K.M.G. COLLEGE OF ARTS AND SCIENCE

(AUTONOMOUS)

Approved by the Government of Tamil Nadu
Permanently Affiliated to Thiruvalluvar University, Vellore.
Recognized under Section 2(f) and 12(B) of the UGC Act 1956
Accredited by NAAC (2nd Cycle) with (CGPA of 3.24/4) 'A' Grade

PG DEPARTMENT OF MATHEMATICS

M. Sc., MATHEMATICS

SYLLABUS

(CHOICE BASED CREDIT SYSTEM)

Under

LEARNING OUTCOMES-BASED CURRICULUM

FRAMEWORK (LOCF)

(Effective for the Batch of Students Admitted from 2024-2025)

PREFACE

The curriculum of Postgraduate Mathematics is the study of quantity, structure, space and change, focusing on problem solving, with wider scope of application in science, engineering, technology, social sciences etc. The purpose of the outcome-based education is meant to provide an exposure to the fundamental aspects in different branches of Mathematics and its applications, keeping in mind the growing needs for higher education, employability, entrepreneurship and social responsibility. The periodical restructuring of the syllabi is carried out to fulfill the requirements of graduate attributes, qualification descriptors, programme learning outcomes and course outcomes. The outcome-based education enriches the curriculum to deliver the basic principles, synthetic strategies, mechanisms and application-oriented learning for the benefit of students. It also includes self-learning module, minor projects and industrial internship to enable students to get equipped for higher studies and employment. The programme also includes training to students for seminar presentation, preparation of internship reports, hands-on training in lab courses, synthesis and its analysis, developing leadership qualities, organization and participation in the interdepartmental academic competitions. The allied papers provide a platform to strengthen the understanding of the core subjects. The non-major elective courses offer chances to learn and augment interest in other related fields. The outcome-based curriculum is intended to enrich the learning pedagogy to global standards. ICT enabled teaching-learning platforms are provided to students along with the interaction of international Mathematicians. The seminars periodically delivered by subject experts and former professors would certainly help the students to update with latest technology/trends in different fields of Mathematics. The OBE based evaluation methods will reflect the true cognitive levels of the students as the curriculum is designed with course outcomes and cognitive level correlations as per BLOOM's Taxonomy.

In pursuit of the Higher Education Department Policy Note 2022-23 Demand 20, Section 1.4, Tamil Nādu State Council for Higher Education took initiative to revamp the curriculum. On 27 July 2022, a meeting was convened by the Member-Secretary Dr. S. Krishnasamy enlightening the need of the hour to restructure the curriculum of both Undergraduate and Post-graduate programmes based on the speeches at the Tamil Nādu Legislative Assembly Budget meeting by the Honourable Higher Education Minister Dr K. Ponmudy and Honourable Finance Minister Dr. P. Thiagarajan. At present there are three different modes of imparting education in most of the educational institutions throughout the globe. Outcome Based Education, Problem Based Education, and Project Based Education.

Now our Honourable Higher Education Minister announced Industry Aligned Education. During discussion, Member Secretary announced the importance of question papers and evaluation as envisaged by the Honourable Chief Secretary to Government Dr, V. IraiAnbu. This is very well imbedded in Revised Bloom's Taxonomy forms three learning domains: the cognitive (knowledge), affective(attitude), and psychomotor (skill). This classification enables to estimate the learning capabilities of students.

Briefly, it is aimed to restructure the curriculum as student-oriented, skill-based, and institution industry- interaction curriculum with the various courses under "Outcome Based Education with Problem Based Courses, Project Based Courses, and Industry Aligned Programmes" having revised Bloom's Taxonomy for evaluating students skills. Three domains:

(i)Cognitive Domain

(Lower levels: K1: Remembering ; K2: Understanding ; K3: Applying; Higher levels: K4: Analysing ; K5: Evaluating; K6: Creating)

(ii) Affective Domain

(iii) Psychomotor Domain

ABOUT THE COLLEGE

The College was founded in the new millennium 2000 by the vision of late Shri.K.M.Govindarajan fondly known as Iyah, with a mission to offer higher education in the fields of Arts and Science to the needy and the poor middle class students of this area and make them fully employable and economically self-reliant. With a humble beginning of launching an elementary school named Thiruvalluvar Elementary School in the year 1952, Iyah groomed it into a Higher Secondary School and later into a college. Education was his soul and breath. The college has grown into a full-fledged educational hub offering 12 under graduate programmes, 8 post graduate programmes, 5 M.Phil research programmes and 4 Ph.D programmes. The college has been accredited with 'A' grade by NAAC in 2nd cycle and recognized under section 2(f) & 12(B) of the UGC act 1956. The College is permanently affiliated to Thiruvalluvar University. The College is also acquired the status of Autonomous from the academic year 2024-2025. The College is an associate member of ICT Academy and registered member of NPTEL and Spoken Tutorials of IIT Bombay. The college is also a member of INFLIBNET and NDL.

VISION OF THE COLLEGE

Empower young men and women by educating them in the pursuit of excellence, character building and responsible citizen.

MISSION OF THE COLLEGE

Offer higher education in the fields of Arts, Science & Management to the needy and make them fully self-dependent.

QUALITY POLICY OF THE COLLEGE

KMG Students achieve the best learning results and personal growth with modern education that equip them for working life and a changing society to become deserving citizens.

ABOUT THE DEPARTMENT

The Department of Mathematics was Established in the Year 2007 and made a Steady Growth to the Height of Establishing Post Graduate Level in the Year 2010. The Department offers Research Programme (M.Phil) from 2013. Our Aim is to Promote Students in the field of Mathematics and working Knowledge of Mathematics. Every Year Department Organizes National Conference/Seminar, Association Activities and Special Lecture.

VISION OF THE DEPARTMENT

- To Emerge as a Global Center of Learning, Academic Excellence, and Innovative Research.

MISSION OF THE DEPARTMENT

- Imparting of Quality Mathematics Education and the inculcating of the spirit of Research through Innovative Teaching and Research Methodologies.

- To Provide an Environment where Students can Learn, become Competent users of Mathematics, and Understand the use of Mathematics in Other Disciplines.

ROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: **Knowledge Enhancement and Application:** Graduates will demonstrate proficiency in their chosen discipline by applying theoretical knowledge and analytical skills to solve complex problems in diverse professional contexts.

PEO2: **Effective Communication and Leadership:** Graduates will exhibit strong communication skills and leadership abilities, enabling them to effectively collaborate with diverse teams, convey ideas persuasively, and contribute positively to organizational goals.

PEO3: **Ethical Decision-Making and Social Responsibility:** Graduates will uphold ethical principles and social responsibility in their professional practices, making informed decisions that consider the well-being of stakeholders and society at large.

PEO4: **Continuous Learning and Adaptability:** Graduates will embrace a commitment to lifelong learning, continuously updating their knowledge and skills to remain agile and adaptable in dynamic work environments characterized by rapid technological advancements and evolving global trends.

PEO5: **Entrepreneurial Mindset and Innovation:** Graduates will demonstrate an entrepreneurial mindset, leveraging their knowledge and skills to identify opportunities, innovate solutions, and potentially initiate and manage ventures that contribute to economic growth and societal development.

PROGRAM OUTCOMES (POs)

On successful completion of the programme, the students will be able to:

POs	Graduate Attributes	Statements
PO1	Disciplinary Knowledge	Acquire detailed knowledge and expertise in all the disciplines of the subject.
PO2	Communication Skills	Ability to express thoughts and ideas effectively in writing, listening and confidently Communicate with others using appropriate media
PO3	Critical Thinking	Students will develop aptitude Integrate skills of analysis, critiquing, application and creativity.
PO4	Analytical Reasoning	Familiarize to evaluate the reliability and relevance of evidence, collect, analyze and interpret data.
PO5	Problem Solving	Capacity to extrapolate the learned competencies to solve different kinds of non-familiar problems.
PO6	Employability and Entrepreneurial Skill	Equip the skills in current trends and future expectations for placements and be efficient entrepreneurs by accelerating qualities to facilitate startups in the competitive environment.
PO7	Individual and Team Leadership Skill	Capability to lead themselves and the team to achieve organizational goals and contribute significantly to society.
PO8	Multicultural Competence	Possess knowledge of the values and beliefs of multiple cultures and a global perspective.
PO 9	Moral and Ethical awareness/reasoning	Ability to embrace moral/ethical values in conducting one's life.
PO10	Lifelong Learning	Identify the need for skills necessary to be successful in future at personal development and demands of work place.

PROGRAM SPECIFIC OUTCOMES (PSOs)

On successful completion of the M.Sc., Mathematics, the students will be able to:

PSOs	Statements
PSO1	Acquire good knowledge and understanding, to solve specific theoretical & applied problems in different area of mathematics & statistics.
PSO2	Understand, formulate, develop mathematical arguments, logically and use quantitative models to address issues arising in social sciences, business and other context /fields.
PSO3	To prepare the students who will demonstrate respectful engagement with other's ideas, behaviors, beliefs and apply diverse frames of references to decisions and actions. To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.

Correlation Rubrics:

High	Moderate	Low	No Correlation
3	2	1	-

Mapping of PSOs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PSO1	3	3	3	3	3	3	1	-	-	2
PSO2	3	2	3	3	3	3	1	-	-	2
PSO3	3	3	3	3	3	3	1	-	-	3

K.M.G. COLLEGE OF ARTS AND SCIENCE

(AUTONOMOUS)

Subject and Credit System- M.Sc., Mathematics

(Effective for the Batch of Students Admitted from 2024-2025)

Semester	Part	Category	Course Code	Course Title	Ins.Hrs / Week	Credit	Maximum Marks		
							Internal	External	Total
SEMESTER - I	Part - I	Core Paper-I	APCMA11	Algebraic Structures	07	05	25	75	100
		Core Paper-II	APCMA12	Real Analysis – I	07	05	25	75	100
		Core Paper-III	APCMA13	Ordinary Differential Equations	06	04	25	75	100
		Elective Course-I (Choose any One)	APEMA14A	Number Theory and Cryptography	05	03	25	75	100
			APEMA14B	Graph Theory and Applications					
			APEMA14C	Formal Languages and Automata Theory					
			APEMA14D	Programming in C++ and Numerical Methods					
		Elective Course-II (Choose any One)	APEMA15A	Lie Groups and Lie Algebras	05	03	25	75	100
			APEMA15B	Mathematical Programming					
			APEMA15C	Fuzzy Sets and Their Applications					
			APEMA15D	Discrete Mathematics					
				Semester Total	**30**	**20**			

Semester	Part	Category	Course Code	Course Title	Ins.Hrs / Week	Credit	Maximum Marks		
							Internal	External	Total
SEMESTER - II	Part - I	Core Paper-IV	APCMA21	Advanced Algebra	06	05	25	75	100
		Core Paper-V	APCMA22	Real Analysis – II	06	05	25	75	100
		Core Paper-VI	APCMA23	Partial Differential Equations	06	04	25	75	100
		Elective Course-III (Choose any One)	APEMA24A	Reliability and Queuing Theory	03	03	25	75	100
			APEMA24B	Mathematical Statistics					
			APEMA24C	R Programming Language (Only Practical)					
			APEMA24D	Tensor Analysis and Relativity					
		Elective Course-IV (Choose any One)	APEMA25A	Wavelets	03	03	25	75	100
			APEMA25B	Machine Learning and Artificial Intelligence					
			APEMA25C	Neural Networks					
			APEMA25D	Difference Equations					
	Part II	Skill Enhancement Course-I (Choose any One)	APSMA26A	Office Automation and ICT Tools	04	02	25	75	100
			APSMA26B	Computational Mathematics using Sage Math					
			APSMA26C	Mathematical documentation using LATEX / other packages					
			APSMA26D	Numerical analysis using SCILAB					
			APSMA26E	Differential equations using SCILAB					
			APSMA26F	Industrial Mathematics/Statisticsusing latest programming packages					
			APSMA26G	Research Tools and Techniques					
		Compulsory	APHR20	Human Rights	02	02	25	75	100
		Compulsory	APMOOC20	MOOC	-	02	-	100	100
				Semester Total	**30**	**26**			

Semester	Part	Category	Course Code	Course Title	Ins.Hrs / Week	Credit	Maximum Marks		
							Internal	External	Total
SEMESTER - III	Part - I	Core Paper-VII	APCMA31	Complex Analysis	06	05	25	75	100
		Core Paper-VIII	APCMA32	Probability Theory	06	05	25	75	100
		Core Paper-IX	APCMA33	Topology	06	05	25	75	100
		Core Paper-X	APCMA34	Mechanics(Industry Modules)	06	04	25	75	100
		Elective Course-V (Choose any One)	APEMA35A	Fluid Dynamics	03	03	25	75	100
			APEMA35B	Algebraic Number Theory					
			APEMA35C	Stochastic Processes					
			APEMA35D	Mathematical Python					
	Part - II	Skill Enhancement Course-II	APSPMA36	Professional Communication Skill - Term paper & Seminar presentation	03	02	25	75	100
		Compulsory	APIMA37	(Carried out in Summer Vacation at the end of I year – 30 hours) Summer Internship Report to be submitted to the Department.	-	02	100	-	100
				Semester Total	**30**	**26**			
SEMESTER - IV	Part - I	Core Paper-XI	APCMA41	Functional Analysis	06	05	25	75	100
		Core Paper-XII	APCMA42	Differential Geometry	06	05	25	75	100
		Core Paper-XIII	APPMA43	Project with viva voce	10	07	25	75	100
		Elective Course-VI (Choose any One)	APEMA44A	Financial Mathematics	04	03	25	75	100
			APEMA44B	Resource Management Techniques					
			APEMA44C	Modeling and Simulation with Excel					
			APEMA44D	Mathematical Python - Practical					
	Part - II	Professional Competency Skill Enhancement Course **(Internal Assessment)**	APSPMA45	1.Training for Competitive Examinations Mathematics for NET / UGC - CSIR/ SET/TRB Competitive Examinations (2 hours) 2.General Studies for UPSC/TNPSC/ Other Competitive Examinations (2 Hrs)	04	02	25	75	100
	Part - III	Compulsory	APEA40	Extension Activity	-	01	100	-	100
				Semester Total	**30**	**23**			

Consolidated Semester wise and Component wise Credit distribution

Parts	Semester-I	Semester-II	Semester-III	Semester-IV	Total Credits
Part-I	20	20	22	20	82
Part-II	-	06	04	02	12
Part-III	-	-	-	01	01
Total	20	26	26	23	**95**

*Part I, Part II and Part III components will be separately taken into account for CGPA calculation and classification for the post graduate programme and has to be completed during the duration of the programme as per the norms, to be eligible for obtaining the PG degree.

Title of the Course	ALGEBRAIC STRUCTURES	Hours/Week	07
Course Code	APCMA11	Credits	05
Category	CORE- I	Year & Semester	I & I
Prerequisites	UG Level Modern Algebra	Regulation	2024

Objectives of the course:

- To introduce the concepts and to develop working knowledge on class equation, solvability of groups, finite abelian groups, linear transformations, real quadratic forms

.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	Counting Principle - Class equation for finite groups and its applications - Sylow's theorems (For theorem 2.12.1, First proof only). **Chapter 2: Sections 2.11 and 2.12 (Omit Lemma 2.12.5)**	CO1	K1 K2 K3
UNIT-II	Solvable groups - Direct products - Finite abeliangroups- Modules **Chapter 5 : Section 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1)** **Chapter 2: Section 2.13 and 2.14 (Theorem 2.14.1 only)** **Chapter 4: Section 4.5**	CO2	K1 K2 K3
UNIT-III	Linear Transformations: Canonical forms –Triangularform - Nilpotent transformations. **Chapter 6: Sections 6.4, 6.5**	CO3	K1 K2 K3
UNIT-IV	Jordan form - rational canonical form. **Chapter 6 : Sections 6.6 and 6.7**	CO4	K1 K2 K3
UNIT-V	Trace and transpose - Hermitian, unitary, normaltransformations, real quadratic form. **Chapter 6 : Sections 6.8, 6.10 and 6.11 (Omit 6.9)**	CO5	K1 K2 K3

Recommended Text Books

1.I.N. Herstein. *Topics in Algebra* (II Edition) Wiley Eastern Limited, New Delhi, 1975.

Reference Books

1. M.Artin, *Algebra*, Prentice Hall of India, 1991.
2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, *Basic Abstract Algebra* (II Edition) Cambridge University Press, 1997. (IndianEdition)
3. I.S.Luther and I.B.S.Passi, *Algebra*, Vol. I –Groups(1996); Vol.II Rings, Narosa Publishing House , New Delhi, 1999
4. D.S.Malik, J.N. Mordeson and M.K.Sen, *Fundamental of Abstract Algebra*, McGraw Hill (International Edition), NewYork. 1997.
5. N.Jacobson, *Basic Algebra*, Vol. I & II W.H.Freeman (1980);also published by Hindustan Publishing Company, New Delhi.

Website and e-learning source

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.algebra.com

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	To Demonstrate ability to think group actions .	K1,K2,K3
CO2	Know the internal and external direct product of groups	K1,K2,K3
CO3	Formulate the concept Canonical & Triangular forms, Nilpotent transformations.	K1,K2,K3
CO4	To Know module and difference between Jordan - rational canonical form	K1,K2,K3
CO5	Explain the properties of trace and transpose matrix form	K1,K2,K3,

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	1	-	-	1	3	2	2
CO2	2	1	3	1	3	3	1	-	-	1	3	2	2
CO3	3	2	3	1	3	3	1	-	-	1	3	2	2
CO4	1	2	3	2	3	3	1	-	-	1	3	2	1
CO5	3	1	2	3	3	3	1	-	-	1	3	2	1

COURSE DESCRIPTORS

Title of the Course	**REAL ANALYSIS - I**	**Hours/Week**	07
Course Code	APCMA12	**Credits**	05
Category	CORE -II	**Year & Semester**	I & I
Prerequisites	UG Level Real Analysis Concepts	**Regulation**	2024

Objectives of the course:

- To work comfortably with functions of bounded variation, Riemann- Stieltjes Integration, convergence of infinite series, infinite product anduniform convergence and its interplay between various limiting operations.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Functions of Bounded Variation** - Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation - Total variation on [a, x] as a function of x - Functions of bounded variation expressed as the difference of two increasing functions - Continuous functions of bounded variation. **Chapter – 6 : Sections 6.1 to 6.8** **Infinite Series:** Absolute and conditional convergence - Dirichlet'stest and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series. **Chapter 8 : Sections 8.8, 8.15, 8.17, 8.18**	CO1	K1 K2 K3 K4
UNIT-II	**The Riemann - Stieltjes Integral** - Introduction - Notatio - The definition of the Riemann - Stieltjes integral - Linear Properties -Integration by parts- Change of variable in a Riemann - Stieltjes integral - Reduction to a Riemann Integral – Euler's summation formula - Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper, lower integrals - Riemann's condition - Comparison theorems. **Chapter - 7 : Sections 7.1 to 7.14**	CO2	K1 K2 K3

UNIT-III	**The Riemann-Stieltjes Integral** - Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of RS integrals-Mean value theorems -integrals as a function of the interval – Second fundamental theorem of integral calculus-Change of variable -Second Mean Value Theorem for Riemann integral- Riemann-Stieltjes integrals depending on a parameter- Differentiation under integral sign-Lebesgue criteriaon for existence of Riemann integrals. **Chapter - 7 : 7.15 to 7.26**	CO3	K1 K2 K3
UNIT-IV	**Infinite Series and infinite Products** - Double sequences -Double series - Rearrangement theorem for double series - A sufficient condition for equality of iterated series - Multiplication of series – Cesaro summability - Infinite products. **Chapter - 8 Sec, 8.20, 8.21 to 8.26** **Power series** - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem **Chapter 9 : Sections 9.14 9.15, 9.19, 9.20, 9.22, 9.23**	CO4	K1 K2 K3
UNIT-V	**Sequences of Functions** – Point wise convergence of sequences of functions - Examples of sequences of real - valued functions - Uniform convergence and continuity - Cauchy condition for uniform convergence - Uniform convergence of infinite series of functions - Riemann - Stieltjes integration – Non-uniform Convergenceand Term-by-term Integration - Uniform convergence and differentiation - Sufficient condition for uniform convergence of aseries - Mean convergence. **Chapter -9 Sec 9.1 to 9.6, 9.8,9.9,9.10,9.11, 9.13**	CO5	K1 K2 K3

Recommended Text Books

1. Tom M.Apostol : *Mathematical Analysis*, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974.

Reference Books

1. Bartle, R.G. *Real Analysis*, John Wiley and Sons Inc., 1976.
2. Rudin,W. *Principles of Mathematical Analysis*, 3rd Edition. McGrawHill Company, New York, 1976.
3. Malik,S.C. and Savita Arora. *Mathematical Anslysis*, Wiley EasternLimited.New Delhi, 1991.
4. Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, SatyaPrakashan, New Delhi, 1991.
5. Gelbaum, B.R. and J. Olmsted, *Counter Examples in Analysis*,Holden day, San Francisco, 1964.
6.A.L.Gupta and N.R.Gupta, *Principles of Real Analysis*, PearsonEducation, (Indian print) 2003.

Website and e-learning source

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Analyze and evaluate functions of bounded variation and Rectifiable Curves.	K1,K2,K3, K4
CO2	Describe the concept of Riemann-Stieltjes integral and its properties.	K1,K2,K3
CO3	Demonstrate the concept of step function, upper function, Lebesgue function and their integrals.	K1,K2,K3
CO4	Construct various mathematical proofs using the properties of Lebesgue integrals and establish the Levimonotone convergence theorem.	K1,K2,K3
CO5	Formulate the concept and properties of inner products, norms and measurable functions.	K1,K2,K3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	1	-	-	1	3	2	3
CO2	2	1	3	1	3	3	1	-	-	1	3	2	2
CO3	3	2	3	1	3	3	1	-	-	1	3	2	2
CO4	1	2	3	2	3	3	1	-	-	1	3	2	2
CO5	3	1	2	3	3	3	1	-	-	1	3	2	1

COURSE DESCRIPTORS

Title of the Course	**ORDINARY DIFFERENTIAL EQUATIONS**	**Hours/Week**	06
Course Code	APCMA13	**Credits**	05
Category	CORE- III	**Year & Semester**	I & I
Prerequisites	UG Level Calculus and Differential Equations	**Regulation**	2024

Objectives of the course:

- To develop strong background on finding solutions to lineardifferential equations with constant and variable coefficients and also with singular points, to study existence and uniqueness of the solutionsof first order differential equations

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Linear equations with constant coefficients** Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian-Non-homogeneous equation of order two. **Chapter 2: Sections 1 to 6**	CO1	K1 K2 K3
UNIT-II	**Linear equations with constant coefficients** Homogeneous and non-homogeneous equation of order n –Initial valueproblems-Annihilator method to solve non-homogeneous equation-Algebra of constant coefficient operators. **Chapter 2 : Sections 7 to 12**.	CO2	K1 K2 K3
UNIT-III	**Linear equation with variable coefficients** Initial value problems -Existence and uniqueness theorems – Solutions to solve a non-homogeneous equation – Wronskian and linear dependence – reduction of the order of a homogeneous equation – homogeneous equation with analytic coefficients-The Legendre equation. **Chapter : 3 Sections 1 to 8 (Omit section 9)**	CO3	K1 K2 K3 K4
UNIT-IV	**Linear equation with regular singular points** Euler equation – Second order equations with regular singular points –Exceptional cases – Bessel Function. **Chapter 4 : Sections 1 to 4 and 6 to 8 (Omit sections 5 and 9)**	CO4	K1 K2 K3
UNIT-V	**Existence and uniqueness of solutions to first order equations:** Equation with variable separated – Exact equation – method of successive approximations – the Lipschitz condition – convergence of the successive approximations and the existence theorem. **Chapter 5 : Sections 1 to 6 (Omit Sections 7 to 9)**	CO5	K1 K2 K3

Recommended Text Books

1. E.A.Coddington, *A introduction to ordinary differential equations* (3rd Printing) Prentice-Hall of India Ltd., New Delhi, 1987.

Reference Books

1. Williams E. Boyce and Richard C. DI Prima, *Elementary differential equations and boundary value problems*, John Wileyand sons, New York, 1967.
2. George F Simmons, *Differential equations with applications and historical notes*, Tata McGraw Hill, New Delhi, 1974.
3. N.N. Lebedev, *Special functions and their applications*, Prentice Hall of India, New Delhi, 1965.
4. W.T. Reid. *Ordinary Differential Equations*, John Wiley and Sons, New York, 1971
5. M.D.Raisinghania, *Advanced Differential Equations*, S.Chand & Company Ltd. New Delhi 2001
6. B.Rai, D.P.Choudary and H.I. Freedman, *A Course in Ordinary Differential Equations*, Narosa Publishing House, New Delhi,2002.

Website and e-learning source

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Establish the qualitative behavior of solutions of systems of differential equations.	K1,K2,K3
CO2	Recognize the physical phenomena modeled by differential equations and dynamical systems.	K1,K2,K3
CO3	Analyze solutions using appropriate methods and give examples.	K1,K2,K3,K4
CO4	Formulate Green's function for boundary value problems.	K1,K2,K3
CO5	Understand and use various theoretical ideas and results that underlie the mathematics in this course.	K1,K2,K3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	2	-	-	1	3	2	3
CO2	2	1	3	1	3	3	2	-	-	1	3	2	2
CO3	3	2	3	1	3	3	2	-	-	1	3	2	3
CO4	1	2	3	2	3	3	2	-	-	1	3	2	1
CO5	3	1	2	3	3	3	2	-	-	1	3	2	2

COURSE DESCRIPTORS

Title of the Course	**NUMBER THEORY AND CRYPTOGRAPHY**	**Hours/Week**	05
Course Code	APEMA14A	**Credits**	03
Category	ELECTIVE-I	**Year & Semester**	I & I
Prerequisites	UG Level Number Theory	**Regulation**	2024

Objectives of the course:

- Demonstrate ability to learn elementary ideas from number theorywhich will haveapplications in cryptography.
- Introduce various cryptosystems and apply them in the necessary fields.
- Understand the concepts of public key and primarily.
- Learn the public key cryptography and RSA algorithm
- Get the knowledge about Factoring concepts.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**UNIT–I: Some topics in Elementary Number Theory** Time Estimates for doing arithmetic – Divisibility and Euclidean Algorithm –Congruence's–Some Applications to Factoring. **Chapter 1**	CO1	K1 K2 K3
UNIT-II	**UNIT–II: Cryptography** Some simple cryptosystems – Enciphering matrices. **Chapter 3**	CO2	K1 K2 K3
UNIT-III	**UNIT–III:** Quadratics – Residues and reciprocity. **Chapter 2**	CO3	K1 K2 K3
UNIT-IV	**UNIT–IV: Public Key** The idea of Public key Cryptography – RSA – DiscreteLaw– Knapsack –Zero–Knowledge. **Chapter 4: Sections 1 to 5**	CO4	K1 K2 K3
UNIT-V	**UNIT–V:Primality and Factoring** Pseudo–primes – The rho method – Fermat factorization and factor bases – The continued fraction method – The quadratic sieve method. **Chapter 5: Sections 1 to 5**	CO5	K1 K2 K3

Recommended Text Books

1. Neal Koblitz, A Course in Number Theory and Cryptography, Springer-Verlag, New York,1987

Reference Books

1.I.Niven and H.S.Zuckermann, An Introduction to Theory ofNumbers(Edn. 3), Wiley Eastern Ltd., New Delhi,1976 2.David M.Burton, Elementary Number Theory, Brown Publishers,Iowa,1989

3.K.Ireland and M.Rosen, A Classical Introduction to ModernNumberTheory, Springer Verlag, 1972

4.N.Koblitz, Algebraic Aspects of Cryptography, Springer 1998.

Website and e-learning source

1. https://nptel.ac.in/courses/111101137
2. https://archive.nptel.ac.in/courses/106/103/106103015/
3. https://onlinecourses-archive.nptel.ac.in/noc17_cs36/preview

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Acquire the knowledge of elementary number theory	K1,K2,K3
CO2	Apply various cryptosystems and understand the concepts of quadratic, residues and reciprocity	K1,K2,K3
CO3	Develop the idea of public key cryptography, RSA Algorithms.	K1,K2,K3
CO4	Solve problems using the continued fraction method and the quadratic sieve method.	K1,K2,K3
CO5	Demonstrate ability to apply concepts of Fermat factorization and factor bases.	K1,K2,K3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3	1	-	-	1	3	3	2
CO2	3	3	3	2	2	2	1	-	-	1	3	3	2
CO3	3	3	3	2	3	3	1	-	-	1	3	3	3
CO4	3	3	3	3	3	3	1	-	-	1	3	3	2
CO5	3	3	3	3	3	3	1	-	-	1	3	3	3

COURSE DESCRIPTORS

Title of the Course	**GRAPH THEORY AND APPLICATIONS**	**Hours/Week**	05
Course Code	APEMA14B	**Credits**	03
Category	ELECTIVE-I	**Year & Semester**	I & I
Prerequisites	UG Level Graph Theory	**Regulation**	2024

Objectives of the course:

- To study and develop the concepts of graphs, sub graphs, trees, connectivity, Euler tours, Hamilton cycles, matching, coloring ofgraphs, independent sets, cliques, vertex coloring, and planar graphs

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Graphs, Sub graphs and Trees** Graphs and simple graphs - Graph Isomorphism - The Incidence and Adjacency Matrices- Subgraphs - Vertex Degrees - Paths and Connection - Cycles - Trees - Cut Edges and Bonds - Cut Vertices. **Chapter 1 (Section 1.1 - 1.7) ; Chapter 2 (Section 2.1 - 2.3)**	CO1	K1 K2 K3
UNIT-II	**Connectivity, Euler Tours and Hamilton Cycles** Connectivity - Blocks - Euler tours – Hamilton **Chapter 3 (Section 3.1 -3.2) ; Chapter 4(Section 4.1 - 4.2)**	CO2	K1 K2 K3
UNIT-III	**Matchings, Edge Colourings** Matchings - Matchings and Coverings in Bipartite Graphs – Edge Chromatic Number - Vizing's Theorem. **Chapter 5 (Section 5.1 - 5.2) ; Chapter 6 (Section 6.1 - 6.2)**	CO3	K1 K2 K3
UNIT-IV	**Independent Sets and Cliques, Vertex Colourings** Independent sets - Ramsey's Theorem – Chromatic Number -Brooks' Theorem - Chromatic Polynomials. **Chapter 7 (Section 7.1 – 7.2); Chapter 8 (Section 8.1 – 8.2, 8.4)**	CO4	K1 K2 K3
UNIT-V	**Planar Graphs** Plane and planar Graphs - Dual graphs - Euler's Formula - TheFive-Colour Theorem andthe Four-Colour Conjecture. **Chapter 9 (Section 9.1 - 9.3, 9.6)**	CO5	K1 K2 K3

Recommended Text Books

1.J.A.Bondy and U.S.R. Murthy, Graph Theory and Applications,Macmillan, London,1976.

Reference Books

1.J.Clark and D.A.Holton , A First look at Graph Theory, AlliedPublishers, New Delhi,1995.
2.R. Gould. Graph Theory, Benjamin/Cummings, Menlo Park, 1989.
3.A.Gibbons, Algorithmic Graph Theory, CambridgeUniversity Press, Cambridge,1989.
4.R.J.Wilson and J.J.Watkins, Graphs : An IntroductoryApproach, John Wiley andSons, New York, 1989.
5.R.J. Wilson, Introduction to Graph Theory, PearsonEducation, 4th Edition, 2004,Indian Print.
6.S.A.Choudum, A First Course in Graph Theory, MacMillan India Ltd.1987.

Website and e-learning source

https://nptel.ac.in/courses/111106050/

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Graphs features and properties of various types of graphs.	K1,K2,K3
CO2	Demonstrate capacity of illustration for mathematical reasoning through analyzing, providing and explaining concepts of Eulerian circuits and Hamiltonicity in graphs.	K1,K2,K3
CO3	Understand the definitions and properties of matching and independent sets.	K1,K2,K3
CO4	Apply the concepts of graphs to model them in real life situations.	K1,K2,K3
CO5	Explicate the applications of planarity and colorability.	K1,K2,K3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	2	-	-	1	3	3	2
CO2	3	3	2	2	2	3	2	-	-	1	3	3	2
CO3	3	3	2	2	3	3	2	-	-	1	3	3	2
CO4	3	3	3	3	3	3	2	-	-	1	3	3	2
CO5	3	3	3	3	3	3	2	-	-	1	3	3	3

Title of the Course	FORMAL LANGUAGES AND AUTOMATA THEORY	Hours/Week	05
Course Code	APEMA14C	Credits	03
Category	ELECTIVE-I	Year & Semester	I & I
Prerequisites	Elementary Algebra	Regulation	2024

Objectives of the course:

- The purpose of this course is to acquaint the student with an overview of the theoretical foundations of computer science from the perspective of formal languages.
- Classify machines by their power to recognize languages. Employ finite state machines to solve problems in computing
- Explain deterministic and non-deterministic machines.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Finite Automata and Regular Expressions:** Finite state systems- Deterministic Finite state Automata- Non deterministic Finite Automata- Finite Automata with Epsilon-Transitions – Regular Expressions- Finite Automata and Regular Expressions.	CO1	K1 K2 K3
UNIT-II	**Properties of Regular Languages** The Pumping Lemma for Regular Languages – Application of the Pumping Lemma – Closure Properties of Regular Languages – Reversal– Homomorphism – Decision properties of Regular Languages –Converting NFA's to DFA'S – Minimization of DFA's.	CO2	K1 K2 K3
UNIT-III	**Context Free Grammars and Languages** Context Free Grammars – Parse Trees – Normal forms for Context Free Grammars – Chomsky Normal Form – Greibach Normal Form.	CO3	K1 K2 K3
UNIT-IV	**Pushdown Automata** Definition – The languages of a PDA – Equivalence of PDA's and CFG's – Deterministic Pushdown Automata.	CO4	K1 K2 K3
UNIT-V	**Properties of Context-Free Languages** The Pumping Lemma for Context-free Languages – Closure Properties of Context- Free Languages – Decision properties of CFL's.	CO5	K1 K2 K3

Recommended Text Books

1.Introduction to Automata Theory Languages and Computation‖.Hopcroft H.E. and Ullman J. D. Pearson Education.
2.Introduction to Theory of Computation - Sipser 2nd edition Thomson

Reference Books

1 .Languages and Computation, Pearson Education, 2013.A Salomaa , Formal Languages , Academic press , New York , 1973
2.John C. Martin, Introduction to Languages and theory of Computations (2ndEdn), Tata – McGraw Hill company Ltd., New Delhi, 1997.
3.Dr. Rani Siromoney , Formal Languages and Automata,The ChristianLiterature Society, 1979.

Website and e-learning source

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	To gain knowledge of fundamental concepts of automata.	K1,K2,K3
CO2	To know properties of regular languages.	K1,K2,K3
CO3	To know finite automata theory.	K1,K2,K3
CO4	To Understand the concept of context free grammars and normal form.	K1,K2,K3
CO5	To know push down automata and context free languages.	K1,K2,K3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	2	-	-	1	3	3	2
CO2	3	3	2	3	2	3	2	-	-	1	2	3	3
CO3	3	2	3	2	2	3	2	-	-	1	3	2	2
CO4	3	3	3	3	3	2	2	-	-	1	2	3	3
CO5	2	3	3	3	3	3	2	-	-	1	3	3	2

COURSE DESCRIPTORS

Title of the Course	**PROGRAMMING IN C++ AND NUMERICAL ANALYSIS**	**Hours/Week**	05
Course Code	APEMA14D	**Credits**	03
Category	ELECTIVE-I	**Year & Semester**	I & I
Prerequisites	-	**Regulation**	2024

Objectives of the course:

- This course introduces a higher level language C++ and numerical methods for hands-on experience on computers. Stress is also given on the error analysis.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	Principles of OOP-Tokens-Expressions, Control Structures Functions-Classes and Objects-constructors and destructors. **Chapter 1 to 6**	CO1	K1 K2 K3
UNIT-II	Operator Overloading and type Conversions - Inheritance - Pointers, Virtual Functions and Polymorphism-Managing Console I/O Operations-Working with Files. **Chapter 7 to 11**	CO2	K1 K2 K3
UNIT-III	**Finite Digit Arithmetic and Errors** Floating point arithmetic - Propagated Error - Generated Error - Error in Evaluation of a function f(x). - Non-linear Equations: Bisection method- Secant Method - Regula Falsi Method - Newton‘s method - Muller‘s method - Fixed Point method. **Chapters 1,2 : Only 2.1 to 2.6**	CO3	K1 K2 K3
UNIT-IV	**System of Linear Equations** Gauss- Elimination Method Crout‘s method - Inverse of a matrix - Condition numbers and errors Jacobi‘s method - Gauss-Seidel Method - Relaxation method. Numerical Differentiation and Integration: Numerical Differentiation - Numerical Integration - Newton-Cotes Formulas - Gaussian Quadrature - Double Integral. **Chapter 3 and 5 : 5.1 to 5.5 and 5.7(omit 5.6)**	CO4	K1 K2 K3

UNIT-V	**Ordinary Differential Equations:** Difference equation - Differential Equations: Single Step method-Runge-Kutta Method-Multi-step. **Chapter 6: 6.1 to 6.4 (omit 6.5)**	CO5	K1 K2 K3

Recommended Text Books

1. E. Balagurusamy, Object Oriented Programming with C++, TataMcGraw Hill, New Delhi, 1999.
2. Devi Prasad, An Introduction to Numerical Analysis (3rd edn)Narosa Publishing House, New Delhi, 2006.

Reference Books

1. D. Ravichandran, Programming with C++, Tata McGraw Hill, NewDelhi, 1996
2. Conte and de Boor, Numerical Analysis, McGraw Hill, New York,1990
3. John H.Mathews, Numerical Methods for Mathematics, Science andEngineering (2nd Edn.), Prentice Hall, New Delhi, 2000

Website and e-learning source

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,

http://www.opensource.org, www.mathpages.com

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Know the tokens expressions and control structures in C++.	K1,K2,K3
CO2	Understand the usage of all basic functions in C++.	K1,K2,K3
CO3	Comprehend the significance of various types of classes in C++.	K1,K2,K3
CO4	Acquire the knowledge about solving system of linear equations.	K1,K2,K3
CO5	Acquire the knowledge about solving ordinary differential equations.	K1,K2,K3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	2	-	-	1	3	3	3
CO2	3	2	2	1	2	2	2	-	-	1	3	2	3
CO3	3	3	3	2	3	3	2	-	-	1	3	3	3
CO4	3	1	3	3	3	3	2	-	-	1	3	2	3
CO5	3	2	3	3	3	3	2	-	-	1	3	3	3

COURSE DESCRIPTORS

Title of the Course	**LIE GROUPS and LIE ALGEBRAS**	**Hours/Week**	05
Course Code	APEMA15A	**Credits**	03
Category	ELECTIVE-II	**Year & Semester**	I & I
Prerequisites	UG level linear algebra and matrix groups	**Regulation**	2024

Objectives of the course:

- In physics, Lie groups appear as symmetry groups of physical systems, and their Lie algebras (tangent vectors near the identity) may be thought of as infinitesimal symmetry motions.
- Lie algebras and their representations are used extensively in physics,
  Notably in quantum mechanics and particle physics

UNITS	Contents	COs	Cognitive Levels
UNIT-I	Matrix Lie Groups **Chapter 1**	CO1	K1 K2 K3
UNIT-II	The Matrix Exponential **Chapter 2**	CO2	K1 K2 K3
UNIT-III	Lie Algebras **Chapter 3**	CO3	K1 K2 K3
UNIT-IV	Basic Representation Theory **Chapter 4**	CO4	K1 K2 K3
UNIT-V	Semi simple Lie Algebras **Chapter 7**	CO5	K1 K2 K3

Recommended Text Books

1. Brain Hall, Lie Groups, Lie Algebras and Representations: An Elementary Introduction (Second Edition), Springer, USA, 2015.

Reference Books

1. V.S.Varadarajan, Lie groups, Liealgebras and their representations,Sringer 1984.
2. Brian Hall, Lie groups, Lie algebras and representations, Springer2003.
3. Barry Simon, Representations of finite and compact groups, AMS1996.
4. A. W. Knapp, Representation theory of semi smiple Lie groups. Anoverview based on examples, Princeton university press 2002.
5. S. Kumaresan S, A course in differential geometry and Lie groups, Texts and Readings in Mathematics, 22. Hindustan Book Agency, New Delhi, 2002.

Website and e-learning source

1. https://archive.nptel.ac.in/courses/111/108/111108134/
2. https://www.digimat.in/nptel/courses/video/111108134/L42.html

.

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Demonstrate systematic understanding of key aspects of Matrix Lie Groupsand Lie groups.	K1,K2,K3
CO2	Determine the exponential of a matrix.	K1,K2,K3
CO3	Differentiate Lie groups and Lie Algebras	K1,K2,K3
CO4	Find the representation of $s_l(2 ; C)$.	K1,K2,K3
CO5	Explain reductive Lie algebra	K1,K2,K3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	2	-	-	1	3	2	2
CO2	2	2	2	2	1	1	2	-	-	1	3	1	1
CO3	3	2	2	2	1	1	2	-	-	1	3	2	2
CO4	2	2	3	2	2	1	2	-	-	1	2	2	1
CO5	3	2	2	2	1	2	2	-	-	1	2	2	2

COURSE DESCRIPTORS

Title of the Course	**MATHEMATICAL PROGRAMMING**	**Hours/Week**	05
Course Code	APEMA15B	**Credits**	03
Category	ELECTIVE-II	**Year & Semester**	I & I
Prerequisites	UG Level Mathematical Programming	**Regulation**	2024

Objectives of the course:

- This course introduces advanced topics in Linear and non-linearProgramming.

.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Integer Linear Programming** Types of Integer Linear Programming Problems - Concept of Cutting Plane - Gomory's All Integer Cutting Plane Method - Gomory's mixed Integer Cutting Plane method - Branch and Bound Method. - Zero-One Integer Programming. Dynamic Programming: Characteristics of Dynamic Programming Problem - Developing Optimal Decision Policy - Dynamic Programming Under Certainty - DP approach to solve LPP. **Chapter-7: 7.1 - 7.7 Chapter-20: 20.1 - 20.5**	CO1	K1 K2 K3
UNIT-II	**Classical Optimization Methods** Unconstrained Optimization - Constrained Multi-variable Optimization with Equality Constraints - Constrained Multi-variable Optimization with inequality Constraints Non-linear Programming Methods: Examples of NLPP - General NLPP - Graphical solution - Quadratic Programming - Wolfe's modified Simplex Methods - Beale's Method **Chapter-23: 23.1 - 23.4 Chapter-24: 24.1 - 24.4**	CO2	K1 K2 K3
UNIT-III	**Theory of Simplex Method** Canonical and Standard form of LP - Slack and Surplus Variables - Reduction of any Feasible solution to a Basic Feasible solution - Alternative Optimal solution - Unbounded solution - Optimality conditions - Some complications and their resolutions - Degeneracy and its resolution. **Chapter-25: 25.1 - 25.4, 25.6-25.9**	CO3	K1 K2 K3
UNIT-IV	**Revised Simplex Method** Standard forms for Revised simplex Method - Computational procedure for Standard form I - comparison of simplex method and Revised simplex Method. Bounded Variables LP problem: The simplex algorithm **Chapter-26: 26.1 - 26.4 Chapter-28: 28.1, 28.2**	CO4	K1 K2 K3

UNIT-V	**Parametric Linear Programming** Variation in the coefficients cj , Variations in the Right hand side, bi . Goal Programming: Difference between LP and GP approach - Concept of Goal Programming - Goal Programming Model formulation - Graphical Solution Method of Goal Programming - Modified Simplex method of Goal Programming. **Chapter-29: 29.1 - 29.3**	CO5	K1 K2 K3

Recommended Text Books

.1. J.K.Sharma, Operations Research, Theory and Applications, ThirdEdition (2007) Macmillan India Ltd.

Reference Books

1. Hamdy A. Taha, Operations Research, (seventh edition) Prentice -Hall of India Private Limited, New Delhi, 1997.
2. F.S. Hillier & J.Lieberman Introduction to Operation Research (7thEdition) TataMcGraw Hill ompany, New Delhi, 2001.
3. Beightler. C, D.Phillips, B. Wilde ,Foundations of Optimization(2nd Edition) Prentice Hall Pvt Ltd., New York, 1979
4. S.S. Rao - Optimization Theory and Applications, Wiley Eastern Ltd. New Delhi. 1990

Website and e-learning source

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,

http://www.opensource.org, www.mathpages.com

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	To know about integer programming	K1,K2,K3
CO2	To know about optimization methods for solving non linear programming problems.	K1,K2,K3
CO3	To know simplex method for solving linear programming problems.	K1,K2,K3
CO4	To know revised simplex method for solving linear programming problems	K1,K2,K3
CO5	To know parametric linear programming problems.	K1,K2,K3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	2	-	-	1	3	3	2
CO2	3	2	2	1	2	2	2	-	-	1	3	2	2
CO3	3	3	3	2	3	3	2	-	-	1	3	3	3
CO4	3	1	3	3	3	3	2	-	-	1	3	2	2
CO5	3	2	3	3	3	3	2	-	-	1	3	3	3

COURSE DESCRIPTORS

Title of the Course	**FUZZY SETS AND THEIR APPLICATIONS**	**Hours/Week**	05
Course Code	APEMA15C	**Credits**	03
Category	ELECTIVE-II	**Year & Semester**	I & I
Prerequisites	Knowledge of graphs, relations, composition	**Regulation**	2024

Objectives of the course:

- Fuzzy is one of the latest topic in Mathematics that has real life applications. Hence it is essential for the students to learn this topic. This topic introduces the concept of uncertainty and fuzziness in logic that will enable the student to develop their intuitive mind further.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Crisp sets and fuzzy sets** Overview of Classical Sets, Membership Function, Height of a fuzzy set – Normal and sub normal fuzzy sets – Support – Level sets, fuzzy points, α–cuts – Decomposition Theorems, Extension Principle.	CO1	K1 K2 K3
UNIT-II	**Operation on fuzzy sets** Standard fuzzy operations –Union, intersection and complement – properties De. Morgan's laws - zy sets – Support– Level sets, fuzzy points, α–Cuts of fuzzy operations.	CO2	K1 K2 K3
UNIT-III	**Fuzzy relations** Cartesian Product, Crisp relations – cardinality – operations and properties of Crisp and Fuzzy relations. Image and inverse image of fuzzy sets - Various definitions of fuzzy operations – Generalizations – Non interacting fuzzy sets, Tolerance and equivalence relations.	CO3	K1 K2 K3
UNIT-IV	Decision making in Fuzzy environments General Discussion – Individual Decision making – multi person decision making – multi criteria decision making – multi stage decision making – fuzzy ranking methods – fuzzy linear programming.	CO4	K1 K2 K3
UNIT-V	**Applications** Medicine – Economics – Fuzzy Systems and Genetic Algorithms – Fuzzy Regression – Interpersonal Communication – Other Applications	CO5	K1 K2 K3

Recommended Text Books

1. G.J. Klir, and Bo Yuan, Fuzzy Sets and fuzzy Logic: Theory andApplications, Prentice Hall of India Ltd., New Delhi, 2005.

Reference Books

1 .George J.Klir and Bo Yuan , Fuzzy sets and Fuzzy Logic Theory and Applications, PHI Leaning Private Limited, New Delhi (2009).

2.A.K. Bhargav, Fuzzy Set Theory, Fuzzy Logic and their Applications, published by S. Chand Pvt. Limited (2013).

3.K.Pundir and R.Pundir, Fuzzy sets and their application,Published by A Pragati edition (2012)

4.H.J.Zimmermann, Fuzzy set theory and its applications,
Springer (2012).

Website and e-learning source

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
http://www.opensource.org, www.mathpages.com

.

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	To know the basic concepts of fuzzy logic.	K1,K2,K3
CO2	To know about the operations on fuzzy sets.	K1,K2,K3
CO3	To know about Fuzzy relations.	K1,K2,K3
CO4	To understand decision making in Fuzzy environments	K1,K2,K3
CO5	To know the applications of fuzzy logic in various fields.	K1,K2,K3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	2	-	-	1	3	3	3
CO2	3	2	2	1	2	2	2	-	-	1	3	2	3
CO3	3	3	3	2	3	3	2	-	-	1	3	3	3
CO4	3	1	3	3	3	3	2	-	-	1	3	2	3
CO5	3	2	3	3	3	3	2	-	-	1	3	3	3

COURSE DESCRIPTORS

Title of the Course	**DISCRETE MATHEMATICS**	**Hours/Week**	05
Course Code	APEMA15D	**Credits**	03
Category	ELECTIVE-II	**Year & Semester**	I & I
Prerequisites	UG Level Discrete Mathematics	**Regulation**	2024

Objectives of the course:

- Introduce the algebraic structures of lattices and Boolean algebra.Construct the switching circuits with applications.
- Educate the finite fields and its mathematics properties.
- Inculcate the polynomials over finite fields,Irreducibility andfactorization of polynomials.
- Indoctrinate the coding theory with the linear and cyclic codes

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Lattices** Properties and Examples of Lattices – Distributive Lattices – Boolean Algebras – Boolean Polynomials - Minimal Forms of Boolean Polynomials. **Chapter 1: Sections 1–6**	CO1	K1 K2 K3
UNIT-II	**Applications of Lattices** Switching Circuits – Applications of Switching Circuits. **Chapter 2:Sections 7–8**	CO2	K1 K2 K3
UNIT-III	**Finite Fields** Finite Fields. **Chapter 3:Sections 13**	CO3	K1 K2 K3
UNIT-IV	**Polynomials** Irreducible Polynomials over Finite Fields - Factorization of Polynomialsover Finite Fields. **Chapter 3:Sections 14–15**	CO4	K1 K2 K3
UNIT-V	**Coding Theory** Linear Codes – Cyclic Codes. **Chapter 4:Sections 17–18**	CO5	K1 K2 K3

Recommended Text Books
1. Rudolf Lidl and Gunter Pilz, Applied Abstract Algebra, 2nd IndianReprint, Springer Verlag,NewYork, 2006.
Reference Books
1.A.Gill, Applied Algebra for Computer Science, Prentice Hall Inc., NewJersey. 2.J.L.Gersting, Mathematical Structures for Computer Science,3rdEdn., ComputerSciencePress, New York. 3.S.Wiitala,Discrete Mathematics - A Unified Approach, McGraw HillBook Co.
Website and e-learning source
1.https://nptel.ac.in/courses/111106050/http://www.discrete-math-hub.com/resources-and-help.html 2.https://onlinecourses.nptel.ac.in/noc22_cs123/preview 3. https://onlinecourses.nptel.ac.in/noc22_cs85/preview

.

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Know the algebraic structures of lattices and Boolean algebra, and sketch the minimization ofBoolean polynomials.	K1,K2,K3
CO2	Model the switching circuits with applications.	K1,K2,K3
CO3	Understand the finite fields and its mathematics properties	K1,K2,K3
CO4	Acquire the notions of the polynomials over finite fields, Irreducibility and factorization ofpolynomials	K1,K2,K3
CO5	Apply the coding theory with the linear and cyclic codes in cryptography.	K1,K2,K3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	2	-	-	1	3	3	2
CO2	3	3	2	2	3	3	2	-	-	1	3	3	3
CO3	3	3	2	2	2	3	2	-	-	1	3	3	2
CO4	3	3	2	2	3	3	2	-	-	1	3	3	2
CO5	3	3	2	2	3	3	2	-	-	1	3	3	3

COURSE DESCRIPTORS

Title of the Course	ADVANCED ALGEBRA	Hours/Week	06
Course Code	APCMA21	Credits	05
Category	Core Paper-IV	Year & Semester	I & II
Prerequisites	Algebraic Structures	Regulation	2024

Objectives of the Course:

- To study field extension, roots of polynomials, Galois Theory, finite fields, division rings, solvability byradical and to developcomputational skill in abstract algebra

UNITS	Contents	COs	Cognitive Levels
UNIT-I	Extension fields – Transcendence of e. **(Chapter 5: Section 5.1 and 5.2)**	CO1	K1 K2 K3 K4
UNIT-II	Roots of Polynomials.- More about roots **(Chapter 5: Sections 5.3 and 5.5)**	CO2	K1 K2 K3 K4
UNIT-III	Elements of Galois theory. **(Chapter 5 : Section 5.6)**	CO3	K1 K2 K3 K4
UNIT-IV	Finite fields -Wedderburn's theorem on finite divisionrings. **(Chapter 7: Sections 7.1 and 7.2 (Theorem 7.2.1 only))**	CO4	K1 K2 K3 K4
UNIT-V	Solvability by radicals - A theorem of Frobenius - Integral Quaternions and the Four - Square theorem. **(Chapter 5: Section 5.7 (omit Lemma 5.7.1, Lemma 5.7.2 and Theorem 5.7.1))** **(Chapter 7 : Sections 7.3 and 7.4)**	CO5	K1 K2 K3 K4

Recommended Text Book

1.I.N. Herstein. *Topics in Algebra* (II Edition) Wiley EasternLimited,New Delhi, 1975.

Reference Books

1. M.Artin, *Algebra*, Prentice Hall of India, 1991.
2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, *Basic Abstract Algebra* (II Edition) Cambridge University Press, 1997. (Indian Edition)
3. I.S.Luther and I.B.S.Passi, *Algebra*, Vol. I –Groups(1996); Vol. II *Rings*,Narosa Publishing House , New Delhi, 1999
4. D.S.Malik, J.N. Mordeson and M.K.Sen, *Fundamental of AbstractAlgebra*, McGraw Hill (International Edition), New York. 1997.
5. N.Jacobson, *Basic Algebra*, Vol. I & II Hindustan Publishing Company, New Delhi.

Website and e-learning source

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.algebra.com

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Prove theorems applying algebraic ways of thinking.	K1,K2,K3,K4
CO2	Connect groups with graphs and understanding about Hamiltonian graphs.	K1,K2,K3,K4
CO3	Compose clear and accurate proofs using the concepts of Galois Theory.	K1,K2,K3,K4
CO4	Bring out insight into Abstract Algebra with focus on axiomatic theories.	K1,K2,K3,K4
CO5	Demonstrate knowledge and understanding of fundamental concepts including extension fields, Algebraic extensions, Finite fields, Class equations and Sylow's theorem.	K1,K2,K3,K4

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	1	-	-	1	3	2	2
CO2	2	1	3	1	3	3	1	-	-	1	3	2	2
CO3	3	2	3	1	3	3	1	-	-	1	3	2	2
CO4	2	2	3	2	3	3	1	-	-	1	3	2	2
CO5	3	1	3	3	3	3	1	-	-	1	3	2	2

COURSE DESCRIPTORS

Title of the Course	**REAL ANALYSIS - II**	**Hours/Week**	06
Course Code	**APCMA22**	**Credits**	05
Category	Core Paper-V	**Year & Semester**	I & II
Prerequisites	Elements of Real Analysis	**Regulation**	2024

Objectives of the Course:

- To introduce measure on the real line, Lebesgue measurability and integrability, Fourier series and Integrals, in-depth study inmultivariable calculus.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Measure on the Real line** - Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability **(Chapter - 2 Sec 2.1 to 2.5 (De Barra))**	CO1	K1 K2 K3 K4
UNIT-II	**Integration of Functions of a Real variable** - Integration of Non-negative functions - The General Integral - Riemann and Lebesgue Integrals **(Chapter - 3 Sec 3.1,3.2 and 3.4 (De Barra))**	CO2	K1 K2 K3 K4
UNIT-III	**Fourier Series and Fourier Integrals** - Introduction - Orthogonal system of functions - The theorem on best approximation - The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer Thorem - The convergence and representation problems in for trigonometric series - The Riemann - Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums of Fourier series - Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point – Cesarosummability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem **(Chapter 11 : Sections 11.1 to 11.15 (Apostol))**	CO3	K1 K2 K3 K4
UNIT-IV	**Multivariable Differential Calculus** - Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function - The Jacobian matrix - The chain rule - Matrix form of chain rule - The mean - value theorem for differentiable functions - A sufficient condition for differentiability - A sufficient condition for equality of mixed partial derivatives - Taylor's theorem forfunctions of R^n to R^1 **(Chapter 12 : Section 12.1 to 12.14 (Apostol))**	CO4	K1 K2 K3 K4

UNIT-V	**Implicit Functions and Extremum Problems:** Functions with non-zero Jacobian determinants – The inverse function theorem- The Implicit function theorem-Extrema of real valued functions of severable variables-Extremum problems with side conditions. **(Chapter 13 : Sections 13.1 to 13.7 (Apostol))**	CO5	K1 K2 K3 K4,K5

Recommended Text Books

1. G. De Barra, *Measure Theory and Integration*, Wiley Eastern Ltd., New Delhi, 1981. (for Units I and II)
2. Tom M.Apostol : *Mathematical Analysis*, 2nd Edition, Addison- Wesley Publishing Company Inc. New York, 1974. (for Units III, IV and V)

Reference Books

1.Burkill,J.C.*The Lebesgue Integral*, Cambridge University Press,1951.
2.Munroe,M.E.*Measure and Integration*. Addison-Wesley, Mass.
3.Roydon,H.L.*Real Analysis*, Macmillan Pub. Company, New York,1988.
4.Rudin, W. *Principles of Mathematical Analysis*, McGraw HillCompany, New York,1979.
5.Malik,S.C. and Savita Arora. *Mathematical Analysis*, Wiley EasternLimited. New Delhi, 1991.
6.Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, New Delhi, 1991.

Website and e-learning source

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Understand and Analyze the Lebesgue Outer Measure - Measurable sets	K1,K2,K3,K4
CO2	Describe the concept Integration of Functions of a Real variable	K1,K2,K3,K4
CO3	Understand and describe the basic concepts of Fourier series and Fourier integrals with respect to orthogonalsystem.	K1,K2,K3,K4
CO4	Analyze the Multivariable Differential Calculus	K1,K2,K3,K4
CO5	Understand and Solve Implicit Functions and Extremum Problems	K1,K2,K3,K4,K5

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	1	-	-	1	3	2	3
CO2	2	1	3	1	3	3	1	-	-	1	3	2	2
CO3	3	2	3	1	3	3	1	-	-	1	3	2	2
CO4	3	2	3	2	3	3	1	-	-	1	3	2	2
CO5	3	2	2	3	3	3	1	-	-	1	3	2	2

COURSE DESCRIPTORS

Title of the Course	PARTIAL DIFFERENTIAL EQUATIONS	Hours/Week	06
Course Code	APCMA23	Credits	04
Category	Core Paper-VI	Year & Semester	I & II
Prerequisites	UG level partial differential equations	Regulation	2024

Objectives of the Course:

- To classify the second order partial differential equations and to study Cauchy problem, method of separation of variables, boundary valueproblems.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Mathematical Models and Classification of second order equation :** Classical equations-Vibrating string – Vibrating membrane –waves in elastic medium – Conduction of heat in solids – Gravitational potential – Second order equations in two independent variables – canonical forms – equations with constant coefficients – general solution. **(Chapter 2 : Sections 2.1 to 2.6) (Chapter 3 : Sections 3.1 to 3.4 (Omit 3.5))**	CO1	K1 K2 K3 K4
UNIT-II	**Cauchy Problem :** The Cauchy problem – Cauchy- Kowalewsky theorem – Homogeneous wave equation – Initial Boundary value problem- Non-homogeneous boundary conditions – Finite string with fixed ends – Non-homogeneous wave equation – Riemann method – Goursat problem – spherical wave equation – cylindrical wave equation. **(Chapter 4 : Sections 4.1 to 4.11)**	CO2	K1 K2 K3 K4,K5
UNIT-III	**Method of separation of variables:** Separation of variable- Vibrating string problem – Existence and uniqueness of solution of vibrating string problem - Heat conduction problem – Existence and uniqueness of solution of heat conduction problem – Laplace and beam equations. **(Chapter 6 : Sections 6.1 to 6.6 (Omit section 6.7))**	CO3	K1 K2 K3 K4,K5
UNIT-IV	**Boundary Value Problems :** Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorem – Dirichlet Problem for a circle , a circular annulus, a rectangle– Dirichlet problem involving Poisson equation – Neumann problem fora circle and a rectangle. **(Chapter 8 : Sections 8.1 to 8.9)**	CO4	K1 K2 K3 K4

UNIT-V	**Green's Function:** The Delta function – Green's function – Method of Green's function – Dirichlet Problem for the Laplace and Helmholtz operators – Method of images and eigen functions – Higher dimensional problem – Neumann Problem. **(Chapter 10 : Section 10.1 to 10.9)**	CO5	K1 K2 K3 K4

Recommended Text Book

1. TynMyint-U and Lokenath Debnath, *Partial Differential Equations for Scientists and Engineers* (Third Edition), North Hollan, New York, 1987.

Reference Books

1.M.M.Smirnov, *Second Order partial Differential Equations*,Leningrad, 1964.
2.I.N.Sneddon, *Elements of Partial Differential Equations*, McGrawHill, New Delhi, 1983.
3.R. Dennemeyer, *Introduction to Partial Differential Equations and Boundary Value Problems*, McGraw Hill, New York, 1968.
4.M.D.Raisinghania, *Advanced Differential Equations*, S.Chand &Company Ltd., New Delhi, 2001.
5.S, Sankar Rao, *Partial Differential Equations*, 2nd Edition, PrenticeHall of India, New Delhi. 2004

Website and e-learning source

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Understand and classify second order equations and find general solutions.	K1,K2,K3,K4
CO2	Analyze and solve wave equations in different polar coordinates.	K1,K2,K3,K4,K5
CO3	Solve Vibrating string problem, Heat conduction problem, to identify and solve Laplace and beam equations.	K1,K2,K3,K4,K5
CO4	Apply maximum and minimum principle's and solve Dirichlet, Neumann problems for various boundary conditions	K1,K2,K3,K4
CO5	Apply Green's function and solve Dirichlet, Laplace problems, to apply Helmholtz operation and to solve Higher dimensional problem	K1,K2,K3,K4

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	1	-	-	1	3	2	3
CO2	2	1	3	1	3	3	1	-	-	1	3	2	2
CO3	3	2	3	1	3	3	1	-	-	1	3	2	2
CO4	1	2	3	2	3	3	1	-	-	1	3	2	3
CO5	3	1	2	3	3	3	1	-	-	1	3	2	2

COURSE DESCRIPTORS

Title of the Course	RELIABILITY AND QUEUING THEORY	Hours/Week	03
Course Code	APEMA24A	Credits	03
Category	Elective Course-III	Year & Semester	I & II
Prerequisites	UG level Queuing Theory	Regulation	2024

Objectives of the Course:

- To introduce the subject of Reliability Engineering this provides the working knowledge to determine the Reliability of a System and suggests approaches to enhance System Reliability. Also includes Queuing theory, a Mathematical Approach to Analysis of Waiting Lines.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Reliability Definition and Failure Data Analysis** Introduction – Definition of Reliability – Failure Data – Mean Failure Rate *h* – Mean Time To Failure(MTTF) – Mean Time Between Failures (MTBF) – Graphical Plots. **(Book – 1: Chapter 2, Sections: 2.1 & 2.2 and Chapter 3, Sections: 3.2 to 3.6)**	CO1	K1 K2 K3 K4,K5
UNIT-II	**Failure Data Analysis** Four important points – MTTF in terms of Failure density – Generalization –Reliabilityin terms of Hazard rate and failure density – MTTF in integral form. **(Book – 1: Chapter 3, Sections: 3.7 to 3.11)**	CO2	K1 K2 K3 K4,K5
UNIT-III	**System Reliability** Introduction – Series Configuration – Parallel Configuration – Mixed Configuration –Application to Specific Hazard Models. **(Book 1: Chapter 6, Sections :6.1- 6.5)**	CO3	K1 K2 K3 K4,K5
UNIT-IV	**Introduction to Queueing Processes** Measures of System Performance – Characteristics of Queueing systems – The Experience of waiting – Little's Law - General results- Simple data book keeping for queues **(Book 2: Chapter- 1 Sections: 1.1–1.6)**	CO4	K1 K2 K3 K4,K5
UNIT-V	**Review of Stochastic Processes and Simple Markovian Queueing Models** Exponential distribution - Poisson process – Discrete time Markov Chains – Continuous time Markov Chains – Birth and Death Process – Single server Queues M/M/1. **(Book 2: Chapter 2 Sections : 2.1 – 2.4, Chapter 3, Sections : 3.1, 3.2)**	CO5	K1 K2 K3 K4,K5

Recommended Text Books

1. 1 Srinath. L.S., *Reliability Engineering*, East West Press, 4-ed, NewDelhi. Reprint, 2013.
2. Donald Gross, John F. Shortle, James M. Thompson and Carl M. Harris, *Fundamentals of Queueing Theory*, 5th edition, WileyIndia. Reprint 2018.

Reference Books

1.Cox. D. R. and H. D. Miller, *Theory of Stochastic Processes*, Methuen,London, 1965.
2.Cramer. H. and M. Leadbetter, *Stationary and Related StochasticProcesses*, Wiley, New York, 1966.
3. Karlin. S and H. Taylor, *A First course in Stochastic Processes*, 2nd edition, Academic Press, New York, 1975.

Website and e-learning source

https://en.wikipedia.org/wiki/Reliability_engineering
https://en.wikipedia.org/wiki/Queueing_theory

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Understand and classify second order equations and find general solutions.	K1,K2,K3,K4,K5
CO2	Analyze and solve wave equations in different polar coordinates.	K1,K2,K3,K4,K5
CO3	Solve Vibrating string problem, Heat conduction problem, to identify and solve Laplace and beam equations.	K1,K2,K3,K4,K5
CO4	Apply maximum and minimum principle's and solve Dirichlet, Neumann problems for various boundary conditions	K1,K2,K3,K4,K5
CO5	Apply Exponential distribution - Poisson process and Birth and Death Process.	K1,K2,K3,K4,K5

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	1	-	-	1	3	2	3
CO2	2	1	3	1	3	3	1	-	-	1	3	2	2
CO3	3	2	3	1	3	3	1	-	-	1	3	2	2
CO4	1	2	3	2	3	3	1	-	-	1	3	2	3
CO5	3	1	2	3	3	3	1	-	-	1	3	2	2

COURSE DESCRIPTORS

Title of the Course	MATHEMATICAL STATISTICS	Hours/Week	03
Course Code	APEMA24B	Credits	03
Category	Elective Course-III	Year & Semester	I & II
Prerequisites	UG level Mathematical Statistics	Regulation	2024

Objectives of the Course:

- To know about Statistics, its scope and importance in various areas such as Medical, Engineering, Agricultural etc.
- To apply problem solving technique to solve real world event andacquire knowledge about hypothesis testing and the significance test.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Significance Test(Large samples)** The notion of a sample - The notion of a statistic - The distribution of the arithmetic mean of - independent normally distributed random variables –Test for sample proportions-Test for means. **(Chapter 9: Sections 9.1 to 9.3)**	CO1	K1 K2 K3 K4
UNIT-II	**Significance Test(Small samples)** The chi-square distribution - The distribution of the statistic - Student'st-distribution –Fisher's Z-distribution. **(Chapter 9: Sections 9.4 to 9.7)**	CO2	K1 K2 K3K4
UNIT-III	**Significance Test** The concept of a statistical test - Parametric test for small samples - Parametric tests for large – samples- Examples based on small and large samples - The chi – square test - Independence tests by contingency tables. **(Chapter 12: Sections 12.1 to 12.4 and 12.7)**	CO3	K1 K2 K3 K4,K5
UNIT-IV	**Theory of Estimation** Preliminary notions - Consistent estimate - Unbiased estimate - Sufficiency – efficiency - Asymptotically most efficient estimate - Methods of finding estimates. **(Chapter 13: Sections, 13.1 to 13.4)**	CO4	K1 K2 K3 K4,K5
UNIT-V	**Theory of Estimation (contd…)** Efficiency of an Estimate - Asymptotically most efficient estimate - Method of finding estimates. . **(Chapter 13: 13.5 to 13.7)**	CO5	K1 K2 K3 K4

Recommended Text Book

1. Marek Fisz - Probability Theory and Mathematical Statistics,3rdEdition – John Wiley and Sons Inc, 1963.

Reference Books

1. Suddhenda Biswas and G. L. Sriwastav – Mathematical Statistics – Narosa Publishing House, 2011.
2. Alexander M. Mood, Franklin A.Graybill and Duane C.Bose – Introduction to Theory of Statistics, 3rd Edition - Tata McGraw Hill, 1974.
3. P. Kandasamy, K. Thilagavathy and K. Gunavathy - Probability, Statistics and Queuing Theory, 2nd Edition - Sultan Chand and Sons, 2005.

Website and e-learning source

1. https://www.scribd.com/document/294762054/Probability-Theory-and-Mathematical

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Understand the sample moments and their functions and analyze chi-square, Student-t, Fishers-Z distributions.	K1,K2,K3,K4
CO2	Demonstrate the knowledge of the properties of parametric testing procedures.	K1,K2,K3,K4
CO3	Estimate population parameters from data sets and use the sampling distributions to compute confidence intervals for these population parameters.	K1,K2,K3,K4,K5
CO4	Learn the basic components of hypothesis testing and perform hypothesis test on population means.	K1,K2,K3,K4,K5
CO5	Understand the basic terms used in design of experiments and use appropriate experimental designs to analyze the experimental data.	K1,K2,K3,K4

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	1	-	-	1	3	3	3
CO2	3	3	3	3	3	3	1	-	-	1	3	1	2
CO3	3	3	3	3	2	1	1	-	-	1	3	3	3
CO4	2	3	3	2	3	1	1	-	-	1	3	1	2
CO5	3	2	3	3	2	3	1	-	-	1	3	3	3

COURSE DESCRIPTORS

Title of the Course	**R PROGRAMMING LANGUAGE (Only Practical)**	**Hours/Week**	03
Course Code	**APEMA24C**	**Credits**	03
Category	Elective Course-III	**Year & Semester**	I & II
Prerequisites	-	**Regulation**	2024

Objectives of the Course:

- To master the use of R interactive environment with an understanding of the use of R documentation.
- To use R for descriptive statistics and write simple programs in R.

Contents
1. Perform arithmetic operations. 2. Create a Sequence and find the mean of numbers. 3. Find the first 10 Fibonacci numbers. 4. Find the factors of a given number. 5. Find the Maximum and Minimum of a given vector. 6. Read the CSV file and display the content. 7. Create matrix and perform matrix operations. 8. Create a bar plot,a scatter plot and a line graph. 9. Create a data frame and display the details. 10. Extract rows and columns from a data frame. 11. Create a list containing strings, numbers and vectors. 12. Find the Correlation and the Linear Regression between two variables. 13. Perform conditional executions. 14. Fit Binomial, Poisson and Normal distributions. Perform Chi Square test for independence of attributes.

Recommended Text Book

1.W. John Braun, Duncan J. Murdoch, A first course in statistical programming with R, Cambridge University Press, 2007.

Reference Books

1.Suddhenda Biswas and G. L. Sriwastav – Mathematical Statistics – Narosa Publishing House, 2011.

2..Alexander M. Mood, Franklin A.Graybill and Duane C.Bose – Introduction to Theory of Statistics, 3rd Edition - Tata McGraw Hill, 1974.

3.P. Kandasamy, K. Thilagavathy and K. Gunavathy - Probability, Statistics and Queuing Theory, 2nd Edition - Sultan Chand and Sons, 2005. Gardener, M. Beginning R: The statistical programming language, JohnWiley & Sons,2012.

4.Martin, T. The Undergraduate Guide to R. A beginner's introduction toR programming Language, 2009.

5. Chambers, J. Software for data analysis: programming with R. SpringerScience & Business Media, 2008.

Website and e-learning source

1. https://www.scribd.com/document/294762054/Probability-Theory-and-Mathematical
   https://www.cs.upc.edu/~robert/teaching/estadistica/TheRBook.pdf
2. https://nptel.ac.in/

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Familiarize with basics of R software and built in function of R..	K1,K2,K3,K4
CO2	Identify the characteristics of datasets and plot the datasets in R using graphical methods.	K1,K2,K3,K4
CO3	Demonstrate understanding and use data frames	K1,K2,K3,K4
CO4	Implement the learning techniques and computing environmentthat are suitable for the applications under consideration.	K1,K2,K3,K4
CO5	Compute vectors and matrices, matrix inverse, Eigen values and Eigen vectors.	K1,K2,K3,K4

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	1	1	-	-	1	3	3	2
CO2	3	2	2	1	2	1	1	-	-	1	3	2	2
CO3	2	3	1	2	3	2	1	-	-	1	3	3	2
CO4	3	1	3	3	3	3	1	-	-	1	3	2	1
CO5	3	2	3	1	3	1	1	-	-	1	3	3	1

COURSE DESCRIPTORS

Title of the Course	**TENSOR ANALYSIS AND RELATIVITY**	**Hours/Week**	03
Course Code	**APEMA24D**	**Credits**	03
Category	Elective Course-III	**Year & Semester**	I & II
Prerequisites	UG level Vector Calculus and Mechanics.	**Regulation**	2024

Objectives of the Course:

- The course aims to introduce vector algebra and vector calculus and special relativity and relativistic kinematics, dynamics andaccelerated systems

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Tensor Algebra** Systems of Different orders - Summation Convention - Kronecker Symbols - Transformation of coordinates in Sn - Invariants - Covariant and Contravariant vectors - Tensors of Second Order - Mixed Tensors - Zero Tensor - Tensor Field Algebra of Tensors - Equality of Tensors - Symmetric and Skew – symmetric tensors - Outer multiplication, Contraction and Inner Multiplication - Quotient Law of Tensors - Reciprocal Tensor of Tensor Relative Tensor - Cross Product of Vectors.(**Chapter I : I.1 - I.3, I.7 and I.8 and Chapter II : II.1 - II.19**	CO1	K1 K2 K3 K4
UNIT-II	**Tensor Calculus** Riemannian Space - Christoffel Symbols and their properties **Chapter III: III.1 and III.2**	CO2	K1 K2 K3K4
UNIT-III	**Tensor Calculus (Contd)** Covariant Differentiation of Tensors - Riemann - Christoffel Curvature Tensor - Intrinsic Differentiation. **Chapter III: III.3 - III.5**	CO3	K1 K2 K3K4
UNIT-IV	**Introduction to Relativity** Introduction- Maxwell's equation-the ether theory-the principle of relativity-relativistic kinematics –Events and simultaneity – examples	CO4	K1 K2 K3 K4
UNIT-V	**Introduction to Relativity(Cont…..)** Time dilation – longitudinal contradiction-the invariant interval-proper time and proper distance –the world line line –example addition of velocities-example –the relativistic Doppler effect-example.	CO5	K1 K2 K3 K4

Recommended Text Books

1. 1. U.C. De, Absos Ali Shaikh and Joydeep Sengupta, Tensor Calculus, Narosa Publishing House, New Delhi, 2004. (For Units I,II and III)
2. D. Greenwood, Classical Dynamics, Prentice Hall ofIndia, New Delhi, 1985. (For Units IV and V)

Reference Books

1. . J.L.Synge and A.Schild, Tensor Calculus, Toronto, 1949.
2. A.S.Eddington. The Mathematical Theory of Relativity, CambridgeUniversity Press, 1930.
3. P.G.Bergman, An Introduction to Theory of Relativity, New York,1942
4. C.E.Weatherburn, Riemannian Geometry and the Tensor Calculus,Cambridge, 1938.
5. Goldstein , Classical Mechanics (Addition Wesley)
6. N E Rana & P.S Joag, Classical Mechanics (Tata McGraw Hills) Schaum's outline series, vector analysis metric editions schaum'sR.spiegell

Website and e-learning source

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Understand the system of different orders in Tenor Algebra.	K1,K2,K3,K4
CO2	Explain about Tensor Calculus in Riemann spaces.	K1,K2,K3,K4
CO3	Understand the concept of Covariant of differentiation and intrinsic differentiation	K1,K2,K3,K4
CO4	Explain about the theory of relativity and Doppler effect.	K1,K2,K3,K4
CO5	Analyze about the conservation of mass and energy.	K1,K2,K3,K4

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	2	1	2	2	1	-	-	1	3	2	1
CO2	2	1	3	1	3	2	1	-	-	1	3	2	1
CO3	3	2	1	3	2	1	1	-	-	1	3	2	1
CO4	2	3	1	2	3	1	1	-	-	1	3	2	1
CO5	3	1	3	2	1	3	1	-	-	1	3	2	1

COURSE DESCRIPTORS

Title of the Course	**WAVELETS**	**Hours/Week**	03
Course Code	**APEMA25A**	**Credits**	03
Category	Elective Course-IV	**Year & Semester**	I & II
Prerequisites	Basic Analysis and Linear Algebra	**Regulation**	2024

Objectives of the Course:

- To establish the theory necessary to understand and use wavelets andrelated constructions.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**An Overview** Fourier to Wavelets – Integral Wavelets Transform and Time frequency analysis – Inversion formulas and duals – Classification of Wavelets – Multi-resolution analysis – Spines and Wavelets. Fourier Analysis : Fourier and Inverse Fourier Transformation – Continuous Time Convolution – The delta function – Fourier Transformation of square integrable functions.	CO1	K1 K2 K3 K4
UNIT-II	**Fourier Analysis (Cont…..)** Fourier Series – Basic Convergence Theory – Poisson Summation Formula. **Wavelet Transforms and Time Frequency Analysis** The Gabor Transforms – Short time Fourier Transforms and the uncertainty principle – The integral Wavelet Transform – Dyadic Wavelets – Inversion – Frames – Wavelet Series	CO2	K1 K2 K3 K4
UNIT-III	**Cardinal Spline Analysis** Cardinal Spline spaces – B-splines and their basic properties – The time scale relation and an interpolating graphical display algorithm – B-Net representations and computation of cardinal splines - Constructions of cardinal splines – constructions of spline application formulas – Construction of Spline interpolation formulas.	CO3	K1 K2 K3 K4
UNIT-IV	**Scaling functions and Wavelets** Multi-resolution analysis – Scaling functions with finite two scale relation – Direction sum Decompositions of - Wavelets and their duals.	CO4	K1 K2 K3 K4
UNIT-V	**Cardinal Splines Wavelets** Interpolating splines wavelets – Compactly supported spline – Wavelets – Computation of Cardinal spline Wavelets – Euler – Frebenious Polynomials.	CO5	K1 K2 K3 K4

Recommended Text Book

1.Charles K. Chui, An Introduction to Wavelets. Academic Press, 1992

Reference Books

1. Chui C. K. (ed), Approximation theory and Fourier Analysis,Academic Press Boston, 1991.
2. Daribechies I, Wavelets, CBMS-NSF Series in Appl, SIAMPhiladelphia, 1992.
3. Schurnaker L, L. Spline Functions : Basic Theory, Wiley, New York,1981.
4. Nurnberger G, Applications to Spline Functions, Springer Verlag, New York, 1989

Website and e-learning source

https://archive.nptel.ac.in/courses/108/101/108101093/
https://onlinecourses.nptel.ac.in/noc23_ee32/preview

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Know Fourier transform and convolution of signals.	K1,K2,K3,K4
CO2	Know Fourier analysis and summation of series.	K1,K2,K3,K4
CO3	Learn scaling functions and wavelets.	K1,K2,K3,K4
CO4	Learn and wavelet transform of digital signals.	K1,K2,K3,K4
CO5	Learn interpolation of cardinal spline wavelets.	K1,K2,K3,K4

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	2	1	3	2	1	-	-	1	3	2	1
CO2	2	3	2	1	2	1	1	-	-	1	3	2	1
CO3	3	3	3	1	3	2	1	-	-	1	2	2	1
CO4	3	3	3	3	2	3	1	-	-	1	1	2	1
CO5	3	2	3	3	2	2	1	-	-	1	1	2	1

COURSE DESCRIPTORS

Title of the Course	MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE	Hours/Week	03
Course Code	APEMA25B	Credits	03
Category	Elective Course-IV	Year & Semester	I & II
Prerequisites	-	Regulation	2024

Objectives of the Course:

- To Learn about Machine Intelligence and Machine Learning applications
- To implement and apply machine learning algorithms to real-world applications.
- To identify and apply the appropriate machine learning technique to classification, pattern recognition, optimization and decision problems. To understand how to perform evaluation of learning algorithms and model selection.
- To understand about the basic theory of problem solving paradigms and search strategies in artificial intelligence
- To make the students familiar with knowledge representation, planning, learning, natural language processing and robotics

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Introduction** Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.	CO1	K1 K2 K3 K4
UNIT-II	**NeuralNetworks and Genetic Algorithms** Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms– Hypothesis Space Search –Genetic programming –Models of Evaluation and Learning.	CO2	K1 K2 K3 K4
UNIT-III	**Bayesian and Computational Learning** Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier –Bayesian Belief Network– EM Algorithm – Probability Learning – Sample Complexity –Finite and Infinite Hypothesis Spaces – Mistake Bound Model.	CO3	K1 K2 K3 K4
UNIT-IV	Introduction - Intelligent Agents- Problem Solving - by Searching - Informed Search Strategies-Optimization Problems - Adversarial Search-Knowledge and Reasoning - Logical Agents - First-Order Logic - Inference in First-Order Logic - Knowledge Representation	CO4	K1 K2 K3 K4

UNIT-V	Planning – Planning and Acting in the Real World - Uncertain knowledge and reasoning - Uncertainty - Probabilistic Reasoning - Probabilistic Reasoning over Time - Making Simple Decisions - Making Complex Decisions	CO5	K1 K2 K3 K4,K5

Recommended Text Books

1. Tom M. Mitchell,—Machine Learning, McGraw-Hill Education(India) Private Limited, 2013.
2. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach," Third Edition, Prentice Hall of India, New Delhi, 2010

Reference Books

1. Ethem Alpaydin,—Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.
2. Stephen Marsland,—Machine Learning: An Algorithmic Perspective, CRC Press,2009.
3. Michael Affenzeller, Stephan Winkler, Stefan Wagner, AndreasBeham, –Genetic Algorithms and Genetic Programming‖,CRC Press Taylor and Francis Group.
4. Elaine Rich, Kevin Knight, B. Nair, "Artificial Intelligence," Third Edition, Tata McGraw-Hill, New Delhi, 2017.
5. Eugene Charniak, Drew McDermott, "Introduction to Artificial Intelligence," Pearson, 2002

Website and e-learning source

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Understand fundamental issues and challenges of machine learning.	K1,K2,K3,K4
CO2	Understand the strengths and weaknesses of many popular machinelearning approaches	K1,K2,K3,K4
CO3	Appreciate the underlying mathematical relationships within and across MachineLearning algorithms and the paradigms of supervised and unsupervised learning	K1,K2,K3,K4
CO4	Understand the computation intelligence.	K1,K2,K3,K4
CO5	Apply basic principles of AI in solutions that require problem solving, inference,perception, knowledge representation, and learning	K1,K2,K3,K4,K5

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	1	-	-	1	3	3	2
CO2	2	1	2	1	3	2	1	-	-	1	3	3	3
CO3	3	2	2	2	2	3	1	-	-	1	2	2	2
CO4	2	2	2	2	2	2	1	-	-	1	3	2	2
CO5	3	1	2	2	3	3	1	-	-	1	2	2	2

COURSE DESCRIPTORS

Title of the Course	**NEURAL NETWORKS**	**Hours/Week**	03
Course Code	**APEMA25C**	**Credits**	03
Category	Elective Course-IV	**Year & Semester**	I & II
Prerequisites	Familiarity with linear algebra, multivariate calculus and probabilitytheory	**Regulation**	2024

Objectives of the Course:

- To know the main fundamental principles and techniques of neural network systems and investigate the principal neural network modelsand applications.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Neuron Model and Network Architectures** Mathematical Neural Model-Network Architectures-Perceptron-Hamming Network-Hopfield Network-Learning Rules.	CO1	K1 K2 K3 K4
UNIT-II	**Perceptron Architectures** Perceptron Architectures and Learning Rules with proof of convergence-Supervised Hebbian Learning-Linear Associator.	CO2	K1 K2 K3 K4
UNIT-III	**Supervised Hebbian Learning** The Hebb Rule-Pseudo inverse rule-Variation of Hebbian Learning-Back Propagation-Multilayer Perceptrons.	CO3	K1 K2 K3 K4
UNIT-IV	**Back Propagation** Back Propagation algorithm-convergence and Generalization-Performances surfaces and optimum points-Taylor series.	CO4	K1 K2 K3 K4
UNIT-V	**Performance Surface and PerformanceOptimizations** Directional derivatives-Minima-Necessary conditions for Optimality-Quadratic functions-Performance optimizations-Steepest Descent Newton's method-Conjugate Gradient.	CO5	K1 K2 K3 K4,K5

Recommended Text Book

1.Martin T. Hagan, Howard B/Demuth and Mark Beale, Neural Network Design, Vikas Publishing House, New Delhi, 2002.

Reference Books

1. James A.Freeman, David M.Skapura, Neural Networks Algorithms, Applications and Programming Techniques, Pearson Education, 2003.
2. Robert J. Schalkoff, Artificial Neural Network, McGraw-Hill International Edition, 1997.

Website and e-learning source

https://nptel.ac.in/courses/117/105/117105084/
https://nptel.ac.in/courses/106/106/106106184/

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Understand and analyze different neutron network models	K1,K2,K3,K4
CO2	Understand the basic ideas behind most common learning algorithms for multilayer perceptions, radialbasis function networks.	K1,K2,K3,K4
CO3	Describe Hebb rule and analyze back propagation algorithms with examples.	K1,K2,K3,K4
CO4	Study convergence and generalization and implement common learning algorithms.	K1,K2,K3,K4
CO5	Study directional derivatives and necessary conditions for optimality and to evaluate quadraticfunctions.	K1,K2,K3,K4,K5

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	2	2	2	1	1	-	-	1	2	3	3
CO2	3	2	2	1	1	1	1	-	-	1	1	2	2
CO3	1	2	2	3	1	1	1	-	-	1	1	2	2
CO4	2	2	1	1	2	1	1	-	-	1	1	1	2
CO5	2	2	2	1	1	1	1	-	-	1	1	3	2

COURSE DESCRIPTORS

Title of the Course	**DIFFERENCE EQUATIONS**	**Hours/Week**	03
Course Code	**APEMA25D**	**Credits**	03
Category	Elective Course-IV	**Year & Semester**	I & II
Prerequisites	UG level Difference Equations	**Regulation**	2024

Objectives of the Course:

- To provide basic knowledge about the discretization process, the discrete version of difference equations and understand the Linear periodic systems.
- Develop the students ability to difference equations using Z-transforms.
- Enable to use of Oscillation Theory.
- Study oscillation and asymptotic behavior of solutions ofcertain classes of difference equations.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Linear Difference Equations of Higher Order** Difference Calculus-General Theory of Linear Difference Equations- Linear Homogeneous Equations with Constant coefficients –Non-homogeneous equations: Method of Undetermined Coefficients, the method of variation of constants - Limiting behavior of Solutions. **(Chapter 2: Sections 2.1 to 2.5)**	CO1	K1 K2 K3 K4,K5
UNIT-II	**System of Linear Difference Equations** Autonomous Systems - The Basic Theory - The Jordan form –Linear periodic systems. **(Chapter3: Sections 3.1to 3.4)**	CO2	K1 K2 K3 K4
UNIT-III	**The Z-Transform Method** Definitions and Examples, Properties of Z-transform-The Inverse Z-transform and Solutions Difference Equations: Power series method,partial fraction method, the inverse integral method **(Chapter 6: Sections 6.1 to 6.3)**	CO3	K1 K2 K3 K4
UNIT-IV	**Oscillation Theory** Three-term difference Equations– Self- Ad joint Second OrderEquations-Non linear Difference Equations. **(Chapter 7: Sections7.1 to 7.3)**	CO4	K1 K2 K3 K4

UNIT-V	**Asymptotic Behavior of Difference Equation** Tools of Approximation - Poincare"s Theorem - Asymptotically Diagonal Systems – High-Order Difference Equations - Second OrderDifference Equations. **(Chapter 8: Sections 8.1 to 8.5)**	CO5	K1 K2 K3 K4

Recommended Text Book

1.Saber N .Elaydi, An Introduction to Difference Equations, Third Edition,Springer Verlag, NewYork, 2005(First Indian Reprint 2008).

Reference Books

1.RonaldE.Mickens, Difference Equations Theory, Applications and Advanced Topics, Third Edition, CRC Press, NewYork,2015.
2.R.P.Agarwal.,Difference Equations and Inequalities,MarcelDekker,1999.
3.S.Goldberg,Introduction to Difference Equations,DoverPublications,1986
4.V.Lakshmikantham and Trigiante,Theory of Difference Equations Numerical Methods and Applications, Second Edition, Academic Press, New York,1988.
5.Walter G.Kelly,Allan C.Peterson, Difference Equations, An Introduction with Applications, Academic Press, NewYork,2001(FirstIndianReprint2006).

Website and e-learning source

http://people.math.aau.dk/~matarne/11-mat/notes2011a.pdf,
http://pj.freefaculty.org/guides/stat/Math/Difference Equations/Difference Equations-guide.pdf

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Solve problems on Linear Difference Equations of Higher order.	K1,K2,K3,K4,K5
CO2	Understand the system of Linear Difference Equation	K1,K2,K3,K4
CO3	Apply Z-transform techniques indifference equations.	K1,K2,K3,K4
CO4	Explain on Oscillation Theory.	K1,K2,K3,K4
CO5	Discuss on Asymptotic Behavior of Difference Equation.	K1,K2,K3,K4

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	2	1	-	-	1	3	1	3
CO2	2	3	2	3	3	2	1	-	-	1	2	3	1
CO3	3	3	1	3	1	3	1	-	-	1	3	2	1
CO4	2	1	2	1	3	2	1	-	-	1	2	3	2
CO5	3	2	3	3	2	1	1	-	-	1	2	1	3

COURSE DESCRIPTORS

Title of the Course	OFFICE AUTOMATION AND ICT TOOLS	Hours/Week	04
Course Code	APSMA26A	Credits	02
Category	Skill Enhancement Course-I	Year & Semester	I & II
Prerequisites	-	Regulation	2024

Objectives of the Course:

- To know the main fundamental principles and techniques of Office Automation systems Computer Mail Systems and Hardware Configuration.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	Office Automation-Office and Office Automation	CO1	K1 K2 K3
UNIT-II	Computer Mail Systems - Telecommunication and Word Processor	CO2	K1 K2 K3
UNIT-III	WP Hardware Configuration	CO3	K1 K2 K3
UNIT-IV	Reprographics-Electronic Mail and Electronic-Filing	CO4	K1 K2 K3
UNIT-V	Facsimile Transmission and Micrographics -Voice Technology	CO5	K1 K2 K3,K6

Recommended Text Books 1. Office Automation Tools and Technology (Unit I & Unit-II) 2.Office Automation Tools ,Yatendra kumar & suitha varshney ,Naveen prakashan pvt .Ltd
Reference Books 1.Office Automation Tools ,Dr.Rizwan Ahmed , Naveen prakashan pvt .Ltd 2.Office Automation Tools, Dr.Babasaheb Ambedkar
Website and e-learning source http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Understand the basics of computer systems and its components.	K1,K2,K3
CO2	Understand and apply the basic concepts of a Computer Mail Systems - Telecommunication and Word Processor	K1,K2,K3
CO3	Understand and apply the basic concepts of WP Hardware Configuration	K1,K2,K3
CO4	Understand and apply the basic concepts of Electronic Mail and Electronic-Filing	K1,K2,K3
CO5	Understand and create Facsimile Transmission and Micrographics	K1,K2,K3,K6

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	2	1	-	-	1	3	1	3
CO2	2	3	2	3	3	2	1	-	-	1	2	3	1
CO3	3	3	1	3	1	3	1	-	-	1	3	2	1
CO4	2	1	2	1	3	2	1	-	-	1	2	3	2
CO5	3	2	3	3	2	1	1	-	-	1	2	1	3

COURSE DESCRIPTORS

Title of the Course	COMPUTATIONAL MATHEMATICS USING SAGE MATH	Hours/Week	04
Course Code	APSMA26B	Credits	02
Category	Skill Enhancement Course-I	Year & Semester	I & II
Prerequisites	-	Regulation	2024

Objectives of the Course:

Students learn to use Sage Math, a free and open-source computer algebra system based on Python to explore topic in calculus, linear algebra, Numerical methods and linear programming

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**First Steps** The Sage Program -Sage as a Calculator	CO1	K1 K2 K3
UNIT-II	**Analysis and Algebra** Symbolic Expressions and Simplification – Equations – Analysis Basic Linear Algebra	CO2	K1 K2 K3
UNIT-III	**Programming and Data Structures** Syntax –Algorithmic -Lists and Other Data Structures	CO3	K1 K2 K3
UNIT-IV	**Graphics** 2D Graphics - 3D Curves	CO4	K1 K2 K3
UNIT-V	**Computational Domains** Sage is Object-Oriented- Elements, Parents, Categories-Domainswith a Normal Form-Expressions vs Computational Domains	CO5	K1 K2 K3

Recommended Text Book

1.Mathematical Computation with SageMath ,Paul ZimmermannAlexandre Casamayou.

Reference Books

1. Uri M. Ascher and Linda R. Petzold, Computer Methods for Ordinary Differential Equations and Differential-Algebraic Equations. Society for Industrial and Applied Mathematics, 1998, ISBN 0898714128.
2. Noga Alon and Joel H. Spencer, The Probabilistic Method. Wiley-Interscience, 2000, ISBN 0471370460.
3. Bernard Beauzamy, Robust mathematical methods for extremelyrare events. On-line, 2009.

Website and e-learning source

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Understand the Sage Program -Sage as a Calculator	K1,K2,K3
CO2	Understand and apply the Symbolic Expressions and Simplification Equations, Analysis Basic Linear Algebra	K1,K2,K3
CO3	Understand and apply Programming and Data Structures	K1,K2,K3
CO4	Apply the 2D Graphics - 3D Curves	K1,K2,K3
CO5	Understand Computational Domains	K1,K2,K3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	2	1	-	-	1	3	1	3
CO2	2	3	2	3	3	2	1	-	-	1	2	3	1
CO3	3	3	1	3	1	3	1	-	-	1	3	2	1
CO4	2	1	2	1	3	2	1	-	-	1	2	3	2
CO5	3	2	3	3	2	1	1	-	-	1	2	1	3

COURSE DESCRIPTORS

Title of the Course	**Mathematical documentation using LATEX / other packages**	**Hours/Week**	04
Course Code	**APSMA26C**	**Credits**	02
Category	Skill Enhancement Course-I	**Year & Semester**	I & II
Prerequisites	-	**Regulation**	2024

Objectives of the Course:

- Inculcate the computer knowledge.
- Introduce the LaTeX software
- Train in the Preparation of Project and dissertations using LaTex

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Basic Document and Bibliography** What is LATEX – Simple typesetting – Fonts Type size – Document class – page numbering – Formatting lengths – parts of a document – Dividing the document – what next? – Introduction – natbib – The BIBTEX program – BIBTEX Style files – Creating a bibliographic database. **(Chapter: 1 to 4)**	CO1	K1 K2 K3
UNIT-II	**Contents, Index, Glossary, Text, Row and Column** Table of contents – Index – Glossary. Borrowed words – Poetry in typing – Making lists – When order matters – Description and definitions. **(Chapter: 5 to 6)**	CO2	K1 K2 K3
UNIT-III	**Typesetting Equations and Theorems** Keeping tabs – Tables – The basics – Custom commands – More on mathematics miscellany – New operations– The many fact of mathematics – Symbols – Theory in LATEX – Designer theorem-the amsthm package – Housekeeping. **(Chapter: 7 to 9)**	CO3	K1 K2 K3
UNIT-IV	**Several Kinds of Boxes and Floats** LR boxes – Paragraph boxes – Paragraph boxes with specific height – Nested boxes – Role boxes – The figure environment – The table environment. **(Chapter: 10 to 11)**	CO4	K1 K2 K3
UNIT-V	**Cross References in Latex, Footnotes, Margin pars and endnotes** Why cross reference? – Let LATEX do it – Pointing to a pagethe package varioref – Pointing outside-the package xr – Lost the keys? Use lables.tex – Footnotes – Marginal notes – Endnotes. **(Chapter: 12 to 13)**	CO5	K1 K2 K3

Recommended Text Book

1. A Primer, Latex Tutorials, Indian TEX users group, Trivandrum, India

Reference Books

1. Peter Flynn, A beginner‟s introduction to typesetting with
2. LATEX,Silmaril Consultants,Textual Therapy Division, 2003.
3. George Gratzer,More Math Into LATEX, 4th Edition, Springer Science(2007).
4. Frank Mittelbach,Michel Goossens,The LaTex Companion,Second Edition, Addison-Wesley, 2004

Website and e-learning source

https://www.latex-tutorial.com/tutorials/
https://www.latex-tutorial.com/
http://www.tug.org.in/tutorials.html

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Understand the Basic Document and Bibliography	K1,K2,K3
CO2	Write, Test and Debug Table of contents	K1,K2,K3
CO3	Apply Typesetting Equations and Theorems	K1,K2,K3
CO4	Apply the LR boxes – Paragraph boxes – Paragraph boxes with specific height	K1,K2,K3
CO5	Understand the concepts of Cross References, Footnotes,	K1,K2,K3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	2	1	-	-	1	3	1	3
CO2	2	3	2	3	3	2	1	-	-	1	2	3	1
CO3	3	3	1	3	1	3	1	-	-	1	3	2	1
CO4	2	1	2	1	3	2	1	-	-	1	2	3	2
CO5	3	2	3	3	2	1	1	-	-	1	2	1	3

COURSE DESCRIPTORS

Title of the Course	Numerical Analysis using SCILAB	Hours/Week	04
Course Code	APSMA26D	Credits	02
Category	Skill Enhancement Course-I	Year & Semester	I & II
Prerequisites	-	Regulation	2024

Objectives of the Course:

- To understand numerical analysis by using SCILAB

UNITS	Contents	COs	Cognitive Levels
UNIT-I	Transcendental and Polynomial Equations	CO1	K1 K2 K3
UNIT-II	System of Linear Algebraic Equations and Eigen value Problems	CO2	K1 K2 K3
UNIT-III	Interpolation and Approximation	CO3	K1 K2 K3
UNIT-IV	Differentiation and Integration	CO4	K1 K2 K3
UNIT-V	Ordinary Differential Equations Initial Value Problems	CO5	K1 K2 K3

Recommended Text Book 1.Numerical Methods For Scientific And Engineering Computation by M. K.Jain, S. R. K. Iyengar And R. K. Jain
Reference Book 1.Numerical Methods and principles analysis and algorithms ,S.Pal ,Oxford University Press
Website and e-learning source http://mathforum.org http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Apply Transcendental and Polynomial Equations by using SCILAB	K1,K2,K3
CO2	Apply Eigen value Problems by using SCILAB	K1,K2,K3
CO3	Apply Interpolation by using SCILAB	K1,K2,K3
CO4	Apply Differentiation and Integration by using SCILAB	K1,K2,K3
CO5	Apply Ordinary Differential Equations Initial Value Problems by using SCILAB	K1,K2,K3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	2	1	-	-	1	3	2	2
CO2	2	3	2	3	3	2	1	-	-	1	2	3	1
CO3	3	3	1	3	1	3	1	-	-	1	3	2	1
CO4	2	1	2	1	3	2	1	-	-	1	2	3	2
CO5	3	2	3	3	2	1	1	-	-	1	2	1	2

COURSE DESCRIPTORS

Title of the Course	Differential Equations using SCILAB	Hours/Week	04
Course Code	APSMA26E	Credits	02
Category	Skill Enhancement Course-I	Year & Semester	I & II
Prerequisites	-	Regulation	2024

Objectives of the Course:

- Understand the basic commands
- Solve the system of equations
- Evaluate the polynomials
- Solve the Ordinary differential equations.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Introduction to Scilabb** Login - Talking between Scilab and the Editor - Basic Commands - Linear Algebra - Loops and Conditionals - Help in Scilab. **(Chapter 1: Sections 1.1 to 1.7)**	CO1	K1 K2 K3
UNIT-II	**Matrix Calculation** Matrices and Vectors - Solving Equations - Creating Matrices - Systemsof Equations. **(Chapter 2: Section 2.2)**	CO2	K1 K2 K3
UNIT-III	**Data and Function Plots** Plotting Lines and Data - Adding a Line - Hints for Good Graphs – Graphs - Function Plotting – Component Arithmetic - Printing Graphs - Saving Graphs. **(Chapter 3: Sections 3.2, 3.3)**	CO3	K1 K2 K3
UNIT-IV	**Polynomials** Evaluation of Polynomials – Polynomials - Linear Least Squares (Heath Computer Problem). **(Chapter 6: Sections 6.2, 6.3, 6.4)**	CO4	K1 K2 K3,K6
UNIT-V	**Differential Equation** Differential Equations - Scalar ODE's - Order 2 ODE's . (**Chapter 8: Sections 8.2)**	CO5	K1 K2 K3

Recommended Text Book

1. Graeme Chandler and Stephen Roberts, Scilab Tutorials for Computational Science, 2002.

Reference Books

1.Scilab for very beginners, Scilab Enterprises, S.A.S, 143, bis rue Yves Le Coz – 78000 Versailles (France).

2.K. S. Surendran, SCILAB FOR DUMMIES, Version 2.6.

3.Some notes on SCILAB, Universit´e de Nice Sophia-Antipolis.

Website and e-learning source

https://www.scilab.org/

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Understand the basic commands SCILAB	K1,K2,K3
CO2	Understand Matrix Calculation by using SCILAB	K1,K2,K3
CO3	Understand Data and Function Plots by using SCILAB	K1,K2,K3
CO4	Evaluation of Polynomials by using SCILAB	K1,K2,K3,K6
CO5	Understand Differential Equations by using SCILAB	K1,K2,K3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	2	1	-	-	1	3	2	2
CO2	2	3	2	3	3	2	1	-	-	1	2	3	1
CO3	3	3	1	3	1	3	1	-	-	1	3	2	1
CO4	2	1	2	1	3	2	1	-	-	1	2	3	2
CO5	3	2	3	3	2	1	1	-	-	1	2	1	2

COURSE DESCRIPTORS

Title of the Course	INDUSTRIAL MATHEMATICS/STATISTICS USING LATEST PROGRAMMING PACKAGES	Hours/Week	04
Course Code	APSMA26F	Credits	02
Category	Skill Enhancement Course-I	Year & Semester	I & II
Prerequisites	-	Regulation	2024

Objectives of the Course:

- Industrial Mathematics Course aim to develop the ability to find and use efficient mathematical methods to solve problems in industrial settings.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	Mathematics in industry- Overview of the case studies-Units and dimensions - Diffusion equations - Heat conduction equations	CO1	K1 K2 K3
UNIT-II	Boundary conditions -Solving the heat/diffusion equation - Scaling equations - Dimensional analysis	CO2	K1 K2 K3
UNIT-III	Continuous Casting - Introduction to the case study problem - The Boltzmann similarity solution- A moving boundary problem - The pseudo- steady-state approximate solution-Solving the continuous casting case Study	CO3	K1 K2 K3
UNIT-IV	Water Filtration - Introduction to the case study problem – Stretching transformations - Diffusion from a point source -Solving the water filtration case study	CO4	K1 K2 K3,K6
UNIT-V	Laser Drilling -Introduction to the case study problem - Method of perturbations -Boundary perturbations - Solving the laser drilling case study	CO5	K1 K2 K3,K6

Recommended Text Book 1. Industrial Mathematics Case Studies in the Diffusion of Heat andMatter ,GLENN R. FULFORD PHILIP BROADBRIDGE
Reference Book 1.Case Studies in Industrial Mathematics,H.W. Engl/H.Wacker/W.Zulehner,B.G Teubner Stuttgart, Kluwer Academic Publishers.
Website and e-learning source http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Understand Heat conduction equations	K1,K2,K3
CO2	Understand Dimensional analysis	K1,K2,K3
CO3	Understand the case study problem	K1,K2,K3
CO4	Solve the water filtration case study	K1,K2,K3,K6
CO5	Solve the laser drilling case study	K1,K2,K3,K6

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	2	1	-	-	1	3	2	1
CO2	2	3	2	3	3	2	1	-	-	1	2	3	1
CO3	3	3	1	3	1	3	1	-	-	1	3	2	1
CO4	2	1	2	1	3	2	1	-	-	1	2	3	1
CO5	3	2	3	3	2	1	1	-	-	1	2	1	1

COURSE DESCRIPTORS

Title of the Course	RESEARCH TOOLS AND TECHNIQUES	Hours/Week	04
Course Code	APSMA26G	Credits	02
Category	Skill Enhancement Course-I	Year & Semester	I & II
Prerequisites	-	Regulation	2024

Objectives of the Course:

- Research Tools and Techniques are the Statistical methods of collection, analysis, interpretation, presentation and organization of data.
- Statistics provides numerous tools and Techniques to analyze the data and interpret the results of the analysis.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	Research Process- Research Design	CO1	K1 K2 K3
UNIT-II	Research Problem-Variables and Their Types	CO2	K1 K2 K3,K6
UNIT-III	Formulation of Hypothesis– Sampling- Tools of Data Collection	CO3	K1 K2 K3
UNIT-IV	Data Analysis- Interpretation of Data	CO4	K1 K2 K3
UNIT-V	Research Methods - Descriptive or Survey Method - Experimental Method	CO5	K1 K2 K3

Recommended Text Book

1. Research Methodology: Tools And Techniques Dr. Prabhat PandeyDr. Meenu Mishra Pandey © Bridge Center, 2015

Reference Books

1. Ackoff, Russell L. (1961). The Design of Social Research,University of Chicago Press: Chicago.
2. Allen, T. Harrell, (1978). New Methods in Social Research, PraegerPublication: New York.
3. Baker, R.P. & Howell, A.C. (1958). The Preparation of Reports,Ronald Press: New York.
4. Barzun, Jacques & Graff. F. (1990).The Modern Researcher,Harcourt, Brace Publication: New York.
5. Berelson Conard & Colton, Raymond. (1978). Research and Report Writing for Business and Economics, Random House: New York

Website and e-learning source

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Understand Research Design	K1,K2,K3
CO2	Solve Research Problem	K1,K2,K3,K6
CO3	Understand Formulation of Hypothesis– Sampling- Tools of Data Collection	K1,K2,K3
CO4	Understand Data Analysis	K1,K2,K3
CO5	Understand Research Methods	K1,K2,K3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	2	1	-	-	1	3	2	2
CO2	2	3	2	3	3	2	1	-	-	1	2	3	2
CO3	3	3	1	3	1	3	1	-	-	1	3	2	2
CO4	2	1	2	1	3	2	1	-	-	1	2	3	2
CO5	3	2	3	3	2	1	1	-	-	1	2	2	2

COURSE DESCRIPTORS

Title of the Course	**COMPLEX ANALYSIS**	**Hours/Week**	06
Course Code	**APCMA31**	**Credits**	05
Category	Core Paper-VII	**Year &Semester**	II & III
Prerequisites	UG level Complex Analysis	**Regulation**	2024

Objectives of the Course:

- To Study Cauchy integral formula, local properties of analytic functions, general form of Cauchy's theorem and evaluation of definite integral and harmonic functions

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Cauchy's Integral Formula:** The Index of a point with respect to a Closed curve – The Integral formula – Higher derivatives. Local Properties of analytical Functions: Removable Singularities-Taylors's Theorem – Zeros and poles – The local Mapping – The Maximum Principle. **Chapter 4 : Section 2 : 2.1 to 2.3** **Chapter 4 : Section 3 : 3.1 to 3.4**	CO1	K1 K2 K3 K4
UNIT-II	**The General form of Cauchy's Theorem:** Chains and cycles- Simple Continuity - Homology - The General statement of Cauchy's Theorem - Proof of Cauchy's theorem - Locally exact differentials- Multiply connected regions - Residue theorem – The argument principle. **Chapter 4 : Section 4 : 4.1 to 4.7** **Chapter 4 : Section 5: 5.1 and 5.2**	CO2	K1 K2 K3 K4
UNIT-III	**Evaluation of Definite Integrals and Harmonic Functions** Evaluation of definite integrals - Definition of Harmonic function and basic properties - Mean value property - Poisson formula. **Chapter 4 : Section 5 : 5.3** **Chapter 4 : Sections 6 : 6.1 to 6.3**	CO3	K1 K2 K3 K4
UNIT-IV	**Harmonic Functions and Power Series Expansions:** Schwarz theorem - The reflection principle - Weierstrass theorem – Taylor's Series – Laurent series. **Chapter 4 : Sections 6.4 and 6.5** **Chapter 5 : Sections 1.1 to 1.3**	CO4	K1 K2 K3 K4

UNIT-V	**Partial Fractions and Entire Functions:** Partial fractions -Infinite products – Canonical products – Gamma Function- Jensen'sformula – Hadamard's Theorem **Chapter 5 : Sections 2.1 to 2.4** **Chapter 5 : Sections 3.1 and 3.2**	CO5	K1 K2 K3 K4

Recommended Text Book

1. Lars V. Ahlfors, *Complex Analysis*, (3rd edition) McGraw Hill Co., New York, 1979

Reference Books

1.H.A. Presfly, *Introduction to complex Analysis*, Clarendon Press, oxford, 1990.
2. J.B. Conway, *Functions of one complex variables* Springer -Verlag, International student Edition, Naroser Publishing Co.1978
3. E. Hille, *Analytic function Thorey* (2 vols.), Gonm & Co, 1959.
4. M.Heins, *Complex function Theory*, Academic Press, New York, 1968.

.

Website and e-learning source

http://mathforum.org,
http://ocw.mit.edu/ocwweb/Mathematics,
http://www.opensource.org , http://en.wikipedia.org

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Analyze and evaluate local properties of analytical functions and definite integrals.	K1,K2,K3,K4
CO2	Describe the concept of definite integral and harmonic functions.	K1,K2,K3,K4
CO3	Demonstrate the concept of the general form of Cauchy's theorem	K1,K2,K3,K4
CO4	Develop Taylor and Laurent series .	K1,K2,K3,K4
CO5	Explain the infinite products, canonical products and jensen's formula .	K1,K2,K3,K4

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	1	-	-	1	3	2	2
CO2	2	1	3	1	3	3	1	-	-	1	3	2	2
CO3	3	2	3	1	3	3	1	-	-	1	3	2	2
CO4	2	2	3	2	3	3	1	-	-	1	3	2	2
CO5	3	1	3	3	3	3	1	-	-	1	3	2	2

COURSE DESCRIPTORS

Title of the Course	**PROBABILITY THEORY**	**Hours/Week**	06
Course Code	**APCMA32**	**Credits**	05
Category	Core Paper-VIII	**Year & Semester**	II & III
Prerequisites	UG level Probability Theory	**Regulation**	2024

Objectives of the Course:

- To introduce axiomatic approach to probability theory, to study some statistical characteristics, discrete and continuous distribution functions and their properties, characteristic function and basic limit theorems of probability

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Random Events and Random Variables**: Random events – Probability axioms – Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables. **Chapter 1: Sections 1.1 to 1.7 Chapter 2 : Sections 2.1 to 2.9**	CO1	K1 K2 K3 K4
UNIT-II	**Parameters of the Distribution:** Expectation- Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types. **Chapter 3 : Sections 3.1 to 3.8**	CO2	K1 K2 K3 K4
UNIT-III	**Characteristic functions :** Properties of characteristic functions – Characteristic functions and moments – semi0invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions. **Chapter 4 : Sections 4.1 to 4.7**	CO3	K1 K2 K3 K4
UNIT-IV	**Some Probability distributions:** One point , two point , Binomial – Polya – Hyper geometric – Poisson (discrete) distributions – Uniform – normal- gamma – Beta – Cauchy and Laplace (continuous) distributions. **Chapter 5 : Section 5.1 to 5.10 (Omit Section 5.11)**	CO4	K1 K2 K3K4
UNIT-V	**Limit Theorems :** Stochastic convergence – Bernaulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems – de Moivre-Laplace Theorem – Poisson, Chebyshev, Khintchine Weak law of large numbers – Lindberg Theorem – Lapunov Theroem – Borel-Cantelli Lemma - Kolmogorov Inequality and Kolmogorov Strong Law of large numbers. **Chapter 6: Sections 6.1 to 6.4, 6.6 to 6.9, 6.11 and 6.12. (Omit Sections 6.5, 6.10,6.13 to 6.15)**	CO5	K1 K2 K3 K4,K5

Recommended Text Books

1. M. Fisz, Probability Theory and Mathematical Statistics, John Wiley and Sons, New York, 1963.

Reference Books

1. R.B. Ash, Real Analysis and Probability, Academic Press, New York, 1972
2. K.L.Chung, A course in Probability, Academic Press, New York, 1974.
3. R.Durrett, Probability: Theory and Examples, (2nd Edition) Duxbury Press, New York, 1996.
4. V.K.Rohatgi An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd., New Delhi, 1988(3rd Print).
7. S.I.Resnick, A Probability Path, Birhauser, Berlin,1999.
8. B.R.Bhat , Modern Probability Theory (3rd Edition), New Age International (P)Ltd, New Delhi, 1999

Website and e-learning source

http://mathforum.org,
http://ocw.mit.edu/ocwweb/Mathematics,
http://www.opensource.org,
http://www.probability.net

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Understand and Analyze Random Events, Random Variables, to describe Probability, to apply Bayes, to define Distribution Function,	K1,K2,K3,K4
CO2	Describe the concept Expectation, Moments and Chebyshev Inequality	K1,K2,K3,K4
CO3	Understand and describe the Characteristic functions, to define distribution function, to find probability generating functions.	K1,K2,K3,K4
CO4	Analyze the Uniform, normal, gamma, Beta distributions	K1,K2,K3,K4
CO5	Understand Stochastic convergence, Bernaulli law of large numbers.	K1,K2,K3,K4,K5

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	1	-	-	1	3	2	3
CO2	2	1	3	1	3	3	1	-	-	1	3	2	2
CO3	3	2	3	1	3	3	1	-	-	1	3	2	2
CO4	3	2	3	2	3	3	1	-	-	1	3	2	2
CO5	3	2	2	3	3	3	1	-	-	1	3	2	2

COURSE DESCRIPTORS

Title of the Course	**TOPOLOGY**	**Hours/Week**	06
Course Code	**APCMA33**	**Credits**	05
Category	Core Paper-IX	**Year & Semester**	II& III
Prerequisites	Real Analysis	**Regulation**	2024

Objectives of the Course:

- To study topological spaces, continuous functions, connectedness, compactness, counts ability and separation axioms.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Topological spaces :** Topological spaces – Basis for a topology – The order topology – The product topology on X × Y – The subspace topology – Closed sets and limit points. **Chapter 2 : Sections 12 to 17**	CO1	K1 K2 K3 K4
UNIT-II	**Continuous functions:** Continuous functions – the product topology – The metric topology. **Chapter 2 : Sections 18 to 21 (Omit Section 22)**	CO2	K1 K2 K3 K4,K5
UNIT-III	**Connectedness:** Connected spaces- connected subspaces of the Real line – Components and local connectedness. **Chapter 3: Sections 23 to 25.**	CO3	K1 K2 K3 K4,K5
UNIT-IV	**Compactness :** Compact spaces – compact subspaces of the Real line – Limit Point Compactness – Local Compactness. **Chapter 3: Sections 26 to 29.**	CO4	K1 K2 K3 K4
UNIT-V	**Countability and Separation Axiom:** The Countability Axioms – The separation Axioms – Normal spaces – The Urysohn Lemma – The Urysohnmetrization Theorem – The Tietz extension theorem. **Chapter 4: Sections 30 to 35.**	CO5	K1 K2 K3 K4

Recommended Text Book

1. James R. Munkres, Topology (2nd Edition) Pearson Education Pve. Ltd., Delhi-2002 (Third Indian Reprint)

Reference Books

1. J. Dugundji ,Topology , Prentice Hall of India, New Delhi, 1975.
2. George F.Sinmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Co., 1963
3. J.L. Kelly, General Topology, Van Nostrand, Reinhold Co., New York
4. L.Steen and J.Subhash, Counter Examples in Topology, Holt, Rinehart and Winston, New York, 1970.
5. S.Willard, General Topology, Addison - Wesley, Mass., 1970

Website and e-learning source

http://mathforum.org,
http://ocw.mit.edu/ocwweb/Mathematics,
http://www.opensource.org,
http://en.wikipedia.org

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Define and illustrate the concept of topological spaces	K1,K2,K3,K4
CO2	Understand continuity, compactness, connectedness, homeomorphism and topological properties	K1,K2,K3,K4,K5
CO3	Analyze and apply the topological concepts in Functional Analysis.	K1,K2,K3,K4,K5
CO4	Ability to determine that a given point in a topological space is either a limit point or not for a given subset of a topological space.	K1,K2,K3,K4
CO5	Develop qualitative tools to characterize connectedness, compactness, second countable, Hausdorff and develop tools to identify when two are equivalent(homeomorphic).	K1,K2,K3,K4

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	1	-	-	1	3	2	3
CO2	2	1	3	1	3	3	1	-	-	1	3	2	2
CO3	3	2	3	1	3	3	1	-	-	1	3	2	2
CO4	1	2	3	2	3	3	1	-	-	1	3	2	3
CO5	3	1	2	3	3	3	1	-	-	1	3	2	2

COURSE DESCRIPTORS

Title of the Course	MECHANICS	Hours/Week	06
Course Code	APCMA34	Credits	04
Category	Core Paper-X	Year & Semester	II& III
Prerequisites	UG level Calculus and Differential equations.	Regulation	2024

Objectives of the Course:

- Understand mechanical systems under generalized coordinate systems.
- Apply mechanics techniques in virtual work.
- Develop student's ability to deal with Energy and momentum.
- Look at the concept of Hamilton, Lagrange.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Mechanical Systems** The Mechanical system-Generalized coordinates- Constraints Virtual work–Energy and Momentum. **Chapter-1: Sections 1.1 to 1.5**	CO1	K1 K2 K3 K4,K5
UNIT-II	**Lagrange's Equations** Derivation of Lagrange's equations- Examples - Integrals of motion. **Chapter -2: Sections2.1 to 2.3**	CO2	K1 K2 K3 K4,K5
UNIT-III	**Hamilton's Equations** Hamilton's Principle - Hamilton's Equation - Other variational principle. **Chapter-4: Sections 4.1 to 4.3**	CO3	K1 K2 K3 K4,K5
UNIT-IV	**Hamilton-Jacobi Theory** Hamilton Principal Function- Hamilton- Jacobi Equation-Separability **Chapter 5: Sections 5.1 to 5.3**	CO4	K1 K2 K3 K4,K5
UNIT-V	**Canonical Transformation** Differential forms and generating functions - Lagrange and Poisson brackets. **Chapter 6: Sections6.1 and 6.3**	CO5	K1 K2 K3 K4,K5

Recommended Text Books

1. D.T.Greenwood, Classical Dynamics, Prentice Hall of India,NewDelhi,1985.

Reference Books

1. H.Goldstein, Classical Mechanics,(2ndEdition) Narosa Publishing House, New Delhi.
2. N.C.Rane and P.S.C.Joag, ClassicalMechanics,TataMcGrawHill,1991.
3. J.L.Synge and B.A.Griffth, Principles of Mechanics (3rd Edition) McGraw Hill Book Co., New York, 1970

Website and e-learning source

https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall2014

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Explain the basics concepts of mechanical systems under generalized coordinate systems.	K1,K2,K3,K4,K5
CO2	Identify the Lagrange's equations and its application. Identify the Lagrange's equations and its application	K1,K2,K3,K4,K5
CO3	Derive the Hamilton Equation.	K1,K2,K3,K4,K5
CO4	Analyze the Hamilton's Principle and Hamilton-Jacobi Equation and separability.	K1,K2,K3,K4,K5
CO5	Discuss the Lagrange and Poisson brackets	K1,K2,K3,K4,K5

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	1	-	-	1	3	2	3
CO2	2	1	3	1	3	3	1	-	-	1	3	2	2
CO3	3	2	3	1	3	3	1	-	-	1	3	2	2
CO4	1	2	3	2	3	3	1	-	-	1	3	2	3
CO5	3	1	2	3	3	3	1	-	-	1	3	2	2

COURSE DESCRIPTORS

Title of the Course	**FLUID DYNAMICS**	**Hours/Week**	03
Course Code	**APEMA35A**	**Credits**	03
Category	Elective Course-V	**Year &Semester**	II & III
Prerequisites	-	**Regulation**	2024

Objectives of the Course:

- To discuss Kinematics in motion, to know about three dimensional flow and to analyze viscous flows.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Kinematics of Fluids in Motion** Real fluids and ideal fluids – Velocity of a fluid at a point, Stream lines, path lines, steady and unsteady flows –Velocity potential – The vorticity vector – Local and particle rates of changes – Equations of continuity – Worked examples. **Chapter 2: Sections 2.1 to 2.8**	CO1	K1 K2 K3 K4
UNIT-II	**Equations of Motion of Fluid** Pressure at a point in a fluid at rest – Pressure at a point in a moving fluid – Conditions at a boundary of two in viscid immiscible fluids – Euler's equation of motion –Discussion of the case of steady motion under conservative body forces. **Chapter 3: Sections 3.1 to 3.7**	CO2	K1 K2 K3K4
UNIT-III	**Some Three Dimensional Flows** Introduction – Sources, sinks and doublets – Images in a rigid infinite plane – Axis symmetric flows – Stokes stream function. **Chapter 4: Sections 4.1, 4.2, 4.3, 4.5**	CO3	K1 K2 K3K4
UNIT-IV	**Some Two Dimensional Flows** The stream function – The complex potential for two dimensional, irrational incompressible flow –Complex velocity potentials for standard two dimensional flows – Some worked examples – Two dimensional image systems –The Milne Thompson circle Theorem. **Chapter 5: Sections 5.3 to 5.8**	CO4	K1 K2 K3 K4
UNIT-V	**Viscous Flows** Stress components in a real fluid – Relations between Cartesian components of stress – Translational motion of fluid elements –The co-efficient of viscosity and Laminar flow – The Navier – Stokes equations of motion of a Viscous fluid. **Chapter 8: Sections 8.1 to 8.3, 8.8 and 8.9**	CO5	K1 K2 K3 K4

Recommended Text Books

1. F. Chorlton, Text Book of Fluid Dynamics, CBS Publications. Delhi ,1985

Reference Books

1. R.W.Fox and A.T.McDonald. Introduction to Fluid Mechanics, Wiley, 1985.
2. E.Krause, Fluid Mechanics with Problems and Solutions, Springer, 2005.
3. B.S.Massey, J.W.Smith and A.J.W.Smith, Mechanics of Fluids, Taylor and Francis, New York, 2005
4. P.Orlandi, Fluid Flow Phenomena, Kluwer, New Yor, 2002.
5. T.Petrila, Basics of Fluid Mechanics and Introduction to Computational Fluid Dynamics, Springer, Berlin, 2004.

Website and e-learning source

http://web.mit.edu/1.63/www/lecnote.html

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Understand the concepts of kinematics of fluids in motions.	K1,K2,K3,K4
CO2	Find the pressure at a point in a moving fluid.	K1,K2,K3,K4
CO3	Discuss Stokes stream function.	K1,K2,K3,K4
CO4	Analyze complex velocity potential for two dimensional flows	K1,K2,K3,K4
CO5	Derive the Navier – Stokes equations of motion of a Viscous fluid	K1,K2,K3,K4

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	2	1	2	2	1	-	-	1	3	3	3
CO2	2	1	3	1	3	2	1	-	-	1	3	2	3
CO3	3	2	1	3	2	1	1	-	-	1	3	3	3
CO4	2	3	1	2	3	1	1	-	-	1	3	2	3
CO5	3	1	3	2	1	3	1	-	-	1	3	2	3

COURSE DESCRIPTORS

Title of the Course	ALGEBRAIC NUMBER THEORY	Hours/Week	03
Course Code	APEMA35B	Credits	03
Category	Elective Course-V	Year & Semester	II & III
Prerequisites	UG level Number Theory and Algebra Concept	Regulation	2024

Objectives of the Course:

- .The course aims to provide a study on modules over rings, finite fields, algebraic extensions, number fields and cyclotomic fields, Noetherian rings and modules and Dedekind rings.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Algebraic Background** Rings and Fields- Factorization of Polynomials - Field Extensions - Symmetric Polynomials - Modules - Free Abelian Groups. **Chapter 1: Sec. 1.1 to 1.6**	CO1	K1 K2 K3 K4
UNIT-II	**Algebraic Numbers** Algebraic numbers - Conjugates and Discriminants - Algebraic Integers - Integral Bases - Norms and Traces - Rings of Integers. **Chapters 2: Sec. 2.1 to 2.6**	CO2	K1 K2 K3K4
UNIT-III	**Quadratic and Cyclotomic Fields** Quadratics and cyclotomatic fields: Factorization into irreducibles: Trivial factorization - Factorization into irreducibles - Examples of non unique factorization into irreducible. **Chapter 3: Sec. 3.1 and 3.2 ; Chapter 4: Sec. 4.2 to 4.4**	CO3	K1 K2 K3 K4,K5
UNIT-IV	**Prime Factorization** Prime Factorization - Euclidean Domains - Euclidean Quadratic fields - Consequences of unique factorization - The Ramanujan -Nagell Theorem. **Chapter 4: Sec. 4.5 to 4.9**	CO4	K1 K2 K3 K4,K5
UNIT-V	**Ideals** Prime Factorization of Ideals - The norms of an Ideal - Non-unique Factorization in Cyclotomic Fields. **Chapter 5 : Sec. 5.2 to 5.4**	CO5	K1 K2 K3 K4

Recommended Text Book

1. Steward and D.Tall. Algebraic Number Theory and Fermat's Last Theorem (3rd Edition) A.K.Peters Ltd., Natrick, Mass. 2002.

Reference Books

1. Z.I.Bosevic and I.R.Safarevic, Number Theory, Academic Press, New York, 1966.
2. J.W.S.Cassels and A.Frohlich, Algebraic Number Theory, Academic Press, New York, 1967.
3. P.Ribenboim, Algebraic Numbers, Wiley, New York, 1972.
4. P. Samuel, Algebraic Theory of Numbers, Houghton Mifflin Company, Boston, 1970.
5. A.Weil. Basic Number Theory, Springer, New York, 1967.

Website and e-learning source

http://mathforum.org,
http://ocw.mit.edu/ocwweb/Mathematics
http://www.opensource.org
www.mathpages.com

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Discuss the rings, fields and factorization of polynomials.	K1,K2,K3,K4
CO2	Solve the problems in norms and traces.	K1,K2,K3,K4
CO3	Derive factorization to irreducible polynomials.	K1,K2,K3,K4,K5
CO4	Understand Euclidean Quadratic fields	K1,K2,K3,K4,K5
CO5	Apply the concepts of ideals.	K1,K2,K3,K4

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	1	-	-	1	3	3	3
CO2	3	3	3	3	3	3	1	-	-	1	3	2	3
CO3	3	3	3	3	2	1	1	-	-	1	3	3	3
CO4	2	3	3	2	3	1	1	-	-	1	3	2	2
CO5	3	2	3	3	2	3	1	-	-	1	3	3	3

COURSE DESCRIPTORS

Title of the Course	STOCHASTIC PROCESSES	Hours/Week	03
Course Code	APEMA35C	Credits	03
Category	Elective Course-V	Year &Semester	II& III
Prerequisites	--	Regulation	2024

Objectives of the Course:

- This course aims to introduce advanced topics in Markov process, Markov chains and Renewal theory.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Stochastic Processes** Stochastic processes – Specification of Stochastic processes – Markov Chains : Definitions and Examples – Higher transition probabilities – Generalization of independent Bernoulli trials. **Chapter1 :1.5; Chapter2 :2.1to 2.3**	CO1	K1 K2 K3 K4
UNIT-II	**Markov Chains** Stability of Markov system – Graph theoretic approach – Markov chain with denumerable number of states – Reducible chains – Statistical inference for Markov chains. **Chapter2:2.6 to2.10**	CO2	K1 K2 K3 K4
UNIT-III	**Markov Processes with Discrete State Space** Poisson process: Poisson process and Related distributions – Generalizations of Poisson process. **Chapter3 :3.1 to 3.3**	CO3	K1 K2 K3 K4
UNIT-IV	**Markov Processes with Discrete State Space (Cont…..)** Birth and death process – Markov processes with discrete state space (Continuous time Markov chain).Continuous time Markov chain). **Chapter3 :3.4 and 3.5**	CO4	K1 K2 K3 K4
UNIT-V	**Markov Processes with Continuous State Space** Brownian motion – Weiner process – Differential equations for Weiner Process – Kolmogorov equations – First passage time distribution for Weiner process. **Chapter4 :4.1 to 4.5**	CO5	K1 K2 K3 K4

Recommended Text Book

1. J. Medhi, Stochastic Processes (3rd Edition), New Academic Science Limited, 2012.

Reference Books

1.S. Karlin, A first course in Stochastic Processes, (2nd Edition), Academic Press, 1958.
2.U.N. Bhat, Elements of Applied Stochastic Prcesses, John Wiley Sons, 1972.
3.E. Cinlar, Introduction to Stochastic Processes, PHI, 1975
4.S.K. Srinivasan and A. Vijayakumar, Stochastic Processes, Narosa, 2003.

Website and e-learning source

http://mathforum.org,
http://ocw.mit.edu/ocwweb/Mathematics,
http://www.opensource.org,
www.mathpages.com

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Discuss the classification of stochastic processes.	K1,K2,K3,K4
CO2	Derive Markov chains and the stability condition.	K1,K2,K3,K4
CO3	Apply Poisson process and its properties.	K1,K2,K3,K4
CO4	Calculate birth and death process.	K1,K2,K3,K4
CO5	Apply Markov Process and it properties.	K1,K2,K3,K4

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	2	1	3	2	1	-	-	1	3	2	1
CO2	2	3	2	1	2	1	1	-	-	1	3	2	1
CO3	3	3	3	1	3	2	1	-	-	1	2	2	1
CO4	3	3	3	3	2	3	1	-	-	1	3	2	1
CO5	3	2	3	3	2	2	1	-	-	1	3	2	1

COURSEDESCRIPTORS

Title of the Course	**MATHEMATICAL PYTHON**	**Hours/Week**	03
Course Code	**APEMA35D**	**Credits**	03
Category	Elective Course	**Year &Semester**	II & III
Prerequisites	-	**Regulation**	2024

Objectives of the Course:

- To introduce to students Python programming.
- To learn python coding to implement algorithms for Mathematical problems.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Introduction to Python** Basicsyntax, variabletypes, basicoperators, numbers, strings, lists, tuples. Some simple programs to understand the relational, conditional and logical operators. Compare two numbers (less than, greater than) using if statement. Sum of natural numbers using whileloop; To check the given number is prime or not(useif...elsestatement); Find the factorial of a number (use if...if...else).	CO1	K1 K2 K3 K4
UNIT-II	**Matrices, Differential Calculus & Analytical Geometry of Three Dimensions** Python command storeduce given matrix to echelon form and normal form with examples. Python command to find the nth derivatives. Python program to find nth derivative with and without Leibnitz rule. its extension and Jacobean. Python program for reduction formula with or without limits. Python program to find equation and plot sphere, cone, cylinder.	CO2	K1 K2 K3 K4
UNIT-III	**Roots of High-Degree Equations-Systems of Linear Equations** Introduction, Simple Iterations Method - Gauss Elimination Method, Jacobi's Method, Gauss-Seidel's Method.	CO3	K1 K2 K3 K4
UNIT-IV	**Numerical differentiation, Integration and Ordinary Differential Equations** Introduction & Euler's Method, Second Fourth Order Runge-Kutta's Method, Fourth Order Runge Kutta's Method: Plot Numerical and Exact Solutions.	CO4	K1 K2 K3 K4

UNIT-V	**Two-Point Boundary Value Problems Introduction to two point boundary value Problems** Second order differential equations - Higherorderdifferentialequationssolutionofsecondorderdifferentialequationusing	CO5	K1 K2 K3 K4,K5

Recommended Text Books

1.J.Kiusalaas, Numerical methods in engineering with Python3.Cambridge University Press, 2013.

2.H.P.Langtangen, Solving PDEs in Python: the FEniCStutorialI. Springer Open,2016

Website and e-learning source

1.www.python.org

2.www.rosettacode.org

3.http://faculty.msmary.edu/heinold/python.html

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Understand Python basic Concepts.	K1,K2,K3,K4
CO2	Understand the Python program to find equation and plot sphere, cone, cylinder	K1,K2,K3,K4
CO3	Uderstand Roots of High-Degree Equations-Systems of Linear Equations	K1,K2,K3,K4
CO4	Understand the Numerical differentiation, Integration and Ordinary Differential Equations in Python Program .	K1,K2,K3,K4
CO5	Solve Python Program in Two-Point Boundary Value Problems	K1,K2,K3,K4,K5

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	1	-	-	1	3	3	2
CO2	2	1	2	1	3	2	1	-	-	1	3	3	3
CO3	3	2	2	2	2	3	1	-	-	1	2	2	2
CO4	2	2	2	2	2	2	1	-	-	1	3	2	2
CO5	3	1	2	2	3	3	1	-	-	1	2	2	2

COURSE DESCRIPTORS

Title of the Course	**Professional Communication Skill : TERM PAPER & SEMINAR PRESENTATION**	**Hours/Week**	03
Course Code	**APSPMA36**	**Credits**	02
Category	Skill Enhancement Course – II	**Year & Semester**	II & III
Prerequisites	--	**Regulation**	2024

Course Outline

Professional Communication Skill : Term Paper & Seminar Presentation

Assignment of Problem by faculty Lecture

- I (by the student) 25% Lecture
- II (by the student) 25% Lecture
- III (by the student) 25%

Submission of a write-up (10 to 15 pages using LaTex) 25% Marks / Grade Points / Lecture Grade as per the Regulation)

COURSE DESCRIPTORS

Title of the Course	**FNCTIONAL ANALYSIS**	**Hours/Week**	06
Course Code	**APCMA41**	**Credits**	05
Category	Core Paper-XI	**Year &Semester**	II & IV
Prerequisites	Elements of Real Analysis	**Regulation**	2024

Objectives of the Course:

- To provide students with a strong foundation in functional analysis, focusing on spaces, operators and fundamental theorems.
- To develop student's skills and confidence in mathematical analysis and proof techniques.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Banach Spaces** Normed Linear Space-Banach Space - Definition - Some examples – Holder's Inequality –Minkowski's Inequality-Continuous Linear Transformations – Conjugate Space- Continuous Linear Functionals-The Hahn –Banach Theorem.	CO1	K1 K2 K3 K4
UNIT-II	**Banach Spaces And Hilbert Spaces** Open mapping theorem–Projection-Closed Graph Theorem- Conjugate of an Operator-Properties- Hilbert Spaces-Inner Product Space - Definition and some simple properties -Orthogonal Complements – Orthonormal Sets.	CO2	K1 K2 K3 K4
UNIT-III	**Hilbert Spaces** Conjugate space H* - Adjoint of an Operator -Properties - Self-Adjoint Operators - Normal and Unitary Operators– Projections-Range and Null Space-Invariant-Orthogonal Projection.	CO3	K1 K2 K3 K4
UNIT-IV	**Preliminaries of Banach Algebras** Definition and some examples - Regular and Singular elements - Topological divisors of zero- Spectrum the Formula for the Spectral Radius-the radical and Semi-Simplicity-Maximality for two sided Ideals.	CO4	K1 K2 K3 K4
UNIT-V	**The Structure of Commutative Banach Algebras:** The Gelfand mapping – Properties –Multiplicative Functional – Maximal Ideals -Application of the formula $r(x) = lim\|x^n\|^{1/n}$ Involutions in Banach Algebras-The Gelfand-Neumark theorem.	CO5	K1 K2 K3 K4

Recommended Text Book

1. G.F.Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Education (India)Private Limited,New Delhi,2012.

UNIT-I : Chapter-9(Sections 46 to 48)
UNIT-II : Chapter-9 (Sections 50 and 51) & Chapter 10(Sections 52, 53 and 54)
UNIT-III : Chapter-10 (Sections 55,56,57,58 and 59)
UNIT-IV : Chapter-12 (Sections 64 to 69)
UNIT-V : Chapter-13(Sections 70 to 73)

Reference Books

1. W.Rudin, Functional Analysis, McGraw Hill Education (India) Private Limited, New Delhi, 1973.
2. B.V.Limaye,Functional Analysis, New Age International,1996.
3. C. Goffman and G. Pedrick, First course in Functional Analysis, Prentice Hall of India, NewDelhi,1987.
4. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978.
5. M. Thamban Nair, Functional Analysis, A First course, Prentice Hall of India, New Delhi, 2002.

Website and e-learning source

http://mathforum.org,
http://ocw.mit.edu/ocwweb/Mathematics,
http://www.opensource.org, http://en.wikiepedia.org

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Analyze Banach theorem and open mapping theorem.	K1, K2, K3, K4
CO2	Describe orthogonal and orthonormal sets.	K1, K2, K3, K4
CO3	Analyze Finite-Dimensional Spectral Theory	K1, K2, K3, K4
CO4	Establish the regular and singular elements.	K1, K2, K3, K4
CO5	Describe the Structure of Commutative BanachAlgebras	K1, K2, K3, K4

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	1	-	-	1	3	2	2
CO2	2	1	3	1	3	3	1	-	-	1	3	2	2
CO3	3	2	3	1	3	3	1	-	-	1	3	2	2
CO4	2	2	3	2	3	3	1	-	-	1	3	2	2
CO5	3	1	3	3	3	3	1	-	-	1	3	2	2

COURSE DESCRIPTORS

Title of the Course	**DIFFERENTIAL GEOMETRY**	**Hours/Week**	06
Course Code	**APCMA42**	**Credits**	05
Category	Core Paper-XII	**Year & Semester**	II & IV
Prerequisites	Linear Algebra concepts and Calculus	**Regulation**	2024

Objectives of the Course:

- This course introduces space curves and their intrinsic properties of a surface and geodesics. Further the non-intrinsic properties of surface and the differential geometry of surfaces are explored.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Space Curves:** Definition of a space curve – Arc length – tangent – normal and binormal – curvature and torsion – contact between curves and surfaces- tangent surface- involutes and evolutes- Intrinsic equations – Fundamental Existence Theorem for space curves- Helies.	CO1	K1 K2 K3 K4
UNIT-II	**Intrinsic Properties of a Surface:** Definition of a surface – curves on a surface – Surface of revolution – Helicoids – Metric- Direction coefficients – families of curves- Isometric correspondence- Intrinsic properties.	CO2	K1 K2 K3
UNIT-III	**Geodesics:** Geodesics – Canonical geodesic equations – Normal property of geodesics- Existence Theorems – Geodesic parallels – Geodesics curvature- Gauss- Bonnet Theorem – Gaussian curvature- surface of constant curvature.	CO3	K1 K2 K3 K4
UNIT-IV	**Non Intrinsic Properties of a Surface:** The second fundamental form- Principle curvature – Lines of curvature – Developable - Developable associated with space curves and with curves on surface - Minimal surfaces – Ruled surfaces.	CO4	K1 K2 K3 K4
UNIT-V	**Differential Geometry of Surfaces :** Compact surfaces whose points are umblics- Hilbert's lemma – Compact surface of constant curvature – Complete surface and their characterization – Hilbert's Theorem – Conjugate points on geodesics.	CO5	K1 K2 K3 K4 K5

Recommended Text Book

1.T.J.Willmore, *An Introduction to Differential Geometry,* Oxford University Press, (17th Impression) New Delhi 2002.(Indian Print)

UNIT-I : Chapter-I(Sections 1 to 9)
UNIT-II : Chapter-II(Sections 1 to 90
UNIT-III : Chapter-II(Sections 10 to 18)
UNIT-IV : Chapter-III(Sections 1 to 8)
UNIT-V : Chapter-IV(Sections 1 to 8)

Reference Books

1. Struik, D.T. Lectures on Classical Differential Geometry, Addison – Wesley, Mass. 1950.
2. Kobayashi. S. and Nomizu. K. Foundations of Differential Geometry, Inter science Publishers, 1963.
3. Wilhelm Klingenberg: A course in Differential Geometry, Graduate Texts in Mathematics, Springer-Verlag 1978.
4. J.A. Thorpe Elementary topics in Differential Geometry, Under- graduate Texts in Mathematics, Springer - Verlag 1979.

Website and e-learning source

http://mathforum.org,
http://ocw.mit.edu/ocwweb/Mathematics,
http://www.opensource.org,
http://www.probability.net

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Analyze the space curves, Curves between surfaces, metrics on a surface and fundamental form of a surface.	K1, K2, K3, K4
CO2	Apply the Concepts with related examples in Intrinsic properties of a surface	K1, K2, K3
CO3	Analyze the problems on geodesics	K1, K2, K3, K4
CO4	Analyze of developable.	K1, K2, K3, K4
CO5	Construct Differential Geometry of Surfaces	K1, K2, K3, K4, K5

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	1	-	-	1	3	2	3
CO2	2	1	3	1	3	3	1	-	-	1	3	2	2
CO3	3	2	3	1	3	3	1	-	-	1	3	2	2
CO4	3	2	3	2	3	3	1	-	-	1	3	2	2
CO5	3	2	2	3	3	3	1	-	-	1	3	2	2

COURSE DESCRIPTORS

Title of the Course	**PROJECT WITH VIVA VOCE**	**Hours/Week**	10
Course Code	**APPMA43**	**Credits**	07
Category	Core Paper-XIII	**Year & Semester**	II & IV
Prerequisites	UG Level Mathematics	**Regulation**	2024

COURSE DESCRIPTORS

Title of the Course	FINANCIAL MATHEMATICS	Hours/Week	04
Course Code	APEMA44A	Credits	03
Category	Elective Course-VI	Year & Semester	II & IV
Prerequisites	HSC Mathematics	Regulation	2024

Objectives of the Course:

- To study financial mathematics through various models and to study the various aspects of financial mathematics.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	Single Period Models: Definitions from Finance - Pricing a forward - One-step Binary Model - a ternary Model - Characterization of no arbitrage - Risk-Neutral Probability Measure.	CO1	K1 K2 K3
UNIT-II	Binomial Trees and Discrete Parameter Martingales: Multi-period Binary model - American Options - Discrete parameter martingales and Markov processes - Martingale Theorems - Binomial Representation Theorem –Overture to Continuous models.	CO2	K1 K2
UNIT-III	Brownian Motion: Definition of the process - Levy's Construction of Brownian Motion - The Reflection Principle and Scaling - Martingales in Continuous time.	CO3	K1 K2 K3
UNIT-IV	Stochastic Calculus: Non-differentiability of Stock prices – Stochastic Integration - Ito's formula - Integration by parts and Stochastic Fubini Theorem – Girsanov Theorem - Brownian Martingale Representation Theorem – Geometric Brownian Motion - The Feynman – Kac Representation.	CO4	K1 K2 K3
UNIT-V	Block-Scholes Model: Basic Block-Scholes Model - Block-Scholes price and hedge for European Options - Foreign Exchange - Dividends – Bonds – Market price of risk.	CO5	K1 K2

Recommended Text Book

1. Alison Etheridge, A Course in Financial Calculus, Cambridge University Press, Cambridge, 2002.

UNIT-I : Chapter-1
UNIT-II : Chapter-2
UNIT-III : Chapter-3
UNIT-IV : Chapter-4
UNIT-V : Chapter-5

Reference Books

1. Martin Boxter and Andrew Rennie, Financial Calculus: An Introduction to Derivatives Pricing, Cambridge University Press,Cambridge, 1996.
2. Damien Lamberton and Bernard Lapeyre, (Translated by Nicolas Rabeau and Farancois Mantion)
3. Introduction to Stochastic Calculus Applied to Finance, Chapman and Hall,1996.
4. Marek Musiela and Marek Rutkowski, Martingale Methods in Financial Modeling, Springer Verlag, New York, 1988.
5. Robert J.Elliott and P. Ekkehard Kopp, Mathematics of Financial Markets,Springer Verlag, New York, 2001 (3rd Printing)

Website and e-learning source
https://archive.org/details/financialmathema032436mbp

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Use discrete and continuous processes in financial modeling.	K1, K2, K3
CO2	Gain knowledge in the relationship between stochastic and deterministic models.	K1, K2
CO3	Apply the roles of Put and Call options in risk reduction	K1, K2, K3
CO4	Apply hedging strategies to reduce risk.	K1, K2, K3
CO5	Understand the role of the Black-Scholes partial differential equation and its boundary and final conditions in option pricing.	K1, K2

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	1	-	-	1	3	2	3
CO2	2	1	3	1	3	3	1	-	-	1	3	2	2
CO3	3	2	3	1	3	3	1	-	-	1	3	2	2
CO4	1	2	3	2	3	3	1	-	-	1	3	2	3
CO5	3	1	2	3	3	3	1	-	-	1	3	2	2

COURSE DESCRIPTORS

Title of the Course	RESOURCE MANAGEMENT TECHNIQUES	Hours/Week	04
Course Code	APEMA44B	Credits	03
Category	Elective Course-VI	Year &Semester	II & IV
Prerequisites	Basic Mathematics	Regulation	2024

Objectives of the Course:

- To be Familiar with Resource Management Techniques.
- To learn to solve problems in linear programming and Integer programming.
- To Understand Critical Path Method and Programme Evaluation and Review Technique in scheduling problems.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Linear Programming:** Introduction-Structure of Linear Programming Model-Advantages of using Linear Programming-Limitation of Linear Programming-Application Areas of Linear Programming-General Mathematical Model of L.P.P-Guidelines on Linear Programming Model Formulation(Examples on Production)-Graphical Method-Simplex Method.	CO1	K1 K2 K3
UNIT-II	**Duality in Linear Programming:** Introduction- Formulation of Dual Linear Programming Problem-Symmetrical Form-Economic Interpretation of Dual Variable-Economic Interpretation of Dual Constraints-Rules for Constructing the Dual from Primal-Problems-Dual Simplex Method-Problems.	CO2	K1 K2 K3
UNIT-III	**Integer Linear Programming** Introduction-Types of Integer Programming Problems-Enumeration and Cutting Plane Solution Concept-Gomory's All Integer Cutting Plane Method- Gomory's Mixed Integer Cutting Plane Method-Branch and Bound Method.	CO3	K1 K2 K3 K4
UNIT-IV	**Classical Optimization Methods** Introduction -Unconstrained Optimization –Constrained Multivariable Optimization with Equality Constraints(Lagrange Multipliers Method)- Constrained Multivariable Optimization with Inequality Constraints(Kuhn-Tucker Necessary and Sufficient Condition).	CO4	K1 K2 K3 K4

UNIT-V	**Project Management PERT and CPM** Introduction-Basic Difference between Programme Evaluation and Review Technique and Critical Path Method -Phases of Project Management - Programme Evaluation and Review Technique (PERT)/Critical Path Method (CPM) Network Components and Precedence Relationships-Critical Path Analysis-Project Scheduling with Uncertain Activity Times.	CO5	K1 K2 K3 K4

Recommended Text Book

1. J.K.Sharma, Operations Research Theory and Applications (Sixth Edition), Trinity Press, Laxmi Publications Pvt. Ltd., New Delhi, Reprint 2017.

UNIT-I : Chapter-2(2.1to 2.8(2.8.1only)), Chapter-3(3.1 to 3.3)and Chapter-4(4.1 to 4.3)
UNIT-II : Chapter-5(5.1,5.2), Chapter-27(27.1,27.2)
UNIT-III : Chapter-7(7.1 to 7.6)
UNIT-IV : Chapter-23(23.1 to 23.4)
UNIT-V : Chapter-13(13.1 to 13.6)

Reference Books

1. H.A. Taha, ‐Operation Research‖, Prentice Hall of India, 2002.
2. Vohra, Quantitative Techniques in Management, Tata Mc GrawHill, 2002.
3. Anand Sarma, Operation Research‘, Himalaya Publishing House,2003.
4. Paneer Selvam, Operations Research, Prentice Hall of India, 2002.

Website and e-learning source

http://mathforum.org,
http://ocw.mit.edu/ocwweb/Mathematics,
http://www.opensource.org,
www.mathpages.com

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Apply the linear programming problems by using simplex method	K1, K2, K3
CO2	Apply Duality in Linear Programming	K1, K2, K3
CO3	Analyze Integer Linear Programming	K1, K2, K3, K4
CO4	Analyze the problems optimization theory	K1, K2, K3, K4
CO5	Analyze CPM and PERT for project scheduling	K1, K2, K3, K4

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	2	1	2	2	1	-	-	1	3	3	3
CO2	2	1	3	1	3	2	1	-	-	1	3	2	3
CO3	3	2	1	3	2	1	1	-	-	1	3	3	3
CO4	2	3	1	2	3	1	1	-	-	1	3	2	3
CO5	3	1	3	2	1	3	1	-	-	1	3	2	3

COURSE DESCRIPTORS

Title of the Course	MODELING AND SIMULATION WITH EXCEL	Hours/Week	04
Course Code	APEMA44C	Credits	03
Category	Elective Course-VI	Year & Semester	II & IV
Prerequisites	Basic in Excel	Regulation	2024

Objectives of the Course:

- Modeling and simulation with Excel typically include developing skills for data analysis, forecasting, and decision-making by creating dynamic, data-driven models.

UNITS	Contents	COs	Cognitive Levels
UNIT-I	**Presentation of Quantitative Data** Introduction-Data Classification-Data Context and Data Orientation-Types of Charts and Graphs-An Example of Graphical Data Analysis and Presentation. **Analysis of Quantitative Data :** Introduction-Data Analysis Tools-Data Analysis for Two Data Sets-Analyses of Time Series Data—Forecasting/Data Relationship Tools-Analysis of Cross-Sectional Data—Forecasting/Data Relationship Tools.	CO1	K1 K2
UNIT-II	**Presentation of Qualitative Data** Introduction-Essentials of Effective Qualitative Data Presentation-Data Entry and Manipulation-Data queries with Sort, Filter, and Advanced Filter. **Analysis of Qualitative Data** Introduction- Know to present and analyze qualitative data - PivotChart or PivotTable Reports.	CO2	K1 K2 K3 K4
UNIT-III	**Inferential Statistical Analysis of Data** Introduction-Chi-Square Test of Independence for Categorical Data-z-Test and t-Test of Categorical and Interval Data-An Example-ANOVA-Experimental Design.	CO3	K1 K2
UNIT-IV	**Modeling and Simulation: Part 1** Introduction-An Example of Deterministic Modeling-Understanding the Important Elements of a Model-Model Building with Excel.	CO4	K1 K2 K3 K4
UNIT-V	**Modeling and Simulation: Part 2** Types of Simulation and Uncertainty - The Monte Carlo Sampling Methodology - A Financial Example – Income Statement - An Operations Example - Autohaus.	CO5	K1 K2

Recommended Text Book

1. Excel data analysis modelling and simulation, Hector Guerrero, Springer-Verlag Berlin Heiddelberg 2010.

Website and e-learning source

http://mathforum.org,
http://ocw.mit.edu/ocwweb/Mathematics
http://www.opensource.org
www.mathpages.com

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Understand the Presentation of Quantitative Data	K1, K2
CO2	Analyze the present Data Entry and Manipulation	K1, K2, K3, K4
CO3	Know inferential statistical analysis of data.	K1, K2
CO4	Analyze the modelling and simulation for deterministic data.	K1, K2, K3, K4
CO5	Understand Monte Carlo Sampling Methodology.	K1, K2

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	1	-	-	1	3	3	3
CO2	3	3	3	3	3	3	1	-	-	1	3	2	3
CO3	3	3	3	3	2	1	1	-	-	1	3	3	3
CO4	2	3	3	2	3	1	1	-	-	1	3	2	2
CO5	3	2	3	3	2	3	1	-	-	1	3	3	3

COURSE DESCRIPTORS

Title of the Course	MATHEMATICAL PYTHON -Practical	Hours/Week	04
Course Code	APEPMA44D	Credits	03
Category	Elective Course-VI	Year &Semester	II & IV
Prerequisites	Basic Mathematics and Computer Science	Regulation	2024

Objectives of the Course:

- To Apply basic Python and to solve mathematical problems, Graphical representation and manipulation of data using python

Contents	COs	Cognitive Levels
1. Find minimum/maximum in a list / guess an integer in given range 2. Distance between two points 3. Find GCD 4. Sum an array of numbers 5. Linear search 6. Binary search. 7. Find the numbers which are divisible by in a given range 8. Print first n Fibonacci numbers 9. Selection sort 10. Insertion sort 11. Merge sort 12. Count word frequencies 13. Generate adjacency matrix of any graph on n vertices 14. Find degree of vertices from given adjacency matrix of the graph 15. Find odd number in given array/ Replace odd numbers with giveninteger in the given array 16. Compute multiplication of two 3x3 matrices 17. Compute mean and standard deviation of given array 18. Create a Barplot/Piechart for comparing three features	CO1 CO2 CO3 CO4 CO5	K1 – K4

Recommended Text Book

1. Allen B. Dowley, *Think Python: How to Think Like a ComputerScientist*, 2nd Edition

Reference Books

1. Wes McKinney, *Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Ipython*, O'Reilly, 2nd Edition, 2018.
2. Jake VanderPlas, *Python Data Science Hand Book: Essential Tools for working with Data*, O'Reilly, 2017.
3. Wesley J. Chun, *Core Python Programming*, Prentice Hall, 2006.
4. N.Safina Devi and C.Devamanoharan, *Algorithmic ProblemSolving and Python- A Beginner's Guide*, Francidev Publications,2023.

Website and e-learning source

www.python.org
www.rosettacode.org
http://faculty.msmary.edu/heinold/python.html

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

COs	CO Description	Cognitive Level
CO1	Understand the programs using advanced concepts of Python.	K1, K2
CO2	Apply the Test and Debug Python Programs.	K1, K2, K3, K4
CO3	Understand the Conditionals and Loops for Python Programs.	K1, K2
CO4	Understand the functions and represent Compound data using Lists, Tuples and Dictionaries.	K1, K2, K3
CO5	Analyze the manipulate data from and to files in Python.	K1, K2, K3, K4

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	1	-	-	1	3	3	2
CO2	2	1	2	1	3	2	1	-	-	1	3	3	3
CO3	3	2	2	2	2	3	1	-	-	1	2	2	2
CO4	2	2	2	2	2	2	1	-	-	1	3	2	2
CO5	3	1	2	2	3	3	1	-	-	1	2	2	2

COURSE DESCRIPTORS

Title of the Course	**Professional Competency Skill Enhancement Course (Internal Assessment)**	**Hours/Week**	04
Course Code	**APSPMA45**	**Credits**	02
Category	Skill Enhancement Course – III	**Year & Semester**	II & IV
Prerequisites	--	**Regulation**	2024

Course Outline

1. Training for Competitive Examinations

Mathematics for NET / UGC - CSIR/ SET / TRB Competitive Examinations(2 hours)

2. General Studies for UPSC / TNPSC / Other Competitive Examinations(2 hours)

(OR)

Mathematics For Advanced Research Studies (4 hours)