Programme outcome for UG and PG Programmes

2021-22

Programme outcome for BSc Programme

1.   DEPARTMENT OF BIOCHEMISTRY

1.1.   Programme Offered: B.Sc. BIOCHEMISTRY

1.2.   Programme Specific Outcome:

PO1: Students will gain the ability to understand diverse biological processes taking place in living organisms at the molecular level.

PO2: Students will get to learn about the importance and applications of Biochemistry in health and nutrition.

PO3: Acquire practical laboratory skills that will be beneficial for a future career in the interdisciplinary areas of life sciences.

Course Outcomes

Course Code	Course Title	Objective	Course Outcome
BC1141	Perspectives, Methodology & Biomolecules-I	To familiarize the students about the fundamental characteristics of science as a human enterprise and enable them to understand how science works and to impart a general Introduction to Biochemistry.	• Elicit the concepts of science • Describe the evolution and scope of biochemistry as a science discipline. • List out the different experimental approaches to study biochemical processes.

			• Prepare solutions of different concentration and pH. • Classify and characterize carbohydrates and lipids.
BC1141	Practical for BC 1141	To resolve quantitative problems concerning the preparation of solutions, buffers, reagents and analysis of biomolecules etc.	
BC1221	Biomolecules-II & Bioinformatics	To provide a basic idea about the application of biological data bases and general informatics.	• Elaborate the composition of proteins and their function. • Detail the importance of genetic information carrier molecules in life. • Recognize the scope and application of Bioinformatics. • Perform statistical investigations related to biochemical problems. • Identify application of information technology in biology.
BC1221	Practical for BC 1221	To gain a basic knowledge about bioinformatics and qualitative analysis of biomolecules like amino acids and proteins.	
BC1341	Cellular Biochemistry	To prepare the students for understanding biological systems at cellular level	• List out cell organelles and describe their structure and function.

		by imparting necessary knowledge that underpins various concepts in Cell Biology and to describe the structural characteristics, functional properties and regulation of enzymes.	• Elaborate the different types of transport systems across cell membrane. • Explain types of cell division • Outline the characteristics of cancer cells and mechanisms involved in cancer biology. • Detail on the mechanism of interaction between cell and its environment. • Classify enzymes; describe types of enzyme inhibition and regulation.
BC1341	Practical for BC 1341	To enable students to qualitatively analyze biomolecules like carbohydrates and lipids and to analyze the progress curve of enzymes.	
BC1441	Techniques in Biochemistry	To familiarize the students with the principle, functioning and applications of techniques commonly used for the characterization, separation and identification of biological compounds. The course aims to introduce the students to the basics of	• Explain the principle, working and application of different microscopic, photometric chromatographic, electrophoretic, centrifugation and radioactive techniques.

		research methodology which will be useful for their future scientific endeavors.	• Select most suitable technique for the isolation and purification of biomolecules based on different criteria.
BC1442	Qualitative Analysis of Biomolecules	The course aims at providing the skill for identifying a particular biomolecule through systematic analysis.	• Qualitatively analyse the type of biomolecule. • Identify the subclass of each biomolecule by schematic analysis
BC1541	Physiology & Immunology	This course aims at providing an idea regarding the physiological functions of the biological system and to discuss the basics of immunology and immunological techniques.	• Explain hemopoiesis and biochemical basis of blood group classification. • Elaborate on the transport of gases, acid base and water balance in the body. • Remember structure of muscle, neuron and bone. • Classify hormones and explain the functions of hormones. • Describe various aspects in basic immunology • Identify the applications of various techniques involved in immunology.
BC1542	Bioenergetics and Carbohydrate Metabolism	The course aims at providing an overview of bioenergetics and energy	• Describe the bioenergetics of metabolic pathways. • Elaborate the reactions and regulation involved

		production by explaining the general principles of cellular energy metabolism and schematizing the oxidative pathways of carbohydrates.	in the metabolism of carbohydrates. • List out the inborn errors of carbohydrate metabolism. • Enumerate the link between ETC and energy production in plant and animal cells. • Elicit the mechanism of energy production in carbohydrate metabolism.
BC1543	Food Science	This course aims at providing a thorough understanding of different aspects of human nutrition, types of food preservation, adulteration, microbiological aspects of food, role of functional foods and nutraceuticals and food safety and quality management systems.	• Elaborate on the importance of human nutrition. • Describe the chemical composition of different types of food. • Explain the various food preservation techniques employed. • Identify the common adulterants in food. • Gain knowledge about the role of microorganisms in food and nutrition • Explain the importance of food safety and management systems.
BC1544	Classical and Molecular Genetics	To create awareness about the molecular details of the biological system and to describe the events encompassing the central dogma of molecular biology	• Give an account of Mendelian and non-Mendelian genetics. • Predict the type of inheritance of a trait/disease using pedigree analysis.

			• Explain the organization of chromatin and events during gene expression.
			• Illustrate the consequences of different types of mutations and DNA-repair systems
			• Depict the concepts of gene regulation in prokaryotic cells
			• Describe the methods involved in rDNA technology.
			• Provide insight into the molecular and cell-based methods used in the field of biology
			• Understand several modern molecular methods to elucidate molecular and genetic questions
BC1545	Quantitative Analysis of Biomolecules	To develop skill in quantitative analysis of different biomolecules in a given test sample.	• Student will be able to quantitatively analyze different biomolecules in a given test sample.
BC1641	Clinical Biochemistry	To introduce the students to the clinical applications of biochemistry and to provide them basic information about microbiology and pharmacology.	• List out the methods of clinical laboratory management and laboratory safety. • Describe the principle & procedure for studying clinical parameters used for diagnosis. • Detail the basic concepts of microbiology and pharmacology
BC1642	Metabolism-II	To detail the metabolic events occurring in the biological system by explaining	• Describe the metabolism of lipids, nucleic acids,

		the different pathways of energy production and biosynthesis and to discuss different inborn errors of metabolism.	amino acids and heme. • Explain the role of enzymes involved under physiological and pathophysiological conditions. • List out the inborn errors of metabolism of above mentioned biomolecules. • Detail the processes involved in biological nitrogen fixation. • Enumerate the important detoxification processes in the body.
BC 1643	Practical: Clinical Biochemistry and Enzymology	The course aims to develop skill in quantitative analysis of different parameters of clinical significance in blood/urine and detection of abnormal constituents in urine.	• Quantitatively analyze parameters of clinical significance in blood and urine. • Detect the presence of abnormal constituents in the urine sample.
BC 1644	Practical: Food Analysis	The course aims at developing skill in the quantitative analysis of specific biomolecule in the food sample and detection of common adulterants.	• Quantitatively estimate the specific biomolecule in any given food sample. • Detect the presence of adulterants in different food samples.
BC 1661.1	Analytical Biochemistry	The course aims at enabling the students to understand the fundamentals of Analytical Biochemistry. A sound knowledge of analytical biochemistry will help in understanding the analysis of phytochemicals, food adulterants, water and	• Perform phytochemical analysis. • Identify the importance and impact of pesticides in life • Detect food adulteration

		toxicants in food and biological samples.	• Elaborate standards for respective category of water • Recognize the effect of toxic metals in foods • Analyze toxicants in biological samples
BC 1661.2	Immunology and Immunological Techniques	It aims at enabling the students to understand the fundamentals of Immunology and Immunological techniques. A proper understanding of life processes requires familiarity with the discipline of immunology. A sound knowledge of immunology and techniques will help in understanding assessment of functions, disordered functions, diagnosis and treatment of diseases	• Describe various aspects in basic immunology • Identify the applications of various techniques involved in immunology.
BC 1551.1	Open Course: Clinical Diagnosis of Common Diseases	To provide the fundamental basis for the interpretation of various biochemical tests of diseased conditions.	• Explain the importance of each clinical parameter studied. • List out the parameters measured under various disease conditions. • Gain knowledge about the normal levels of different clinical parameters • Identify the diseases by interpreting the variations in clinical data.
BC 1551.2	Lifestyle Diseases	To create general awareness among students about the various diseases associated with lifestyle and which could be prevented by managing life style.	• Enumerate the different causes and risk factors of life style diseases like atherosclerosis, hypertension, stroke, diabetes,

			obesity, nephritis and liver diseases.
			• List out the methods to diagnose the diseases and gain a basic knowledge regarding interpretation of the test results.
			• Spell out the methods of prevention, treatment and management of the diseases.
			• Identify healthy and unhealthy life habits and adopt better life style.

2.   DEPARTMENT OF BIOTECHNOLOGY

2.1.Programme offered: B.Sc. BIOTECHNOLOGY

2.2.Programme Specific Outcome:

PO1: To develop proficiency in the theory as well as practical experiments, common
    equipments, laboratory, along with the collection and interpretation and presentation
    of scientific data in proper manner.
PO2: The students will be equipped with knowledge in the modern areas of biotechnology
and its application in medical science, agriculture, industry, proteomics, genomics,
metabolomics, bioinformatics, nanobiotechnology etc.
PO3: Apart from understanding biotechnology and its power in developing the nation, it will
create awareness about biotechnology and will help in eliminating public fear about the
contribution of biotechnology and confusion on GM crops, GM foods and transgenic
organisms.
2.3.Course Outcome:

Course Code	Course Title	Objective	Course Outcome
BV 1121	Methodology and Perspective of Biotechnology	The aim is to introduce the modern scientific methods and to familiarize biotechnology and its various applications in various fields of human life.	• The students will be able to understand how science works. • They will learn how to apply statistics and IT in Biological science.

			• They will receive a general awareness about biotechnology and its application in various fields for the betterment of mankind.
BV1221	**Biophysics & Instrumentation**	To introduce the physical aspects and bioenergetics of the living system and to familiarize the principle and working of various instruments used in biotechnology experiments.	To understand the fundamentals of biophysics and the general instrumentation techniques used in biotechnology
BV-1131.1	**Animal Diversity- Non Chordata & Chordata**	To communicate a basic understanding about the biodiversity of animals and its systematic position.	It should give very good information about the morphological diversity and adaptation of the animal world. It should also provide basic information about the animal resources of the globe.
BV-1231.1	**Animal Physiology & Anatomy**		To provide the students with the basic information on the general physiology of animals.
BV-1331.1	**Developmental Biology, Human Genetics and Animal Behaviour**		To develop general understanding on animal development, human genetics and animal behaviour for non-zoology students.
BV-1431.1	**Practical COMP**		To introduce and train the students on the practical components of the theory courses
BV1131.2	**Phycology Mycology, Lichenology, Bryology Pteridology, Gymnosperms and Plant Pathology**		•
BV1231.2	**Plant Physiology, Angiosperm**		•

	Anatomy & Reproductive Botany		
BV 1331.2	Angiosperm Morphology, Systematic Botany & Economic Botany		•
BV 1431.2	Practical of BV1131.2, BV1231.2 & BV1331.2		•
BV1141.1	Microtechnique, Angiosperm Anatomy and Reproductive Botany		•
BV1241.1	Environmental Studies	Students should acquire a basic understanding about the structure function of the environment and its interaction with the living systems.	It will impart the geographical distribution of plants and the impact of human intervention in the environment and the delicate balance of various factors in the environment. It gives an idea about the various types of biodiversity • and the influence of environmental pollution on the biodiversity.
BV1242.1	Practical of BV1141.1 & BV1241.1		•
BV1141.1	Microtechnique, Angiosperm Anatomy and		The course is aimed to bring the basic concept and understanding about the

	Reproductive Botany Microtechnique		simple basics of microtechnique and also the concept and understanding of anatomy of the flowering plants and its relationship to the physiology and environmental adaptability of the plants. It also gives a basic idea on their production and development of the flowering plants and its adaptation to suit to its environment.
BV1341.1	**Phycology, Mycology, Lichenology & Phytopathology**		This course is to expose the world of cryptogams and other lower forms of plants such as algae, fungi, lichens etc and also plant diseases caused by virus and fungi, including there control measures.
BV1342.1	**Bryology, Pteridology, Gymnosperms & Paleobotany**		It's a course on lower plants such as bryophytes, pteridophytes and gymnosperms. It will give the students the fundamentals on the systematics, morphology and anatomy and life cycle of these lowerplants, which are essential for the proper understanding of the biosphere.
BV1441.1	**Plant Physiology**	The course should give the fundamentals about the biophysical and biochemical aspects on the functioning of the plant system.	Students should learn the functions of various plant system through very specific experiments, which are very important to understand the basis of life activities. It should prepare the students pursue higher studies in plant science as well as in Biotechnology.

BV 1442.1	**Cell Biology, Plant Breeding & Evolutionary Biology**	The course should impart the basics of the biology plant cell and its structural and functional relationship.	It should equip the students to understand the fine cellular and molecular details of the plant system in total.
BV1443.1	**Practical Botany II (Practical of BV1341.1, BV1342.1, BV1441.1 & BV1442.1)**		
BV1541.1	**Angiosperm Morphology and Systematic Botany**		
BV1542.1	**Economic Botany, Ethnobotany & Medicinal Botany**		
BV1641.1	**GENETICS**		This course is giving a thorough knowledge in classical genetics, which is the base of all genetica studies –basic as well as applied science including genetic engineering and gene therapy. This will prepare the students to pursue higher studies in genetics and molecular biology
BV1642.1	**Practical Botany III(Practical of BV1541.1, BV1542.1 & BV1641.1)**		
BV1541.1	**Angiosperm Morphology and Systematic Botany**		
BV1542.1	**Economic Botany, Ethnobotany & Medicinal**		

BV1641.1	Genetics		
BV1141.2	Animal Diversity – I: Nonchordata		
BV1241.2	Environmental Studies		
BV1242.2	Practical Zoology – I[Practical of BV1141.2 & BV1241.2]		
BV1341.2	Developmental Biology and Reproductive Biology		
BV1342.2	Animal Diversity – II: Chordata		
BV1441.2	Animal Physiology		
BV 1442.2	Cell Biology		
BV1443.2	Practical Zoology – II [Practical of BV1341.2, BV1342.2, BV1441.2 & BV1442.2]		
BV1541.2	Systematics, Biodiversity and Animal Behaviour		
BV 1542.2	Genetics		
BV1641.2	Evolution		
BV1642.2	Practical Zoology III [Practical of BV1541.2, BV1542.2 & BV1641.2]		
BV1142	Inorganic Chemistry I		To understand the structure of atomic nucleus, properties of elements in relation to electronic configuration. To learn the principles of chemical analysis. Upon course completion, the student will be able to appreciate how the inner

			structure of elements dictates the chemical properties of elements, how elements bond together to form compounds. She/He will acquire basic laboratory skills required for chemical analysis and become familiar with data collection, record keeping and data analysis in a chemical laboratory.
BV1243	Inorganic Chemistry – II		The course is to impart a basic understanding of the principles of inorganic chemistry as the continuation of the previous course in inorganic chemistry. It will prepare the students to pursue studies in the biochemical and molecular aspects of biology and biotechnology.
BV1244	Practical Chemistry-I (Practical of BV1142 & BV1243)		This the practical course based on the practical components contained in the theory of the respective courses- BV1142 & BV1243. It will give a working knowledge on the analysis of inorganic compounds.
BV1343	Physical Chemistry I		The syllabus deals with the different states of matter, Thermodynamics and group theory. It familiarizes the student with the important topics like defects in crystals and point groups of molecules like water.

			Students become aware of the different states of matter, liquid crystals, basics of group theory and thermodynamic properties like entropy, enthalpy and free energy.
BV1444	**Physical Chemistry II**		The aim of the course is to make the students aware of quantum mechanics, statistical thermodynamics, spectroscopic and non-spectroscopic methods of studying molecules and adsorption phenomena. To introduce the basics of the developing fields such as spectroscopy, quantum mechanics and statistical thermodynamics.
BV 1445	**Practical Chemistry II (Practical of BV1343 & BV1444)**		
BV1543	**Organic Chemistry I**	The syllabus includes hybridization, mechanism of reactions, aromaticity and the chemistry of aliphatic and aromatic substituted compounds.	It learns the behaviour of aliphatic and aromatic compounds like aromatic aldehydes, ketones and halides. By studying these topics the students get an idea of the mechanism of reactions of organic compounds and hybridization.
BV1646	**Organic Chemistry II**	The syllabus deals with organic compounds like ethers, acids, carbohydrates, aminoacids, proteins, nucleic acids, oils, fats, detergents, vitamins, terpenes, alkaloids, hormones and enzymes and their properties and the	

		stereochemistry of organic compounds. The students will get an interesting idea about the stereochemistry of organic compounds and the preparation and properties of organic compound	
BV1644	BV1644Practical Chemistry-III (Practical of BV1543 & BV1643)		
BV1143	Biochemistry & Metabolism	The course will impart a basic understanding about the concept of the biochemical basis of phenomenon life and metabolic reaction of cells that are essential for the sustenance of life. It specially focuses on the development of analytical skills in biochemistry by giving more importance to the laboratory experiments of biochemistry.	The course explores the impact of biochemistry on bioenergy and health.
BV1245	Microbiology	Microbiology works with function, structure, uses and existane of microscopic organisms. This course aims to provide a thorough understanding of microbial world, genetics, metabolism and culture.	Student will be able to understand the scope of microbiology in various fields such as Pharmacy, Medicine, Clinical research, Agriculture, Dairy industry, Water industry etc and gain practical knowledge on handling and culturing microbes.
BV1246	Biotechniques- I	This course is the practicals of the course BV1143 and 1245, which gives hands on training on the analytical techniques and experiments of	

		Biochemistry and Microbiology which are the core components of Biotechnology experiments	
BV1344	**Food and Industrial Biotechnology**	The students will be introduced to the industrial application of Food Biotechnology and Bioprocess technology through this course. Students should be trained to understand commercial importance of biotechnology through its industrial aspects.	Students will be able to understand the potential of food and industrial biotechnology and career opportunities in industries R & D
BV1345	**Molecular Biology**	Molecular biology is basis of modern biology and biotechnology. This course imparts a very essential foundation for the proper understanding of life at molecular level, which is essential for further studies related to genetic engineering, immunology and other modern applied aspects of biology.	The student gains basic understanding of molecular basics of life, and become able to learn structure and functioning and regulation of genes in prokaryotes and eukaryotes.
BV 1446	**Recombinant DNA Technology**	To impart a foundation on genetic engineering and its applications.	The stdents gains basic understanding on gene manipulation methods and principles.
BV1447	**Immunology**	To give a basic training to the students of Biotechnology on immune system, immunology and immunology related techniques.	The student becomes capable of identifying the components of human immune system and its interactions.
BV1448	**Biotechniques II (Practical of BV1344, BV1345, BV1446, BV1447)**		
BV1544	**Environmental Biotechnology**	This core course is concerned with the application of biotechnology in keeping	Student gains an understanding of the need of application of Biotechnology in

		the environment clean and healthy. Various techniques are described and will be benefited by the students in their higher studies in biotechnology.	environment for its protection and a susutainable future.
BV 1545	**Plant Biotechnology & Animal Biotechnology**	This course is designed to impart basic knowledge in the applied aspects of plant biotechnology and animal biotechnology for the improvement of agriculture and related industries. It gives an introduction about the various techniques of animal cell culture, cloning and tissue culture of plants and animals.	Students gain the basic knowledge of techniques of plant and animal cell culture and maintenance.
BV1651	**Biotechniques III (Practical of BV1544 and BV1545)**		
BV1551	**Bioinformatics**	To introduce the subject of bioinformatics to the students of non-biology. Students should be familiarized to the importance of the bioinformatics, databases, genomics and proteomics, tools and software of bioinformatics at the elementary levels.	The students get a broad understanding of applications of IT in Biological data analysis
BV1552/ BV1649	**Food & Diary Biotechnology**	To introduce the importance of biotechnology in food and diary industries to the students of non-biology.	The students get a broad understanding of food production, preservation and Spoilage.
BV 1553 / BV 1650	**Genetic Engineering**	To introduce the principles of gene manipulation to the students of nonbiology.	The students get a broad understanding of tools, methods and applications of genetic engineering.

BV 1554	Basics of Environmental Biotechnology	This course is aimed to bring an enthusiasm on environmental protection and it should give the contribution of biotechnology techniques to keep the environment clean and healthy. As well it should highlight the economic aspects in the application of biotechnology in protecting the environment from pollution.	The students understand the importance of environmental protection and the role of biotechnology in it.
BV 1648	Bioinformatics and Nanobiotechnology	This course is for biotechnology students, who are interested to know about the methods and application of bioinformatics and modern Nano-biomolecules and their contribution in the various fields of biotechnology and healthcare.	Students get familiarised to databases, application softwares, and tools of bioinformatics, and to the ease of storing and interpretation of biological data.
BV1661	Project Work / Dissertation		
BV16421.1	Horticulture		
BV1643.1	Mushroom Cultivation and Marketing		
BV1644.1	Forestry		
BV1661.1	Economic Zoology - Vermiculture and Apiculture		
BV1661.2	Ornamental Fresh water fish production		
BV1661.3	Human Nutrition		

3.   DEPARTMENT OF CHEMISTRY

3.1.Programme offered: B.Sc. Chemistry and Industrial Chemistry

3.2.Programme Specific Outcome:

1. Students should be able to acquire an understanding of chemical bonding and structure of atoms,solid state, liquid and gaseous state properties of matter, kinetics in order to understand the rates of reactions .

2. In order to familiarize the students with various environmental aspects, different natural resources, biodiversity conservation,understand the need for conservation of ecosystems, various harmful effects of different types of pollution, their syllabus was designed with the intention of addressing all the above topics thereby creating an environmental awareness in their mind and analyze the social issues related to environment.

3. Nanomaterials, Green chemistry and supramolecular chemistry are recentfastly developing areas of wide interest. A flavour in those subjects are also provided.

4. In the organic chemistry topics, they understand the behaviour of different kinds of aliphatic and aromatic compounds, their preparation and properties, their stereochemistry and also they gain an understanding of mechanism of various reactions taking place. They also learn about special bioorganic compounds like proteins, nucleic acids, oils,fats,vitamins, hormones, enzymes etc.

5. In inorganic chemistry they get a detailed understanding of theories of coordination, how metals combine with organic compounds which leads to the exciting field of organometallic chemistry.In this context the important application of metal ions in biological systems also studied.

6. In order to make the students aware of different states of matter, liquid crystals, basics of group theory and quantum mechanics, various thermodynamic principles and properties including statistical thermodynamics, developing field such as spectroscopy are taught which could be considered as the curtainraiser for their future master programmes.

7. The main attraction of this course compared to other BSc chemistry course is that during the second and third year they learn about a large number of industrially important materials such as Glass, cement, soap, refractories, ceramics, paints, fertilizers etc., their manufacture and properties and uses, basic concepts of cosmetics, different techniques in food processing, dyeing etc. Different methods of extraction of metals from their ores and different stages of purification are described in detail. Industrial aspects of organic chemistry is also highlighted such as application in non renewable energy sources such as coal, natural gas, crude oil etc. They also need to study about different local chemical industries in Kerala and they also pay visit for their

projects. Basics of polymer industry is also studied. Various separation and purification techniques, processes in organic chemical manufacture, industrial waste water treatment methods, how to combat different kinds of pollution such as air, water etc., are also studied.

8. After understanding the basic principles of various analytical techniques, they apply in their practicals. Utilizing practical classes they are enabled to make a qualtitative analysis of different cations and anions in a given mixture of solution, determine the weight of elements by using gravimetric analysis, volumetric titration experiments in order to make a quantitative analysis of compounds. Determine the hardness, pH and total dissolved solids in waste water,develop skill in organic compound analysis, gravimetric estimation and determination of physical constants.

3.3.Course Outcome

Course Code	Course Title	Objective	Course Outcome
IC 1141	**INORGANIC CHEMISTRY-I**		1. To understand the structure of atomic nucleus, properties of elements in relation to electronic configuration . 2. To learn the principles of chemical analysis. Upon course completion, the student will be able to appreciate how the inner structure of elements dictates the chemical properties of elements, how elements bond together to form compounds. S/He will acquire basic laboratory skills required for chemical analysis and become familiar with data collection, record keeping and data analysis in a chemical laboratory.
IC 1121	**METHODOLOGY AND INFORMATICS**	To familiarize the student with the methodology and perspectives of Science and the importance of Science in the development of culture.	On completion of the course the students will be able to understand how Science or in special, Chemistry works. They will be able to apply Scientific methods

		How to study Chemistry using the basics of informatics.	independently.
IC 1241	**INORGANIC CHEMISTRY-II**	Bonding among atoms, nano Chemistry and radioactivity are the main topics in this course. Nano field is the developing area in science.	It gives the students an idea about the theories of bonding, nuclear chemistry and nano materials.
IC 1221	METHODOLOGY OF CHEMISTRY	To familiarize the students with the methodology of science with special reference to chemistry	To have a broad outline of the methodology of science in general and Chemistry in particular To understand the important analytical and instrumental tools used for practicing chemistry To learn computer based presentation and statistical analysis of data using spreadsheet software To apply these skills in the analysis of experimental data in chemical analysis
IC 1341	**ORGANIC CHEMISTRY - I**	The syllabus includes hybridization, mechanism of reactions, aromaticity and the chemistry of aliphatic and aromatic substituted compounds.	It learns the behaviour of aliphatic and aromatic compounds like aromatic aldehydes, ketones and halides. By studying this topics the students get an idea of the mechanism of reactions of organic compounds and hybridization.
IC 1342	**PHYSICAL CHEMISTRY – I**	The syllabus deals with the different states of matter, thermodynamics and group theory. It attempts to familiarize the student with the defects in crystals and point groups of simple molecules.	To make the students aware of the different states of matter, liquid crystals, basics of group theory and thermodynamic properties like entropy, enthalpy and free energy .
IC 1371	**INDUSTRIAL CHEMISTRY- I**		

IC 1441	**INORGANIC CHEMISTRY - III**	To learn about d-block and f–block elements, their properties and their coordination, inorganic polymers and organometallics.	After completion, the students will understand how the transition metals coordinate, the theories of coordination, how metals combine with organic compounds to form organometallic compounds and the role of metal ions in biological systems.
IC 1442	**PHYSICAL CHEMISTRY – II**	The aim of the course is to make the students aware of quantum mechanics, statistical thermodynamics, spectroscopic and non-spectroscopic methods of studying molecules and adsorption phenomena.	This course introduces the basics of the developing fields such as spectroscopy, quantum mechanics and statistical thermodynamics .
IC1471	**INDUSTRIAL CHEMISTRY II**		
IC 1541	**ORGANIC CHEMISTRY – II**	The syllabus deals with organic compounds like ethers, acids, carbohydrates, aminoacids, proteins, nucleic acids, oils, fats, detergents, vitamins, terpenes, alkaloids, hormones and enzymes and their properties and the stereochemistry of organic compounds.	The students will get an interesting idea about the stereochemistry of organic compounds and the preparation and properties of organic compound
IC 1571	**INDUSTRIAL CHEMISTRY- III**	The students are expected to acquire knowledge about synthesis of organic compounds, the preparation and properties of organic sulphur and nitrogen compounds, types of polymers, their synthesis	By studying this part the students get an idea of polymerization and organic spectroscopy.

		and applications and organic spectroscopy.	
IC 1572	INDUSTRIAL CHEMISTRY- IV		
IC 1551.1	ESSENTIALS OF CHEMISTRY		
IC 1551.2	PETROCHEMICALS		
IC 1551.3	PHARMACEUTICALS		
IC 1551.4	DYES		
IC 1641	PHYSICAL CHEMISTRY- III	This syllabus deals with kinetics of reactions, chemical and ionic equilibria, phase equilibria, binary liquid systems, catalysis and photochemistry, electrical conductance and electromotive force.	The students get a clear idea of conductance, emf, phase equilibria, rate of reactions and binary liquid mixtures.
IC 1671	INDUSTRIAL CHEMISTRY-V		
IC 1672	INDUSTRIAL CHEMISTRY-VI		
IC 1651.1	SUPRAMOLECULAR, NANO, AND GREEN CHEMISTRY		
IC 1651.2	COMPUTATIONAL, COMBINATORIAL AND PHYSICAL ORGANIC CHEMISTRY		
IC 1651.3	POLYMER CHEMISTRY		
IC 1651.4	BIOHEMISTRY		
IC1142 & IC1242	Lab Course Number 1 and 2		

IC1542 & IC1642	**Chemistry Lab Course Number 5 and 6**		
IC1343 & IC1443	**Chemistry Lab Course Number 3 and 4**		
IC1372 & IC1472	**Industrial Chemistry Lab Course Number 1 and 2**		
MM 1131.7	**Mathematics-I** (Complex numbers, Differentiation and Matrices)s		
MM 1231.7	**Mathematics-II (Analytic Geometry, Integration, Differential Equations and Theory of Equations)**		
MM 1331.7	**Mathematics-III (Vector Differentiation, Coordinate systems, Abstract Algebra and Fourier Series and transforms)**		
MM 1431.7	**Mathematics-IV (Linear transformations, Vector integration¡ Abstract Algebra, Fourier Series and Transforms)**		

4.   DEPARTMENT OF COMPUTER SCIENCE

4.1.Programme offered: B.Sc. Computer Science

4.2.Programme specific outcome:
The First Degree Programme in Computer Science is designed with the objective of equipping the students to cope with the emerging trends and challenges in field of computers and

interrelated disciplines like computer engineering, computer science, information systems, information technology, and software engineering.

4.3. Course Outcome:

Course Code	Course Title	Course Outcome
CS1121	Computer fundamentals and programming in c	Remember the basics of computer Understand the structure of program writing Apply control structures and pointers Analyze user defined functions Understand dynamic memory allocation Understand string handling functions
CS1132	Digital Electronics	Remember the basic concepts of electronics Familarise the concept of different number systems Understanding the properties of logic gates Apply different techniques and theorems to simplify the sop forms Analyse the characteristics of different combinational logic circuits.
CS1122	Value Education	Remember the basic concepts on NSS and NCC Understand the impacts of disaster management in different environments. Understand the features of Constitution of India
CS1141	C PROGRAMMING LAB	To familiarise programs in C.
CS1133	DIGITAL ELECTRONICS LAB	To familiarise the components in digital electronics.
CS1221	ENVIRONMENTAL STUDIES	Understand environmental systems Understand the biodiversity and conservation concepts Remember concepts of biodiversity and conservations Understand natural systems and resources Apply pollution management techniques
CS1241	DATA STRUCTURES	Remember purpose of Data Structures Understand different Data Structures Apply programming languages Analyze working of different data structures Evaluate expressions Create different Data Structures
CS1242	COMPUTER ARCHITECTURE AND MICROPROCESSORS	Remember the basic concepts of computers. Understand the functional units of a standard PC and its working. Understand the architectural features of 8086 processor.

		Create assembly language programs for 8086 processor. Apply the tools debug, TASM/ MASM.
CS1243	DATA STRUCTURES LAB	To familiarise various data structures.
CS1244	ASSEMBLY LANGUAGE PROGRAMMING LAB	To familiarise 8086 programs
CS1341	PROGRAMMING IN JAVA	Understand the java programming and oops concepts. Understand the concepts of Interface, exception handling, threading, and package Understand the basic concepts of Applet, Networking. Idea to approach and use a new package.
CS1342	SOFTWARE ENGINEERING	Understand the importance of having a process for software development. Familiarize with various software testing techniques and tools. Apply various models in the software development projects. Analyze the process of software development
CS1343	OPERATING SYSTEMS	Understand working of various Operating Systems Apply constrained resource allocation, process scheduling and memory management techniques Evaluate synchronization of processes and protection of an Operating System Analyze salient features available to various Operating Systems
CS1344	DATABASE MANAGEMENT SYSTEMS	Understand the concept of database. Develop skills to design an ER diagram. Create database using SQL and perform operations in SQL. Familiarize the management of concurrent transactions. Apply the design concepts and normalization in database easily.
CS1345	DESIGN AND ANALYSIS OF ALGORITHMS	Develop and analyze new algorithms. Analyze the complexity of algorithms Understand good algorithms among multiple solutions for a problem. Have better knowledge on fundamental strategies of algorithm design and awareness on algorithm design strategies Implement some typical algorithms

CS1346	JAVA PROGRAMMING LAB	To familiarize the Java programs
CS1347	DBMS Lab	To familiarize the SQL queries in MySQL
CS1441	SYSTEM SOFTWARE	Understand different System Software. Analyze SIC machine architecture with its instruction sets and capable to do programing. Illustrate machine dependent, independent assemblers and macro processors. Remember the functions of loaders, linkers and illustrate machine dependent loaders and independent loaders. Understand the functions of compilers and illustrate the machine dependent and independent compilers.
CS1442	WEB PROGRAMMING AND PHP	Understand the basic skills in moderately complex use of the following tools/scripts/languages: HTML, DHTML, CSS, Javascript. Apply the appropriate web tools/languages for creating state-of-the art websites Understand the current trends and styles in web design and applications Apply PHP in web designing
CS1443	COMPUTER NETWORKS AND SECURITY	Remember various network technologies, design issues and characteristics Understand the purpose of computer networks and the basic issues in information security Apply the use of layer architecture for networking systems, information security measures Analyze the concept of different models of network and the working of various ciphers Evaluate data link controls and Information Security policies Create awareness on different networking protocols and information security policies
CS1444	COMPUTER GRAPHICS	Compare various graphics devices Apply various transformations to 2D and 3D graphics objects Analyze algorithms for clipping Classify various projections of 3D objects Explain current trends in computer graphics
CS1445	MINOR PROJECT	Plan And Estimate a Project Design And Analysis of a Problem Coding / Implementation of a Software

CS1446	COMPUTER GRAPHICS LAB	To familiarise the drawing, clipping algorithms in Computer Graphics
CS1447	WEB PROGRAMMING AND PHP LAB	To familiarise web programming using PHP
CS1541	PYTHON PROGRAMMING	Remember the concepts of python programming Understand data types and differences Apply CGI programming Analyze the concepts of database programming in python Evaluate the usage of Python package installer PIP Create programs using libraries such as Flask, SQL Alchemy, Pandas, Numpy etc..
CS1542	ARTIFICIAL INTELLIGENCE	Remember features of AI and knowledge-based systems Understand basic parsing techniques Apply search and control strategies Understand expert systems Evaluate the performance of various searching algorithms Evaluate different knowledge representation schemes
CS1543	FREE AND OPEN SOURCE SOFTWARES (FOSS)	Remember FOSS concepts, features Understand Linux OS Apply shell programming Analyze various Linux commands Evaluate conditional and looping statements Create user defined function
CP1551.1	OBJECT ORIENTED ANALYSIS AND DESIGN	Remember object oriented features Understand Object Oriented System Development Apply Unified Approach Analyze various UML diagrams Evaluate objects static and dynamic model Create UML diagrams for any system
CS1551.2	EMBEDDED SYSTEMS	To understand the basic concepts of Embedded System. To familiar with the architecture of Embedded System. To understand the Embedded Operating system and Programming languages. To analyze the process of Embedded Software Development process. To familiarize the various applications of Embedded System.
CS1551.3	CLOUD COMPUTING	Remember the basics of cloud computing Understand the main concepts and key technologies of cloud computing.

		Apply the concept of virtualization in the cloud computing
		Analyze the evolution of cloud from the existing technologies.
		Evaluate and choose the technologies for implementation and use of cloud.
		Create services using cloud computing
CS1561.1	DIGITAL MARKETING	Understand different digital marketing types
		Understand the main concepts and key technologies of digital marketing.
		Remember the concept of e-banking, cyber security
		Analyze the evolution of digital marketing from the existing technologies.
		Analyze services using digital marketing
CS1561.2	INTERNET AND WWW	To **understand** the basic concepts of Networks.
		To **learn** the working of Internet.
		To **analyse** different search engines and its working
		To **familiarise** Network Protocols and WWW.
CS1561.3	IMPACT OF SOCIAL MEDIA NETWORKS	To understand the types of social media networks and its uses.
		To learn the impact of social media on society& commerce
		To analyse the impact of social media on work, training & development and on relationships
		To familiarize challenges of social media in terms of privacy, security & health
CS1544	PYTHON PROGRAMMING LAB	To familiarise the programming in Python
CS 1545	FREE and OPEN SOURCE SOFTWARE (FOSS) LAB	To understand Linux commands and desktop components
CS1641	DATA ANALYTICS	Remember purpose of data analytics
		Understand the principles and tools of data analytics
		Apply different analytical theories and methods
		Analyze text data
CS1642	Internet of Things (IoT)	Remember the purpose of computer networks and its developments
		Understand various network technologies, design issues and characteristics
		Apply the use of layer architecture for networking systems

		Analyze the working of different models of network and data communication Evaluate data link controls Create different networking protocols
CS1643	CYBER SECURITY	Understand the features, development and use of information systems Identify the various types of information system risks, threats and pitfalls. Analyze the security approaches applied. Compare the approaches in the context of achieving security goals. Create awareness about cyber laws and cyber crimes and cyber ethics.
CS1661.1	MACHINE LEARNING	Remember applications of machine learning Understand different learning techniques Apply clustering of raw data Analyse the performance of classification methods Evaluate hierarchical methods Create a semi supervised learning model
CS1661.2	BLOCKCHAIN TECHNOLOGY	**Understand** the concepts behind Blockchain technology **Analyze** the challenges in practical uses **Evaluate** the various implementation criteria **Remember** the new components of Blockchain technology
CS1661.3	DIGITAL MARKETING	Understand different digital marketing types Understand the main concepts and key technologies of digital marketing. Remember the concept of e-banking, cyber security Analyze the evolution of digital marketing from the existing technologies. Analyze services using digital marketing
CS1644	MAJOR PROJECT	CREATE an industry-standard project through a real-life project work under time and deliverable constraints, applying the knowledge acquired through various courses. To provide an opportunity to apply the knowledge gained through various courses in solving a real life problem To provide an opportunity to practice different phases of software/system development lifecycle To introduce the student to a professional environment and/or style typical of a global IT industry

		To provide an opportunity for structured team work and project management
		To provide an opportunity for effective, real-life, technical documentation
		To provide an opportunity to practice time, resource and person management.

5.   DEPARTMENT OF GEOGRAPHY

Programme Offered: B. Sc. Geography

Program Specific Outcome:

The general outcome that the Department of Geography in the college expects from those who majors in the discipline is to be accomplished in disciplinary theories, methodologies, and content and its practicality in real world situation.

The following learning goals and objectives are anticipated from graduation at the end of the programme:

1. Students should be able to acquire an understanding of and appreciation for the relationship between geography and culture. Articulate the theories, philosophies, and concepts in the discipline of geography, including unifying themes of spatial patterns and structures, the interrelationship between people and places, and the interactions between nature and society.

2. A general understanding of geographic processes, the global distribution of landforms and ecosystems, and the role of the physical environment on human populations there by creating an inbuilt environmental awareness progressively.

3. Students are able to read, interpret, and generate maps and other geographic representations as well as extract, analyze, and present such information from a spatial point of view.

4. Students acquire an understanding of and appreciation for the role that geography can play in sustainable life management

5. Students get an understanding of current global population pattern, factors influencing the distribution and mobility of human populations including settlement and economic activities and networks and their impacts on the physical environment.

6. Students are able to correlate past with the present using various geographic so as to plan for the future.

7. Students are capable to estimate the contradictory agenda of society's various stakeholders and the need to reconcile environmental, economic and socio-cultural concerns.

8. Students enhance their personality through learning human geography

9. Students are able to synthesize geographic knowledge and apply innovative research strategies to solve problems in resource conservation, environmental degradation, and sustainable development within the community, region and the world.

10. Students can identify and assess how geographic concepts apply in the place of work and in day to day life to solve real-world problems.

11. Geography mainly concerns with the changes in spatial characteristic of a phenomenon in a temporal perspective. The B.Sc. programme in geography is adapted to meet specific educational and professional goals in mind of students. It focuses on spatial studies both qualitative as well as quantitative, with much emphasize on human-environment relationship. After completing the course, the students will be adequately prepared to pursue masters in the fields as well as for professional careers in geography and allied disciplines like Spatial technology what the world witness today.

Course outcomes:

The following are the courses offered by the Department of Geography and their outcomes.

Principles of Geomorphology	Appreciate earth's tectonic and structural evolution Comprehend the knowledge about earth's interior Develop an idea about concept of plate tectonics, and resultant landforms Identify various endogenic & exogenic forces of earth
Fundamentals of GIS & Remote Sensing	Perform basic ways of maps generation through GIS and ways to generate the data collected through satellites

Climatology & Oceanography	Link atmospheric and climatic elements with other science disciplines Develop an idea about cyclones Investigate the mechanism of monsoon
Human Geography	Correlate various elements of human environment with their real world practices and events Analyze the problems of physical as well as cultural environments of both rural and urban areas
Maps & Scales: Practical 1	Learn to draw the projections of many cartography diagram and apply this is in different statistical data Able to select the appropriate scale & technique for graphical presentation of a maps and data Learn graphically about the enlargement and reduction of maps
Geography of India	Identify various land formation, climate and natural vegetation Evaluate the economic resources of India Examine economic & social distribution of population of the country Develop an idea about agricultural and industrial regionalisation of India
Geography of Kerala	Identify various land formation, climate and natural vegetation of the state Evaluate the economic and human resources of the state Examine economic & social development of population
Geography of Resources	Identify spatial distribution of various resources in the world Recognize various resource depletion causes and potential threats Find out possible practical solutions for 4R's concept
World Regional Geography	Correlate natural and cultural regions of the world

Cartography	Develop an idea on the development of maps and chart chronologically Acquire knowledge on different types of thematic mapping techniques Identify the stages of development of a raw data to a final map
Environmental Geography	Develop an idea about human-nature relationships Build an idea about ecosystem and its various cycles Observe various environmental issues of the world Evaluate environmental programmes and policies of the government
An Introduction to Disaster Management	Gain knowledge about approaches to hazard study Develop ideas on factors, consequences and management of various natural disasters Acquire knowledge about human induced disaster and policies to reduce the events
Weather & Climatic Data Analysis: Practical 2	Develop an idea about different types of thematic mapping techniques Interpret weather charts and bulletins of IMD and other meteorological departments
Map Interpretation: Practical 3	Gain knowledge about topographical maps and apply this knowledge in ground surface
Surveying: Practical 4	Conduct different types of surveying instruments like Indian clinometers, prismatic compass, dumpy level etc.
Project	Conduct a social/environmental survey project in relation to their discipline so as to measuring the status of development of a particular section/area in relation to environment Find out the possible measures to solve those problems that arise due to several human interventions as part of such developments

6.   DEPARTMENT OF PHYSICS

6.1.Programme Offered: B. Sc. Geography

6.2.Program Specific Outcome:

PROGRAMME OUTCOMES (PO)

The programme is designed with the intension that the graduate will be able to accomplish the following programme outcomes at the completion of the FDP in Physics

NO.	PROGRAMME OUTCOMES
PO – 1	**CRITICAL THINKING: -** Instill an attitude of being inquisitive, develop a capacity to become an active leaner through self-governing and reflective thinking in order to identify and analyze the logic connections between theoretical Physics and its applications
PO – 2	**EFFECTIVE COMMUNICATION: -** Competent proficiency in communication to deliver the acquired knowledge, problem solving skills, analyzing capacity formally or informally to a spectrum of spectators.
PO – 3	**SKILL DEVELOPMENT:** - Practical oriented and problem-solving approach provide opportunity to develop knowledge and skills to the best of their potential.
PO – 4	**INDIVIDUAL AND TEAM WORK:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO – 5	**DIGITAL COMPETENCE:** Ability to use techniques, skills and modern information technology tools at their study and work place.
PO – 6	**SOCIAL ACUITY AND OBLIGATION: -** Impart perception about social issues, human values, foster scientific temper, practice inclusiveness for the betterment of the society and disseminate scientific knowledge in appropriate situation.
PO – 7	**ENVIRONMENTAL AWARENESS: -** Discern the environmental issues and involves in promoting ethics and attitudes that endorse coexistence and sustainable living with reduced, minimal, or no damage upon ecosystems
PO – 8	**MULTIDISCIPLINARY APPROACH:** -Interdisciplinary and multidisciplinary approaches permit to gain a solid foundation in various disciplines of science and provide a basis for higher studies and research
PO – 9	**SUSTAINABLE LEARNING: -** make the students to realize that acquiring knowledge and skills suitable for their professional developments is a never-ending process
PO – 10	**ETHICAL STANDARDS: -** Inspire the students to recognize values such as justice, equity, trust, kindness and to develop a commitment and upholding standards of ethical behavior in all walks of life.

7.   DEPARTMENT OF STATISTICS

7.1.Programme offered: B.Sc. Statistics

7.2.Programme Specific Outcome:

PSO1: After completion of the degree apart from his/her specialty in the program of his/her choice the student learns a lot during their three year stay that makes them mature enough to take the right decisions at the right time.

PSO2: Students develop analytical thinking and good communication skills during classroom teaching (through projects/presentation/practical) and also as they participate in various activities both at departmental as well as college level.

PSO3: As part of various activities in college like seminars and workshops he learns to respect and protect the environment. These programs also help in generating building of ethical values to become a responsible citizen when he/she graduates from the college.

7.3.Course Outcome:

Courses	Outcomes
ST:1141 Statistical Methods I	Concepts of statistical population and sample, variables and attributes. Tabular and graphical representation of data based on variables. 'Conditions for the consistency' and criteria for the independence of data based on attributes. Measures of central tendency, Dispersion, Skewness and Kurtosis.
	Moments and their use in studying various characteristics of data
ST:1241 Statistical Methods II	Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation coefficient, partial correlation coefficient and Multiple correlation coefficient. Concept of Principle of least squares for curve fitting and regression lines.
ST:1341 Probability and Distribution-I	Basic properties of the field of real numbers, the knowledge of the series of real numbers and convergence, Bolzano– Weirstrass theorem, Cauchy criteria Different approaches to the theory of probability. Important theorems on probability and their use in solving problem
ST:1441 Probability and Distribution-II	
ST:1541 Probability and Distribution-III	The knowledge of real functions-limits of functions and their properties, notion of continuous functions and their properties and the differentiability of real functions and related theorems To understand the concept of sampling distributions and their applications in statistical inference theoretical concepts of Bivariate Normal and Multinomial distribution along with their properties
ST:1542 Estimation	Drawing conclusions about the whole population on the basis of a sample Various method of estimation along with order statistics
ST:1543 Testing of Hypothesis	To understand the process of hypothesis testing and its significance To derive the most powerful test
ST:1544 Sample Survey Methods	Basic concepts of survey sampling Principles of survey sampling and main steps involved in selecting a sample Simple random sampling Stratified random sampling Systematic sampling Ratio and Regression method of estimation
ST:1551 Open Course 1	Gives an opportunity to other department students to learn and practice statistics as a part of research methodology

ST:1641Design of Experiments and Vital Statistics	The fundamental concepts of design of experiments. Introduction to planning valid and economical experiments within given resources. Completely randomized design. Randomized block design. Latin square design
ST:1642 Applied Statistics	give exposure to four applied fields of statistics viz. Time Series, Index Numbers
ST:1643 Operation Research and Statistical Quality Control	Formulate and solve LPP, Assignment problems, Transportation problems Different types of control chart
ST:1661.5 Stochastic process	The fundamental concepts of stochastic processes Tools needed to analyze stochastic processes Markov chains and its Stability Poisson process and its variations Branching process Time series
Statistical Data Analysis Using R Practical	Practices of data analysis and graphical interpretation using `R'. .

Programme outcome for MSc Programme

UNIVERSITY OF KERALA

M. Sc Degree Program in Physics (Space Physics)

Objectives: Major objective of the M. Sc Physics program of University of Kerala is to equip the students for pursuing higher studies and employment in any branches of Physics and related areas. The program also envisages developing thorough and in-depth knowledge in Mathematical Physics, Classical Mechanics, Quantum Mechanics, Statistical Physics, Electromagnetic Theory, Nuclear Physics, Atomic and Molecular Spectroscopy and Electronics. The program also aims to enhance problem solving skills of students so that they will be well equipped to tackle national level competitive exams. The program also acts as a bridge between theoretical knowhow and its implementation in experimental scenario. Since the specialization of this program is space physics it covers basic ideas of atmospheric physics, solar physics and elements of cosmology. The program also introduces the students to the scientific research approach in defining problems, execution through analytical methods, systematic presentation of results keeping in line with the research ethics through M. Sc dissertations.

Program Outcome

(i)   Define and explain fundamental ideas and mathematical formalism of theoretical and applied physics.

(ii)   Identify, classify and extrapolate the physical concepts and related mathematical methods to formulate and solve real physical problems.

(iii)   Identify and solve interdisciplinary problems that require simultaneous implementation of concepts from different branches of physics and other related areas.

(iv)   To define and explain fundamental ideas of space physics and astrophysics.

(v)   To define a research problem, translate ideas into working models, interpret the data collected draw the conclusions and report scientific data in the form of dissertation.

(vi)   To disseminate scientific knowledge and scientific temper in the society to contribute towards greater human cause.

UNIVERSITY OF KERALA
M.Sc Physics (with specialization in Space Physics) Degree Program
(Effective from 2020 admissions)

A: COURSE STRUCTURE & MARK DISTRIBUTION

Semester	Paper Code	Title of Paper	Contact hours per week			UE duration (h)	Maximum marks		
			L	T	P		IA	UE	Total
I	PH 211	Classical Mechanics	6	1	…	3	25	75	100
	PH 212	Mathematical Physics	6	1	…	3	25	75	100
	PH 213	Basic Electronics	6	1	…	3	25	75	100
	PH 251	General Physics Practicals	…	1	3	…	…	…	…
	PH 252	Electronics & Computer Science Practicals	…	1	4	…	…	…	…
		Total for Semester I (S1)	18	5	7	…	75	225	300
II	PH 221	Modern Optics & Electromagnetic theory	6	1	…	3	25	75	100
	PH 222	Thermodynamics, Statistical Physics & Basic Quantum Mechanics	6	1	…	3	25	75	100
	PH 223	Computer Science & Numerical Techniques	6	1	…	3	25	75	100
	PH 251	General Physics Practicals	…	1	3	6	25	75*	100
	PH 252	Electronics & Computer Science Practicals	…	1	4	6	25	75*	100
		Total for Semester II (S2)	18	5	7	…	125	375	500

Sem	Code	Course	L	T	P		IA	UE	Total
III	PH 231	Advanced Quantum Mechanics	6	1	…	3	25	75	100
	PH 232	Atomic and Molecular Spectroscopy	6	1	…	3	25	75	100
	PH 233	Condensed Matter Physics	6	1	…	3	25	75	100
	PHS 234	Physics of the Atmosphere	7	1	…	3	25	75	100
		Total for Semester III (S3)	25	4			100	300	400
IV	PH 241	Nuclear & Particle Physics	6	1	…	3	25	75	100
	PHS 242	Space Physics	5	1	…		25	75	100
	PHS 243	Introduction to Astrophysics	5	1			25	75	100
	PHS 244	Lab: Space Physics	…	…	5	6	25	75*	100
	PHS 245	Project	…	…	4	…	25	75	100
	PHS 246	Viva voce	…	…	…	…	…	100	100
		Total for Semester IV (S4)	16	3	9	…	125	475	600
		Grand Total				…	**425**	**1375**	**1800**

* 10 marks for records

L - Lecture IA - Internal Assessment

T - Tutorial   UE - University Exam

P - Practical

B: SPECIAL PAPERS FOR THIRD AND FOURTH SEMESTERS

Sl. No	Special paper Category	Code Nos of	Name of Special Papers
1	SPACE PHYSICS	PHS 234 PHS 242 PHS 243 PHS 244	Physics of the Atmosphere Space Physics Introduction to Astrophysics Lab: Space Physics

C: GENERAL GUIDELINES
C-1 Theory papers

Books of study and corresponding chapters are given for most of the theory papers in the syllabus to define the scope of the syllabus.

For internal evaluation of theory papers at least one Viva must be conducted for each paper

For assignments and seminars current developments in the areas of the syllabus may be chosen for improving the general awareness of the student

In tutorial sessions of theory papers problem solving in different topics of the syllabus may be discussed.

C-2 Lab Courses

Rough records may be properly maintained for each practical paper and should be produced during the University Practical Examinations along with original record book.

Each student is encouraged to include critical comments on each experiment done in the original records including sources and estimates of errors, limitations in the experiments done and scope for improvements/additions in the experimental work.

In performing Electronics Practicals: Bread Board Practice is recommended in addition to soldering of electronic circuits.

C3-Project work and Project Evaluation

The project work should be carried out in the area of space physics and related areas only. The project may be started during the third semester of the M.Sc programme. 25 marks of the project are to be awarded on the basis of internal assessment carried out in the College for each student concerned. A Project rough record may be maintained by each student to help to evaluate the progress of the project. Each student is required to present the completed project along with experimental demonstration if any in the college before the final University examinations in the Fourth Semester of the MSc (Physics) Programme.

For University Examinations for the Project: 50 marks is allotted for Project report evaluation and 25 marks allotted for Project based Viva Voce to be conducted along with General Viva Voce examination by the University.

D Pattern of University Question papers D-1
Theory Papers

Each question Paper has three parts: Part A, Part B and Part C

Part A: Eight short answer questions covering the entire syllabus. *One of the questions from this section may be used to test the CURRENT AWARENESS (general knowledge) of the student in the areas of syllabus covered for this paper.* Each question carries 3 marks.

Part B: contains three compulsory questions with internal choice. Questions cover all the three units in the syllabus. Each question carries 15 marks.

Part C: contains six problems covering the entire syllabus. The student needs to answer any three. Each question carries five marks.

The question paper pattern for the theory papers is given separately.

D-2 PRACTICALS

Each practical paper carries a total of 75 marks. 10 marks are allotted for practical records.

PH 251 General Physics Practicals (6h): Section A (45 marks) and Section B (20 marks)

PH 252: Electronics and Computer Science (6h): Unit A-Electronics practical (45 marks)

Unit B- Computer Science (20 marks)

PHS 244 Lab: space Physics (5h): (65 marks)

PHS 245 Project: Internal Evaluation for project is 25 marks

For University Examinations: 50 marks for Project Dissertation/report evaluation and 25 marks for Project based Viva Voce

PHS 246 General Viva Voce: For General Viva Voce covering the entire MSc Syllabus,

University Examinations: 100 marks

(University Question Paper pattern given separately)

| | materials |
| | • Give the students an idea about the necessary steps required to assist any industrial project |

DEPARTMENT OF MATHEMATICS

Programme Offered: M. Sc. Mathematics

Program Outcome: Through this programme, we expect to achieve a significant aspect of well-structured Mathematical theory. We would be expecting to get good concepts, clarification of certain aspects in between pure analysis and abstract analysis. We expect a thorough knowledge in definitions and characteristics of concepts in Abstract algebra, Topology, Differential Calculus, Real analysis, Linear algebra, Measure theory, Functional analysis, Complex analysis, Operations research, Number theory, Graph theory and Scientific Programming with Python as main subjects. To evaluate algorithms for solving substantial problems, computer programming using Python have also been included in the syllabus. The following learning goals and objectives are anticipated from graduation at the end of the programme:

1.   Develop mathematical curiosity and use inductive and deductive reasoning when solving problems.

2.   Become confident in using mathematics to analyse and solve problems in real-life situations.

3.   Develop a critical appreciation of the use of information and communication technology in mathematics.

4.   Appreciate the international dimension of mathematics and its multicultural and historical perspectives.

5.   know and demonstrate understanding of the concepts from the twelve branches of mathematics (Abstract algebra, Topology, Differential Calculus, Real analysis & Measure theory, Linear algebra,, Functional analysis, Complex analysis, Operations research, Number theory, Graph theory and Computer programming).

6.   use appropriate mathematical concepts and skills to solve problems in both familiar and unfamiliar situations including those in real-life contexts

7.   select and apply general rules correctly to solve problems including those in real-life contexts.

8.   As Bertrand Russel said, realize Mathematics is a world of perfection.

9.   Investigating patterns allows students to experience the excitement and satisfaction of mathematical discovery. Mathematical inquiry encourages students to become risk-takers, inquirers and critical thinkers.

10.   Scientific Programme in Python also included in the course to give an introduction to mathematical computing, with Python as tool for computation.

11.   Through the use of mathematical investigations, students are given the opportunity to apply mathematical knowledge and problem-solving techniques to investigate a problem, generate and/or analyse information, find relationships and patterns, describe these mathematically as general rules, and justify or prove them.

Specific Outcomes: Mathematics is a science as well as art. Through this programme students are able to read and understand higher-level proofs and be able to write the proofs. We are expected to develop and maintain problem-solving skills for each student. This programme gives the student to be able to communicate mathematical ideas with others. Students will get the ability to apply analytical and theoretical skills to model and solve mathematical problems.

Course	Objectives
Linear algebra	● Develop understanding about Linear maps, their null spaces and ranges, Operations on linear maps in the set of all linear maps from one space to another , Rank-Nullity Theorem , Matrix of linear map, its invetibilty. ● Develop understanding in Invariant subspaces, Definition of eigen values and vectors, Polynomials of operators, Upper triangular matrices of linear operators, Equivalent condition for a set of vectors to give an upper triangular operator, Diagonal matrices, Invariant subspaces on real vector spaces ● Develop Concept of generalized eigen vectors, Nilpotent operators, Characteristic polynomial of an operator, Cayley-Hamilton theorem, Condition for an operator to have a basis consisting of generalized eigen vectors, Minimal polynomial. Jordan form of an operator Acquire knowledge in Change of basis, trace of an operator, Showing that trace of an operator is equal to the trace if its matrix, determinant of an operator, invertibilty of an operator and its determinant relation between characteristic polynomial and determinant, determinant of matrices of an operator w.r.t. two base are the same. Determinant of a matrix. ● Able to generalize the vectors in Higher dimensions. ● Learn about the immense applications of Linear Algebra.
Real analysis I	● Develop concept in Functions of Bounded Variation and

	Rectifiable Curves. ● Develop concept in The Riemann-Stieltjles Integral. ● Acquire knowlrdge in Sequences of Functions. ● Comprehend kn owledge in Multivariate Calculus. ● Learn about the applications of Partial and Total Differentiation
Real analysis II	● Acquire knowledge of concepts of modern analysis, such as convergence, continuity, completeness, compactness and a glimpse into metric spaces and Topological concepts. ● develop a higher level of mathematical maturity combined with the ability to think analytically. ● Acquire ability to operate with Lebesgue Outer Measure, Measurable sets, Regularity, Measurable functions, Borel and Lebesque, Measurability. ● Acquire knowledge in Integration of Non-negative functions, The General Integral, Integration of Series, Riemann and Lebesgue Integrals, The Four Derivatives, Lebesgue's Differentiation Theorem, Differentiations and Integration. ● Appreciate the idea of Abstract Measure Spaces: ● Acquire knowledge in the Lp Spaces, Convex Functions, Convergence in Measure, Signed Measures and the Hahn Decomposition, The Jordan Decomposition, The Radon-Nikodym Theorem. ● Appreciate the idea of Abstract Measure Spaces:

	● Acquire knowledge in the Lp Spaces, Convex Functions, Convergence in Measure, Signed Measures and the Hahn Decomposition, The Jordan Decomposition, The Radon-Nikodym Theorem. ● Be able to apply the Radon-Nikodym Theorem in practical extent.
Differential Equations	● Acquire knowledge in Solving second order Linear Equations. ● Able to find Series solutions of first order equations. ● COmprehend the knowledge in Special functions - Legendre polynomials - Bessel's functions - Gamma functions. ● First Order PDE - Curves and Surfaces, Genesis of first order PDE, Classifications of integrals-Linear equation of first order-Pfaffian Differential Equations- Compatible systems- Charpits equations, Jacobi's method. ● Second order PDE - Classification of second order PDE - One dimensional wave equations-Vibration of finite string - Vibration of semi infinite string - Vibrations of infinite string, Laplace equations - Boundary value problem, Maximum and minimum principles. ● Students should be able to use technology to help solve problems, experiment, interpret results, and verify conclusions.
Topology I	● Develop an intuition to the subject ● Acquire knowledge in Metric Spaces:-Definition, Examples, Open sets, Closed sets, Interior, closure and boundary. Continuous functions, Equivalence of metric spaces, Complete metric spaces-Cantor's Intersection Theorem. ● Acquire knowledge in Topological spaces :-Definition, Examples, Interior, Closure, Boundary, Base, Sub base, Continuity, Topological Equivalence, Subspaces. ● Develop concept in Connectedness and disconnected

	spaces, Theorems on connectedness, Connected subsets of real line, Applications of connectedness, Path connected spaces. ● Develop concept in Compact spaces, compactness and continuity, Properties related to compactness, One point compactification. ● Emphasizes the geometric nature of the subject and the applications of topological ideas to geometry and mathematical analysis. ● To realize that topology is an excellent subject ➢ for learning to prove theorems correctly ➢ for learning the concepts of mathematical rigor ➢ for developing the mathematical maturity and sophistication that are required for higher level courses.
Topology II	Develop the concepts ● In Product and Quotient spaces. ● Separation axioms and Separation by continuous functions. ● Convergence, Tychnoff's Theorem. ● Algebraic topology:- The fundamental group ● Examples of fundamental groups, The Brouwer Fixed Point Theorem.

Abstract Algebra	• Develop understanding about the role of abstract algebra as the main part of Mathematics. • Comprehend the knowledge about the importance of applications of Abstract algebra. • Develop an idea about Groups, different types of groups, rings and Fields. Galois theory in solving the polynomial equations. • Divisibility in Integral domains-Irreducibles, Primes, Historical Discussion of Fermat's Last Theorem, Unique Factorization domains, Euclidean domains. Extension fields, Fundamental Theorem of Field Theory, Splitting fields, Zeros of irreducible polynomial. • Algebraic extensions, Characterization of extensions, Finite extensions, Properties of algebraic extensions, Fundamental theorem of Galois Theory, Solvability of polynomials by radicals, Insolvability of Quintic.
Scientific Programming with Python	• Visualizing Data with Graphs - learn a powerful way to present numerical data: by drawing graphs with Python. • Acquire knowledge in Algebra and Symbolic Math with SymPy and Solving Calculus Problems, Graphical Equation Solver, Summing a Series and Solving Single-Variable Inequalities, Finding the Length of a Curve. • Ability to programme Interpolation and Curve Fitting - Polynomial Interpolation - Lagrange's Method, Newton's Method and Limitations of Polynomial Interpolation, Roots of Equations - Method of Bisection and Newton-Raphson Method, Numerical Integration - Newton-Cotes Formulas - Trapezoidal rule, Simpson's rule and Simpson's 3/8 rule, Initial Value Problems - Euler's Method and Runge-Kutta methods.

Complex analysis I	• Analyzing the concepts of modern analysis, such as convergence, continuity in complex number system.
	• Acquire knowledge in Elementary properties and examples of analytic functions, Power series, Analytic function, Riemann Stieltjess, Power series representation of an analytic function, Zeros of an analytic function, The index of a closed curve.
	• Acquire knowledge in Cauchy's Theorem and integral formula, Homotopic version of Cauchy's Theorem, Simple connectivity, Counting zeros: The open Mapping Theorem, Goursat's Theorem.
	• Be able to define Singularities: Classification, Residues, The argument principle.
	• Acquire knowledge in The extended plane and its spherical representation, Analytic function as mapping, Mobius transformations, The maximum principle, Schwarz's Lemma.
	• Ability to explain the concepts, prove theorems and properties involving complex functions.
Complex analysis II	• Develop concept in Compactness and Convergence in the space of Analytic functions, The space $C(G,\Omega)$, Space of Analytic functions, Riemann Mapping Theorem.
	• Acquire knowledge in Wierstrass factorization Theorem, Factorization of sin function, The Gamma function.
	• Acquire knowledge in Riemann Zeta function, Runge's Theorem, Simple connectedness, Mittag-Leffler's Theorem.
	• Develop concept in Analytic continuation and Riemann surfaces, Schwarz Reflexion Principle, Analytic continuation along a path, Monodromy Theorem.
	• Acquire knowledge in Basic properties of Harmonic functions, Harmonic function on a disc, Jensen's formula, The genus and order of an entire function, Hadamard factorization Theorem.

Functional analysis I	● Familiarize the student with the basic concepts, principles and methods of functional analysis and its applications. ● Identify abstract concepts concerning vector and function spaces. ● Identify the applicability of functional analysis as a tool for solving a variety of Mathematical problems such as the solution of partial differential equations, engineering fields such as information engineering and Quantum physics. ● Analyzing infinite dimensional spaces Also, develop the concept in ● Normed spaces and continuity of linear maps. ● Hahn-Banach theorems and Banach spaces. ● Uniform boundedness principle, closed graph and open mapping theorems.
	● Bounded inverse theorem, spectrum of a bounded operator. ● Weak convergence, reflexivity and compact linear maps.
Functional analysis II	● Acquire knowledge in Spectrum of a compact operator. ● Acquireknowledge in Inner product spaces, orthonormal sets. ● Develop concept in Approximation and optimization, projection and Riesz representation theorems. ● Acquireknowledge in Bounded operators and adjoints, normal, unitary and self-adjoint operators. ● Develop concept in Spectrum and numerical range, compact self-adjoint operators.

Operations research	● Analyzing the Linear Programming Problems, Transportation problems, Assignment problems, Project management, Dynamic Programming. ● Analyzing the Non- linear Programming Problems through techniques of Kuhn-Tucker optimality conditions. ● construct linear integer programming models and discuss the solution techniques. ● Acquire knowledge in CPM and PERT techniques, to plan, schedule, and control project activities. ● More applications of Operations Research.
Graph theory	● Comprehend about isomorphism, Isomorphism as a relation, Graphs and groups, Cut-vertices, Blocks, Connectivity. ● Appreciate Eulerian graphs, Hamilton graphs, Hamilton walks and numbers ● Develop ideas in Strong diagraphs, Tournaments, matching, Factorization. ● Acquire knowledge about The Four colour problem, Vertex colouring, The Ramsey number of graphs, Turan's Theorem.
	● Acquire concept on The centre of a graph, Distant vertices, Locating numbers, Detour and Directed distance.
Number theory	● Analyzing the Fundamental Theorem of Arithmetic ● Gain knowledge about Arithmetical function and Dirichlet multiplication ● Appreciate the idea of Congruences, Chinese Remainder Theorem ● Appreciate Quadratic residues, Reciprocity law, Jacobi symbol. ● Comprehend the Primitive roots, Existence and number of primitive roots.

Project	Project/Dissertation is aimed to attain an appreciation to the students that mathematics can be used to communicate thinking effectively. This aims to encourage students to become more creative.