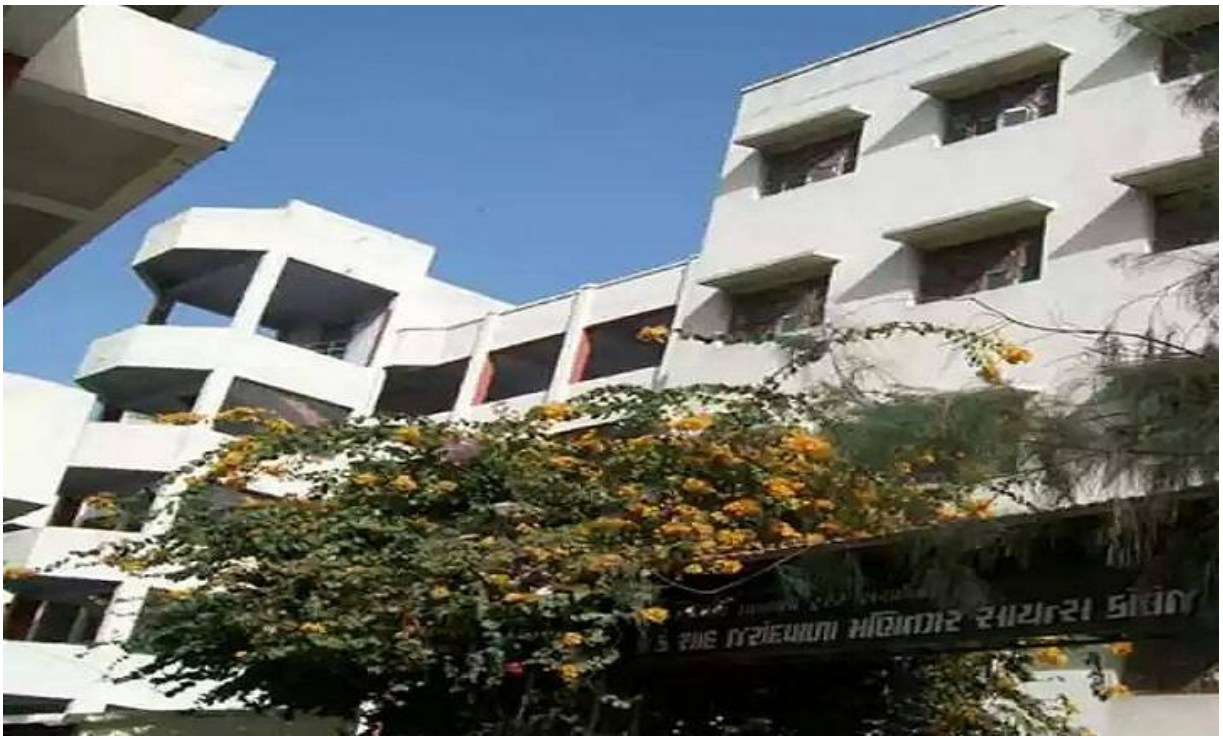
Programme outcome



K. K. SHAH JARODWALA MANINAGAR SCIENCE COLLEGE, AHMEDABAD

DEPARTMENT OF CHEMISTRY

M.Sc. PROGRAMME IN CHEMISTRY

PROGRAMME OUTCOMES

The post graduate program in Chemistry offers degree in Organic Chemistry. The design of curriculum is of topical importance and broad based with multi-disciplinary approach. The outcomes of the study (program specific and course) indicate the expected consequences subsequent to the post-graduation degree. At the end of the PG programme in offered branch of Organic Chemistry, the students will be able to:

- Recite the fundamental and advanced laws of organic chemistry.
- Understand the potential of the recited laws in industry as well as academics.
- Explain the knowledge of contemporary issues in the field of chemistry and allied sciences.
- Apply the knowledge of Chemistry, in all the fields of learning including education, research and extension activities.
- Adjust completely to the demands of the growing field of chemistry.
- Communicate effectively by writing reports/documents, making presentations.
    - Crack various competitive exams CSIR – NET, GATE and SLET.

PROGRAMME SPECIFIC OUTCOMES:

- Analyze all the chemical compounds in terms of their physical, chemical and medicinal properties.
- Interpret the pictorial and numerical data obtained from a variety of analytical instruments.
- Synthesize a variety of organic, inorganic and hybrid materials useful for industrial and other sophisticated applications.
- Innovate and invent complex chemical processes using the knowledge of pure and applied chemistry.
- Facilitate the research in allied branches of sciences like physics, microbiology, biotechnology, biochemistry, pharmacy and botany.

Course outcome M.Sc. Organic Chemistry

Semester	Course code	Title	Outcome End of this paper the student will be able to understand the;
I	CHE-401	Inorganic Chemistry	Students will study about different topics of inorganic chemistry like Quantum mechanics, Group theory, Organometallic compounds and Electronic spectroscopy.
I	CHE-402	Organic Chemistry	Students are study regarding basic and fundamental of organic chemistry of elimination-Substitution reaction, aromaticity, reactive intermediates, stereochemistry and name reactions.
I	CHE-403	Physical Chemistry	Physical chemistry related topics like thermodynamics, chemical kinetics, Surface chemistry and behavior of solid state chemistry will study from this course.
I	CHE-404	Analytical Chemistry	Concepts and tools of analytical chemistry, Data handling and statistical analysis , Instrumental analysis and general study of ion selective electrodes are included in this course.
I	CHE-405	Practical	In this course covers two type of chemistry practicals, one is Inorganic chemistry, in which students analysis semi-micro analysis of six radicals with one rare elements and one insoluble compound. The other part includes organic chemistry preparation of single steps and general study of prepared final product.

I	CHE-406	Practical	In this course covers two type of chemistry practicals, (A) Physcial chemistry, in which students perform the instrumental analysis and chemical Kinetics experiments. (B) Analytical chemistry-Calibration of glassware and valuable instrument and determine various types of compound like tobacco, bleaching powder and vinegar.
II	CHE-407	Inorganic Chemistry	Studies of theories of chemical bonding, application of Symmetry, metal-ligand equilibrium.
II	CHE-408	Organic Chemistry	Photochemistry, Heterocyclic compounds, name reactions and organic reagents cover in this course.
II	CHE-409	Physical Chemistry	Students will learn about statistical thermodynamics, polymer chemistry, Nuclear and radio chemistry and electrochemistry.
II	CHE-410	Analytical Chemistry	Students will learn about sampling and sample preparation, chromatographic methods, Spectro-photometry and Photochemistry related topics.
II	CHE-411	Practical	Students will perform the practicals of Inrganic Chemistry (synthesis of metal complexs and salts) and Organic chemistry (One step organic preparation).
II	CHE-412	Practical	This course covers practical based on Physical chemistry –Instrumental, Kinetics and Adsorption. The other practical perform based on Analytical chemistry-determination of several chemical compounds.
III	CHE(O)-501	Natural Products and Bio molecules	Learners can understand different types of steroids and hormones. Different types of carbohydrates and their structures. The importance of nucleic acid in the DNA, RNA and proteins.

III	CHE(O)-502	Advanced organic synthesis	Deep aspects of retrosynthesis and oxidationreduction reaction, synthesis of the important organic molecule, can be able to design new molecules of interest, PCR and Conformational analysis can give understanding of how the reactions take place by bond shifting and geometry, Use of Protection groups in synthesis to avoid side reaction/products during organic synthesis.
III	CHE(O)-503	Organic spectroscopy	Understand the concept, importance and scope of UV-Visible spectroscopy, concept and importance of IR spectroscopy, concept and application of NMR (^{1}H NMR and ^{13}C NMR) in organic synthesis as well as medicinal chemistry, fragmentation patterns by Mass spectroscopy, analyze and interpret the spectral data collected from different spectroscopic techniques.
III	CHE (EO-1) -504 Elective-1	Medicinal & Industrial Chemistry	Learns will understand the classification of drugs, concepts of how to develop drug, synthesis the drugs by best route of synthesis, what are antibiotics and where/when to use them.
III	CHE(O)-505	Practical	One or multi steps Organic synthesis experiments learn in it.
III	CHE(O)-506	Practical	One or multi steps Organic synthesis experiments learn in it.
IV	CHE(O) 507	Scientific Writing	Students will develop skill for writing of Research Article/Review Article/Commentary Article/Case Study/ Monograph/Book Chapter/Book Review/Research Proposal or any other scientific article type.

IV	CHE(O) 508	Report Writing	Students will develop skill Report Writing for Participation and/or presentation (Poster/Oral/Invited talk as applicable) in University/State level/National/ International Seminar/ Conference/Webinar/ Symposium/ Workshop/Hands-on training /Software learning of at least 2 days. In case of one day seminar/ webinar/ conference/workshop, it is mandatory to participate in two such events.
IV	CHE(O) 509	Industrial Training/ NET-GSET based Test	Students undergo 3 weeks industrial training under the supervision of a faculty from the concerned department. This training will enhance industrial knowledge and skill in area like R&D, QA, QC, Production or any other relevant department on different instrumental techniques or other laboratory equipment.
IV	CHE(O) 510	Dissertation	Each student must carry out a project under the supervision of a faculty from the concerned department. Students will gain the necessary skills and knowledge in order to organize and conduct a research project.

B. Sc. PROGRAMME IN CHEMISTRY

PROGRAMME OUTCOMES

At the graduation in science faculty a student should have:

- Acquired the knowledge with facts and figures related to various subjects in pure sciences such as Physics, Chemistry, Botany, Zoology, Mathematics, etc.
- Understood the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life.
- Acquired the skills in handling scientific instruments, planning and performing in laboratory experiments
- The skills of observations and drawing logical inferences from the scientific experiments. Analyzed the given scientific data critically and systematically and the ability to draw the objective conclusions.
- Been able to think creatively (divergently and convergent) to propose novel ideas in explaining facts and figures or providing new solution to the problems.
- Realized how developments in any science subject helps in the development of other science subjects and vice-versa and how interdisciplinary approach helps in providing better solutions and new ideas for the sustainable developments.
- Developed scientific outlook not only with respect to science subjects but also in all aspects related to life.
- Realized that knowledge of subjects in other faculties such as humanities, performing arts, social sciences etc. can have greatly and effectively influence which inspires in evolving new scientific theories and inventions.

- Imbibed ethical, moral and social values in personal and social life leading to highly cultured and civilized personality. Developed various communication skills such as reading, listening, speaking, etc., which we will help in expressing ideas and views clearly and effectively.
- Realized that pursuit of knowledge is a lifelong activity and in combination with untiring efforts and positive attitude and other necessary qualities leads towards a successful life.
- Developed flair by participating in various social and cultural activities voluntarily, in order to spread knowledge, creating awareness about the social evils, blind faith, etc.

Programme Specific Outcome

At the completion of B. Sc. in Chemistry students are able to:

- Provide a broad foundation in chemistry that stresses scientific reasoning and Analytical problem solving with a molecular perspective.
- Achieve the skills required to succeed in graduate school, the chemical industry and professional school.
- Get exposures of a breadth of experimental techniques using modern instrumentation.
- Understand the importance of the Periodic Table of the Elements, how it came to be, and its role in organizing chemical information.
- Understand the interdisciplinary nature of chemistry and to integrate knowledge of mathematics, physics and other disciplines to a wide variety of chemical problems.
- Learn the laboratory skills needed to design, safely and interpret chemical research.
- Acquire a foundation of chemistry of sufficient breadth and the depth to enable them to understand and critically interpret the primary chemical literature.
- Develop the ability to communicate scientific information and research results in written and oral formats.

Course outcome Chemistry:

Semester	Course code	Title	Outcome End of this paper the student will be able to understand the;
I	DSC-C-CHE-111T	General Chemistry-I	• Learn the preparations of alkanes, alkenes and alkynes and their reactions. • Solve the problems regarding hybridization and types of bonding. • Draw the structures, shapes and geometry of the different molecules. • Understand stereochemistry involved in the different organic molecules. • Understand the principles involved in the different organic reactions.
I	DSC-C-CHE-112P	Chemistry lab – C I & II lab	• Prepare different types of standard solutions. • Handle properly chemical and glassware. • Calibrate the apparatus used in the titrations. • Understand the theory and applications of titrations. • Find Normality, Molarity, Gram/liter of the solutions. • Find the elements present in organic compounds. • Find melting point and boiling point of the organic compounds.
I	DSC-M-CHE-113T	Basic Chemistry	• Learn the preparations of alkanes, alkenes and alkynes and their reactions. • Draw the IUPAC and Bond line structures of hydrocarbons. • Solve the problems regarding hybridization and types of bonding. • Draw the structures, shapes and geometry of the different molecules.
I	DSC-M-CHE-113P	Chemistry lab – C I lab	• Prepare different types of standard solutions. • Handle properly chemical and glassware. • Calibrate the apparatus used in the titrations. • Understand the theory and applications of titrations. • Find Normality, Molarity, Gram/liter of the solutions.

I	IDC-CHE-114T	Chemistry in Biological Science	• Learn the preparations of alkanes, alkenes and alkynes and their reactions. • Understand the bio-reactivity of hydrocarbons. • Solve the problems regarding hybridization and types of bonding of biomolecules. • Understand the solubility and characteristics of biomolecules. • Study bio-inorganic chemistry.
I	IDC-CHE-114P	Chemistry lab – C I lab	• Prepare different types of standard solutions. • Handle properly chemical and glassware. • Calibrate the apparatus used in the titrations. • Understand the theory and applications of titrations. • Find Normality, Molarity, Gram/liter of the solutions.
II	DSC-C-CHE-121T	General Chemistry	• Learn the history of Indian Chemistry, ancient Indian knowledge and philosophy of chemistry. • Significance of the Indian knowledge with modern scientific perspectives. • Scientific theory of atoms, concept of wave functions and the fundamentals of quantum mechanics. • Solve the conceptual questions regarding quantum numbers, electronic configuration, shapes of the orbitals, radial and angular distribution curves. • Learn the different types of electrolytes and conductance, dissociation of electrolytes and their applications. • Solve the conceptual questions regarding hydrolysis of salts, pH of the solutions and buffer solutions. • Learn the application of nuclear energy and nuclear reactions. • Learn Nuclear reactions, Nuclear Fission and fusion reactions, Artificial radioactivity.
II	DSC-C-CHE-122P	Chemistry lab – C III & IV lab	• Understand difference between iodimetry and iodometry titrations. • Operate and calibrate pH – meter. • Understand the theory and applications of titrations. • Perform different test for inorganic qualitative analysis. • Identify positive and negative ion present in the salt.

II	DSC-M-CHE-123T	Structural and Electro Chemistry	• Learn scientific theory of atoms, concept of wave functions and the fundamentals of quantum mechanics. • Solve the conceptual questions regarding quantum numbers, electronic configuration, shapes of the orbitals, radial and angular distribution curves. • Learn the different types of electrolytes and conductance, dissociation of electrolytes and their applications. • Solve the conceptual questions regarding hydrolysis of salts, pH of the solutions and buffer solutions.
II	DSC-M-CHE-123P	Chemistry lab – C III lab	• Understand difference between iodimetry and iodometry titrations. • Operate and calibrate pH – meter. • Understand the theory and applications of titrations.
II	IDC-CHE-124T	Chemistry in Physical Sciences	• Learn the history of Indian Chemistry, ancient Indian knowledge and philosophy of chemistry. • Learn significance of the Indian knowledge with modern scientific perspectives. • The application of nuclear energy and nuclear reactions. • Learn Nuclear reactions, Nuclear Fission and fusion reactions, Artificial radioactivity.
II	IDC-CHE-124P	Chemistry lab – C III lab	• Understand difference between iodimetry and iodometry titrations. • Operate and calibrate pH – meter. • Understand the theory and applications of titrations.
III	CHE-201	Organic Chemistry	basics of bioorganic molecules, SE reactions, Polynuclear hydrocarbons, Heterocyclic, Beta dicarbonyl compounds and Acid-base properties of organic compounds
III	CHE-202	Physical Chemistry	Basics of Thermodynemics, Electrochemistry, Phase rule, Adsorption, Catalysis, Polymer Chemistry and Colloids
III	CHE-203	Chemistry Practical	Inorganic qualitative analysis of mixture and Physical experiments including Kinetic and various instrumental study to measure physical parameter

IV	CHE-204	Inorganic chemistry	basics of Quantum chemistry Non-aqueous solvents, Physicochemical properties
IV	CHE-205	Analytical Chemistry	Theoretical aspects of Gravimetric, Acid-base, Redox, complexometry, precipitation Titrations
IV	CHE-206	Chemistry practical	concepts organic analysis and quantitative inorganic analysis
V	CHE-301	Organic chemistry	Concepts of stereochemistry, some rearrangements and name reactions, SN reactions, some complex bio molecule such as alkaloids and Disaccharides
V	CHE-302	Inorganic chemistry	Concepts of structural chemistry such as Symmetry, Chemical bonding, Co-ordination chemistry, Kinetics and reaction rates of substitution, Inorganic polymers and Mossbauer Spectroscopy in detail
V	CHE-303	Physical chemistry	Concepts of Thermodynamics, Electrochemistry, Chemical Kinetics, polymer chemistry, Nuclear Chemistry and Molecular spectra in detail
V	CHE-304	Analytical chemistry	principles and applications of various spectroscopy such as UV-visible, IR, NMR and atomic spectroscopy
V	CHE-305	Soil analysis	Principles, working and applications to determine the various parameters of soil, which can be helpful to know the quality of soil, which can be useful for higher studies and research
V	CHE-306	Chemistry practical	Basics of Organic Preparations, TLC, and Inorganic Quantitative Analysis of complexed mixtures, Analysis of Alloy, Kinetic and instrumental titrations in detail,
VI	CHE-307	Organic chemistry	Advanced organic chemistry including the study Stereo Chemistry (II), biomolecules such as Terpenods, alkaloids, vitamins and drugs and some industrial products such as dyes, pesticides and explosives, in detail

VI	CHE-308	Inorganic chemistry	Advanced Inorganic chemistry in detail including Term symbol, Electronic spectra of metal complexes, Quantum chemistry, Chemical bonding and Metal carbonyls and Organometallic compounds
VI	CHE-309	Physical chemistry	Advanced Physical chemistry including Thermodynamics, Electro chemistry, Phase Rule, Osmosis, Photochemistry and Metal corrosion in detail
VI	CHE-310	Analytical chemistry	Advanced analytical chemistry including Errors and treatment of Analytical data, Chromatographic methods, Solvent Extraction Separation, Electro analytical Techniques such as Polarography and Potentiometry, Acid-base, Redox and Complexometry Titrations in detail
VI	CHE-311	Nano structures and Nanochemistry	Elective subject as Nano science includes introduction, synthesis, Nano structured materials, identification and applications
	CHE-312	Chemistry practical	Experiments including Organic separation and Identification, Inorganic Gravimetric & Volumetric Analysis, Alloy Analysis, Kinetic and instruments study in detail

DEPARTMENT OF PHYSICS

Programme Specific Outcome

At the completion of B. Sc. in Physics students are able to:

- Demonstrate a rigorous understanding of the core theories & principles of physics, which includes mechanics, electromagnetism, thermodynamics, & quantum mechanics.
- Learn the Concepts as Quantum Mechanics, Relativity, introduced at degree level in order to understand nature at atomic levels.
- Provide knowledge about material properties and its application for developing technology to ease the problems related to the society.
- Understand the set of physical laws, describing the motion of bodies, under the influence of system of forces.
- Understand the relationship between particles & atom, as well as their creation & decay.
- Relate the structure of atoms & subatomic particles.
- Understand physical properties of molecule the chemical bonds between atom as well as molecular dynamics.
- Analyze the applications of mathematics to the problems in physics & develop suitable mathematical method for such application & for formulation of physical theories.
- Learn the structure of solid materials & their different physical properties along with metallurgy, cryogenics, electronics, & material science.
- Understand the fundamental theory of nature at small scale & levels of atom & sub-atomic particles.

Course outcome Physics:

Semester	Course code	Title	Outcome At the end of this paper the student will be able to understand the;
I	DSC-C-PHY-111T	Vectors, Waves, Optics and LASER	Understanding of vector analysis, including vector multiplication, differentiation, and theorems like Green's, Stokes', and Divergence, along with applications such as Gauss's law. They will gain insights into wave mechanics, exploring the velocity of acoustic waves in gases, solids, and strings, as well as the principles behind human speech, hearing mechanisms, and musical sounds. The course introduces ultrasonics, covering generation methods like magnetostriction and piezoelectric oscillators, velocity measurement, and applications. In optics, students will study Fermat's principle, laws of reflection and refraction, and interference phenomena in thin films, including Newton's rings and the operation of interferometers like Michelson and Fabry-Perot. The unit on lasers provides foundational knowledge on light-matter interaction, Einstein coefficients, and the principles of light amplification. Students will explore various types of lasers, their components, characteristics, and diverse applications in modern science and technology.

I	DSC-C-PHY-112P	General Physics, Optics, Electronics	Hands-on experience with foundational experiments in physics, optics, and electronics. They will determine the refractive index of prisms and liquids, validate physical constants through Melde's experiment, and test the resonance relationships in acoustic systems. Students will compute the moment of inertia for different setups, use traveling microscopes for precision measurements, and analyze magnetic fields of bar magnets in varied orientations. They will enhance their graphing skills, error estimation, and data analysis through linear, logarithmic, and polar plots. Practical understanding of pendulum motion, including quality factors, and gravitational acceleration determination is emphasized. In electronics, students will gain proficiency in circuit analysis, transformer efficiency evaluation, and multimeter usage for measuring resistance, capacitance, and inductance. They will explore diode behavior, analyze rectifier performance, and apply key theorems like Thevenin, Norton, and Maximum Power Transfer. Additionally, they will verify logic gate operations and evaluate resonance in AC circuits.
I	DSC-M-PHY-113T	Vectors and Waves	Comprehensive understanding of vector analysis, including operations like vector multiplication, triple scalar and vector products, and differentiation of vectors. They will apply key theorems such as Green's, Divergence, Stokes', and Gauss's law in practical contexts. In the study of waves, students will analyze the velocity of acoustic waves in gases, solids, and strings under tension, incorporating concepts like Newton's value and Laplace's correction. They will explore the mechanics of human speech and hearing, musical sounds, and scales. Additionally, students will understand ultrasonic wave generation using magnetostriction and piezoelectric methods and their applications.

I	DSC-M-PHY-113P	Understanding of Physics	Practical skills in experimental physics and electronics. They will test resonance principles to determine frequencies, calculate the moment of inertia using a flywheel, and perform precise measurements with a traveling microscope. They will master graph plotting techniques, error estimation, and analyze pendulum dynamics to find relaxation time and quality factors. Students will measure physical constants like ggg using a bar pendulum and Boltzmann's constant via a diode. In electronics, they will analyze circuits using Thevenin and Norton theorems, evaluate inductance and transformer performance, and verify logic gate operations. They will also study rectifier behavior and understand multimeter applications for measuring resistance, capacitance, and inductance.
I	MDC-PHY-114T	Vectors and Waves	Comprehensive understanding of vector analysis, including operations like vector multiplication, triple scalar and vector products, and differentiation of vectors. They will apply key theorems such as Green's, Divergence, Stokes', and Gauss's law in practical contexts. In the study of waves, students will analyze the velocity of acoustic waves in gases, solids, and strings under tension, incorporating concepts like Newton's value and Laplace's correction. They will explore the mechanics of human speech and hearing, musical sounds, and scales. Additionally, students will understand ultrasonic wave generation using magnetostriction and piezoelectric methods and their applications.
I	MDC-PHY-114P	General Physics, Electronics	Determine prism angles and refractive indices using spectrometers and validate physical constants through Melde's experiments. They will analyze resonator relationships, measure unknown fork frequencies, and utilize a traveling microscope for precise distance and diameter measurements. Students will calculate gravitational acceleration using a bar pendulum and perform comprehensive error analysis. They will accurately measure resistance, capacitance, inductance, and diode characteristics with multimeters, determine Boltzmann's constant, and evaluate inductance through series and parallel connections. Additionally, students will assess transformer efficiency, verify logic gate operations, analyze half-wave rectifier performance, and investigate series resonance by varying capacitors, ensuring a robust understanding of general physics and electronics.

II	DSC-C-PHY-121T	Indian Astronomy, Nuclear Physics, Circuits and Electrostatics	• The development of astronomy from Vedic times to the recent times • the basic concepts of celestial sphere • the different coordinate system, Celestial longitude and latitude, Right ascension, azimuth, altitude and equinox • the Zodiac systems • growth and decay of radioactive elements, different types of equilibrium like ideal, transient, impossible and secular equilibrium • radioactive series, radioactive isotopes and artificial radioactivity • determination of age of the earth through radioactivity. • the functioning of resistance, capacitance, and inductors in the DC as well as AC circuits. • working of bridge circuits and its applications • Active basic component diode and its application in different rectifier circuits • Gauss's law, electric potential, and electrostatic energy with examples • Potential and electric field of an electric dipole

II	DSC-C-PHY-122P	Indian Astronomy, General Physics, Optics and Electronics	• Plotting and understanding of different types of charts used in Astronomy. • Thermal radiation using Stefan Boltzmann fourth power law • Simulation of radioactive decay using calculator, data fitting least square method and probability distribution of two-coin system • Interference in wedge shape film and calibration of spectrometer • The magnetic moment using deflection and vibration magnetometer • The phase transition in paraffin and to find the acceleration due to gravity using spring mass system • Discharging of the capacitor • Construction of ammeter and voltmeter • Activation energy, I-V characteristics and load line analysis of diode and rectifier circuits • AC and DC bridges and its applications • Universal logic gates NAND and NOR
II	DSC-M-PHY-123T	Circuits and Electrostatics	• The functioning of resistance, capacitance, and inductors in the DC as well as AC circuits. • Working of bridge circuits and its applications • Active basic component diode and its application in different rectifier circuits • Gauss's law, electric potential, and electrostatic energy with examples • Potential and electric field of an electric dipole
II	DSC-M-PHY-123P	General Physics and Electronics	• Thermal radiation using Stefan Boltzmann fourth power law • Calibration of spectrometer • The magnetic moment using deflection and deflection magnetometer • Discharging of the capacitor • Activation energy, I-V characteristics and load line analysis of diode and rectifier circuits • Universal logic gates NAND and NOR • Rectifier

II	MDC-PHY-124T	Indian Astronomy and Nuclear Physics	• the development of astronomy from Vedic times to the recent times • the basic concepts of celestial sphere • the different coordinate system, Celestial longitude and latitude, Right ascension, azimuth, altitude and equinox • the Zodiac systems • growth and decay of radioactive elements, different types of equilibrium like ideal, transient, impossible and secular equilibrium • radioactive series, radioactive isotopes and artificial radioactivity • determination of age of the earth through radioactivity.
II	MDC-PHY-124P	Indian Astronomy, General Physics, Optics and Electronics	• Plotting and understanding of different types of charts used in Astronomy. • Interference in wedge shape film • Simulation of radioactive decay using calculator, probability distribution of two-coin system • the magnetic moment using deflection magnetometer and the magnetic field lines of bar magnet • discharging of the capacitor, LDR Characteristics and parallel resonance • activation energy of diode and rectifier circuits • absorption coefficient of liquid • bridge circuit and its applications

III	PHY- 201	Solid State Physics, Electronics , Modern Physics and Elementary Quantum Mechanics, Wave Optics .	Students know the fundamentals of crystal structure, Brag's law, experimental diffraction methods, Fundamentals of transistors , amplifiers , solid state electronic devices and their applications. They also learn basic course of Quantum mechanics. The topics included in optics impart their knowledge to understand principles of optical instruments having large applications in experimental astrophysics, atomic spectroscopy and molecular spectroscopy. Experiments involving optics, electronics , solid state physics and general physics give very much clarity in concepts of their theory course work of the syllabus. Physics problems are also solved by numerical study. Numerical technique is a powerful tool in the study of theoretical physics research.
III	PHY- 202	Mathematical Physics, Classical mechanics, Nuclear Physics, dielectrics and magneto statics.	Students acquire more general understanding of periodic functions by studying furrier series in mathematical physics. Applications of furrier series are wide in physics, chemistry and electronics. In classical mechanics, basic understanding in laws of planetary physics and collision theory are developed. Many nuclear physics experiment instruments are taught in detail and understanding of electrostatics and magneto statics is taught. Apart from electrodynamics electrostatics and magneto statics concepts have wide applications in some types of scientific instruments and engineering.
IV	PHY-204	Solid state physics, heat and thermo dynamics, electronics and atomic spectroscopy.	Hands on training they get to understand Principles of optical instruments, numerical calculations in lattice dynamics, and experiments on atomic spectra. Characteristics of solid state electronic devices and fundamental experiments in electronics they learn are very much useful for designing electronic circuits.

IV	PHY- 205	Sound and optics, statistical mechanics, relativity and quantum mechanics.	Study on the optical phenomena of polarization is covered in detail. The course of statistical mechanics introduced here gives preliminary understanding for study in statistical mechanics branch of physics. Students are capable to grasp understanding of atomic structure, atomic spectroscopy, molecular structure , molecular spectroscopy, nuclear physics and many modern branches of physics by understanding of fundamentals of quantum mechanics taught over here.
V	PHY-301	Mathematical Physics , Classical Mechanics and Quantum Mechanics	The Students gain knowledge regarding basic frame work of mathematical physics, classical mechanics and quantum mechanics. The concept of angular momentum and spherical harmonics enable students to understand electronic structure of atoms and molecules and the concepts are also helpful for study of light scattering in astronomy and astrophysics.
V	PHY- 302	Molecular Spectra, Statistical Mechanics and Solid-state Physics.	Students can calculate bond length; force constant, moment of inertia, rotational frequency and vibrational frequency, Raman shift of diatomic molecules .They also know to find out absorption and emission frequencies of molecular radiation. Students know all different types of partition functions of statistical mechanics and in material science; they get knowledge about different mechanical, thermodynamic and electronic properties of material.
V	PHY- 303	Electromagnetic induction,Electro-magnetic waves, Electro-magnetic Radiation , Alpha, Beta and Gamma Rays and liquid drop model of the nucleus.	Students understand fundamentals of electrodynamics namely Maxwell's equations, Lorentz gauge, Polarizations, Energy flux Radiation, pressure and Momentum of Plane waves in conducting medium and Skin effect. Detail understanding about radiation by charge particle. Students understand fundamentals of alpha beta and gamma rays spectra, nuclear fission and nuclear model.

V	PHY- 304	Linear and nonlinear electronic circuits	Students get knowledge of basics of amplifier , current gain, voltage gain and power gain, distortion and low frequency and high frequency response of transistor amplifier . Students also get clarity in fundamentals of digital principles and applications and get considerable understanding in network lines and field
V	PHY- 305	Nano science and nanotechnology	Useful knowledge of the study in nanotechnology will update and support their understanding of requirements of various research labs and applications in electronics, biotechnology and medical, automobiles, space, defence, sports, cosmetics, cloth industry. Students are also given experimental work on general physics, nuclear physics instrument and optical instruments. The fundamentals they develop have applications in experimental astrophysics, the principals involved in fibre optics communication. Basic experiments of analogue and digital electronics are very useful to understand designing of advance electronic circuits and integrated circuits.
VI	PHY -307	Mathematical Physics, classical mechanics and quantum mechanics.	Mathematical physics, classical mechanics and quantum mechanics Courses introduced here are building blocks for understanding advance technologies and research in any branch of theoretical physics.

VI	PHY- 308	Electronic Spectra, Statistical Mechanics & Solid State Physics	Comprehensive information of diatonic molecular spectra is completed here with the electronic spectra. Completing the study work of statistical mechanics, students have understanding of all basic concepts of statistical mechanics. The scope of statistical mechanics is very wide. It is applicable to all phenomena of macroscopic bodies whose behaviour cannot be completely described by classical or quantum mechanics. It is applicable to physics, chemistry, material science, astronomy and biology. Detail study of dielectrics make students knowledgeable about the dielectric property of materials. Understanding of Dielectric character of the material plays very important role for many applications for example, designing drugs in pharmaceutical industry. Concepts of diamagnetism and Para magnetism study are important for study of superconductivity and material science.
VI	PHY- 309	Plasma Physics and Nuclear Physics.	Students are capable to understand the subject of plasma physics. Study in plasma physics has fantastic applications. Apart from applications range from energy production by thermonuclear fusion to laboratory astrophysics, plasma physics has many industrial applications such as, blood coagulation, skin treatment, dental cleaning, treatment of certain types of cancer, hair treatment, and sterilization of hands, vegetables, seeds, and biofilms. To increase germanise rate of seeds, increase surface energy of polymer films, surface hardening of metals, nanoparticle production by plasma. Students get fundamental understanding in nuclear fission .The understanding is essential for designing purpose of nuclear reactors. Nuclear science also have many applications in medical science.
VI	PHY- 310	Linear & Non-Linear Electronics circuits	These topics make students capable to understand working and designing of any electronic circuit may have any application. They also understand Preliminary concepts required for microprocessor study. Students also get detail understanding of many electronic instruments which are used for precise scientific measurements.

VI	PHY- 311	Transducers, Electronic Instruments, Signal Generators	Students become knowledgeable to principles behind different types of transducers. Transducers are widely used in automation, measurement and control system. Students understand mechanism of working and designing of electronics instruments which are frequently required for scientific measurements of different physical quantities. Considerable knowledge of signal generators is also acquired. There are many different types of signal generators with different purpose and applications. Signals generated by signal generators are used as a stimulus for electronic measurements, typically in designing, testing, troubleshooting and repairing electronic or electroacoustic devices.

DEPARTMENT OF MATHEMATICS

B.Sc. PROGRAMME IN Mathematics

Programme Specific Outcome

Students will learn an understanding of major concepts, principal in all disciplines of Mathematics.

The programme leading to this degree provides the opportunities to develop and demonstrate knowledge and understanding in the following areas. When one has completed this degree, she/he will have knowledge and understanding of the fundamental concept, principles and techniques from a range of topic areas. When one has completed this degree, she/he will be able to understand how to solve some problems using the methods taught and develop abstract mathematical thinking. When one has completed this degree, she/he will be able to demonstrate the communication clearly knowledge, ideas and conclusions about mathematical and improve his/her own learning and performance.

Course outcome Mathematics:

Semester	Course Code	Course Name	Outcomes Upon successful completion of this course, students will be able to:
I	DSC-C-MAT-111T	CALCULUS – I	1. Understand and Apply Successive Derivatives: Demonstrate the ability to compute higher-order derivatives using standard results and Leibniz's theorem. Apply Taylor's and Maclaurin's theorems to expand functions into power series. 2. Solve Differential Equations: Solve first-order and first-degree differential equations using methods such as variable separation, homogeneous, non-homogeneous, exact, and integrating factors. Analyze and solve higher-degree differential equations, including Clairaut's and Lagrange's differential equations. 3. Analyze Theorems and Rules in Calculus: Comprehend and apply Roll's, Lagrange's, and Cauchy's Mean Value Theorems to analyze function behaviors. Solve problems involving indeterminate forms using L'Hospital's Rule. 4. Work with Functions of Several Variables: Understand the concepts of limits, continuity, and partial derivatives for multivariable functions. Apply vector analysis techniques with geometric interpretations. These outcomes aim to provide a solid foundation in calculus and its applications, equipping students with skills to approach complex mathematical problems effectively.

I	DSC-C-MAT-112P	Mathematics Practical: Calculus-I	1. Apply Successive Differentiation and Leibniz's Theorem Solve problems involving successive derivatives using Leibniz's theorem and standard results. 2. Solve Differential Equations: Develop problem-solving skills for first-order differential equations using various methods such as variable separation, homogeneous, non-homogeneous, and exact equations. 3. Understand and Apply Calculus Theorems: Verify and apply Mean Value Theorems, including Rolle's, Lagrange's, and Cauchy's Theorems, in practical scenarios. Solve problems involving L'Hospital's Rule for indeterminate forms. 4. Work with Multivariable Functions and Vector Analysis: Explore the concepts of limits, continuity, and differentiation for functions of several variables. Analyze and solve problems using vector analysis, including gradient, divergence, and curl computations. These outcomes ensure students gain practical experience in applying calculus concepts to mathematical problems, preparing them for more advanced applications in mathematics and related fields.
I	DSC-M-MAT-113T	CALCULUS – I	1. Master Successive Derivatives: Compute higher-order derivatives using standard results and Leibniz's theorem. Apply Taylor's and Maclaurin's theorems to derive power series expansions for various functions. 2. Solve First-Order Differential Equations: Analyze and solve first-order, first-degree differential equations using methods such as variable separation, homogeneous and non-homogeneous equations, exact differential equations, integrating factors, and

			Bernoulli's equation. 3. Solve Higher-Degree Differential Equations: Solve first-order and higher-degree differential equations solvable for , , or . Analyze and solve Clairaut's and Lagrange's differential equations. These outcomes ensure students gain foundational knowledge in differential calculus and acquire problem-solving skills applicable to both theoretical and practical scenarios in mathematics.
I	DSC-M-MAT-113P	Mathematics Practical: Calculus-I	1. Apply Successive Differentiation and Leibniz's Theorem: Solve problems involving higher-order derivatives using successive differentiation techniques. Utilize Leibniz's theorem for computing the nth derivative in various mathematical contexts. 2. Solve Differential Equations: Develop problem-solving skills for first-order differential equations, including variable separation, homogeneous, non-homogeneous, and exact equations. Apply analytical methods to solve practical differential equation problems effectively. These outcomes aim to equip students with foundational skills in calculus and enhance their ability to solve mathematical problems through theoretical and applied approaches.
I	MDC-MAT-114T	CALCULUS – I and its APPLICATIONS	1. Develop Skills in Successive Differentiation: Calculate higher-order derivatives using standard results and Leibniz's theorem. Utilize Taylor's and Maclaurin's theorems to obtain power series expansions for various functions. 2. Understand and Solve Differential Equations: Solve first-order, first-degree

			differential equations using methods such as variable separation, homogeneous and non-homogeneous equations, exact equations, and integrating factors. Solve Bernoulli's differential equations and apply techniques for equations solvable for , , or . 3. Master Advanced Differential Equations: Analyze and solve higher-degree equations, including Clairaut's and Lagrange's differential equations. These outcomes ensure that students acquire a fundamental understanding of calculus concepts and their applications in solving real-world mathematical problems.
I	MDC-MAT-114P	Mathematics Practical: Calculus-I and its APPLICATIONS	1. Apply Successive Differentiation and Leibniz's Theorem: Solve problems involving successive derivatives using standard techniques and Leibniz's theorem. Analyze mathematical scenarios requiring higher-order derivatives and apply appropriate methodologies. 2. Solve Differential Equations in Practical Contexts: Solve first-order differential equations, including variable separable, homogeneous, and non-homogeneous cases. Apply learned methods to exact equations and other real-world applications involving differential equations. These outcomes aim to strengthen students' computational skills and their ability to apply calculus concepts in practical and interdisciplinary contexts.
II	DSC-C-MAT-121T	CALCULUS – II	1. Apply Differentiation and Integration Concepts in Indian Knowledge Systems (IKS) Compute Taylor series and use Vedic methods for differentiation and integration, such as chain rule and integration by parts. Understand higher-order derivatives using traditional techniques like Meru Prastara.

			2. Work with Multivariable Functions: Analyze and apply Euler's theorem for homogeneous functions. Solve problems using Taylor's and Maclaurin's theorems for multivariable functions. 3. Understand Geometric Aspects of Curves: Study multiple points, double points, and calculate the radius of curvature for Cartesian, polar, and parametric equations. 4. Evaluate Multiple Integrals: Compute double and triple integrals and understand their geometric interpretations. Transform and evaluate integrals using Jacobian and other techniques. 5. Analyze Functions of Several Variables: Differentiate multivariable functions using total derivatives and implicit functions. Determine extreme values and solve optimization problems using Lagrange's multipliers. These outcomes ensure students gain advanced knowledge in multivariable calculus and its applications in solving complex mathematical and real-world problems.
II	DSC-C-MAT-122P	Mathematics Practical: Calculus-II	1. Analyze Functions of Several Variables: Solve problems on differentiability, implicit functions, and extreme values of functions of multiple variables. 2. Apply Theorems and Techniques: Apply Euler's theorem, Taylor's theorem, and Lagrange's method of undetermined multipliers to solve relevant problems. 3. Compute Geometric Properties: Calculate radius of curvature for Cartesian, polar, and parametric curves. 4. Work with Special Functions: Solve problems involving reduction formulas, Gamma, Beta functions, and their relationships.

			5. Solve Multiple Integral Problems: Evaluate multiple integrals, including changing the order of integration and variables, and calculate areas and volumes. 6. Use Vector Calculus Theorems: Apply Green's, Stokes', and Gauss's divergence theorems in practical problems. These outcomes help students develop a deeper understanding of advanced calculus concepts and their applications in various mathematical and real-world scenarios.
II	DSC-M-MAT-123T	Introduction to Matrices and Co-ordinate Geometry	1. Understand Matrix Fundamentals: Identify different types of matrices and perform basic operations, including addition, multiplication, and transposition. Utilize elementary operations to simplify matrices and understand symmetric, skew-symmetric, Hermitian, and skew-Hermitian matrices. 2. Analyze Matrix Properties: Determine linear dependence and independence of row and column matrices. Compute the rank of a matrix and transform matrices into Row Reduced Echelon (RRE) form for inversion and problem-solving. 3. Understand and Apply Concepts of Spheres: Derive and solve equations for spheres in , including their Cartesian and general forms. Calculate tangent planes, check tangency of planes, and analyze orthogonality of spheres. 4. Explore Conicoids: Classify central and non-central conicoids in three-dimensional space and solve problems related to their geometry. These outcomes aim to build a foundational understanding of matrices and coordinate geometry, equipping students to solve mathematical problems with theoretical and practical applications.
II	DSC-M-MAT-123P	Introduction to Matrices and Co-	1. Analyze and Classify Matrices: Differentiate between symmetric, skew-symmetric,

		ordinate Geometry	Hermitian, and skew-Hermitian matrices through problem-solving. Represent square matrices as sums of symmetric and skew-symmetric, or Hermitian and skew-Hermitian matrices. 2. Perform Advanced Matrix Operations: Solve problems using the Row Reduced Echelon (RRE) form of matrices. Determine the rank of matrices and compute matrix inverses using RRE techniques. 3. Understand and Solve Geometric Problems in 3D: Derive and solve equations for spheres, including cases with diametrically opposite endpoints and their intersections with lines or planes. Analyze and solve problems involving tangent planes and orthogonal spheres. 4. Explore Conicoids: Solve problems involving central and non-central conicoids in three-dimensional space. These outcomes aim to develop a strong understanding of matrix theory and coordinate geometry, with practical problem-solving skills applicable to advanced mathematical and real-world scenarios.
II	MDC-MAT-124T	Introduction to Matrices and IKS	1. Understand the Historical and Vedic Context of Matrices and Determinants: Explore the history and foundational concepts of matrices and determinants in the context of Indian Knowledge Systems (IKS). Solve 3x3 and 4x4 determinants using Vedic methods like Urdhva Tiryagbhyam. Compute the inverse of matrices through traditional techniques. 2. Apply Vedic Methods to Linear Equations: Solve systems of simultaneous linear equations using Vedic sutras, such as Paravartya Yojayet, Anurupye Sunyamanyat, and

			Sankalana Vyavakalana-bhyam. 3. Analyze Matrix Properties and Perform Operations: Identify and classify matrices into different types, such as symmetric, skew-symmetric, Hermitian, and skew-Hermitian. Perform basic operations on matrices, including addition, multiplication, and transposition. 4. Develop Skills in Advanced Matrix Techniques: Determine the rank of matrices using row rank, column rank, and Row Reduced Echelon (RRE) form. Invert matrices and evaluate linear dependence and independence of rows and columns. These outcomes aim to integrate modern mathematical concepts with traditional Indian methodologies, providing a holistic understanding of matrices and their applications.
II	MDC-MAT-124P	Mathematics Practicals	1. Perform Matrix Operations: Apply properties and operations on matrices, including matrix multiplication and the use of the Row Reduced Echelon (RRE) form. 2. Classify and Represent Matrices: Solve problems involving symmetric, skew-symmetric, Hermitian, and skew-Hermitian matrices. Represent a square matrix as the sum of symmetric and skew-symmetric, or Hermitian and skew-Hermitian matrices. 3. Analyze Matrix Properties: Compute the rank of matrices and determine matrix inverses using RRE. 4. Solve Systems of Linear Equations: Solve systems of linear equations using the RRE method and Cramer's rule. 5. Work with Determinants: Solve practical problems involving the calculation of determinants and the inverse of matrices. These outcomes ensure students gain hands-on experience in matrix theory and its

			application in solving systems of linear equations and other mathematical problems.
III	MAT-201	Advanced Calculus -I	This course is next step for calculus course done in previous semesters, it is designed to understand further concept of limit, continuity, differentiability, for functions with several variables it involves concepts of partial derivatives and their application too. With this course student will be able to extend the idea of limit, continuity, differentiability, and integrability for function with more than one variables. And they will be able to solve problems based on that.
III	MAT-202	Linear Algebra – I	This course is designed to understand one of the basic algebraic structure known as vector space, and to serve pure mathematical ideas regarding vector space, their basis, dimensions etc. It will also involve linear transformations, and connection of linear transformation with matrices. Students will be able to understand the basic idea of vector space and will observe this kind of abstract structures in real, students will be able to find dimension and basis of this vector space structures.
III	MAT-203	Practical (Based on MAT201, MAT202 and Numerical Methods - I)	This course is designed to acquire knowledge of numerical methods as well as examples based on numerical solutions. Curve tracing and some problems based on advanced calculus -1 and linear algebra-1. Student will be able to distinguish different types or errors, finding missing terms from given values, also will come to learn concept of factorial polynomials, students will be able to interpolate and inverse interpolate values for given data, student will be able to learn methods for solving system of linear equations, and will be able to solve problems based on continuity, differentiation, integration, and problem based on vector space,

			and linear transformations etc
IV	MAT-204	Advanced Calculus - II	This course is designed for introducing concept of multiple integrals , line, surface and volume integrals, also one will acquire knowledge of beta, gamma functions and their applications , and it also involve partial differential. Student will be able to learn multiple integrals and will be able to calculate multiple integrals , line integral , volume integral, surface integrals. Student will be able to solve problems based on beta, gamma functions, and problems based on partial differential equations.
IV	MAT-205	Abstract Algebra - I	This course is designed to understand another basic algebraic structure known group, and to serve pure mathematical ideas regarding groups, their generators etc.. It will also involve homomorphism and isomorphism of group. It also involve permutations groups, subgroups and lattice diagrams. Student will be able to understand abstract mathematical structure of groups and subgroups. Student will able to solve problems based on lattice diagrams, permutations, and problem based on isomorphism and homomorphism.
IV	MAT-206	Practical (Based on MAT204, MAT205 and Numerical Methods - II)	This course is designed to acquire knowledge of numerical methods as well as examples based on numerical solutions, it involves problems based on solving polynomial equation using different numerical method, it also involves numerical methods to solve IVP and find numerical differentiations, it also involves problems based on advanced calculus -II, and abstract algebra-I. Student will be able to solve problems based on finding roots of different equations using numerical methods, student will be able to solve IVPs and numerical

			differentiations using numerical methods. Student will be able to solve problems based on advanced calculusII and abstract algebra-I.
V	MAT-301	Linear Algebra - II	This course is designed to enable students to acquire the knowledge and next level understanding of linear maps, dual spaces , annihilators, inner product spaces. It also involves core knowledge of determinants and eigen values and eigen vectors of various matrices. Students will be able to solve problems based on linear maps, dual spaces, inner product spaces. Student will learn core knowledge of determinant function, eigen values and eigen vectors and quadratic forms.
V	MAT-302	Analysis - I	This course is designed to enable students to acquire the pure knowledge of sets, functions, limits , continuity and differentiations. Also it involves sequences and properties of sequences and properties of functions. Students will be able to solve problems based on algebraic properties of real numbers system, student will be able to solve problems on functions and continuity. Student will be able to solve problems on sequences and derivatives.
V	MAT-303	Complex Variables and Fourier Series	This course is designed to introduce core knowledge of complex numbers, different forms of complex numbers, function, continuity and derivatives of functions on complex variables, it also introduces basic transformations, and Fourier series. Student will be able to acquire knowledge of complex numbers and various properties of complex number systems like finding roots, and sequences and series. Student will be able to learn functions on complex variables their continuity and derivatives. Student will able to solve problems on Fourier series.

V	MAT-304	Mathematical Programming	This course is designed to enable students to acquire knowledge on real world problems on linear programming problems, transportation problems and assignment problems. Student will be able to sole various lpp using different methods. Student will be able to solve problems based on assignment problems and transportation problem.
V	MAT-305 (Elective course)	Discrete Mathematics	This course is designed to introduce core knowledge on discrete mathematics. It introduces concepts of partially ordered set, chain, lattice, lattice homomorphism, lattice isomorphism, sub-lattice, direct product of two lattices, Boolean algebra, direct product of two Boolean algebras, sum of product and product of sum canonical forms. Student will be able to solve problems based on discrete mathematics related problems. Student will be able to find sum of product and product of sum canonical forms.
V	MAT-305 (Elective course)	Number Theory	This course is designed to introduce core knowledge on number system. It introduces concepts of divisibility of numbers, primness of numbers, and theory of congruence theory. And their relative results. Student will be able to solve problems based on number theory related problems. Student will be able to find prime factors of any natural numbers. Student will learn main results to solve real problems related with numbers.
V	MAT-306	Practical - I (Based on MAT301, MAT302)	It involves problems Based on MAT301, MAT302. Student will be able to solve problems Based on MAT301, MAT302
		Practical - II (Based on	It involves problems Based on MAT303, MAT304. Students will be able to solve problems Based on MAT303, MAT304.

		MAT303, MAT304)	
VI	MAT-307	Abstract Algebra - I	This course is designed to enable students to acquire core knowledge of two algebraic structures Rings and Fields and problems related to that. Student will be able to understand the Ring structure and Field structure and will be able to solve problems based on that. Using polynomial rings student will be able to solve problems related with polynomials and reducibility of them.
VI	MAT-308	Analysis - II	This course is designed to enable students to acquire core knowledge of Riemann integral, limit sup and limit inf of sequences, various convergence, concepts on power series, and related problems. Student will be able to understand the process of integration they already doing in previous semester as core idea. And student will be able to verify integrability for any functions using definition. Student will be able to solve problems based on power series.
VI	MAT-309	Analysis - III	This course is designed to enable students to acquire core knowledge of topological structure on set, as metric spaces. Student will able to understand concept of functions, continuity and other properties of sets like connectedness, compactness, etc using pure basic concepts. Course also introduce uniform convergence of power series and application of it. Student will be able to understand real structure as topological structure and will be able to solve problems related to metric space structure, continuity, compactness, connected ness, uniform convergence and their applications.

VI	MAT-310	Graph Theory	As graph theory is one of the emerging field of mathematics, this course is introduced to enable students to understand concept of graphs and their basic properties. This course also introduces different types of graphs and their applications. Student will be able to understand new concept of graph other than cartesian co-ordinates graph of functions and will be able to distinguish between these concepts. Student will be able to convert some real world problems as graph theoretic problems and using techniques they will be able to solve the problems.
VI	MAT-311	Operations Research	This course is designed to introduce applied mathematical theory like inventory theory, PERT & CPM, and Game Theory. Students will be able to understand and convert inventory based real problem in to mathematical model and using different method will be able to solve it. Student will also be able to convert and solve real problems to PERT & CPM theory based problems and Game theory based problems.
VI	MAT-312	Practical - I (Based on MAT307, MAT308)	It involves problems Based on MAT307, MAT308. Student will be able to solve problems Based on MAT307, MAT308.
		Practical - II (Based on MAT309, MAT310)	It involves problems Based on MAT309, MAT310. Students will be able to solve problems Based on MAT309, MAT310.

DEPARTMENT OF STATISTICS

B.Sc. PROGRAMME IN STATISTICS

Programme Outcome

Students will demonstrate an understanding of major concepts in statistics.

Students tend to think critically and apply their understanding to develop ability to design, collection, presentation, analyse and interpret data based problems of real life situations.

Programme Specific Outcome

The ability to identify type of observable phenomena and probability distributions that are associated with. This helps them to collect the relevant data and to verify whether different properties of underlying probability distribution. The design and execution of the proper statistical analysis reveals their understanding of good analytical skills and proper handling of statistical data.

Course Outcomes

Semester	Course code	Title	Outcome At the end of this paper the student will be able to understand the;
I	DSC-C-STA-111T	Descriptive Statistics-I	The main objective of this course is to acquaint students with some basic concepts in Statistics. They will be introduced to some elementary statistical methods of analysis of data. At the end of this course students are expected to be able, 1. to tabulate statistical information given in descriptive form. 2. to use graphical techniques and interpret. 3. to compute various measures of central tendency, dispersion, skewness and kurtosis. 4. to analyze data pertaining to attributes and to interpret the results. 5. to summarize and analyze the data using computer. 6. to apply statistics in the various fields.
I	DSC-C-STA-112P	Descriptive Statistics-I Practical	At the end of the semester, students can identify nature of the problem and type of data to be collected. Also, He/She can ably obtain certain summary statistics in order to present the data in meaningful way. This will help them to understand the other associated methods and procedures used in analysis in a better way. The topics for this paper are based on Theory paper DSC-C-STA –111T

I	DSC-M-STA-113T	Descriptive Statistics-I	The main objective of this course is to acquaint students with some basic concepts in Statistics. They will be introduced to some elementary statistical methods of analysis of data. At the end of this course students are expected to be able, 1. to tabulate statistical information given in descriptive form. 2. to use graphical techniques and interpret. 3. to compute various measures of central tendency, dispersion, skewness and kurtosis. 4. to analyze data pertaining to attributes and to interpret the results. 5. to summarize and analyze the data using computer. 6. to apply statistics in the various fields.
I	DSC-M-STA-113P	Descriptive Statistics-I Practical	At the end of the semester, students can identify nature of the problem and type of data to be collected. Also, He/She can ably obtain certain summary statistics in order to present the data in meaningful way. This will help them to understand the other associated methods and procedures used in analysis in a better way. Topics for this paper are based on Theory paper DSC-C-STA –113T

I	MDC-STA-114T	Basics of Data Science – I	The main objective of this course is to acquaint students with some basic concepts in Statistics. They will be introduced to some elementary statistical methods of analysis of data. At the end of this course students are expected to be able, 1. to tabulate statistical information given in descriptive form. 2. to use graphical techniques and interpret. 3. to compute various measures of central tendency, dispersion, skewness and kurtosis. 4. to analyze data pertaining to attributes and to interpret the results. 5. to summarize and analyze the data using computer. 6. to apply statistics in the various fields.
I	MDC-STA-114P	Basics of Data Science – I Practical	At the end of the semester, students can identify nature of the problem and type of data to be collected. Also, He/She can ably obtain certain summary statistics in order to present the data in meaningful way. This will help them to understand the other associated methods and procedures used in analysis in a better way. The topics for this paper are based on Theory paper MDC-STA –114T

II	DSC-C-STA-121T	Probability Theory	The design of this course helps learning basic concept of probability and its application. The paper is about to develop a scientific thinking. Outcomes: 1. Students easily generate sample space, identify its type, define associated events and find probabilities of different events as well. 2. Students can define random variable with prior knowledge of sample space and probability and develop probability distribution. 3. Students can obtain Moments generating functions in order to study properties of probability distributions. 4. Various probability inequalities, idea of bivariate distribution and joint probability distribution will be clear.
II	DSC-C-STA-122P	Probability Theory Practical	At the end of the semester, students can identify nature of the problem, and can calculate probabilities of different events. Also, students can ably obtain certain summary statistics for probability distributions of random variables. This will help them to understand the other associated methods and procedures used in analysis in a better way. Topics for this paper are based on theory paper DSC-C-STA – 121T

II	DSC-M-STA-123T	Probability Theory	The main objective of this course is to acquaint students with some basic concepts in Statistics. They will be introduced to some elementary statistical methods of analysis of data. At the end of this course students are expected to be able, 1. to tabulate statistical information given in descriptive form. 2. to use graphical techniques and interpret. 3. to compute various measures of central tendency, dispersion, skewness and kurtosis. 4. to analyze data pertaining to attributes and to interpret the results. 5. to summarize and analyze the data using computer. 6. to apply statistics in the various fields.
II	DSC-M-STA-123P	Probability Theory Practical	At the end of the semester, students can identify nature of the problem and type of data to be collected. Also, He/She can ably obtain certain summary statistics in order to present the data in meaningful way. This will help them to understand the other associated methods andprocedures used in analysis in a better way. Topics for this paper are based on Theory paper DSC-C-STA –123T

II	MDC-STA-124T	Elements of Probability Theory	The design of this course helps learning basic concept of probability and its application. The paper is about to develop a scientific thinking. Outcomes: 1. Students easily generate sample space, identify its type, define associated events and find probabilities of different events as well. 2. Students can define random variable with prior knowledge of sample space and probability and develop probability distribution. 3. Students can obtain Moments generating functions in order to study properties of probability distributions. 4. Various probability inequalities, idea of bivariate distribution and joint probability distribution will be clear.
II	MDC-STA-124P	Elements of Probability Theory Practical	At the end of the semester, students can identify nature of the problem, and can calculate probabilities of different events. Also, students can ably obtain certain summary statistics for probability distributions of random variables. This will help them to understand the other associated methods and procedures used in analysis in a better way. Topics for this paper are based on theory paper MDC-STA – 124T

III	STA – 201	Distribution Theory-I	This course is designed to enable students to acquire basic understanding of statistical probability distributions, properties and applications in different fields. The outcomes are 1. Develop an understanding of observable characteristics and in context to that understanding and classification of different discrete and continuous probability distributions. 2. Shall learn the properties of different probability distributions. 3. Student would be able develop an understanding of solving the problems based on different probability distributions.
III	STA – 202	Descriptive Statistics 1	This course is designed to enable students to understand the purpose of extension of one dimensional random variables to Two or Three or Multi- dimensional random variables. At under graduate level, study is restricted to Three random variables. The students can establish association among variables and its measure in terms of correlation. The outcomes are 1. Develop understanding about bivariate data, association through scatter diagram, least square principle for error minimization, correlation coefficient 2. Multiple and partial correlation coefficient 3. Independent and dependent variable, and establish the relation between them by computing correlation coefficient and association of attributes.
III	STA – 203	Statistics Paper (Practical)	This course is designed to learn basic concepts to find line of best fit, measure of correlation and its coefficient, line of regression and other related aspects through numerical data and interpretation. This paper is based on Theory papers STA – 201 and STA – 202.

IV	STA – 204	Distribution Theory-II	This course is designed to enable students to acquire basic understanding of advanced statistical probability distributions, their properties and applications. The outcomes are: 1. Develop an understanding of advanced statistical probability distributions. 2. Students Shall learn the properties of advanced statistical probability distributions. 3. Students would be able develop an understanding of solving the problems based on these probability distributions.
V	STA – 205	Applied Statistics	This course is designed to enable students to acquire basic understanding of Application of statistics in economics. The course contains different aspects of a. index numbers and its utility in understanding of economic activities b. Time series and its importance in business forecasting c. Demography and its importance in wellbeing of human population. The outcomes are: 1. Develop understanding of application of statistics in economics. 2. Shall learn Index number, its computation and interpretation. 3. Time series data, its components, curve fitting, various smoothing methods, Students would be able to analyse time series data, 4. compute different measures of vital events that have influence on human population.

IV	STA – 206	(Practical)	This course is designed to apply advanced probability distributions to numerical data, drawing of random samples to verify their properties, use of different formulas of finding indices, chain and fixed based indices, whole sale and consumer price index numbers, short term variations, seasonal indices, statistics of vital events, interpretations of Net and Gross Reproduction Rates. This paper is based on Theory papers Sta – 204 and Sta – 205.
V	STA – 301	Statistics Paper (Theory) Statistical Inference-I	This course is designed to enable students to acquire basic understanding of the statistical inference – with three main components (a) Point Estimation, (b) Testing of Hypothesis and (c) Interval Estimation. specifically concept of Estimation and various methods estimating the parameter(s) of the probability distributions. The outcomes of this papers are: 1. To acquire knowledge and understanding of various method of estimation and study the properties of estimations. 2. Enabling the students to solve the problems based of point estimation and interval.
V	STA – 302	Statistics Paper (Theory) Sampling Distributions	This course is designed to enable students to acquire basic understanding of sampling distributions and their applications in real life situations. The outcomes are: 1. To acquire the knowledge of derivation of different sampling distributions and their uses in real life problems. 2. To study the various sampling distributions and their use in real life situations for estimation and testing of hypothesis point of view

V	STA – 303	Statistics Paper (Theory) Statistics in Psychology and Education	The use of statistics in Psychology and Education is important. The behavioral analysis is possible with the help of Statistics. This course is designed to enable students to acquire basic understanding application of statistics in psychology and education. The outcomes are: 1. To acquire the knowledge of various procedure to analyse psychological data. 2. To study the various methods of analysis for the educational data
V	STA – 304	Statistics Paper (Theory) Design of Experiments	This course is designed to enable students to acquire basic understanding application of statistics in the field of agriculture and industries. The importance of planning and analysis of more than two samples are the main aspects of experimental design. The outcomes are 1. Enabling students to know and understand various aspects, experimental material, requirements of number of treatments and its replications 2. Students can understand the importance of basic principles of designs given by Prof. R. A. Fisher 3. Different basic designs – Completely Randomised Design (CRD), Randomised Block Design (RBD), Latin Square Design (LSD), Factorial design etc. 4. Students will be able to identify the data and can classify in an appropriate design format, apply statistical Test Procedure for analysis and can interpret the results.

V	STA – 305	Statistics Paper (Theory-Elective-1) Statistics Using R	The programing languages and open source statistical tools are need of present time. They, not only make the analysis part easy but also, it gives output quickly and in desired format. This course is designed to enable students to acquire basic understanding of R language. We offer this paper as an elective paper. The outcomes are: Enabling students to know concept of R language, its various codes, and its application in data analysis.
V	STA – 305	Statistics Paper (Theory-Elective-2) Business Statistics	The mathematical programming has been used in planning of resources in a better manner. The mathematical modelling and its applications are part of this. This course is designed to enable students to acquire basic understanding of applications of statistics We offer this paper as an elective paper. The outcomes are: 1. Enabling students to understand markov chain and its application 2. Taking optimum decision to maximize profit or minimize loss. 3. Simulate data from the given model.
V	STA – 306	Statistics Paper (Practical)	This paper is divided into two parts Part – A – Practical Problems based on Theory Papers Sta – 301, 302, 303 Part – B – Practical Problems based on Theory Papers Sta – 304 Both the parts include finding solutions manually and using MS EXCEL.

VI	STA – 307	Statistics Paper (Theory) Testing of Hypothesis	This course will enable students to understand the another important aspect of statistical inference – testing of hypothesis. It includes mainly parametric tests that are used to compare different situations and to take decisions under uncertainty. The comparison of situations are forms or framed as statements called statistical hypothesis. The outcomes are: 1. Enabling students to know and understand the parametric and non-parametric tests. 2. Students will be able test the significance of parameter for one sample, two samples or three or more samples by using various statistical test.
VI	STA – 308	Statistics Paper (Theory) Sampling Theory	The sampling Theory plays a vital role in statistical analysis. The generalization of the underlying population is done through the sampling. It includes drawing of samples, classification of population, determination of sample size to make statistical analysis more precise, unbiased estimation of means and variances, efficiency of different sampling techniques. This course will enable students to understand various sampling techniques. The outcomes are: Enabling students to select a sample by using appropriate sampling method from the several like simple random sampling, stratified random sampling systematic sampling,

VI	STA – 309	Statistics Paper (Theory) Statistical Quality Control	Meaning and purpose of Statistical Quality Control (SQC), quality of the product, need of process control, statistical process control, on line process control methods, (control charts) and offline process control methods (Sampling schemes and plans) as lot control method. This course will enable students to understand various techniques in statistical quality control. The outcomes are: 1. Enabling students to check the quality of lot by using mean chart, range chart 2. Sampling plan will help students to decide probability of acceptance or rejection of the lot.
VI	STA – 310	Statistics Paper (Theory) Operations Research-1	The mathematical programming has been used in planning of resources in a better manner. The mathematical modelling and its applications are part of this. This course is designed to enable students to acquire basic knowledge of various optimization techniques and study various methods of solving real optimization problems. The outcomes are: 1. Enabling the students to know and understand the basics of various optimization techniques. 2. To study the algorithms of various optimization techniques. 3. Enabling the students to apply these algorithms to solve real life optimization problems

VI	STA – 311	Statistics Paper (Theory-Elective) Medical Statistics	This course is designed to enable students to acquire basic knowledge and understanding of various statistical methods used in medical science and clinical trials. The outcomes are: 1. Enabling the students to understand the application of statistics in medical science and clinical industry. 2. To learn how statistical methods are used in clinical trials.
VI	STA – 312	Statistics Paper (Practical)	This paper is divided into two parts Part – A – Practical Problems based on Theory Papers Sta – 307, 308 Part – B – Practical Problems based on Theory Papers Sta – 309, 310. Both the parts include finding solutions manually and using MS EXCEL.