K.R. MANGALAM UNIVERSITY

THE COMPLETE WORLD OF EDUCATION

SCHOOL OF BASIC AND APPLIED SCIENCES

Bachelor of Science (Honours) Mathematics

B.Sc. (Hons.) Mathematics

Programme Code: 11

2021-2024

Approved in the 26th Meeting of Academic Council Held on 11

August 2021

Academic Council
Member Secretary
K.R. Mangalam University

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

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PREAMBLE

The objective of any programme at Higher Education Institute is to prepare their students for the society at large. The K. R. Mangalam University visualizes all its programmes in the best interest of their students and in this endeavour; it offers a new vision to all its Under-Graduate courses. It imbibes a combination of Learning Outcome-based Curriculum Framework (LOCF) and Choice Based Credit System (CBCS) for all its Undergraduate programmes. The LOCF approach is envisioned to provide a focused, outcome-based syllabus at the undergraduate level with an agenda to structure the teaching-learning experiences in a more student-centric manner. The LOCF approach has been adopted to strengthen students' experiences as they engage themselves in the programme of their choice. The CBCS provides an opportunity for the students to choose courses from the presecribed courses comprising core, elective/minor or skill-based courses. The courses can be evaluated following the grading system, which is better than the conventional marks system. The Undergraduate Programmes will prepare the students for both, academia and employability. The programmes also state the attributes that it offers to inculcate at the graduation level. The graduate attributes encompass values related to emotional stability, well-being, critical thinking and also skills for employability.

The new curriculum of B.Sc. (Hons.) Mathematics offers courses keeping in view of the wide applications of Mathematics in science, engineering, social science, business and a host of other areas. All the courses are having defined objectives and learning outcomes, which will help prospective students in choosing the elective courses to broaden their skills in the field of mathematics and interdisciplinary areas. The courses will train students with sound theoretical and experimental knowledge that suits the need of academics and industry. The courses also offer ample skills to pursue research as career in the field of mathematics and allied areas. The K. R. Mangalam University hopes the LOCF approach of the programme B.Sc. (Hons) Mathematics will help students in making an informed decision regarding the goals that they wish to pursue in further education and life, at large.

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1. Introduction

K.R. Mangalam University located on Sohna Road, Gurugram, is one of the fastest growing and most promising upcoming universities in India. It is a State Private University established in 2013 by an act of the legislature of the Haryana Government under Haryana Private Universities Act (Amendment) 8 of 2013.It is recognized by the UGC under Section 2f of the UGC Act, 1956. The primary aim of the University is to promote excellence in basic and professional education while upholding moral values.

KRMU offers sixty-eight Undergraduate, Postgraduate and Doctoral Degree programs across different disciplines. The group of educational units in the University promotes education in the areas of Engineering& Technology, Legal Studies, Basic and Applied Sciences, Management Sciences, Commerce, Journalism and Mass Communication, Hotel Management and Catering Technology, Medical and Allied Sciences, Architecture and Planning, Agriculture, Fashion Designing, Humanities and Education. All the disciplines follow a well-defined curriculum design keeping in view the guidelines of UGC/AICTE and appropriate regulatory bodies like Council of Architecture (COA), Bar Council of India (BCI), Pharmacy Council of India (PCI), National Council for Teachers Education (NCTE) etc., wherever applicable. All courses are semester and credit based.

K. R. Mangalam University is unique because of its

- An enduring legacy of providing education to high achievers who demonstrate leadership in diverse fields.
- 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 both teaching and research through its various science disciplines viz Mathematics, Chemistry, Physics.

School of Basic and Applied Sciences imparts students' disciplinary knowledge, enhances their skills and ability, motivating them to think ingeniously, 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 for the development of society and Nation.

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

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, postgraduate M.Sc. Programmes, and Doctoral Programmes. All these programmes are designed to impart scientific knowledge to the students and are aimed to provide theoretical as well as practical training in their respective fields.

3.1 Programmes in Mathematics

School offers undergraduate B.Sc. (Hons) Mathematics. This course emphasized on hands on practice, innovative thought process and project based learning.

Graduate Attributes

GA1: To demonstrate competence in discipline specific theoretical and practical Knowledge
GA2: To develop creativity and innovation
GA3: To enhance communication and interpersonal skills
GA4: To enable critical & logical thinking and investigative research attitude amongst students
GA5: To develop ethical values, teamwork and lifelong learning approach

Programme Educational Objectives (PEO)

PEO1: To acquire knowledge in functional areas of Mathematics and apply in all the fields of learning.

PEO2: To recognise the need for lifelong learning and demonstrate the ability to explore some mathematical content independently.

PEO3: To employ mathematical ideas encompassing logical reasoning, analytical, numerical ability and theoretical skills to model real-world problems and solve them.

PEO4: To develop critical thinking, creative thinking, and self-confidence for eventual success in career.

PEO5: To analyse, and interpret solutions and to enhance entrepreneurial skill skills, and rial skill and foster leadership.

PEO6: To prepare the students to communicate mathematical ideas effectively and develop their ability to collaborate both intellectually and creatively in diverse contexts.

PEO7: To provide variegated career avenues in Education, Industry, Banks, MNCs to graduates and explore prospects of pursuing higher studies.

Programme Outcomes (POs)

PO1	**Apply information on scientific facts to face day to day requirements.**
PO2	**Apply moral principles and responsibilities of a science graduate to serve the society.**

PO3	**Create innovative ideas by using scientific knowledge for analysis and interpretation of data.**
PO4	**Ability to work independently as well as in collaboration with other individuals /institutions.**
PO5	**Knowledge regarding advancement in various branches of mathematics.**
PO6	**Inculcate moral/ethical values and environmental consciousness.**
PO7	**Enhance employability/ entrepreneurship skills.**
PO8	**Ability to communicate various concepts of mathematics effectively.**
PO9	**Capable to use appropriate software to solve mathematical equations.**
PO10	**Develop the protocols as per laboratory standards to accomplish the objectives.**

4. B.Sc. (Hons.) Mathematics

Bachelor's degree in mathematics is the culmination of in-depth knowledge of algebra, calculus, geometry, differential equations, and several other branches of mathematics. This also leads to study of related areas like computer science and statistics. Thus, this programme helps learners in building a solid foundation for higher studies in mathematics. The program enhances career prospects in a huge array of fields by fostering a creative spirit to help students fulfil their potential, to become creative mathematician and to become successful in a wide range of professions where logical and analytical thinking is required.

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 / Differential Equations / Solid Geometry / Real Analysis / Computer Programming / Modern Algebra / Numerical Analysis / Linear Algebra / Complex Analysis / Probability and Statistics / Operational Research.

Career Options: - Mathematicians work in business and management, finance, industry, public and private enterprises, education and sciences.

Programme Specific Outcome (PSOs)

PSO 1	**To gain a strong foundation in various branches of mathematics to investigate and solve real-life problem.**
PSO 2	**Acquire jobs in government and public sector undertakings, banks, and central government institutes and pursue higher studies countrywide.**
PSO 3	**Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.**
PSO 4	**To develop entrepreneurial skills to become empowered and self-reliant.**
PSO 5	**Understand the basic concepts of statistics, algebra, and differential equations.**
PSO 6	**Apply mathematical modeling and reasoning to solve basic problems.**

5. 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.

6. Class Timings

The classes will be held from Monday to Friday from 09:10 am to 04:30 pm.

7. Scheme of Studies and Syllabi

The syllabi of B.Sc. (Hons.) Mathematics for all years offered by the school with scheme of studies are given in the following pages.

B.Sc. (Hons.) Mathematics Three Years Undergraduate Programme at a Glance

SEMESTER	I	II	III	IV	V	VI	TOTAL
COURSES	6	8	9	7	6	6	42
CREDITS	24 Credits	27 Credits	22 + GE Credits	21 + GE Credits	24 Credits	24 Credits	142+ Total GE Credits = 152/ 154

SCHEME OF STUDIES AS PER CHOICE-BASED CREDIT SYSTEM (CBCS) AND LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (LOCF)

			SEMESTER I				
SN	**COURSE CODE**	**NATURE OF COURSE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1	BSMA121A	CC	Calculus	4	0	0	4
2	BSMA171A	SEC	Calculus Lab	0	0	4	2
3	BSMA123A	CC	Algebra And Geometry	5	1	0	6
4	UCES 125A	AECC	Environmental Studies	3	0	0	3
5	UCDM301A	AECC	Disaster Management	3	0	0	3
6		GEC	Open /Generic Elective (GE) - I	6	0	0	6
			TOTAL	**24 Credits**			

			SEMESTER II				
SN	**COURSE CODE**	**NATURE OF COURSE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1	BSMA122A	CC	Multivariable Calculus	4	0	0	4
2	BSMA172A	SEC	Multivariable Calculus Lab	0	0	4	2
3	BSMA124A	CC	Ordinary Differential Equations	4	0	0	4
4	BSMA174A	SEC	Ordinary Differential Equations Lab	0	0	4	2
5	ETCS104A	SEC	Introduction to Computer Science and Programming in Python	3	1	0	4
6	ETCS150A	SEC	Introduction to Computer Science and Programming in Python Lab	0	0	2	1
7	UCCS155A	AECC	Communication Skills	4	0	0	4
8			Open/Generic Elective (GE) - II	6	0	0	6
			TOTAL	**27 Credits**			

			SEMESTER III				
SN	**COURSE CODE**	**NATURE OF COURSE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1	BSMA211A	CC	Partial Differential Equations and Calculus of Variations	4	0	0	4
2	BSMA275A	SEC	Partial Differential Equations and Calculus of Variations Lab	0	0	4	2
3	BSMA213A	CC	Group Theory	5	1	0	6
4	BSMA215A	CC	Probability and Statistics	4	0	0	4
5	BSMA277A	SEC	Probability and Statistics Lab	0	0	2	1
6	BSCS109A	SEC	Data Analysis and Visualization	2	0	0	2
7	BSCS159A	SEC	Data Analysis and Visualization Lab	0	0	2	1
8		GEC	Generic Elective (GE) -III	-	--		-
9	MOOC003A	MOOC	Plastic Waste Management	2	-	-	2
			TOTAL	**22 + GE Credits**			

			SEMESTER IV				
SN	**COURSE CODE**	**NATURE OF COURSE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1	BSMA212A	CC	Advanced Algebra	5	1	0	6
2	BSMA214A	CC	Linear Algebra	5	1	0	6
3	BSMA216A	CC	Real Analysis	5	1	0	6
4	BSMA274A	SEC	Introduction to LaTeX	0	0	2	1
5		GEC	Generic Elective (GE) - IV	-	-	-	-
6	BSMA222A	AECC	Internship in Mathematics	2	-	-	2
7	VAC		VAC				
			TOTAL	**21 + GE Credits**			

			SEMESTER V				
SN	**COURSE CODE**	**NATURE OF COURSE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1	BSMA301A	CC	Numerical Analysis	4	0	0	4
2	BSMA371A	SEC	Numerical Analysis Lab	0	0	4	2
3	BSMA303A	CC	Set Theory and Metric Spaces	5	1	0	6
4		DSE	Discipline Specific Elective - I	-	-	-	6
5		DSE	Discipline Specific Elective - II	-	-	-	6
6	VAC		VAC				
			TOTAL	**24 Credits**			

			SEMESTER VI				
SN	**COURSE CODE**	**NATURE OF COURSE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1	BSMA302A	CC	Complex Analysis	4	0	0	4
2	BSMA372A	SEC	Complex Analysis Lab	0	0	4	2
3	BSMA304A	CC	Linear Programming	4	0	0	4
4	BSMA374A	SEC	Linear Programming Lab	0	0	4	2
5		DSE	Discipline Specific Elective - III	-	-	-	6
6	BSMA314A	DSE	Discipline Specific Elective- IV (Dissertation on any topic of Mathematics)	-	-	-	6
			TOTAL	**24 Credits**			

Total Credits [C]	**142 + Total GE Credits = 152-154**

			Discipline Specific Elective III (Choose any one)				
SN	**COURSE CODE**		**COURSE TITLE**	**L**	**T**	**P**	**C**
1	BSMA306A	DSE	Advanced Mechanics	5	1	0	6
2	BSMA308A	DSE	Wavelets and Applications	5	1	0	6
3	BSMA310A	DSE	Number Theory	5	1	0	6
4	BSMA312A	DSE	Cryptography	5	1	0	6
5	BSMA338A	DSE	Mathematical Modelling	5	1	0	6
6	BSCS113A	DSE	C++Programming for Mathematics	4	0	0	4
	BSCS167A	DSE	C++Programming for Mathematics Lab	0	0	4	2
7	BSMC671A	DSE	Mathematical Finance	5	1	0	6

Discipline Specific Electives

			Discipline Specific Elective I and II (Choose any two)				
SN	**COURSE CODE**	**NATURE OF COURSE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1	BSMA305A	DSE	Tensors and Differential Geometry	5	1	0	6
2	BSMA307A	DSE	Mathematical Logic	5	1	0	6
3	BSMA309A	DSE	Integral Transforms and Fourier Analysis	5	1	0	6
4	BSMA311A	DSE	Information Theory and Coding	5	1	0	6
5	BSMA313A	DSE	Graph Theory	5	1	0	6
6	BSMA315A	DSE	Special Theory of Relativity	5	1	0	6
7	BSMA327A	DSE	Dynamics	5	1	0	6

- Student may choose two non-credit courses, one in odd semester and one in even semester during the entire duration of Programme from the pool of courses provided by the university.

- Student may choose available MOOCs recommended by Dean Academics and approved by Vice Chancellor of K. R. Mangalam University, from the list of approved MOOCs by SWAYAM Board in each semester.

GENERIC ELECTIVES:-

Generic Elective III (Choose any one)							
1	BSMA329A	GEC	Discrete Mathematics	4	1	0	5
2	ETCS425A	GEC	Machine Learning	4	-	-	4
	ETCS455A	GEC	Machine Learning Lab	-	-	1	1
3	ETCS217A	GEC	Data Structures	4	0	0	4
	ETCS 257A	GEC	Data Structures Lab	0	0	2	1
4	SHES213A	GEC	Statistical Methods for Economics	5	1	0	6

Generic Elective IV (Choose any one)							
1	ETCS401A	GEC	Artificial Intelligence	3	1	0	4
	ETCS451A	GEC	Artificial Intelligence Lab	0	0	2	1
2	ETCS307A	GEC	DATABASE MANAGEMENT SYSTEMS	3	1	-	4
	ETCS 355A	GEC	DATABASE MANAGEMENT SYSTEMS LAB	-	-	2	1
3	ETCS 220A	GEC	Analysis and Design of Algorithms	4	0	0	4
	ETCS262A	GEC	Analysis and Design of Algorithms Lab	0	0	2	1
4	SHES216A	GEC	Econometrics	5	1	0	6

BSMA121A	CALCULUS	L	T	P	C
Version 3.0		4	0	0	4
Total Contact Hours	60 Hours				
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. To assimilate the notions of limit of a sequence and convergence of a series of real numbers.
2. To calculate the limit and examine the continuity of a function at a point.
3. To understand the consequences of various mean value theorems for differentiable functions.
4. Sketch curves in Cartesian and polar coordinate systems.
5. Apply derivative tests in optimization problems appearing in social sciences, physical sciences, life sciences and a host of other disciplines.

Course Outcomes

On completion of this course, the students will be able to

CO1. Applied the methods to test convergence/divergence of some basis series.
CO2. Appreciate how functions can be used to model situations such as population growth tides, vibrating springs, and gas emissions.
CO3. Recognize the rules of identifying asymptotes and employ the same to different curves.
CO4. Learn the concepts of curvature, circle of curvature and apply the concepts to solve problems.
CO5. Determine limits numerically, algebraically, and from a graph.
CO6. Apply the derivative to solve a variety of problems (related rates problems, optimization problems, curve sketching).

Catalog Description

Calculus is a transition course to upper-division mathematics and computer science courses. Students will extend their experience with functions as they study the fundamental concepts of calculus: limiting behaviors, derivatives, optimization, related rates, graphing and other applications of derivatives. Important objectives of the calculus sequence are to develop and strengthen the students' problem-solving skills and to teach them to read, write, speak, and think in the language of mathematics. In particular, students learn how to apply the tools of calculus to a variety of problem situations.

Course Content

Unit I: **14 lecture hours**

Sequences and Integration: Real numbers, Sequences of real numbers, Convergence of sequences and series, Bounded and monotonic sequences; Definite integral as a limit of sum, Integration of irrational algebraic functions and transcendental functions, Reduction formulae, Definite integrals.

Unit II: **15 lecture hours**

Limit and Continuity: $\epsilon - \delta$definition of limit of a real valued function, Limit at infinity and infinite limits; Continuity of a real valued function, Properties of continuous functions, Intermediate value theorem, Geometrical interpretation of continuity, Types of discontinuity; Uniform continuity.

Unit III: **17 lecture hours**

Differentiability: Differentiability of a real valued function, Geometrical interpretation of differentiability, Relation between differentiability and continuity, Differentiability and monotonicity, Chain rule of differentiation; Darboux's theorem, Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Geometrical interpretation of mean value theorems; Successive differentiation, Leibnitz's theorem.

Expansions of Functions: Maclaurin's and Taylor's theorems for expansion of a function in an infinite series, Taylor's theorem in finite form with Lagrange, Cauchy and Roche–Schlomilch forms of remainder; Maxima and minima.

Unit IV: **14 lecture hours**

Curvature, Asymptotes and Curve Tracing: Curvature; Asymptotes of general algebraic curves, Parallel asymptotes, Asymptotes parallel to axes; Symmetry, Concavity and convexity, Points of inflection, Tangents at origin, Multiple points, Position and nature of double points; Tracing of Cartesian, polar and parametric curves.

Textbooks

1. Gorakh Prasad (2016). *Differential Calculus* (19th edition). Pothishala Pvt. Ltd

Reference Books/Materials

1. Howard Anton, I. Bivens & Stephan Davis (2016). *Calculus* (10th edition). Wiley India.
2. Gabriel Klambauer (1986). *Aspects of Calculus*. Springer-Verlag.
3. WieslawKrawcewicz&Bindhyachal Rai (2003). *Calculus with Maple Labs*. Narosa.
4. George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. Weir (2018). *Thomas*' *Calculus* (14thedition). Pearson Education.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Applied the methods to test convergence/divergence of some basis series.	PO1
CO2	To calculate the limit and examine the continuity of a function at a point.	PO8
CO3	To understand the consequences of various mean value theorems for differentiable functions.	PO2
CO4	Sketch curves in Cartesian and polar coordinate systems.	PO4
CO5	Apply derivative tests in optimization problems appearing in social sciences, physical sciences, life sciences and a host of other disciplines.	PO3
CO6	To calculate the limit and examine the continuity of a function at a point.	PO1

	CALCULUS	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate software's to solve mathematical equations	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA 121A		2	3	3	2				2			3		3			2

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**2**										**3**	**2**	**1**	**1**	**2**	**2**
CO2								**2**			**3**	**2**	**1**	**1**	**2**	**2**
CO3		**3**									**3**	**2**	**1**	**1**	**2**	**2**
CO4				**2**							**3**	**2**	**1**	**1**	**2**	**2**
CO5			**3**								**3**	**2**	**1**	**1**	**2**	**2**
CO6	**3**										**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA171A	CALCULUS LAB	L	T	P	C
Version 1.0		0	0	4	2
Total Contact Hours	30 Hours				
Pre-requisites/Exposure					
Co-requisites	MATLAB software				

Course Objectives

1. Understand how to plot the graph of functions, polynomials and evolution of limit.
2. Learn how to trace conics in both coordinates system by MATLAB.
3. Understand how to plot of ellipsoid, hyperboloid by MATLAB.

Course Outcomes

On completion of this course, the students will be able to
CO1. Students learn by plotting graph of functions and polynomials of order 4 and 5.
CO2. Understanding of the evaluation limit and derivative by MATLAB
CO3. To skech the grapg of parametic curve, and obtained surface of revolution with MATLAB.
CO4. Students learn how to trace conics in Cartesian coordinates/polar coordinates by MATLAB.
CO5. To plot the graph of ellipsoid, hyperboloid of one and two sheets by MATLAB

Catalog Description

The purpose of these labs is to help students talk and write in meaningful ways about mathematics. Specifically to describe quantities and changes in quantities clearly in terms of context, to make rigorous arguments about how such quantities are related, and to make connections between these features in the contexts and on graphs

Course Content

List of practical

- Plotting the graphs of the functions $exp(ax+b), log(ax+b), 1/(ax+b), sin(ax+b),$ $cos(ax+b),$ and to illustrate the effect of a and b on the graph.
- Plotting the graphs of the polynomial of degree 4 and 5.
- Calculate the limit and derivative of above function.
- Sketching parametric curves (eg. Trochoid, cycloid, hypocycloid).
- Obtaining surface of revolution of curves.
- Tracing of conics in Cartesian coordinates/polar coordinates.
- Sketching ellipsoid, hyperboloid of one and two sheets (using Cartesian co-ordinates)

Textbooks

1. Lisa Oberbroeckling, Programming Mathematics Using MATLAB, Academic Press
2. Ronald L. Lipsman, Jonathan M. Rosenberg, Calculus with MATLAB: With Applications to Geometry and Physics, Springer International Publishing

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Conduct of Experiment	Attendance	Lab Record/ Quizzes/ Viva-Voice	End Term Practical Exam
Weightage (%)	**20**	**10**	**20**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Students learn by plotting graph of functions and polynomials of order 4 and 5.	**PO1,PO9**
CO2	Understanding of the evaluation limit and derivative by MATLAB	**PO2,PO10**
CO3	To skech the grapg of parametic curve, and obtained surface of revolution with MATLAB	**PO9**
CO4	Students learn how to trace conics in Cartesian coordinates/polar coordinates by MATLAB	**PO2,PO10**
CO5	To plot the graph of ellipsoid, hyperboloid of one and two sheets by MATLAB	**PO10**

	CALCULUS LAB	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate softwa re's to solve mathematical equations	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at countrywide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA		2	2							3	3	3	3	2		2	2

171 A																	

1= weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**								**2**		**3**	**2**	**1**	**1**	**2**	**2**
CO2		**3**								**2**	**3**	**2**	**1**	**1**	**2**	**2**
CO3									**3**		**3**	**2**	**1**	**1**	**2**	**2**
CO4		**3**								**2**	**3**	**2**	**1**	**1**	**2**	**2**
CO5										**3**	**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA123A	ALGEBRA AND GEOMETRY	L	T	P	C
Version 2.0		5	1	0	6
Total Contact Hours	90 Hours				
Pre-requisites/Exposure	Senior Secondary level knowledge of Algebra and Geometry				
Co-requisites	--				

Course Objectives

1. Understand the importance of roots of real and complex polynomials and learn various methods of obtaining roots.
2. Familiarize with relations, equivalence relations and partitions.
3. Employ De-Moivre's theorem in a number of applications to solve numerical problems.
4. Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, using rank.
5. Find eigenvalues and corresponding eigenvectors for a square matrix.
6. Explain the properties of three dimensional shapes.

Course Outcomes

On completion of this course, the students will be able to

CO1. Remember and understand important concepts of number system, matrices and geometry.

CO2. Apply these concepts on interrelated topics such as image processing, Cryptography and many more.

CO3. Analyze and evaluate results of problems based on algebra and geometry.

CO4. Formulate and solve problems with the help of models.

CO5. Compare different geometrical shapes.

CO6. Design various geometrical figures.

Catalog Description

This course imparts the basic concepts of algebra and geometry. It enables them to differentiate between real and imaginary numbers. This course helps students in variety of ways to solve the problem efficiently. The course introduces the basic concepts about number system, matrices and geometry. It also discusses about daily problems like one dimensional figure, two dimensional figures.

Course Content

Unit I: **22 lecture hours**

Theory of Equations and Complex Numbers: Elementary theorems on the roots of an equations including Cardan's method, The remainder and factor theorems, Synthetic division, Factored form of a polynomial, The Fundamental theorem of algebra, Relations between the roots and the coefficients of polynomial equations, Imaginary roots, Integral and rational roots; Polar representation of complex numbers, The n^{th} roots of unity, De-Moivre's theorem for integer and rational indices and its applications.

Unit II: **22 lecture hours**

Relations and Basic Number Theory: Relations, Equivalence relations, Equivalence classes; Functions, Composition of functions, Inverse of a function; Finite, countable and uncountable sets; The division algorithm, Divisibility and the Euclidean algorithm, The fundamental theorem of arithmetic, Modular arithmetic and basic properties of congruences; Principles of mathematical induction and well ordering.

Unit III: **23 lecture hours**

Row Echelon Form of Matrices and Applications: Systems of linear equations, Row reduction and echelon forms, Linear independence, The rank of a matrix and applications; Introduction to linear transformations, The matrix of a linear transformation, Matrix operations, Determinants, The inverse of a matrix, Characterizations of invertible matrices; Applications to Computer Graphics; Eigenvalues and eigenvectors, The characteristic equation and the Cayley-Hamilton theorem.

Unit IV: **23 lecture hours**

Planes, Straight Lines and Spheres: Planes-Distance of a point from a plane, Angle between two planes, pair of planes, Bisectors of angles between two planes; Straight lines-Equations of straight lines, Distance of a point from a straight line, Distance between two straight lines, Distance between a straight line and a plane; Spheres- Different forms, Intersection of two spheres, Orthogonal intersection, Tangents and normal, Radical plane, Radical line, Coaxial system of spheres, Pole, Polar and Conjugacy.

Locus, Surfaces, Curves and Conicoids: Space curves, Algebraic curves, Ruled surfaces, Some standard surfaces, Classification of quadric surfaces, Cone, Cylinder, Central conicoids, Tangent plane, Normal, Polar planes, and Polar lines.

Textbooks

1. Titu Andreescu, & Dorin Andrica (2014). Complex Numbers from A to...Z. (2nd edition). Birkhäuser.
2. Robert J. T. Bell (1994). An Elementary Treatise on Coordinate Geometry of Three Dimensions. Macmillan India Ltd.
3. D. Chatterjee (2009). Analytical Geometry: Two and Three Dimensions. Narosa Publishing House.
4. Leonard Eugene Dickson (2009). First Course in the Theory of Equations. The Project Gutenberg EBook (http://www.gutenberg.org/ebooks/29785)
5. Edgar G. Goodaire & Michael M. Parmenter (2015). Discrete Mathematics with Graph Theory (3rd edition). Pearson Education Pvt. Ltd. India.
6. Bernard Kolman & David R. Hill (2003). Introductory Linear Algebra with Applications (7th edition). Pearson Education Pvt. Ltd. India.
7. David C. Lay, Steven R. Lay & Judi J. McDonald (2016). Linear Algebra and its Applications (5th edition). Pearson Education Pvt. Ltd. India.

Reference Books/Materials

1. Schaum's outline series, "Linear Algebra", McGraw Hills.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Remember and understand important concepts of number system, matrices and geometry	**PO1,PO2,PO7**
CO2	Apply these concepts on interrelated topics such as image processing, Cryptography and many more.	**PO5,PO2,PO7**
CO3	Analyze and evaluate results of problems based on algebra and geometry	**PO8,PO2,PO7**
CO4	Formulate and solve problems with the help of models	**PO4,PO2,PO7**
CO5	Compare different geometrical shapes.	**PO4,PO7**
CO6	Design various geometrical figures.	**PO4,PO7**

	ALGEBRA AND GEOMETRY	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA123A		1	3		3	1		3	3			3	3	3	3	3	3

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**	**3**					**2**				**3**	**2**	**1**	**1**	**2**	**2**
CO2		**3**			**2**		**2**				**3**	**2**	**1**	**1**	**2**	**2**
CO3		**3**					**2**	**2**			**3**	**2**	**1**	**1**	**2**	**2**
CO4		**3**		**2**			**2**				**3**	**2**	**1**	**1**	**2**	**2**
CO5				**3**			**2**				**3**	**2**	**1**	**1**	**2**	**2**
CO6				**2**			**2**				**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

UCES125A	ENVIRONMENTAL STUDIES	L	T	P	C
Version 2.0		3	0	0	3
Total Contact Hours	45 Hours				
Pre-requisites/Exposure	Basics of Environment				
Co-requisites	--				

Course Objectives

1. To aware the students about the environment.
2. To learn the students concepts and methods from ecological and physical sciences and their application in environmental problem solving.
3. To think across and beyond existing disciplinary boundaries, mindful of the diverse forms of knowledge and experience that arise from human interactions with the world around them.
4. communicate clearly and competently matters of environmental concern and understanding to a variety of audiences in appropriate forms.

Course Outcomes

On completion of this course, the students will be able to

CO1. To comprehend and become responsive regarding environmental issues.
CO2. 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.
CO3. Enable the students to discuss their concern at national and international level with respect to formulate protection acts and sustainable developments policies.
CO4. To know that the rapid industrialization, crazy consumerism and over-exploitation of natural resources have resulted in degradation of earth at all levels.
CO5. Become consciousness about healthy and safe environment.

Catalog Description

This course imparts the basic concepts of environment which enable them to solve basic problems related to their surroundings. This course helps them to get an idea adverse effect of industrialization, population and degradation of natural resources on the environment. The course introduces the concepts of renewable and non-renewable resources.

Course Content

UNIT I **10 Lectures**

Environment and Natural Resources:
Multidisciplinary nature of environmental sciences; Scope and importance; Need for public awareness. Land resources; land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).
Energy resources: Renewable and non- renewable energy sources, use of alternate energy sources, growing energy needs, case studies. Carbon Footprints.

UNIT II **14 Lectures**

Ecosystems and Biodiversity:
Ecosystem: Definition and Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession.
Case studies of the following ecosystems:
a) Forest ecosystem
b) Grassland ecosystem
c) Desert ecosystem
d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots ; India as a mega-biodiversity nation; Endangered and endemic species of India; Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity; Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

UNIT III **10 Lectures**

Environmental Pollution and Environmental Policies:
Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution Nuclear hazards and human health risks; Solid waste management: Control measures of urban and industrial waste; Pollution case studies.

Sustainability and sustainable development; Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture; Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context. Fundamentals and Application of ESG (Environment Social Governance).

UNIT IV **11 Lectures**

Human Communities and the Environment and Field work:
Human population growth: Impacts on environment, human health and welfare; Resettlement and rehabilitation of project affected persons; case studies; Disaster management: floods, earthquake, cyclones and landslides; Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan; Environmental ethics: Role of Indian and other religions and cultures in evironmental conservation; Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.
Study of common plants, insects, birds and basic principles of identification.
Study of simple ecosystems-pond, river, Delhi Ridge, etc.

Textbooks

1. Kaushik and Kaushik, Environmental Studies, New Age International Publishers (P) Ltd. New Delhi.

Reference Books/Materials

1. A.K. De, Environmental Chemistry, New Age International Publishers (P) Ltd. New Delhi.
2. S.E. Manahan, Environmental Chemistry, CRC Press.
3. S.S Dara and D.D. Mishra, Environmental Chemistry and Pollution Control, S.Chand & Company Ltd, New Delhi.
4. R. Gadi, S. Rattan, S. Mohapatra, Environmental Studies Kataria Publishers, New Delhi.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	The learners will be able to comprehend and become responsive regarding environmental issues.	**PO2**
CO2	Students 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.	**PO6**
CO3	It enables the students to discuss their concern at national and international level with respect to formulate protection acts and sustainable developments policies.	**PO7**
CO4	Students come to know that the rapid industrialization, crazy consumerism and over-exploitation of natural resources have resulted in degradation of earth at all levels.	**PO4**
CO5	Students become consciousness about healthy and safe environment.	**PO1**

	ENVIRONMENTAL STUDIES	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at countrywide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
UCES 125 A		3	3		1		3	2							3		3

1=weakly mapped
2= moderately mapped
3=strongly mapped

UCDM301A	DISASTER MANAGEMENT	L	T	P	C
Version 1.0		3	0	0	3
Total Contact Hours	45 Hours				
Pre-requisites/Exposure	Basics of disasters and control techniques				
Co-requisites	--				

Course Objectives

1. To create awareness about various types of disasters.
2. To educate the students about basic disaster management strategies and problem solving.
3. To examine disaster profile of our country and illustrates the role of governmental and non- governmental organizations in its effective management.
4. To acquaints students with the existing legal framework for disaster management and understanding the appropriate rules and regulations.

Course Outcomes

On completion of this course, the students will be able to

CO1. To enable the students to know the difference between natural and man- made disaster

CO2. Acquire the knowledge related to disaster preparedness.

CO3. To aware the student about recovery after disaster

CO4. To know the structure and functioning of disaster management framework of our country

CO5. To provide the knowledge about disaster management act

Catalog Description

This course imparts the basic concepts of environment which enable them to solve basic problems related to their surroundings. This course helps them to get an idea adverse effect of industrialization, population and degradation of natural resources on the environment. The course introduces the concepts of renewable and non-renewable resources.

Course Content

UNIT I **12 Lectures**

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.

UNIT- II **10 Lectures**

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

UNIT III **12 Lectures**

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.

UNIT IV **11 Lectures**

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. Applications of AI and ML in Disaster Management and risk predictions.

Textbooks

1. Content building programme (CBP) book on Disaster Management, Forum AS.

Reference Books/Materials

1. Government of India, Department of Environment, Management of Hazardous Substances Control
2. Act and Structure and Functions of Authority Created Thereunder.
3. Indian Chemical Manufacturers' Association & Loss Prevention Society of India, Proceedings of the National Seminar on Safety in Road Transportation of Hazardous Materials: (1986).
4. Author Title Publication Dr. Mrinalini Pandey Disaster Management Wiley India Pvt. Ltd.
5. Tushar Bhattacharya Disaster Science and Management McGraw Hill Education (India) Pvt. Ltd.
6. Jagbir Singh Disaster Management: Future Challenges and Opportunities K W Publishers Pvt. Ltd.
7. J. P. Singhal Disaster Management Laxmi Publications.
8. Shailesh Shukla, Shamna Hussain Biodiversity, Environment and Disaster Management Unique Publications
9. C. K. Rajan, Navale Pandharinath Earth and Atmospheric Disaster Management: Nature and Manmade B S Publication
10. Indian law Institute (Upendra Baxi and Thomas Paul (ed.), Mass Disasters and Multinational Liability: The Bhopal Case (1986)
11. Indian Law Institute, Upendra Baxi (ed.), Environment Protection Act: An Agenda for Implementation (1987)
12. Asian Regional Exchange for Prof. Baxi., Nothing to Lose But our Lives: Empowerment to Oppose
13. Industrial Hazards in a Transnational world (1989)
14. Gurudip Singh, Environmental Law: International and National Perspectives (1995), Lawman (India) Pvt. Ltd.
15. Leela Krishnan, P, The Environmental Law in India, Chapters VIII, IX and X (1999), Butterworths, New Delhi.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO 1	To enable the students to know the difference between natural and man- made disaster	PO1
CO 2	Acquire the knowledge related to disaster preparedness	PO4
CO 3	To aware the student about recovery after disaster	PO2
CO 4	To know the structure and functioning of disaster management framework of our country	PO6
CO 5	To provide the knowledge about disaster management act	PO7

	DISASTER MANAGEMENT	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
UCDM 301A		2	2		2		3	3							3		3

1=weakly mapped 2= moderately mapped 3=strongly mapped

SEMESTER II

BSMA122A	MULTIVARIABLE CALCULUS	L	T	P	C
Version 2.0		4	0	0	4
Total Contact Hours	60 Hours				
Pre-requisites/Exposure					
Co-requisites	MATLAB				

Course Objectives

The goal of this course is to see that many quantitates in various scientific fields depend on more than one variable: the strength of the gravitational force between two bodies depends on their masses and their distance apart; the monthly mortgage payments depend on the amount borrowed, the interest rate, and the number of years to pay off. Then we will see many different ways of representing functions of several variables including algebraic formulas, graphs, contour diagrams, cross sections, and numerical tables.

Course Outcomes

On completion of this course, the students will be able to

1. Learn conceptual variations while advancing from one variable to several variables in calculus.
2. Apply multivariable calculus in optimization problems.
3. Inter-relationship amongst the line integral, double and triple integral formulations
4. Apply the partial differentiation in Functions of several variables
5. Applications of multivariable calculus tools in physics, economics, optimization, and understanding the architecture of curves and surfaces in plane and space etc.
6. Realize importance of Green, Gauss and Stokes' theorems in other branches of mathematics.

Catalog Description

Calculus is a transition course to upper-division mathematics and computer science courses. Students will extend their experience with functions as they study the fundamental concepts of calculus: limiting behaviors, derivatives, optimization, related rates, graphing and other applications of derivatives. Important objectives of the calculus sequence are to develop and strengthen the students' problem-solving skills and to teach them to read, write, speak, and think in the language of mathematics. In particular, students learn how to apply the tools of calculus to a variety of problem situations.

Course Content

Unit I: **15 lecture hours**

Partial Differentiation: Functions of several variables, Level curves and surfaces, Limits and continuity, Partial differentiation, Tangent planes, Chain rule, Directional derivatives, The gradient, Maximal and normal properties of the gradient, Tangent planes and normal lines.

Unit II: **14 lecture hours**

Differentiation: Higher order partial derivatives, Total differential and differentiability, Jacobians, Change of variables, Euler's theorem for homogeneous functions, Taylor's theorem for functions of two variables and more variables, Envelopes and evolutes.

Unit III: **16 lecture hours**

Extrema of Functions and Vector Field: Extrema of functions of two and more variables, Method of Lagrange multipliers, Constrained optimization problems, Definition of vector field, Divergence, curl, gradient and vector identities.

Double and Triple Integrals: Double integration over rectangular and nonrectangular regions, Double integrals in polar co-ordinates, Triple integral over a parallelepiped and solid regions, Volume by triple integrals, Triple integration in cylindrical and spherical coordinates, Change of variables in double and triple integrals, Drichlet integral.

Unit IV: **15 lecture hours**

Green's, Stokes' and Gauss Divergence Theorem: Line integrals, Applications of line integrals**:** Mass and Work, Fundamental theorem for line integrals, Conservative vector fields, Green's theorem, Area as a line integral, Surface integrals, Stokes' theorem, The Gauss divergence theorem.

Textbooks

Gorakh Prasad (2016). *Differential Calculus* (19th edition). Pothishala Pvt. Ltd

References:

1. Jerrold Marsden, Anthony J. Tromba & Alan Weinstein (2009). *Basic MultivariableCalculus*, Springer India Pvt. Limited.
2. James Stewart (2012). *Multivariable Calculus* (7th edition). Brooks/Cole. Cengage.
3. Monty J. Strauss, Gerald L. Bradley & Karl J. Smith (2011). *Calculus* (3rd edition). Pearson Education. Dorling Kindersley (India) Pvt. Ltd.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Learn conceptual variations while advancing from one variable to several variables in calculus.	**PO1**
CO2	Apply multivariable calculus in optimization problems.	**PO8**
CO3	Inter-relationship amongst the line integral, double and triple integral formulations	**PO2**
CO4	Apply the partial differentiation in Functions of several variables	**PO4**
CO5	Applications of multivariable calculus tools in physics, economics, optimization, and understanding the architecture of curves and surfaces in plane and space etc.	**PO3**
CO6	Realize importance of Green, Gauss and Stokes' theorems in other branches of mathematics	**PO1**

		Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate softwar e's to solve mathematical equations	Capable to use appropriate softwar e's to solve mathematical equations	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA 122A		2	3	3	2				2				2	3			2

1=weakly mapped

2= moderately mapped

3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**										**3**	**2**	**1**	**1**	**2**	**2**
CO2								**3**			**3**	**2**	**1**	**1**	**2**	**2**
CO3		**3**									**3**	**2**	**1**	**1**	**2**	**2**
CO4				**2**							**3**	**2**	**1**	**1**	**2**	**2**
CO5			**3**								**3**	**2**	**1**	**1**	**2**	**2**
CO6	**3**										**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA 172 A	MULTIVARIABLE CALCULUS LAB	L	T	P	C
Version 1.0		0	0	4	2
Total Contact Hours	30 Hours				
Pre-requisites/Exposure					
Co-requisites	MATLAB / Mathematica / Maple software				

Course Objectives

1. Understand the evaluation of multiple integrals, volume of closes curve, arc length,Crical point and saddle point.
2. Learn how to evaluate dot product, cross product, gradient, Divergence and curl by MATLAB.
3. Learn how to solve partial differentiation by by MATLAB.

Course Outcomes

On completion of this course, the students will be able to

CO1. Students learn analysis of multivariable functions, continuity, and differentiability.

CO2. Understanding of the evaluation of multiple integrals by MATLAB

CO3. To calculate volume of closes curve, arc length, Crical point and saddle point with MATLAB

CO4. Students learn analysis of dot product, cross product, gradient, Divergence and curl by by MATLAB.

CO5.To calculate partial derivatives and higher order of derivative by MATLAB.

Catalog Description

The purpose of these labs is to help students talk and write in meaningful ways about mathematics. Specifically, to describe quantities and changes in quantities clearly in terms of context, to make rigorous arguments about how such quantities are related, and to make connections between these features in the contexts and on graphs.

Course Content

List of practical

Modelling of the following problems using MATLAB / Mathematica / Maple etc.

- Evaluate the integration of the function
- Evaluate the double/ triple integral integration of the function
- Evaluate the area of closed curve
- Evaluate the arc length of curve
- Evaluate the Volume of closed curve

- Find the critical points and use Mathematica to graph the surface and determine the max/min/saddle nature of these points.
- Calculate the dot and cross product of vectors
- Calculate the Gradient of a vector, Divergence and Curl of vector

Textbooks

1. Lisa Oberbroeckling, Programming Mathematics Using MATLAB, Academic Press
2. Ronald L. Lipsman, Jonathan M. Rosenberg, Multivariable Calculus with MATLAB: With Applications to Geometry and Physics, Springer International Publishing

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Conduct of Experiment	Attendance	Lab Record/ Quizzes/ Viva-Voice	End Term Practical Exam
Weightage (%)	**20**	**10**	**20**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Students learn analysis of multivariable functions, continuity, and differentiability	**PO1,PO9**
CO2	Understanding of the evaluation of multiple integrals by MATLAB	**PO2, PO10**
CO3	To calculate volume of closes curve, arc length,Crical point and saddle point with MATLAB	**PO2, PO9**
CO4	Students learn analysis of dot product, cross product, gradient, Divergence and curl by MATLAB	**PO9**
CO5	To calculate partial derivatives and higher order of derivative by MATLAB	**PO10**

	MULTIVARIABLE CALCULUS LAB	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate software's to solve mathematical equations	Capable to use appropriate software's to solve mathematical equations	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA 172A		2	2							3	3	2	3	2		3	2

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**								**2**		**3**	**2**	**1**	**1**	**2**	**2**
CO2		**2**								**2**	**3**	**2**	**1**	**1**	**2**	**2**
CO3		**3**							**2**		**3**	**2**	**1**	**1**	**2**	**2**
CO4									**3**		**3**	**2**	**1**	**1**	**2**	**2**
CO5										**2**	**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA124A	ORDINARY DIFFERENTIAL EQUATIONS	L	T	P	C
Version 2.0		4	0	0	4
Total Contact Hours	60 Hours				
Pre-requisites/Exposure	Differentiation, Integration				
Co-requisites	--				

Course Objectives

1 Identify, analyse and subsequently solve physical situations whose behaviour can be described by ordinary differential equations

2 Enhance and develop the ability of using the language of mathematics in analyzing the real-world problems of sciences and engineering.

3 Demonstrate the strength of mathematics in modelling and simulating real world problems of science and engineering.

Course Outcomes

On completion of this course, the students will be able to

CO1 Understand the genesis of ordinary differential equations.

CO2 Learn various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order.

CO3 Know Picard's method of obtaining successive approximations of solutions of first order differential equations, passing through a given point in the plane and Power series method for higher order linear equations, especially in cases when there is no method available to solve such equations.

CO4 Grasp the concept of a general solution of a linear differential equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations.

CO5 Analyse mathematical models using first order differential equations to solve application problems such as circuits, mixture problems, population modeling, orthogonal trajectories, and slope fields.

CO6 Formulate mathematical models in the form of ordinary differential equations to suggest possible solutions of the day-to-day problems arising in physical, chemical and biological disciplines.

Catalog Description

In this introductory course on Ordinary Differential Equations, we first provide basic terminologies on the theory of differential equations and then proceed to methods of solving various types of ordinary differential equations. We handle first and second order differential equations and then higher order linear differential equations. The course demonstrates the usefulness of ordinary differential equations for modelling physical, biological, financial or economic problems. The ability to predict the way in which these systems evolve or behave is determined by modelling these systems and find solutions of the equations explicitly or approximately. The course includes complementary mathematical approaches for their solution, including analytical methods, graphical analysis and numerical techniques. A significant part of the course is emphasis on solving linear systems with computer software as a mathematical tool.

Course Content

UNIT-I **14 Lectures**

First Order Differential Equations: Basic concepts and genesis of ordinary differential equations, Order and degree of a differential equation, Differential equations of first order and first degree, Equations in which variables are separable, Homogeneous equations, Linear differential equations and equations reducible to linear form, Exact differential equations, Integrating factor, First order higher degree equations solvable for x, y and p. Clairaut's form and singular solutions. Picard's method of successive approximations and the statement of Picard's theorem for the existence and uniqueness of the solutions of the first order differential equations.

UNIT-II **14 Lectures**

Second Order Linear Differential Equations: Statement of existence and uniqueness theorem for linear differential equations, General theory of linear differential equations of second order with variable coefficients, Solutions of homogeneous linear ordinary differential equations of second order with constant coefficients, Transformations of the equation by changing the dependent/independent variable, Method of variation of parameters and method of undetermined coefficients, Reduction of order, Coupled linear differential equations with constant coefficients.

UNIT-III **17 Lectures**

Higher Order Linear Differential Equations: Principle of superposition for a homogeneous linear differential equation, Linearly dependent and linearly independent solutions on an interval, Wronskian and its properties, Concept of a general solution of a linear differential equation, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler-Cauchy equation, Method of variation of parameters and method of undetermined coefficients, Inverse operator method.

UNIT-IV **15 Lectures**

Series Solutions of Differential Equations: Power series method, Legendre's equation, Legendre polynomials, Rodrigue's formula, Orthogonality of Legendre polynomials, Frobenius method, Bessel's equation, Bessel functions and their properties, Recurrence relations.

Applications: Orthogonal trajectories, Acceleration-velocity model, Minimum velocity of escape from Earth's gravitational field, Growth and decay models, Malthusian and logistic population models, Radioactive decay, Drug assimilation into the blood of a single cold pill; Free and forced mechanical oscillations of a spring suspended vertically carrying a mass at its lowest tip, Phenomena of resonance, LCR circuits, Lotka-Volterra population model.

Reference Books/Materials

1. Belinda Barnes & Glenn Robert Fulford (2015). *Mathematical Modelling with Case Studies***:** *A Differential Equation Approach Using* Maple *and* MATLAB (2nd edition). Chapman & Hall/CRC Press, Taylor & Francis.
2. H. I. Freedman (1980). *Deterministic Mathematical Models in Population Ecology*. Marcel Dekker Inc.
3. Erwin Kreyszig (2011). *Advanced Engineering Mathematics* (10th edition). Wiley.
4. Daniel A. Murray (2003). *Introductory Course in Differential Equations*, Orient.
5. B. Rai, D. P. Choudhury & H. I. Freedman (2013). *A Course in Ordinary Differential Equations* (2nd edition). Narosa.
6. Shepley L. Ross (2007). *Differential Equations* (3rd edition), Wiley India.
7. George F. Simmons (2017). *Differential Equations with Applications and Historical Notes* (3rd edition). CRC Press. Taylor & Francis.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand the genesis of ordinary differential equations.	**PO7**
CO2	Learn various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order.	**PO1**
CO3	Know Picard's method of obtaining successive approximations of solutions of first order differential equations, passing through a given point in the plane and Power series method for higher order linear equations, especially in cases when there is no method available to solve such equations.	**PO2**
CO4	Grasp the concept of a general solution of a linear differential equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations.	**PO4**
CO5	Analyze mathematical models using first order differential equations to solve application problems such as circuits, mixture problems, population modeling, orthogonal trajectories, and slope fields.	**PO8**
CO6	Formulate mathematical models in the form of ordinary differential equations to suggest possible solutions of the day-to-day problems arising in physical, chemical and biological disciplines.	**PO3**

	ORDINARY DIFFERENTIAL EQUATIONS	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA 124A		1	1	3	2			2	3			3			1		3

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1							**3**				**3**	**2**	**1**	**1**	**2**	**2**
CO2	**3**										**3**	**2**	**1**	**1**	**2**	**2**
CO3		**3**									**3**	**2**	**1**	**1**	**2**	**2**
CO4				**2**							**3**	**2**	**1**	**1**	**2**	**2**
CO5								**2**			**3**	**2**	**1**	**1**	**2**	**2**
CO6			**3**								**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA174A	ORDINARY DIFFERENTIAL EQUATIONS LAB	L	T	P	C
Version 2.0		0	0	4	2
Total Contact Hours	30 Hours				
Pre-requisites/Exposure					
Co-requisites	MATLAB SOFTWARE				

Course Objectives

The purpose of these labs is to help students talk and write in meaningful ways about mathematics. Specifically, to describe quantities and changes in quantities clearly in terms of context, to make rigorous arguments about how such quantities are related, and to make connections between these features in the contexts and on graphs.

Course Outcomes

On completion of this course, the students will be able to

CO1. Test program output for accuracy using hand calculations and plotting the different type of the differential equation graphs

CO2. Analyses the applicability solve of second order differential equation and find the double and triple integration of function

CO3. Find and evaluate the area of closed curve and arc length.

CO4. To draw two- and three-dimensional graph.

CO5. Write efficient, well-documented MATLAB code and present numerical results in an informative way of different real-life problems.

Catalog Description

The aim of this course is to learn theory of ordinary differential equations and solution methods. Use knowledge of Ordinary Differential Equations (ODEs), modelling, the general structure of solutions, and analytic and numerical methods for solution. Nature of ODEs.. After completion of the course, the students will be able to solve the ODEs independently. They can solve PDEs in higher dimension. Convert ordinary differential equations to canonical form.

Course Content

List of practical

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

NOTE: Ten experiments are to be performed, out of which at least seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & setup by the concerned person as per the scope of the syllabus.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Conduct of Experiment	Attendance	Lab Record/ Quizzes/ Viva-Voice	End Term Practical Exam
Weightage (%)	**20**	**10**	**20**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Test program output for accuracy using hand calculations and plotting the different type of the differential equation graphs	**PO9**
CO2	Analyses the applicability solve of second order differential equation and find the double and triple integration of function	**PO9**
CO3	Find the evaluate the area of closed curve and arc length	**PO9**
CO4	The ability to draw two- and three-dimensional graph.	**PO9**
CO5	Write efficient, well-documented MATLAB code and present numerical results in an informative way of different real-life problems.	**PO9**

	ORDINARY DIFFERENTIAL EQUATIONS LAB	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA174A										3	3	3	3	2	3	3	

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1									**3**		**3**	**2**	**1**	**1**	**2**	**2**
CO2									**3**		**3**	**2**	**1**	**1**	**2**	**2**
CO3									**2**		**3**	**2**	**1**	**1**	**2**	**2**
CO4									**2**		**3**	**2**	**1**	**1**	**2**	**2**
CO5									**3**		**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

ETCS 104A	INTRODUCTION TO COMPUTER SCIENCE AND PROGRAMMING IN PYTHON	L	T	P	C
Version 1.0		**3**	**1**	**0**	**4**
Total Contact Hours	**60 Hours**				
Pre-requisites/Exposure	**--**				
Co-requisites	**--**				

Course Objectives

- Provide an understanding of the role computation can play in solving problems.
- Help students, including those who do not plan to major in Computer Science and Electrical Engineering, feel confident of their ability to write small programs that allow them to accomplish useful goals.
- Position students so that they can compete for research projects and excel in subjects with programming components.

Course Outcomes

On completion of this course, the students will be able to

CO1. Develop solutions to simple computational problems using Python programs.

CO2. Solve problems using conditionals and loops in Python. Develop Python programs by defining functions and calling them.

CO3. Use Python lists, tuples and dictionaries for representing compound data.

CO4. Develop Python programs using files.

Catalog Description

Introduction to Computers and Programming in Python is intended for students with little or no programming experience. It aims to provide students with an understanding of the role computation can play in solving problems and to help students, regardless of their major, feel justifiably confident of their ability to write small programs that allow them to accomplish useful goals. The class will use the Python 3.5 programming language.

Course Content

UNIT I **15 Lectures**

Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)

Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart / Pseudo code with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code

UNIT II **15 Lectures**

Introduction to Python: The basic elements of python, Branching Programs, Control Structures, Strings and Input, Iteration, String Manipulation, Guess and Check, Approximations, Bisection, Functions, Scoping and Abstraction: Functions and scoping, Specifications, Recursion, Global variables, Modules, Files

Unit III **16 Lectures**

Classes and Object: Oriented Programming: Abstract Data Types and Classes, Inheritance, Encapsulation and Information Hiding, Handling Exceptions, Decorators

Unit IV **14 Lectures**

Simple Algorithms and Data structures: File Handling, Search Algorithms, Sorting, Algorithms, Hash Tables,

TEXTBOOKS:

1. John V Guttag. "Introduction to Computation and Programming Using Python", Prentice Hall of India

Reference Books

1. R. Nageswara Rao, "Core Python Programming", Dreamtech
2. Wesley J. Chun. "Core Python Programming, Second Edition", Prentice Hall
3. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley
4. Kenneth A. Lambert, "Fundamentals of Python,First Programs", CENGAGE Publication

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz I	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Develop solutions to simple computational problems using Python programs.	**PO1, PO9**
CO2	Solve problems using conditionals and loops in Python. Develop Python programs by defining functions and calling them.	**P01, PO8**
CO3	Use Python lists, tuples and dictionaries for representing compound data.	**PO3**
CO4	Develop Python programs using files.	**PO1,PO7,PO9**

	INTRODUCTION TO COMPUTERS AND PROGRAMMING IN PYHTON	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate softwar e's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSCS 104A		3		3				1	3	3			1			1	2

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**										**3**	**2**	**1**	**1**	**2**	**2**
CO2	**3**							**2**			**3**	**2**	**1**	**1**	**2**	**2**
CO3			**3**								**3**	**2**	**1**	**1**	**2**	**2**
CO4	**3**						**2**		**2**		**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

ETCS 150A	INTRODUCTION TO COMPUTER SCIENCE AND PROGRAMMING IN PYTHON LAB	L	T	P	C
Version 1.0		**0**	**0**	**2**	**1**
Total Contact Hours	**22 Hours**				
Pre-requisites/Exposure	**--**				
Co-requisites	**--**				

Course Objectives

- Provide an understanding of the role computation can play in solving problems.
- Help students, including those who do not plan to major in Computer Science and Electrical Engineering, feel confident of their ability to write small programs that allow them to accomplish useful goals.
- Position students so that they can compete for research projects and excel in subjects with programming components.

Course Outcomes

On completion of this course, the students will be able to

CO1. Develop solutions to simple computational problems using Python programs.

CO2. Solve problems using conditionals and loops in Python. Develop Python programs by defining functions and calling them.

CO3. Use Python lists, tuples and dictionaries for representing compound data.

CO4. Develop Python programs using files.

Catalog Description

Introduction to Computers and Programming in Python is intended for students with little or no programming experience. It aims to provide students with an understanding of the role computation can play in solving problems and to help students, regardless of their major, feel justifiably confident of their ability to write small programs that allow them to accomplish useful goals. The class will use the Python 3.5 programming language.

Course Content

LIST OF EXPERIMENTS

1	Develop programs to understand the control structures of python	**2 lab hours**
2	Develop programs to implement list	**2 lab hours**
3	Develop programs to implement Dictionary	**2 lab hours**
4	Develop programs to implement tuples	**2 lab hours**
5	Develop programs to implement function with stress on scoping	**2 lab hours**
6	Develop programs to implement classes and objects	**2 lab hours**
7	Develop programs to implement exception handling	**2 lab hours**
8	Develop programs to implement linear search and binary search	**2 lab hours**
9	Develop programs to implement insertion sort	**2 lab hours**
10	Develop programs to implement bubble sort	**2 lab hours**
11	Develop programs to implement quick sort	**2 lab hours**

TEXTBOOKS:

John V Guttag. "Introduction to Computation and Programming Using Python", Prentice Hall of India

Reference Books

1 R. Nageswara Rao, "Core Python Programming", Dreamtech
2 Wesley J. Chun. "Core Python Programming, Second Edition", Prentice Hall
3 Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley
4 Kenneth A. Lambert, "Fundamentals of Python,First Programs", CENGAGE Publication

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Conduct of Experiment	Attendance	Lab Record/ Quizzes/ Viva-Voice	End Term Practical Exam
Weightage (%)	**20**	**10**	**20**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Develop solutions to simple computational problems using Python programs.	**PO1, PO9**
CO2	Solve problems using conditionals and loops in Python. Develop Python programs by defining functions and calling them.	**P01, PO8**
CO3	Use Python lists, tuples and dictionaries for representing compound data.	**PO3**
CO4	Develop Python programs using files.	**PO1,PO7,PO9**

	INTRODUCTION TO COMPUTERS AND PROGRAMMING IN PYTHON LAB	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BS CS 150 A		3		3				1	3	3			1			1	2

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**										**3**	**2**	**1**	**1**	**2**	**2**
CO2	**3**							**2**			**3**	**2**	**1**	**1**	**2**	**2**
CO3			**3**								**3**	**2**	**1**	**1**	**2**	**2**
CO4	**3**						**2**		**2**		**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

UCCS 155A	COMMUNICATION SKILLS	L	T	P	C
Version 2.0		4	0	0	4
Total Contact Hours	60 Hours				
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

1. Understand the basics of Grammar to improve written and oral communication skills.
2. Understand the correct form of English with proficiency
3. Improve student's personality and enhance their self-confidence.
4. Improve professional communication.
5. Enhance academic writing skills.

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand the basics of Grammar to improve written and oral communication skills
CO2. Understand the correct form of English with proficiency
CO3. Improve student's personality and enhance their self-confidence
CO4. Improve professional communication
CO5. Enhance academic writing skills

Catalog Description

This learning program with its practice-based learning tasks will facilitate the learners to enhance their communication skills in a modern and globalized context, enhance their linguistic and communicative competence and hone their interpersonal skills.

Course Content

UNIT I **12 lecture hours**

Introduction to Communication: Importance of Communication Skills, Meaning, Forms & Types of Communication; Process of Communication; Principles of Effective Communication/7Cs, Barriers in Communication (Interpersonal, Intrapersonal and Organizational).

UNIT II **12 lecture hours**

Academic Writing: Précis (Summary – Abstract – Synopsis – Paraphrase – Précis: Methods), Letter & Résumé (Letter Structure & Elements – Types of letter: Application & Cover - Acknowledgement – Recommendation – Appreciation – Acceptance – Apology – Complaint –Inquiry).Writing a proposal and synopsis. Structure of a research paper. Citations and plagiarism.

UNIT III **12 lecture hours**

Technology-Enabled Communication: Using technology in communication tasks, E-mails, tools for constructing messages, Computer tools for gathering and collecting information; Different virtual medium of communication.

UNIT IV **12 lecture hours**

Building Vocabulary: Word Formation (by adding suffixes and prefixes); Common Errors; Words Often Confused; One word substitution, Homonyms and Homophones; Antonyms &Synonyms, Phrasal Verbs, Idioms & Proverbs (25 each); Commonly used foreign words (15 in number);

UNIT V **12 lecture hours**

Personality Development: Etiquettes& Manners; Attitude, Self-esteem & Self-reliance; Public Speaking; Work habits (punctuality, prioritizing work, bringing solution to problems), Body Language: Posture, Gesture, Eye Contact, Facial Expressions; Presentation Skills/ Techniques.

Textbook:

Kumar, Sanjay and Pushplata.*Communication Skills*.Oxford University Press, 2015.

Reference Books/Materials:

1. Mitra, Barun K. *Personality Development and Soft Skills*. Oxford University Press, 2012.
2. Tickoo, M.L., A. E.Subramanian and P.R.Subramaniam.*Intermediate Grammar, Usage and Composition.* Orient Blackswan, 1976.
3. Bhaskar, W.W.S., AND Prabhu, NS., " English Through Reading", Publisher: MacMillan,1978
4. Business Correspondence and Report Writing" -Sharma, R.C. and Mohan K. Publisher: Tata McGraw Hill1994
5. Communications in Tourism & Hospitality- Lynn Van Der Wagen, Publisher: HospitalityPress
6. Business Communication-K.K.Sinha
7. Essentials of Business Communication By Marey Ellen Guffey, Publisher: ThompsonPress
8. How to win Friends and Influence People By Dale Carnegie, Publisher: Pocket Books
9. Basic Business Communication By Lesikar&Flatley, Publisher Tata McGraw Hills
10. Body Language By Allan Pease, Publisher SheldonPress

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Quiz I	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand the basics of Grammar to improve written and oral communication skills	**PO1, PSO3**
CO2	Understand the correct form of English with proficiency	**PO7,PSO3**
CO3	Improve student's personality and enhance their self-confidence	**PO7**
CO4	Improve professional communication.	**PO7**
CO5	Enhance academic writing skills	**PO3,PSO4**

	COMMUNICATION SKILLS	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate softwar e's to solve mathematical equations	Capable to use appropriate softwar e's to solve mathematical equations	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
UCCS 155A		3		3				3						3	3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**												**3**			
CO2							**3**						**2**			
CO3							**3**									
CO4							**2**									
CO5			**3**											**3**		
1=lightly mapped 2= moderately mapped 3=strongly mapped																

Semester III

BSMA211A	PARTIAL DIFFERENTIAL EQUATIONS AND CALCULUS OF VARIATIONS	L	T	P	C
Version 2.0		4	0	0	4
Total Contact Hours	60 Hours				
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

This course enables the students to understand.

1. Origin of partial differential equations and their types, Lagrange's method, Cauchy's problem
2. Charpit's and Jacobi's methods, Cauchy's method of characteristics, Higher order linear partial differential equations with constant coefficients.
3. Classification and canonical transformation of second order linear partial differential equations. Method of separation of variables for solving hyperbolic, parabolic
4. Dirichlet, Neumann, Cauchy boundary conditions. Dirichlet and Neumann problems for a rectangle, theory of Green's function for Laplace equation.

Course Outcomes

This course will enable the students to:

CO1. Identify, analyse and subsequently solve physical situations whose behaviour can be described by
ordinary differential equations.
CO2. Competence in solving applied problems which are linear and nonlinear form.
CO3. Solve the problems choosing the most suitable method
CO4. Determine the solutions of differential equations with initial conditions
CO5. Determine the solutions of differential equations with initial and boundary conditions.

Catalog Description

The aim of this course is to learn theory of partial differential equations and solution methods. Use knowledge of Partial Differential Equations (PDEs), modelling, the general structure of solutions, and analytic and numerical methods for solution. Nature of PDEs like parabolic, elliptic, hyperbolic. After completion of the course, the students will be able to solve the PDEs independently. They can solve PDEs in higher dimension. Convert partial differential equations to canonical form.

Course Content

Unit I: **15 lecture hours**

First Order Partial Differential Equations Order and degree of Partial differential equations (PDE), Concept of linear and non-linear partial differential equations, Partial differential equations of the first order, Lagrange's method, Some special type of equation which can be solved easily by methods other than the general method, Charpit's general method.

Unit II: **15 lecture hours**

Second Order Partial Differential Equations with Constant Coefficients Classification of linear partial differential equations of second order, Homogeneous and non-homogeneous equations with constant coefficients.

Unit III: **16 lecture hours**

Second Order Partial Differential Equations with Variable Coefficients Partial differential equations reducible to equations with constant coefficient, Second order PDE with variable coefficients, Classification of second order PDE, Reduction to canonical or normal form; Monge's method; Solution of heat and wave equations in one and two dimensions by method of separation of variables.

Unit IV: **14 lecture hours**

Calculus of Variations-Variational Problems with Fixed Boundaries Euler's equation for functional containing first order and higher order total derivatives, Functionals containing first order partial derivatives, Variational problems in parametric form, Invariance of Euler's equation under coordinates transformation. Calculus of Variations-Variational Problems with Moving Boundaries Variational problems with moving boundaries, Functionals dependent on one and two variables, One sided variations. Sufficient conditions for an extremum-Jacobi and Legendre conditions, Second variation.

Textbooks

1. A. S. Gupta (2004). Calculus of Variations with Applications. PHI Learning.
2. Erwin Kreyszig (2011). Advanced Engineering Mathematics (10th edition). Wiley.
3. TynMyint-U & Lokenath Debnath (2013). Linear Partial Differential Equation for Scientists and
Engineers (4th edition). Springer India.
4. H. T. H. Piaggio (2004). An Elementary Treatise on Differential Equations and Their Applications.
CBS Publishers.
5. S. B. Rao & H. R. Anuradha (1996). Differential Equations with Applications. University Press.
6. Ian N. Sneddon (2006). Elements of Partial Differential Equations. Dover Publications.

Reference Books/Materials

1. M.D. Raisinghania: Advanced Differential Equations, S. Chand & Co.

2. Walter A. Strauss: An Introduction to Partial Differential Equation, Wiley

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Identify, analyse and subsequently solve physical situations whose behaviour can be described by ordinary differential equations.	**PO1**
CO2	Competence in solving applied problems which are linear and nonlinear form.	**PO5**
CO3	Solve the problems choosing the most suitable method	**PO8**
CO4	Determine the solutions of differential equations with initial conditions	**PO9**
CO5	Determine the solutions of differential equations with initial and boundary conditions.	**PO10**

	PARTIAL DIFFERENTIAL EQUATIONS AND CALCULUS OF VARIATIONS	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate software's to solve mathematical equations	Capable to use appropriate software's to solve mathematical equations	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA211A		2				3			2	2	3		2			3	2

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**										**3**	**2**	**1**	**1**	**2**	**2**
CO2					**3**						**3**	**2**	**1**	**1**	**2**	**2**
CO3								**3**			**3**	**2**	**1**	**1**	**2**	**2**
CO4									**2**		**3**	**2**	**1**	**1**	**2**	**2**
CO5										**3**	**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA275A	PARTIAL DIFFERENTIAL EQUATIONS AND CALCULUS OF VARIATIONS LAB	L	T	P	C
Version 2.0		0	0	4	2
Total Contact Hours	30 Hours				
Pre-requisites/Exposure					
Co-requisites	MATLAB software				

Course Objectives

The purpose of these labs is to help students talk and write in meaningful ways about mathematics. Specifically, to describe quantities and changes in quantities clearly in terms of context, to make rigorous arguments about how such quantities are related, and to make connections between these features in the contexts and on graphs.

Course Outcomes

On completion of this course, the students will be able to

CO1. Test program output for accuracy using hand calculations and debugging techniques

CO2. Analyses the accuracy of numerical approximations to derivatives and integrals and their dependence.
on grid resolution

CO3. Analyses the applicability and accuracy of matrix numerical solutions to linear systems of equations.

CO4. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.

CO5. Write efficient, well-documented MATLAB code and present numerical results in an informative way of different real-life problems.

Catalog Description

The aim of this lab course is to learn the experimental work of partial differential equations and solution methods. Use knowledge of Partial Differential Equations (PDEs) lab, modelling, the general structure of solutions, and analytic and numerical methods for solution. Nature of PDEs like parabolic, elliptic,hyperbolic. After completion of the course, the students will be able to solve the PDEs independently. They can solve PDEs in higher dimension. Convert partial differential equations to canonical form.

Course Content

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.
14. Fitting of binomial distributions for n and $p = q = ½$.
15. Fitting of binomial distributions for given n and p.
16. Fitting of binomial distributions after computing mean and variance.
17. Fitting of Poisson distributions for given value of lambda.
18. Fitting of Poisson distributions after computing mean.
19. Fitting of negative binomial.
20. Application problems based on binomial distribution.
21. Application problems based on Poisson distribution.
22. Application problems based on negative binomial distribution.
23. Problems based on area property of normal distribution.
24. To find the ordinate for a given area for normal distribution.
25. Application based problems using normal distribution.
26. Fitting of normal distribution when parameters are given.
27. Fitting of normal distribution when parameters are not given.
28. Fitting of Binomial, Poisson distribution and apply Chi-square test for goodness of fit

Reference Books/Materials

1. M.D. Raisinghania: Advanced Differential Equations, S. Chand & Co.
2. Walter A. Strauss: An Introduction to Partial Differential Equation, Wiley
3. Rudra Pratap; Getting Started with MATLAB 7, Oxford Press.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Conduct of Experiment	Attendance	Lab Record/ Quizzes/ Viva-Voice	End Term Practical Exam
Weightage (%)	**20**	**10**	**20**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Test program output for accuracy using hand calculations and debugging techniques	**PO9**
CO2	Analyses the accuracy of numerical approximations to derivatives and integrals and their dependence on grid resolution	**PO9**
CO3	Analyses the applicability and accuracy of matrix numerical solutions to linear systems of equations	**PO9**
CO4	Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.	**PO9**
CO5	Write efficient, well-documented MATLAB code and present numerical results in an informative way of different real-life problems.	**PO9**

	PARTIAL DIFFERENTIAL EQUATIONS AND CALCULUS OF VARIATIONS LAB	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate software's to solve mathematical equations	Capable to use appropriate software's to solve mathematical equations	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA275A										3	3	3	3	2		2	2

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1									**3**		**3**	**2**	**1**	**1**	**2**	**2**
CO2									**3**		**3**	**2**	**1**	**1**	**2**	**2**
CO3									**3**		**3**	**2**	**1**	**1**	**2**	**2**
CO4									**3**		**3**	**2**	**1**	**1**	**2**	**2**
CO5									**3**		**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA213A	GROUP THEORY	L	T	P	C
Version 2.0		5	1	0	6
Total Contact Hours	90 Hours				
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives:

The course will enable the students to:

1. Recognize the mathematical objects called groups.
2. Link the fundamental concepts of groups and symmetries of geometrical objects.
3. Explain the significance of the notions of cosets, normal subgroups, and factor groups.
4. Analyze consequences of Lagrange's theorem.
5. Learn about structure preserving maps between groups and their consequences.

Course Outcomes:

On completion of this course, the students will be able to

CO1. Understand the concept of algebraic structure groups
CO2. To connect algebraic structure with geometrical objects
CO3. To apply the notions of cosets, normal subgroups, and factor groups.
CO4. To make inferences about relations between group and its subgroup
CO5. Apply some special type maps like homomorphisms on algebraic structures
CO6. Compare various properties of group

Catalog Description:

This course particularly attempts to give an introduction to group theory and shall lay a foundation for a more advanced course in algebra. The course begins with the concept of a group with definitions and examples of it. Subgroups and their properties are the key concepts in this learning programme. Moreover, the concept of cosets, normal subgroups, homomorphisms and their applications are also considered in the plan of action.

Course Content

Unit I: **22 lecture hours**

Groups and its Elementary Properties: Symmetries of a square, Definition and examples of groups including dihedral, permutation and quaternion groups, Elementary properties of groups. Subgroups and examples of subgroups, Cyclic groups, Properties of cyclic groups, Lagrange's theorem,

Unit II: **22 lecture hours**

Normal Subgroups: Properties of cosets, Normal subgroups, Simple groups, Factor groups, Cauchy's theorem for finite abelian groups; Centralizer, Normalizer, Center of a group, Product of two subgroups; Classification of subgroups of cyclic groups

Unit III: **23 lecture hours**

Permutation Groups: Cycle notation for permutations, Properties of permutations, Even and odd permutations, alternating groups, Cayley's theorem, and its applications

Unit IV: **23 lecture hours**

Group Homomorphisms, Rings and Fields: Group homomorphisms, Properties of homomorphisms, Group isomorphisms, Properties of isomorphisms; First, second and third isomorphism theorems for groups; Definitions and elementary properties of rings and fields.

Textbooks

1. Joseph A. Gallian (2017). Contemporary Abstract Algebra (9th edition). Cengage.
2. I.S. Luthar & I.B.S. Passi (2013). Algebra: Volume 1: Groups. Narosa.

Reference Books/Materials

1. John B. Fraleigh (2007). A First Course in Abstract Algebra (7th edition). Pearson.
3. I. N. Herstein (2006). Topics in Algebra (2nd edition). Wiley India.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand the concept of algebraic structure groups	**PO2**
CO2	To connect algebraic structure with geometrical objects	**PO3**
CO3	To apply the notions of cosets, normal subgroups, and factor groups.	**PO7**
CO4	To make inferences about relations between group and its subgroup	**P10**
CO5	Apply some special type maps like homomorphisms on algebraic structures	**PO5**
CO6	Compare various properties of group	**PO4**

	GROUP THEORY	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at countrywide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA 213A		3		3	1	2		2	3						2		3

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1		**3**									**3**	**2**	**1**	**1**	**2**	**2**
CO2			**3**								**3**	**2**	**1**	**1**	**2**	**2**
CO3							**2**				**3**	**2**	**1**	**1**	**2**	**2**
CO4										**3**	**3**	**2**	**1**	**1**	**2**	**2**
CO5					**2**						**3**	**2**	**1**	**1**	**2**	**2**
CO6				**2**												
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA215A	PROBABILITY AND STATISTICS	L	T	P	C
Version 2.0		4	0	0	4
Total Contact Hours	60 hours				
Pre-requisites/Exposure	Basic algebra				
Co-requisites	--				

Course Objectives

1 To understand distributions in the study of the joint behavior of two random variables.

2 To establish a formulation helping to predict one variable in terms of the other that is, correlation and linear regression.

3 To understand central limit theorem, which establish the remarkable fact that the empirical frequencies of so many natural populations, exhibit a bell-shaped curve.

Course Outcomes

On completion of this course, the students will be able to

CO1 Apply key concepts of probability, including discrete and continuous random variables, probability distributions, conditioning, independence, expectations, and variances.

CO2 Define and explain the different statistical distributions and the typical phenomena that each distribution often describes.

CO3 Calculate probabilities and derive the marginal and conditional distributions of bivariate random variables.

CO4 Compute the covariance and correlation between jointly distributed variables.

CO5 Apply the method of least squares to estimate the parameters in a regression model.

CO6 Understand the law of large numbers and the central limit theorem.

Catalog Description

This course aims to provide an understanding of the basic concepts in probability, conditional probability and independent events. It will also focus on the random variable, mathematical expectation, and different types of univariate and bivariate distributions. In this course, student will learn how to describe relationships between two numerical quantities and characterized these relationships graphically, in the form of summary statistics, and through simple linear regression models.

Course Content

UNIT-I **15 Lectures**

Probability Functions and Moment Generating Function

Basic notions of probability, Conditional probability and independence, Baye's theorem; Random variables - Discrete and continuous, Cumulative distribution function, Probability mass/density functions; Transformations, Mathematical expectation, Moments, Moment generating function, Characteristic function.

UNIT-II **15 Lectures**

Univariate Discrete and Continuous Distributions

Discrete distributions**:** Uniform, Bernoulli, Binomial, Negative binomial, Geometric and Poisson; Continuous distributions**:** Uniform, Gamma, Exponential, Chi-square, Beta and normal; Normal approximation to the binomial distribution.

UNIT-III **16 Lectures**

Bivariate Distribution

Joint cumulative distribution function and its properties, Joint probability density function, Marginal distributions, Expectation of function of two random variables, Joint moment generating function, Conditional distributions, and expectations.

UNIT-IV **14 Lectures**

Correlation, Regression and Central Limit Theorem

The Correlation coefficient, Covariance, Calculation of covariance from joint moment generating function, Independent random variables, Linear regression for two variables, The method of least squares, Bivariate normal distribution, Chebyshev's theorem, Strong law of large numbers, Central limit theorem and weak law of large numbers.

Modeling Uncertainty

Uncertainty, Information and entropy, Uniform Priors, Polya's urn model and random graphs.

Reference Books/Materials

1. Robert V. Hogg, Joseph W. McKean & Allen T. Craig (2013). *Introduction to Mathematical Statistics* (7th edition), Pearson Education.
2. Irwin Miller &Marylees Miller (2014). *John E. Freund's Mathematical Statistics with Applications* (8thedition). Pearson. Dorling Kindersley Pvt. Ltd. India.
3. Jim Pitman (1993). *Probability*, Springer-Verlag.
4. Sheldon M. Ross (2014). *Introduction to Probability Models* (11th edition). Elsevier.
5. A. M. Yaglom and I. M. Yaglom (1983). *Probability and Information.* D. Reidel Publishing Company. Distributed by Hindustan Publishing Corporation (India) Delhi.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Apply key concepts of probability, including discrete and continuous random variables, probability distributions, conditioning, independence, expectations, and variances.	**PO8**
CO2	Define and explain the different statistical distributions and the typical phenomena that each distribution often describes.	**PO3**
CO3	Calculate probabilities and derive the marginal and conditional distributions of bivariate random variables.	**PO1**
CO4	Compute the covariance and correlation between jointly distributed variables.	**PO5**
CO5	Apply the method of least squares to estimate the parameters in a regression model.	**PO4**
CO6	Understand the law of large numbers and the central limit theorem.	**PO7**

	PROBABILITY AND STATISTICS	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA 215A		3		3	2	2		2	2			3			2		3

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1								**3**			**3**	**2**	**1**	**1**	**2**	**2**
CO2			**3**								**3**	**2**	**1**	**1**	**2**	**2**
CO3	**3**										**3**	**2**	**1**	**1**	**2**	**2**
CO4					**2**						**3**	**2**	**1**	**1**	**2**	**2**
CO5				**3**							**3**	**2**	**1**	**1**	**2**	**2**
CO6							**3**									
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA277A	PROBABILITY AND STATISTICS LAB	L	T	P	C
Version 1.0		0	0	2	1
Total Contact Hours	22 Hours				
Pre-requisites/Exposure	--				
Co-requisites	MS Excel				

Course Objectives

1 To understand the concept of random variables, probability distributions and expectation.

2 The fundamental concept of expectation for univariate and bivariate random variables with their distributions and properties.

3 To acquire knowledge of correlation, regression analysis, regression diagnostics, partial and multiple correlations.

4 To understand Central Limit Theorem and its applications.

Course Outcomes

On completion of this course, the students will be able to work on

CO1 Tabular and graphical representation of data based on variables.
CO2 Concept of joint, marginal and conditional probability distribution for two dimensional random variables and their independence.
CO3 Univariate transformation and expectation of random variables.
CO4 Knowledge related to concept of discrete and continuous random variables and their probability distributions including expectation and moments.
CO5 Acumen to apply standard discrete and continuous probability distributions to different situations.
CO6 Laws of convergence, their inter relations and applications.

Catalog Description

We generally do not pay attention to the significance of statistics but its significance can be seen from business to politics or from agriculture to sports. This course shall begin with elementary statistical concepts such measures of central tendency and measures of dispersion. Furthermore, some more advanced concepts like correlation and regression are planned to be uncovered. Also students shall learn to determine the probability of an event, and to apply both discrete and continuous probability distributions to practical human problems.

Course Content

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.
14. Fitting of binomial distributions for n and p = q = ½.
15. Fitting of binomial distributions for given n and p.
16. Fitting of binomial distributions after computing mean and variance.
17. Fitting of Poisson distributions for given value of lambda.
18. Fitting of Poisson distributions after computing mean.
19. Fitting of negative binomial.
20. Application problems based on binomial distribution.
21. Application problems based on Poisson distribution.
22. Application problems based on negative binomial distribution.
23. Problems based on area property of normal distribution.
24. To find the ordinate for a given area for normal distribution.
25. Application based problems using normal distribution.
26. Fitting of normal distribution when parameters are given.
27. Fitting of normal distribution when parameters are not given.
28. Fitting of Binomial, Poisson distribution and apply Chi-square test for goodness of fit.

Reference Books/Materials

1. Robert V. Hogg, Joseph W. McKean & Allen T. Craig (2013). *Introduction to Mathematical Statistics* (7th edition), Pearson Education.
2. Irwin Miller & Marylees Miller (2014). *John E. Freund's Mathematical Statistics with Applications* (8thedition). Pearson. Dorling Kindersley Pvt. Ltd. India.
3. Jim Pitman (1993). *Probability*, Springer-Verlag.
4. Sheldon M. Ross (2014). *Introduction to Probability Models* (11th edition). Elsevier.
5. A. M. Yaglom and I. M. Yaglom (1983). *Probability and Information*. D. Reidel Publishing Company. Distributed by Hindustan Publishing Corporation (India) Delhi.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Conduct of Experiment	Attendance	Lab Record/ Quizzes/ Viva-Voice	End Term Practical Exam
Weightage (%)	**20**	**10**	**20**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Tabular and graphical representation of data based on variables.	**PO10**
CO2	Concept of joint, marginal and conditional probability distribution for two dimensional random variables and their independence.	**PO8**
CO3	Univariate transformation and expectation of random variables.	**PO5**
CO4	Knowledge related to concept of discrete and continuous random variables and their probability distributions including expectation and moments	**PO9**
CO5	Acumen to apply standard discrete and continuous probability distributions to different situations.	**PO2**
CO6	Laws of convergence, their inter relations and applications.	**PO4**

	PROBABILITY AND STATISTICS LAB	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA273A			3		2	2			2	3	3	3	3		2		

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1										**3**	**3**	**2**	**1**	**1**	**2**	**2**
CO2								**2**			**3**	**2**	**1**	**1**	**2**	**2**
CO3					**2**						**3**	**2**	**1**	**1**	**2**	**2**
CO4									**3**		**3**	**2**	**1**	**1**	**2**	**2**
CO5		**3**									**3**	**2**	**1**	**1**	**2**	**2**
CO6				**2**												
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSCS109A	DATA ANALYSIS AND VISUALIZATION	L	T	P	C
Version 1.0		2	0	0	2
Total Contact Hours	30 Hours				
Pre-requisites/Exposure	Basics of Python				
Co-requisites	--				

Course Objectives

The objective of this course is to teach students the concepts of Python Programming Language with Libraries.

Course Outcomes

On completion of this course, the students will be able to:-

CO1. Theoretical and practical understanding of data analysis with Python package like NumPy and Pandas.

CO2. The knowledge of visualization tools (matplotlib and seaborn) so that one will be able to visualize and make correct decision based on the data.

CO3. To practice with real life data to feel confident of the topic and be able to ready to work on data analysis project or interview.

CO4. Write research proposal on data analysis.

Catalog Description

Data Analysis with Python is for everyone who would like to create meaningful insight out of the data with the power of NumPy, Pandas, Matplotlib & Seaborn. The course has the right recipe to equip students with the right set of skill to ingest, clean, merge, manipulate, transform and finally visualize the data to create the meaning out of the data at hand.

Course Content

UNIT – I **7 Lectures**

NumPy: Array and vectorized computation: Multidimensional array object. Creating ndarrays, arithmetic with numpy array, basic indexing and slicing, Boolean indexing, transposing array and swapping axes, universal functions, array-oriented programming with arrays, conditional logic as arrays operations, file input and output with array.

UNIT -II **9 Lectures**

Pandas: Pandas data structure, series, DataFrame, Index Object, Reindexing, dropping entities from an axis, indexing, selection and filtering, integer indexes, arithmetic and data alignment, function application and mapping, scoring and ranking, correlation and covariance, unique values, values controls and membership, reading and writing data in text format

UNIT -III **7 Lectures**

Visualization with Matplotlib: Figures and subplots, colors, markers, line style, ticks, labels, legends, annotation and drawing on sublots, matplotlib configuration.

UNIT -IV **7 Lectures**

Plotting with pandas and seaborn: line plots, bar plots, histogram, density plots, scatter and point plots, facet grids and categorical data.

Textbooks

1. Fabio Nelli, Python Data Analytics 2nd Edition, Apress.

Reference Books/Materials

1. Python for Data Analysis: A Complete Beginner Guide for Python basics, Numpy, Pandas, Seaborn, Bokeh and Matplotlib for Data Analysis, AI Publishing LLC.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Theoretical and practical understanding of data analysis with Python package like NumPy and Pandas.	**PO10**
CO2	The knowledge of visualization tool (matplotlib and seaborn) so that one will be able to visualize and make correct decision based on the data.	**PO3**
CO3	To practice with real life data to feel confident of the topic and be able to ready to work on data analysis project or interview.	**PO1**
CO4	Write research proposal on data analysis.	**PO7**

	DATA ANALYSIS AND VISUALIZATION	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate software's to solve mathematical equations	Capable to use appropriate software's to solve mathematical equations	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSCS 109A		3		3				3			2					2	3

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1										**2**	**3**	**2**	**1**	**1**	**2**	**2**
CO2			**3**								**3**	**2**	**1**	**1**	**2**	**2**
CO3	**3**										**3**	**2**	**1**	**1**	**2**	**2**
CO4							**3**				**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSCS159A	DATA ANALYSIS AND VISUALIZATION LAB	L	T	P	C
Version 1.0		0	0	2	1
Total Contact Hours	22 Hours				
Pre-requisites/Exposure	Basics of Python				
Co-requisites	--				

Course Objectives

The objective of this course is to teach students the concepts of Python Programming Language with Libraries.

Course Outcomes

On completion of this course, the students will be able to learn: -

CO1. Practical understanding of data analysis with Python package like NumPy and Pandas.

CO2. Implementation of visualization tool (matplotlib and seaborn) so that one will be able to visualize and make correct decision based on the data.

CO3. To practice with real life data to feel confident of the topic and be able to ready to work on data analysis project or interview.

Catalog Description

This course complements BSCS109A. It enables them to write algorithms/programs for implementing python libraries such as NumPy, Pandas, Seaborn etc. The list of experiments helps organizing the data in variety of ways using python and to solve the given problem efficiently.

Course Content

The list of experiments will be based upon syllabus of BSCS109A.

Text Books

1. Fabio Nelli, Python Data Analytics 2nd Edition, Apress.

Reference Books/Materials

1. Python for Data Analysis: A Complete Beginner Guide for Python basics, Numpy, Pandas, Seaborn, Bokeh and Matplotlib for Data Analysis, AI Publishing LLC.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Conduct of Experiment	Attendance	Lab Record/ Quizzes/ Viva-Voice	End Term Practical Exam
Weightage (%)	**20**	**10**	**20**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Practical understanding of data analysis with Python package like NumPy and Pandas.	**PO10**
CO2	Implementation of visualization tool (matplotlib and seaborn) so that one will be able to visualize and make correct decision based on the data.	**PO3**
CO3	To practice with real life data to feel confident of the topic and be able to ready to work on data analysis project or interview.	**PO1**

	DATA ANALYSIS AND VISUALIZATION LAB	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate softwar e's to solve mathematical equations	Capable to use appropriate softwar e's to solve mathematical equations	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSCS 159A		3		3							2					2	3

1=weakly mapped

2= moderately mapped

3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1										**2**	**3**	**2**	**1**	**1**	**2**	**2**
CO2			**3**								**3**	**2**	**1**	**1**	**2**	**2**
CO3	**3**										**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

Semester IV

BSMA212A	ADVANCED ALGEBRA	L	T	P	C
Version 2.0		5	1	0	6
Total Contact Hours	90 Hours				
Pre-requisites/Exposure	Group Theory				
Co-requisites	--				

Course Objectives:

The course will enable the students to:

1. Understand the basic concepts of group actions and their applications.
2. Recognize and use the Sylow theorems to characterize certain finite groups.
3. Know the fundamental concepts in ring theory such as the concepts of ideals, quotient rings, integral domains, and fields.
4. Learn in detail about polynomial rings, fundamental properties of finite field extensions, and classification of finite fields

Course Outcomes:

On completion of this course, the students will be able to

CO1. Understand the concept of Orbits and stabilizers
CO2. To connect algebraic structure finite simple groups
CO3. To apply the notions polynomial rings in different kinds of ideals.
CO4. To make inferences from classification of finite fields
CO5. Apply conjugacy classes in class equation of a group
CO6. Write various properties of group,ring and field

Catalog Description:

This course particularly deals with some more advanced algebra concepts, and it is laid on a preliminary course in algebra. The course begins with the concept of orbits and stabilizers with definitions and examples of it. Subgroups and their properties are the key concepts in this learning programme. Moreover, the concept of Rings, ED, PID and some concepts from fields are also considered in the plan of action.

Course Content

Unit I: **23 lecture hours**

Group Actions: Group actions, Orbits and stabilizers, Conjugacy classes, Orbit-stabilizer theorem, Normalizer of an element of a group, Center of a group, Class equation of a group, Inner and outer automorphisms of a group

Sylow's Theorems: Cauchy's theorem for finite abelian groups, Finite simple groups, Sylow theorems and applications including non-simplicity tests.

Unit II: **23 lecture hours**

Rings and Fields: Definition, examples and elementary properties of rings, Commutative rings, Integral domain, Division rings and fields, Characteristic of a ring, Ring homomorphisms and isomorphisms, Ideals and quotient rings. Prime, principal and maximal ideals, Relation between Polynomial Rings: Polynomial rings over commutative ring and their basic properties, The division algorithm; Polynomial rings over rational field, Gauss lemma and Eisenstein's criterion, Euclidean domain, principal ideal domain, and unique factorization domain. domain and field, Euclidean rings and their properties, Wilson and Fermat's theorems.

Unit III: **22 lecture hours**

Polynomial Rings: Polynomial rings over commutative ring and their basic properties, The division algorithm; Polynomial rings over rational field, Gauss lemma and Eisenstein's criterion, Euclidean domain, principal ideal domain, and unique factorization domain

Unit IV: **22 lecture hours**

Field Extensions and Finite Fields: Extension of a field, Algebraic element of a field, Algebraic and transcendental numbers, Perfect field, Classification of finite fields.

Textbooks

1. Joseph A. Gallian (2017). Contemporary Abstract Algebra (9th edition). Cengage.
2. I.S. Luthar & I.B.S. Passi (2013). Algebra: Volume 1: Groups. Narosa.
3. Michael Artin (2014). Algebra (2nd edition). Pearson.
4. P. B. Bhattacharya, S. K. Jain & S. R. Nagpaul (2003). Basic Abstract Algebra (2nd edition). Cambridge University Press.

Reference Books/Materials

1. John B. Fraleigh (2007). A First Course in Abstract Algebra (7th edition). Pearson.
5. I. N. Herstein (2006). Topics in Algebra (2nd edition). Wiley India.
6. David S. Dummit & Richard M. Foote (2008). Abstract Algebra (2nd edition). Wiley.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination/

Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand the concept of Orbits and stabilizers	**PO1**
CO2	To connect algebraic structure finite simple groups	**P10**
CO3	To apply the notions polynomial rings in different kinds of ideals.	**PO7**
CO4	To make inferences from classification of finite fields	**PO8**
CO5	Apply conjugacy classes in class caution of a group	**PO5**
CO6	Write various properties of group,ring and field	**PO4**

	ADVANCED ALGEBRA	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA 212A		3		3	2			3		2		3		2			

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**										**3**	**2**	**1**	**1**	**2**	**2**
CO2										**2**	**3**	**2**	**1**	**1**	**2**	**2**
CO3							**3**				**3**	**2**	**1**	**1**	**2**	**2**
CO4								**2**			**3**	**2**	**1**	**1**	**2**	**2**
CO5					**2**						**3**	**2**	**1**	**1**	**2**	**2**
CO6			**3**								**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA214A	LINEAR ALGEBRA	L	T	P	C
Version 2.0		5	1	0	6
Total Contact Hours	90 Hours				
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. Provide the brief idea to students of vector spaces, Basis and dimensions.
2. To understand the consequences of linear transformation and matrix representation of a linear transformation.
3. Find the Eigen values and eigen vectors of LT. Diagonalization, Cayley Hamilton theorem.
4. Find the inner product spaces and Orthonormal basis.
5. Apply derivative tests in optimization problems appearing in social sciences, physical sciences, life sciences and a host of other disciplines.

Course Outcomes

On completion of this course, the students will be able to

1. Applied the methods to solve the vector and matrix algebra, including linear dependence / independence, basis and dimension of a subspace, rank and nullity, for analysis of matrices and systems of linear equations.
2. Appreciate and identify linear transformations of finite dimensional vector spaces and compose their matrices in specific bases.
3. Recognize the characteristic polynomial to compute the eigenvalues and eigenvectors of a square matrix and use them to diagonalise matrices when this is possible; discriminate between diagonalizable and non-diagonalizable matrices.
4. Learn the concepts of orthogonally diagonalise symmetric matrices and quadratic forms.
5. Determine the concepts of Halbert space and inner product space.
6. Apply the mathematical modelling and reasoning to solve basic problems.

Catalog Description

This course covers matrix theory and linear algebra, emphasizing topics useful in other disciplines. Linear algebra is a branch of mathematics that studies systems of linear equations and the properties of matrices. The concepts of linear algebra are extremely useful in physics, economics and social sciences, natural sciences, and engineering. Due to its broad range of applications, linear algebra is one of the most widely taught subjects in college-level mathematics.

Important objectives of linear algebra are to develop and strengthen the students' problem-solving skills and to teach them to read, write, speak, and think in the language of mathematics. Students learn how to apply the tools of calculus to a variety of problem situations.

Course Content

Unit I: **22 lecture hours**

Vector Space: Definition and examples, Subspace, Linear span, Quotient space and direct sum of subspaces, Linearly independent and dependent sets, Bases and dimension.

Unit II: **22 lecture hours**

Linear transformations: Definition and examples, Algebra of linear transformations, Matrix of a linear transformation, Change of coordinates, Rank and nullity of a linear transformation and rank-nullity theorem.

Unit II: **23 lecture hours**

Further Properties of Linear Transformations: Isomorphism of vector spaces, Isomorphism theorems, Dual and second dual of a vector space, Transpose of a linear transformation, Eigen vectors and eigenvalues of a linear transformation, Characteristic polynomial and Cayley-Hamilton theorem, Minimal polynomial.

Unit IV: **23 lecture hours**

Inner Product Spaces: Inner product spaces and orthogonality, Cauchy-Schwarz inequality, Gram-Schmidt orthogonalization, Diagonalization of symmetric matrices.

Adjoint of a Linear Transformation and Canonical Forms: Adjoint of a linear operator; Hermitian, unitary, and normal linear transformations; Jordan canonical form, Triangular form, Trace and transpose, Invariant subspaces.

Textbooks

1. 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.

Reference Books/Materials

1. Joseph A. Gallian; *Contemporary Abstract Algebra*; Narosa Publishing House.
2. S. Lang; *Introduction to Linear Algebra*; Springer.
3. S. Kumaresan; *Linear Algebra- A Geometric Approach*; Prentice Hall of India.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Applied the methods to solve the vector and matrix algebra, including linear dependence / independence, basis and dimension of a subspace, rank and nullity, for analysis of matrices and systems of linear equations.	**PO1**
CO2	Appreciate and identify linear transformations of finite dimensional vector spaces and compose their matrices in specific bases.	**PO8**
CO3	Recognize the characteristic polynomial to compute the eigenvalues and eigenvectors of a square matrix and use them to diagonalise matrices when this is possible; discriminate between diagonalizable and non-diagonalizable matrices.	**PO2**
CO4	Learn the concepts of orthogonally diagonalise symmetric matrices and quadratic forms.	**PO4**
CO5	Determine the concepts of Halbert space and inner product space.	**PO3**
CO6	Apply the mathematical modelling and reasoning to solve basic problems	**PO1**

	LINEAR ALGEBRA	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate software's to solve mathematical equations	Capable to use appropriate software's to solve mathematical equations	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA 214A		2	3	3	2				2			3		3			2

1=weakly mapped

2= moderately mapped

3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**2**										**3**	**2**	**1**	**1**	**2**	**2**
CO2								**2**			**3**	**2**	**1**	**1**	**2**	**2**
CO3		**3**									**3**	**2**	**1**	**1**	**2**	**2**
CO4				**2**							**3**	**2**	**1**	**1**	**2**	**2**
CO5			**3**								**3**	**2**	**1**	**1**	**2**	**2**
CO6	**2**										**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA216A	REAL ANALYSIS	L	T	P	C
Version 3.0		5	1	0	6
Total Contact Hours	90 Hours				
Pre-requisites/Exposure	Limit, Continuity and Differentiability				
Co-requisites	--				

Course Objectives

After successful completion of this course students will be able to

1. Learn basic properties and theorems of Real Numbers
2. Know about higher order derivative and their application
3. Learn some of the properties of Riemann integrable functions, and the applications of the fundamental theorems of integration
4. Apply the ratio, root, alternating series and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand many properties of the real line $\mathbb{R}$ and learn to define sequence in terms of functions from $\mathbb{R}$ to a subset of $\mathbb{R}$.
CO2. Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and concept of limit superior, limit inferior, and the limit of a bounded sequence.
CO3. Analyze and correlate the difference between theorem, lemma and corollary.
CO4. Formulate and solve problems based upon higher order derivative.
CO5. Formulate and solve problems based upon sequence and Series.
CO6. Differentiate between point wise and Uniform Convergence.

Catalog Description

This course imparts the basic concepts of Real numbers, sequence and Series. It enables students to differentiate between point wise and Uniform Convergence. This course helps students in variety of ways to solve the problems based upon improper integral. The course introduces the basic concepts about Riemann Integral and its properties. It also explains concept of Uniform Convergence.

Course Content

Unit I: **22 lecture hours**

Real Number System: Algebraic and order properties of $\mathbb{R}$, Absolute value of a real number; Bounded above and bounded below sets, Supremum and infimum of a nonempty subset of $\mathbb{R}$,The completeness property of $\mathbb{R}$, Archimedean property, Density of rational numbers in $\mathbb{R}$, Definition and types of intervals, Nested intervals property; Neighborhood of a point in $\mathbb{R}$, Open, closed and perfect sets in $\mathbb{R}$, Connected subsets of $\mathbb{R}$, Cantor set and Cantor function

Unit. II: **22 lecture hours**

Sequences of Real Numbers: Convergent sequence, Limit of a sequence, Bounded sequence, Limit theorems, Monotone sequences, Monotone convergence theorem, Subsequences, Bolzano Weierstrass theorem for sequences, Limit superior and limit inferior of a sequence of real numbers, Cauchy sequence, Cauchy's convergence criterion.

Unit III: **23 lecture hours**

Infinite Series: Convergence and divergence of infinite series of positive real numbers, Necessary condition for convergence, Cauchy criterion for convergence; Tests for convergence of positive term series**;** Basic comparison test, Limit comparison test, D'Alembert's ratio test, Cauchy's n^{th} root test, Integral test; Alternating series, Leibniz test, Absolute and conditional convergence, Rearrangement of series and Riemann's theorem.

Unit IV: **23 lecture hours**

Riemann Integration: Riemann integral, Integrability of continuous and monotonic functions, Fundamental theorem of integral calculus, First mean value theorem, Bonnet and Weierstrass forms of second mean value theorems.

Uniform convergence and Improper integral: Pointwise and uniform convergence of sequence and series of functions, Weierstrass's M-test, Dirichlet test and Abel's test for uniform convergence, Uniform convergence and continuity, Uniform convergence and differentiability, Improper integrals, Dirichlet test and Abel's test for improper integrals.

Textbooks

1. Robert G. Bartle & Donald R. Sherbert (2015). Introduction to Real Analysis (4^{th} edition).Wiley India.
2. Gerald G. Bilodeau, Paul R. Thie & G. E. Keough (2015). An Introduction to Analysis (2^{nd} edition), Jones and Bartlett India Pvt. Ltd.
3. K. A. Ross (2013). Elementary Analysis**:** The Theory of Calculus (2^{nd} edition). Springer.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand many properties of the real line $\mathbb{R}$ and learn to define sequence in terms of functions from $\mathbb{R}$ to a subset of $\mathbb{R}$.	**PO1,PO7**
CO2	Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and concept of limit superior, limit inferior, and the limit of a bounded sequence.	**PO5,PO7**
CO3	Analyze and correlate difference between theorem, lemma and corollary.	**PO8,PO7**
CO4	Formulate and solve problems based upon higher order derivative.	**PO4,PO7**
CO5	Formulate and solve problems based upon sequence and Series	**PO10,PO7**
CO6	Differentiate between point wise and Uniform Convergence	**PO3,PO7**

	REAL ANALYSIS	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA216A		1		3	1	1			1		1	3	3	3	3	3	3

1=weakly mapped

2= moderately mapped

3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**1**						**1**				**3**	**2**	**1**	**1**	**2**	**2**
CO2					**1**		**1**				**3**	**2**	**1**	**1**	**2**	**2**
CO3							**1**	**1**			**3**	**2**	**1**	**1**	**2**	**2**
CO4				**2**			**1**				**3**	**2**	**1**	**1**	**2**	**2**
CO5										**1**	**3**	**2**	**1**	**1**	**2**	**2**
CO6			**3**				**1**				**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA274A	INTRODUCTION TO LaTeX	L	T	P	C
Version 1.0		0	0	2	1
Total Contact Hours	22 Hours				
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

The objective of the course is.

1. To learn about a document preparation system for high-quality typesetting
2. To learn typesetting of complex mathematical formulas

Course Outcomes

On completion of this course, the students will be able to

CO1. Typesetting journal articles, technical reports, books, and slide presentations.
CO2. Control over large documents containing sectioning, cross-references.
CO3. Automatic generation of bibliographies and indexes

Catalog Description

The course aims to introduce students to LaTeX - a high quality open-source typesetting software. LaTeX is most used for medium to large technical or scientific documents but can be used for almost any type of publication. The course will, therefore, enable students to type a report, article, or mathematical document.

Course Content

Introduction to LaTeX, Benefits and comparison with word processor, Installing LaTeX, Formatting lines and paragraph, typesetting a simple document, Text alignment, Installing packages Creating Lists, Typing Math Formulas, Environments – equations, arrays, matrices, Footnotes, Fonts, Title and headers, Sectioning, Listing references, Math styles – cases, braces, math symbols Graphics in LaTeX, Inserting Tables and Figures, Simple pictures using PSTricks, Sample article and report, Beamer presentation, Sample presentation, Using online resources

Textbooks

1. David F. Griffiths, Desmond J. Higham, Learning LaTeX, Society for Industrial and Applied Mathematics(SIAM), 2016.
2. Stefan Kottwitz , LaTeX Beginner's Guide. Packt Publishing, Birmingham, UK, 2011.
3. Lamport, Leslie, LaTeX: A Document Preparation System, User's Guide and Reference Manual (2nd ed.). Addison-Wesley, 1994.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Conduct of Experiment	Attendance	Lab Record/ Quizzes/ Viva-Voice	End Term Practical Exam
Weightage (%)	**20**	**10**	**20**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Typesetting journal articles, technical reports, books, and slide presentations.	**PO9, PO10**
CO2	Control over large documents containing sectioning, cross-references	**PO5**
CO3	Automatic generation of bibliographies and indexes	**PO9, PO10**

	INTRODUCTION TO LaTeX	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA 274A						2				3	3			2			

1=weakly mapped
2=moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1									**3**	**3**	**3**	**2**	**1**	**1**	**2**	**2**
CO2					**2**						**3**	**2**	**1**	**1**	**2**	**2**
CO3									**3**	**3**	**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA222A	Internship in Mathematics	L	T	P	C
Version 1.0		0	0	0	2
Pre-requisites/Exposure	Practical exposure				
Co-requisites	--				

Course Objectives

1. To learn how to carry out literature surveys on the assigned topic.
2. To be associated with an area of research/research project and contribute towards domain knowledge through hands on.
3. To learn the art of technical report writing.
4. To learn the art of verbal communication with the help of modern presentation techniques.

Course Outcomes

On completion of this course, the students will be able to

CO1. Carry out the extensive literature survey on the topic assigned by academicians and industry experts.

CO2. Learn to write and present technical reports/articles.

CO3. Learn to analyze various methods and techniques applicable to the topic to study and contribute to domain knowledge.

CO4. Learn to analyze/evaluate the result of the experiment carried out and present the results using data visualization methods.

Catalog Description

1. In the end of Semester IV, students will be asked to join research/academic organizations or industries to get hands on knowledge on the selected topics.

3. The student will work on the assigned topic for 3-4 weeks in regular consultation with his/her assigned expert/guide.

4. The student will write a report based on the work carried out during internship and prepare two copies to be submitted to the office of the Head of the Department duly signed by the student and the expert.

5. The student will make a power point presentation based on the work carried out and mentioned in the report to the board of examiners appointed by the University in the fifth semester. The student will be evaluated based on a report and presentation.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Internal (Interaction of Student with Supervisor)	External			Total
		Relevance of topic (20)	Presentation (20)	viva (10)	100
Weightage (%)	50	20	20	10	

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Carry out the extensive literature survey.	PO1, PO3
CO2	Learn to write and present technical reports/articles.	PO1, PO5, PO8, PO9
CO3	Learn to analyze various methods and techniques applicable to the topic to study and contribute to domain knowledge.	PO2, PO3, PO4, PSO1, PSO4
CO4	Learn to analyze/evaluate the result of the experiment carried out and present the results using data visualization methods.	PO5, PO6,PSO2 and PSO3

	Programme and Course Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	**3**		**3**												
CO2	**3**				**3**			**3**	**3**						
CO3		**3**	**3**	**3**								**3**			**3**
CO4					**3**	**3**							**2**	**3**	
	1=lightly mapped 2= moderately mapped 3=strongly mapped														

	Internship
Local	-
Regional	-
National	-
Global	-
Employability	Choice Based Credit System having field projects / research projects / internships (1.3.4) Courses on employability/ entrepreneurship/ skill development (1.1.3); Student centric methods, such as experiential learning, participative learning and problem-solving methodologies (2.3.1)
Entrepreneurship	Entrepreneurship; Team work/ Creativity by designing research problem
Skill Development	Disciplinary knowledge; Research related skills; scientific skills,
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	Equal Access to TVET and Higher Education (SDG 4.3), Quality Education and skills for employability 4.4
NEP	Higher Education System through scientific temper (9.1.1) India's Higher Education System through scientific temper (9.1.1)Towards a More Holistic and Multidisciplinary Education opportunitiesfor cross-disciplinary and interdisciplinary thinking (11.6); strong culture of research and knowledge creation (17.6) "
POE/4th IR	Employability, Project, Hands on Experience, Entrepreneurship; Team work

VAC116

K R Mangalam University, Gurugram

Syllabus of Understanding Research

Course Objective: After completion of this course, students will be

(i) Introduce students to exploratory and experiential learning

(ii) Acquainted problem solving approach and

(iii) Introduce students to research ethics.

Unit 1: Basics of Research

Scientific Methods and Research: Concept, Definitions of research; Purpose, importance, steps levels and rigor of research; different paradigms of research.

Basic Types of Researches: Fundamental/Applied research, Descriptive/Analytical research, Quantitative /Qualitative research, Conceptual/Empirical research, Diagnostic/Hypothesis testing research, Conclusion oriented/Decision oriented research, Theoretical / Action research, Longitudinal /Cross sectional research

Research Hypothesis: Meaning of research hypothesis, sources of hypothesis, qualities of workable hypothesis, utilities of hypothesis

Designing of Research work: Introduction, Purposes, Characteristics of a research design, Principles of designing a research, conceptual framework and its operationalization, Sectors of research design, Research methods as research designing, similarities and differences between Research design and research method.

Unit 2: Analysis and Statement of the problem

Research Question: Introduction, types and identification; Research Problem: Definition, identification of problem, ways of understanding problem, criteria of a good problem, guidelines for selecting meaningful problem;

Literature Review: How to read and analyze the paper, identifying gap areas from literature and research database, development of working hypothesis.

Unit 3: Search Engines and Research Ethics

Tools used to search the papers: Searching the literature through open access engines like google scholar, sci-hub, research-gate, science-direct, Mandley, Zotero

Plagiarism: introduction, tools used to detect plagiarism, plagiarism prevention.

References: how to write the references in different styles like MLA, APA.

Unit 4: Research article/ report

Introduction, purpose and different forms of report; Qualities of research reports; Presentation of preliminary, general and technical reports; Format of research report, Necessary elements of research report, Precautions for report preparation.

Overall evaluation of students through assignments.

Semester V

BSMA301A	**NUMERICAL ANALYSIS**	**L**	**T**	**P**	**C**
Version 2.0		**4**	**0**	**0**	**4**
Total Contact Hours	**60 Hours**				
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. To develop the mathematical skills of the students in the areas of numerical methods
2. The explaining and understanding of the several available methods to Solve the simultaneous equations.
3. Obtaining numerical solutions to problems of mathematics
4. Familiar with numerical integration and differentiation, numerical solution of ordinary differential equations.

Course Outcomes

This course will enable the students to:

CO1. Obtain numerical solutions of algebraic and transcendental equations.
CO2. Find numerical solutions of system of linear equations and check the accuracy of the solutions.
CO3. Learn about various interpolating and extrapolating methods.
CO4. Solve initial and boundary value problems in differential equations using numerical methods.
CO5. Apply various numerical methods in real life problems.

Catalog Description

This course Understand the basic concepts of statistics, algebra, and differential equations. Analyze the relationship of basic mathematics in real life. Acquire the ability to calculate and reason to design complex and critical financial models for any organization and after completing this course students apply the mathematical modeling and reasoning to solve basic problems.

Course Content

Unit I: **14 lecture hours**

Numerical Methods for Solving Algebraic and Transcendental Equations Round-off error and computer arithmetic, Local and global truncation errors, Algorithms and convergence; Bisection method, False position method, Fixed point iteration method, Newton's method and secant method for solving equations.

Unit II: **14 lecture hours**

Numerical Methods for Solving Linear Systems Partial and scaled partial pivoting, Lower and upper triangular (LU) decomposition of a matrix and its applications, Thomas method for tridiagonal systems; Gauss−Jacobi, Gauss−Seidel and successive over-relaxation (SOR) methods.

Unit III: **16 lecture hours**

Interpolation Lagrange and Newton interpolations, Piecewise linear interpolation, Cubic spline interpolation, Finite difference operators, Gregory−Newton forward and backward difference interpolations.

Unit IV: **16 lecture hours**

Numerical Differentiation and Integration First order and higher order approximation for first derivative, Approximation for second derivative; Numerical integration: Trapezoidal rule, Simpson's rules and error analysis, Bulirsch−Stoer extrapolation methods, Richardson extrapolation. Initial and Boundary Value Problems of Differential Equations Euler's method, Runge−Kutta methods, Higher order one step method, Multi-step methods; Finite difference method, Shooting method, Real life examples: Google search engine, 1D and 2D simulations, Weather forecasting.

Textbooks

1. Brian Bradie (2006), A Friendly Introduction to Numerical Analysis. Pearson
2. C. F. Gerald & P. O. Wheatley (2008). Applied Numerical Analysis (7th edition), Pearson Education, India.
3. F. B. Hildebrand (2013). Introduction to Numerical Analysis: (2nd edition). Dover Publications.
4. M. K. Jain, S. R. K. Iyengar & R. K. Jain (2012). Numerical Methods for Scientific and Engineering Computation (6th edition). New Age International Publishers.
5.Robert J. Schilling & Sandra L. Harris (1999). Applied Numerical Methods for Engineers Using MATLAB and C. Thomson-Brooks/Cole.

Reference Books/Materials

1.B. S. Grewal, *Numerical Methods in Engineering and Science*, Khanna Publishers.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Obtain numerical solutions of algebraic and transcendental equations.	PO4
CO2	Find numerical solutions of system of linear equations and check the accuracy of the solutions.	PO5
CO3	Learn about various interpolating and extrapolating methods.	PO3
CO4	Solve initial and boundary value problems in differential equations using numerical methods	PO9
CO5	Apply various numerical methods in real life problems.	PO10

	NUMERICAL ANALYSIS	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate software's to solve mathematical equations	Capable to use appropriate software's to solve mathematical equations	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BS MA 301 A				2	2	3				2	3	3				3	

1=weakly mapped

2= moderately mapped

3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1				**2**							**3**	**2**	**1**	**1**	**2**	**2**
CO2					**3**						**3**	**2**	**1**	**1**	**2**	**2**
CO3			**2**								**3**	**2**	**1**	**1**	**2**	**2**
CO4									**2**		**3**	**2**	**1**	**1**	**2**	**2**
CO5										**2**	**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA371A	NUMERICAL ANALYSIS LAB	L	T	P	C
Version 1.0		0	0	4	2
Total Contact Hours	30 Hours				
Pre-requisites/Exposure					
Co-requisites	MATLAB SOFTWARE				

Course Objectives

The purpose of these labs is to develop the mathematical skills of the students in the areas of numerical methods, The explaining and understanding of the several available methods to Solve the simultaneous equations, Perform statistical data analysis, data interpolation by MATLAB and to calculate the numerical integration and differentiation, numerical solution of differentiation equation with MATLAB

Course Outcomes

On completion of this course, the students will be able to
CO1. To develop the mathematical skills of the students in the areas of numerical methods
CO2. The explaining and understanding of the several available methods to Solve the simultaneous equations.
CO3. Perform statistical data analysis, data interpolation by MATLAB.
CO4. To calculate the numerical integration and differentiation, numerical solution of differentiation equation with MATLAB

Catalog Description

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

- Understand the errors, source of error and its effect on any numerical computations and also analysis the efficiency of any numerical algorithms.
- Learn how to obtain numerical solution of nonlinear equations using bisection, secant, newton, and fixed-point iteration methods.
- Solve system of linear equations numerically using direct and iterative methods.
- Understand how to approximate the functions using interpolating polynomials.
- Learn how to solve definite integrals and initial value problems numerically.

Course Content

List of practical

1. Calculate the sum 1/1 + 1/2 + 1/3 + 1/4 + ----------+ 1/ N.
2. To find the absolute value of an integer.
3. Enter 100 integers into an array and sort them in an ascending order.
4. Bisection Method.
5. Newton Raphson Method.
6. Secant Method.
7. Regula-Falsi Method.
8. LU decomposition Method.
9. Gauss-Jacobi Method.
10. SOR Method or Gauss-Siedal Method.
11. Lagrange Interpolation or Newton Interpolation.
12. Simpson's rule
13. Solution of Ordinary Differential Equation

Note: For any of the CAS (Computer aided software) Data types-simple data types, floating datatypes, 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

Textbooks

1.B. S. Grewal, *Numerical Methods in Engineering and Science*, Khanna Publishers.

2. Brian Bradie (2006), A Friendly Introduction to Numerical Analysis. Pearson

3. C. F. Gerald & P. O. Wheatley (2008). Applied Numerical Analysis (7th edition), Pearson Education, India.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Conduct of Experiment	Attendance	Lab Record/ Quizzes/ Viva-Voice	End Term Practical Exam
Weightage (%)	**20**	**10**	**20**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	To develop the mathematical skills of the students in the areas of numerical methods	**PO9**
CO2	The explaining and understanding of the several available methods to Solve the simultaneous equations.	**PO10**
CO3	Perform statistical data analysis, data interpolation by MATLAB.	**PO9**
CO4	To calculate the numerical integration and differentiation, numerical solution of differentiation equation with MATLAB	**PO9**

	NUMERICAL ANALYSIS LAB	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate software's to solve mathematical equations	Capable to use appropriate software's to solve mathematical equations	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BS MA 371 A										3	3	3	3	2		2	2

1=weakly mapped

2= moderately mapped

3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1									**2**		**3**	**2**	**1**	**1**	**2**	**2**
CO2										**2**	**3**	**2**	**1**	**1**	**2**	**2**
CO3									**3**		**3**	**2**	**1**	**1**	**2**	**2**
CO4									**2**		**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA303A	SET THEORY AND METRIC SPACES	L	T	P	C
Version 2.0		5	1	0	6
Total Contact Hours	90 Hours				
Pre-requisites/Exposure	Basic knowledge of set theory				
Co-requisites	--				

Course Objectives

1. Learn basic facts about the cardinality of a set.
2. Understand several standard concepts of metric spaces and their properties like openness, closeness, completeness, Bolzano Weierstrass property, compactness, and connectedness.
3. Identify the continuity of a function defined on metric spaces and homeomorphisms.

Course Outcomes

On completion of this course, the students will be able to

CO1. Remember and understand important concepts of set theory, boundedness, compactness, and completeness.
CO2. Apply these concepts in other courses.
CO3. Analyze and correlate the difference between theorem, lemma and corollary.
CO4. Formulate and solve problems based upon compact set.
CO5. Formulate and solve problems based upon completeness axioms.
CO6. Write a research paper on metric spaces.

Catalog Description

This course imparts the basic concepts of set theory and metric spaces. It enables students to differentiate between open and closed metric spaces. This course helps students in variety of ways to solve the problems based upon supremum, infimum, maximum and minimum efficiently. The course introduces the basic concepts about Set theory, countability, bounded set and all properties of Metric Spaces. It also explains concept of connectedness.

Course Content

Unit I: **22 lecture hours**

Theory of Sets: Finite and infinite sets, Countable and uncountable sets, Cardinality of sets, S chröder Bernstein theorem, Cantor's theorem, Order relation in cardinal numbers, Arithmetic of cardinal numbers, Partially ordered set, Zorn's lemma and Axiom of choice, Various set theoretic paradoxes

Unit II: **22 lecture hours**

Concepts in Metric Spaces: Definition and examples of metric spaces, Open spheres and closed spheres, Neighbourhoods, Open sets, Interior, exterior and boundary points, Closed sets, Limit points and isolated points, Interior and closure of a set, Boundary of a set, Bounded sets, Distance between two sets, Diameter of a set, Subspace of a metric space

Unit III: **23 lecture hours**

Complete Metric Spaces and Continuous Functions: Cauchy and Convergent sequences, Completeness of metric spaces, Cantor's intersection theorem, Dense sets and separable spaces, nowhere dense sets and Baire's category theorem, Continuous and uniformly continuous functions, Homeomorphism, Banach contraction principle.

Unit IV: **23 lecture hours**

Compactness: Compact spaces, Sequential compactness, Bolzano Weir strass property, Compactness and finite intersection property, Heine Borel theorem, Totally bounded sets, Equivalence of compactness and sequential compactness, Continuous functions on compact spaces. Connectedness: Separated sets, Disconnected and connected sets, Components, Connected subsets of $\mathbb{R}$, Continuous functions on connected sets.

Textbooks

1. E. T. Copson (1988). Metric Spaces. Cambridge University Press.
2. P. R. Halmos (1974). Naive Set Theory. Springer.
3. P. K. Jain & Khalil Ahmad (2019). Metric Spaces. Narosa.
4. S. Kumaresan (2011). Topology of Metric Spaces (2^{nd} edition). Narosa.
5. Satish Shirali & Harikishan L. Vasudeva (2006). Metric Spaces. Springer-Verlag.
6. Micheál O'Searcoid (2009). Metric Spaces. Springer-Verlag.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Remember and understand important concepts of set theory,boundedness, compactness and completeness	**PO1,PO7**
CO2	Apply these concepts to connected and disconnected set	**PO5,PO7**
CO3	Analyze and correlate difference between theorem, lemma and corollary	**PO8,PO7**
CO4	Formulate and solve problems based upon compact set	**PO4,PO7**
CO5	Formulate and solve problems based upon completeness axioms	**PO4,PO7**
CO6	Write a research paper on metric spaces.	**PO4**

	SET THEORY AND METRIC SPACES	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BS MA 303 A		1			3	2		2	3			3	2	2	1	2	3

1=weakly mapped

2= moderately mapped

3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**						**2**				**3**	**2**	**1**	**1**	**2**	**2**
CO2					**3**		**2**				**3**	**2**	**1**	**1**	**2**	**2**
CO3							**2**	**2**			**3**	**2**	**1**	**1**	**2**	**2**
CO4				**2**			**2**				**3**	**2**	**1**	**1**	**2**	**2**
CO5				**2**			**2**				**3**	**2**	**1**	**1**	**2**	**2**
CO6				**3**							**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

VAC----	Ancient Science	L	T	P	C
		-	-	-	0

Course Objective:

In this course students will apply concepts of ancient science in advanced studies.Vedic mathematics is an ancient technique consisting of sixteen sutras and sixteensub-sutras. It simplifies not only the fundamental arithmetic operations,such as multiplication and division, but also more advanced concepts such as simultaneous equations, quadratic equations, the factorization of cubic equations, and so on. Vedic mathematical technique is rapidly emerging as a tool for students appearing in various competitive examinations, where speed and accuracy play a vital role. This course will make learners understand various phases of indian astronomy starting from Vedic era to post vedic and then to Modern astronomy era.

UNIT I: Techniques of Vedic Mathematics

Introduction of Vedic Mathematics, Base and Complements, Instant/Mental Subtraction General Subtractions, Magic with 11, Multiplication by 11 – 19, General/Random Multiplication, Multiplication with 99999 in less than 04 seconds (Type 1, 2 and 3).

UNIT II: Rapid operations using Vedic Mathematics

Multiplication of any number by 111, Multiplication of Numbers near Bases (Type 1, 2 and 3), General Squares/ Finding Squares in One Line, Faster Addition, Mental Addition.

UNIT III: Vedic Astronomy

Astronomical Facets of Vedic Era, Works of Rig Veda and Surya Sidhanta, mention of other unknown astronomers of Vedic era, Famous vedic stories linked with Astronomy.

UNIT IV: Evolution of Chemistry in Ancient India

History of the science of chemistry; Evolution of Chemistry in Ancient India-Vedic period, Indus Valley civilization, Harappan Culture, Mohanjodaro era, Gupta Empire and Rajputs Period; Contribution of ancient Indian Chemists, metallurgists, scholars; Modern Chemistry and its comparison to early chemistry in ancient time.

Course Outcomes:

CO1.Students will be able to undertake the basic Scientific knowledge about Indian Knowledge System

CO2. Students will be able to undertake a thoughtfulness of ancient indians and their role for the development in Mathematics,Physisc and Chemistry.

CO3. Students will demonstrates knowledge and awareness about major chemical products practisized in earliest civilizations

CO4. Understanding the impact of ancient indian scientists in the field of science & technology.

CO5. Capability to deal with future research development.

TEXTBOOK:

1. Datta, B., & Singh, A. N. (1935). History of Hindu mathematics I, II. *Delhi: Bharatiya Kala Prakashan.(Reprinted (2001))*.
2. Flood, G. (Ed.). (2008). *The blackwell companion to hinduism*. John Wiley & Sons.
3. Mohan, Chander. (2015). The story of astronomy in india.
4. L. Satpathy, Ancient Indian Astronomy and Contributions of Samanta Chandra Sekha, Publisher: Narosa Publishing House, 2003,ISBN 8173194327, 9788173194320
5. G. R. KAYE, (1998), HINDU ASTRONOMY, Publisher :Archaeological survey of india.

REFERENCES:

1. http://www.ms.uky.edu/~sohum/ma330/files/chennai_talks/Emch_Sridharan_Srinivas%20%20Contributions%20ot%20the%20History%20of%20Indian%20Mathematics%20(2005).pdf
2. https://www.youtube.com/watch?v=T0gCkyKVQUg
3. Hayashi, T. (1994). Indian mathematics. *Companion Encyclopedia of the History and Philosophy of the Mathematical Sciences, 1*, 118-130.
4. https://www.sanskritimagazine.com/vedic_science/surya-siddhanta-the-oldest-book-known-to-man-on-astro&#8230
5. "A history of Hindu chemistry from the earliest times to the middle of the 16th century, A.D.," by Acharya P. C. Roy;
6. "Rasa Ratnakararam," by Siddha Nitya Nath, with volumes "Rasa," "Rasayana," and"Ridhi"; "Rasaratna Samuccaya of 13th, 14th, or 16th century A.D.," by Baghbhatta;
7. "Ayurveda Prakasa," by Sri Madhava Upadhyaya;
8. A brief history of indian alchemy covering transitional andtantric periods (Circa 800 A.D. - 1300A. D) Momin AL
9. Inducting Rasayana Therapy in our Daily Routine by Dr. Krishna R.S

DISCIPLINE SPECIFIC ELECTIVES

BSMA305A	TENSORS AND DIFFERENTIAL GEOMETRY	L	T	P	C
Version 2.0		5	1	0	6
Total Contact Hours	90 Hours				
Pre-requisites/Exposure					
Co-requisites	--				

Objectives

1. Explain the basic concepts of tensors.
2. Understand role of tensors in differential geometry.
3. Learn various properties of curves including Frenet Serret formulae and their applications.
4. Know the Interpretation of the curvature tensor, Geodesic curvature, Gauss and Weingarten formulae.
5. Understand the role of Gauss's Theorema Egregium and its consequences.
6. Apply problem-solving with differential geometry to diverse situations in physics, engineering and in other mathematical contexts.

Course Outcomes

On completion of this course, the students will be able to

1. Understand concepts of tensor variables and difference from scalar or vector variables.
2. Understand the reason why the tensor analysis is used and explain usefulness of the tensor analysis.
3. Derive base vectors, metric tensors and strain tensors in an arbitrary coordinate system.
4. To get introduced to geodesics on a surface and their characterization. Discuss the fundamental Theorem for regular surfaces.
5. To understand geodesics as distance minimizing curves on surfaces and find geodesics on various surfaces.
6. To be introduced to Christoffel symbols and their expression in terms of metric coefficients and their derivatives.

Catalog Description

This course is an introduction to the basic machinery behind the modern differential geometry: tensors, differential forms, smooth manifolds and vector bundles. The geometries lying above these structures are involved in several applications through mathematical analysis, physics, stochastics and statistical modells. The central goal is to become familiar with this particular language of abstract mathematics that opens the venue to apply geometric methods in different applications. The course provides basic skills to recognize geometric phenomena in mathematical analysis and applications.

Course Content

Unit I: **22 lecture hours**

Contravariant and covariant vectors, Transformation formulae, Tensor product of two vector spaces, Tensor of type (r, s), Symmetric and skew-symmetric properties, Contraction of tensors, Quotient law, Inner product of vectors**.**

Unit II: **22 lecture hours**

Fundamental tensors, Associated covariant and contravariant vectors, Inclination of two vectors and orthogonal vectors, Christoffel symbols, Law of transformation of Christoffel symbols, Covariant derivatives of covariant and contravariant vectors, Covariant differentiation of tensors, Curvature tensor, Ricci tensor, Curvature tensor identities.

Unit III: **23 lecture hours**

Basic definitions and examples, Arc length, Curvature and the Frenet-Serret formulae, Fundamental existence and uniqueness theorem for curves, Non-unit speed curves.
Basic definitions and examples, The first fundamental form, Arc length of curves on surfaces, Normal curvature, Geodesic curvature, Gauss and Weingarten formulae, Geodesics, Parallel vector fields along a curve and parallelism.

Unit IV: **23 lecture hours**

Basic definitions and examples, The first fundamental form, Arc length of curves on surfaces, Normal curvature, Geodesic curvature, Gauss and Weingarten formulae, Geodesics, Parallel vector fields along a curve and parallelism.

Textbook

1. P.P.Gupta, G.S.Malik, *Differential Geometry*,Pragati Prakashan,2012.

Reference Books/Materials

1. Christian Bär (2010). Elementary Differential Geometry. Cambridge University Press.
2. Manfredo P. do Carmo (2016). Differential Geometry of Curves & Surfaces (Revised and updated 2nd edition). Dover Publications.
3. Alferd Gray (2018). Modern Differential Geometry of Curves and Surfaces with Mathematica (4th edition). Chapman & Hall/CRC Press, Taylor & Francis.
4. Richard S. Millman & George D. Parkar (1977). Elements of Differential Geometry. Prentice-Hall.
5. R. S. Mishra (1965). A Course in Tensors with Applications to Riemannian Geometry. Pothishala Pvt. Ltd.
6. Sebastián Montiel & Antonio Ross (2009). Curves and Surfaces. American Mathematical Society.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand concepts of tensor variables and difference from scalar or vector variables.	**PO1**
CO2	Understand the reason why the tensor analysis is used and explain usefulness of the tensor analysis.	**PO6**
CO3	Derive base vectors, metric tensors and strain tensors in an arbitrary coordinate system.	**PO2**
CO4	To get introduced to geodesics on a surface and their characterization. Discuss the fundamental Theorem for regular surfaces.	**PO4**
CO5	To understand geodesics as distance minimizing curves on surfaces and find geodesics on various surfaces.	**PO3**
CO6	To be introduced to Christoffel symbols and their expression in terms of metric coefficients and their derivatives	**PO2**

		Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate software's to solve mathematical equations	Capable to use appropriate software's to solve mathematical equations	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	**TENSOR AND DIFFERENTIAL GEOMETRY**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BS MA 305 A	Course Title	2	2	3	2				2			3		3			2

1=weakly mapped 2= moderately mapped 3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**										**3**	**2**	**1**	**1**	**2**	**2**
CO2						**2**					**3**	**2**	**1**	**1**	**2**	**2**
CO3		**2**									**3**	**2**	**1**	**1**	**2**	**2**
CO4				**3**							**3**	**2**	**1**	**1**	**2**	**2**
CO5			**2**								**3**	**2**	**1**	**1**	**2**	**2**
CO6		**3**									**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

Course Objectives

1. Provide the brief knowledge of Mathematical logic.
2. To understand and find the Structures of first order languages.
3. Solve the Semantics of propositional logic and Compactness theorem for propositional logic.
4. Identify the applications of Consistency and completeness.
5. Apply Compactness theorem and applications appearing in social sciences, physical sciences,
   life sciences and a host of other disciplines.

Course Outcomes

On completion of this course, the students will be able to

CO1. Apply the syntax of first-order logic and semantics of first-order languages in real world.

CO2. Recognize and learn Learn the syntax of first-order logic and semantics of first-order languages.

CO3. Understand the propositional logic and basic theorems like compactness theorem, meta theorem and post-tautology theorem.

CO4. Assimilate the concept of completeness interpretations and their applications with special emphasis on applications in algebra.

CO5. Recognize and apply the applications of Consistency and completeness

CO6. Determine compactness theorem and applications appearing in social sciences, physical sciences, life sciences and a host of other disciplines.

Catalog Description

Mathematical logic is indeed a beautiful and useful branch of mathematics. It is one of the classical subjects with most of the main results extending back into the nineteenth century and earlier. Yet, the subject is far from dormant. It is a launching point for many areas of research and it continues to find new areas of applicability, from pure mathematics to applied physics. Many of the giants of mathematics have contributed to the development of mathematical logic. Important objectives of mathematical logic is to develop and strengthen the students' problem-solving skills and to teach them to read, write, speak, and think in the language of mathematics. In particular, students learn how to apply the tools of calculus to a variety of problem situations.

Course Content

Unit I: **22 lecture hours**

Syntax of First-order Logic: First-order languages, Terms of language, Formulas of language, First order theory.

Unit II: **22 lecture hours**

Semantics of First-order Languages: Structures of first order languages, Truth in a structure, Model of a theory, Embedding and isomorphism.

Unit III: **23 lecture hours**

Propositional Logics: Syntax of propositional logic, Semantics of propositional logic, Compactness theorem for propositional logic, Proof in propositional logic, Meta theorem in propositional logic, Post
Tautology theorem.

Unit IV: **23 lecture hours**

Proof and Meta Theorems in First-order Logic: Proof in first-order logic, Meta theorems in first-order logic, some Meta theorem in arithmetic, Consistency and completeness.

Completeness Theorem and Model Theory: Completeness theorem, Interpretation in a theory, Extension by definitions, Compactness theorem and applications, complete theories, Applications in algebra

Reference Books/Materials

1. Richard E. Hodel (2013). An Introduction to Mathematical Logic. Dover Publications.
2. Yu I. Manin (2010). A Course in Mathematical Logic for Mathematicians (2^{nd} edition). Springer.
3. Elliott Mendelson (2015). Introduction to Mathematical Logic (6th edition). Chapman & Hall/CRC.
4. Shashi Mohan Srivastava (2013). A Course on Mathematical Logic (2nd edition). Springer.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Apply the syntax of first-order logic and semantics of first-order languages in real world.	**PO1**
CO2	Recognize and learn Learn the syntax of first-order logic and semantics of first-order languages.	**PO8**
CO3	Understand the propositional logic and basic theorems like compactness theorem, meta theorem and post-tautology theorem.	**PO2**
CO4	Assimilate the concept of completeness interpretations and their applications with special emphasis on applications in algebra.	**PO4**
CO5	Recognize and apply the applications of Consistency and completeness	**PO3**
CO6	Determine compactness theorem and applications appearing in social sciences, physical sciences, life sciences and a host of other disciplines.	**PO1**

	MATHEMATICAL LOGIC	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate software's to solve mathematical equations	Capable to use appropriate software's to solve mathematical equations	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA 307A		2	3	3	2				2			3		3			2

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**										**3**	**2**	**1**	**1**	**2**	**2**
CO2								**2**			**3**	**2**	**1**	**1**	**2**	**2**
CO3		**2**									**3**	**2**	**1**	**1**	**2**	**2**
CO4				**3**							**3**	**2**	**1**	**1**	**2**	**2**
CO5			**2**								**3**	**2**	**1**	**1**	**2**	**2**
CO6	**3**										**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA309A	INTEGRAL TRANSFORMS AND FOURIER ANALYSIS	L	T	P	C
Version 2.0		5	1	0	6
Total Contact Hours	90 Hours				
Pre-requisites/Exposure	Basic knowledge of Trigonometry, Integration and Differentiation				
Co-requisites	--				

Course Objectives

This course will enable the students to:

1. Know about piecewise continuous functions, Dirac delta function, Laplace transforms and its properties.
2. Solve ordinary differential equations using Laplace transforms.
3. Familiarise with Fourier transforms of functions, relation between Laplace and Fourier transforms.
4. Explain Parseval's identity, Plancherel's theorem and applications of Fourier transforms to boundary value problems.
5. Learn Fourier series, Bessel's inequality, term by term differentiation and integration of Fourier series.
6. Apply the concepts of the course in real life problems.

Course Outcomes

On completion of this course, the students will be able to

CO1. Remember and understand important concepts of Laplace and Fourier Transform.
CO2. Apply these concepts in other courses such as Electronics and Signal Processing.
CO3. Analyze and correlate the difference between Fourier series and transform.
CO4. Formulate and solve problems based upon various Integral Transforms.
CO5. Write a research article on the application of Fourier transform.
CO6. Compare various Integral transforms.

Catalog Description

This course imparts the basic concepts of Know about piecewise continuous functions, Dirac delta function, Laplace transforms and its properties. It enables students to solve ordinary differential equations using Laplace transforms. Familiarise with Fourier transforms of functions, relation between Laplace and Fourier transforms. This course explain Parseval's identity, Plancherel's theorem and applications of Fourier transforms to boundary value problems.Students will learn Fourier series, Bessel's inequality, term by term differentiation and integration of Fourier series.

Course Content

Unit I: **22 lecture hours**

Laplace Transforms: Laplace transform, Linearity, Existence theorem, Laplace transforms of derivatives and integrals, Shifting theorems, Change of scale property, Laplace transforms of periodic functions, Dirac's delta function.

Unit II: **22 lecture hours**

Further Properties of Laplace Transforms and Applications: Differentiation and integration of transforms, Convolution theorem, Integral equations, Inverse Laplace transform, Lerch's theorem, Linearity property of inverse Laplace transform, Translations theorems of inverse Laplace transform, Inverse transform of derivatives, Applications of Laplace transform in obtaining solutions of ordinary differential equations and integral equations.

Unit III: **23 lecture hours**

Fourier Transforms: Fourier and inverse Fourier transforms, Fourier sine and cosine transforms, Inverse Fourier sine and cosine transforms, Linearity property, Change of scale property, Shifting property, Modulation theorem, Relation between Fourier and Laplace transforms.

Solution of Equations by Fourier Transforms: Solution of integral equation by Fourier sine and cosine transforms, Convolution theorem for Fourier transform, Parseval's identity for Fourier transform, Plancherel's theorem, Fourier transform of derivatives, Applications of infinite Fourier transforms to boundary value problems, Finite Fourier transform, Inversion formula for finite Fourier transforms.

Unit IV: **23 lecture hours**

Fourier Series: Fourier cosine and sine series, Fourier series, Differentiation and integration of Fourier series, Absolute and uniform convergence of Fourier series, Bessel's inequality, The complex form of Fourier series.

Textbooks

1. James Ward Brown & Ruel V. Churchill (2011). Fourier Series and Boundary Value Problems. McGraw-Hill Education.
2. Charles K. Chui (1992). An Introduction to Wavelets. Academic Press.
3. Erwin Kreyszig (2011). Advanced Engineering Mathematics (10^{th} edition). Wiley.
4. Walter Rudin (2017). Fourier analysis on Groups. Dover Publications.
5. A. Zygmund (2002).Trigonometric Series (3^{rd} edition). Cambridge University Press.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Remember and understand important concepts of Laplace and Fourier Transform	**PO1,PO7**
CO2	Apply these concepts in other courses such as Electronics and Signal Processing.	**PO5,PO7**
CO3	Analyze and correlate difference between Fourier series and Transform.	**PO8,PO7**
CO4	Formulate and solve problems based upon various Integral Transforms.	**PO4,PO7**
CO5	Write research article on the application of Fourier transform	**PO7**
CO6	Compare various Integral transforms	**PO4**

	INTEGRAL TRANSFORMS AND FOURIER ANALYSIS	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA309A		1			3	3		3	3			3	3	3	1	3	3

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**						**2**				**3**	**2**	**1**	**1**	**2**	**2**
CO2					**2**		**2**				**3**	**2**	**1**	**1**	**2**	**2**
CO3							**2**	**2**			**3**	**2**	**1**	**1**	**2**	**2**
CO4				**3**			**2**				**3**	**2**	**1**	**1**	**2**	**2**
CO5							**2**				**3**	**2**	**1**	**1**	**2**	**2**
CO6				**3**							**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA311A	INFORMATION THEORY AND CODING	L	T	P	C
Version 1.0		5	1	0	6
Total Contact Hours	**90 Hours**				
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

1 Understand and explain the basic concepts of information theory, source coding, channel and channel capacity, cha`nnel coding and relation among them.

2 Describe the real-life applications based on the fundamental theory.

3 Calculate entropy, channel capacity, bit error rate, code rate, and steady-state probability and so on.

4 Implement the encoder and decoder of one block code or convolution code using any program language.

Course Outcomes

On completion of this course, the students will be able to

CO1 Study simple ideal statistical communication models.

CO2 Understand the development of codes for transmission and detection of information.

CO3 Learn about the input and output of a signal via transmission channel.

CO4 Study detection and correction of errors during transmission.

CO5 Represent a linear code by matrices - encoding and decoding.

CO6 Explain how this quantitative measure of information may be used in order to build efficient solutions to multitudinous engineering problems

Catalog Description

Information produced in many ways every day such as text, image, video etc. If directly stored as it received makes the security in question mark also it occupies more storage area. This course discusses about the various forms of information and its storage methods.

Course Content

UNIT-I **22 Lectures**

Concepts of Information Theory: Communication processes, A model of communication system, A quantitative measure of information, Binary unit of information, A measure of uncertainty, *H* function as a measure of uncertainty, Sources and binary sources, Measure of information for two-dimensional discrete finite probability schemes.

UNIT-II **22 Lectures**

Entropy Function: A sketch of communication network, Entropy, Basic relationship among different entropies, A measure of mutual information, Interpretation of Shannon's fundamental inequalities; Redundancy, efficiency, and channel capacity; Binary symmetric channel, Binary erasure channel, Uniqueness of the entropy function, Joint entropy and conditional entropy, Relative entropy and mutual information, Chain rules for entropy, Conditional relative entropy and conditional mutual information, Jensen's inequality and its characterizations, The log sum inequality and its applications.

UNIT-III **23 Lectures**

Concepts of Coding: Block codes, Hamming distance, Maximum likelihood decoding, Levels of error handling, Error correction, Error detection, Erasure correction, Construction of finite fields, Linear codes, Matrix representation of linear codes, Hamming codes.

UNIT-IV **23 Lectures**

Bounds of Codes: Orthogonality relation, Encoding and decoding of linear codes, The singleton bound and maximum distance separable codes, The sphere-packing bound and perfect codes, The Gilbert-Varshamov bound, MacWilliams' identities.

Cyclic Codes: Definition and examples of cyclic codes, Generator polynomial and check polynomial, Generator matrix and check matrix, Bose-Chaudhuri-Hocquenghem (BCH) code as a cyclic code.

Reference Books/Materials

1. Robert B. Ash, (2014). *Information Theory*. Dover Publications.
2. Thomas M. Cover & Joy A. Thomas (2013). *Elements of Information Theory* (2nd edition). Wiley India Pvt. Ltd.
3. Joseph A. Gallian (2017). *Contemporary Abstract Algebra* (9th edition), Cengage.
4. Fazlollah M. Reza, (2003). *An Introduction to Information Theory*. Dover Publications.
5. Ron M. Roth (2007). *Introduction to Coding Theory*. Cambridge University Press.
6. Claude E. Shannon & Warren Weaver (1969). *The Mathematical Theory of Communication*. The University of Illinios Press.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Study simple ideal statistical communication models.	**PO1**
CO2	Understand the development of codes for transmission and detection of information.	**PO5**
CO3	Learn about the input and output of a signal via transmission channel.	**PO2**
CO4	Study detection and correction of errors during transmission.	**PO3**
CO5	Represent a linear code by matrices - encoding and decoding.	**PO6**
CO6	Explain how this quantitative measure of information may be used in order to build efficient solutions to multitudinous engineering problems	**PO4**

		Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
	INFORMATION THEORY AND CODING																
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BS MA 311 A		2	2	3	2	2	3					3		2	2		

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**										**3**	**2**	**1**	**1**	**2**	**2**
CO2					**2**						**3**	**2**	**1**	**1**	**2**	**2**
CO3		**3**									**3**	**2**	**1**	**1**	**2**	**2**
CO4			**2**								**3**	**2**	**1**	**1**	**2**	**2**
CO5						**3**					**3**	**2**	**1**	**1**	**2**	**2**
CO6				**3**							**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA313A	GRAPH THEORY	L	T	P	C
Version 1.0		5	1	0	6
Total Contact Hours	90 Hours				
Pre-requisites/Exposure	--				
Co-requisites	Computer Programming				

Course Objectives

1 To expose to a wide variety of mathematical concepts that are used in the Computer Science discipline, which may include concepts drawn from the areas of Number Theory, Graph Theory and Combinatorics.

2 To come across a number of theorems and proofs. Theorems will be stated and proved formally using various techniques.

3 To gain the various graphs algorithms along with its analysis.

4 To apply graph theory based tools in solving practical problems.

Course Outcomes

On completion of this course, the students will be able to

CO1 model and analyze computational processes using analytic and combinatorial methods
CO2 read and write graph theory in a coherent and technically accurate manner.
CO3 solve the problems of graph theory using graph algorithms
CO4 apply computer programs (e.g. SAGE) to study graphs.
CO5 apply counting techniques to solve combinatorial problems and identify, formulate, and solve computational problems in various fields.
CO6 apply graph theory in the areas of computer science, operation research, biology, chemistry, physics, sociology, and engineering

Catalog Description

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.

Course Content

UNIT-I **22 Lectures**

Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bi-partite graphs, directed graphs, sub graphs, matrix representations, degree, operations on graphs, degree sequences, isomorphism of graphs.

UNIT-II **22 Lectures**

Walks, trails, paths, circuits, connected graphs, distance, eulerian circuits, hamiltonian cycles, cut-vertices, cut-edges, blocks, connectivity, weighted graphs, travelling salesman's problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm.

UNIT-III **23 Lectures**

Planar graphs, eulers formula, polyhedrons and planar graphs, charactrizations, planarity testing, vertex colorings, edge colorings, Five Colour Theorem and four colour Theorem - statement only, cliques and independent sets, ramsey numbers.

UNIT-IV **23 Lectures**

Characterizations of trees, rooted trees, spanning tree, minimum-spanning tree, flow network in a graph, max-flow-min cut theorem, matchings, maximal and maximum matchings.

Reference Books/Materials

1. J.A.Bondy and U.S.R.Murthy, Graph Theory with applications, Elsevier Science Ltd.
2. C.L. Liu & Mahopatra; *Elements of Discrete mathematics*, Tata McGraw Hill.
3. N. Deo, Graph Theory with Applications to Computer Science, Prentice-Hall of India.
4. Kenneth H. Rosen; *Discrete Mathematics and Its Applications*, McGraw-Hill Education.
5. D.B.West: Introduction to Graph Theory, Pearson Education India;
6. R.Diestel: Graph Theory, Springer-Verlag New York Inc.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	model and analyze computational processes using analytic and combinatorial methods	**PO8**
CO2	read and write graph theory in a coherent and technically accurate manner.	**PO3**
CO3	solve the problems of graph theory using graph algorithms	**PO2**
CO4	apply computer programs (e.g. SAGE) to study graphs.	**PO7**
CO5	apply counting techniques to solve combinatorial problems and identify, formulate, and solve computational problems in various fields.	**PO1**
CO6	apply graph theory in the areas of computer science, operation research, biology, chemistry, physics, sociology, and engineering	**PO5**

		Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
	GRAPH THEORY																
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA 313A		2	3	2		3		3	2			3		2	1		3

1=weakly mapped

2= moderately mapped

3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1								**3**			**3**	**2**	**1**	**1**	**2**	**2**
CO2			**2**								**3**	**2**	**1**	**1**	**2**	**2**
CO3		**3**									**3**	**2**	**1**	**1**	**2**	**2**
CO4							**2**				**3**	**2**	**1**	**1**	**2**	**2**
CO5	**3**										**3**	**2**	**1**	**1**	**2**	**2**
CO6					**3**						**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA315A	SPECIAL THEORY OF RELATIVITY	L	T	P	C
Version1.0		5	1	0	6
Total Contact Hours	90 Hours				
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. Provide brief knowledge of the basic elements of Newtonian mechanics including Michelson-Morley, experiment, and geometrical interpretations of Lorentz transformation equations.
2. To understand the length contraction, time dilation and Lorentz contraction factor.
3. Identify and solve 4-dimensional Minkowskian space-time and its consequences.
4. Understand equations of motion as a part of relativistic mechanics.
5. Find the connections between relativistic mechanics and electromagnetism.

Course Outcomes

On completion of this course, the students will be able to

CO1. Applied Newtonian mechanics including Michelson-Morley, experiment and geometrical interpretations of Lorentz transformation equations.

CO2. Appreciate the length contraction, time dilation and Lorentz contraction factor.

CO3. Recognize and learn to solve 4-dimensional Minkowskian space-time and its consequences.

CO4. Determine the equations of motion as a part of relativistic mechanics.

CO5. Apply the connections between relativistic mechanics and electromagnetism.

CO6. Compare various transformation equations

Catalog Description

Special theory and Relativity is indeed a beautiful and useful branch of mathematics. It is one of the classical subjects with most of the main results extending back into the nineteenth century and earlier. Yet, the subject is far from dormant. It is a launching point for many areas of research and it continues to find new areas of applicability, from pure mathematics to applied physics. Many of the giants of mathematics have contributed to the development of Special theory and Relativity. Important objectives of the Special theory and Relativity is to develop and strengthen the students' problem-solving skills and to teach them to read, write, speak, and think in the language of mathematics. In particular, students learn how to apply the tools of calculus to a variety of problem situations.

Course Content

Unit I: **22 lecture hours**

Newtonian Mechanics: Inertial frames, Speed of light and Gallilean relativity, Michelson-Morley experiment, Lorentz-Fitzgerold contraction hypothesis, Relative character of space and time, Postulates of special theory of relativity, Lorentz transformation equations and its geometrical interpretation, Group properties of Lorentz transformations.

Unit II: **23 lecture hours**

Relativistic Kinematics: Line integral, Path independence, Complex integration, Green's theorem, Anti-derivative theorem, Cauchy-Goursat theorem, Cauchy integral formula, Cauchy's inequality, Derivative of analytic function, Liouville's theorem, Fundamental theorem of algebra, Maximum modulus theorem and its consequences.

Geometrical representation of space-time: Four dimensional Minkowskian space-time of special relativity, Time-like, light-like and space-like intervals, Null cone, Proper time, World line of a particle, Four vectors and tensors in Minkowiskian space-time.

Unit III: **23 lecture hours**

Relativistic Mechanics: Variation of mass with velocity. Equivalence of mass and energy. Transformation equations for mass momentum and energy. Energy-momentum four vector. Relativistic force and Transformation equations for its components. Relativistic equations of motion of a particle.

Unit IV: **22 lecture hours**

Electromagnetism: Transformation equations for the densities of electric charge and current. Transformation equations for electric and magnetic field strengths. The Field of a Uniformly Moving Point charge. Forces and fields near a current carrying wire. Forces between moving charges. The invariance of Maxwell`s equations.

Textbooks

1. James L. Anderson (1973). Principles of Relativity Physics. Academic Press.

Reference Books/Materials

1. Peter Gabriel Bergmann (1976). Introduction to the Theory of Relativity. Dover Publications.
2. C. Moller (1972). The Theory of Relativity (2nd edition). Oxford University Press.
3. Robert Resnick (2007). Introduction to Special Relativity. Wiley.
4. Wolfgang Rindler (1977). Essential Relativity: Special, General, and Cosmological. Springer-Verlag.
5. V. A. Ugarov (1979). Special Theory of Relativity. Mir Publishers, Moscow.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Applied Newtonian mechanics including Michelson-Morley, experiment and geometrical interpretations of Lorentz transformation equations.	**PO1**
CO2	Appreciate the length contraction, time dilation and Lorentz contraction factor.	**PO8**
CO3	Recognize and learn to solve 4-dimensional Minkowskian space-time and its consequences.	**PO2**
CO4	Determine the equations of motion as a part of relativistic mechanics.	**PO4**
CO5	Apply the connections between relativistic mechanics and electromagnetism.	**PO3**
CO6	Compare various transformation equations	**PO7**

	SPECIAL THEORY OF RELATIVITY	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate software's to solve mathematical equations	Capable to use appropriate software's to solve mathematical equations	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA 315A		2	3	3	2			3	2			3		3			2

1=weakly mapped

2= moderately mapped

3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**										**3**	**2**	**1**	**1**	**2**	**2**
CO2								**2**			**3**	**2**	**1**	**1**	**2**	**2**
CO3		**3**									**3**	**2**	**1**	**1**	**2**	**2**
CO4				**3**							**3**	**2**	**1**	**1**	**2**	**2**
CO5			**2**								**3**	**2**	**1**	**1**	**2**	**2**
CO6							**3**				**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA327A	DYNAMICS	L	T	P	C
Version 1.0		5	1	0	6
Total Contact Hours	90 Hours				
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. The students will introduce about the forces, angular momentum, and knowledge about the Constraint.
2. Provide a brief knowledge of dynamic.
3. The students will learn about the application of dynamics in mathematics.

Course Outcomes

This course will enable the students to:

1. Resolve the motion of single particles in multiple coordinate systems,
2. Demonstrate the motion of multiple particles in constrained motion.
3. Use the equations of motion to compute the position, velocity, and acceleration of multiple points on rigid bodies in constrained motion.
4. Apply the basic concepts of force, mass and acceleration; of work and energy; and of impulse and momentum for particles and rigid bodies

Catalog Description

After completing this course the student able to: inertia constants for a rigid body and the equation of momenta ellipsoid together with the idea of principal axes and deal with two-dimensional fluid motion using the complex potential and also to understand the concepts of sources, sinks, doublets and the image systems of these with regard to a line and a circle.

Course Content

Unit I: 22 lecture hours

Velocity and acceleration along radial, transverse, tangential and normal directions. Relative velocity and acceleration.

Unit II: **22 lecture hours**

Simple harmonic motion. Motion under different Laws of forces, Elastic strings.

Unit III: **23 lecture hours**

Motion on smooth and rough plane curves, Projectile motion of a particle in a plane, Vector angular velocity.

Unit IV: **23 lecture hours**

General motion of a rigid body. Central Orbits, Kepler laws of motion, Motion of a particle in three dimensions. Acceleration in terms of different co-ordinate systems

Text Books S.L.Loney, An Elementary Treatise on the Dynamics of a Particle and a Rigid Bodies, Cambridge University Press

Reference Books/Materials

1. F. Chorlton; Dynamics*;* CBS Publishers, New Delhi.

2. A.S. Ramsey; *Dynamics Part-1&2*; CBS Publisher & Distributors.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Assignment/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Velocity and acceleration along radial, transverse, tangential and normal directions	**PO1**
CO2	Simple harmonic motion. Motion under different Laws of forces	**PO3**
CO3	Motion on smooth and rough plane curves, Projectile motion of a particle in a plane	**PO5**
CO4	General motion of a rigid body. Central Orbits	**PO2**
CO5	Motion of a particle in three dimensions.	**PO8**

	ADVANCED MECHANICS	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate software's to solve mathematical equations	Capable to use appropriate software's to solve mathematical equations	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BS MA 306 A		2	2	2		3			2								

1=weakly mapped

2= moderately mapped

3=strongly mapped

Programme and Course Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PSO 1	PSO 2	PSO3	PSO4	PSO5	PSO6
CO1	**2**										**3**	**2**	**1**	**1**	**2**	**2**
CO2			**3**								**3**	**2**	**1**	**1**	**2**	**2**
CO3					**2**						**3**	**2**	**1**	**1**	**2**	**2**
CO4		**3**									**3**	**2**	**1**	**1**	**2**	**2**
CO5								**3**			**3**	**2**	**1**	**1**	**2**	**2**

1=lightly mapped 2= moderately mapped 3=strongly mapped

Semester VI

BSMA302A	COMPLEX ANALYSIS	L	T	P	C
Version 2.0		4	0	0	4
Total Contact Hours	60 Hours				
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. Provide the brief knowledge of Complex number.
2. To understand and find the limit and continuity of the Complex variable function.
3. Solve the Analytic function and its properties.
4. Identify the applications of Cauchy Integral formula and Residues.
5. Apply Taylor and Laurent series expansions appearing in social sciences, physical sciences, life sciences and a host of other disciplines.

Course Outcomes

On completion of this course, the students will be able to

1. Applied Visualize complex numbers as points of $\mathbb{R}$ and stereographic projection of complex plane on the Riemann sphere.
2. Appreciate the significance of differentiability and analyticity of complex functions leading to the Cauchy-Riemann equations.
3. Recognize and learn the role of Cauchy-Goursat theorem and Cauchy integral formula in evaluation of contour integrals.
4. Apply Liouville's theorem in fundamental theorem of algebra.
5. Determine the convergence, term by term integration and differentiation of a power series.
6. Apply Taylor and Laurent series expansions of analytic functions, classify the nature of singularity, poles and residues and application of Cauchy Residue theorem.

Catalog Description

Complex analysis is indeed a beautiful and useful branch of mathematics. It is one of the classical subjects with most of the main results extending back into the nineteenth century and earlier. Yet, the subject is far from dormant. It is a launching point for many areas of research and it continues to find new areas of applicability, from pure mathematics to applied physics. Many of the giants of mathematics have contributed to the development of complex analysis. Important objectives of the Complex analysis is to develop and strengthen the students' problem-solving skills and to teach them to read, write, speak, and think in the language of mathematics. In particular, students learn how to apply the tools of calculus to a variety of problem situations.

Course Content

Unit I: **14 lecture hours**

Complex Plane and functions: Complex numbers and their representation, algebra of complex numbers; Complex plane, Open set, Domain and region in complex plane; Stereographic projection and Riemann sphere; Complex functions and their limits including limit at infinity; Continuity, Linear fractional transformations and their geometrical properties.

Unit II: **14 lecture hours**

Analytic Functions and Cauchy-Riemann Equations: Differentiability of a complex valued function, Cauchy-Riemann equations, Harmonic functions, necessary and sufficient conditions for differentiability, Analytic functions; Analyticity and zeros of exponential, trigonometric and logarithmic functions; Branch cut and branch of multi-valued functions.

Unit III: **17 lecture hours**

Cauchy's Theorems and Fundamental Theorem of Algebra: Line integral, Path independence, Complex integration, Green's theorem, Anti-derivative theorem, Cauchy-Goursat theorem, Cauchy integral formula, Cauchy's inequality, Derivative of analytic function, Liouville's theorem, Fundamental theorem of algebra, Maximum modulus theorem and its consequences.

Unit IV: **15 lecture hours**

Power Series: Sequences, series and their convergence, Taylor series and Laurent series of analytic functions, Power series, Radius of convergence, Integration and differentiation of power series, Absolute and uniform convergence of power series.

Singularities and Contour Integration: Meromorphic functions, Zeros and poles of meromorphic functions, Nature of singularities, Picard's theorem, Residues, Cauchy's residue theorem, Argument principle, Rouche's theorem, Jordan's lemma, Evaluation of proper and improper integrals.

Textbooks

1. (AR) A.R. Vashisth, Complex Analysis, krishana prakashan Media, Meerut, 1942.i.

Reference Books/Materials

1. J.B. Conway, Functions of One Complex Variable, 2nd ed., Narosa, New Delhi, 1978.
2. T.W. Gamelin, Complex Analysis, Springer International Edition, 2001.
3. R. Remmert, Theory of Complex Functions, Springer Verlag, 1991.
4. A.R. Shastri, An Introduction to Complex Analysis, Macmilan India, New Delhi, 1999.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Applied Visualize complex numbers as points of $\mathbb{R}$ and stereographic projection of complex plane on the Riemann sphere.	**PO1**
CO2	Appreciate the significance of differentiability and analyticity of complex functions leading to the Cauchy-Riemann equations.	**PO8**
CO3	Recognize and learn the role of Cauchy-Goursat theorem and Cauchy integral formula in evaluation of contour integrals.	**PO2**
CO4	Apply Liouville's theorem in fundamental theorem of algebra.	**PO4**
CO5	Determine the convergence, term by term integration and differentiation of a power series.	**PO3**
CO6	Apply Taylor and Laurent series expansions of analytic functions, classify the nature of singularity, poles and residues and application of Cauchy Residue theorem.	**PO1**

	COMPLEX ANALYSIS	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate software's to solve mathematical equations	Capable to use appropriate software's to solve mathematical equations	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BS MA 302 A		2	3	3	2				2			3		3			2

1=weakly mapped

2= moderately mapped

3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**										**3**	**2**	**1**	**1**	**2**	**2**
CO2								**2**			**3**	**2**	**1**	**1**	**2**	**2**
CO3		**3**									**3**	**2**	**1**	**1**	**2**	**2**
CO4				**3**							**3**	**2**	**1**	**1**	**2**	**2**
CO5			**2**								**3**	**2**	**1**	**1**	**2**	**2**
CO6							**3**				**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA372A	COMPLEX ANALYSIS LAB	L	T	P	C
Version 1.0		0	0	4	2
Total Contact Hours	30 Hours				
Pre-requisites/Exposure					
Co-requisites	MATLAB SOFTWARE				

Course Objectives

The purpose of these labs is to help students talk and write in meaningful ways about mathematics. Specifically, to describe quantities and changes in quantities clearly in terms of context, to make rigorous arguments about how such quantities are related, and to make connections between these features in the contexts and on graphs.

Course Outcomes

On completion of this course, the students will be able to

CO1. Test program output for accuracy using hand calculations and plotting the different type of the complex function's graphs.

CO2. Analyses the applicability solve of Taylor series expansion and Laurent series.

CO3. Determine different types of poles and corresponding residues of complex functions.

CO4. The ability to draw Conformal Mapping and Bilinear Transformations graphs.

CO5. Write efficient, well-documented MATLAB code and present numerical results in an informative way of different real-life problems.

Catalog Description

It is one of the classical lab of complex analysis with most of the main results extending back into the nineteenth century and earlier. Yet, the subject is far from dormant. It is a launching point for many areas of research and it continues to find new areas of applicability, from pure mathematics to applied physics. Many of the giants of mathematics have contributed to the development of complex analysis. Important objectives of the Complex analysis lab is to develop and strengthen the students' problem-solving skills and to teach them to read, write, speak, and think in the language of mathematics. In particular, students learn how to apply the tools of calculus to a variety of problem situations.

Course Content

List of practical

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.

6. To plot the complex functions and analyse the graph.
   e.g., (i) f(z) = Z (ii) f(z)=Z3 (iii) f(z) = $(Z^4$-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 Laurent's 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.

NOTE: Ten experiments are to be performed, out of which at least seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & setup by the concerned person as per the scope of the syllabus.

Reference Books/Materials

1. J.B. Conway, Functions of One Complex Variable, 2nd ed., Narosa, New Delhi, 1978.
2. T.W. Gamelin, Complex Analysis, Springer International Edition, 2001.
3. Rudra Pratap; Getting Started with MATLAB 7, Oxford Press.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Conduct of Experiment	Attendance	Lab Record/ Quizzes/ Viva-Voice	End Term Practical Exam
Weightage (%)	**20**	**10**	**20**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Test program output for accuracy using hand calculations and plotting the different type of the complex function's graphs	**PO9**
CO2	Analyses the applicability solve of Taylor series expansion and Laurent series	**PO9**
CO3	Determine different types of poles and corresponding residues of complex functions	**PO9**
CO4	The ability to draw Conformal Mapping and Bilinear Transformations graphs	**PO9**
CO5	Write efficient, well-documented MATLAB code and present numerical results in an informative way of different real-life problems.	**PO9**

	CoMPLEX ANALYSIS LAB	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate software's to solve mathematical equations	Capable to use appropriate software's to solve mathematical equations	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA 372A										3	3	3	3	2	3	3	

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1									**3**		**3**	**2**	**1**	**1**	**2**	**2**
CO2									**3**		**3**	**2**	**1**	**1**	**2**	**2**
CO3									**3**		**3**	**2**	**1**	**1**	**2**	**2**
CO4									**3**		**3**	**2**	**1**	**1**	**2**	**2**
CO5									**3**		**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA304A	LINEAR PROGRAMMING	L	T	P	C
Version 2.0		4	0	0	4
Total Contact Hours	60 Hours				
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. Analyze and solve linear programming models of real-life situations.
2. Provide graphical solutions of linear programming problems with two variables, and illustrate the concept of convex set and extreme points.
3. Understand the theory of the simplex method.
4. Know about the relationships between the primal and dual problems, and to understand sensitivity analysis.
5. Learn about the applications to transportation, assignment and two-person zero-sum game problems.

Course Outcomes

On completion of this course, the students will be able to

CO1- Understand the origin and development of operation research, linear programming.
CO2- Analyze the real-life systems with limited constraints, Identify and formulate the problem.
CO3- Used the theory of the simplex method, and their cases.
CO4- Check and find a solution by Duality of simplex method, two phase method.
CO5- Investigate the Maximize the profit, minimize the cost, minimize the time in transportation problem.
CO6 Analyze the application of liner programming : Assignment problem

Catalog Description

This course covers some core areas of Operational Research, namely Linear programming, Transportation problem, Assignment problem and Game Theory. Emphasis will be placed both on the mathematical techniques and on problem formulation through examples from applications.

Course Content

UNIT – I **14 lecture hours**

Linear Programming Problem, Convexity and Basic Feasible Solutions,Formulation, Canonical and standard forms, Graphical method; Convex and polyhedral sets,Hyperplanes, Extreme points; Basic solutions, Basic Feasible Solutions, Reduction of feasible solution to basic feasible solution, Correspondence between basic feasible solutions and extreme points.

Unit II **14 lecture hours**

Simplex Method

Optimality criterion, improving a basic feasible solution, Unboundedness, Unique and alternate optimal solutions; Simplex algorithm and its tableau format; Artificial variables, Two-phase method, Big-M method**.**

Unit III **15 lecture hours**

Formulation of the dual problem, Duality theorems, Complimentary slackness theorem, Economic interpretation of the dual, Dual-simplex method.

Unit IV: **17 lecture hours**

Transportation Problem: Definition and formulation, Methods of finding initial basic feasible solutions: Northwest-corner rule, Least- cost method, Vogel approximation method; Algorithm for obtaining optimal solution. Assignment Problem: Mathematical formulation and Hungarian method.
Game Theory: Formulation and solution of two-person zero-sum games, Games with mixed strategies, Linear programming method for solving a game.

Textbooks

Kanti Swarup, P.K. Gupta and Manmohan, Operations Research, Sultan Chand & Sonsv

Reference Books/Materials

1. H.A. Taha, Operation Research-An introducton, Printice Hall of India.
2. P.K. Gupta and D.S. Hira, Operations Research, S. Chand & Co.
3. S.D. Sharma, Operation Research, Kedar Nath Ram Nath Publications

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand the origin and development of operation research, linear programming.	**PO2**
CO2	Analyze the real-life systems with limited constraints, Identify and formulate the problem.	**PO1**
CO3	Used the theory of the simplex method, and their cases	**PO8**
CO4	Check and find a solution by Duality of simplex method, two phase method	**PO5**
CO5	Investigate the Maximize the profit, minimize the cost, minimize the time in transportation problem	**PO6**
CO6	Analyze the application of liner programming: Assignment problem	**PO5**

	LINEAR PROGRAMMING	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate software's to solve mathematical equations	Capable to use appropriate software's to solve mathematical equations	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA 304A		2	2			3	3		2			2	3		3	3	2

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1		**2**									**3**	**2**	**1**	**1**	**2**	**2**
CO2	**3**										**3**	**2**	**1**	**1**	**2**	**2**
CO3								**2**			**3**	**2**	**1**	**1**	**2**	**2**
CO4					**3**						**3**	**2**	**1**	**1**	**2**	**2**
CO5						**2**					**3**	**2**	**1**	**1**	**2**	**2**
CO6					**2**											
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA374A	LINEAR PROGRAMMING LAB	L	T	P	C
Version 2.0		0	0	4	2
Total Contact Hours	30 Hours				
Pre-requisites/Exposure					
Co-requisites	MATLAB				

Course Objectives

The purpose of these labs is to help students talk and write in meaningful ways the linear programming duality and the simplex and revised simplex algorithms, transportation problem, Assignment problem, game theory. Specifically, to describe LPP clearly in terms are related to transportation ad assignment problem, and to make connections between these two.

Course Outcomes

On completion of this course, the students will be able to

CO1. Investigate the Solution of LPP problem by Graphical method by MATLAB
CO2. To Solve the LPP problem simplex method and their dual of LPP
CO3. Solution the initial basic feasible solution of the transportation problem by MATLAB software
CO4. Check Optimality test for transportation problem by MATLAB
CO5. To obtain the solution of balanced and unbalanced Assignment Problem by MATLAB.

Catalog Description

· Understand how to find the formulation solution of LPP having more than three variable
· Learn how to find IBFS and optimal of transportation problem by MATLAB.
· Understand how to solve balanced and unbalanced Assignment problem by MATLAB.

Course Content

List of practical

1. Investigate the Solution of LPP problem by Graphical method.
2. To Solve the LPP problem simplex method.
3. Find the dual of simplex method.
4. Investigate and find the initial basic feasible solution of the transportation problem.
5. Analyse the Optimality test for transportation problem.
6. To Obtain the solution of balanced and unbalanced assignment Problem.

Reference Books

1. Lisa Oberbroeckling, Programming Mathematics Using MATLAB, Academic Press
2. Kanti Swarup, P.K. Gupta and Manmohan, Operations Research, Sultan Chand & Sonsv

Components	Conduct of Experiment	Attendance	Lab Record/ Quizzes/ Viva-Voice	End Term Practical Exam
Weightage (%)	**20**	**10**	**20**	**50**

Relationship between the Course Outcoms (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Investigate the Solution of LPP problem by Graphical method by MATLAB	**PO1**
CO2	To Solve the LPP problem simplex method and their dual of LPP	**PO8**
CO3	Solution the initial basic feasible solution of the transportation problem by MATLAB software	**PO2**
CO4	Check Optimality test for transportation problem by MATLAB	**PO9**
CO5	To obtain the solution of balanced and unbalanced Assignment Problem by MATLAB.	**PO3**

	LINEAR PROGRAMMING LAB	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate software's to solve mathematical equations	Capable to use appropriate software's to solve mathematical equations	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA 374A		2	2	2					3	3			3	2	2		2

1=weakly mapped

2= moderately mapped

3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**										**3**	**2**	**1**	**1**	**2**	**2**
CO2								**3**			**3**	**2**	**1**	**1**	**2**	**2**
CO3		**2**									**3**	**2**	**1**	**1**	**2**	**2**
CO4									**2**		**3**	**2**	**1**	**1**	**2**	**2**
CO5			**3**								**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA314A	DISSERTATION	L	T	P	C
Version 1.0		0	0	0	6
Total Contact Hours					
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

1 Demonstrate advanced critical research skills in relation to career development or work-related learning studies.

2 Acquire the skills to publish the data in reputed journals, conference proceeding and workshops.

3 Demonstrate an ability to present and defend their research work to a panel of experts.

Course Outcomes

On completion of this course, the students will be able to

CO1 Know the concept, scope of research.

CO2 Enable the students to gain knowledge on particular areas of research.

CO3 Understand the scientific methods to study region.

CO4 Analyze the practical knowledge of research and apply the subject matter knowledge in the field

CO5 Learn the art of reporting.

CO6 Able to educate the technical skill of writing.

Catalog Description

The objective of research project is to enable the student with hands-on experiences with learning to lead a research work. Research gives them experience based and active learning. It engages students with contexts, including the social and civic. The mentoring and collaboration dimensions of undergraduate research can foster ownership for commitment to high standards and accountability. While the research process in a discipline may be well-established, research always requires creativity, as well as patience and resolve in grappling with what sometimes feels ambiguous to all participants, including the faculty mentor. These features create opportunities for students to explore their own learning styles as well as develop exposure to those of others.

Guidelines

1. Students will be divided among faculty members for the supervision of the research work.
2. In the first week of Semester V, each faculty member will assign a suitable research topic to the students from the selected topics in the areas of mathematical sciences.
3. The student will work on the assigned research topic during semesters V and VI in regular consultation with his/her assigned faculty member.
4. The student will write a dissertation based on the research work carried out during Semesters V and VI and prepare two copies to be submitted to the office of the Dean duly signed by the student and the supervisor in the sixth week of VI semester or a date decided by the Dean of the school.
5. Before preparing power point presentation and submission of dissertation, each student has to deliver a seminar talk on his/ her research project work on a date fixed by HOD, necessary suggestions has to be incorporated in the final draft of dissertation.
6. The student will make a power point presentation based on the work carried out and mentioned in the dissertation to the board of examiners appointed by the University.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	**Internal (Interaction of Student with Supervisor)**	**External**			**Total**
		Relevance of topic (20)	**Presentation (20)**	**viva (10)**	**100**
Weightage (%)	**50**	**20**	**20**	**10**	

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Know the concept, scope of research.	**PO4**
CO2	Enable the students to gain knowledge on particular areas of research.	**PO6**
CO3	Understand the scientific methods to study region.	**PO5**
CO4	Analyze the practical knowledge of research and apply the subject matter knowledge in the field	**PO8**
CO5	Learn the art of reporting.	**PO7**
CO6	Able to educate the technical skill of writing.	**PO3**

	DISSERTATION	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA 314A				3	3	3	3	3	3			3		3	3		

1=weakly mapped

2= moderately mapped

3=strongly mapped

Programme and Course Mapping																	
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**2**											**3**	**2**	**1**	**1**	**2**	**1**
CO2								**2**				**3**	**2**	**1**	**1**	**2**	**1**
CO3		**3**										**3**	**2**	**1**	**1**	**2**	**1**
CO4				**2**								**3**	**2**	**1**	**1**	**2**	**1**
CO5			**3**									**3**	**2**	**1**	**1**	**2**	**1**
CO6	**3**											**3**	**2**	**1**	**1**	**2**	**1**
1=lightly mapped 2= moderately mapped 3=strongly mapped																	

	Dissertation/Research Project
Local	-
Regional	-
National	-
Global	-
Employability	Choice Based Credit System having field projects / research projects / internships (1.3.4) Courses on employability/ entrepreneurship/ skill development (1.1.3); Student centric methods, such as experiential learning, participative learning and problem-solving methodologies (2.3.1)
Entrepreneurship	Entrepreneurship; Team work/ Creativity by designing research problem
Skill Development	Disciplinary knowledge; Research related skills; scientific skills,
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	Equal Access to TVET and Higher Education (SDG 4.3), Quality Education and skills for employability 4.4
NEP	Higher Education System through scientific temper (9.1.1) India's Higher Education System through scientific temper (9.1.1)Towards a More Holistic and Multidisciplinary Education opportunitiesfor cross-disciplinary and interdisciplinary thinking (11.6); strong culture of research and knowledge creation (17.6) "
POE/4th IR	Employability, Project, Hands on Experience, Entrepreneurship; Team work

BSMA306A	ADVANCED MECHANICS	L	T	P	C
Version 1.0		5	1	0	6
Total Contact Hours	90 Hours				
Pre-requisites/Exposure					
Co-requisites	--				

Discipline Specific Elective -II

Course Objectives

1.The students will introduce the forces, angular momentum, and knowledge about the Constraint.
2. The course will give knowledge about the general parameter like velocity, acceleration.
3. The course provide the students about the knowledge of M.I.
4. The course provide the students about the knowledge of hollow cylinder and solid cylinder.

Course Outcomes

This course will enable the students to:

1. Understand the reduction of force system in three dimensions to a resultant force acting at a base point and a resultant couple, which is independent of the choice of base of reduction.
2. Learn about a nul point, a nul line, and a nul plane with respect to a system of forces acting on a rigid body together with the idea of central axis.
3. Know the inertia constants for a rigid body and the equation of momental ellipsoid together with the idea of principal axes and principal moments of inertia and to derive Euler's equations of motion of a rigid body, moving about a point which is kept fixed
4. Study the kinematics and kinetics of fluid motions to understand the equation of continuity in Cartesian, cylindrical polar and spherical polar coordinates which are used to derive Euler's equations and Bernoulli's equation.
5. Deal with two-dimensional fluid motion using the complex potential and also to understand the concepts of sources, sinks, doublets and the image systems of these with regard to a line and a circle.
6. Compare theories of mechanics and advanced mechanics.

Catalog Description

After completing this course the student able to: inertia constants for a rigid body and the equation of momental ellipsoid together with the idea of principal axes and deal with two-dimensional fluid motion using the complex potential and also to understand the concepts of sources, sinks, doublets and the image systems of these with regard to a line and a circle.

Course Content

Unit I: **22 lecture hours**

Statics in Space: Forces in three dimensions, Reduction to a force and a couple, Equilibrium of a system of particles, Central axis and Wrench, Equation of the central axis, Resultant wrench of two wrenches; Nul points, lines and planes with respect to a system of forces, Conjugate forces and conjugate lines.

Unit II: **22 lecture hours**

Motion of a Rigid Body: Moments and products of inertia of some standard bodies, Momental ellipsoid, Principal axes and moments of inertia; Motion of a rigid body with a fixed point, Kinetic energy of a rigid body with a fixed point and angular momentum of a rigid body, Euler's equations of motion for a rigid body with a fixed point, Velocity and acceleration of a moving particle in cylindrical and spherical polar coordinates, Motion about a fixed axis, Compound pendulum.

Unit III: **23 lecture hours**

Kinematics of Fluid Motion :Lagrangian and Eulerian approaches, Material and convective derivatives, Velocity of a fluid at a point, Equation of continuity in Cartesian, cylindrical polar and spherical polar coordinates, Cylindrical and spherical symmetry, Boundary surface, Streamlines and pathlines, Steady and unsteady flows, Velocity potential, Rotational and irrotational motion, Vorticity vector and vortex lines.

Unit IV: **23 lecture hours**

Kinetics of Fluid Motion: Euler's equations of motion in Cartesian, cylindrical polar and spherical polar coordinates; Bernoulli's equation, Impulsive motion.

Motion in Two-Dimensions Stream function, Complex potential, Basic singularities: Sources, sinks, doublets, complex potential due to these basic singularities; Image system of a simple source and a simple doublet with regard to a line and a circle, Milne−Thomson circle theorem.

Textbooks

1. A. S. Ramsay (1960). A Treatise on Hydromechanics, Part-II Hydrodynamics. G. Bell & Sons.
2. F. Chorlton (1967). A Textbook of Fluid Dynamics. CBS Publishers.
3. Michel Rieutord (2015). Fluid Dynamics An Introduction. Springer.
4. E. A. Milne (1965). Vectorial Mechanics, Methuen & Co.Limited. London.

Reference Books/Materials

1. G. E. Dieter, "Mechanical metallurgy",third edition; Mc-Graw Hill, 1988.
2. E. P. Popov,"Engineering mechanics of Solids",Second edition, Prentice Hall, 1998.
3. M. H. Sadd,"Elasticity: theory, applications and numerics",Third edition, Elsevier Butterworth Heinemann publications, 2014.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand the reduction of force system in three dimensions to a resultant force acting at a base point and a resultant couple, which is independent of the choice of base of reduction.	**PO1**
CO2	Learn about a nul point, a nul line, and a nul plane with respect to a system of forces acting on a rigid body together with the idea of central axis.	**PO3**
CO3	Know the inertia constants for a rigid body and the equation of momental ellipsoid together with the idea of principal axes and principal moments of inertia and to derive Euler's equations of motion of a rigid body, moving about a point which is kept fixed	**PO5**
CO4	Study the kinematics and kinetics of fluid motions to understand the equation of continuity in Cartesian, cylindrical polar and spherical polar coordinates which are used to derive Euler's equations and Bernoulli's equation.	**PO2**
CO5	Deal with two-dimensional fluid motion using the complex potential and also to understand the concepts of sources, sinks, doublets and the image systems of these with regard to a line and a circle.	**PO8**
CO6	Compare theories of mechanics and advanced mechanics	**PO7**

	ADVANCED MECHANICS	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate software's to solve mathematical equations	Capable to use appropriate software's to solve mathematical equations	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BS MA 306 A		2	2	2		3		2	2								

1=weakly mapped

2= moderately mapped

3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**2**										**3**	**2**	**1**	**1**	**2**	**2**
CO2			**3**								**3**	**2**	**1**	**1**	**2**	**2**
CO3					**2**						**3**	**2**	**1**	**1**	**2**	**2**
CO4		**2**									**3**	**2**	**1**	**1**	**2**	**2**
CO5								**2**			**3**	**2**	**1**	**1**	**2**	**2**
CO6							**3**									
1=lightly mapped 2= moderately mapped 3=strongly mapped																

Course Objectives

1. To learn applications of wavelets to the real-world problems.
2. To learn applications of wavelets in signal compression, analysis and classification

Course Outcomes

This course will enable the students to:

CO1. Know basic concepts of signals and systems
CO2. Understand the concept of Haar spaces
CO3. Learn Fourier transform and wavelet transform of digital signals
CO4. Apply wavelets in signal processing and image processing
CO5. Write research article on application of wavelets
CO6. Compare fourier and wavelet transform.

Catalog Description

The course begins with the basic concepts of signals and systems and moves forward with Classification of signal and systems, decomposition and reconstruction, Time-frequency analysis. Fourier Transforms and Classes - Haar, Morlet, Maxican hat, Meyer and Daubechies wavelets are the key concepts in this programme. Additionally, applications in signal compression, and analysis and classification of audio signals using DWT are also considered in the scheme.

Course Content

Unit I: 22 lecture hours

Signals and Systems: Basic concepts of signals and systems, Frequency spectrum of signals; Classification of signals: Discrete time signals and continuous time signals, periodic and non-periodic signals; Classification of systems: Linear, nonlinear, time-variant, time-invariant, stable and unstable systems.

Unit II: 22 lecture hours

Haar Scaling Function and Wavelet, Time-Frequency Analysis: Orthogonal functions, Orthonormal functions, Function spaces, Orthogonal basis functions, Haar scaling function, Haar spaces: Haar space , general Haar space ; Haar wavelet, Haar wavelet spaces: Haar wavelet space, general Haar wavelet space ; Decomposition and reconstruction, Time-frequency analysis, Orthogonal and orthonormal bases.

Unit III: **23 lecture hours**

Fourier Transforms and Wavelets: Discrete Fourier transform of a digital signal, Complex form of a Fourier series, Inverse discrete Fourier transform, Window Fourier transform, short time Fourier transform, Admissibility condition for a wavelet, Classes of wavelets: Haar, Morlet, Maxican hat, Meyer and Daubechies wavelets; Wavelets with compact support.

Unit IV: **23 lecture hours**

Discrete Wavelet Transforms: Stationary and non-stationary signals, Haar transform, 1-level Haar transform, Multi-level, Haar transform, Conservation and compaction of energy, Multiresolution analysis, Decomposition and reconstruction of signals using discrete wavelet transform (DWT).

Applications: Wavelet series expansion using Haar and other wavelets, Applications in signal compression, Analysis and classification of audio signals using DWT, Signal de-noising: Image and ECG signals.

Textbooks

1. Charles K. Chui (1992). *An Introduction to Wavelets.* Academic Press.
2. Michael W. Frazier (1999). *An Introduction to Wavelets Through Linear Algebra*. Springer-Verlag.

Reference Books/Materials

1. Stéphane Mallat (2008). *A Wavelet Tour of Signal Processing* (3rd edition). Academic Press.
2. David K. Ruch & Patrick J. Van Fleet (2009), *Wavelet Theory***:** *An Elementary Approach with Applications*. John Wiley & Sons.
3. James S. Walker (2008). *A Primer on Wavelets and Their Scientific Applications* (2nd edition). Chapman & Hall/CRC, Taylor & Francis.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Know basic concepts of signals and systems	**PO3**
CO2	Understand the concept of Haar spaces	**PO4**
CO3	Learn Fourier transform and wavelet transform of digital signals	**PO5**
CO4	Apply wavelets in signal processing and image processing	**PO9**
CO5	Write research article on application of wavelets	**PO7**
CO6	Compare fourier and wavelet transform	**PO4**

	WAVELETS AND APPLICATIONS	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA 308A				3	2			2	3			3					3

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**2**										**3**	**2**	**1**	**1**	**2**	**2**
CO2			**3**								**3**	**2**	**1**	**1**	**2**	**2**
CO3					**2**						**3**	**2**	**1**	**1**	**2**	**2**
CO4		**2**									**3**	**2**	**1**	**1**	**2**	**2**
CO5								**2**			**3**	**2**	**1**	**1**	**2**	**2**
CO6							**3**									
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA310A	NUMBER THEORY	L	T	P	C
Version 1.0		5	1	0	6
Total Contact Hours	90 Hours				
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives:

The course will enable the students to:

1. Learn about some important results in the theory of numbers including the prime number theorem, Chinese remainder theorem, Wilson's theorem and their consequences.
2. Learn about number theoretic functions, modular arithmetic and their applications.
3. Familiarize with modular arithmetic and find primitive roots of prime and composite numbers.
4. Know about open problems in number theory, namely, the Goldbach conjecture and twin-prime conjecture.
5. Apply public crypto systems, in particular, RSA

Course Outcomes:

On completion of this course, the students will be able to

CO1. Understand the concept prime numbers, number theoretic functions, and primitive roots.
CO2. Make connection between prime counting function and Goldbach conjecture
CO3. Apply the notions of quadratic residue of odd primes.
CO4. Apply concepts from number theory in security systems.
CO5. Apply Möbius inversion formula.
CO6.Compare various number theoretic functions.

Catalog Description:

This course particularly deals with distribution of prime numbers, number theoretic functions, and primitive roots. The course begins with the concept of prime counting function, prime number theorem and Goldbach conjecture. Sum and number of divisors, and Euler’s phi-function and its properties are the key concepts in this learning programme. Moreover, Public key encryption, RSA encryption and decryption with applications in security systems are also considered in the plan of action.

Course Content

Unit I: **22 lecture hours**

Distribution of Primes and Theory of Congruencies: Linear Diophantine equation, Prime counting function, Prime number theorem, Goldbach conjecture, Twin-prime conjecture, Odd perfect numbers conjecture, Fermat and Mersenne primes, Congruence relation and its properties, Linear congruence and Chinese remainder theorem, Fermat's little theorem, Wilson's theorem

Unit II: **22 lecture hours**

Number Theoretic Functions: Number theoretic functions for sum and number of divisors, Multiplicative function, The Möbius inversion formula, Greatest integer function, Euler's phi-function and properties, Euler's theorem..

Unit III: **23 lecture hours**

Primitive Roots: Order of an integer modulo n, Primitive roots for primes, Composite numbers having primitive roots; Definition of quadratic residue of an odd prime, Euler's criterion.

Quadratic Reciprocity Law: The Legendre symbol and its properties, Quadratic reciprocity, Quadratic congruencies with composite module

Unit IV: **23 lecture hours**

Applications: Public key encryption, RSA encryption and decryption with applications in security systems.

Textbooks

1. David M. Burton (2007). Elementary Number Theory (7th edition). McGraw-Hill.
2. Gareth A. Jones & J. Mary Jones (2005). Elementary Number Theory. Springer.

Reference Books/Materials

1. Neville Robbins (2007). Beginning Number Theory (2nd edition). Narosa.
2. I.Niven (2012). An Introduction to the Theory of Numbers (5th edition). John Wiley & Sons.
3. Neal Koblitz (1994). A Course in Number Theory and Cryptography (2nd edition). Springer-Verlag.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand the concept prime numbers, number theoretic functions, and primitive roots	**PO1**
CO2	Make connection between prime counting function and Goldbach conjecture	**PO3**
CO3	Apply the notions of quadratic residue of odd primes.	**PO5**
CO4	Apply concepts from number theory in security systems.	**PO10**
CO5	Apply Möbius inversion formula	**PO9**
CO6	Compare various number theoretic functions.	**PO4**

	NUMBER THEORY	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BS MA 310 A			2	3	2			3	3			3					2

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**2**										**3**	**2**	**1**	**1**	**2**	**2**
CO2			**3**								**3**	**2**	**1**	**1**	**2**	**2**
CO3					**2**						**3**	**2**	**1**	**1**	**2**	**2**
CO4										**2**	**3**	**2**	**1**	**1**	**2**	**2**
CO5									**3**		**3**	**2**	**1**	**1**	**2**	**2**
CO6				**3**												
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA312A	CRYPTOGRAPHY	L	T	P	C
Version 1.0		5	1	0	6
Total Contact Hours	90 Hours				
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. Understand the difference between classical and modern cryptography.
2. Learn the fundamentals of cryptography, including Data and Advanced Encryption Standards (DES & AES) and RSA.
3. Encrypt and decrypt messages using block ciphers, sign and verify messages using well-known signature generation and verification algorithms.
4. Know about the aspects of number theory which are relevant to cryptography.

Course Outcomes

On completion of this course, the students will be able to

CO1. Describe network security services and mechanisms.
CO2. Differentiate between Symmetrical and Asymmetrical cryptography.
CO3. Analyze Data integrity, Authentication, Digital Signatures
CO4. Understand various network security applications, IPSec, Firewall, IDS, Web security, Email security, and malicious software etc.
CO5. Write security codes.
CO6. Compare various network security applications.

Catalog Description

Cryptography is an indispensable tool for protecting information in computer systems. In this course students will learn the inner workings of cryptographic systems and how to correctly use them in real-world applications. The course begins with a detailed discussion of how two parties who have a shared secret key can communicate securely when a powerful adversary eavesdrops and tampers with traffic. Students will examine many deployed protocols and analyze mistakes in existing systems. The second half of the course discusses public-key techniques that let two parties generate a shared secret key. Throughout the course participants will be exposed to many exciting open problems in the field and work on fun (optional) programming projects. In a second course (Crypto II) we will cover more advanced cryptographic tasks such as zero-knowledge, privacy mechanisms, and other forms of encryption.

Course Content

Unit I: **22 lecture hours**

Introduction to Cryptography and Classical Cryptography: Cryptosystems and basic cryptographic tools: Secret-key cryptosystems, Public-key cryptosystems, Block and stream ciphers, Hybrid cryptography, Message integrity: Message authentication codes, Signature schemes, Nonrepudiation, Certificates, Hash functions, Cryptographic protocols, Security; Hybrid cryptography: Message integrity, Cryptographic protocols, Security, Some simple cryptosystems, Shift cipher, Substitution cipher, Affine cipher, Vigenère cipher, Hill cipher, Permutation cipher, Stream ciphers, Cryptanalysis of affine, substitution, Vigenère, Hill and LFSR stream ciphers.

Unit II: **22 lecture hours**

Cryptographic Security, Pseudo Randomness and Symmetric Key Ciphers: Shannon's theory, Perfect secrecy, Entropy, Spurious keys and unicity distance; Bit generators, Security of pseudorandom bit generators. Substitution-permutation networks, Data encryption standard (DES), Description and analysis of DES; Advanced encryption standard (AES), Description and analysis of AES; Stream ciphers, Trivium

Unit III: **23 lecture hours**

Basics of Number Theory and Public-Key Cryptography: Basics of number theory; Introduction to public-key cryptography, RSA cryptosystem, Implementing RSA; Primality testing, Legendre and Jacobi symbols, Solovay Strassen algorithm, Miller Rabin algorithm; Square roots modulo *n*, Factoring algorithms, Pollard p 1 algorithm, Pollard rho algorithm, Dixon's random squares algorithm, Factoring algorithms in practice; Rabin cryptosystem and its security.

Unit IV: **23 lecture hours**

More on Public-Key Cryptography: Basics of finite fields; ElGamal cryptosystem, Algorithms for the discrete logarithm problem, Shanks' algorithm, Pollard rho discrete logarithm algorithm, Pohlig Hellman algorithm; Discrete logarithm algorithms in practice, Security of ElGamal systems, Bit security of discrete logarithms.

Hash Functions and Signature Schemes: Hash functions and data integrity, SHA-3; RSA signature scheme, Security requirements for signature schemes, Signatures and Hash functions, ElGamal signature scheme, Security of ElGamal signature scheme, Certificates.

Reference Books

1. Jeffrey Hoffstein, Jill Pipher & Joseph H. Silverman (2014). An Introduction to Mathematical Cryptography (2nd edition). Springer.
2. Neal Koblitz (1994). A Course in Number Theory and Cryptography (2nd edition). Springer-Verlag.
3. Christof Paar & Jan Pelzl (2014). Understanding Cryptography. Springer.
4. Simon Rubinstein-Salzedo (2018). Cryptography. Springer.
5. Douglas R. Stinson & Maura B. Paterson (2019). Cryptography Theory and Practice

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Describe network security services and mechanisms.	**PO1,PO7**
CO2	Differentiate between Symmetrical and Asymmetrical cryptography.	**PO5,PO7**
CO3	Analyze Data integrity, Authentication, Digital Signatures	**PO8,PO7**
CO4	Understand various network security applications, IPSec, Firewall, IDS, Web security, Email security, and malicious software etc.	**PO4,PO7**
CO5	Write security codes	**PO7**
CO6	Compare various network security applications	**PO4**

	CRYPTOGRAPHY	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMA 312A		2			2	2		3	3			3	3	3	1	3	3

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**2**						**2**				**3**	**2**	**1**	**1**	**2**	**2**
CO2					**3**		**2**				**3**	**2**	**1**	**1**	**2**	**2**
CO3							**2**	**3**			**3**	**2**	**1**	**1**	**2**	**2**
CO4				**2**			**3**				**3**	**2**	**1**	**1**	**2**	**2**
CO5							**2**				**3**	**2**	**1**	**1**	**2**	**2**
CO6				**3**												
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSCS113A	C++ PROGRAMMING FOR MATHEMATICS	L	T	P	C
Version 1.0		4	0	0	4
Total Contact Hours	60 Hours				
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. Capability to use software to solve system of mathematical equations.
2. Capability to understand and apply the programming concepts of C++ to mathematical investigation and problem solving.

Course Outcomes

On completion of this course, the students will be able to

1. Understand and apply the programming concepts of C++ which is important for mathematical investigation and problem solving.
2. Use mathematical libraries for computational objectives.
3. Represent the outputs of programs visually in terms of well formatted text and plots.
4. Be able to understand advanced features of C++ specifically stream I/O, templates and exception handling.

Catalog Description

This course introduces the concept of object-oriented programming using C++. This course will teach how common mathematical algorithms are implemented. It provides a significant value addition for those who want to use computer programming for mathematical problem solving.

Course Content

UNIT – I **12 lecture hours**

C++ Essentials: Fundamentals of programming, Organization of logic flow in stored program model of computation, C++ as a general-purpose programming language, Structure of a C++ program, Common compilers and IDE's, Basic data-types, Variables and literals in C++, Operators, Expressions, Evaluation precedence and type compatibility; Outline of program development in C++, Debugging and testing; Applications**:** Greatest common divisor and random number generation.

Unit II: **15 lecture hours**

Structured Data: Structured datatypes in C++, Arrays and manipulating data in arrays; Objects and classes**:** Information hiding, modularity, constructors and destructors, methods and polymorphism; Applications**:** Factorization of an integer, Euler's totient, Images in Cartesian geometry using points in two & three dimensions, Pythagorean triples.

Unit III: **15 lecture hours**

Containers and Templates: Containers and Template Libraries**:** Sets, iterators, multisets, vectors, maps, lists, stacks and queues; Applications**:** Basic set algebra, modulo arithmetic and congruence's, projective plane, permutations, monotone sequences and polynomials.

Unit IV: **18 lecture hours**

Libraries and Packages: Libraries and Packages for arbitrary precision arithmetic and linear algebra**;** Features of C++ for input/output and visualization**:** Strings, streams, formatting methods, processing files in a batch, command-line arguments, visualization packages and their uses; Applications**:** Arbitrary precision arithmetic using GMP, BOOST; Finding nullity, rank, eigen values, eigen vectors, linear transformations, systems of linear equations; Plots.

Odds and Ends: Runtime errors and graceful degradation, Robustness in a program; Exception handling: Try-catch and throw; Defining and deploying suitable exception handlers in programs; Compiler options; Conditional compilation; Understanding and defining suitable pragmas; Applications**:** Identification and description of install parameters of mathematical libraries, debugging installation, working with multiple libraries simultaneously and maintaining correctness and consistency of data.

Textbooks

Nell Dale & Chip Weems (2013).*Programming and Problem Solving with C++* (6th edition). Jones & Bartlett Learning.

Reference Books/Materials

1. Peter Gottschling (2016). *Discovering Modern C++***:** *An Intensive Course for Scientists, Engineers, and Programmers*. Pearson.
2. Nicolai M. Josuttis (2012). *The C++ Standard Library*: *A Tutorial and Reference* (2nd edition). Addison-Wesley, Pearson.
3. Edward Scheinerman (2006). *C++ for Mathematicians*: *An Introduction for Students and Professionals*. Chapman & Hall/CRC. Taylor & Francis.
4. B. Stroustrup (2013). *The C++ Programming Language* (4th edition). Addison-Wesley.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand and apply the programming concepts of C++ which is important for mathematical investigation and problem solving.	**PO8**
CO2	Use mathematical libraries for computational objectives.	**PO9**
CO3	Represent the outputs of programs visually in terms of well formatted text and plots.	**PO3**
CO4	Be able to understand advanced features of C++ specifically stream I/O, templates and exception handling.	**PO5**

	C++ PROGRAMMING FOR MATHEMATICS	Apply information on scientific facts to face day to day requirements.	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate software's to solve mathematical equations	Develop the protocols as per laboratory standards to accomplish the objectives.	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSCS 113A				3		2			3	2							3

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1								**2**			**3**	**2**	**1**	**1**	**2**	**2**
CO2									**3**		**3**	**2**	**1**	**1**	**2**	**2**
CO3			**2**								**3**	**2**	**1**	**1**	**2**	**2**
CO4					**3**						**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSCS167A	C++ PROGRAMMING FOR MATHEMATICS LAB	L	T	P	C
Version 1.0		0	0	4	2
Total Contact Hours	30 Hours				
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. Capability to use software to solve system of mathematical equations.
2. Capability to understand and apply the programming concepts of C++ to mathematical investigation and problem solving.

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand and apply the programming concepts of C++ which is important for mathematical investigation and problem solving.
CO2. Use mathematical libraries for computational objectives.
CO3. Represent the outputs of programs visually in terms of well formatted text and plots.
CO4. Be able to understand advanced features of C++ specifically stream I/O, templates and exception handling.

Catalog Description

This course complements BSCS 113A. It enables them to write algorithms for solving problems with the help of object-oriented paradigms specifically using C++. The list of experiments helps organizing the data in variety of ways and emphasize on solve the given problem efficiently. The aim is to create and execute common mathematical algorithms.

List of Experiments (Indicative)

1	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	**3 lab hours**

2	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	**2 lab hours**
3	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.	**2 lab hours**
4	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.	**2 lab hours**
5	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.	**2 lab hours**

6	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 rectangle interactively and display the area. Remember the two values given as input will be treated as lengths of two sides in the ca 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	**3 lab hours**
7	A Pythagorean triplet is a set of three positive integers a, b and c such that $a^2 + b^2 = c^2$. Given a limit, generate all Pythagorean Triples with values smaller than given limit.	**2 lab hours**
8	A stack is an abstract data structure that contains a collection of elements. Stack implements the LIFO mechanism i.e. the element that is pushed at the end is popped out first. Some of the principal operations in the stack are − • Push - This adds a data value to the top of the stack. • Pop - This removes the data value on top of the stack. • Peek - This returns the top data value of the stack. Write a program that implements a stack using array?	**4 lab hours**
9	Consider a matrix A. We must find the column vector X and the constant L (L=lamda) such that: [A]{X} = L{X} Now, consider these three sets of equations: a11x1 + a12x2 + a13x3 = Lx1 a12x1 + a22x2 + a23x3 = Lx2 a31x1 + a32x2 + a33x3 = Lx3 These equations can be written as: (a11-L)x1 +a12x2 +a13x3 = 0 a21x1 +(a22-L)x2 +a23x3 = 0 a31x1 +a32x2 + (a33-L)x3 = 0 Now the determinant of the 3*3 matrix formed of the coefficients of x1, x2 and x3 terms gives three roots, namely L1, L2 and L3 (read L as lamda). These values are called characteristic or eigen values. For each of these values, we get a set of column vector	**6 lab hours**

	with elements x1, x2 and x3. This vector is the required eigen vector. Write a program to determine eigen values?	
10	Write a program using standard template library for implementing stack and queue?.	**4 lab hours**

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	**Conduct of Experiment**	**Attendance**	**Lab Record/ Quizzes/ Viva-Voice**	**End Term Practical Exam**
Weightage (%)	**20**	**10**	**20**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand and apply the programming concepts of C++ which is important for mathematical investigation and problem solving.	**PO8**
CO2	Use mathematical libraries for computational objectives.	**PO9**
CO3	Represent the outputs of programs visually in terms of well formatted text and plots.	**PO3**
CO4	Be able to understand advanced features of C++ specifically stream I/O, templates and exception handling.	**PO5**

	C++ PROGRAMMING FOR MATHEMATICS LAB	Apply information on scientific facts to face day to day requirements.	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate softwa re's to solve mathematical equations	Develop the protocols as per laboratory standards to accomplish the objectives.	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at countrywide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSCS 167A				3		2			3	2							3

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1								**2**			**3**	**2**	**1**	**1**	**2**	**2**
CO2									**3**		**3**	**2**	**1**	**1**	**2**	**2**
CO3			**2**								**3**	**2**	**1**	**1**	**2**	**2**
CO4					**3**						**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMC671A	MATHEMATICAL FINANCE	L	T	P	C
Version 2.0		5	1	0	6
Total Contact Hours	90 Hours				
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

1. Provide the students with knowledge of a range of mathematical and computational techniques that are required for a wide range of quantitative positions in the financial sector.
2. To develop student appreciation of the major issues involved in rigorous advances in the area of financial mathematics
3. Introduction to the application of mathematics in financial world, that enables the student to understand some computational and quantitative techniques required for working in the financial markets and actuarial mathematics

Course Outcomes

On completion of this course, the students will be able to

CO1 Understand the standard and advanced quantitative methodologies and techniques of importance to a range of careers in investment banks and other financial institutions.

CO2 Appreciation of emerging theory and techniques in the area of financial mathematics.

CO3 Apply scientific models and tools effectively.

CO4 Design, build, investigate and evaluate forward contract using arbitrage-free pricing methods.

CO5 Construct, evaluate and analyze models for investments and securities.

CO6 Create and evaluate potential models for the price of shares.

Catalog Description

This course establishes the basics of the one-period model, shows how securities can be represented by vectors and matrices, and introduces the concept of hedging. Further, the course introduces important financial notions such as returns, arbitrage and state prices, and gives examples of asset pricing both in complete and incomplete markets. Then, we introduce the multi-period binomial model for stock prices and compute a dynamic hedging strategy that replicates a given option. Finally, we take the binomial modeling from the discrete-time numerical explorations to the continuous-time complete market trail in Black-Scholes option pricing formula.

Course Content

Unit-I: Basic Theory of Interest and Fixed-Income Securities 22 hours

Principal and interest: simple, compound and continuous; Present and future value of cash flow streams; Net present value, Internal rates of return and their comparison; Inflation, Annuities; Bonds, Bond prices and yields, Macaulay duration and modified duration.

Unit-II: Term Structure of Interest Rates, Bonds and Derivatives 22 hours

Spot rates, forward rates and explanations of term structure; Running present value, Floatingrate bonds, Immunization, Convexity; Putable and callable bonds; Exchange-traded markets and over-the-counter markets; Derivatives: Forward contracts, Future contracts, Options, Types of traders, Hedging, Speculation, Arbitrage.

Unit-III: Mechanics of Options Markets 23 hours

No-arbitrage principle, Short selling, Forward price for an investment asset; Types of options: Call and put options, Option positions, Underlying assets, Factors affecting option prices, Upper and lower bounds for option prices, Put-call parity, Effect of dividends.

Unit-IV: Stochastic Analysis of Stock Prices and Black-Scholes Model 23 hours

Binomial option pricing model, Risk neutral valuation: European and American options on assets following binomial tree model; Lognormal property of stock prices, Distribution of rate of return, Expected return, Volatility, Estimating volatility from historical data, Extension of risk-neutral valuation to assets following geometric Brownian motion, Black-Scholes formula for European options.

Hedging Parameters, Trading Strategies and Swaps

Hedging parameters: Delta, gamma, theta, rho and vega; Trading strategies involving options, Swaps, Mechanics of interest rate swaps, Comparative advantage argument, Valuation of interest rate swaps, Currency swaps, Valuation of currency swaps.

References:

1. John C. Hull & Sankarshan Basu (2018). *Options, Futures and Other Derivatives* (10th edition). Pearson Education.
2. David G. Luenberger (2013). *Investment Science* (2nd edition). Oxford University Press.
3. Sheldon M. Ross (2011). *An Elementary Introduction to Mathematical Finance* (3rd edition). Cambridge University Press.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand the standard and advanced quantitative methodologies and techniques of importance to a range of careers in investment banks and other financial institutions.	**PO1, PO2**
CO2	Appreciation of emerging theory and techniques in the area of financial mathematics	**PO5**
CO3	Apply scientific models and tools effectively	**PO3**
CO4	Design, build, investigate and evaluate forward contract using arbitrage-free pricing methods.	**PO7**
CO5	Construct, evaluate and analyze models for investments and securities.	**PO10**
CO6	Create and evaluate potential models for the price of shares.	**PO6**

	MATHEMATICAL FINANCE	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data.	Ability to work independently as well as in collaboration with other individuals /institutions.	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively.	Capable to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives	To gain a strong foundation in various branches of mathematics to investigate and solve the real-life problem	Acquire jobs in government and public sector undertakings, banks, central government institutes and pursuing higher studies at country wide.	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BSMC 671A		3	3	2		2	3	3			3	3	3	3	3	1	1

1=weakly mapped
2= moderately mapped
3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**2**	**3**									**3**	**2**	**1**	**1**	**2**	**2**
CO2					**2**						**3**	**2**	**1**	**1**	**2**	**2**
CO3			**3**								**3**	**2**	**1**	**1**	**2**	**2**
CO4							**3**				**3**	**2**	**1**	**1**	**2**	**2**
CO5										**2**	**3**	**2**	**1**	**1**	**2**	**2**
CO6						**3**					**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

BSMA 338A	MATHEMATICAL MODELING	L	T	P	C
Version 1.0		5	1	0	6
Total Contact Hours	90 hours				
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

The objectives of this course can be illustrated as:

- To provide conceptual understanding of formulation of mathematical models.
- To develop the skill of solving real world problems.

Course Outcomes

On completion of this course, the students will be able to

CO1 understand powerful mathematical tools such as calculus of several variables, differential equations and elementary dynamical systems theory.

CO2 apply these tools to mathematically analyze and solve contemporary problems of both theoretical and practical importance.

CO3 assemble a mathematical model for a range of physical situations and able to identify, formulate, and solve engineering problems.

CO4 critically analyse the effectiveness of any differential equation in modelling specified situations recognising that useful qualitative information in the behaviour of a system can often be gleaned from suitably "crude" models.

CO5 recognition of the need for, and an ability to engage in life-long learning.

CO6 understand the balance between the complexity / accuracy of the mathematical / statistical models used and the timeliness of the delivery of the solution.

Catalog Description

The course also provides introduction to state-of-the-art mathematical resources for mathematical modelling, optimization, numerical simulation, graph theory and forecasting techniques. Case studies will form a large part of the course. In addition to learning the mathematics behind the modelling tools, the course aims to equip students with the modelling skills and presentation skills for dealing with real world problems.

Course Content

Unit I: **22 lecture hours**

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, Dynamics Problems

Unit II: **22 lecture hours**

Mathematical Modelling through systems of Ordinary Differential Equation of First Order: Population Dynamics, Epidemics and Compartment Models. Modelling in Economics, Medicine, Arms Race, Battles and International Trades.

Unit III: **23 lecture hours**

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

Unit IV: **23 lecture hours**

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

Textbooks

J. N. Kapur, Mathematical Modelling, New Age International Publishers.

Reference Books/Materials

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.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	understand powerful mathematical tools such as calculus of several variables, differential equations and elementary dynamical systems theory.	**PO5**
CO2	apply these tools to mathematically analyze and solve contemporary problems of both theoretical and practical importance.	**PO2**
CO3	assemble a mathematical model for a range of physical situations and able to identify, formulate, and solve engineering problems.	**PO8**
CO4	critically analyse the effectiveness of any differential equation in modelling specified situations recognising that useful qualitative information in the behaviour of a system can often be gleaned from suitably "crude" models.	**PO1**
CO5	recognition of the need for, and an ability to engage in life-long learning.	**PO4**
CO6	understand the balance between the complexity / accuracy of the mathematical / statistical models used and the timeliness of the delivery of the solution.	**PO6**

	ADVANCED MECHANICS	Apply information on scientific facts to face day to day requirements	Apply moral principles and responsibilities of a science graduate to serve the society	Create innovative ideas by using scientific knowledge for analysis and interpretation of data	Ability to work independently as well as in collaboration with other individuals /institutions	Knowledge regarding advancement in various branches of mathematics	Inculcate moral/ethical values and environmental consciousness	Enhance employability/ entrepreneurship skills	Ability to communicate various concepts of mathematics effectively	Capable to use appropriate software's to solve mathematical equations	Capable to use appropriate software's to solve mathematical equations	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	To gain a strong foundation in various branches of mathematics to investigate and solve the real life problem	Analyze the local and global impacts of understanding of values, ideas, and outcomes in a specific subject area.	To develop entrepreneurial skills to become empowered and self-reliant	Understand the basic concepts of statistics, algebra, and differential equations	Apply the mathematical modeling and reasoning to solve basic problems.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
BS MA 338 A		2	2		2	3	3		2								

1=weakly mapped

2= moderately mapped

3=strongly mapped

Programme and Course Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1					**3**						**3**	**2**	**1**	**1**	**2**	**2**
CO2		**2**									**3**	**2**	**1**	**1**	**2**	**2**
CO3								**2**			**3**	**2**	**1**	**1**	**2**	**2**
CO4	**3**										**3**	**2**	**1**	**1**	**2**	**2**
CO5				**3**							**3**	**2**	**1**	**1**	**2**	**2**
CO6						**2**					**3**	**2**	**1**	**1**	**2**	**2**
1=lightly mapped 2= moderately mapped 3=strongly mapped																

ETCS425A	Machine Learning	L	T	P	C
Version 1.0		4	0	0	4
Pre-requisites/Exposure	NIL				
Co-requisites					

Course Objectives

1. To develop an appreciation for what is involved in learning from data.
2. To understand a wide variety of learning algorithms.
3. To understand how to apply a variety of learning algorithms to data.
4. To understand how to perform evaluation of learning algorithms and model selection.
5. To become familiar with Dimensionality reduction Techniques.

Course Outcomes

On completion of this course, the students will be able to

CO1. Gain knowledge about basic concepts of Machine Learning

CO2. Identify machine learning techniques suitable for a given problem.

CO3. Solve the problems using various machine learning techniques.

CO4. Apply neural networks for suitable application.

CO5. Use a tool to implement typical clustering algorithms for different types of applications.

CO6. Apply Dimensionality reduction techniques.

Catalog Description

This course imparts comprehensive introduction to various topics in machine learning. It enables them to design and implement machine learning solutions to classification, regression, and clustering problems; and be able to evaluate and interpret the results of the algorithms.

Course Content

UNIT I **8 Hours**

Machine learning: overview and survey of its applications. Problem of induction and statistical inference: Input-output functions, Boolean functions, Parametric and nonparametric inference, Probability, uncertainty and Bayes theorem, Introduction to typical learning tasks: regression, pattern recognition, feature selection, classification, clustering, rule induction (association). Model validation techniques: cross-validation, leave-one-out, majority, Measures of performance (sensitivity, specificity, ROC curves, etc.)

UNIT II **8 Hours**

Dimensionality Reduction: Subset Selection, Shrinkage Methods, Principle Components Regression Linear Classification, Logistic Regression, Linear Discriminant Analysis Optimization, Classification-Separating Hyperplanes Classification

UNIT III **9 Hours**

Neural Networks: Non-linear Hypothesis, Biological Neurons, Model representation, Intuition for Neural Networks, Multiclass classification, Cost Function, Back Propagation Algorithm, Back Propagation Intuition, Weights initialization, Neural Network Training.

Support Vector Machines: Optimization Objective, Large Margin Classifiers, Kernels, SVM practical considerations

UNIT IV **10 Hours**

Supervised Learning: Additive model: logistic regression, Generative model: naïve Bayes classifier, Discriminative model: Decision trees, Neural networks.

Unsupervised Learning: Clustering: k-means, hierarchical, self-organizing map, EM algorithm, Feature selection principal component analysis.

Reinforcement Learning: Q-learning, Value function approximation, Policy search.

Textbooks:

1. The Elements of Statistical Learning, T. Hastie, R. Tibshirani and J. H. Friedman, Springer.

Reference Books:

1. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media
2. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems", 1st Edition, O'Reilly Media
3. Jain V.K., “Data Sciences”, Khanna Publishing House, Delhi.
4. Jain V.K., “Big Data and Hadoop”, Khanna Publishing House, Delhi.
5. Jeeva Jose, “Machine Learning”, Khanna Publishing House, Delhi.
6. Chopra Rajiv, “Machine Learning”, Khanna Publishing House, Delhi.
7. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press
8. http://www.deeplearningbook.org
9. Jiawei Han and Jian Pei, "Data Mining Concepts and Techniques", Third Edition, Morgan Kaufmann Publisher

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Gain knowledge about basic concepts of Machine Learning	PO1
CO2	Identify machine learning techniques suitable for a given problem.	PO4
CO3	Solve the problems using various machine learning techniques.	PO5
CO4	Apply neural networks for suitable application.	PO2
CO5	Use a tool to implement typical clustering algorithms for different types of applications.	PO3
CO6	Apply Dimensionality reduction techniques.	PO3

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Innovation and Industry Friendly	Ethics and Communication Skills
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETCS 425A	Machine Learning	2	3	3	3	3								3	3	

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS455A	Machine Learning Lab	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basics of Artificial Intelligence				
Co-requisites	--				

Course Objectives

1. Develop the technical and practical skills to apply machine learning to solve real-world problems.
2. Explore regression as a supervised machine learning technique to predict a continuous variable (response or target) from a set of other variables (features or predictors)
3. Discover how variable selection and shrinkage methods are used to improve the efficiency of a regression model when applied to complex data sets.
4. Explore classification as a supervised machine learning technique to predict binary (or discrete) response variables from a set of features.
5. Understand what neural networks are, its most successful applications, and how it can be used within a business context.

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand the implementation procedures for the machine learning algorithms.

CO2. Design Java/Python programs for various Learning algorithms.

CO3. Apply appropriate data sets to the Machine Learning algorithms.

CO4. Identify and apply Machine Learning algorithms to solve real world problems.

Note: The programs can be implemented in either JAVA or Python.

1.For Problems 1 to 6 and 10, programs are to be developed without using the built-in classes or APIs of Java/Python.

2.Datasetscan be taken from standard repositories (https://archive.ics.uci.edu/ml/datasets.html) or constructed by the students.

Catalog Description

Machine Learning is concerned with computer programs that automatically improve their performance through experience. This course covers the theory and practical algorithms for machine learning from a variety of perspectives. We cover topics such as FIND-S, Candidate Elimination Algorithm, Decision tree (ID3 Algorithm), Back propagation Algorithm, Naïve Bayesian classifier, Bayesian Network, k-Means Algorithm, k-Nearest Neighbor Algorithm, Locally Weighted Regression Algorithm.

List of Experiments (Indicative)

1	Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.	2 lab hours
2	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.	2 lab hours
3	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	2 lab hours
4	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.	2 lab hours
5	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	2 lab hours
6	Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.	4 lab hours
7	Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.	4 lab hours
8	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.	4 lab hours
9	Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.	4 lab hours
10	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.	4 lab hours

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Understand the implementation procedures for the machine learning algorithms.	PO2
CO2	Design Java/Python programs for various Learning algorithms.	PO3
CO3	Apply appropriate data sets to the Machine Learning algorithms.	PO5
CO4	Identify and apply Machine Learning algorithms to solve real world problems.	PO8

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Life-long Learning	Application of Concepts	Innovation and Industry Friendly	Ethics and Communication Skills
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO12	PSO1	PSO2	PSO3
ETCS455A	Machine learning Lab		3	3		2			2				3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

BSCS401A	ARTIFICIAL INTELLIGENCE	L	T	P	C
Version 1.0		4	0	0	4
Pre-requisites/Exposure	Logical and Analytical skill				
Co-requisites	--				

Course Objectives

1 Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.

2 To understand how machines act accordingly to situations as a human brain

3 To understand different search algorithms and their implementation at realistic models.

4 Investigate applications of AI techniques in intelligent agents, expert systems, and other machine learning models

Course Outcomes

On completion of this course, the students will be able to know.

CO1 Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.

CO2 Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.

CO3 Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, and other machine learning models.

CO4 Understanding of rule based and knowledge-based approaches in real life scenarios.

CO5 Demonstrate proficiency in applying scientific method to models of machine learning.

Catalog Description

In this course, An introduction to the basic principles, techniques, and applications of Artificial Intelligence. Coverage includes knowledge representation, handling uncertainties, logic inference, problem solving, search algorithms, natural language processing, perception, learning, planning, and agent design. In addition, how artificial intelligence is used in real-world situations.

Course Content

UNIT-I **10 Hours**

Scope of AI: Games, theorem proving, natural language processing, vision and speech processing, robotics, expert systems, AI techniques-search knowledge, abstraction.

Problem Solving (Blind): State space search; production systems, search space control; depth-first, breadth-first search.

Heuristic Based Search: Heuristic search, Hill climbing, best-first search, A* Algorithm, Problem Reduction, Constraint Satisfaction

UNIT-II **11 Hours**

Knowledge Representation: Predicate Logic: Unification, Modus Ponens, Modus Tokens, Resolution in Predicate Logic, Conflict Resolution Forward Chaining, Backward Chaining, Declarative and Procedural Representation, Rule based Systems.

Structured Knowledge Representation: Semantic Nets: Slots, exceptions and default frames, conceptual dependency.

UNIT-III **8 Hours**

Handling Uncertainty: Non-Monotonic Reasoning, Probabilistic reasoning: Bayesian Inference, use of uncertainty factors.

Natural Language Processing: Introduction, Syntactic Processing, Semantic Processing, Pragmatic Processing.

UNIT-IV **12 Hours**

Learning: Concept of learning, learning automation, genetic algorithm, learning by inductions, neural nets.

Expert Systems: Need and justification for expert systems, knowledge acquisition, Case Studies: MYCIN, RI.

Textbooks

1. Artificial Intelligence, E. Rich and K. Knight, TMH.

Reference Books/Materials

1. Artificial Intelligence, P. H. Winston, Pearson Education.
2. Introduction to AI and Expert Systems, D. W. Patterson, PHI.
3. Principles of AI, N. J. Nilsson, Narosa Publishing House.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.	**PO7, PO8**
CO2	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.	**PSO4**
CO3	Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, and other machine learning models.	**PO4, PSO1**
CO4	Understanding of rule based and knowledge-based approaches in real life scenarios.	**PO6**
CO5	Demonstrate proficiency in applying scientific method to models of machine learning.	**PSO3**

		Encourage critical thinking to conduct scientific investigations in a biased manner without prejudiced assumptions.	Assist students in analyzing questions, formulating hypotheses, evaluating and validating findings, and drawing logical conclusions.	Prepare students for pursuing research or careers and to design methods to conduct investigations of complex societal and environmental issues.	Continue to acquire relevant knowledge and skills to evaluate the concepts and scientific developments to take up any challenge.	Enhance knowledge mobilization through increased application of mathematics.	Able to use the advance knowledge in consultancy to solve real life problems.	Learn the subject with curiosity to understand new scientific developments.	Understand international perspective about mathematics.	Capability to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives.	Develop aptitude to formulate concepts based on fundamental axioms of mathematics.	Innovate, invent and solve complex mathematical problems using the knowledge of pure and applied mathematics.	Understand demands of the growing field of Mathematics by lifelong learning.	Develop problem-solving skills, critical thinking, and interest through assignments and project work	Prepare students for competitive examinations such as NET, GATE, and many others.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
BSCS401A	Artificial Intelligence				2		2	3	3			2		2	3	

1=weakly mapped

2= moderately mapped

3=strongly mapped

BSCS451A	ARTIFICIAL INTELLIGENCE LAB	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basics of Programming				
Co-requisites	--				

Course Objectives

1. The basic objective of AI (also called heuristic programming, machine intelligence) is to enable computers to perform such intellectual tasks as decision making, problem solving, perception, understanding human communication (in any language, and translate among them).
2. To understand main aim of Artificial intelligence how to automate the things as far as it can and reduce the need for manpower.

Course Outcomes

On completion of this course, the students will be able to know.

CO1 Understand how to set up an environment for working with AI problems. What are the other options/software that can be used for AI problems

CO2 How prolog can be used for inference, perception, knowledge representation, and learning processes.

CO3 How to apply rule based and knowledge-based approaches in real life scenarios by checking the working of different algorithms on prolog

CO4 Using knowledge of reasoning in the presence of incomplete and/or uncertain information

Catalog Description

While AI applications can be developed in any number of different languages, certain language features make programming AI applications straightforward. Prolog is structured in such a way that AI program development is supported by Prolog language features. Other languages, such as Java, support AI programming through code libraries. This course will provide students with an introduction to AI via programming features that support basic AI applications. It enables them to write algorithms for solving problems with the help of fundamental of artificial intelligence.

List of Experiments (Indicative)

1	Write a program to solve 8-queens problem.	4 lab hours
2	Solve any problem using depth first search.	2 lab hours
3	Solve any problem using best first search.	2 lab hours
4	Solve 8-puzzle problem using best first search.	3 lab hours
5	Solve Robot (traversal) problem using means End Analysis.	2 lab hours
6	Solve traveling salesman problem.	2 lab hours

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Projects/ etc.	End Term Exam
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand how to set up an environment for working with AI problems. What are the other options/software that can be used for AI problems	**PO1, PO5**
CO2	How prolog can be used for inference, perception, knowledge representation, and learning processes.	**PO2, PO8, PSO4**
CO3	How to apply rule based and knowledge-based approaches in real life scenarios by checking the working of different algorithms on prolog	**PO6, PSO3**
CO4	Using knowledge of reasoning in the presence of incomplete and/or uncertain information	**PSO1, PO4**

		Encourage critical thinking to conduct scientific investigations in a biased manner without prejudiced assumptions.	Assist students in analyzing questions, formulating hypotheses, evaluating and validating findings, and drawing logical conclusions.	Prepare students for pursuing research or careers and to design methods to conduct investigations of complex societal and environmental issues.	Continue to acquire relevant knowledge and skills to evaluate the concepts and scientific developments to take up any challenge.	Enhance knowledge mobilization through increased application of mathematics.	Able to use the advance knowledge in consultancy to solve real life problems.	Learn the subject with curiosity to understand new scientific developments.	Understand international perspective about mathematics.	Capability to use appropriate software's to solve mathematical equations.	Develop the protocols as per laboratory standards to accomplish the objectives.	Develop aptitude to formulate concepts based on fundamental axioms of mathematics.	Innovate, invent and solve complex mathematical problems using the knowledge of pure and applied mathematics.	Understand demands of the growing field of Mathematics by lifelong learning.	Develop problem-solving skills, critical thinking, and interest through assignments and project work	Prepare students for competitive examinations such as NET, GATE, and many others.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
BSCS 451A	Artificial Intelligence Lab	2	2		3	2	2		3			2		2	3	

1=weakly mapped

2= moderately mapped

3=strongly mapped

ETCS307A	Database Management Systems	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Basics of Data Base				
Co-requisites	--				

Course Objectives

1. To understand the different issues involved in the design and implementation of a database system.

2. To study the physical and logical database designs, database modeling, relational, hierarchical, and network models.

3. To understand and use data manipulation language to query, update, and manage a database.

4. To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing.

5. To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

6. For a given query write relational algebra expressions for that query and optimize the developed expression.

Course Outcomes

On completion of this course, the students will be able to
CO1. Independently understand basic database technology.
CO2.Describe the fundamental elements of relational database management systems
CO3. Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
CO4.Design ER-models to represent simple database application scenarios
CO5. Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data.
CO6.Improve the data base design by normalization.
CO7. Familiar with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing.
CO8. Students will be able to work in a group on the design, and implementation of a database system project.

Catalog Description

Database Management Systems (DBMS) are vital components of modern information systems. Database applications are pervasive and range in size from small in-memory databases to terra bytes or even larger in various applications domains. The course focuses on the fundamentals of knowledge base and relational database management systems, and the current developments in database theory and their practice. The course reviews topics such as conceptual data modelling, relational data model, relational query languages, relational database design and transaction processing and current technologies.

Course Content

Unit I: **12 lecture hours**

Database system architecture: Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML). Data models: Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.

Unit II: **8 lecture hours**

Relational query languages: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server. Relational database design: Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design. Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.

Unit III: **12 lecture hours**

Storage strategies: Indices, B-trees, hashing, Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery

Unit IV: **8 lecture hours**

Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection. Advanced topics: Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.

Textbooks

1."Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.

2. "Principles of Database and Knowledge – Base Systems", Vol 1 by J.D. Ullman, Computer Science Press.

Reference Books/Materials

1. "Fundamentals of Database Systems", R. Elmasri and S. Navathe, Pearson Education

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Independently understand basic database technology.	**PO2**
CO2	Describe the fundamental elements of relational database management systems	**PO3**
CO3	Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.	**PO4**
CO4	Design ER-models to represent simple database application scenarios	**PO5**
CO5	Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data.	**PO4**
CO6	Improve the database design by normalization.	**PO4**
CO7	Familiar with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing.	**PO9**
CO8	Students will be able to work in a group on the design, and implementation of a database system project.	**PSO1**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Innovation and Industry Friendly	Ethics and Communication Skills
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO1 2	PSO1	PSO2	PSO3
ETCS 307A	Database Management Systems		2	3	3	3				3				3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCS355A	Database Managemet Systems Lab	L	T	P	C
Version 1.0		-	-	2	1
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

1. To explain basic database concepts, applications, data models, schemas, and instances.
2. To demonstrate the use of constraints and relational algebra operations.
3. To facilitate students in Database design.
4. To familiarize issues of concurrency control and transaction management.

Course Outcomes

On completion of this course, the students will be able to:-
CO1. Apply the basic concepts of Database Systems and Applications.
CO2. Use the basics of SQL and construct queries using SQL in database creation and interaction.
CO3. Design a commercial relational database system (Oracle, MySQL) by writing SQL using the system.
CO4. Analyze and Select storage and recovery techniques of database system.

Catalog Description

This course introduces the core principles and techniques required in the design and implementation of database systems. This introductory application-oriented course covers the relational database systems RDBMS - the predominant system for business scientific and engineering applications at present. It includes Entity-Relational model, Normalization, Relational model, Relational algebra, and data access queries as well as an introduction to SQL. It also covers essential DBMS concepts such as: Transaction Processing, Concurrency Control and Recovery. It also provides students with theoretical knowledge and practical skills in the use of databases and database management systems in information technology applications.

Course Content

List of Experiments

S.No	Experiment	No of Hours
1	Design a Database and create required tables. For e.g. Bank, College Database	4
2	Apply the constraints like Primary Key, Foreign key, NOT NULL to the tables.	2
3	Write a SQL statement for implementing ALTER, UPDATE and DELETE.	2
4	Write the queries to implement the joins.	4
5	Write the queries for implementing the following functions: MAX (), MIN (), AVG (), COUNT ().	2
6	Write the queries to implement the concept of Integrity constrains	4
7	Write the queries to create the views.	2
8	Perform the queries for triggers.	4
9	Perform the following operation for demonstrating the insertion, updating and deletion using the referential integrity constraints.	2
10	Do some more practice based on your class work.	2

Text Books

1. "Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.

Reference Books/Materials

"Principles of Database and Knowledge – Base Systems", Vol 1 by J.D. Ullman, Computer Science Press.
"Fundamentals of Database Systems", R. Elmasri and S. Navathe, Pearson Education.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Apply the basic concepts of Database Systems and Applications	**PO5**
CO2	Use the basics of SQL and construct queries using SQL in database creation and interaction	**PO3**
CO3	Design a commercial relational database system (Oracle, MySQL) by writing SQL using the system	**PO3**
CO4	Analyze and Select storage and recovery techniques of database system.	**PO2**

		Engineering Knowlsedge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Moderm tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Application of Concepts	Innovation and Industry Friendly	Ethics and Communication Skills
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETCS 355A	Database Management Systems Lab		3	3		2								3		

1=weakly mapped
2= moderately mapped
3=strongly mapped