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

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

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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	7	5	25	75	100
		Core Paper-II	APCMA12	Real Analysis - I	7	5	25	75	100
		Core Paper-III	APCMA13	Ordinary Differential Equations	6	4	25	75	100
		Elective Course-I (Choose any One)	APEMA14A	Number Theory and Cryptography	5	3	25	75	100
			APEMA14B	Graph Theory and Applications					
			APEMA14C	Formal Languages and Automata Theory					
			APEMA14D	Programming in C++ and NumericalMethods					
		Elective Course-II (Choose any One)	APEMA15A	Lie Groups and Lie Algebras	5	3	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 - II	Core Paper-IV	APCMA21	Advanced Algebra	6	5	25	75	100
		Core Paper-V	APCMA22	Real Analysis - II	6	5	25	75	100
		Core Paper-VI	APCMA23	Partial Differential Equations	6	4	25	75	100
		Elective Course-III (Choose any One)	APEMA24A	Reliability and Queuing Theory	3	3	25	75	100
			APEMA24B	Mathematical Statistics					
			APEMA24C	R Programming Language (OnlyPractical)					
			APEMA24D	Tensor Analysis and Relativity					
		Elective Course-IV (Choose any One)	APEMA25A	Wavelets	3	3	25	75	100
			APEMA25B	Machine Learning and Artificial Intelligence					
			APEMA25C	Neural Networks					
			APEMA25D	Difference Equations					
		Skill Enhancement Course-I (Choose any One)	APSMA26A	Office Automation and ICT Tools	4	2	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					
	Part II	Compulsory	APHR20	Human Rights	2	2	25	75	100
		Compulsory	APMOOC20	MOOC Course	-	2	-	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 - III	Core Paper-VII	APCMA31	Complex Analysis	6	5	25	75	100
		Core Paper-VIII	APCMA32	Probability Theory	6	5	25	75	100
		Core Paper-IX	APCMA33	Topology	6	5	25	75	100
		Core Paper-X	APCMA34	Mechanics(Industry Modules)	6	4	25	75	100
		Elective Course-V (Choose any One)	APEMA35A	Fluid Dynamics	3	3	25	75	100
			APEMA35B	Algebraic Number Theory					
			APEMA35C	Stochastic Processes					
			APEMA35D	Mathematical Python					
		Skill Enhancement Course-II	APSMA36	Professional Communication Skill - Term paper & Seminar presentation	3	2	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.	-	2	100	-	100
				Semester Total	**30**	**26**			
SEMESTER - IV	Part - I	Core Paper-XI	APCMA41	Functional Analysis	6	5	25	75	100
		Core Paper-XII	APCMA42	Differential Geometry	6	5	25	75	100
		Core Paper-XIII	APPMA43	Project with viva voce	10	7	25	75	100
		Elective Course-VI (Choose any One)	APEMA44A	Financial Mathematics	4	3	25	75	100
			APEMA44B	Resource Management Techniques					
			APEMA44C	Modeling and Simulation with Excel					
			APEMA44D	Mathematical Python - Practical					
		Professional Competency Skill Enhancement Course (Choose any One)	APSMA45A	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 rs)	4	2	25	75	100
			APSMA45B	Mathematics for Advanced Research Studies (4 hours)					
	Part - II	Compulsory	APEA40	Extension Activity	-	1	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	22	26	22	90
Part-II	-	04	-	01	05
Total	20	26	26	23	**95**

*****Part I and Part II 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

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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

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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.

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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

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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

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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