

Subject CHEMISTRY MSc PART I	Programme Specific outcomes	Course Code	Paper Title	Course Outcomes
	The course that is designed for the Master's degree is more focused than the graduate course.. The learners seeking is equipped with a basic degree in the subject and is expected to have garnered the basic knowledge about the subject. The focus of the objective is introducing the learners to the advanced level of the subject and making him or her aware of the cutting edge of knowledge in the subject, may be in the form of new advances in the field or a new chapter opened, representing the frontiers of the research, that is been carried out. The three-fold objective of the course is to advance the knowledge that can be put to practical use. It can be inspiring the learners for the research fields. This is absolutely necessary because the advances in any branch of science come through the research frontiers of that subject. The third objective is to train the learner to take major decisions as and when required regarding the day –to-day working in the field of the subject. This will require not only the advanced knowledge of the subject but will also require the perspective to look at the problem in totality making use of all the available resources on hand.	RPSCHE101	PHYSICAL CHEMISTRY	After completion of this Course, the learner will be able to: • Derive Maxwell equations and understand their significance. • Understand limitations of classical mechanics at molecular length scales. • Connect quantum mechanical operators to observables. • Calculate probabilities, amplitudes, averages values of the observables. • Derive rate laws of different types of the reactions.
	Programme Specific Outcomes Learner with a masters degree in the specific branch of chemistry should be well versed with the following: 1. The knowledge of the advance concepts in the branch of specialization. 2. Application of the knowledge acquired to the practical problems may be in the field of research or analysis. 3. The learner should be able to get not only bird's eye view of the subject but even the intricate details that may pertain to a particular specialized field on the branch. In conclusion, the learners with the masters degree should be a master of all the parts of the branch.	RPSCHE102	INORGANIC CHEMISTRY	After completion of this Course, the learner will be able to: • Comprehend the derivation of different hybridizations such as sp, sp², sp³ using sigma bonding concept. • Recognize the concept of MOT and how MOT is constructed for polyatomic molecules. • Know how the physical properties like melting and boiling points of molecules get affected by chemical forces present in it. • Understand Symmetry operations and Symmetry elements. • Differentiate Abelian and Non-abelian point groups. • Use of Great Orthogonality Theorem for construction of character table. • Examine chemical bonding, visualizing molecular orbitals, behaviour of atoms, molecules and solids using group theory. • Know the importance of Material Chemistry and its potential in developing applications, either by compositional control to optimize properties or by fabrication into desired forms, shapes or products. • Recognize the importance of Stability as we all seek to achieve stability including molecules. • Aware of the various methods/ techniques used to detect complex formation between metal and ligand. • Interpret the electronic spectra of octahedral and square planar complexes. • Calculate the various spectral parameters using correlation diagram and spectra.
			ORGANIC CHEMISTRY	After completion of this course, the learner will be able to: • Know the kinetic and thermodynamic requirements of organic reactions and a few methods to determine the reaction mechanisms. • Recognize the factors affecting acidity and basicity. • Understand advanced nucleophilic substitutions with special emphasis on Neighboring Group Participations (NGP) and factors affecting the NGP. • Identify structural, thermochemical, and magnetic criteria for aromaticity, including NMR characteristics of aromatic systems. • Comprehend the concept of chirality, Molecules with tri- and tetra-coordinate centers, Axial and planar chirality and prochirality. • Explore the applications of different oxidizing and reducing agents in organic reactions.
		RPSCHE104	ANALYTICAL CHEMISTRY	After completion of this Course, the learner will be able to: • Identify the relationships among the different instrument components and

the flow of information from the characteristics of the analyte through the components to the numerical or graphical output produced by the instrument.

- Determine the different types of errors in chemical analysis.
- Make use of calibration curve and standard addition method to carry out quantitative analysis of sample.
- Outline the role and importance of total quality management, safety, accreditations and GLP in industries.
- Apply the knowledge learned to all scientific data analyses during their studies and future career-related activities.
- Explain the working principle and Enlist the applications of UV visible and IR spectroscopy.
- Elaborate on the basic principle underlying the different types of thermal methods and will understand how these methods are employed in industries and research for characterization of sample.
- Compare the technique of DTA with DSC.
- Comprehend the utility of automation in chemical analysis.
- Outline the Objectives of automation in chemical analysis.
- Enlist the advantages and disadvantages of Automatic Analysis.

RPSCHE201 PHYSICAL CHEMISTRY After completion of this Course, the learner will be able to:

- Distinguish between physical and chemical adsorption.
- Predict spontaneous nature of thermodynamic mixing.
- Calculate energy of hydrogen atom.
- Draw the atomic orbital and locate radial and angular nodes.
- Derive rate laws for the solid-state reaction.
- Analyse the effect of inhibitor on enzyme catalysed reaction.
- Draw phase diagram for two and three component system.

RPSCHE202 INORGANIC CHEMISTRY After completion of this Course, the learner will be able to:

- Analyze the reaction pathways of metal complexes and to develop a deeper understanding of their mechanisms.
- Know the rate behavior of the reaction using reaction mechanism.
- Recognize the general shape of the transition state using trans effect, steric effect and stereochemistry of the coordination complexes.
- Illustrate the importance of 18 and 16 electron rules.
- Understand the synthesis and bonding involved in d block Organometallic compounds on the basis of VBT and MOT.
- Critically review environmental issues as a matter of widespread public concern.
- Know the toxicology of certain elements through case studies
- Identify the importance of essential elements for the organisms.
- Evaluate the role of metal ions in biological systems.

RPSCHE203 ORGANIC CHEMISTRY After completion of this Course, the learner will be able to:

- Correlate between kinetically and thermodynamically formed enolates and the factors affecting their formation.

SPECIALISATIONS PART II

RPSCHE204	ANALYTICAL CHEMISTRY	• Understand the interaction of carbon nucleophiles with carbonyl groups and its reaction mechanism. • Draw the mechanism and stereochemistry (if applicable) of various rearrangement reactions. • Apply Molecular orbital theory to organic molecules with special emphasis on the FMO theory. • Make use of advanced application of UV, IR and NMR spectroscopy techniques in structural elucidation of molecules. • Know the concept of McLafferty Rearrangement and its implications on Fragmentation pattern of molecules. After completion of this Course, the learner will be able to: • Utilize GC & HPLC techniques for separation of the different components present in a sample. • Make use of X-ray spectroscopy for qualitative and quantitative analysis of elements. • Describe the function of different components of a mass spectrometer. • Explain the essential principle underlying the applications of radioanalytical methods. • Elaborate on the methods of electrogravimetry and coulometry. • Compare the advantages/disadvantages of electrogravimetry and coulometry. • Describe the functioning of different types of ion selective electrodes. • Select the best method from among those covered in these units while carrying out analysis of a sample and will be able to justify their choice.
RPSCHEP301	POLYMER , SURFACE & PHOTOCHEMISTRY	After studying this course, the learner will be able to: • Determine the molar mass of polymer using different techniques. • Distinguish the various types of polymers. • Classify the surfactants by their process of formation. • Know about the various applications of surfactant in different fields. • Describe the various deactivation processes of molecular excited states. • Describe the photochemical reactivity of ethenes and carbonyl compounds. • Enlist the application of Fluorescence Phenomena.
RPSCHEP302	NANO-CHEMISTRY , APPLIED ELECTROCHEMISTRY , STATISTICAL MECHANICS & NUCLEAR CHEMISTRY	After completing this course, the learner will be able to: • Perceive the concept of nanomaterials and preparation of various nanomaterials and apply these concepts in the research of material science. • Apply the concept of probability to the thermodynamic properties at micro level. • Derive Maxwell-Boltzmann, Fermi-Dirac statistics. • Explain the working of particle accelerators viz. Linear, cyclotron. • Comprehend the concept of nuclear model's Liquid drop, Fermi gas, Shell, Optical etc. • Elaborate on the applications of nuclear radiations in pharma, geology, industry.
RPSCHEP303	ATOMIC AND MOLECULAR :	After completing this course, the learner will be able to: • Solve the Schrodinger equation for complex system.

	STRUCTURE & SPECTROSCOPY	• Understand molecule formation with different theories and comparison. • Explain the general principles and theory of spectroscopy. • Distinguish the specialties and applications of various types of spectroscopic methods.
RPSCHEP EC-I 304	ADVANCED INSTRUMENTAL TECHNIQUES	After studying this course, the learner will be able to: • Make use of the surface analytical techniques (such as XPS, AUGER , UPS) for obtaining information about the surfaces while characterizing the samples. • Enlist the advantages of development of hyphenated techniques and will be able to explain the different types of interfaces that are used to achieve this hyphenation. • Elaborate on the essential principles underlying the applications of thermal methods and radiochemical methods. • Develop a working knowledge of various methods used in Voltammetry. • Select a suitable method of voltammetry for the analysis of a particular sample.
RPSCHEPEC-II 304	MODERN METHODS IN INSTRUMENTAL ANALYSIS	After studying this course, the learner will be able to: • Explain the basic working principles and applications of reflectance spectroscopy, photoacoustic spectroscopy, Chemiluminescence methods, and polarimetry. • Enlist the advantages of chemically modified electrodes used in
RPSCHEP401	POLYMER , GREEN , BIOPHYSICAL & APPLIED CHEMISTRY	After completing this course, the learner will be able to: • Correlate Macromolecules and their properties, catalyst and its characterization. • Know photo physical kinetics of unimolecular and bimolecular processes using Stern-Volmer kinetics. • Acquire basic knowledge about how physical methods can be applied to understand biological processes. • Account for the different interactions that are important for the formation of structures in biological systems and for how thermodynamic parameters can be measure. • Describe the principle & working of the different types of electrophoresis. • List the important uses of the solar cell.
RPSCHEP402	SOLID STATE CHEMISTRY , NETWORK AND IRREVERSIBLE THERMODYNAMICS	After completing this course, the learner will be able to: • Explain the concept of bonding and structure of crystalline solids. • Explore different types of lattices, unit cells and defects in crystal in detail. • Determine the crystal structure using powder diffraction and single crystal X-ray diffraction. • Elaborate on the use of lasers in chemistry, their generations, characteristics and different types. • Describe applications of lasers in chemistry such as spectroscopy, isotope separation, and kinetics of fast reactions. • Explain Band theory, superconductors how do they work and magnetic properties. • State second law of thermodynamics at non-equilibrium i.e. entropy production and rate. Also, comprehend principle of microscopic
RPSCHEP403	SYMMETRY & SPECTROSCOPY	After completing this course, the learner will be able to: • Describe the selection rule for infrared-active transitions.

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		• Determine whether the molecular vibrations of a triatomic molecule are Raman active. • Analyse the hybridization of given compounds. • Understand the concepts of equivalent and non-equivalent hydrogens. • Identify the effect of structure on chemical shift and coupling constants. • Elucidate the electronic structure of free radicals and paramagnetic transition metal complexes. • Study the magnetic properties of the materials and its order of orientations.
RPSCHEP OC-I 404	INTELLECTUAL PROPERTY RIGHTS & CHEMINFORMATICS	After completing this course, the learner will be able to: • Be well versed with the concept of intellectual property and the terms involved with respect to Indian Patent Law. • Distinguish between patents and copyrights. • Elaborate on the economic impact and legislature involved in Intellectual property rights. • Make use of the software tools pertaining to Cheminformatics and Molecular Modelling. • Conduct structure and sub-structure search online, determine SMILES codes for various molecules. • Gain knowledge about the application of the research-based tools.
RPSCHEI OC-II 404	Research Methodology	After studying this course, the learner will be able to: • Know basics of research methodology. • Get the technical know-how of research from developing a problem. • Be able to write a research paper, study formats of existing research papers and review papers. • Be aware about importance of lab-safety and the safety protocols in R&D laboratories.
RPSCHEI301	SOLID STATE CHEMISTRY-I	After studying this course the learner will be able to: • Predict the structures of some known type of compounds based on their stoichiometry like AB, AB₂ etc. • Classify the oxides based on structure whether inverse, normal or random and how the polyhedra forms by sharing its corner, edge or face. • Have a clear distinction between Perfect and imperfect crystals and how these defects lead to change the properties of solids. • Be well versed with the methods available to synthesize the inorganic solids based on the compositions. • Identify the importance of Single Crystal and its method of preparation. • Understand the behaviour studies of solids using diffusion as property.
RPSCHEI302	BIOINORGANIC & COORDINATION CHEMISTRY	After studying this course the learner will be able to: • Outline the role of Iron, Zinc, Manganese and Nickel in different biological processes. • Illustrate the reactivity of Lewis acids and bases and Classification based on Frontier Molecular Orbital concept.

		• Know the different features of groups from 13-17 with respect to the acidity. • Predict the strength, hardness and softness of acids and bases. • Be well versed with the Latimer, Pourbaix and Frost diagrams. • Explain the different routes of synthesizing coordination complexes. • Differentiate between sigma and pi bonding of coordination complexes and geometries of tetrahedral and octahedral. • Rationalize the chiral and fluxional behaviour of coordination complexes.
RPSCHEI303	INSTRUMENTAL METHODS OF ANALYSIS	After studying this course the learner will be able to: • Elucidate the structure by powder diffraction and single crystal X-ray diffraction patterns. • Determine the crystal structure using X-ray diffraction. • Explain Bragg's law relation to crystal structure. • Identify and describe different diffraction methods. • Interpret and assign X-ray and electron diffraction patterns. • Describe the principle and enlist the applications of Mossbauer Spectroscopy. • Elaborate on the fine structure of ESR absorption, Hyperfine structure, double resonance in ESR and explain the technique of ESR spectroscopy.
RPSCHEI EC-I 304	APPLIED CHEMISTRY-I	After studying this course the learner will be able to: • Have a clear idea of some important inorganic chemicals and materials and their application in day to day life. • Explain the process by which metals are extracted, recovered and recycled. • Be well versed with the inorganic chemicals or materials used in pharmaceuticals. • Outline the importance of environment monitoring and assessment. • Have an idea about the different aspects of environmental legislation pertaining to e-waste, Forest Act and plastic manufacture.
RPSCHEI EC-II 304	APPLIED CHEMISTRY-II	At the end of this course, the learner will be able to: • Synthesize nanomaterials by choosing an appropriate method out of the various methods learned. • Prepare some of the industrially important inorganic chemicals and materials used in day to day life. • Explain the PUREX process used for the recovery of Uranium & Plutonium from spent nuclear fuel. • Be well versed with the super heavy elements and its importance in Chemistry. • Elaborate on the importance of Safety in Chemical Laboratory. • Have an idea about the Environment Protection act.
RPSCHEI401	SOLID STATE CHEMISTRY-II	After studying this course, the learner will be able to: • Understand the electrical properties of inorganic solids and how these materials can be used as superconductors. • Outline the importance of inorganic materials in making batteries and sensors. • Make use of hopping model to describe the carrier transport in a disordered semiconductor or in amorphous solid. • Know transition metal oxides such as spinels, perovskites and the strength of
RPSCHEI402	ORGANOMETALLIC	After Studying this course, the learner will be able to:

ORGANIC CHEMISTRY	AND MAIN GROUP CHEMISTRY	• Discuss classification of clusters and different structural patterns of metal clusters . • Explain how low nuclearity clusters differ from high nuclearity clusters and capping rules in metal clusters. • Be well versed with the Synthesis of various palladium Coupling complexes and its properties along with applications. • Enlist the Homogenous and heterogeneous catalytic applications of organometallic compounds in various industrial fields. • Explain the preparation methods and properties of silicates, inorganic polymers.
	RPSCHEI403	INSTRUMENTAL METHODS IN INORGANIC CHEMISTRY After studying this course, the learner will be able to: • Describe the selection rule for infrared-active transitions. • Determine whether the molecular vibrations of a triatomic molecule are Raman active. • Analyse the hybridization of given compounds. • Understand the concepts of equivalent and non-equivalent hydrogens. • Identify the effect of structure on chemical shift and coupling constants. • Make use of the surface analytical techniques (such as XPS, AUGER , UPS, SIMS , LEIS) for obtaining information about the surfaces while characterizing the samples. • Elaborate on the essential principles underlying the applications of thermal methods and radiochemical methods.
	RPSCHEI OC-I 404	INTELLECTUAL PROPERTY RIGHTS & CHEMINFORMATICS After completing this course, the learner will be able to: • Be well versed with the concept of intellectual property and the terms involved with respect to Indian Patent Law. • Distinguish between patents and copyrights. • Elaborate on the economic impact and legislature involved in Intellectual property rights. • Make use of the software tools pertaining to Cheminformatics and Molecular Modelling. • Conduct structure and sub-structure search online, determine SMILES codes for various molecules. • Gain knowledge about the application of the research-based tools.
	RPSCHEI OC-II 404	Research Methodology After studying this course, the learner will be able to: • Know basics of research methodology. • Get the technical know-how of research from developing a problem. • Be able to write a research paper, study formats of existing research papers and review papers. • Be aware about importance of lab-safety and the safety protocols in R&D laboratories.
	RPSCHEO301	THEORETICAL ORGANIC CHEMISTRY-I After studying this course, the learner will be able to: • Predict pathways of reaction mechanism and stability of intermediates. • Study of stereochemistry of pericyclic reactions. • Determine point groups based on symmetry elements and carry out

conformational analysis of ring compounds.

- Understand photochemical reactions with special reference to cleavage of carbonyl compounds and photochemistry of olefins.

RPSCHEO302	SYNTHETIC ORGANIC CHEMISTRY-I	After studying this course, the learner will be able to: • Write mechanism for various named reactions, including Multicomponent reactions and Click reactions. • Predict the product formed in the above reactions. • Give the method for preparing synthetically important compounds involving radicals. • Give the method for preparing synthetically important compounds via enamines and ylides. • Understand and explore the application of various metals and non metals in organic synthesis.
RPSCHEO303	NATURAL PRODUCTS & SPECTROSCOPY	After studying this course, the learner will be able to: • Know basic structural elucidation of carbohydrates, organic pigments and alkaloids. • Understand the synthetic strategies towards the synthesis of important biologically active molecules. • Develop a problem solving approach towards the structural elucidation from spectral data.
RPSCHEOEC-I 304	MEDICINAL , ENZYMES AND GREEN CHEMISTRY	After studying this course, the learners will be able to: • Know basic terms involved in medicinal chemistry, procedures involved in drug design and factors affecting the activity and potency of a particular drug, • Understand the effect of Structure-Activity Relationship on drug function and the concept of prodrugs. • Summarize the twelve principles of Green Chemistry and study their applications in synthetic organic chemistry.
RPSCHEOEC-II 304	BIOORGANIC CHEMISTRY	After studying this course, the learner will be able to: • Develop a deeper understanding in the Chemistry of Proteins and Nucleic Acids. • Infer the effect of physical parameters on the structure and function of nucleic acids. • Apply the basic concepts of organic reaction mechanism to enzyme action and the action of coenzymes. • Understand the biomimetic approach towards enzyme activity. Understand the various pathways towards the biosynthesis of important molecules and predict their pathways of synthesis.
RPSCHEO401	THEORETICAL ORGANIC CHEMISTRY-II	After studying this course, the learner will be able to: • Correlate the effects of substituent's on a substrate with its reactivity. • Understand the concept of molecular assembly and intermolecular bond in macromolecules and their effects on their catalytic activity. • Determine enantiomeric and diastereomeric compositions using various

available methods.

- Understand the properties of molecules by studying physical phenomenon like Circular Dichroism (CD) and Optical Rotatory Dispersion (ORD).
- Discuss the types of Asymmetric Synthesis controlled by Chiral Auxiliary, chiral catalyst, chiral substrate and chiral reagent with examples.
- Appreciate the importance and challenges in asymmetric synthesis, exemplified by Felkin-Anh and chelation models and asymmetric aldol reactions.

**RPSCHEO402 SYNTHETIC ORGANIC
CHEMISTRY-II**

After studying this course, the learner will be able to:

- Propose a retrosynthetic strategy for an organic compound.
- Give the forward synthesis, recognizable starting material and steps involved in the synthesis of the compound.
- Know the current trends in synthesizing organic compound.
- Explore the applications of modern and greener methods of organic synthesis.
- Understand the application of transition metal reagents and catalysts in organic synthesis.
- Know the use of electrochemical methods for organic synthesis.

**RPSCHEO403 NATURAL PRODUCTS
AND HETEROCYCLIC
CHEMISTRY**

After studying this course, the learner will be able to:-

- Understand the occurrence and biological roles of steroids, vitamins, terpenoids and antibiotics.
- Have an enhanced approach towards structural elucidation.
- Apply the rules of IUPAC nomenclature and other methodologies towards nomenclature of heterocycles.
- Understand the reactivity of various heterocyclic molecules and their importance towards synthesis of certain biologically active molecules.

**RPSCHEOOC-I 404 INTELLECTUAL
PROPERTY RIGHTS &
CHEMINFORMATICS**

After studying this course, the learner will be able to:

- Be well versed with the concept of intellectual property and the terms involved with respect to Indian Patent Law.
- Distinguish between patents and copyrights.
- Elaborate on the economic impact and legislature involved in Intellectual property rights.
- Make use of the software tools pertaining to Cheminformatics and Molecular Modelling.
- Conduct structure and sub-structure search online, determine SMILES codes for various molecules.
- Gain knowledge about the application of the research based tools.

RPSCHEOOC-II 404 Research Methodology

After studying this course, the learner will be able to:

- Know basics of research methodology.
- Get the technical know-how of research from developing a problem.
- Be able to write a research paper, study formats of existing research papers and review papers.
- Be aware about importance of lab-safety and the safety protocols in R&D laboratories.

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**RPSCHEA 301 QUALITY IN
ANALYTICAL
CHEMISTRY**

After completion of this course, the learner will be able to:

- Elaborate on the concept of Sampling and various methods involved in sample preparation and storage.

		• Select the best method out of all the methods available for the analysis of samples. • Calculate the uncertainty involved in a measurement. • Describe the sources & different methods used for the enhancement of signal to noise ratio. • Apply the parameters involved in method validation for developing a new method for the analysis of a sample. • Make use of the principles involved in various chromatographic techniques such as Ion-exchange, Size exclusion, SCF, Affinity, Inverse gas to carry out separation & analysis of sample.
RPSCHEA 302	ADVANCED INSTRUMENTAL TECHNIQUES	After completion of this course, the learner will be able to: • Make use of the surface analytical techniques (such as SIMS, PIXE) for obtaining information about the surfaces while characterizing the samples. • Apply the principle underlying spectro-electrochemistry & the use of optically transparent electrodes to carry out the analysis of samples. • Develop a working knowledge of various methods used in polarography. • Explain anodic, cathodic and adsorptive stripping methods in voltammetry. • Select a suitable method of voltammetry for the analysis of a particular sample. • Make use of the phenomenon of chemiluminescence for varied applications. • Elaborate on the concept of ORD & CD. • Discuss the principle, instrumentation involved in Photoacoustic spectroscopy and will be able to use it for the trace analysis of solid, liquid and gaseous samples.
RPSCHEA 303	BIOANALYTICAL CHEMISTRY & FOOD ANALYSIS	After completion of this course, the learner will be able to: • Describe the composition of body fluids (blood & Urine). • Enlist the physiological and nutritional significance of vitamins & biological macromolecules. • Apply the various analytical (microbiological techniques) learned for the analysis of these vitamins and biological macromolecules which in turn will help them in identification and diagnosis of diseases. • Explain the mechanism of operation of immune system. • Describe the various food preservation techniques that are widely practiced in food industries as quality control measure. • Design an experiment to confirm the presence and amount of various components present in different types of food samples for further label claim studies.
RPSCHEAEC-I 304	ENVIRONMENTAL AND CERTAIN INDUSTRIALLY IMPORTANT MATERIALS	After completion of this course, the learner will be able to: • List the major sources of different types of pollutants. • Classify the different types of pollutants. • Estimate the pollutants present in air. • Outline the role of pollution control boards in monitoring and controlling pollution.

		• Apply the methods learned in sampling of these pollutants to procure a sample for analysis. • Indicate appropriate measures to reduce/or minimize the effects of these pollutants on environment. • Evaluate the quality of potable water based on the guidelines laid down by the regulatory bodies. • Acquire awareness of the principles of green chemistry. • Plan out the synthesis of a sample by incorporating benign and environmentally safe solvents.
RPSCHEAEC-II 304	PHARMACEUTICAL AND ORGANIC ANALYSIS	After completion of this course, the learner will be able to: • Categorize the different types of drugs and dosage forms. • Outline the role of FDA in pharmaceutical industry. • Make use of the different methods learned to estimate the amount of drug present in a sample. • Apply the concept of impurity profiling, stability studies, limit tests, bioavailability and bioequivalence used to ensure the uniformity in standards of quality, efficacy & safety of pharmaceutical products. • Elaborate on the role of analytical chemistry in forensic laboratories. • Identify and estimate the amount of the toxins found at crime scenes. • Evaluate the quality of the cosmetic products by carrying out their analysis using the methods learned.
RPSCHEA 401	QUALITY IN ANALYTICAL CHEMISTRY	After completion of this course, the learner will be able to: • Identify and design the suitable membrane separation technique for intended problem. • Elaborate on the importance of concept of pH $\frac{1}{2}$ in solvent extraction. • Select an appropriate method for the processing, extraction using different techniques and standardization of the herbal materials as per WHO cGMP guidelines. • Recommend methods for the biodegradation of insecticides and pesticides. • Judge the quality of the detergents by making use of the various methods which are used in industries for carrying out their analysis. • Enlist properties of an ideal fuel. • Determine the calorific value of fuels using the methodologies learned. • Separate & estimate the amount of biomolecules using appropriate electrophoretic technique.
RPSCHEA 402	ADVANCED INSTRUMENTAL TECHNIQUES	After completion of this course, the learner will be able to: • Explain the basic theory of ^1H NMR spectroscopy & Raman Spectroscopy. • Describe the working of the different components of NMR spectrophotometer & Raman spectrometer and will be able to explain how the spectrum is recorded. • Apply ^1H, ^{13}C, ^{31}P and ^{19}F NMR spectroscopy techniques in combination with other spectroscopic data to carry out structure

		combination with other spectroscopic data to carry out accurate determination. • Explain the mechanism of formation and fragmentation of ions in gas phase. • Interpret the information contained in the mass spectra. • Apply the basic working principles involved in the spectroscopic techniques learned for carrying out identification and analysis of samples. • Enlist the advantages of development of hyphenated techniques and will be able to describe working of the different types of interfaces that are used to achieve this hyphenation. • Elaborate on the essential principles underlying the applications of thermal methods and radiochemical methods.
RPSCHEA 403	ENVIRONMENTAL AND CERTAIN INDUSTRIALLY IMPORTANT MATERIALS	After completion of this course, the learner will be able to: • Elaborate on the various physical, chemical and biological processes which are used in CETP to remove the contaminants from wastewater. • Apply the concept of recycling, reuse & reclamation in managing solid waste in real life. • Classify the different types of plastics. • Outline the importance of additives in plastic. • Estimate the amount of metallic impurities in plastics. • Describe the composition of paints. • Make use of the methodologies learned to carry out the analysis of each and every component present in paints. • Develop an understanding of zone refining and vacuum fusion and extraction techniques. • Classify the kinds of elements that can be purified by the process of zone refining. • Suggest a method for analysing different elements present in ores & alloys.
RPSCHEAOC-I 404	INTELLECTUAL PROPERTY RIGHTS & CHEMINFORMATICS	After studying this course, the learner will be able to: • Be well versed with the concept of intellectual property and the terms involved with respect to Indian Patent Law. • Distinguish between patents and copyrights. • Elaborate on the economic impact and legislature involved in Intellectual property rights. • Make use of the software tools pertaining to Cheminformatics and Molecular Modelling. • Conduct structure and sub-structure search online, determine SMILES codes for various molecules. • Gain knowledge about the application of the research based tools.
RPSCHEAOC-II 404	Research Methodology	After studying this course, the learner will be able to: • Know basics of research methodology. • Get the technical know-how of research from developing a problem. • Be able to write a research paper, study formats of existing research papers and review papers. • Be aware about importance of lab-safety and the safety protocols in R&D laboratories.

PHYSICS	Programme OUTCOME	Course Code	Paper Title	Course Outcomes
MSc in Physics (Electronics)	After successful completion of this course, students would acquire the following knowledge & skills:	RPSPHY101	Mathematical Methods of Physics	On successful completion of this course students will be able to: a) Understand the basic concepts of mathematical physics and their applications in physical situations b) Demonstrate quantitative problem solving skill in all the topics covered
	(1) The ability to apply the principles of physics to solve new and unfamiliar problems	RPSPHY102	Classical Mechanics	On successful completion of this course students will be able to: (1) Understand the concepts of Classical mechanics & to apply them to problems (2) Comprehend the basic concepts of mechanics & its applications in physical situation (3) Learn about situations in different problems (4) Demonstrate tentative problem solving skills in all above areas
	(2) The ability to analyze and interpret quantitative results in the areas of physics	RPSPHY103	Quantum Mechanics I	On successful completion of this course students will be able to: (1) Understand the postulates of quantum mechanics and to understand its importance in explaining significant phenomena in Physics (2) Demonstrate quantitative problem solving skills in all the topics covered
	(3) The ability to use contemporary experimental apparatus and analysis tools to acquire, analyze and interpret scientific data	RPSPHY104	Solid State Physics	On successful completion of this course, students will be able to: a. Understand the concepts of Solid State mechanics & Devices, how to apply them to problems b. Comprehend the basic concepts Solid State Physics & its applications in physical situation c. Demonstrate cautious problem solving skills in all above areas
	(4) The ability to communicate scientific results effectively in presentations or posters	RPSPHY201	Advanced Electronics	On successful completion of this course students will be able to: a) Understand the basics of Microprocessors & microcontroller with their programming b) Understand the basic concepts of analog & data acquisition system c) Understand the basic concepts of Data Transmissions, Instrumentations Circuits& Designs d) Understand the basic concepts of Instrumentation Circuits and Designs e) Demonstrate quantitative problem solving skill in all the topics covered

(5) A comprehensive, quantitative and conceptual understanding of the core areas of physics, including mechanics, optics, thermodynamics, electrostatics, electrodynamics at a level attuned with graduate programs in physics at peer institutions.	RPSPHY202	Electrodynamics	On successful completion of this course students will be able to: a) Understand the laws of electrodynamics and be able to perform calculations using them b) Demonstrate quantitative problem solving skill in all the topics covered
	RPSPHY203	Quantum Mechanics II	On successful completion of this course students will be able to: (1) Understand the postulates of quantum mechanics and to understand its importance in explaining significant phenomena in Physics (2) Demonstrate quantitative problem solving skills in all the topics covered
	RPSPHY204	Solid State Devices	On successful completion of this course, students will be able to: a. Understand the basic laws of Solid State Physics and be able to perform calculations using them b. Comprehend the basic concepts Solid State Physics & its applications in physical situation c. Demonstrate cautious problem solving skills in all above areas
	RPSPHY301	Statistical Mechanics	On successful completion of this course, students will be able to: a. Understand the concepts of Classical statistical mechanics how to apply them to problems b. Comprehend the basic concepts of Quantum statistical mechanics & its applications in physical situation c. Learn about situations of different systems d. Demonstrate cautious problem solving skills in all above areas
	RPSPHY302	Nuclear Physics	On successful completion of this course, students will be able to: a. Understand the concepts of Nuclear Physics how to apply them to problems b. Comprehend the basic concepts of decays & its applications in physical situation c. Demonstrate cautious problem solving skills in all above areas

RPSPHY303	Microcontroller & interfacing	On successful completion of this course students will be able to: a) Understand the assembly language programming of Microprocessors & microcontrollers b) Understand the assembly language programming of PIC microcontrollers c) Understand the basic concepts of Instrumentation Circuits and Designs d) Demonstrate quantitative problem solving skill in all the topics covered
RPSPHY304	Embedded & RTOs	On successful completion of this course students will be able to: a) Understand the basic concepts of Embedded systems and Designs b) Understand the basic concepts of RTOs and Designs c) Understand the assembly language programming d) Demonstrate quantitative problem solving skill in all the topics covered
RPSPHY401	Experimental Physics	On successful completion of this course students will be able to: a) Understand the basic concepts of Data Analysis for physical sciences b) Understand the basic concepts Vacuum techniques c) Understand the Characterization techniques for materials analysis d) Demonstrate quantitative problem solving skill in all the topics covered
RPSPHY402	Atomic and Molecular Physics	On successful completion of this course students will be able to: a) Understand the basic concepts of Atomic and Molecular Physics b) Understand the basic problem solving techniques on basis of various laws c) Demonstrate quantitative problem solving skill in all the topics covered
RPSPHY403	Advanced Microprocessor & ARM – 7	On successful completion of this course students will be able to: a) Understand the Assembly language programming in microprocessors and microcontrollers b) Understand the basic of architecture of microprocessors and microcontrollers c) Demonstrate quantitative problem solving skill in all the topics covered

RPSPHY404	VHDL & Communication Interface	On successful completion of this course students will be able to: a) Understand the Assembly language programming in VHDL b) Understand the basic of Communication Interface c) Demonstrate quantitative problem solving skill in all the topics covered.
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SUBJECT	Programme specific Outcomes	Course Code	Paper Title	Course Outcomes
BOTANY	PSO: CYTOGENETICS AND PLANT BIOTECHNOLOGY 1. Students will be able to identify the major groups of organisms with an emphasis on plants and be able to classify them within a phylogenetic framework. Students will be able to compare and contrast the characteristics of Cryptogams and Phanerogams that differentiate them from each other and from other forms of life. 2. Students will be able to explain how organisms function at the level of the gene, genome, cell, tissue, organ and organ-system. Drawing upon this knowledge, they will be able to give specific examples of the physiological adaptations, development, reproduction and behaviour of different forms of life. 3. Students will be able to explicate the ecological interconnectedness of life on earth by tracing energy and nutrient flow through the environment. They will be able to relate the physical features of the environment to the structure of populations, communities, and ecosystems. 4. Students will be able to use the evidence of comparative biology to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life on earth. They will be able to use specific examples to explicate how descent with modification has shaped plant morphology, physiology, and life history. 5. Students will be able to demonstrate proficiency in the experimental techniques and methods of analysis appropriate for their area of specialization within biology. 6. Students will be able to learn the utilisation of various plant groups, ethnobotanical aspects and medicinal uses of plants with special reference to usage as mentioned in different Pharmacopoeia. 7. Students will be able to learn the finer aspects of emerging areas such as in instrumentation nanotechnology and Bioinformatics 8. Students will be able to apply the scientific method to questions in biology by formulating testable hypotheses, gathering data that address these hypotheses, and analyzing those data to assess the degree to which their scientific work supports their hypotheses. 9. Students will be able to present scientific hypotheses and data both orally and in writing in the formats that are used by practicing scientists. 10. Students will be able to access the primary literature, identify relevant works for a particular topic, and evaluate the scientific content of these works. 11. Students will be able to apply fundamental mathematical tools (statistics, calculus) and physical principles (physics, chemistry) to the analysis of relevant biological situations. 12. Students will study more recent techniques in molecular biology and cytogenetics. They will acquire knowledge in IPR, Traditional knowledge systems and also environmental biotechnology. 13. Students will learn techniques of plant breeding and their immense agricultural and horticultural applications therein. 14. Research methodology, a project and preparation of dissertation will give them exposure to literature survey, research and publications More emphasis will be given to application, analysis, entrepreneurship and projects at the post graduate level.	RPSBOT101	Plant Diversity-Cryptogams I (Phycology and Bryophyta)	Learning outcomes:the student will be able to: • Classify algae into various groups, understand the importance in various fields and will be able to collect and identify them • Classify Bryophytes into various groups, their importance Learning outcomes: The students will be able to differentiate between gymnosperms and angiosperms , their origin and nomenclature
		RPSBOT102	Plant Diversity – Spermatophyta I (Gymnosperms and Angiosperms)	
		RPSBOT103	Plant Physiology	Learning outcomes:Students should be able to understand how to apply the basic concepts of Plant Physiology in other fields and also to know and discuss the concept of physiological processes of plants
		RPSBOT104	Cytogenetics, Molecular Biology, Biotechnology and Research Methodology	Learning outcomes: Students will be able to outline the genomic technologies, events involved in generating recombinant DNA molecules also basics of research methodology. Students should understand a general definition of research design. 2. Students should know why educational research is undertaken, and the audiences that profit from research studies. 3. Students should be able to identify the overall process of designing a research study from its inception to its report. 4. Students should be familiar with ethical issues in educational research, including those issues that arise in using quantitative and qualitative research.
		RPSBOT201	Plant Diversity-Cryptogams II (Mycology and Pteridophyta)	Learning outcomes: Upon successful completion of this course, the student will be able to: • Classify fungi into various groups, understand the role of fungi in various fields and will be able to collect and identify fungi, fungal pathogens and culture them. • Classify pteridophytes into various groups, their importance and multiplication of important ferns References: Learning outcomes: Students will be able to understand the development of pollen, spore, fertilization and to apply palynological information to plant systematics
		RPSBOT202	Plant Diversity – SpermatophytaII (Anatomy, Developmental Botany and Palynology)	
		RPSBOT203	Plant Physiology and Environmental Botany	Learning outcomes: On completion of the course students should be able to: • Distinguish key physiological processes underlying the seed germination • Identify the physiological factors that regulate growth and developmental processes of plants • Demonstrate clear understanding of crop-environment interaction and its implication on crop growth and yield • Integrate and apply their knowledge of crop physiology for analytical thinking and solving practical problems experienced in agricultural systems
		RPSBOT204	Medicinal Botany, Dietetics and Research Methodology	Learning outcomes: • Critically evaluate the various pharmaceutical forms for administration of herbs therapeutically and their appropriateness to different health conditions. • Students will be able to identify medicinal plants and understand the effects of plant chemical constituents on humans. • Students will be familiar with conducting a literature review for an educational study and different types of literature reviews. • Students should be able design a good research hypotheses and select appropriate data analysis method
		RPSBOT301	TECHNIQUES AND INSTRUMENTATION	Learning Outcome: Students will be able understand 1) Importance of Biostatistics in Plant Science 2) Use bioinformatics software's and work with different databases for applications in upcoming fields of biology. 3) The techniques and applications of electrophoresis and Microscopy.
		RPSBOT302	Molecular Biology	Outcomes: • Enable students to build a career in genetic engineering, genomics and proteomics • Understanding of molecular mechanisms and design treatments related to diseases. • Basic understanding of cellular and molecular biology
		RPSBOT303	Plant BiotechnologyIII	Outcomes: 1. Developing a skill base for working in industries like pharmaceuticals, food industries, fermentation units etc. 2. Understanding the baseline requirements to set up an enterprise based on fermentation technology 3. Developing efficient methods for product recovery 4. Developing ability to understand, explore and address problems associated with current tissue culture techniques
		RPSBOT304	Molecular Biology and Cytogenetics	The students will be able to understand : • The structure of the cell membrane with respect to its function, regulatory aspects of cell division and PCD, along with non-nuclear genomes. • The nature, development and causes of cancer. • The components of the immune system and applications in health care. • The application of the study of genetic disorders for genetic counselling and therapy.
		RPSBOT401	TECHNIQUES AND INSTRUMENTATION	Learning Outcome: 1) Students will be able understand the technique and application of Centrifugation, Chromatography, and PCR. 2) Able to understand recent research in membrane biophysics 3) They will also gather knowledge about plant research in space.
		RPSBOT402	Molecular Biology	Outcomes: • Awareness regarding various processes of cell signaling and mechanism of signaling • Develop knowledge of gene regulation mechanism and gene expression
		RPSBOT403	Plant Biotechnology	Outcomes: • Creating awareness regarding the need of alternate source of energy. Development of ideas and technologies to increase production and use of biofuels and biological sources of energy. • Developing interest among students in patent filing, patent law and related fields. • Understanding the rapidly developing field of nanotechnology and developing skill base for advanced research endeavours in nanotechnology. • Understanding the pros and cons of nanotechnology and applicability of the same in various industries. • Understanding requirement and technologies involved in food biotechnology and implementation of quality control parameters.
		RPSBOT404	Molecular Biology and Cytogenetics	Learning Outcomes : • To be able to apply principles of plant breeding and hybridisation along with latest molecular techniques for the production of high yielding, abiotic and biotic stress resistant plants in agriculture and horticulture.

ZOOLOGY

PSO	Paper Code	Title	CO
1. Identify, explore, understand the classification of invertebrates and vertebrates and compare between the anatomy and physiology of different phylum.	RPSZOO101	Non-chordates, chordates and their phylogeny - I	Students can compare the characteristics of different phyla and can know about the comparative study of different bones in different animals
2. Gain comprehensive knowledge about different animal species and appreciate the differences and similarities, thereby achieving proficiency in handling them experimentally or for research purposes.			
3. Understand and learn various behavioural patterns displayed by animals and interrelate to evolutionary pattern.	RPSZOO102	Biochemistry and Metabolism – I	They will get an idea about research work in biochemistry and drug discovery. It will help them to prepare for exams like NET, SET etc.
4. Evaluate and analyse basics of chemical thermodynamics and various biochemical pathways with respect to metabolism.			
5. Analyse the various communication pathways taking place inside the cell and interrelate it with genetics.	RPSZOO103	Genetics, Evolution and Developmental Biology - I	The syllabus will provide students the opportunity to carry out research work related to developmental biology. Comprehensive, detailed understanding of the chemical basis of heredity and the role of genetic mechanisms in evolution.
6. Compare and contrast between Mendelian inheritance, Extension of Mendelian genetics and Non-Mendelian genetics			
7. Interpret and analyse how morphological change due to change in environment helps drive evolution over a period of time.	RPSZOO104	Tools and Techniques in Biology - I	The knowledge gained will help students to handle the instruments. They will also learn to calibrate and take care of it hence increasing their shelf life. Through research methodology they will develop ideas regarding desertation
8. Compare the different developmental stages of all the animals and connect it to the evolutionary link.			
9. Apply the fundamentals and techniques of molecular biology in various fields.	RPSZOO201	Non-chordates, chordates and their phylogeny - II	The students can correlate similarities and differences in different phyla, and different girdles. Construction of phylogenetic tree will help them to remember the origin and divergence of different animals
10. Gain knowledge and understand various techniques in the field of environmental, medical and animal biotechnology			
11. Understand the broad concepts of nutritional, endocrinology, reproduction biology, human pathology and develop employable skills with regards to clinical pathology.	RPSZOO202	Biochemistry and Metabolism II	The knowledge obtained will provide students opportunities to enter in areas dealing with different types of enzymes related work. And also the syllabus will help them to face competitive exams.
12. Understand the broad concepts of plate tectonics, physico-chemical parameters of sea, Ocean currents and tides, biological life and fisheries and develop research based employable skills in the same field.			
13. Apply their knowledge in problem solving and future course of their career development in higher education and research.	RPSZOO203	Genetics, Evolution and Developmental Biology - II	Students will understand the following how gene expression is regulated, relationship between genotype and phenotype in human traits, statistical approach towards genetics and influence of particular allele on population.
14. Develop critical thinking, planning and executing research projects and prepare themselves for various competitive examinations.			
	RPSZOO204	Tools and Techniques in Biology- II	At the end of the course the student should be able to explain the principles of the most important liquid and gas chromatographic technique. They must have acquired some technical knowledge, some practical experience and will be able to evaluate strengths and limitations of the most important chromatographic separation and detection methods in relation to the properties of the sample and of the analysis task.

M.SC-II

RPSZOO301	BASICS OF INDUSTRIAL & ENVIRONMENTAL BIOTECHNOLOGY I	Students will get opportunities in areas like biotech companies, research and development institutes and in pharmaceutical industries.
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RPSZOO302	GENETIC ENGINEERING TECHNIQUES AND ITS APPLICATIONS	Upon successful completion the students can apply the obtained knowledge in basic and applied field of biological research. They will have opportunities in Bioinformatics Company. And also the content of syllabus will help them to face competitive exams.
RPSZOG303	GENERAL, PHYSICAL, CHEMICAL AND BIOLOGICAL OCEANOGRAPHY	Explain the theory of plate tectonics and its relationship to the formation of the major features of the sea-floor. • Demonstrate how the oceans are connected to and drive major Earth ocean processes, such as atmospheric and oceanic circulation, climate and weather being helpful to students in the field of research.
RPSZOG304	PLANKTOLOGY, FISH, FISHERY SCIENCE, IMMUNOLOGY OF FISH AND AQUACULTURE	Identify the role of the immunological system of fish, its components and various external factors that affect it. Since fish and seafood requirements on a global level are high, students will learn the major fisheries and different systems of aquaculture which could provide an alternate means of livelihood.
RPSZOP303	Comprehensive Physiology-I	Understand and comprehend the concepts of nutritional physiology, its regulations and neural physiology. Compare and contrast between the different transport systems across the cell membranes. Differentiate and analyse the different physiologies of heart and circulatory systems amongst invertebrates and vertebrates. Understand and analyse the physiology of motility, biochemistry of contractile proteins, and physiology of skeletal muscle fibre.
RPSZOP304	Environmental and Applied Physiology -I	Understand and comprehend the concepts of water, oxygen and solar radiation as environmental factors affecting physiology of animals. Compare and contrast between the different adaptations of invertebrates and vertebrates during oxygen deplete conditions and correlate it with their evolution. Evaluate and analyse the effect of radiation at cellular and molecular levels in animals and understand the phenomenon of radioprotection. Interpret the correlation of enzymes with different cancers. Develop employable skills related to testing various parameters of blood
RPSZOO401	BASICS OF INDUSTRIAL & ENVIRONMENTAL BIOTECHNOLOGY II	Students will have opportunities in research and development related to environmental and agricultural work. They can work in area's dealing with waste management
RPSZOO402	Genome Management, Manipulation, Regulations And Patents In Biotechnology	The subject will help the students to work in research related to genetic engineering.. The techniques taught will help the student to work in immunology department of pathology lab
RPSZOG403	Oceanographic Instruments And Expeditions, Marine	Identify and explain the various oceanographic instruments for the purpose of studying physico-chemical parameters of the sea,
RPSZOG404	Planktology, Fish, Fishery Science And Biology Of The Ocean	Enumerate the methods used in studies of planktons and learn about their relationship with other marine organisms. Study the statistical methods widely used in research analysis and also the factors affecting the dynamics of a population. Identify the various endogenous rhythms in the oceans and discuss the types of reproduction and larvae found in marine organisms.
RPSZOP403	Comprehensive Physiology-II	Understand the physiology of respiration & nitrogen metabolism. Detailed learning in excretion physiology and studying the excretory systems present in various animals. Explore the new technologies used for human interventions. Understand the physiology of hormones in detail.

RPSZOP404

**Environmental and Applied
physiology-II**

Enumerate the pressure as environmental factor and study its effect at cellular level. Understand and gain the knowledge about temperature as an environmental factor and study its importance. Learn in detail about the biological rhythms and Photoperiodism. Understand the antibodies and organ function test as clinical diagnostic tool.

	Programme Outline and Programme specific Outcomes	Course Code	Paper Title	Course Outcomes
MSc Life Science	MSc Life Science Programme Outline The main objectives of the MSc Life Science Program curriculum involve: • The application, attainment and synthesis of knowledge. • Improving written as well as spoken communication skills. • Developing research skills, critical and analytical. • Encouraging critical thinking and problem solving. The MSc (Life Science) is also designed keeping in mind the highly competitive CSIR-NET (Council of Scientific & Industrial Research - National Eligibility Test) exam which only Life Science students in the subject of choice for biological sciences. Qualifying the exam enables the students to secure a Junior Research Fellowship as well as eligibility to apply for teaching positions at various colleges, universities and autonomous. The Life Science program also gives students the freedom of choice to branch out and pursue whatever occupation they wish in any field of biological sciences because of the diversity of the core subjects. The programme of the first two semesters allows BSc students of all biological science streams to have a common foundation in the basics of Life Sciences. The course of the first semester is designed so that every student begins in the same level before advancing to more specialized topics. It includes the basic concepts in Ecology, Cell biology, Biochemistry, Molecular Biology, etc. Topics that help to inculcate a scientific temperament and research acumen are also taught before the students begin their dissertation projects. The second semester is a mix of basic subjects such as Animal and Plant Physiology, Microbiology, Immunology as well as advanced subjects like Cellular Signalling, Cancer biology, Epigenetics, Genetic manipulation and Genetic engineering. The third semester is designed to further the knowledge of the students in the specialization of Biotechnology. Topics like Tissue culture, Fermentation technology and Bioprocess are focused on which have a direct industrial application. Students will also get a chance to work on an individual research project either in research institutes like ACTREC, NRIHRI, BARC, etc. or in the college itself. The individual project work will culminate in a final presentation and thesis at the end of the third semester. Students can also publish their work of suitable. The final semester rounds off the knowledge they have gained by focusing on presenting areas of research like Microfluidics and Nanobiotechnology. Environmental biotechnology and novel areas of research involved in it are also taught to allow the students to find possibilities in improving the environment. The students will also be exposed to the frontiers of Pharmaceutical and Medical biotechnology industries. The teaching style encourages students to use large and reasoning instead of rote learning. Concepts are explained through discussions, debates, presentations and group interactive games. By the end of the program the intellectual mould of the students is well equipped and fortified along with the sense of responsibility and scientific temperament that will assist them in their future endeavours.	RPLSC001	Environment and Biology, Biodiversity and Evolution	This paper covers the basics in ecology, environmental science, biodiversity, evolution, paleontology and anthropology. It also covers the use of software applications that are essential in research. 1. Gain an understanding of ecological concepts and environmental issues. 2. Apply the concepts to the study of life in its relation to the environment. 3. Understand the value of biodiversity and the importance of conservation. 4. Understand biological theories relating to evolution which form the basis of phenomena like antibiotic resistance as well as cancer progression. 5. Appreciate the establishment of biological lifelines existing in water species. 6. Gain the ability to use various essential software that will help them in their respective careers. 7. Build a fully functional website of their choice.
		RPLSC002	Cell and Molecular Biology	This paper provides a great combination of cellular components, molecular level studies in a cell and the subsequent pattern in these interrelated topics world class student's concepts. Students understand the most basic concepts fundamentals of cellular structures, components and their functions along with the detailed events occurring in the cell cycle, its role, regulation and checkpoints which is most important and highly coordinated process in all multicellular organisms. The event of Synthesis cell cycle and role of the checkpoints is dedicated as a separate unit to understand the details of mechanism involved in DNA Replication, recombination and repair. The event of Translation and Transcription gives detailed concepts of the central dogma of life from DNA to RNA to protein which serve the whole purpose of molecular biology. Genetics will enable the students to understand not only the inheritance pattern of gene but entire unit comprises of comparative aspects of genes right from knowing the molecular genetics to quantitative genetics to population genetics and also the gene mapping methods.
		RPLSC003	Biochemical Studies	Biochemistry are the basis of life right from the composition of a DNA and this paper is dedicated to these biochemical aspects which includes knowing the structure and function of certain basic biomolecules and the pathway / mechanisms for food and energy production. Proteins are used to be the building blocks of life and comprehending their unique properties will help understand advanced subjects like protein engineering, vaccine formulation and drug designing. Understanding the structure and properties of lipids are vital in the development of novel drug DNA delivery systems like liposomes. The other unit describes the chemical, structural properties with the concept of intermolecular and biological roles of carbohydrates. It also includes the topics of vitamins and minerals which gives the details of their structures, importance and roles along with deficiencies. All the biochemical reactions are not possible without enzymes and hence the unit of enzymology gives detailed facts of enzyme structure, active site, substrate interactions, kinetics and regulation of their activities that helps all the metabolic pathways to run smoothly. Continuation of food and energy production which comprises the synthesis and oxidation of biomolecules includes detailed understanding of the pathway and mechanisms involved in ATP synthesis in plants as well as organisms which are illustrated in a separate unit of photosynthesis and electron transport chain.
		RPLSC004	Research Basics and IPR	Students will have a strong foundation in essential components of research in Life Sciences like Research methodology, Scientific writing, instrumentation and Biostatistics, as well as an introduction to Intellectual property rights and patenting.
		RPLSC005	Microbiology, Immunology and Plant Physiology	The microbiology unit gives a complete overview of the subject including the classification of microbial diversity, cell structure as well as growth curve patterns. Students also get insight on the important secondary metabolism produced by microbes like antibiotics. They also learn the important aspects of host-parasite interactions. Knowledge of antigen-antibody interactions are vital for the development of immunochemical methods used in diagnostics or therapeutics as well as in drug development. Understanding immunology is essential for a career in medical biotechnology. Plants hold an important place in human society and have developed amazing strategies and mechanisms for survival and growth. These units focus on various aspects of plant physiology including photosynthesis, development and stress responses. Knowledge of stress physiology will help in the development of resilient transgenic plants to be used in agriculture. Other aspects of plant biology will help students understand plant tissue culture principles and techniques.
		RPLSC006	Model organisms and life processes	This paper involves the study of higher organisms including animal physiology, developmental biology and microbiology. Animal physiology deals with the comparative biology and anatomy of various life forms like digestion, respiration, circulation and excretion. Students should be able to understand various processes that help as functions. It will allow them to understand drug metabolism and uptake as well as the various disorders arising from defects in biological processes. The understanding of events between gene expression, cell division and differentiation are the basic foundations that cause multicellular organisms with tissues and organs. These beautiful biological aspects are part of the developmental biology unit that highlights these concepts in development of organisms. Students not only learn the depth concepts of gene expression, classification and formation of germ layers during development process but they are also introduced to various important fundamental concepts of development like commitment, specification, determination, differentiation, competence, cell fate and lineage to name a few which are explained with different examples. This gives a clear idea of comparative studies of various development processes. Nanobiology is a unit that enables students to understand various system particularly that of humans. Students will learn the basis of neuroanatomy and neurochemical mechanisms like electrical & chemical signaling and neurotransmission. Students will also be exposed to advanced features of the nervous system such as the sensory system, motor and movement control, behavior, emotions, learning, memory and pain. Research mainly involves innovation that are in the form of novel experiments which are incomplete without studying model organisms. This unit is dedicated to understanding and naming various model animal organisms. Students learn the life cycles, traditional and new methods for culturing and maintaining these organisms along with information on their latest diseases and experimental models.
		RPLSC007	Genetic Engineering and Cell Signaling	This paper comprises advanced topics in molecular biology which deals with the regulation of gene expression with insights to the introduction to genetic engineering and also cell communication and signaling processes. Expression of a gene depends on the fact whether it is present in a prokaryotic or a eukaryotic organism as both hold completely different mechanisms. Two separate units are designed in a way that students would get a clear idea regarding not only the details of mechanisms involved but the comparative concepts of gene regulation overall. One such unit gives details of the structure and the importance of the components involved in eukaryotic gene regulation. It also explains certain aspects of eukaryotic gene expression due along with the introduction to the new emerging field of research in Epigenetics that highlight the concept of availability of a gene for its expression in eukaryotic organism due to the regulatory of the structure of the fundamental unit of eukaryotic gene regulation. The other unit deals with the detailed anatomy of the mechanisms involved in prokaryotic gene regulation where students understand various system in comparison with the processes involved in eukaryotic gene regulation including the post transcriptional as well as post translational modifications and role of various factors involved in both the processes. Students will be introduced to the tools used for genetic engineering like restriction enzymes, vectors and the concept of Transformation, Transfection and Transduction methods used for introducing recombinant genes into various host organisms. The last unit consists of the various types of cellular signaling, receptors and signaling pathways, apoptosis and cancer biology. Understanding how cells communicate with each other as well as the internal pathway that govern several cellular processes are vital when studying cell physiology and other diverse of abnormal signaling. This unit has new treatment strategies.
		RPLSC008	Genetic Engineering	This entire paper deals with the several recombinant techniques that we currently used in the genetic engineering field and various comparative expression systems using prokaryotes & eukaryotes that have been successfully developed. It gives a complete picture to students where they learn these recombinant techniques as well as their applications in the form of expression systems. Students understand the detailed mechanisms of techniques such as transposons, genome editing using CRISPR-Cas9, TALENs, the various RNAi methods and nucleic acid manipulations using various tools of Biotechnology. The other units involve use of different genetic engineering tools and combinations of these techniques used for different applications in the form of expression systems with examples like insulin, growth factors, antibodies and etc. In comparison with the microbial expression systems students also learn the expression systems in lower eukaryotes such as algae, fungi, yeasts and protozoans which display unique applications of their own.
		RPLSC009	Tissue Culture and Agriculture	This course deals with introducing the techniques, principles and practical considerations of plant tissue culture, animal tissue culture, aquaculture as well as the production of transgenic plants and animals using these techniques. The students will be aware of the technological aspects of plant tissue culture which have direct industrial and commercial applications in agriculture, horticulture, crop improvement and secondary metabolite production. They will also be able to prepare plant tissue specific media, sterilize and inoculate explants and maintain cultures in the laboratory. Agriculture is one of the most important occupations but is at risk due to the challenges of global warming, high demand and less crop irrigation. The field of plant biotechnology is vital for ensuring the survival of the human race as it tackles these problems by the production of transgenic plants. Students will be able to understand the strategies for crop improvement and yield. Animal tissue culture also has a great deal of medical, commercial and industrial applications. The students will understand the key concepts of animal tissue culture such as culture principles, techniques, applications as well as identification and control of contamination.
		RPLSC010	Fermentation Technology and its Application	Along with agriculture, much of society is dependent on water resources either as a source of income or for food. The unit on aquaculture explains the culturing techniques and importance of various aquatic species and will give the knowledge of various artificial breeding practices, factors that affect optimum growth of aquatic organisms and evaluate the status of aquaculture in India and the world. They will also understand the scope of aquaculture as a lucrative business. This paper is dedicated to the industrial aspects & applications where students acquire knowledge about the various fermentation processes and concepts behind them. Students gain detailed knowledge about the fundamental concepts of fermentation techniques, components involved in designing of a fermenter, culture & growth kinetics of the organism used which is critically important for the production of primary and secondary metabolites and the systems as well as downstream processes. Separate units are designed to understand various applications of fermentation processes involved in production of commercial products from primary to secondary metabolites. Secondary metabolites from plants as well as microbes have a wide range of applications, i.e. from cosmetic to pharmaceutical. The large scale production of these metabolites requires an understanding of fermentation technology and specific parameters for each kind of product to be produced. Students will be aware of the various types of secondary metabolites, their classification and biochemical pathways and the industrial production of specific examples like Tansol. The downstream process unit enables students to understand the product recovery and economics behind it along with the efficient downstream methods which is an important part of any industrial process.
		RPLSC011	Bioinformatics, Instrumental Standards and Bioethics	In this paper students will be introduced to the theoretical and practical techniques of bioinformatics. The application of bioinformatics and biological databases to problems solving recent problems will be emphasized. This paper also includes a brief introduction to instrumental standards, bio-entrepreneurship as well as various bioethical issues. The first part provides an introduction to computer science and internet protocols as a brief to fully appreciate its role in society as well as in research. The students will also become familiar with the use of a wide variety of biological databases and will be able to apply these methods to research problems. The concept of Alignment explains the basis involved in creating a phylogenetic tree. Students will learn the concept of multiple sequence alignment and various methods along with the various sequence alignment and different software for the same. This will be the foundation for understanding the concepts of phylogenetic trees. It further details the concept, terminology, types and properties of phylogenetic trees and the various methods of building it: manually as well as computationally in order to clearly understand the principle behind construction of the tree. In order to set up any medical, pharmaceutical, food or diagnostic industry one needs to have a know-how of the various standards and guidelines applicable to be able to succeed. This paper includes a brief outline of such as GMP and GLP practices. Students will gain an understanding of the requirements, procedure and importance of these certifications. This will also provide a basis for a future career in quality assurance, quality management or auditing. There is a strong emphasis in encouraging the youth to set up their own businesses and their own houses instead of joining the corporate world. However most students are aware of the facts that a bold vision is not enough. This unit highlights the importance of setting up a successful biotechnology industry and gives several examples of successful Indian bio-entrepreneurs. Along with setting up a successful business, it is also important to have a strong foundation in regulatory setting developments in biology and medicine. It is best understood through debates on various topics as it gives a unique perspective on both sides of an issue. At the end of this unit students will be able to bridge the gap between the laboratory and the commercial marketplace as well as have a strong foundation on bioethical issues.
		RPLSC012	Project Work	This paper is meant entirely for an individual research project which can be carried out in research institutes like ACTREC, NRIHRI, BARC, etc. or in the college itself which includes a final presentation, viva voce and a written report. Students will learn to design and perform experiments, document results, perform statistical analysis and write their observations and conclusions independently. They will also learn how to give oral presentations, troubleshoot failed experiments and be successful in the defense of certain instruments or apparatus. Students can eventually publish their work in research journals or present their work in the form of oral or poster presentations at national or international conferences of interest suitable by their research goals.
		RPLSC013	Medical Biotechnology	Students gain insightful knowledge regarding the applications of biotechnology in the field of medicine. The first unit includes the principles, production and examples of gene therapy, antisense therapy and protein therapeutics. Students will be aware of the strategies of applying gene therapy or antisense therapy to combat various diseases. Students will also learn the classification, production methods and applications of therapeutic proteins that are engineered proteins that have revolutionized the field of medicine and diagnostics. Separate unit is designed for engineering of vaccines and antibodies that help students to understand the important new concepts and their applications for various diseases. Working on designing a drug is the core application for the medical field which are separate units where students learn concepts right from identification of the API in activity guided drug development to its metabolism and action. These units will provide students with a background in pharmaceutical research and the journey of a drug before it reaches the market. Students will also study the various methods used for developing new therapeutics, and the use of computational models for rational drug design. This is coupled with the interesting concept of pharmacogenomics to help assess various diseases like cancer syndromes, neurodegenerative and cardiovascular disorders to name a few.
		RPLSC014	Applied Biotechnology	Applied biotechnology is a paper which includes a diverse range of fields like animal reproductive technology, nanotechnology, forensics, microfluidics, biosensor design and nanotechnology. This gives students the ability to understand a wide variety of application and career oriented topics. The increase in infertility rates has led to a boom in the field of assisted reproductive technology (ART). Students will gain an understanding of the issues behind infertility, the physiology of reproduction, principles and techniques of ART, cryopreservation and latest developments in the field. Nanobiotechnology is the application of nanoscience in the field of biological sciences. It has a huge application in the medical field as a delivery system for drugs and other molecules. Students will learn the types of nanomaterials, its synthesis and characterizations as well as novel areas of research in the field. They will also understand about zinc oxide and ferromagnetic nanoparticles in the laboratory and determine their biological activity. Students will be introduced to the existing genes of interest like microfluidics and biomimetics where they learn to apply the fundamentals and concepts and their various applications. Use of different biosensors makes them understand the basis in designing chips. Microfluidics will enable them to learn the nature of fluids at a microscale and design different applications in a small arena known as a lab-on-chip. Biomimetics allows them to understand how to mimic natural observations for better creation or be inspired to give rise to important commercial products and unique techniques that can benefit the human. Forensic science is a challenging field with a variety of applications. This unit combines crime scene investigations with molecular biology techniques so students will be expected to be the basis of forensic sciences. They will also perform sample experiments like hair microscopy to put their investigative and deducing skills to the test. The second part of the unit explores the field of diagnostics. Creating an accurate, quick but cost effective diagnostic kit for a certain disease or infection is a challenge. Students will learn the importance of diagnostics and its application to create kits for rapid diagnosis of diseases.
		RPLSC015	Environmental Biotechnology	Environmental biotechnology is a vital branch of biotechnology which deals with the use of the principles of biotechnology to improve the environment for humans as well as other organisms. The first unit deals with the challenges of pests to agriculture and the biological alternatives to harmful chemical pesticides. Students will understand the drawbacks of various types of chemical pesticides, their biological alternatives, their mode of action and mass production. They will also learn the techniques of Integrated Pest Management (IPM) to sustain the least amount of crop damage while maintaining pest populations. Similarly students will be able to compare the use of chemical fertilizers with biological alternatives and the use of genetic engineering to improve nitrogen fixation. They will learn about soil enriching techniques like composting, the ecological role of mycorrhizae and the emerging technique of aquaponics. As an integral part of environmental studies this unit of Bioremediation starts with the topic of solid waste management where students are made aware of their responsibility to keep the environment clean by learning the types of waste generated around as well as the various strategies and methods to manage these wastes right from segregating plastics to safe disposal. Along with this they also are made aware with the history of all different environmental acts & laws and current status of the steps taken by the government like the "Swachh Bharat Abhiyan". Being in the field of Biotechnology they will also help them to gain knowledge regarding the natural way of cleaning the environment using microbial organisms either in their natural form or genetically modified. They will learn various adaptive strategies of micro-organisms in the steps of expert systems to combat toxicity and stress. Using different examples, pathways and strategies involved in these microbes they put an insight into the concepts involved in the process of bioremediation. Along with bioremediation, phytoremediation is also taught as an in situ and biologically pleasing method of pollution remediation. Students will understand the role of various species of plants in phytoremediation, phytoremediation types, steps involved in the process and a plant's intrinsic detoxification mechanisms. They will also be exposed to phytoremediation of various metals like gold and the various uses of the process.
	RPLSC016	Protein Studies, Biochemical and Advanced Bioinformatics	Metabolic pathways occurring in-cell organelles can teach some very important attributes of life such as organization, co-ordination, synchronization, perfection, time management and trouble-shooting. One of the perfect examples to display these attributes is the most beautiful but complicated process of protein trafficking right from synthesis to targeting where every step needs to be so perfectly and timely synchronized to avoid major disorders. Students get to explore the world of protein trafficking by learning all the intricate details of protein synthesis, glycosylation process, intrinsic - extrinsic pathways as well as vesicle transport, targeting to their respective organelles and how the correct trouble shooting mechanisms like the ERAD pathway. As an important interrelated process in the above unit of protein trafficking is the appropriate folding of the protein in its native conformation to become fully functional which deals in details as a separate unit of Protein folding. Students will understand the folding pathway involved in protein achieving their native conformation with the associated thermodynamics aspects and the chapters families that help in the process. The unit of advanced bioinformatics is also coupled with this paper as students can learn the concepts and advanced software used in the field of proteomics and genomics to give an overall perspective of complete protein studies under one roof. Students will also be able to visualize drug docking into target proteins in the process of drug discovery. Bioinformatics is a blend of mathematics and its role in understanding biological phenomena. A strong basis in maths is required to understand biological modelling, growth curves, population genetics, epidemic modelling, enzyme kinetics, analyzing their effectiveness as well as cancer treatment modelling to name a few. Students will be given a crash course on advanced calculus and basic problems in biological sciences to solve.	

M.Sc. MICROBIOLOGY				
SUBJECT	PROGRAMME OUTCOME	Course Code	Paper Title	Course Outcomes
M.Sc. MICROBIOLOGY	1. As a part of Master's course, students will revise few topics of virology like properties of bacterial viruses, T4 bacteriophage replication along with introduction to other bacteriophages like T7, lambda, phi X174.	RPSMIC 101	Microbial Genetics	A complete understanding of basic genetic mechanisms like transcription and translation mechanisms, including post translational modifications will create a firm base of gene functioning and will help students distinguish between prokaryotic and eukaryotic transcription. The learner will also be able to assimilate the different levels of gene expression regulation and the different mechanisms by which it is regulated. Further, a detailed study and significance of Mt and Cp DNA and chromosomal rearrangements will equip the learner with a strong foundation for applying these principles for any biological system and comprehend their importance in evolution. The section on transposons will make the learner capable of stating the medical significance and evolutionary significance of transposons, explaining the role of Ac, Ds elements of Maize and P element of Drosophila as transposable elements. Awareness on the genetic basis of cancer and the role of cellular homologs of viral oncogenes and tumor suppressor genes will enhance the learners understanding of oncogenes and cancer and help the learner use this knowledge in further applications in research
	2. Plant viruses were one of the earliest viruses to be discovered and have economic importance due to its ability to infect plants and decrease their yield. Students will understand plant viruses with respect to their morphology, transmission, life cycle and detection methods.	RPSMIC 102	Microbial biochemistry I	The section on „Aqueous solutions and acid base chemistry“ in this course promotes problem solving such that the learner will be able to solve calculations in preparation of solutions and manipulation of behavior of biomolecules for analytical techniques and apply these techniques to the advancement of knowledge in microbial Biochemistry. The second section reinforces the fundamentals of structure and function of biomolecules, knowledge of which will help the learner analyze and evaluate several biological processes related to complex processes like signaling and communication. The course also introduces biological pathways for metabolism of 1C and 2C compounds and transport mechanism across membrane like drug export mechanism giving rise to antibiotic resistance to emphasize some key biochemical processes not covered in the UG level.
	3. Animal viruses have clinical significance. Important animal viruses like influenza virus, rabies virus, pox virus and such other animal viruses will be taught to students with emphasis on epidemiology, clinical significance and life cycle.	RPSMIC 103	Medical and Clinical Microbiology	Elaborate on pathogenesis mechanisms, and mode of transmission, epidemiology and therefore modes of prophylaxis of some current and emerging diseases Understand nature of regulation of expression of pathogenicity, evasion of host defense. Understand the nature and methods of eradication of biofilms, especially those on implants and medical devices contribute to the tackling of the threat of antibiotic resistance Perform and analyze all kinds of clinical microbiological tests associated with antibiotic susceptibility testing.

	4. Students will be introduced to cell biology which will include revision of structure of cell organelles like mitochondria and chloroplast and study of other cell structures like cell membrane, endoplasmic reticulum, Golgi apparatus in detail.	RPSMIC 104	Emerging areas in Biology	Students undertaking this course will participate in multiple hands-on practical sessions and be able to perform common applications as mentioned above including introductory computational analyses and interpretations as well as an understanding of considerations undertaken for the analysis of high throughput data sets from various databases. The course will help student understand fundamental engineering concepts applicable to biological engineering, recognize key research work from academia & industry towards practical applications, receive hands on training with computational and experimental synthetic biology. Students will be introduced to the emerging field of nanobiotechnology. They will understand the synthesis of nanomaterials and their applications in the field of biology and medicines. Students will appreciate the technological advances in the field of nanobiotechnology. They will be able to understand methods for chemical synthesis and sequencing of DNA, the process of genetic manipulation in eukaryotic models and methods of directed mutagenesis.
	5. Students will understand cellular processes like cell division, cell cycle, cell to cell communication. Students will be taught molecular mechanisms involved in these processes as well as physiological significance of these processes.	RPSMIC 201	CELL BIOLOGY	A detailed account of components of the cell membrane and also their significance in several functions of the cell including electron transport and solute transport and cell signaling would make the student capable of investigating further on transport of specific components. They will also able to distinguish between different types of transporters, channels and pumps functioning in influx and efflux of solute. Understanding mechanisms of protein sorting, the mechanism of transportation of proteins into different cell organelles and nucleus would enable the student extrapolate to various branches of biology like, enzymology, immunology etc. Understanding the structure and mechanism by which mitochondria produces ATP, and chloroplasts perform photosynthesis will help student gather overall information on cell energetics and also know how light reactions are integral part of energy generation in photosynthetic systems and therefore apply it to specific systems, while the section on cytoskeletal functioning will help the students appreciate how the cytoskeletal framework supports the cell structure and cell behavior in different environments A thorough understanding of the mechanism of cell cycle, relationship of cell cycle and programmed cell death via intracellular and extracellular control mechanisms, the importance of cell junctions and cell adhesion, the role of signaling genes and regulatory proteins in the development of multicellular organisms, sex determination and cell communication will help in completing a strong base of cell biology for the learners such that it will ease their progression to research in biological sciences

	6. Students will revisit some of the basic concepts of genetics like prokaryotic transcription, translation, homologous recombination. Students will also learn topics like regulation of gene expression, mutation and repair, cytoplasmic inheritance, molecular and population genetics. Thus students will understand various branches of genetics.	RPSMIC 202	Microbial Biochemistry II	The students will be able to calculate molecular weight, purity, length and volume of organic compounds. On learning the principles of methods of enzyme extraction and purification students will be able to apply these methods for extraction of enzymes practically. They will also be aware of the principles and applications of GC-MS, X-ray diffraction and confocal microscopy for mass determination, structure determination and location of protein and of the methods of analysis of biomolecules. With a sound background of Enzymology, students will be able to explain the enzyme terminologies basic concepts of enzyme catalysis, allosteric enzymes and its regulation, regulation by covalent modification, multienzyme complexes and multifunctional enzymes. The students will also be able to differentiate between different methods of enzyme regulation by the understanding developed with the help of this learning. Understanding mechanisms of bacterial stress responses, mechanisms of quorum sensing using different examples will enhance the analytical ability of the learners and also applicability of these responses to other stress conditions or survival mechanisms. Students will be able to discuss the organisms, enzymes, and genes involved in microbial degradation of aromatic compounds. This will enhance their understanding about bioremediation strategies. They will also be able to explain the mechanism of biotransformation of aromatic compounds like Naphthalene, phenanthrene, anthracene, alicyclic and higher aliphatic hydrocarbons and biochemical mechanisms of pesticide detoxification. Overall this section will also make the students more conscious towards environmental problems and also trigger them to find viable solutions.
	7. Students will revisit basic concepts of gene transfer mechanisms like transformation, transduction, and conjugation. Students will study topics like viral genetics and transposable elements in detail.	RPSMIC 203	Environmental Microbiology	Through this course, students will understand basic concepts of microbial ecology. They will realize and appreciate microbial diversity in environment and also know characteristics of various extremophiles. They will know the potential biotechnological applications of proteins from extremophiles. Students will understand techniques in microbial ecology with respect to sampling, sample processing and cultural methods. They will also know physiological methods of analysis of ecological samples. Students will realize the use of modern approaches of studying microbial ecology like genomics, proteomics, immunological and nucleic acid -based methods. Students will understand soil and marine ecosystems with respect to their structures and properties. Students will know agricultural microbiology and interactions between microorganisms and plant structures. Students will get an in depth understanding of role of microbes in biogeochemical cycles for various elements.
	8. Students will be introduced genetic mechanisms involved in development of embryo. Students will be taught about application of genetic technology in diagnosis of genetic disorders and forensics.	RPSMIC 204	Research Methodology	The learner will be able to formulate a hypothesis, differentiate between laws, theory and postulates, design a research project, execute the experiments including appropriate calibrations and controls, with a carefully written record of the outcomes; use different methods of data collection and process the collected data by conventional and modern methods. They will understand the significance of studying different variables in a research study and its effects on the results obtained and the importance of the statistical analysis of the results. At the end the students will also be aware of different methodologies by which research can be effectively communicated

	9. Biochemical calculations is important for practical work in biological sciences. Students will learn to do calculations for various measures of concentrations. They will also learn structure and properties of four major biomolecules viz. proteins, carbohydrates, lipids and nucleic acids.	RPSMIC 301	Immunology and Clinical Research	Students should be able to- Conceptualize how the innate and adaptive immune responses coordinate to fight invading pathogens Discuss the role of antigen in initiating the immune response Understand immune response developed against viral and bacterial infections. Understand molecular basis of generating immunoglobulin diversity Discuss various types of immune tolerances Understanding mechanisms to generate immune tolerance Understand various aspects of clinical research
	10. Students will be taught the techniques used to work with these biomolecules. Various methods involved will be studied with respect to principles and procedure and their relative advantages and disadvantages.	RPSMIC 302	Food Microbiology	Students will realise the importance of microorganisms in foods and how the microbiological quality of food is of great significance. Students will appreciate the roles of good microorganism in giving them fermented foods with the desirable texture, taste and appearance. Students can also try making those foods at home keeping in mind all the conditions required for a well-directed fermentation, e.g. wine, cheese, idli. Exposure to preservation techniques will help to understand the ways to increase the shelf life of the food while still maintaining its quality. It will also make them aware how the foods are wasted or can become toxic for us if not stored properly at a desirable condition. Students will be able to enumerate and detect different pathogenic microorganism by applying the different method which they have studied. Students will learn different ways to ensure the safety of food by keeping the good manufacturing practices in mind. HACCP will help them understand the different points of contamination during production and processing of foods and the measures to be taken to avoid it. A systematic and in depth study of this course will make the learners entry into food industry much easier and will also make it easier for them to adopt to working condition in food microbiological laboratory.
	11. Enzymes are involved in catalysis of biochemical reactions. Students will study enzyme kinetics, enzyme regulation and enzyme catalysis mechanisms in detail.	RPSMIC 303	Advances in Biotechnology	Students will understand basics of plant tissue culture with respect to terminologies and techniques involved. Students will know production of secondary metabolites using plant tissue culture. Students will understand genetic engineering involved in plant biotechnology. Students will realise use of plant cells for production of secondary metabolites. Students will understand concepts associated with animal tissue culture. Students will understand the techniques involved in development of transgenic animals. Students will be introduced to the emerging field of nanobiotechnology. They will understand the synthesis of nanomaterials and their applications in the field of biology and medicines. Students will appreciate the technological advances in the field of nanobiotechnology. Students will know genetic disorders and should understand their diagnosis at pre-implantation and pre-natal stage. Students will be sensitized to the importance of genetic counselling in the process of diagnosis and treatment of genetic disorders. Students will understand the concept of gene therapy. They will also learn the meaning, applications and significance in the modern scenario of terms like pharmacogenetics, toxicogenomics, tissue engineering and biomolecular engineering.

	12. In undergraduate course, students have studied the metabolism of sugars and lipids with respect to their use as carbon sources. In Master's course student will learn utilization of one and two carbon compounds as their carbon source. Students will understand pathways involved in their metabolism and ecological significance of their metabolism. Also students will learn microbial degradation of aromatic compounds and its ecotoxicological significance.	RPSMIC 304	APPLIED AND ENVIRONMENTAL MICROBIOLOGY	Through this course, students will understand basic concepts of microbial ecology. They will realise and appreciate microbial diversity in environment and also know characteristics of various extremophiles. They will know the potential biotechnological applications of proteins from extremophiles. Students will understand techniques in microbial ecology with respect to sampling, sample processing and cultural methods. They will also know physiological methods of analysis of ecological samples. Students will realise the use of modern approaches of studying microbial ecology like genomics, proteomics, immunological and nucleic acid -based methods. Students will understand soil and marine ecosystems with respect to their structures and properties. Students will know agricultural microbiology and interactions between microorganisms and plant structures. Students will get an in depth understanding of role of microbes in biogeochemical cycles for various elements. The background knowledge of the learner about sampling and sample processing approaches for food and water samples, standards used for analysis of food and water laid by regulatory authorities will strengthen his/her knowledge base. Exposure to modern methods of food analysis like use of biosensors, and to nutraceuticals as a class of compounds used for nutritional and pharmaceutical purposes, will trigger the innovative minds; while knowledge on microbiological analysis methods and regulations for drinking water will strengthen skills of the job seekers
	13. Students will learn mechanism of transfer of protein molecules across cell membrane in bacteria.	RPSMIC 401	Medical Microbiology and Epidemiology	Learning outcomes: Students should be able to: Study pathogenesis and clinical features of different diseases Comment on the mode of transmission, epidemiology and therefore modes of prophylaxis of these diseases Given a few key clinical features, identify the likely causative agent. Comment on the methods of diagnosis of the disease. Correlate classes of antibiotics with their mechanism of action Comment on drug resistance mechanisms Evaluate drugs and antibiotics for their efficacy Understand nature of biofilms and its association with human diseases Understand methods of eradication of biofilms Understand definitions associated with epidemiology Understand the concept of microbiome. Know the positive effects of microbiota on human health
	14. Cell to cell signaling is also involved in prokaryotes. Students will learn two component signaling system in prokaryotes. They will learn various examples of physiological conditions under which two component system is operated.	RPSMIC 402	Pharmaceutical Microbiology	Learning outcomes: Students should be able to: Get introduced to terminology used in pharmaceutical microbiology. Understand regulatory aspects in pharmaceutical industry, QC, GCLP. Understand design of pharmaceutical industry. Understand principle behind microbial testing carried out in pharmaceutical industry. Understand concept of validation and apply it to pharmaceutical industry. Get introduced to modern methods of drug discovery. Understand methods used for proteomic and bioinformatics studies. Understand the process of lead identification. Get introduced to various softwares used for studying 3D structures of drug and target molecule.

	15. At master's level students will be trained to carry out research projects. Students will be trained to conduct research methodically by teaching them fundamentals of research methodology. They will be taught how to define a research problem, hypothesis, sampling and data analysis. Thus students will be taught about various aspects of research. Students will also be trained for scientific writing by teaching them report writing.	RPSMIC 403	Advances in Biotechnology	Learning outcomes: Students should be able to: ☐ Understand the process of production of various biopharmaceuticals. ☐ Know about new vaccines and vaccine designing approaches. ☐ Get introduced to various drug discovery tools and appreciate use of in silico methods in drug designing. ☐ Understand basic concepts of IPR, understand requirements of patentability. ☐ Know type and categories of biotechnological patent. ☐ Get sensitized towards ethics in biological sciences. ☐ Know about regulatory authorities for dealing with ethical issues. ☐ Understand methods for chemical synthesis and sequencing of DNA. ☐ Understand process of genetic manipulation in prokaryotic and eukaryotic models. ☐ Understand the method of directed mutagenesis. ☐ Understand various steps involved in protein engineering. ☐ Get introduced to field of synthetic biology and know its applications in industry.
	16. Extensive use of instruments is involved while conducting research in biological science. Thus students will be taught principles and operations of spectroscopic and chromatographic techniques. Students will also learn molecular biology and nanotechnology techniques.	RPSMIC 404	Internship	
	17. Microorganisms are associated with food. Microbes can be beneficial as well as detrimental to food. Students will learn uses of microorganisms in food as well as spoilage of food caused by them. Also they will learn methods of detection and control of microorganisms in food.			
	18. Principles of biology are applied for human benefit through biotechnology. Students will be taught core concepts related to animal and plant biotechnology. They will be introduced to field of nanobiotechnology.			
	19. Microorganisms affect environment in different ways. Students will realize microbial diversity in environment thus presence and survival strategies of microorganisms in varied environmental conditions. Students will learn about techniques involved in study of these microorganisms.			

	20. For study of microorganisms associated with various ecosystems, it is important to understand the formation and characteristics of these ecosystems. Students will understand the soil and marine ecosystem along with the microbes associated with them. They will also learn methods and standards for microbiological analysis of water.			
	21. Pharmaceutical and cosmetic products are produced at industrial scale. These manufacturing processes are prone to microbial contamination. Students will learn guidelines for good manufacturing practices associated with these processes. They will also understand methods for microbial analysis of pharmaceutical and cosmetic products.			
	22. Students will understand the principles underlying the process of drug discovery used which is rational method for development of medicines.			
	23. Students will learn few other branches of advanced biotechnology like Pharmaceutical biotechnology, Marine biotechnology and molecular biotechnology. Studying these subjects will help the student develop competency to pursue career in research in these advanced fields.			
	24. Intellectual property is important in science in order to safeguard things you develop. Students will be introduced to different types of patents intellectual properties and their specifications. Students should be able to identify the patentability of the invention.			
	25. Students will understand concepts of biodegradation and bioremediation process. Students will understand the process of biofilm formation and also methods for biofilm eradication.			

SUBJECT	PROGRAMME SPECIFIC OUTCOMES	COURSE CODE	PAPER TITLE	COURSE OUTCOMES
Computer Science	A student completing master's degree in Science program in the subject of Computer Science will be able to: Develop keen interest in the emerging technologies in the industry. Analyze, innovate, and solve real-life case studies using technology. Work in teams with various disciplines; working on an interdisciplinary project. Understand work culture in the industry and attain skills to become a successful entrepreneur. Develop a skillset analyze, describe, and innovate various methodologies to solve a given problem Understand the philosophy of the subject to apply to various fields of research. Work in an industrial environment under expert supervision and develop expertise in various technologies Effective utilization of available resources to overcome challenging tasks.	RPSCS101	Analysis of Algorithms	Students completing this course will be able to:
		RPSCS102	Advanced Computer and Enterprise Network Architecture	• Working and analysis of Algorithms
		RPSCS103	Advanced Database Management Systems	• Understand architecture of Advanced computer Networks
		RPSCS104	Robot Computing	• Design database schema with the use of appropriate data types • To create ,manupulate query and back up database.
		RPSCS201	Advanced Operating Systems	• Understanding implementation of Robot • Simulating actuators and working with the same. • Designing A.I. strategy and Heuristics.
		RPSCS202	Design and implementation of Modern Compilers	• Understanding various types of ooperating systems • Working with real time & cluster
		RPSCS203B	Elective I - Track B: Cyber and Information Security (Network and Communication Security)	• Working with system softwares • Developing Toy compilers
		RPSCS204A	Elective II - Track C: Business Intelligence and Big Data Analytics (Business Intelligence)	• Working with mobile and cloud security • Developing application to understand computer and network security
		RPSCS204B	Elective II - Track D: Machine Learning (Fundamentals of Machine Learning)	• Developing and understaning business intelligence systems • Working data warehousing and mining for DSS
		RPSCS301	Social Network Analysis	• Machine learning using linear methods and non linear methods • Developing machine learning architectures for clustering
		RPSCS302A	Elective I- Track A: Cloud Computing -II (Cloud Computing Technologies)	• Statistical results for analyzing Social Networking • Understanding the behavior for Social Networking
				• Creating and executing cloud services • Understanding enterprise application services in cloud

RPSCS302B	Elective I- Track B: Cyber and Information Security-II (Cyber Forensics)	- Students completing this course will be able to: - Develop strategies to analyze security loop holes - Develop and understand security protocols in computer and networking
RPSCS303A	Elective II- Track C: Business Intelligence and Big DataAnalytics -II (Mining Massive Data sets)	Students completing this course will be able to: - Big data using Hadoop - Map Reduce using Hadoop - Shingling using hadoop
RPSCS303B	Elective II- Track D: Machine Intelligence - II (Advanced Machine Learning Techniques)	Students completing this course will be able to: - Solving problems involved in machine learning - Developing strategies for machine learning
RPSCS401	Simulation and Modeling	Students completing this course will be able to: - Developing simulation system to simulate real life scenarios - Exploring scenarios using 3D visualizations
RPSCS402A	Specialization: Cloud Computing -III (Building Clouds and Services)	Students completing this course will be able to: Explaining the working or various technologies
RPSCS402B	Specialization: Cyber and Information Security (Cryptography and Crypt Analysis)	Students completing this course will be able to: - cyber security - working with various crypto logical algorithms
RPSCS402C	Specialization: Business Intelligence and Big Data Analytics (Intelligent Data Analysis)	Students completing this course will be able to: - Develop application to perform real life data mining staregies - Working to data warehousing and big data analytics for the same
RPSCS402D	Specialization: Machine Learning -III (Computational Intelligence)	Students completing this course will be able to: - Develop strategies and heuristics for working with ANNs - Develop evolutionary strategies to working on real world problems and solve the same.

SUBJECT	PROGRAMME SPECIFIC OUTCOMES	COURSE CODE	PAPER TITLE	COURSE OUTCOMES
IT	Achieve expertise in various subjects from the broad area of Information technology.	RPSIT101	ADVANCED DATABASE MANAGEMENT SYSTEMS	- Analyze compare and evaluate alternative database architectures and models in different application contexts. - Get promising research direction in advanced topics and techniques. - Use various database tools and software's for designing database applications.
	Design the solution to real world problems and issues using various software and hardware state of the art tools &softwares.	RPSIT102	DISTRIBUTED SYSTEMS	- Develop a familiarity with distributed file systems. - Describe important characteristics of distributed systems and the salient architectural features of such systems. - Describe the features and applications of important standard protocols which are used in distributed systems. - Gain practical experience of inter-process communication in a distributed environment
	Analyze and compare the existing solutions and tools available to the problems and generate new solutions or tools.	RPSIT103	DATA ANALYTICS	- Analyze main statistical features of complex datasets. - Understand how to analyse, characterize empirically complex data. - Use the outcome of data-analytics to draw conclusions in real world.
	Use the techniques, skills and modern computing tools to emerge as a freelancer and entrepreneur in the field.	RPSIT104	SOFTWARE TESTING	- Analyze requirements to determine appropriate testing strategies. - Design and implement comprehensive test plans - Instrument code appropriately for a chosen test technique - Apply a wide variety of testing techniques in an effective and efficient manner - Compute test coverage and yield according to a variety of criteria
	Identify the changing computational domains and adapt the new age technologies and computing domain.	RPSIT201	DATA MINING	- Interpret the contribution of data warehousing and data mining to the decision support level of organizations. - Do research in the area of data mining and related applications. - Categorize and carefully differentiate between situations for applying different data mining techniques: mining frequent pattern, association, correlation, classification, prediction, and cluster analysis. - Design and implement systems for data mining using data mining tools.
	Become a responsible citizen totally aware of environmental issues and develop solutions saving the environment.	RPSIT202	MOBILE & ENTERPRISE NETWORKS	- Understand mobile networks and mobile telecommunication system. - Identify the solutions to the problems in mobile technology. - Develop applications using various development tools.
	Assimilate professional ethics, managerial and soft skills to emerge as a leader to manage diverse projects in industry	RPSIT203	ARTIFICIAL INTELLIGENCE	- be able to design a knowledge based system, - be familiar with terminology used in this topical area, - have read and analyzed important historical and current trends addressing artificial intelligence.
	Apply domain expertise to pursue research in Computer science and Information Technology discipline.	RPSIT204	VIRTUALIZATION & CLOUD COMPUTING	- Describe and compare distributed systems, grid, clusters systems used for computation. - Understand the fundamentals of virtualization and cloud computing. - Use various tools and software used to configure the cloud while implementation. - Understand various programming paradigms used in the development of cloud services.
		RPSIT301	EMBEDDED SYSTEMS	- Describe the differences between the general computing system and the embedded system, also recognize the classification of embedded systems.. - Become aware of the architecture of the ATOM processor and its programming aspects (assembly Level) - Become aware of interrupts, hyper threading and software optimization. - Design real time embedded systems using the concepts of RTOS. - Analyze various examples of embedded systems based on ATOM processor.
		RPSIT302	BIG DATA ANALYTICS	- Use the trick for Big Data use cases and solutions. - Learn to build and maintain reliable, scalable, distributed systems with Apache Hadoop. - Apply Hadoop ecosystem components. - Understand the requirements for Data Analysis.
		RPSIT303A	ETHICAL HACKING	- Understand the core concepts related to computer software and hardware. - Understand the various ways to find the vulnerabilities and solutions to them. - Understand the legal issues and IT Laws laid down in the Cyber Security. - Exploit and find the vulnerabilities using various tools.
		RPSIT303B	ARTIFICIAL NEURAL NETWORKS	- understand the differences between networks for supervised and unsupervised learning - design single and multi-layer feed-forward neural networks - develop and train radial-basis function networks - program linear and nonlinear models for data mining - analyse the performance of neural networks.
		RPSIT304A	DIGITAL FORENSICS	- Identify the type of crime committed in the cyber space. - Initiate and investigate any cyber related crime. - Draw conclusions based on the investigation in the cyber/digital space. - Use various tools for investigating a real time case in the cyber space.
		RPSIT304B	MACHINE LEARNING	- Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc. - Have an understanding of the strengths and weaknesses of many popular machine learning approaches. - Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning. - Be able to design and implement various machine learning algorithms in a range of real-world applications.
		RPSIT401	INFORMATION SECURITY MANAGEMENT	- have an understanding of the key themes and principles of information security management and be able to apply these principles in designing solutions to managing security risks effectively; - understand how to apply the principles of information security management in a variety of contexts; - have an appreciation of the interrelationship between the various elements of information security management and its role in protecting organisations.

SUBJECT	PROGRAMME OUTCOME	Course Code	Paper Title	Course Outcomes
Bioanalytical Sciences	PSO:INTEGRATED M.Sc. IN BIOANALYTICAL SCIENCES	RPSBAS701	Pharmaceutical Microbiology & Pharmaceutical Manufacturing	This will highlight the applications of microbiology for testing quality of pharmaceutical products. Students will understand the norms required for manufacturing in pharmaceutical industry
	This will impart high quality science education in a vibrant academic ambience with the faculty of distinguished teachers and scientists. It will also equip students for the future who will take up the challenge of doing quality research and teaching and also contribute to industrial production and R & D in the fields of Bioanalysis, Bioinformatics and Nutraceutical Sciences. Further it will amalgamate classical analytical chemical techniques with modern genomic and proteomic technologies of manufacturing and analysis to better characterize the products useful as medicines as well as nutraceuticals.	RPSBAS702	Pharmacology & Toxicology	This will highlight the importance of toxicological studies for ensuring safe administration of pharmaceuticals.
		RPSBAS703	Sample handling and Isolation of analytes in Bioanalysis	This will help the student in dealing with different bioMATRICES. The student will be able to chose an appropriate method for extraction and isolation of analytes when varied bio bioanalysis.
		RPSBAS 704	Different systems of Medicine & Regulations	This will underline the importance of bioanalytical techniques for standardization of traditional medicines.
		RPSBAS 801	Molecular Biology & Tissue culture	This will facilitate the student in understanding different tissue culture techniques and studying its applications. Student will also understand th futuristic medicine.
		RPSBAS 802	IPR, Drugs and Cosmetic Act & Regulations	This will familiarize students with the current legal scenario regarding intellectual property rights. Students will understand the importance of Drug act and the need for regulations in Bioanalysisi
		RPSBAS 803	Quality Management in Pharmaceutical Industry	This will give an insight into the good practices followed in industry operations. Students the importance of documentation and strict adherence to protocol in bioanalytical industr
		RPSBAS 804	Pharmaceutical Testing and Proteomics	This will enable the student to make effective use of Pharmacopoeia in evaluation of drugs and related substances. Student will also learn to deal with possible challenges in biopharmaceutica testing.
		RPSBAS901	Research Methodology & Statistics	This will convey the importance of research methodology and research designs in all fields of research. Student will also be able to use descriptive statistics and test of significance for accurate statistical calculations in research
		RPSBAS902	Advances in Bioanalysis I	This will highlight the importance of hyphenated techniques and enable the students to analyze and interpret mass spectrometric data for identification and quantification of analytes.

		RPSBAS903	Automation & Data Management	Student will be aware about the need for Automation analysis. This will convey the importance of electronic data management system. Student will also be able to absorb the concepts of clinical data management.
		RPSBAS 904	Industrial Training	Student will be trained to face the challenges of industry and will acquire requisite skills in the field of Bioanalysis and research.
		RPSBAS1001	Analytical Techniques and their Validation	This will train students to interpret spectral data of IR, NMR and LC-MS for structural elucidation of analytes. Students will understand applications of these techniques with special emphasis on bioanalysis
		RPSBAS1002	Advances in Bioanalysis II	This will enable the students to use mass spectrometry for qualitative and quantitative analysis of data and conduct method development and validation on analytical instruments
		RPSBAS1003	Clinical Research & Ethics	Students will be enlightened about the various aspects of clinical research. They will get a brief idea regarding the case report format involved in BA/BE study
		RPSBAS 1004	Project work	Student will be aware about how to formulate hypothesis, carry out literature survey, effectively analyze the test material, interpret results and properly document and present the research carried out
Bioanalytical Sciences	PSO: MSc Bioanalytical Sciences	RPSBAS101	Principles of Bioanalysis	This will develop curiosity and interest in the field of Bioanalysis. Students will get acquainted with different bio-matrices, and extraction of analytes from the same.
	This course will develop trained manpower in the field of Bio-analytical Sciences with specific emphasis for exploitation of ASU system of medicine as well as its need for changing trends of modern pharmaceutical Industries. It will amalgamate traditional analytical chemical techniques with modern genomic and proteomic technologies of manufacturing and analysis. This course will also introduce the powerful tools of informatics in routine use at manufacturing, QC and research. It will further exposure to National & International regulatory affairs with reference to drugs.	RPSBAS102	Spectroscopic techniques	This will enable students to use spectroscopic techniques like UV-Visible spectrophotometry, colorimetry, Turbidometry, to analyze different biological samples
		RPSBAS103	Introduction to pharmacy	This will empower the student with the knowledge of pharmacopoeias. The student will be able to critically analyze drugs and dosage forms for different pharmacokinetic parameters
		RPSBAS104	Applied Biology	This will train students on analytical techniques like SDS-PAGE and immunoassays. Students will get acquainted with advances in the fields of genomics and proteomics.
		RPSBAS201	Pharmacognosy and Phytochemistry	Students will be able to appreciate the therapeutic properties of plants and effectively use modern methods for extraction and analysis of phytoconstituents

		RPSBAS202	Chromatographic techniques	This will inculcate analytical approach regarding correct choice of analytical method and troubleshooting involved in different chromatographic techniques. The students will be able to effectively use chromatographs for analysis of samples and interpret the results
		RPSBAS203	Practices in Pharmaceutical Industry	This will give an insight into the good practices followed in industry operations. Students will realize the importance of documentation and strict adherence to protocol in bioanalytical industries
		RPSBAS204	IPR, Drug act and Regulations	This will familiarize students with the current legal scenario regarding intellectual property rights. Students will understand the importance of Drug act and the need for regulations in Bioanalysis
		RPSBAS301	Standardization of Ayurveda, Siddha & Unani Medicine	This will underline the importance of Bioanalytical techniques for standardization of traditional medicines. The project work introduced in the syllabus will inculcate the habit of innovative thinking, meticulous work and good laboratory practices
		RPSBAS302	Bioanalytical Techniques I	This will highlight the importance of hyphenated techniques and enable the students to analyze and interpret mass spectrometric data for identification and quantification of analytes. Students will also be able to run bioassays for pharmaceutical samples
		RPSBAS303	Applied Microbiology & Toxicology	This will empower the students to employ antimicrobial agents in an effective way. This will also highlight the importance of toxicological studies for ensuring safe administration of pharmaceuticals
		RPSBAS304	Bioanalytical Data Handling	Students will be able to analyze biological samples in a regulated manner and apply suitable statistical tests to extrapolate the observations to relevant results
		RPSBAS401	Pharmaceutical Biotechnology & Pharmaceutical Manufacturing	This will train students to use appropriate Bioanalytical technique to assess the stability of pharmaceuticals. Students will understand the norms required for manufacturing in pharmaceutical industry
		RPSBAS402	Bioanalytical techniques II	This will enable the students to use mass spectrometry for qualitative and quantitative analysis of data and conduct method development and validation on analytical instruments
		RPSBAS403	Fundamentals of Clinical Research	Students will be enlightened about the various aspects of clinical research. They will get a brief idea regarding the case report format involved in BA/BE study
		RPSBAS404	Modern Analytical Techniques	This will train students to interpret spectral data of IR, NMR and LC-MS for structural elucidation of analytes

SUBJECT	PROGRAMME OUTCOME	Course Code	Paper Title	Course Outcomes
BIOTECHNOLOGY	At the end of program the students would be able to	RPSBTK101	Biochemistry	1. Elucidate the concept of different types of complicated carbohydrate molecules and their structures and comment on analytical methods for detection of carbohydrates
	• Adept in understanding the advanced sections of Biotechnology in the domain of			2. Understand physiological significance of important co factors and molecules like lipids, peptides, endorphins, prostaglandins vitamins and co enzymes
	cytogenetics, Biochemistry along with Molecular Biology ,Cell culture,			3. Discuss different types of inborn errors related to metabolism, glycogen storage, amino acid metabolism, nucleic acid metabolism.
	Immunology, clinical research and IPR thereby understanding the applications and			4. Understand the concept of Neurobiology and establish a basic link to the immune system.
	various opportunities in the field of biotechnology.	RPSBTK102	Immunology	1. Elucidate the concept of antigen presentation and recognition patterns and understand the complement and lectin pathways
	• Identify the problems and understand the gaps in vast array of scientific knowledge			2. Discuss various types of molecules involved in the immune system and comment on role and function of Cytokines
	and would be driven to research and solve to fill those gaps and contribute			3. Discuss methods and procedure of safe sterile Vaccine development, understand basis of Cancer immunology and Elucidate the basis of the Mechanisms of immune response
	immensely to scientific community.	RPSBTK103	Molecular Biology	1. Understand the details of chromatin structure and its functional implications
	• Posses high competitive edge with those of reputed Indian universities and would			2. Understand the basis of gene expression and basic control processes involved in it
	make them competent for jobs in various domains of industries			3. Comment on different post translational events and the underlying functional importance
				4. Comment on protein folding and transport, understand protein sorting
				5. Define the terms genomics and proteomics and understand epigenetic changes and RNA interferences
	PROGRAMME SPECIFIC OUTCOMES	RPSBTK104	Biochemical and Biophysical techniques	1. Comment on advanced and state of the art techniques with various types of electron microscopy
	1. Rigorous evaluation through project based assignments on analytical techniques and bioprocess technology give our students an edge over others in acquiring deeper understanding of the concepts and its practical value in the advanced domains of biotechnology			2. Discuss on the variety of spectroscopic techniques with respect to molecular analysis
	2. Enabling students to understand the importance of handling vast amount of data whether retrieving,processing or analyzing through various tools of bioinformatics and biostatistics			3. Discuss combination and detection methods with spectroscopy and understand different aspects of immunological and histochemical techniques.
	3. Exposed to emerging domains of biotechnology like nanobiotechnology,clinical research opens up vast array of opportunities for research in these areas.	RPSBTK201	Metabolism	1) Understand regulatory pathways, regulation of acid-base balance.
				2) Comment of different Environmental stresses, biotransformation.
	4. Understanding of biotechnological applications,processes,its ethical implications and importance of intellectual property rights .	RPSBTK202	Immunology	1) Understand the details of Immunological disorders.
				2) Understand the concept of hypersensitivity and transplantation.
				3) Familiar with the relation of CNS to immune system
		RPSBTK203	Bioprocess technology	1) Understand the large scale process for plant and animal cell cultivation and its application.
				2) Understand the concept of Food rheology and its application on industrial scale.
		RPSBTK204	Bioinformatics, Phylogenetics	3) Discuss the various applications of enzymes in food processing.
				4) Comment on the enzyme kinetics.
		RPSBTK204	Bioinformatics, Phylogenetics	1) Student would have learnt about Sequencing Alignment and Dynamic Programming
				2) Sequence Databases

		3) Evolutionary Trees and Phylogeny
RPSBTK301	PTC and ATC	1) The student must be able to discuss the basic requirements of a tissue culture laboratory.
		2) Student should be able to understand and carry out minor experiments in PTC, ATC following the required norms and protocols.
		3) Student be able to understand the safety and precaution controls in these labs
		4) Student must be able to design and conduct simple experiments in ATC, PTC labs
RPSBTK302	Medical Microbiology	1) Students should be able to understand the basics of medical microbiology 2) They should be able to comment and appreciate the significance of this field 3) They are expected to develop an understanding of various disease related issues of medical microbiology
RPSBTK303	Clinical Studies	1) Students will understand ethical issues in human subjects research
		2) Students should be familiarized with Roles and responsibilities of the investigator and the institution
		3) Be aware of various related regulatory issues
		4) Know about the companies and organizations associated in this field
RPSBTK304	Developmental Biology	1) Student would be able to apply key principles of developmental biology toward evaluating and analyzing primary literature in the field.
		2) Be able to explain key concepts, including mechanisms by which differential gene activity controls development, mechanisms that determine cell fate and mechanisms that ensure consistency and reliability of development.
RPSBTK401	Nanotechnology	1) Students will be familiar with the basics of nanotechnology, tools used for characterizing nanomaterials and specific applications of nanotechnology.
		2) Have knowledge of latest developments in nanotechnology in the field of medical sciences and other commercial products and be able to appreciate the thrust in this science and feel encouraged to take it ahead in research.
RPSBTK402	GMO and Environment	1) By the end of this course student must be able to explain what GMOs and GM crops are.
		2) Understand the historical context of GMOs.
		3) Have an understanding on the development of GMOs to date and be able to name frequently used GMO crops
		4) Describe the way modification is used to affect agriculture and discuss the potential risks & benefits of human activities on the environment
		5) Discuss the potential risks & benefits associated with GMO crop consumption and be able to make arguments for both sides of the debate
RPSBTK403	Bioinformatics, evolution and vitamins	1) Student would have learnt about Sequencing Alignment and Dynamic Programming 2) Sequence Databases 3) Evolutionary Trees and Phylogeny
RPSBTK404	Biostatistics	1) Student would be able to Calculate standard normal scores and resulting probabilities and interpret and explain a p-value 2) Perform a two-sample t-test and interpret the results; calculate a 95% confidence interval for the difference in population means

		3) Understand and interpret results from Analysis of Variance (ANOVA), a technique used to compare means amongst more than two independent populations 4) Understand and interpret relative risks and odds ratios when comparing two populations
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Department of Biochemistry

Subject	Programme Specific Outcomes	Course Code	Paper Title	Course Outcomes
MSc I Biochemistry	The overall goal of this MSc I course is to introduce the students to the basics & advances of biochemistry, instrumentation, analytical techniques, industrial & environmental biotechnology, bioinformatics, research methodology, developmental biology, biostatistics, and soft skills development.	RPSBCH101	Basics of Biochemistry	Upon completion of the MSc Part I course, the students would learn and understand the following: 1) The basics of Biochemistry to make them understand advanced concepts easily. Also, the basics of Biochemistry unit was included purposely in the syllabus to introduce 6 units Chemistry students to the subject of Biochemistry. 2) Theoretical and practical knowledge of different tools used for various Biochemical estimations which will improve their analytical skills and handling of instruments. 3) The applied aspects of Biochemistry through Biotechnology, Microbiology, Industrial synthesis and environmental biotechnology. 4) Bioinformatics which will enable them to understand the computational application of biology. It is an important topic in modern sciences which will help them to understand protein engineering and drug designing in a better way. 5) Research methodology which will help them to develop research aptitude through research projects. 6) Soft skills development which will create awareness and develop competence in personality development, communication skills, academic and professional skills. Empower the students with leadership qualities, entrepreneurship and start-ups for employment, stress & time management. 7) Biostatistics which will help them to interpret results and draw conclusions of the experimental data generated during their dissertation work and experiments. 8) All the practicals have been rearranged in accordance with the theory of each paper at each semester.
		RPSBCH102	Instrumentation & Analytical Techniques - I	
		RPSBCH103	Industrial Biotechnology & Bioinformatics	
		RPSBCH104	Research Methodology, Developmental Biology & Soft Skills Development	
		RPSBCH201	Advanced Biochemistry	
		RPSBCH202	Instrumentation and Analytical Techniques - II	
		RPSBCH203	Industrial & Environmental Biotechnology	
		RPSBCH204	Biostatistics	
MSc II Biochemistry	The overall goal of this MSc II course is to familiarize the students to the fields of physiology, metabolism, genetics, immunology, nutrition, clinical biochemistry and pharmacology.	RPSBCH301	Physiology & Metabolism – I	Upon completion of the MSc Part II course, the students would learn and understand the following: 1) The metabolic processes which are essential part of Biochemistry and will further help them to understand the physiology of the human body. 2) The important physiological concepts like Hematopoiesis, water electrolyte balance introduced along with in-depth concepts of metabolism which forms the basis of Biochemistry. 3) Nutritional biochemistry and pharmacology which will enable them to explore various career opportunities in the fields of nutrition, dietetics, nutraceuticals, health & wellness, pharmaceuticals, etc. 4) The important genetic processes namely, DNA replication, transcription, translation & Recombinant DNA Technology increasing their knowledge of molecular biology. 5) Basics of human immune system, detailed study of various cells and organs involved. 6) Tumour immunology, immunodeficiencies, immunological tolerance, autoimmunity, transplant immunology and vaccines which will further increase their understanding of Human immune system in a better way. 7) All the practicals have been rearranged in accordance with the theory of each paper at each semester. The over-all syllabus at the Post-Graduation level has been designed such that the student is well prepared to appear for competitive examinations held all over.
		RPSBCH302	Nutrition & Pharmacology	
		RPSBCH303	Basics of Genetics	
		RPSBCH304	Basics of Immunology	
		RPSBCH401	Physiology & Metabolism – II	
		RPSBCH402	Clinical Biochemistry & Pharmacology	
		RPSBCH403	Advanced Genetics	
		RPSBCH404	Advanced Immunology	