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

MICROBIOLOGY

Program Outcomes

On completion of program students will be able to

1. Get ability to apply the process of science by formulating hypotheses and design experiments based on the scientific method.

2. Analyze and interpret results from a variety of microbiological methods.

3. Use quantitative reasoning by using mathematical calculations and graphing skills to solve problems in microbiology.

4. Communicate and collaborate with other disciplines by effectively communicating the fundamental concepts of microbiology in written and oral format.

5. Identify credible scientific sources to interpret and evaluate the evidences

6. Understand the relationship between science and society by recognizing and discussing logical, scientific and ethical issues in microbiology.

7. Prepare and view specimens for examination using light microscopy.

8. Use pure culture and selective techniques to isolate microorganisms. Identify microorganisms (media-based, molecular and serological).

9. Estimate the number of microorganisms in a sample by suitable enumeration technique.

10. Use appropriate microbiological and molecular lab equipment and methods.

11. Practice safe microbiology, using appropriate protective, biosafety and emergency procedures.

12. Document and report on experimental protocols, results and conclusions.

13. Basic knowledge about microbiology, biophysical techniques, biochemistry, cell biology, molecular biology, cancer biology, metabolic disorders etc.

14. To create awareness to become conscious citizens with a sense of responsibility towards their surrounding irrespective of any man made differences.

Shri Rawatpura Sarkar University, Raipur

Faculty of Science

Two Years M. Sc. Programme

Scheme of Teaching and Examination

M. Sc. First Semester Microbiology

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.	SMS07101T	Microbiology I: Cell and Molecular Biology	4	-	-	4	30	70	100	3
2.	SMS07102T	Microbiology II: Microbiology	4	-	-	4	30	70	100	3
3.	SMS07103T	Microbiology III: Biochemistry & Biophysics	4	-	-	4	30	70	100	3
4.	SMS07104T	Microbiology IV: Bioanalytical Techniques	4	-	-	4	30	70	100	3
5.	SMS07191P	Lab course: I (Combining Microbiology I and II)	-	-	4	2	15	35	50	5
6.	SMS07192P	Lab Course: II (Combining Microbiology III and IV)	-	-	4	2	15	35	50	5
7.	SMS07121P	Computer Application and Bioinformatics	-	-	2	2	15	35	50	2
TOTAL						**22**			**550**	

Course Title	Microbiology I: Cell and Molecular Biology				
Course Code	SMS07101T				
Course Credits	L	T	P	Details	
	4			4	
Prerequisites	Basic Knowledge of Cell and Molecular Biology				
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	**Microbiology II: Microbiology**				
Course Code	**SMS07102T**				
Course Credits	**L**	**T**	**P**	**Details**	
	4			**4**	
Prerequisites	**NIL**				
Course objectives	To acquaint the students with various aspects of basic and applied Microbiology				
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. 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. 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, ultrastructure 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	1. This is a basic course offered to the students of other disciplines and student after studying the course will be having knowledge of microbes and their importance, application in day to day life. 2. Explain the theoretical basis of the tools, technologies and methods common to microbiology 3. Demonstrate practical skills in the use of tools, technologies and methods common to microbiology. 4. Gaining knowledge and hands on experience on general microbiological concepts like staining, enrichment and isolation of microbes. 5. Apply the scientific method and hypothesis testing in the design and execution of experiments. 6. Understand about knowledge about major families of viruses detailed account of various viral pathogenesis, symptoms, epidemiology, transmission, diagnosis, prevention and control deep insights about plant viruses & Animal virus.				
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	**Microbiology III: Biochemistry**				
Course Code	**SMS07103T**				
Course Credits	**L**	**T**	**P**	**Detailes**	
	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	1. Knowledge about the molecular biology of life. 2. Understanding the enzymes and how they catalyze reactions as well as enzyme kinetics. 3. Intellectual about the structures of amino acids, their chemical properties and their organization into polypeptides and proteins. 4. Review about the structure of fundamental monosaccharide's and polysaccharides. 5. Knowledge about the structure and biological function of nucleotides and lipids. 6. Understanding the synthesis of biomolecules and their role in metabolic pathways along with their regulation 7. Understanding scientific basics of the life processes at the molecular level. 8. Explain and provide the inter-relationships of biomolecules and their consequences for interpreting & solving clinical problems. 9. This particular paper will help in understanding the basic biochemistry involved in the course including buffers, carbohydrate, lipid, proteins, enzymes.				
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., NewYork. 3. Murray, R.K., Granner, B.K., Mayes. P.A., Rodwell, V.W., Harper'sBiochemistry Prentice Hall International, 29th edition, 2012.				

Course Title	**Microbiology IV: Bioanalytical Techniques**				
Course Code	**SMS07104T**				
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	1.Gaining knowledge and hands on experience on analytical techniques including chromatography, microscopy, enzymology, electrophoresis etc. 2. Beneficial to various scientific areas including life sciences, chemicalsciences, material sciences and environmental science. 3. Provide scientific understanding of analytical techniques and detailinterpretation of results. 4. Understand the working principles, construction and applications ofthe instruments often used in the studies related to various disciplinesof Biological Sciences. 5. This particular course deals with the working of various advanced techniques in Microbiology and Molecular Biology. Student will know the use of various advanced techniques for application in the field of diagnostics. 6. Understanding the principle and uses of microscope, spectroscopy and chromatography . 7. Knowledge about electrophoretic separation of bio molecules,centrifugation and radioactive measurement.				
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 Microbiology I and II)**				
Course Code	**SMS02191P**				
Course Credits	**L**	**T**	**P**	**Details**	
			4	**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	1. An understanding between different stages of cell cycle. 2. The safe methods for isolation, subculture, and maintenance of bacterial and fungal specimens. 3. An understanding of fundamental stains, basic staining techniques, and related bacterial and fungal physiology. 4. An understanding of the uses of various media and testing protocols. 5. Student will be equipped with the knowledge to handle microbes and basic instrumentation used in microbiological laboratory. Various basic techniques to isolate, characterize the microbes morphologically will be known to them.				
Text and References	1. Practical Biochemistry by Plumer 2. Biotechnology: Labrotary Techniques by Aneja				

Course Title	Lab Course: II (Combining Microbiology III and IV)				
Course Code	SMS07192P				
Course Credits	L	T	P	Details	
			4	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	1. Student will be equipped with the knowledge to handle microbes and basic instrumentation used in microbiological laboratory. 2. Various basic techniques to isolate, characterize the microbes morphologically will be known to them. 3. Understanding safe laboratory practices and perform basic molecular biology techniques 4. Understanding the principle and uses of microscope, spectroscopy and chromatography. 5. Knowledge about electrophoretic separation of bio molecules, centrifugation and radioactive measurement.				
Text and References	1. Practical Biochemistry by Plumer 2. Biotechnology: Labrotary Techniques by Aneja				

Course Title	Computer Application and Bioinformatics				
Course Code	SMS07121P				
Course Credits	L	T	P	Details	
			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	1. To give students knowledge of and competence in use of bioinformaticalmethods central to conduction of molecular biological research projects. 2. Emphasis on bioinformatics related to exploration of proteins andincludes analyses of sequences, database searches, sequencecomparison, visualization and analysis of protein structures, andintroduction to phylogenetic analyses. 3. Give an introduction to analysis of DNA sequences, genes and genomes,gene expression and systems biology. 4. To give students a basic competences in the use of bioinformaticaltools. 5. Emphasizes the learning of bioinformatical tools in light of the student'sknowledge of molecular biology. 6. Study the meaning and structure of biological information available inthe existing databases.
Text and References	1. Arthur M Lesk. 2005. Introduction to Bioinformatics(Ed:2). Oxforduniversity 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). JohnWiley & Sons, Inc., Publications, US. 2. David W Mount. 2004. Bioinformatics: sequence and Genomeanalysis(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, NewDelhi