiley & Sons, Inc., Publications, US. 2. David W Mount. 2004. Bioinformatics: sequence and Genome analysis(Ed:2). Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York. 3. Rastogi, S.C., Menderatta, M. and Rastogi, P. 2004. Bioinformatics - concepts, skills and applications. CBS Publishers & Distributors, New Delhi