K.R. MANGALAM UNIVERSITY
THE COMPLETE WORLD OF EDUCATION

SCHOOL OF BASIC AND APPLIED SCIENCES

Bachelor of Science (Hons) Mathematics

B.Sc. (Hons.) Mathematics

Programme Code: 11

2019-22

Approved in the 20th Meeting of Academic Council Held on 16 July 2019

Academic Council
Member Secretary
K.R. Mangalam University

Registrar
K.R. Mangalam University
Sohna Road, Gurugram, (Haryana)

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Content

1. Introduction

The K.R. Mangalam Group has made a name for itself in the field of education. Over a period of time, the various educational entities of the group have converged into a fully functional corporate academy. Resources at KRM have been continuously upgraded to optimize opportunities for the students. Our students are groomed in a truly inter-disciplinary environment wherein they develop integrative skills through interaction with students from engineering, management, journalism and media study streams.

The K.R. Mangalam story goes back to the chain of schools that offered an alternative option of world-class education, pitching itself against the established elite schools, which had enjoyed a position of monopoly till then. Having blazed a new trail in school education, the focus of the group was aimed at higher education. With the mushrooming of institutions of Higher Education in the National Capital Region, the university considered it very important that students take informed decisions and pursue career objectives in an institution, where the concept of education has evolved as a natural process.

K.R. Mangalam University was founded in the year 2013 by Mangalam Edu Gate, a company incorporated under Section 25 of the Companies Act, 1956.

K. R. Mangalam University is unique because of its

i. Enduring legacy of providing education to high achievers who demonstrate leadership in diverse fields.
ii. Protective and nurturing environment for teaching, research, creativity, scholarship, social and economic justice.

Objectives

i. To impart undergraduate, post-graduate and Doctoral education in identified areas of higher education.
ii. To undertake research programmes with industrial interface.
iii. To integrate its growth with the global needs and expectations of the major stake holders through teaching, research, exchange & collaborative programmes with foreign, Indian Universities/Institutions and MNCs.
iv. To act as a nodal center for transfer of technology to the industry.
v. To provide job oriented professional education to the pecia student community with particular focus on Haryana.

2. About the School

The school imparts out both teaching and research through its various science disciplines viz Mathematics, Chemistry and Physics.

School of Basic and Applied Sciences imparts students technical knowledge, enhances their skill and ability, motivating them to think creatively, helping them to act independently and take decisions accordingly in all their scientific pursuits and other endeavors. It strives to empower its students and faculty members to contribute to the development of society and Nation.

The faculty is in constant touch with various experts in the relevant field and is willing to experiment with latest ideas in teaching and research.

The School comprises of Discipline of Chemistry, Physics and Mathematics.

VISION

School of Basic and Applied Sciences intends for continuum growth as centre of advanced learning, research and innovation by disseminating analytical and scientific knowledge in the areas of basic and applied sciences by promoting interdisciplinary research and scientific acumen.

MISSION

M1: Enable students to be scientists/ academicians /entrepreneurs by accomplishing fundamental and advanced research in diverse areas of basic and applied sciences.

M2: Build strong associations with academic organizations/industries for knowledge creation, advancement, and application of scientific fervor.

M3: Create conducive environment for lifelong learning.

M4: Empower students to be socially responsible and ethically strong individuals through value-based science education.

3. Programmes offered by the School

School offers undergraduate B.Sc. (Hons) Programmes and postgraduate M.Sc. Programmes. All these programmes are designed to impart scientific knowledge to the students and will provide theoretical as well as practical training in their respective fields.

3.1 B. Sc. (Hons.) Chemistry

This course aims to impart basic and applied knowledge in various branches in Chemistry with a view to produce good academics, researchers and professionals in the field.

Eligibility Criteria:- The student should have passed the 10+2 examination conducted by the Central Board of Secondary Education or equivalent examination from a recognized Board in Science stream with an aggregate of 50% or more.

Course Outline:- Inorganic chemistry / Organic chemistry / Physical chemistry / Analytical methods in chemical sciences / Environmental chemistry / Biochemistry / Green Chemistry.

Career Options:- Opportunities exist in chemical industry, pharmacy, education and forensics.

Programme scheme: - For Programme scheme see Annexure A.

3.2 B.Sc. (Hons.) Physics

Physics, as a stream of study, helps in understanding fundamentals and develop curiosity in understanding various physical aspects of universe. This course aims to impart basic and applied knowledge in physics with a view to produce good academicians, researchers and professionals in varied fields.

Eligibility Criteria: - The student should have passed the 10+2 examination conducted by the Central Board of Secondary Education or equivalent examination from a recognized Board in Science stream with an aggregate of 50% or more.

Course Outline: - Mathematical Physics / Mechanics / Electricity & Magnetism/Waves & Optics / Thermal Physics / Digital Systems & Applications/Elements of Modern Physics/Analog Systems & Applications/Quantum Mechanics & Applications / Electromagnetic Theory / Statistical Mechanics/ Solid State physics / Elementary Nuclear Physics/ Elementary Particle Physics/Applied Optics.

Career Options: - Opportunities exist in academics, research laboratories and administration besides all the opportunities applicable to any other graduate like UPSC examination's, defence services and other govt. jobs.

Programme scheme: - For Programme scheme see Annexure B.

3.3 B.Sc. (Hons.) Mathematics

Mathematics is a universal part of human culture. This course aims to impart basic and applied knowledge in Mathematics with a view to produce good Mathematicians and researchers. A degree in mathematics provides you with a broad range of skills in problem solving, logical reasoning and flexible thinking.

Eligibility Criteria: - The student should have passed the 10+2 examination conducted by the Central Board of Secondary Education or equivalent examination from a recognized Board with an aggregate of 50% or more with Mathematics as a main subject.

Course Outline: - Calculus / Vector Calculus / Business Mathematics / Differential Equations / Solid Geometry / Computer Programming / Modern Algebra / Numerical Analysis / Linear Algebra
/ Real Analysis / Complex Analysis / Probability and Statistics / Operational research / Mechanics.

Career Options: - Mathematicians work in business, finance, industry, government offices, management, education and science.

Programme scheme: - For Programme scheme see Annexure C.

4. Programme Duration

The minimum period required for the B.Sc. (Hons.) Programme offered by the University shall extend over a period of three Academic Years.

The maximum period for the completion of the B.Sc. (Hons) Programme offered by the University shall be five years.

5. Class Timings

The classes will held from Monday to Friday from 09:10 am to 04:10 pm.

6. Syllabi

The syllabi of B.Sc. (H) Mathematics programme offered by SBAS are given in the following pages. These are arranged as: (a) common courses (b) degree specific courses, in numeric order of the last three digits of the course code.

For each course, the first line contains; Course Code and Credits (C) of the course. This is followed by the course objectives, syllabus (Unit I to IV), Text book and reference books.

6.1 Syllabi of Common Courses in all B.Sc. (Hons.) Programme

BSCH125A ENVIRONMENTAL STUDIES (Credits 3)

Overview:

Everything that surrounds and affects living organisms is environment. Environment includes all those things on which we are directly or indirectly dependent for our survival, whether it is living or biotic components like animals, plants or non-living or abiotic components like soil, air and water etc. It belongs to all, influences all and is important to all.

Environmental Protection Act (1986) defined "Environment as the sum total of water, air and land, their interrelationship among themselves and with the human beings, other living organisms and materials." Environmental studies are important since it deals with the most mundane problems of life like hygienic living conditions, safe and clean drinking water, fresh air, healthy food and sustainable development.

The syllabus for Environmental Studies includes conventional class room teaching as well as field work. In this course the teacher simply acts as a catalyst to infer what the student observes or discovers in his/her own environment. Involvement of students in project work is one of the most effective learning tools for environmental issues. This syllabus is beyond the scope of text book teaching and also the realm of real learning by observing the surroundings. The content of this course provides an overview of introduction to environment, concept of an ecosystem, various renewable and non-renewable resources, how are various biodiversity occur and different means to conserve these. This course also includes various types of pollution and environmental policies & practices related with environs. Finally, it also highlights the relationship of human population with environment. The course further integrates to project work such as visit to an area to document environmental assets river/ forest/ grassland/ hill/ mountain, visit to a local polluted site-Urban/Rural/Industrial/Agricultural, study of common plants, insects, birds, and study of simple ecosystems. These studies are as imperative as it forms a unique synergistic tool for comprehensive learning process. This will help students to recognize and appreciate how the technological advancement at global level, exponential growth of human population and their unlimited demands has put the environment at stake and has contaminated the environment worldwide.

Objective and Expected Outcome:

The main objective of the course is to create consciousness among the students with the idea about healthy and safe environment. This course is aimed to explain students that the rapid industrialization, crazy consumerism and over-exploitation of natural resources have resulted in degradation of earth at all levels. These changes need the discussion, concern and recognition at national and international level with respect to formulate protection acts and sustainable developments policies. It can be possible only if every citizen of the nation is environmentally educated and gets involved into this matter at the grass root level to mitigate pollution.

After studying the course, the learners will be able to comprehend and become responsive regarding environmental issues. They will acquire the techniques to protect our mother earth, as without a clean, healthy, aesthetically beautiful, safe and secure environment no specie can survive and sustain. This is the only inheritance which every genera of specie passes to their future generation.

BSCS102A INFORMATION TECHNOLOGY FUNDAMENTALS (Credits 4)

Overview:

Computing and programming is essential to leverage the technical skills of a student. These techniques equip the students with know-how of the latest technologies and reduce considerabletime in solving problems. Success in college and beyond requires computer and information literacy's that are flexible enough to change with a changing IT environment and adaptable to new problems and tasks. The purpose of the information technology requirement is to ensure that students achieve an essential understanding of information technology infrastructure encompassing systems and devices; and become more sophisticated technology users and consumers.

Objectives and Expected Outcome:

The main objective is to introduce IT in a simple language to all undergraduate students, regardless of their specialization. It will help them to pursue specialized programs leading to technical and professional careers and certifications in the IT industry. The focus of the subject is on introducing skills relating to IT basics, computer applications, programming, interactive media, Internet basics, etc.

The aims is to: 1. Understand basic functions of computer software components including operating system functions; 2. Develop a critical attitude to gathering, processing and evaluating information; 3. Develop a broad understanding of hardware, software, networks, databases and information systems and their uses; 4. Sensitise students to the use of Information Technologyin conducting and living their daily lives; 5. Develop an awareness of the power and pitfalls of Information Technology.

OPEN ELECTIVE COURSE I:

IIIT101A HARNESSING THE POWER OF THE WEB AS A KNOWLEDGE DEVICE (Credits 6)

Overview:

This course will give the learner an understanding of internet as a medium of learning. "Internet" is a gigantic library where information about almost any subject is available in depth and up to date. Through this program the student learns to appreciate the richness of the Web and the Internet, and gets an understanding to make clear what is reality and what is false propaganda and uses his/her own intelligence or mind to investigate further.

Internet has been incredibly useful as a learning medium as it facilitates both information and communication. The Internet has increased the accessibility of education at all levels and has turned out to be a giant repository of knowledge as it is not only a great place to gather and storeinformation but also allows its easy retrieval whenever desired. In fact, it has turned out to be better than libraries when it comes to gathering information and doing research work.

The Internet expeditiously entered the life of the humankind in the 20th century. Less than a decade back we did not know much about the modern Internet and imagine its facilities and our life with it. In few years now it has become not only the hugest information resource in the world. Internet provides unique learning opportunities as the very idea behind invention of internet was education.

Today we live in an information society where knowledge has great value and knowledge can be manifested through qualification. All the countries are using high-end technology which needs highly qualified specialists. Web can be a very effective in promoting this process.

The most important thing is the ability to work with information because it demands a student's ability to use different kinds of intellectual skills. It means that a student should be able to analyzethe information he deals with, to select the facts, data adequate to the problem he investigates.

The information the student comes across in the Internet is not always helpful. The Internet is a very democratic environment where every user can locate his/her information. A lot of educational materials do not undergo any examination. Besides, we should keep in mind that reading electronictexts in the net is not like reading printed texts.

For effective education a mere access to Internet information resources is not enough. It is necessary to prepare the students beforehand to work with information. The goal of this program is to develop critical thinking of student so that he or she can use internet for effective learning.

Objective and Expected Outcome:

The usage of the information resources located in the Internet is not such a simple affair. It requires not only the ability to search for it in the huge ocean of the Internet, but to process it, to use it effectively for the cognitive goals. Through this course the student will develop skills to use search engines effectively for learning and research.

The growth of the Internet has provided many opportunities people in different ways. Students consider the use of the Internet is mainly for information, social and entertainment purposes but the Internet provides huge academic and scientific information as well which makes it as a tool to learn. It provides asynchronous education to student, as they are passionate internet lovers and prefer to use web for information.

The course equips the student to find information on web and use critically and creatively, to become collaborative and cooperative workers and to solve problems

BSEL101A COMMUNICATION SKILLS (Credits 5)

Overview:

The world is shrinking into a global village and therefore, communication skills in English have emerged as a major means of empowerment and human resource development. Many professionals fail to make an impact on the global market as they lack the required communicative competence. The course with its practice-based learning tasks will facilitate the learners to enhance their communication skills in a modern and globalized context. It will enhance the linguistic and communicative competence of the learners and hone their interpersonal skills. This course will augment comprehension skills, enhance vocabulary, acquire impressive writing skills, correspond with others effectively, understand the non-verbal cues and enhance skills in spoken English through a variety of teaching techniques. The course will be instrumental in acquiring proficiency both in spoken and oral language.

Objective and Expected Outcome:

The course will help the learners to focus on communication activities in functional and situational contexts as well as enhance the four language skills of reading, writing, listening and speaking through real-life and professional situations. It will build confidence among the students and encourage them to speak fluently. Through practical learning and delivery, the learners will be able to identify their areas of strengths and weaknesses and improvise their personality and soft skills. The learners will be able to strengthen and broaden their communication skills through various insightful ways.

OPEN ELECTIVE COURSE II:

IIIT104A UNDERSTANDING THE POWER OF DATA (Credits-6)

Overview:

This course is designed to provide students with hands-on experience for gaining an understanding of numbers and data for building models.

Why data is so important in our life? Many of us are knowingly or unknowingly using it but are unknown about the fact. Such as "I sleep for about 8 hours a day.", "I usually drive at 50 km/hr.", "If I start early then the chances that I will pass in the exam are higher." or "Which political party will win next assembly elections?" These are nothing but statistical in nature. We are constantly gathering, organizing and analyzing information, and using it to make judgments and decisions that affect our actions.

This course aims to enable students to figure out and solve problems on their own and use technology efficiently. The activities are designed to encourage students to take accountability for their own learning. The skills the students acquire during the course are necessary for the needs and challenges of the country.

Objective and Expected Outcome:

This course encourages students to blend theoretical and practical knowledge, and transfer it into practice. The themes on which the course is based are –

- Interesting properties of prime numbers without proofs
- Analysis of data for simple quantitative inference
- Correlate real-world observations with theoretical knowledge
- Compute and validate probabilities
- Use of spreadsheets and R for practical work
- Statistical analysis of the stock market, weather, and daily life data.

Data can be used to describe situations or events. For instance, a manufacturer might want to know something about the consumers who will be purchasing his product so he can plan an effective marketing strategy. In another situation, a buyer might survey before purchasing a product. For example, when we purchase a cell phone we look at various features and specifications provided by different companies. Further, trends in the market can be analyzed, enabling prospective buyers to make more intelligent decisions. These examples illustrate a few situations where collecting and analyzing data will help students make better decisions.

The course is about exercising the brain and learning new ideas, not to just mimic steps, procedures, and formulas. The students are expected to acquire the ability to overcome obstacles and keep trying until they reach a goal.

6.2 Syllabi of Common Courses in B.Sc. (Hons.) Chemistry and Mathematics

OPEN ELECTIVE COURSE I:

BSPH120A CONDENSED MATTER PHYSICS (Credits 6)

Overview:

Physics and chemistry may overlap when the system under study involves matter composed of electrons and nuclei made of protons and neutrons. On the other hand, chemistry is not concerned with other forms of matter such as quarks, mu and tau leptons and dark matter. Although fundamental laws that govern the behavior of matter apply both in chemistry and physics, the disciplines of physics and chemistry are distinct.

Physics is concerned with nature from a very large scale (the entire universe) down to a very small scale (subatomic particles). All physical phenomena that are measurable follow some behavior that is in accordance with the most basic principles studied in physics.

Physics is involved with the fundamental principles of physical phenomena and the basic forces of nature, and also gives insight into the aspects of space and time. The course deals with the basic principles that explain matter and energy, and may study aspects of atomic matter by following concepts derived from the most fundamental principles viz spectroscopy, thermodynamics, solid state physics, and crystallography.

Objective and Expected Outcome:

Spectroscopy is used in physical and analytical chemistry because atoms and molecules have unique spectra. The measured spectra are used to determine the chemical composition and physical properties of astronomical objects (such as their temperature and velocity).

The main objectives of the concept of studying thermodynamics to determine the feasibility of the
reaction.

This course gives an introduction to solid state physics, and will enable the student to employ classical and quantum mechanical theories needed to understand the physical properties of solids. Emphasis is put on building models which will be able to explain several different phenomena in the solid state.

Crystallography explains the salient points of higher-symmetry space groups, namely those belonging to the tetragonal, trigonal, hexagonal, and cubic crystal systems through mathematical concepts.

After the end of this course, the student will be able to:

- Interpret UV-Visible spectroscopy, explain basic principles of UV-Visible spectroscopy, will be able to interpret IR spectroscopy, explain basic principles of IR spectroscopy, explain working principles and taking spectrum of IR spectroscopy device, will be able to interpret NMR spectroscopy, explain basic principles of NMR spectroscopy, explain sample preparation procedure in NMR spectroscopy and will be able to interpret elemental analysis technique.

- Explain the concepts of entropy, enthalpy and Ideal gas equation and various gas Laws: Student should able to understand Entropy and its application. Student should able to understand Gas Laws. Student should able to understand thermodynamic processes. Entropy understands the role of thermodynamic cycles, availability and irreversibility. Student should able to quantify the behavior Gas Power Cycles cycle. Student should able to understand concept of Availability. Student should able to understand concept of irreversibility and second law efficiency.
- Explains the fundamental concepts of solid state physics such as what types of matter exist and the methods available to determine their structure and properties. Outline the physical origins which govern the properties of matter in the solid state. Apply the knowledge gained to solve problems in solid state physics using relevant mathematical tools.

OPEN ELECTIVE COURSE II:

BSPH217A APPLICATIONS OF MATERIALS (Credits-6)

Overview:

Both physics and chemistry are concerned with matter and its interaction with energy, the two disciplines differs in approach. In physics, it is typical to abstract from the specific type of matter, and to focus on the common properties of many different materials. In optics, for example, materials are characterized by their index of refraction, and materials with the same index of refraction will have identical properties. Chemistry, on the other hand, focuses on what compounds are present in a sample, and explores how changing the structure of molecules will change their reactivity and their physical properties. Chemistry and physics are interrelated, chemists and physicists work in teams to explore the following topics in this current course related with Material Science, Nuclear physics, and Nanomaterials.

Objective and Expected Outcome:

The use of fundamental sciences and their principles relevant to materials that include the relationships between nano/microstructure, characterization, properties, processing, performance and design of materials. The study of nuclear physics is the understanding of the "Structure of Nuclei". A most basic property of a nucleus is its binding energy. This is brought about by the specific nuclear forces, counteracted partially by the Coulomb repulsion between the protons. An understanding of the structure-property relationships in nano-materials as well as the concepts, not applicable at larger length scales, that need to be taken into consideration for nano-science and nanotechnology. To make quantitative predictions about whether, equilibrium will favour products or reactants in a redox reaction. Imagine each of the above as a competition to gain electrons.

After completion of the course the student should be able to:

- Describe the basic structure of materials at the molecular, microscopic, and macroscopic scales, and will be able to describe modern methods of characterizing materials at each of these length scales. Students will understand diffusion and electrochemical processes in materials.
- Explain the ground state properties of the nucleus for study of the nuclear structure behavior. They can explain the deuteron behavior at ground and excited states. They can apply deuteron physics and the Nucleon-Nucleon scattering for explaining the nuclear forces. They can able to demonstration of the shell model and collective model descriptions. They can apply various aspects of nuclear reactions in view of compound nuclear dynamics.
- Qualitatively describe how the nanoparticle size can affect the morphology, crystal structure, reactivity, and electrical properties.
- Describe several synthesis methods for fabrication of inorganic nanoparticles, one-dimensional nanostructures (nanotubes, nanorods, nanowires), thin films, nanoporous materials, and nanostructured bulk materials, and also could describe how different lithography methods can be used for making nanostructures. The student should have a theoretical background within synthesis/fabrication of nanomaterials which makes he/she prepared for later literature studies and laboratory work within the field.
- Perform simple geometric calculations of surface energy, coordination number, and volume fraction related to nanoscale properties and synthesis, and also simple chemical calculations related to synthesis.
- Use the acquired knowledge to evaluate which synthesis methods that can be best suited for fabricating nanostructured materials of various inorganic compounds (metals, semiconductors, oxides, fullerenes) and constructions of these.

6.3 Syllabi of Common Courses in B.Sc. (Hons.) Physics and Mathematics OPEN ELECTIVE COURSE I:

BSCH120A FUNDAMENTALS OF CHEMISTRY & WATER PROCESSES (Credits 6)

Overview:

This course inculcates the thought process of basic understanding of chemistry for the students of Mathematics and Physics background. It is a mandatory requirement to include chemistry in their course curriculum, which would helpful in their future education. All the higher education and professional context depends on basic sciences, which can relate the theories or concepts based on chemistry. Our daily life processes have an intense relation with chemistry. So, there is a need of an hour to provide exposure of basic chemistry to the students.

Objective and Expected Outcome:

This course will enable the students to appreciate the developments in the field of chemical bonding with respect to Valence Bond theory and Molecular orbital theory. Students can relate these theories with structure and shapes of various homonuclear and heteronuclear molecules. This syllabus is mixture of all types of chemistry. In this course the students can understand basic concepts involved in organic reactions and appreciate the concept of geometric and optical isomerism. Water technology is a part of this course, which provides the complete processes of water quality analysis, hardness determination, softening and disinfection of water.

The outcome of this course enables the students for the analysis of the structure, composition of organic compounds, their orientation and optical activity of compounds. After studying this course students are also capable to determine water quality.

OPEN ELECTIVE COURSE II:

BSCH207A TECHNICAL INTERFACE OF CHEMISTRY (Credits 6)

Overview:

This course inculcates the thought process of basic understanding of chemistry for the students of Mathematics and Physics background. It is a mandatory requirement to include chemistry in their course curriculum, which would helpful in their future prospects. All the higher education and professional context depends on basic sciences with respect to technical aspects, which can relate the theories or concepts based on chemistry. Our daily life processes have an intense relation with chemistry. So, there is a need of an hour to provide exposure of basic chemistry with some technical knowledge to the students.

Objective and Expected Outcome:

This course will enable the students introduce basics of inorganic chemistry like periodic classification of elements and periodic properties, thermo chemistry and their application in engineering science and gain in site of phase and polymers. This syllabus is mixture of all types of chemistry. In this course the students can understand basic concepts involved in element classification and properties, variety of natural and synthetic fuels with respect to classification, analysis, carbonization, fractional distillation, thermal & catalytic cracking, octane &cetane No, and its significance; Power alcohol, Analysis of flue gases. The also enable to understand thermochemistry, phase rule (one component and two components) and polymer chemistry. The outcome of this course provides idea of different spheres of chemistry in one syllabus, which enables the student to understand periodic table, variety of fuels, thermochemistry and polymers.

6.4 Syllabi of Courses specific to B.Sc. (Hons.)Mathematics

BSMA133A CALCULUS (Credits 5)

Overview:

This is considered a first course in calculus, primarily for students intending to continue to advanced courses in calculus, and mathematics in general. Students conduct a detailed study ofdifferential calculus and its applications, and are introduced to antiderivatives.

Objective and Expected Outcome:

Upon the completion of this course, the student will be able to:

- Know what a function is and know the four ways to represent a function.
- Appreciate how functions can be used to model situations such as population growth,tides, vibrating springs, and gas emissions.
- Make new functions from old by transforming, combining, and composing.
- Know when a function has an inverse and how to find the inverse.
- Know and sketch the members of the catalogue of essential functions.
- Understand the concepts of a limit and one-sided limits, continuity, and differentiability.
- Determine limits numerically, algebraically, and from a graph.
- Determine limits of indeterminate forms, using L' Hospital's Rule.
- Understand the concepts of continuity and differentiability and the relationship between
  them.
- Know the differentiation formulas for polynomial, rational, trigonometric, inverse trigonometric, exponential, and logarithmic functions.
- Apply the rules and techniques of differentiation to any combination of functions.
- Apply the derivative to solve a variety of problems (related rates problems, optimization problems, curve sketching).
- Use the derivative to find the linear approximation of a function.
- Use Newton's method to find the roots of a function.
- Understand the concept of the antiderivative, and find antiderivatives.

LEARNING OUTCOMES:

- 1. Understanding of the ideas of limits and continuity and an ability to calculate with them
  and apply them.
- 2. Improved facility in algebraic manipulation.
- 3. Fluency in differentiation.
- 4. Fluency in integration using standard methods, including the ability to find an appropriate method for a given integral.

- 5. Facility in applying Calculus to problems including curve-sketching, areas and volumes.
- 6. Understanding the ideas of infinite series including Taylor approximations.
- 7. Understanding the ideas of differential equations and facility in solving simple standard examples.

BSMA137A ALGEBRA (Credits 4)

Overview:

Algebra is designed to give students a foundation for all future mathematics courses. The fundamentals of algebraic problem-solving are explained. Students will explore the basic concepts of matrices, relation between the roots and coefficients of general polynomial equation in one variable, Nature of roots by inspection of change of sign of equations. Throughout the course thestudent learns how to apply the concepts in real-life situations.

Objective and Expected Outcome:

During this course the student will be able to find the rank, Eigen values of matrices and solve the homogeneous and non-homogeneous systems, solution of cubic and biquadratic equations.

Upon completion of this course, students should be able to understand mathematical concepts, symbols and procedures and are able to apply them to real world situations. Use appropriate mathematical concepts and skills to solve problems in both familiar and unfamiliar situations including those in real-life contexts. Select and apply appropriate inquiry and mathematical problem solving techniques in recognize patterns.

The main objective of this program is to cultivate a mathematical aptitude and nurture the interestsof the students towards problem solving aptitude. Further, it aims at motivating the young minds for research in mathematical sciences and to train computational scientists who can work on reallife challenging problems. It further aims at motivating the students to join teaching profession.

DISCIPLINE ELECTIVE I:

BSMA136A ANALYTICAL GEOMETRY (Credits 4)

Overview:

This course will introduce to the analytic geometry with examples from real life and various sciences. In selecting such problems for our examples and exercises we highlighted this motivationby references to applications in the social, business, and life sciences. The course was preparedwith three related objectives: concreteness, motivation and applicability.

Objective and Expected Outcome:

This is a beginning course in plane analytic geometry emphasizing the correspondence between geometric curves and algebraic equations. This correspondence makes it possible to reformulate problems in geometry as equivalent problems in algebra, and vice versa. Curves studied include straight lines, circles, parabolas, ellipses, and hyperbolas. Coordinate transformations, polar coordinates, and parametric equations are also studied. The course assumes a sound background in algebra, geometry, and trigonometry.

LEARNING OUTCOMES:

- Students will be able to write equations of lines, circles, and conics in 2-space and to identify these curves from their equations.
- Students will be able to write equations of lines and planes in the 3-space and to identify lines and planes from their equation.
- Students will be able to measure the distances between points, lines, and planes
- Students will be able to use vectors in 2- and 3-space to solve problems.
- Students will be able to use rectangular and polar coordinates in 2-space.
- Students will be able to use rectangular, cylindrical, and spherical coordinates in 3-
  space.
- Students will be able to perform translations and rotations in 2-space.
- Determine equations of a circle, parabola, ellipse and hyperbola; cylinder, cone, ellipsoid,
  hyperboloids and paraboloids.

A student who has studied and learned the material should be able to: 1. Solve problems involving lengths and distances in the plane, including midpoint and point-of-division formulas. 2. Demonstrate understanding of the notions of slope and inclination of lines, including angles between lines, parallel lines, and perpendicular lines. 3. Recognize the relationship between equations in two variables and graphs in the plane and use the equations to find pertinent information such as points of intersection, and intercepts. 4. Perform arithmetical and geometric operations involving vectors in the plane. 5. Use vectors to solve geometric and physical problems. 6. Sketch graphs of and discuss relevant features of curves in the plane determined by certain equations (including lines, circles, parabolas, ellipses, hyperbolas, polynomial functions, rational functions, and features such as slope, inclination, center, radius, vertices, foci, axes, eccentricity, intercepts, asymptotes).
7.Determine equations of curves when given information that determines the curves. 8. Perform translations and rotations of the coordinate axes to eliminate certain terms from equations. 9. Model real world situations with equations of conics. 10. Use the polar coordinate system, relate it to the rectangular coordinate system, and graph equations using polar coordinates. 11. Sketch graphs in the plane determined by parametric equations by direct sketching as well as elimination of the parameter to obtain a rectangular equation.

DISCIPLINE ELECTIVE I:

BSMA336A NUMBER THEORY (Credits 4)

Overview:

Number theory is a rich and abstract branch of mathematics which explores the fundamental properties of our number system. Number Theory, branch of mathematics concerned with properties of the positive integers . Sometimes called “higher arithmetic,” it is among the oldest and most natural of mathematical pursuits.

Number theory has always fascinated amateurs as well as professional mathematicians. In contrast to other branches of mathematics, many of the problems and theorems of number theorycan be understood by laypersons, although solutions to the problems and proofs of the theoremsoften require a sophisticated mathematical background.

Until the mid-20th century, number theory was considered the purest branch of mathematics, with no direct applications to the real world. The advent of digital computers and digital communications revealed that number theory could provide unexpected answers to real-world problems. At the same time, improvements in computer technology enabled number theorists to make remarkable advances in factoring large numbers, determining primes, testing conjectures, and solving numerical problems once considered out of reach.

Objective and Expected Outcome:

Modern number theory is a broad subject that is classified into subheadings such as elementary number theory, algebraic number theory, analytic number theory, geometric number theory, and probabilistic numbertheory. These categories reflect the methods used to address problems concerning the integers. Algebraic geometry and algebraic number theory, which provide many natural examples of commutative rings, have driven much of the development of commutative ring theory, which is now, underthe name of commutative algebra, a major area of modern mathematics. Because these three fields (algebraic geometry, algebraic number theory and commutative algebra) are so intimately connected it is usually difficult and meaningless to decide which field a particular result belongs to. For example, Hilbert's Nullstellensatz is a theorem which is fundamental for algebraic geometry, and is stated and proved in terms of commutative algebra. Similarly, Fermat's last theorem is stated in terms of elementary arithmetic, which is a part of commutative algebra, but its proof involves deep results of both algebraic number theory and algebraic geometry.

DISCIPLINE ELECTIVE I:

BSMC119A MATHEMATICAL FINANCE (Credits 4)

Overview:

Mathematical finance, also known as **quantitative finance**, is a field of applied mathematics, concerned with mathematical modeling of financial markets. Generally, mathematical finance will derive and extend the mathematical or numerical models without necessarily establishing a link to financial theory, taking observed market prices as input. Mathematical consistency is required, not compatibility with economic theory.

This four module course demonstrates how a number of financial mathematics formulas can be used to conduct detailed analysis on a set of data and/or variables.

Objective and Expected Outcome:

We explore the concept of the "time value of money". The module focuses on how to calculate present values and future values using compounding and discounting techniques. The module then goes on to outline how the present values of annuities, perpetuities, and growing perpetuities

can be calculated. Each concept is reinforced with practical and applied exercises and case studies. By the end of this module, you will have a solid understanding of how discounted cash flows techniques are used to evaluate future cash flows.

- Understand the concept of the time value of money
- Explain terms such as present value, future value, NPV, DCF, annuities, and perpetuities
- Use DCF techniques to calculate present values
- Calculate the present value of cash flow streams such as annuities and perpetuities

Study of the topics of the course will enable the students to

- Provide active and practical use of mathematics, which includes interrelated financial
  topics.
- Provide an experience of formulating finance problems into computational problems.
- Provide an illustration of the role of optimization in computational finance such as single and multi-period mean-variance portfolio management.

BSCS102A INFORMATION TECHNOLOGY FUNDAMENTALS (Credits 4)

Basics of Computers and its evolution: Evolution of computers, Data, Instruction and Information, Block diagram of a computer, Characteristics of computers, Functions of different units of a computer, Generations of computers, Classification of computers: - Digital, Analog and Hybrid, Micro, Mini, mainframe and Super Computer, Single-board computer.

Introduction to Computer Software: Open source Software**,** Copylefted and Non-copylefted Software; System Software; Application Software; Utility Software; Shareware, Firmware, Freeware, Free Software. Compiler and Interpreter, Generations of languages: Machine Level, Assembly, High Level, 4GL.

Introduction to Operating System: Objectives and Function of OS, Structure of OS, Types of operating systems, Component and Services offered by OS, Layered approach of OS, Properties of OS, System boot, File Management.

Input and Output Devices: Keyboard, Mouse, Joystick, Digitizer, Scanner, MICR, OCR, OMR, Light Pen, Touch Screen, Bar Code and Quick Response Reader, Voice Input Device, Monitor and it's type, Printer and it's type, Plotter

Computer Memory: Memory hierarchy, Primary Memory (ROM and it's type - PROM, EPROM,EEPROM, RAM) Secondary memory- SASD, DASD Concept, Magnetic Disks - Hard disks, Optical disks - CD ROM and it's type (CD ROM, CD ROM-R, CD ROM-EO, DVD ROM), Flash Memory, Blu-ray Disk

Concept of Data Communication and Networking: Networking Concepts, Types of networking (LAN, MAN AND WAN), Communication Media, Mode of Transmission (Simplex, Half Duplex, Full Duplex), Analog and Digital Transmission. Synchronous and Asynchronous Transmission, Network topologies.

Introduction to Internet: Terminology related to Internet: Protocols, TCP/IP, HTTP, Internet addressing, Domain Names, DNS, URL, World Wide Web. Overview of various services on Internet: Webservers, E-mail, FTP, Telnet.

REFERENCE BOOKS:

1. Leon and Leon; Introduction to Information Technology, Leon Tech World.
2. Sinha, Kr. Pradeep and Preeti Sinha; Foundations of Computing, BPB Publication.
3. Jain, V.K.; Computers and Beginners**.**

LIST OF EXPERIMENTS

1. Introduction to GUI based Operating System: Desktop, Task Bar, My Documents, Control panel, logging and resetting window password and various ending a computer session., Working with Disks, Folders and files using file explorer and command prompt, taking backup on Mobile and pend drive using USB Port, music and video player.

2. Understanding and Accessing Individual Control Panel Items along with different ways of operating Control panel items.

3. Introduction to Document Editor Application Software: Document creation and formatting of document, inserting and formatting complex table, using inbuilt word template, office online template, creating-edit-modify template, import/export files, convert word document to web document, PDF files, creating hyperlinks, adding security features to word document- imposing password and checking virus in Macros. Finding and Replacing Text, Basic of E-Mail, E-mail Addressing, Using E-mail-opening mail, mailbox, creating and sending mail, replying mail, forwarding, sorting & searching e-mail, Document Collaboration, Instant Messaging and Mail Merging.

4. Introduction to Presentation Application Software: Creating a presentation, different views of the presentation, customizing slides using predefined layouts/ slide transition / paragraph or text animation, importing data from other sources in PowerPoint presentations.
5. Introduction to Spreadsheet Application Software: Features of a spreadsheet, Data entry, Cell referencing, entering series, editing data, ranges, formulae insertion, inserting functions, creating macros and hyperlink, import and export data.
6. Analysis using Spreadsheet Application Software: Consolidation of data and data analysis in spreadsheet: sorting and filtering techniques drop down list from range of cell, applying and removal of data validation to cell, protecting cell data using password.
7. Pivot table report and Pivot chart report in Spreadsheet Application Software: creating pivot table, grouping fields, drill down pivot, layout and format, filtering, sorting and conditional formatting data, chart creation.
8. Creating form, Reports and queries using Access Application Software.
9. Hand-on experience on Outlook Application Software calendar to organize day-to-day activities, creating an appointment & Repetitive Appointment, working with event, planning a meeting, create, view and delete group schedule.

Semester-II

BSMA135A VECTOR ANALYSIS (Credits 4)

Overview:

This paper presents results from vector analysis that pertains to integration. A major reason to study vector functions over a surface is to measure flux. Flux is an important concept in electricityand magnetism. An intuitive way to visualize flux is the passage of a fluid through a membrane. The divergence and curl are two of the most important operators in vector calculus. One way of presenting them is to define them in terms of mathematical formulas. The line integral of a vectorfield over a path gives the tendency of the vector field to follow that path. This is often called the circulation of the vector field along the path. A positive circulation indicates the movement with thedirection of the vector field.

Objectives and expected outcome:

By the end of the module the student should understand:

- Define double integrals over rectangles
- Compute iterated integrals
- Define and compute double integrals over general regions
- Compute double integrals in polar coordinates
- Find moments and centers of mass using double integrals
- Compute triple integrals in Cartesian coordinates, cylindrical coordinates and spherical

- coordinates
- Apply triple integrals to find volumes and center of mass
- Change variables in multiple integrals
- Define vector fields
- Calculate line integrals along piecewise smooth paths; interpret such quantities as work
  done by a force
- Use the fundamental theorem of line integrals
- Use Green's theorem to evaluate line integrals along simple closed contours on the plane
- Compute the curl and the divergence of vector fields
- Compute the area of parametric surfaces in 3-dimensional space
- Compute surface integrals
- Apply Stokes' theorem to compute line integrals along the boundary of a surface
- Use Stokes' theorem to give a physical interpretation of the curl of a vector field
- Use the divergence theorem to give a physical interpretation of the divergence of a vector field

BSMA138A GROUP THEORY (Credits 4)

Overview:

This course covers the theoretical aspects of groups. However, with the development of computing in the last several decades, applications that involve modern algebra and discrete mathematics have become increasingly important, and many science, engineering, and computer science students are now electing mathematics. Their applications such as coding theory and cryptography have grown significantly. However, one of the major problems in teaching modern algebra course is that for many students it is their first encounter with an environment that requires them to do rigorous proofs. Such students often find it hard to see the use of learning to prove theorems and propositions; applied examples help the instructor provide motivation.

Objective and Expected Outcome:

In real life, however, algebra merges into all other areas as a tool. Whenever life throws a problem at you, for example when you have to solve an equation or work out a geometrical problem, algebra is usually the best way to attack it. The equations you are learning about now are the ones that you're most likely to come across in everyday life. This means that knowing how to solve them is very useful. If you're planning to go into computer programming, however, the algebra you'll need is more complicated and now's the time to make sure you get the basics.

This course starts by introducing the basics of group theory including symmetric group etc.

Group theory, the ultimate theory for symmetry, is a powerful tool that has a direct impact on research in robotics, computer vision, computer graphics and medical image analysis.

BSMA140A ADVANCED CALCULUS (Credits 5)

Overview:

This is a first course in advanced calculus. The focus will be on functions of two and three variables, and using calculus to analyze the geometry of curves and surfaces in three-dimensional space. The official description from the Department of Mathematics is as follows: Parametric equations and polar coordinates. Vectors in 2- and 3-dimensional Euclidean spaces.Partial derivatives.

Multiple integrals.Vector Calculus.Theorems of Green, Gauss, and Stokes.

Objective and Expected Outcome:

The objective of this course to introduce functions of several variable to a student after he has taken a course in one variable calculus. The course will introduce partial derivatives and several of its consequences and will introduce double and triple integrals along with line integrals which are fundamental to all streams where calculus can be used.

After reading this course a student will be able to calculate partial derivatives, directional derivatives, and extreme values and can calculate double, triple and line integrals. He will have idea of basic vector calculus including green's theorem, divergence theorem and stokes theorem. He can take courses in calculus on manifolds, Differential geometry and can help in numerical computations involving several variables.

After completing this course, students should have developed a clear understanding of the fundamental concepts of multivariable calculus and a range of skills allowing them to work effectively with the concepts.

The basic concepts are:

- Derivatives as rates of change, computed as a limit of ratios
- Integrals as a 'sum,' computed as a limit of Riemann sumsThe

skills include:

- Fluency with matrix algebra, including the ability to put systems of linear equation in matrix format and solve them using matrix multiplication and the matrix inverse.
- An understanding of a parametric curve as a trajectory described by a position vector; the ability to find parametric equations of a curve and to compute its velocity and acceleration vectors.
- A comprehensive understanding of the gradient, including its relationship to level curves (or surfaces), directional derivatives, and linear approximation.
- The ability to compute derivatives using the chain rule or total differentials.
- The ability to set up and solve optimization problems involving several variables, with or without constraints.
- An understanding of line integrals for work and flux, surface integrals for flux, general surface integrals and volume integrals. Also, an understanding of the physical interpretation of these integrals.
- The ability to set up and compute multiple integrals in rectangular, polar, cylindrical

and spherical coordinates.

- The ability to change variables in multiple integrals.
- An understanding of the major theorems (Green's, Stokes', Gauss') of the course and of some physical applications of these theorems.

DISCIPLINE ELECTIVE II:

BSMA146A GRAPH THEORY (Credits 4)

Course Description:

What do transportation systems, social networks, the Web, power grids, financial markets and many biological systems have in common? They are examples in which we seek to understand not only the entities which interact, but also the patterns of interaction between the entities. Graph theory is rooted in mathematics and computer science as it serves a mathematical model for any system involving a binary relations.

This is an introductory course on the theory of graphs. The primary focus is on understanding graph properties, learning common proof techniques and studying relations between various graph parameters. Topics covered in this course include: graphs as models, paths, cycles, directed graphs, trees, spanning trees, matchings (including stable matchings), network flows, and graph coloring (including scheduling applications). Various graph algorithms are also discussed along with its analysis.

In this course, among other intriguing applications, we see how GPS systems find shortest routes, how engineers design integrated circuits, how biologists assemble genomes, why a political map can always be colored using a few colors. We also study Ramsey Theory which proves that in a large system, complete disorder is impossible!

Objective and Expected Outcome:

Upon completing this course, the students will be able to: know some important classes of graph theoretic problems; formulate and prove central theorems about trees, matching, connectivity, colouring and planar graphs; describe and apply basic algorithms and use graph theory as a modelling tool. The students will have intimate knowledge about how the graph theory play an important role to solve the technology driven and research oriented problems.

DISCIPLINE ELECTIVE II:

BSMA327A DYNAMICS (Credits 4)

Overview:

The motive that guides this course is the unveiling of facts and information describing the motion of an object.

The motion of an entity or a body connects to a real physical system. A rigid body is formed by a large number of particles and this body has six degrees of freedom in the 3-dimensional space - three translations and three rotations about the x, y, and z-axes. Dynamics helps us to describe the motion of a rigid body, and this description is applied to a specific problem. Let us consider a simple example for the purpose of illustration. If a drum starts rotating at time t with initial angular velocity ω, then how many times will it rotate until it comes to stop?

This course will enable students to learn how laws of physics and mathematics are used to describe the motion of objects in real-world situations.

Objective and Expected Outcome:

The discipline that determines the velocity and position of an object under the action of forces is considered as dynamics. This course starts with the concepts of position, displacement, velocity and acceleration in order to understand the motion of particles along a straight line or a curved path. The course proceeds further with a deeper look at Newton's second law, constraints and degrees of freedom, and units of measurements. Building models and free-body diagrams are the key concepts of this learning module. In addition, students shall encounter problems based on the principles of work, energy and power, and the general motion of a rigid body.

This course serves students by implementing precise mathematics and strengthening deep understanding of the concepts, and that will help them throughout their professional and educational careers.

DISCIPLINE ELECTIVE II:

BSMC226A PORTFOLIO OPTIMIZATION (Credits 4)

Overview:

Analyzing security before committing funds into it is the most important and primitive step one starts with. The analysis of various financial instruments traded in the market is security analysis which determines the real worth of the security. We see its application in normal life routines as well, like we make sure the price what we pay for any item we purchase is worth it or not. The stock which is bought should be assessed in light of all past, present and hidden information. It refers to theories like Portfolio theory, Efficient Market theory, CAPM, APT and brings its relevance in context to selecting asset for building a portfolio. The investor puts

his investments in a group ofassets to make sure the portfolio he makes gives the maximum return and carries less risk. The portfolio construction, which in other words is diversification is built optimally and managed from time to time and revised if the need arises.

Objective and Expected Outcome:

The course would help the learner to fundamentally and technically study the security or any stockbefore considering it for investments. Since the investor makes a portfolio and makes investmentin a group of assets, the learner studies to select the securities in a way that would combat the risk of other security keeping the portfolio theory as the base. The beauty of the course is thatit enables one to plan investments for oneself as well as act as financial advisors for others. The students learn to align the securities with the market index to get the maximum and learnthe significance of beta in calculating the asset 2price. The investment objective and the risk appetite of the individual differs from others and this acts as a stepping stone before suggesting or considering the stock for investments and the course provide a deep insights into this context. The course will make the learner to understand how securities are analyzed and a portfolio is built, managed/revised to enjoy the optimum return from the investment in the given risk. They would learn to assess the security in context to its risk and return and compare it with other securities and with the market.

Semester III

BSMA134A Ordinary Differential Equations (Credits 4)

Geometrical meaning of a differential equation; exact differential equations, integrating factors; First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations; Equation reducible to Clairaut's form; Singular solutions.

Orthogonal trajectories in Cartesian coordinates and polar coordinates, Self orthogonal family of curves, Linear differential equations with constant coefficients, Homogeneous linear ordinary differential equations, Equations reducible to homogeneous.

Linear differential equations of second order: Reduction to normal form; Transformation of the equation by changing the dependent variables and the independent variables; Solution by operators of non-homogeneous linear differential equations; Reduction of order of a differential equation; Method of variations of parameters; Method of undetermined coefficients.

Ordinary simultaneous differential equations, Solution of simultaneous differential equations involving operators x(d/dx) or t(d/dt) etc. Simultaneous equation of the form $dx/P = dy/Q = dz/R$. Total differential equations. Condition for $Pdx + Qdy + Rdz = 0$ to be exact. General method of solving $Pdx + Qdy + Rdz = 0$ by taking one variable constant; Method of auxiliary equations

REFERENCE BOOKS:

1. M.D. Raisinghania; *Ordinary and Partial Differential Equations*; S.Chand, New Delhi.
2. D.A. Murray; *Introductory Course in Differential Equation,* Orient Longaman (India).
3. A.R. Forsyth*; A Treatise on Differential Equations;* Machmillan and Co. Ltd. London.
4. E.A. Codington; *Introduction to Differential Equations*; Mc Graw Hills, New York.
5. S.L.Ross; *Differential Equations*; John Wiley & Sons.
6. B.Rai& D.P. Chaudhary; *Ordinary Differential Equations*; Narosa Publishing House Pvt. Ltd.

BSMA251A ORDINARY DIFFERENTIAL EQUATIONS LAB (Credits 1)

PRACTICAL / LAB WORK

Modeling of the following problems using Matlab / Mathematica / Maple etc.

List of Practicals

1. Plotting of second order solution family of differential equation.
2. Plotting of third order solution family of differential equation.
3. Growth model (exponential case only).
4. Decay model (exponential case only).
5. Lake pollution model
6. Case of single cold pill and a course of cold pills.
7. Limited growth of population (with and without harvesting).
8. Predatory-prey model (basic volterra model)
9. Basic Epidemic model of influenza
10. Basic Battle model
11. Plotting of recursive sequences.
12. Study the convergence of sequences through plotting.
13. Verify Bolzano-Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot.
14. Study the convergence/divergence of infinite series by plotting their sequences of partial sum.
15. Cauchy's root test by plotting n^{th} roots.
16. Ratio test by plotting the ratio of n^{th} and $(n+1)^{th}$ term.

REFERENCE BOOKS:

1. Belinda Barnes and Glenn R. Fulford, *Mathematical Modeling with Case Studies, A Differential Equation Approach using Maple and Matlab,* 2nd Ed., Taylor and Francis group, London and New York, 2009.
2. C.H. Edwards and D.E. Penny, *Differential Equations and Boundary Value problems Computing and Modeling,* Pearson Education India, 2005.
3. S.L. Ross, *Differential Equations,* 3rd Ed., John Wiley and Sons, India, 2004.
4. Martha L Abell, James P Braselton, *Differential Equations with MATHEMATICA,* 3rd Ed., Elsevier Academic Press, 2004.

BSMA217A **Real Analysis** **(Credits 5)**

Review of Algebraic and Order Properties of R, ε-neighborhood of a point in R, Idea of countable sets, uncountable sets and uncountability of R. Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets.

Suprema and Infima, The Completeness Property of R, The Archimedean Property, Density of Rational (and Irrational) numbers in R, Intervals. Limit points of a set, Isolated points, Illustrations of Bolzano-Weierstrass theorem for sets.

Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy's Convergence Criterion.

Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy's nth root test, Integral test, Alternating series, Leibniz test, Absolute and Conditional convergence.

REFERENCE BOOKS:

1. S.C. Malik and Savita Arora*; Mathematical Analysis;* New Age Science.
2. R.G. Bartle and D. R. Sherbert; *Introduction to Real Analysis*; John Wiley and Sons Pvt. Ltd.
3. Gerald G. Bilodeau, Paul R. Thie, G.E. Keough; *An Introduction to Analysis*; Jones& Bartlett.
4. Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner; *Elementary Real Analysis*, Prentice Hall.

BSMA223A **Ring Theory** **(Credits 5)**

Definition and examples of rings, properties of rings, subrings, integral domains and fields, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals.

Ring homomorphisms, properties of ring homomorphisms, Isomorphism theorems I, II and III, field of quotients.

Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion, unique factorization in Z[x]**.** Divisibility in integral domains, irreducibles, primes, unique factorization domains, Euclidean domains.

REFERENCE BOOKS:

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson**.**
2. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson.
3. Joseph A. Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa Publishing House
4. D.A.R. Wallace, *Groups, Rings and Fields*, Springer Verlag London Ltd.

BSEL217A Personality Development and Communication skills (Credits 3)

Remedial Grammar: Errors of Accidence and syntax with reference to parts of speech; Confusion of adjectives and adverbs; Agreement of subject and verb; Simple, Complex and Compound Sentences; Question tags and short responses; Sentence Errors
Vocabulary and Usage: One word substitution; Indianism; Redundant words; Jumbled Sentences; Idiomatic Expressions
Reading Skills: Speed Reading: Skimming and Scanning; Reading at various speeds (slow, fast, very fast); Reading different kinds of text for different purposes (e.g. for relaxation, for information, for discussion at a later stage, etc.); Reading between the lines; Overcoming common obstacles; Comprehension of unseen passages
Selected Short Stories and Poems

1. *The Chimney Sweeper* by William Blake
2. *Mending Wall* by Robert Frost
3. *Of Death* by Francis Bacon
4. *The Diamond Necklace* by Guy De Maupassant
5. *The Grief* by Anton Chekhov

REFERENCE BOOKS:

1. Kumar, Sanjay and Pushplata; *Communication Skills*; Oxford University Press.
2. Sinha, *K.K; Business Communication*; Galgotia Publishers.
3. Tickoo, A. E. Subramanian and P.R. Subramaniam; *Intermediate Grammar*; Usage and Composition, Orient Blackswan.

BSDM301A DISASTER MANAGEMENT (Credits 3)

COURSE OBJECTIVE: The objective of the course is to create awareness about various types of disasters and to educate the learners about basic disaster management strategies. The course examines disaster profile of our country and illustrates the role played by various governmental and non- governmental organizations in its effective management. It also acquaints learners with the existing legal frame work for disaster management.

LEARNING OUTCOME: The course will -

1. Provide students an exposure to disasters, their significance and types.
2. Ensure that the students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
3. Provide the students a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
4. Develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

Introduction to Disasters: Concept and definitions- Disaster, Hazard, vulnerability, resilience, risks.

Different Types of Disaster: Causes, effects and practical examples for all disasters.

- Natural Disaster: such as Flood, Cyclone, Earthquakes, Landslides etc
- Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea, Rail & Road), Structural failures (Building and Bridge), War & Terrorism etc.

Disaster Preparedness and Response Preparedness

- Disaster Preparedness: Concept and Nature
- Disaster Preparedness Plan
- Prediction, Early Warnings and Safety Measures of Disaster.
- Role of Information, Education, Communication, and Training, Role of Government, International and NGO Bodies.
- Role of IT in Disaster Preparedness
- Role of Engineers on Disaster Management.
- Relief and Recovery
- Medical Health Response to Different Disasters

Rehabilitation, Reconstruction and Recovery

- Reconstruction and Rehabilitation as a Means of Development.
- Damage Assessment
- Post Disaster effects and Remedial Measures.
- Creation of Long-term Job Opportunities and Livelihood Options,
- Disaster Resistant House Construction
- Sanitation and Hygiene
- Education and Awareness,
- Dealing with Victims' Psychology,
- Long-term Counter Disaster Planning
- Role of Educational Institute.

Disaster Management in India

- **Disaster Management Act, 2005:**

Disaster management framework in India before and after Disaster Management Act, 2005, National Level Nodal Agencies, National Disaster Management Authority

- **Liability for Mass Disaster**
  - Statutory liability
  - Contractual liability
  - Tortious liability
  - Criminal liability
  - Measure of damages

- **Epidemics Diseases Act, 1897: Main provisions, loopholes.**

- **Project Work**: The project/ field work is meant for students to understand vulnerabilities and to work on reducing disaster risks and to build a culture of safety. Projects must be conceived based on the geographic location and hazard profile of the region where the institute is located.

Reference Books:

- Government of India, Department of Environment, Management of Hazardous Substances Control
- Act and Structure and Functions of Authority Created Thereunder.
- Indian Chemical Manufacturers' Association & Loss Prevention Society of India, Proceedings of the National Seminar on Safety in Road Transportation of Hazardous Materials: (1986).
- Author Title Publication Dr. Mrinalini Pandey Disaster Management Wiley India Pvt. Ltd.
- Tushar Bhattacharya Disaster Science and Management McGraw Hill Education (India) Pvt. Ltd.
- Jagbir Singh Disaster Management: Future Challenges and Opportunities K W Publishers Pvt. Ltd.
- J. P. Singhal Disaster Management Laxmi Publications.
- Shailesh Shukla, Shamna Hussain Biodiversity, Environment and Disaster Management Unique Publications
- C. K. Rajan, Navale Pandharinath Earth and Atmospheric Disaster Management: Nature and Manmade B S Publication
- Indian law Institute (Upendra Baxi and Thomas Paul (ed.), Mass Disasters and Multinational Liability: The Bhopal Case (1986)
- Indian Law Institute, Upendra Baxi (ed.), Environment Protection Act: An Agenda for Implementation (1987)
- Asian Regional Exchange for Prof. Baxi., Nothing to Lose But our Lives: Empowerment to Oppose

- Industrial Hazards in a Transnational world (1989)
- Gurudip Singh, Environmental Law: International and National Perspectives (1995), Lawman (India) Pvt. Ltd.
- Leela Krishnan, P, The Environmental Law in India, Chapters VIII, IX and X (1999), Butterworths, New Delhi.

GENERIC ELECTIVES:

BSMA229A Econometrics (Credits 4)

Introduction: Definition, Scope, and Methodology of econometrics; Nature and sources of data for econometric analysis; Specification of an econometric model.
Simple Regression Models: Estimators (OLS) and their properties; Statistical inference; Tests of significance and tests of restrictions.

Econometric Problems: Nature, consequences, detection and remedial measures of the problems of multicollinearity, hetroscedasticity and autocorrelation.

Test Procedures and Model Selection: Tests of specification and mis-specification, measurement errors, encompassing models, and criteria for model selection.

Dynamic Models: Lags in econometrics, Distributed and autoregressive lags, Koyck model,
Simultaneous Equation Models: Introduction, Identification problem, Simultaneous equation bias and ILS and 2SLS methods of estimation.

REFERENCE BOOKS:

1. Gujarati Damodar N. (2004): Basic Econometrics, McGraw Hill Education.
2. Koutsoyiannis A: Theory of Econometrics, Anebooks - Palgrave / Macmillan.
3. Johnston, J & Nardo, D (1997): Basic Econometrics, Siganpore. McGraw Hills Co.
4. Maddala, G S (1997): Econometric Methods (4th Ed.): Econometrics
5. Pindyck, R S & Rubinfeld, D L (1998): Econometric Models & Economic Forecasts
6. Intriligator, M J & Bodkin, H (1996): Econometric Models Techniques and Application.
7. Green, William (2000): Econometric Analysis.
8. Goldberger, A S (1998): Introductory Econometrics.

BSMA335A APPLICTIONS OF ALGEBRA (Credits 4)

Balanced incomplete block designs (BIBD): definitions and results, incidence matrix of a BIBD, construction of BIBD from difference sets, construction of BIBD using quadratic residues, difference set families, construction of BIBD from finite fields.

Coding Theory: introduction to error correcting codes, linear cods, generator and parity check matrices, minimum distance, Hamming Codes, decoding and cyclic codes.

Symmetry groups and color patterns: review of permutation groups, groups of symmetry and action of a group on a set; colouring and colouring patterns, Polya theorem and pattern inventory, generating functions for non-isomorphic graphs.

Special types of matrices: idempotent, nilpotent, involution, and projection tri diagonal matrices, circulant matrices, Vandermonde matrices, Hadamard matrices, permutation and doubly stochastic matrices, Frobenius- König theorem, Birkhoff theorem. Positive Semi-definite matrices: positive semi-definite matrices, square root of apositive semi-definite matrix, a pair of positive semi-definite matrices, and their simultaneous diagonalization. Symmetric matrices and quadratic forms: diagonalization of symmetric matrices, quadratic forms, constrained optimization, singular value decomposition, and applications to image processing and statistics.

Applications of linear transformations: Fibonacci numbers, incidence models, and differential equations. Least squares methods: Approximate solutions of system of linear equations, approximate inverse of an m×n matrix, solving a matrix equation using its normal equation, finding functions that approximate data. Linear algorithms: LDU factorization, the row reduction algorithm and its inverse, backward and forward substitution, approximate inverse and projection algorithms.

REFERENCE BOOKS:

1. N. Herstein and D. J. Winter, *Primer on Linear Algebra*, Macmillan Publishing Company, New York, 1990.
2. S. R. Nagpaul and S. K. Jain, *Topics in Applied Abstract Algebra,* Thomson Brooks and Cole, Belmont, 2005.
3. Richard E. Klima, Neil Sigmon, Ernest Stitzinger, *Applications of Abstract Algebra with Maple,* CRC Press LLC, Boca Raton, 2000.
4. David C. Lay, *Linear Algebra and its Applications.* 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
5. Fuzhen Zhang, *Matrix theory,* Springer-Verlag New York, Inc., New York, 1999.

Semester IV

BSMA218A Special Functions and Integral Transforms (Credits 5)

Series solution of differential equations – Power series method, Definitions of Beta and Gamma functions. Bessel equation and its solution: Bessel functions and their properties-Convergence, recurrence, Relations and generating functions, Orthogonality of Bessel functions.

Legendre and Hermite differentials equations and their solutions: Legendre and Hermite functions and their properties-Recurrence Relations and generating functions. Orthogonality of Legendre and Hermite polynomials. Rodrigues' Formula for Legendre & Hermite Polynomials, Laplace Integral Representation of Legendre polynomial.

Laplace Transforms – Existence theorem for Laplace transforms, Linearity of the Laplace transforms, Shifting theorems, Laplace transforms of derivatives and integrals, Differentiation and integration of Laplace transforms, Convolution theorem, InverseLaplace transforms, convolution theorem, Inverse Laplace transforms of derivatives andintegrals, solution of ordinary differential equations using Laplace transform.

Fourier transforms: Linearity property, Shifting, Modulation, Convolution Theorem, Fourier Transform of Derivatives, Relations between Fourier transform and Laplace transform, Parseval's identity for Fourier transforms, solution ofdifferential Equations using Fourier Transforms.

REFERENCE BOOKS:

1. Erwin Kreyszing; *Advanced Engineering Mathematics*; John Wiley & Sons, Inc., New York.
2. A.R. Forsyth; *A Treatise on Differential Equations*; Macmillan and Co. Ltd.
3. I.N. Sneddon*; Special Functions on mathematics*; Physics & Chemistry.
4. I.N. Sneddon; *The use of integral transform*; McGraw Hill.
5. Murray R. Spiegel*; Laplace transform*; Schaum's Series.

BSMA219A Partial Differential Equations (Credits 4)

Partial differential equations: Formation, order and degree, Linear and Non-Linear Partial differential equations of the first order: Complete solution, singular solution, General solution, Solution of Lagrange's linear equations, Charpit's general method of solution. Compatible systems of first order equations, Jacobi's method.

Linear partial differential equations of second and higher orders, Linear and non-linear homogenous and non-homogenous equations with constant co-efficient, Partial differential equation with variable co-efficients reducible to equations with constant coefficients, their complimentary functions and particular Integrals, Equations reducible to linear equations with constant co-efficients.

Classification of linear partial differential equations of second order, Hyperbolic, parabolic and elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions, Solution of linear hyperbolic equations, Monge's method for partial differential equations of second order.

Cauchy's problem for second order partial differential equations, Characteristic equations and characteristic curves of second order partial differential equation, Method of separation of variables: Solution of Laplace's equation, Wave equation (one and two dimensions), Diffusion (Heat) equation (one and two dimension) in Cartesian Coordinate system.

REFERENCE BOOKS:

1. M.D. Raisinghania; *Ordinary And Partial Differential Equations*; S.Chand, New Delhi.
2. D.A.Murray; *Introductory Course on Differential Equations;* Orient Longman (India).
3. Erwin Kreyszing; *Advanced Engineering Mathematics;* John Wiley & Sons, Inc., New York.
4. A.R. Forsyth; *A Treatise on Differential Equations;* Macmillan and Co. Ltd.
5. I. N.Sneddon; *Elements of Partial Differential Equations*; McGraw Hill Book Company.

BSMA252A PARTIAL DIFFERENTIAL EQUATIONS LAB (Credits 1)

PRACTICAL / LAB WORK

Modeling of the following problems using Matlab / Mathematica / Maple etc.

List of Practicals

(i) Solution of Cauchy problem for first order PDE.
(ii) Finding the characteristics for the first order PDE.
(iii) Plot the integral surfaces of a given first order PDE with initial data.
(iv) Solution of wave equation $\frac{\partial^2 u}{\partial t^2} - c^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions
(a) *u(x,0) = φ(x), u_t(x,0) = ψ(x), xÎR , t > 0*
(b) *u(x,0) = φ (x), u_t (x,0) = ψ (x), u(0, t) = 0, xÎ (0, ¥), t > 0*
(c) *u(x,0) = φ (x), u_t (x,0) = ψ (x), u_x (0,t) = 0, xÎ (0, ¥), t > 0*
(d) *u(x,0) = φ (x), u_t (x,0) = ψ (x), u(0,t) = 0, u(1,t)= 0, 0 < x < l , t > 0*
(v) Solution of wave equation $\frac{\partial u}{\partial t} - k^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions
(a) *u(x,0) = φ (x), u(0,t) = a, u(1,t)= b, 0 < x < l , t > 0*
(b) *u(x,0) = φ(x), xÎR , 0 < t < T*
(c) *u(x,0) = φ (x), u(0,t) = a, xÎ (0, ¥), t ≥ 0*

REFERENCE BOOKS:

1. Tyn Myint-U and Lokenath Debnath, *Linear Partial Differential Equations for Scientists and Engineers*, 4th edition, Springer, Indian reprint, 2006.
2. S.L. Ross, *Differential equations,* 3rd Ed., John Wiley and Sons, India, 2004.
3. Martha L Abell, James P Braselton, *Differential equations with MATHEMATICA,* 3rd Ed., Elsevier Academic Press, 2004.

BSMA220A LINEAR ALGEBRA (Credits 5)

Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.

Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. Isomorphisms, Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.

Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators, Eigen spaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator.

Inner product spaces and norms, Gram-Schmidt orthogonalisation process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator, Least Squares Approximation, minimal solutions to systems of linear equations, Normal and self-adjoint operators, Orthogonal projections and Spectral theorem.

REFERENCE BOOKS:

1. A. R. Vasishtha, J.N. Sharma, A. K. Vasishtha; Linear Algebra; Krishna Prakashan, Meerut.
2. Kenneth Hoffman, Ray Alden Kunz; *Linear Algebra*; Prentice-Hall of India Pvt.
3. Joseph A. Gallian; *Contemporary Abstract Algebra;* Narosa Publishing House.
4. S. Lang*; Introduction to Linear Algebra*; Springer.
5. S. Kumaresan; *Linear Algebra- A Geometric Approach*; Prentice Hall of India.
6. Gilbert Strang, *Linear Algebra and its Applications,* Thomson.

BSCS112A OBJECT ORIENTED PROGRAMMING (Credits 4)

Introduction: Introducing Object-Oriented Approach related to other paradigms (functional, data decomposition), Characteristics of Object-Oriented Languages.
Basic terms and ideas: Abstraction, Encapsulation, Information hiding, Inheritance, Polymorphism, Review of C, Difference between C and C++, Cin, Cout, new, delete operators.

Classes and Objects: Abstract data types, Object & classes, attributes, methods, C++ class declaration, State identity and behavior of an object, Constructors and destructors, instantiation of objects, Default parameter value, Copy Constructor, Static Class Data, Constant Classes, C++ garbage collection, dynamic memory allocation.

Inheritance and Polymorphism: Inheritance, Types of Inheritance, Class hierarchy, derivation – public, private & protected, Agrégations, composition vs classification hiérarchies, Polymorphism, Type of Polymorphism – Compile time and runtime, Method polymorphism, Polymorphism by parameter, Operator overloading, Parametric polymorphism, Generic function – template function, function name overloading, Overriding inheritance methods

Files and Exception Handling: Persistent objects, Streams and files, Namespaces, Exception handling, Generic Classes

Standard Template Library: Standard Template Library, Overview of Standard Template Library, Containers, Algorithms, Iterates, Other STL Elements, The Container Classes, General Theory of Operation, Vectors.

REFERENCE BOOKS:

1. A.R. Venugopal, Rajjkumar, T. Ravishanker "Mastering C++", TMH
2. R. Lafore, "Object Oriented Programming using C++", BPB Publications
3. Schildt Herbert, "C++ Programming", 2nd Edition, Wiley DreamTech.
4. D. Parasons, "Object Oriented Programming with C++", BPB Publication
5. Steven C. Lawlor, "The Art of Programming Computer Science with C++", Vikas Publication
6. Yashwant Kanethkar, "Object Oriented Programming using C++", BPB

BSCS166A OBJECT ORIENTED PROGRAMMING LAB (Credit 1)

List of Experients

Q1. Raising a number n to a power p is the same as multiplying n by itself p times. Write a function called power ( ) that takes a double value for n and an int value for p, and returns the result as double value. Use a default argument of 2 for p, so that if this argument is omitted, the number will be squared. Write a main ( ) function that gets values from the user to test this function.

Q2. A point on the two dimensional plane can be represented by two numbers: an X coordinate and a Y coordinate. For example, (4,5) represents a point 4 units to the right of the origin along the X axis and 5 units up the Y axis. The sum of two points can be defined as a new point whose X coordinate is the sum of the X coordinates of the points and whose Y coordinate is the sum of their Y coordinates.

Write a program that uses a structure called point to model a point. Define three points, and have the user input values to two of them. Than set the third point equal to the sum of the other two, and display the value of the new point. Interaction with the program might look like this:

Enter coordinates for P1: 3 4

Enter coordinates for P2: 5 7

Coordinates of P1 + P2 are : 8, 11

Q 3. Create the equivalent of a four function calculator. The program should request the user to enter a number, an operator, and another number. It should then carry out the specified arithmetical operation: adding, subtracting, multiplying, or dividing the two numbers. (It should use a switch statement to select the operation). Finally it should display the result. When it finishes the calculation, the program should ask if the user wants to do another calculation. The response can be 'Y' or 'N'. Some sample interaction with the program might look like this.
Enter first number, operator, second number: 10/ 3
Answer = 3.333333
Do another (Y/ N)? Y
Enter first number, operator, second number 12 + 100
Answer = 112
Do another (Y/ N) ? N

Q4. A phone number, such as (212) 767-8900, can be thought of as having three parts: the area code (212), the exchange (767) and the number (8900). Write a program that uses a structure to store these three parts of a phone number separately. Call the structure phone. Create two structure variables of type phone. Initialize one, and have the user input a number for the other one. Then display both numbers. The interchange might look like this:
Enter your area code, exchange, and number: 415 555 1212
My number is (212) 767-8900
Your number is (415) 555-1212

Q 5. Create two classes DM and DB which store the value of distances. DM stores distances in metres and centimeters and DB in feet and inches. Write a program that can read values for the class objects and add one object of DM with another object of DB.
Use a friend function to carry out the addition operation. The object that stores the results maybe a DM object or DB object, depending on the units in which the results are required.
The display should be in the format of feet and inches or metres and cenitmetres depending on the object on display.

Q 6. Create a class rational which represents a numerical value by two double values- NUMERATOR & DENOMINATOR. Include the following public member Functions:
• constructor with no arguments (default).
• constructor with two arguments.
• void reduce( ) that reduces the rational number by eliminating the highest common factor between the numerator and denominator.
• Overload + operator to add two rational number.
• Overload >> operator to enable input through cin.
• Overload << operator to enable output through cout.
Write a main ( ) to test all the functions in the class.

Q 7. Consider the following class definition
class father {
protected : int age;
public;
father (int x) {age = x;}
virtual void iam ( )
{ cout < < “I AM THE FATHER, my age is : ”<< age<< end1:}
};
Derive the two classes son and daughter from the above class and for each, define iam ( ) to write
our similar but appropriate messages. You should also define suitable constructors for these classes.
Now, write a main ( ) that creates objects of the three classes and then calls iam ( ) for them. Declare pointer to father. Successively, assign addresses of objects of the two derived classes to this pointer and in each case, call iam ( ) through the pointer to demonstrate polymorphism in action.

Q 8. Write a program that creates a binary file by reading the data for the students from the terminal. The data of each student consist of roll no., name (a string of 30 or lesser no. of characters) and marks.

Q9. A hospital wants to create a database regarding its indoor patients. The information to store include
a) Name of the patient
b) Date of admission
c) Disease
d) Date of discharge
Create a structure to store the date (year, month and date as its members). Create a base class to store the above information. The member function should include functions to enter information and display a list of all the patients in the database. Create a derived class to store the age of the patients. List the information about all the to store the age of the patients. List the information about all the pediatric patients (less than twelve years in age).

Q 10. Make a class **Employee** with a name and salary. Make a class **Manager** inherit from **Employee**. Add an instance variable, named department, of type string. Supply a method to **toString** that prints the manager’s name, department and salary. Make a class **Executive** inherit from **Manager**. Supply a method **to String** that prints the string **“Executive”** followed by the information stored in the **Manager** superclass object. Supply a test program that tests these classes and methods.

Q11. Imagine a tollbooth with a class called toll Booth. The two data items are a type unsigned int to hold the total number of cars, and a type double to hold the total amount of money collected. A constructor initializes both these to 0. A member function called payingCar ( ) increments the car total and adds 0.50 to the cash total. Another function, called nopayCar ( ), increments the car total but adds nothing to the cash total. Finally, a member function called displays the two totals. Include a program to test this class. This program should allow the user to push one key to count a paying car, and another to count a nonpaying car. Pushing the ESC kay should cause the program to print out the total cars and total cash and then exit.

Q12. Write a function called reversit ( ) that reverses a string (an array of char). Use for loop that swaps the first and last characters, then the second and next to last characters and so on. The string should be passed to reversit ( ) as an argument. Write a program to exercise reversit ( ). The program should get a string from the user, call reversit ( ), and print out the result. Use an input method that allows embedded blanks. Test the program with Napoleon's famous phrase, "Able was I ere I saw Elba)".

Q13. Create some objects of the string class, and put them in a Deque-some at the head of the Deque and some at the tail. Display the contents of the Deque using the forEach ( ) function and a user written display function. Then search the Deque for a particular string, using the first That ( ) function and display any strings that match. Finally remove all the items from the Deque using the getLeft ( ) function and display each item. Notice the order in which the items are displayed: Using getLeft ( ), those inserted on the left (head) of the Deque are removed in "last in first out" order while those put on the right side are removed in "first in first out" order. The opposite would be true if getRight ( ) were used.

Q 14. Create a base class called shape. Use this class to store two double type values that could be used to compute the area of figures. Derive two specific classes called triangle and rectangle from the base shape. Add to the base class, a member function get_data ( ) to initialize base class data Members and another member function display_area ( ) to compute and display the area of figures. Make display_area ( ) as a virtual function and redefine this function in the derived classes to suit their requirements.

Using these three classes, design a program that will accept dimensions of a triangle or a rectangle interactively and display the area.
Remember the two values given as input will be treated as lengths of two sides in the case of rectangles and as base and height in the case of triangles and used as follows:
Area of rectangle = x * y
Area of triangle = ½ * x * y

GENERIC ELECTIVE

BSMA332A COMBINATORIAL MATHEMATICS Credits 4

Basic counting principles, Permutations and Combinations (with and without repetitions), Binomial theorem, Multinomial theorem, Counting subsets, Set-partitions, Stirling numbers

Principle of Inclusion and Exclusion, Derangements, Inversion formulae

Generating functions: Algebra of formal power series, Generating function models, Calculating generating functions, Exponential generating functions.

Recurrence relations: Recurrence relation models, Divide and conquer relations, Solution of recurrence relations, Solutions by generating functions.

Integer partitions, Systems of distinct representatives.

Polya theory of counting: Necklace problem and Burnside's lemma, Cyclic index of a permutation group, Polya's theorems and their immediate applications.

Latin squares, Hadamard matrices, Combinatorial designs: *t* designs, BIBDs, Symmetric designs.

REFERENCE BOOKS:

1. J.H. van Lint and R.M. Wilson, *A Course in Combinatorics*, 2nd Ed., Cambridge University Press.
2. V. Krishnamurthy, *Combinatorics, Theory and Application*, Affiliated East-West Press.
3. P.J. Cameron, *Combinatorics, Topics, Techniques, Algorithms*, Cambridge University Press.
4. M. Jr. Hall, *Combinatorial Theory*, 2nd Ed., John Wiley & Sons.
5. S.S. Sane, *Combinatorial Techniques*, Hindustan Book Agency.
6. R.A. Brualdi, *Introductory Combinatorics*, 5th Ed., Pearson Education Inc.
7. R.P. Grimaldi, *Discrete Mathematics and Combinatorial Mathematics*, Pearson Education.

BSCS312A INFORMATION AND NETWORK SECURITY Credits 4

History of Information Security, Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Securing the Components, Balancing Security and Access, SDLC, Security SDLC, Need for Security, Business Needs Threats, Attacks, Legal, Ethical and Professional Issues

Security Analysis: Risk Management, Identifying and Assessing Risk, Assessing and Controlling Risk

Logical Design: Blueprint for Security, Information Security Policy, Standards and Practices, NIST Models, VISA International Security Model, Design of Security Architecture
Computer Security: Overview, Security Services, Mechanisms, Attacks-Access Control Matrix, Policy, Security policies, Confidentiality policies, Integrity policies and Hybrid policies.
Cryptosystems & Authentication: Classical Cryptography, Substitution Ciphers, permutation Ciphers, Block Ciphers, DES Modes of Operation, AES Linear Cryptanalysis, Differential Cryptanalysis, Hash Function, SHA 512, Message Authentication Codes, HMAC - Authentication Protocols
Public Key Cryptosystems: Introduction to Public key Cryptography, Number theory, RSA Cryptosystem and Factoring Integer, Attacks on RSA
Network Security: Secret Sharing Schemes, Kerberos, Pretty Good Privacy (PGP), Secure Socket Layer (SSL), Intruders, Firewalls, Viruses

REFERENCE BOOKS:

1. Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Vikas Publishing House, New Delhi, 2003
2. William Stallings, "Cryptography and Network Security: Principles and Practices", Third Edition, Pearson Education, 2006.

Semester V

BSMA323A METRIC SPACES (Credits 5)

Metric spaces: definition and examples. Sequences in metric spaces, Cauchy sequences. Complete Metric Spaces.
Open and closed balls, neighbourhood, open set, interior of a set, Limit point of a set, closed set, diameter of a set, Cantor's Theorem, Subspaces, dense sets, separable spaces.
Continuous mappings, sequential criterion and other characterizations of continuity, Uniform continuity, Homeomorphism, Contraction mappings, Banach Fixed point Theorem.
Connectedness, connected subsets of **R,** connectedness and continuous mappings.
Compactness, compactness and boundedness, continuous functions on compact spaces.

REFERENCE BOOKS:

1. Satish Shirali & Harikishan L. Vasudeva, *Metric Spaces*, Springer Verlag London.
2. S. Kumaresan, *Topology of Metric Spaces*, Narosa Publishing House, Second Edition.
3. G. F. Simmons, *Introduction to Topology and Modern Analysis*, Mcgraw-Hill, Edition.
4. E.T.Copson; *Metric Spaces*; Cambridge University Press.
5. P.K. Jain and K. Ahmad*; Metric Spaces*; Narosa Publishing House, New Delhi.

BSMA325A COMPLEX ANALYSIS (Credits 4)

Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability.

Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, definite integrals of functions.

Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals.

Antiderivatives, proof of antiderivative theorem, Cauchy-Goursat theorem, Cauchy integral formula. An extension of Cauchy integral formula, consequences of Cauchy integral formula, Liouville's theorem and the fundamental theorem of algebra.

Convergence of sequences and series, Taylor series and its examples. Laurent series and its examples, absolute and uniform convergence of power series, uniqueness of series representations of power series.

Isolated singular points, residues, Cauchy's residue theorem, residue at infinity. Types of isolated singular points, residues at poles and its examples, definite integrals involving sines and cosines.

REFERENCE BOOKS:

1. Joseph Bak and Donald J. Newman, *Complex analysis* (2nd Edition), Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York.
2. James Ward Brown and Ruel V. Churchill, *Complex Variables and Applications,* 8th Ed., McGraw – Hill International Edition.
3. Murray Spiegel, Seymour Lipschutz ; John Schiller and Dennis Spellman; Schaum's Outline of Complex Variables.
4. J.N.Sharma*; Functions of a Complex Variable*; Krishna Prakashan, Meerut.

BSMA357A COMPLEX ANALYSIS LAB (Credits 1)

PRACTICAL/LAB WORK

(Modeling of the following problems Using Matlab/ Mathematica/ Maple Etc.)

List of Practicals

1. Declaring a complex number and graphical representation. e.g. Z1 =3 + 4i, Z2 = 4 – 7i

2. Program to discuss the algebra of complex numbers.
   e.g., if Z1 =3 + 4i, Z2 = 4 – 7i, then find Z1 + Z2, Z1 - Z2, Z1 * Z2,and Z1 / Z2

3. To find conjugate, modulus and phase angle of an array of complex numbers.
   e.g., Z = [2+ 3i 4-2i 6+11i 2-5i]
4. To compute the integral over a straight line path between the two specified end points.
   e. g., , where C is the straight line path from -1+ i to 2 - i.
5. To perform contour integration.
   e.g., (i) , where C is the Contour given by x = y2 +1; .
   (ii) , where C is the contour given by , which can be parameterized by x = cos (t), y = sin (t) for .
1. To plot the complex functions and analyze the graph.

e.g., (i) f(z) = Z (ii) f(z)=Z3 (iii) f(z) = (Z4-1)1/4

7. To perform the Taylor series expansion of a given function f(z) around a given point z. The number of terms that should be used in the Taylor series expansion is given for each function. Hence plot the magnitude of the function and magnitude of its Taylors series expansion.

e.g., (i) f(z) = exp(z) around z = 0, n =40.
(ii) f(z)=exp(z2) around z = 0, n = 160.

8. To determines how many terms should be used in the Taylor series expansion of a given function f(z) around z = 0 for a specific value of z to get a percentage error of less than 5 %.

e.g., For f(z) = exp(z) around z =0, execute and determine the number of necessary terms to get a percentage error of less than 5 % for the following values of z: (i) z = 30 + 30 i

9. To perform Laurents series expansion of a given function f(z) around a given point z.

e.g., (i) f(z)= (sin z -1)/z4 around z = 0
(ii) f(z) = cot (z)/z4 around z = 0

10.To compute the poles and corresponding residues of complex functions.

11.To perform Conformal Mapping and Bilinear Transformations.

BSMA331A NUMERICAL ANALYSIS (Credits 4)

Algorithms, Convergence, Errors: Relative, Absolute, Round off, Truncation.

Transcendental and Polynomial equations: Bisection method, Newton's method, Secant method.Rate of convergence of these methods.

System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss Seidel method and their convergence analysis.

Interpolation: Lagrange and Newton's methods. Error bounds. Finite difference operators. Gregory forward and backward difference interpolation.

Numerical Integration: Trapezoidal rule, Simpson's rule, Simpsons 3/8th rule, Boole's Rule. Midpoint rule, Composite Trapezoidal rule, Composite Simpson's rule.

Ordinary Differential Equations: Euler's method. Runge-Kutta methods of orders two and four.

REFERENCE BOOKS:

1. M. K. Jain, S.R.K. Iyengar and R.K. Jain; *Numerical Methods for Scientific and Engineering Computation*; New age International Publisher.
2. Brian Bradie; *A Friendly Introduction to Numerical Analysis*; Pearson Education.
3. C.F. Gerald and P.O. Wheatley; *Applied Numerical Analysis*; Pearson Education.
4. Uri M. Ascher and Chen Greif; *A First Course in Numerical Methods*; PHI Learning Private Limited.
5. John H. Mathews and Kurtis D. Fink; *Numerical Methods using Matlab;* PHI Learning Private Limited.
6. B. S. Grewal, *Numerical Methods in Engineering and Science*, Khanna Publishers.

BSMA351A NUMERICAL ANALYSIS LAB (Credits 1)

PRACTICAL/LAB WORK
(Modeling of the following problems Using Matlab/ Mathematica/ Maple Etc.)

List of Practicals

(i) Calculate the sum 1/1 + 1/2 + 1/3 + 1/4 + ----------+ 1/ N.
(ii) To find the absolute value of an integer.
(iii) Enter 100 integers into an array and sort them in an ascending order.
(iv) Bisection Method.
(v) Newton Raphson Method.
(vi) Secant Method.

(vii) Regulai Falsi Method.
(viii) LU decomposition Method.
(ix) Gauss-Jacobi Method.
(x) SOR Method or Gauss-Siedel Method.
(xi) Lagrange Interpolation or Newton Interpolation.
(xii) Simpson's rule.
Note: For any of the CAS (Computer aided software) Data types-simple data types, floating data types, character data types, arithmetic operators and operator precedence, variables and constant declarations, expressions, input/output, relational operators, logical operators and logical expressions, control statements and loop statements, Arrays should be introduced to the students.

REFERENCE BOOKS:

1. Brian Bradie, *A Friendly Introduction to Numerical Analysis*, Pearson Education, India.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 6th Ed., New age International Publisher, India, 2007.
3. C.F. Gerald and P.O. Wheatley, *Applied Numerical Analysis*, Pearson Education, India.
4. Uri M. Ascher and Chen Greif, *A First Course in Numerical Methods*, 7th Ed., PHI Learning Private Limited, 2013.
5. John H. Mathews and Kurtis D. Fink, *Numerical Methods using Matlab*, 4th Ed., PHI Learning Private Limited, 2012.

BSMA333A DESCRIPTIVE STATISTICS (Credits 4)

Statistical Methods: Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, attributes, variables, scales of measurement nominal, ordinal, interval and ratio. Presentation: tabular and graphical, including histogram and ogives, consistency and independence of data with special reference to attributes.

Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, absolute moments, factorial moments, skewness and kurtosis, Sheppard's corrections.

Bivariate data: Definition, scatter diagram, simple, partial and multiple correlation (3 variables only), rank correlation. Simple linear regression, principle of least squares and fitting of polynomials and exponential curves.

Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – classical, statistical, and axiomatic. Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications.

REFERENCE BOOKS:

1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

BSMA355A DESCRIPTIVE STATISTICS LAB (Credits 1)

PRACTICAL/LAB WORK

List of Practical

1. Graphical representation of data.
2. Problems based on measures of central tendency.
3. Problems based on measures of dispersion.
4. Problems based on combined mean and variance and coefficient of variation.
5. Problems based on moments, skewness and kurtosis.
6. Fitting of polynomials, exponential curves.
7. Karl Pearson correlation coefficient.
8. Correlation coefficient for a bivariate frequency distribution.
9. Lines of regression, angle between lines and estimated values of variables.
10. Spearman rank correlation with and without ties.
11. Partial and multiple correlations.
12. Planes of regression and variances of residuals for given simple correlations.
13. Planes of regression and variances of residuals for raw data.

BSMA225A PROBABILITY THEORY Credits 5

Random variables: discrete and continuous random variables, p.m.f., p.d.f. and c.d.f., illustrations and properties of random variables, univariate transformations with illustrations.

Two dimensional random variables: discrete and continuous type, joint, marginal and conditional p.m.f, p.d.f., and c.d.f., independence of variables, bivariate transformations with illustrations.

Mathematical Expectation and Generating Functions: Expectation of single and bivariate random variables and its properties. Moments and Cumulants, moment generating function, cumulant generating function and characteristic function. Uniqueness and inversion theorems (without proof) along with applications. Conditional expectations.

Discrete Probability Distributions: Uniform, Binomial, Poisson, Geometric, Negative Binomial and Hyper-geometric distributions along with their characteristic properties and limiting/approximation cases.

Continuous probability distributions: Normal, Exponential, Uniform, Beta, Gamma, Cauchy, lognormal and Laplace distributions along with their characteristic properties and limiting/approximation cases.

REFERENCE BOOKS:

1. Hogg, R.V., Tanis, E.A. and Rao J.M. , Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.
2. Miller, Irwin and Miller, Marylees, John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Myer, P.L., Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi

BSMA227A **BOOLEAN ALGEBRA AND AUTOMATA THEORY** **(Credits 5)**

Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, lattices as ordered sets, lattices as algebraic structures, sublattices, products and homomorphisms.

Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh diagrams, switching circuits and applications of switching circuits.

Introduction: Alphabets, strings, and languages. Finite Automata and Regular Languages: deterministic and non-deterministic finite automata, regular expressions, regular languages and their relationship with finite automata, pumping lemma and closure properties of regular languages.

Context Free Grammars and Pushdown Automata: Context free grammars (CFG), parse trees, ambiguities in grammars and languages, pushdown automaton (PDA) and the language accepted by PDA, deterministic PDA, Non- deterministic PDA, properties of context free languages; normal forms, pumping lemma, closure properties, decision properties.

Turing Machines: Turing machine as a model of computation, programming with a Turing machine, variants of Turing machine and their equivalence.

Undecidability: Recursively enumerable and recursive languages, undecidable problems about Turing machines: halting problem, Post Correspondence Problem, and undecidability problems about CFGs.

REFERENCE BOOKS:

1. B A. Davey and H. A. Priestley, *Introduction to Lattices and Order*, Cambridge University Press, Cambridge.
2. Edgar G. Goodaire and Michael M. Parmenter, *Discrete Mathematics with Graph Theory,* (2nd Ed.), Pearson Education (Singapore) P.Ltd., Indian Reprint.
3. Rudolf Lidl and Günter Pilz, *Applied Abstract Algebra,* 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint.
4. J. E. Hopcroft, R. Motwani and J. D. Ullman, *Introduction to Automata Theory, Languages,and Computation,* 2nd Ed., Addison-Wesley.
5. H.R. Lewis, C.H. Papadimitriou, C. Papadimitriou, *Elements of the Theory of Computation*, 2nd Ed., Prentice-Hall, NJ.
6. J.A. Anderson, *Automata Theory with Modern Applications*, Cambridge University Press.

BSMA344A BIO - MATHEMATICS (Credits 5)

Mathematical Biology and the modeling process: an overview. Continuous models: Malthus model, logistic growth, Allee effect, Gompertz growth, Michaelis-Menten Kinetics, Holling type growth, Bacterial growth in a Chemostat, Harvesting a single natural population, Prey predator systems and Lotka Volterra equations, Populations in competitions, Epidemic Models (SI, SIR, SIRS, SIC), Activator-Inhibitor system, Insect Outbreak Model: Spruce Budworm, Numerical solution of the models and its graphical representation. Qualitative analysis of continuous models: Steady state solutions, stability and linearization, multiple species communities and Routh-Hurwitz Criteria, Phase plane methods and qualitative solutions, bifurcations and limit cycles with examples in the context of biological scenario. Spatial Models: One species model with diffusion, Two species model with diffusion, Conditions for diffusive instability, Spreading colonies of microorganisms, Blood flow in circulatory system, Travelling wave solutions, Spread of genes in a population. Discrete Models: Overview of difference equations, steady state solution and linear stability analysis, Introduction to Discrete Models, Linear Models, Growth models, Decay models, Drug Delivery Problem, Discrete Prey-Predator models, Density dependent growth models with harvesting, Host-Parasitoid systems (Nicholson-Bailey model), Numerical solution of the models and its graphical representation. Case Studies: Optimal Exploitation models, Models in Genetics, Stage Structure Models, Age Structure Models.

REFERENCE BOOKS:

1. L.E. Keshet, *Mathematical Models in Biology*, SIAM, 1988.
2. J. D. Murray, *Mathematical Biology*, Springer, 1993.
3. Y.C. Fung, *Biomechanics*, Springer-Verlag, 1990.
4. F. Brauer, P.V.D. Driessche and J. Wu, *Mathematical Epidemiology*, Springer, 2008.
5. M. Kot, *Elements of Mathematical Ecology*, Cambridge University Press, 2001.

SEMESTER – VI

BSMA324AORDE **RIEMANN INTEGRATION AND SERIES OF FUNCTION** **(Credits 5)**

Riemann integration; inequalities of upper and lower sums; Riemann conditions of integrability. Riemann sum and definition of Riemann integral through Riemann sums; equivalence of two definitions; Riemann integrability of monotone and continuous functions, Properties of the Riemann integral; definition and integrability of piecewise continuous and monotone functions. Intermediate Value theorem for Integrals; Fundamental theorems of Calculus.

Improper integrals; Convergence of Beta and Gamma functions.

Pointwise and uniform convergence of sequence of functions. Theorems on continuity, derivability and integrability of the limit function of a sequence of functions. Series of functions; Theorems on the continuity and derivability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass M-Test.

Power series, radius of convergence, Cauchy Hadamard Theorem, Differentiation and integration of power series; Abel's Theorem; Weierstrass Approximation Theorem.

REFERENCE BOOKS:

1. K.A. Ross, Elementary Analysis; *The Theory of Calculus, Undergraduate Texts in Mathematics*; Springer (SIE), Indian reprint.
2. R.G. Bartle D.R. Sherbert; *Introduction to Real Analysis;* John Wiley and Sons (Asia)Pvt. Ltd., Singapore.
3. Charles G. Denlinger; *Elements of Real Analysis*; Jones & Bartlett.
4. Savita Arora and S.C.Malik*; Mathematical Analysis*; New Age Publishing.

BSMA326A **OPERATIONAL RESEARCH** **(Credits 4)**

Definition, scope, methodology and applications of OR. Types of OR models.Concept of optimization, Linear Programming: Introduction, Formulation of a Linear Programming Problem (LPP), Requirements for an LPP, Advantages and limitations of LP. Graphical solution: Multiple, unbounded and infeasible solutions.

Principle of simplex method: standard form, basic solution, basic feasible solution. Computational Aspect of Simplex Method: Cases of unique feasible solution, no feasible solution, multiple solutions and unbounded solution and degeneracy. Two Phase and Big-M methods.

Duality in LPP, primal-dual relationship. Transportation Problem: Methods for finding basic feasible solution of a transportation problem, Modified distribution method for finding the optimum solution, Unbalanced and degenerate transportation problems, transshipment problem, maximization in a transportation problem.

Assignment Problem: Solution by Hungarian method, Unbalanced assignment problem, maximization in an assignment problem, Crew assignment and Travelling salesman problem.

Game Theory: Two person zero sum game, Game with saddle points, the rule of dominance; Algebraic, graphical and linear programming methods for solving mixed strategy games.

REFERENCE BOOKS:

1. Kanti Swarup, P.K. Gupta and Manmohan; *Operations Research*; Sultan Chand & Sons.
2. H.A.Taha*; Operations Research – An Introduction;Wiley.*
3. Gupta, P.K. and Hira, D.S.; *Operations Research*; S. Chand & Co.
4. S.I. Gass; *Linear Programming* (3rd Edition); McGraw Hill, NY.
5. G. Hadley*; Linear Programming*; Narosa Publishing.

BSMA352A OPERATIONAL RESEARCH LAB (Credits 1)

PRACTICAL/LAB WORK

List of Practical

1. Mathematical formulation of L.P.P and solving the problem using graphical method, Simplex technique and Charne's Big M method involving artificial variables.
2. Identifying Special cases by Graphical and Simplex method and interpretation

a. Degenerate solution
b. Unbounded solution
c. Alternate solution
d. Infeasible solution

3. Post-optimality

a. Addition of constraint
b. Change in requirement vector
c. Addition of new activity
d. Change in cost vector

4. Allocation problem using Transportation model
5. Allocation problem using Assignment model
6. Networking problem

a. Minimal spanning tree problem
b. Shortest route problem

7. Problems based on game matrix

a. Graphical solution to mx2 / 2xn rectangular game
b. Mixed strategy

BSMA342A MATHEMATICAL STATISTICS (Credits 5)

Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function, discrete distributions: uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential.

Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables, bivariate normal distribution, correlation coefficient, joint moment generating function (jmgf) and calculation of covariance (from jmgf), linear regression for two variables.

Chebyshev's inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers, Central Limit theorem for independent and identically distributed random variables with finite variance, Markov Chains, Chapman-Kolmogorov equations, classification of states.

REFERENCE BOOKS:

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig; *Introduction to Mathematical Statistics*; Pearson Education.
2. Irwin Miller and Marylees Miller, John E. Freund; *Mathematical Statistics with Applications*, Pearson Education, Asia.
3. Sheldon Ross; *Introduction to Probability Models*; Academic Press, Indian Reprint.
4. Alexander M. Mood, Franklin A. Graybill and Duane C. Boes; *Introduction to the Theory of Statistics*; Tata McGraw- Hill, Reprint.

DISCIPLINE ELECTIVE IV:-

BSMA338A MATHEMATICAL MODELLING (Credits 5)

Need, Techniques, Classifications, Characteristic and Limitations of Mathematical Models. Mathematical Modelling through Ordinary Differential Equation of First Order: Linear Growth and Decay Models, Non-Linear Growth and Decay Models, Compartment Models.

Mathematical Modelling through systems of Ordinary Differential Equation of First Order: Population Dynamics, Epidemics and Compartment Models.

Mathematical Modelling through Ordinary Differential Equation of Second Order: Planetary Motion, Circular Motion and Motion of Satellites.

Mathematical Modelling through Graphs: Directed and Signed graphs, Weighted Di-graphs.

REFERENCE BOOKS:

1. Frank R. Giordano, Maurice D. Weir and William P. Fox, A First Course in Mathematical Modeling, Thomson Learning, London and New York.
2. ReinhardIllner, Mathematical Modelling: A Case Studies Approach, Indian Editions of AMS Titles.
3. J. N. Kapur, Mathematical Modelling, New Age International Publishers.
4. Belinda Barnes and Glenn R. Fulford, *Mathematical Modeling with Case Studies, A Differential Equation Approach using Maple and Matlab*, 2nd Ed., Taylor and Francis group, London and New York, 2009.

BSMA334A DIFFERENTIAL GEOMETRY (Credits 5)

Theory of Space Curves: Space curves, Planer curves, Curvature, torsion and Serret-Frenet formulae. Osculating circles, Osculating circles and spheres. Existence of space curves. Evolutes and involutes of curves.

Theory of Surfaces: Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Euler's theorem. Rodrigue's formula, Conjugate and Asymptotic lines.

Developables: Developable associated with space curves and curveson surfaces, Minimal surfaces.

Geodesics: Canonical geodesic equations. Nature of geodesics on a surface of revolution. Clairaut's theorem. Normal property of geodesics. Torsion of a geodesic. Geodesic curvature. Gauss-Bonnet theorem. Surfaces of constant curvature. Conformal mapping. Geodesic mapping. Tissot's theorem.

Tensors: Summation convention and indicial notation, Coordinate transformation and Jacobian, Contra-variant and Covariant vectors, Tensors of different type, Algebra of tensors and contraction, Metric tensor and 3-index Christoffel symbols, Parallel propagation of vectors, Covariant and intrinsic derivatives, Curvature tensor and its properties, Curl, Divergence and Laplacian operators in tensor form, Physical components.

REFERENCE BOOKS:

1. T.J. Willmore, *An Introduction to Differential Geometry*, Dover Publications.
2. B. O'Neill, *Elementary Differential Geometry*, 2nd Ed., Academic Press.
3. C.E. Weatherburn, *Differential Geometry of Three Dimensions*, Cambridge University Press.
4. D.J. Struik, *Lectures on Classical Differential Geometry*, Dover Publications.
5. S. Lang, *Fundamentals of Differential Geometry*, Springer.
6. B. Spain, *Tensor Calculus: A Concise Course*, Dover Publications.

BSMA221A STATICS (Credits 5)

Composition and resolution of forces. Parallel forces. Moments and Couples.

Analytical conditions of equilibrium of coplanar forces. Friction. Centre of Gravity.

Virtual work. Forces in three dimensions. Poinsots central axis.

Wrenches. Null lines and planes. Stable and unstable equilibrium.

REFERENCE BOOKS:

1. S.L. Loney; Statics, Macmillan Company; London.
2. R.S. Verma; A Text Book on Statics; Pothishala Pvt. Ltd., Allahabad.
3. I.H. Shames and G. Krishna Mohan Rao, *Engineering Mechanics: Statics and Dynamics* (4th Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2009.
4. R.C. Hibbeler and Ashok Gupta, *Engineering Mechanics: Statics and Dynamics* (11th Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.

Annexure

B.Sc. (H) Maths		**Year 2019 - 2022 (Scheme of studies as per LOCF and CBCS scheme)**					**SBAS**			
ODD SEMESTER							**EVEN SEMESTER**			
Year	**SN**	**Course Code**	**Nature**	**Course Title**	**C**	**SN**	**Course Code**	**Nature**	**Course Title**	**C**
First	1	BSMA133A	CC	Calculus	5	1	BSMA135A	CC	Vector Analysis	4
	2	BSMA137A	CC	Algebra	4	2	BSMA138A	CC	Group Theory	4
	3		DSE	Discipline Elective I	4	3	BSMA140A	CC	Advanced Calculus	5
	4		GEC	Open Elective I	4	4		DSE	Discipline Elective II	4
	5	BSCH125A	AECC	Environmental Studies	3	5		GEC	Open Elective II	4
	6	BSCS102A	SEC	Information Technology Fundamentals	4	6	BSEL101A	AECC	Communication Skills	5
	TOTAL				**24**	**TOTAL**				**26**

Second	1	BSMA134A	CC	Ordinary Differential Equations	4		1	BSMA218A	CC	Special functions and Integral Transforms	5
	2	BSMA251A	SEC	Ordinary Differential Equations Lab	1		2	BSMA219A	CC	Partial Differential Equations	4
	3	BSMA217A	CC	Real Analysis	5		3	BSMA252A	SEC	Partial Differential Equations Lab	1
	4	BSMA223A	CC	Ring Theory	5		4	BSMA220A	CC	Linear Algebra	5
	5		GEC	Generic Elective II	5		5		GEC	Generic Elective III	4
	6	BSDM301A	AECC	Disaster Management	3		6	BSCS112A	CC	Object Oriented Programming	4
	7	BSEL217A	SEC	Personality Development and Communication Skills	3		7	BSCS166A	SEC	Object Oriented Programming Lab	1
	TOTAL				**26**		**TOTAL**				**24**

Third	1	BSMA323A	CC	Metric Spaces	5		1	BSMA324A	CC	Riemann Integration and Series of Functions	5
	2	BSMA325A	CC	Complex Analysis	4		2	BSMA326A	CC	Operational Research	4
	3	BSMA357A	SEC	Complex Analysis Lab	1		3	BSMA342A	CC	Mathematical Statistics	5
	4	BSMA331A	CC	Numerical Analysis	4		4		DSE	Discipline Elective IV	5
	5	BSMA351A	SEC	Numerical Analysis Lab	1			BSMA352A	SEC	Operational Research Lab	1
	6	BSMA333A	CC	Descriptive Statistics	4		5	BSMA354A	CC	Project	5
	7	BSMA355A	SEC	Descriptive Statistics Lab	1		TOTAL				25
	8		DSE	Discipline Elective III	5						
	TOTAL				25						

Electives				
	Discipline Elective I (Choose any one)			
1	BSMA136A	DSE	Analytical Geometry	4
2	BSMA336A	DSE	Number Theory	4
3	BSMC119A	DSE	Mathematical Finance	4
Discipline Elective II (Choose any one)				
1	BSMA146A	DSE	Graph Theory	4
2	BSMA327A	DSE	Dynamics	4
3	BSMC226A	DSE	Portfolio Optimization	4
Discipline Elective III (Choose any one)				
1	BSMA225A	DSE	Probability Theory	5
2	BSMA227A	DSE	Boolean Algebra and Automata Theory	5
3	BSMA344A	DSE	Bio-Mathematics	5
Discipline Elective IV (Choose any one)				
1	BSMA338A	DSE	Mathematical Modelling	5
2	BSMA334A	DSE	Differential Geometry	5
3	BSMA221A	DSE	Statics	5

	Generic Elective Course I				
	1	BSMA229A	GEC	Econometrics	5
	2	BSMA335A	GEC	Application of Algebra	5
	Generic Elective Course II				
	1	BSMA332A	GEC	Combinatorial Mathematics	4
	2	BSCS312A	GEC	Information and Network Security	4

Total Credits	**150**

Student can choose two non credit courses (2 hours per week), one in odd semester and one in even semester during the entire duration of Programme from the pool of courses provided by the university.