A.V.V.M. Sri Pushpam College (Autonomous), Poondi – 613 503

PG & Research Department of Mathematics

M.Sc. Programme in Mathematics

OUTCOME BASED EDUCATION - CHOICE BASED CREDIT SYSTEM

SCHEME OF PROGRAMME AND SYLLABUS

(For the candidates admitted from 2023-2024 onwards)

Vision and Mission of the college

Vision

To provide quality academic programmes and value oriented higher education to the rural community, equip them to encounter current regional, national and global demands upholding moral standards and intellectual competency.

Mission

- To provide conducive environment for quality teaching-learning process and innovative research.

- To bestow substantial educational experience that is intellectually, socially, and personally transformative.

- To strive to bring out the latent potentiality and core competency of the learners

- To foster the culture of research-based learning, independent academic inquiry by encouraging the students to involve in research activities ranging from hands on training, student projects, publications etc.,

- To nurture essential skills, competent minds and compassionate hearts.

- To impart a practical, demanding and overall development of the personality generated by love, consideration and care for the society.

- To serve the society by extending needful outreach programmes to the rural populace.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

- Make the learners realise the transformative power of education.
- Acquire profound disciplinary, applied, integrative knowledge and intellectual competency and domain specific and generic skills.
- Pursue lifelong learning and generate innovative solutions for the problems at individual and social level.
- Create a collaborative and inclusive environment, and serve the betterment of the society with moral integrity.
- Motivate to become a committed professional with necessary ethics as a leader as well as a team player.

PROGRAMME OUTCOMES for M.Sc. Mathematics Programme

PO1: Disciplinary Knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an Post graduate programme of study.

PO2: Critical Thinking: Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.

PO3: Problem Solving: Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's earning to real life situations.

PO4: Analytical & Scientific Reasoning: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples and addressing opposing viewpoints.

PO5: Research related skills: Ability to analyse, interpret and draw conclusions from quantitative / qualitative data; and critically evaluate ideas, evidence, and experiences from an open minded and reasoned research perspective; Sense of inquiry and capability for asking relevant questions / problem arising / synthesizing / articulating / ability to recognize cause and effect relationships / define problems. Formulate hypothesis, Test / analyse / Interpret the results and derive conclusion, formulation and designing mathematical models

PO6: Self-directed & Lifelong Learning: Ability to work independently, identify and manage a project. Ability to acquire knowledge and skills, including "learning how to learn", through self-placed and self-directed learning aimed at personal development, meeting economic, social and cultural objectives.

PROGRAMME SPECIFIC OUTCOMES for M.Sc. Mathematics Programme

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. To encourage practices grounded in research that comply with employment laws, leading the organization towards growth and development.

Curriculum Structure for PG Programmes (OBE- CBCS) - 2023

	Nature of Course	Total No. of Courses	Total marks	Total credits	Total credits for the Programme
Part – A	Core Course	13	1300	51	80 (CGPA)
	Core Industry Module (CIM)	01	100	3	
	Elective Course	05	500	15	
	Extra Disciplinary Course	01	100	3	
Part – B (i)	Skill Enhancement Course(SEC)	04	400	8	
Part – B (ii)	Ability Enhancement Compulsory Course (AECC) – Soft Skill	04	400	8	10 (Non CGPA)
	Internship / Industrial Activity	--	--	2	
	Total	**28**	**2800**	**90**	**90**
Extra Credit Course - **MOOC / Field visit / Hands on Training**		--	--	Max: 4	

Part A component and Part B (i) will be taken into account for CGPA calculation for the postgraduate programme and the other components Part B and Part C have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the PG degree

Course Structure: M.Sc. Mathematics (2023 – 2024 ONWARDS)

S. No.	Semester	Category	Course Code	Title of the Course	Maximum Marks			Minimum Marks for Pass			Hours/ Week	Credits
					CIA	EE	Total	CIA	EE	Total		
1	I	Core	23P1MAC1	Linear Algebra	25	75	100	10	30	50	5	4
2		Core	23P1MAC2	Real Analysis	25	75	100	10	30	50	5	4
3		Core	23P1MAC3	Ordinary Differential Equations	25	75	100	10	30	50	5	4
4		Elective	23P1MAEL1A/ 23P1MAEL1B	Number Theory and Cryptography/ Formal Languages and Automata Theory	25	75	100	10	30	50	5	3
5		Elective	23P1MAEL2A/ 23P1MAEL2B	Stochastic Processes / Fluid Dynamics	25	75	100	10	30	50	5	3
6		SEC 1	23P1MASEC1	Office Automation and ICT tools - Practical	25	75	100	10	30	50	3	2
7		AECC 1	23P1MAAEC1	Communicative Skill and Personality Development	25	72	100	10	30	50	2	2
		Extra Credit	Field visit / Hands on Training		-	-	-	-	-	-	-	-
8	II	Core	23P2MAC4	Advanced Algebra	25	75	100	10	30	50	5	4
9		Core	23P2MAC5	Partial Differential Equations	25	75	100	10	30	50	5	4
10		Core	23P2MAC6	Advanced Numerical Analysis	25	75	100	10	30	50	5	4
11		Elective	23P2MAEL3A/ 23P2MAEL3B	Graph Theory and Applications/ Mathematical Statistics	25	75	100	10	30	50	5	3
12		Elective	23P2MAEL4AP/ 23P2MAEL4B	Modelling and Simulation Practical with Excel / Discrete Mathematics	25	75	100	10	30	50	5	3
13		SEC 2	23P2MASEC2	Numerical Analysis Practical using SCILAB	25	75	100	10	30	50	3	2
14		AECC 2	23P2MAAECC2	Language Lab	25	75	100	10	30	50	2	2

S. No.	Semester	Category	Course Code	Title of the Course	Maximum Marks			Minimum Marks for Pass			Hours/ Week	Credits
					CIA	EE	Total	CIA	EE	Total		
15	III	Core	23P3MAC7	Complex Analysis	25	75	100	10	30	50	6	4
16		Core	23P3MAC8	Topology	25	75	100	10	30	50	5	4
17		Core	23P3MAC9	Mathematical Python	25	75	100	10	30	50	5	4
18		Core - CIM	23P3MACIM	Core Industry Module: Mathematics of Finance and Insurance	25	75	100	10	30	50	5	3
19		EDC	23P3MAEDC	Extra disciplinary course	25	75	100	10	30	50	4	3
20		SEC 3	23P3MASEC3	Data Analytics Practical with Python	25	75	100	10	30	50	3	2
21		AECC 3	23P3MAAEC3	Research Methodology – Practical	25	75	100	10	30	50	2	2
		Internship / Industrial Activity (Carried out in summer vacation at the end of I Year – 30 hours)									-	2
		Extra Credit	MOOC(Massive open online course)		-	-	-	-	-	-	-	-
22	IV	Core	23P4MAC10	Functional Analysis	25	75	100	10	30	50	5	4
23		Core	23P4MAC11	Differential Geometry	25	75	100	10	30	50	5	4
24		Core	23P4MAC12	Mechanics	25	75	100	10	30	50	5	4
25		Elective	23P4MAEL5A/ 23P4MAEL5B	Resource Management Techniques/ Design and Analysis of Algorithms	25	75	100	10	30	50	5	3
26		Core	23P4MAC13PR	Project with Viva Voce	25	75	100	10	30	50	5	3
27		SEC 4	23P4MASEC4	Mathematical documentations using LATEX - Practical	25	75	100	10	30	50	3	2
28		AECC 4	23P4MAAECC4	Comprehensive Knowledge	-	100	100	-	-	50	2	2
							2800					**90**
		Extra Credit	MOOC(Massive open online course)		-	-	-	-	-	-	-	-

Internship/ Industrial Activity:

Students must complete in-plant training in any industry or organization where a programme-related procedure is being used, and this training must be done during the summer vacation at the end of I Year. A minimum of 30 hours should be spent on training. Students must submit a report on their training together with a certificate from the relevant industry or organization authority.

Ability Enhancement Compulsory Course (AECC): (Communicative Skill and Personality Development, Language Lab, Research Methodology and Comprehensive Knowledge)

Mode of Assessment for these courses is Viva-Voce examination.
<u>Components of Evaluation</u>:
Internal Marks   : 25
External Marks   : 75
Total   : 100

Field visit / Hands on Training:

In order to achieve experiential learning, these programmes with a minimum of 15 hours of contact time are offered as Extra Credit Courses in the I Semester. Evaluation of visit report will be held at the end of II Semester.
<u>Components of Evaluation</u>:
Internal Marks   : 25
External Marks   : 75
Total   : 100

MOOC:

Massive Open Online Course is offered in the III and IV Semester as an Extra Credit Course. Students can avail any one or more of the courses available in MOOC to equip their skill and knowledge themselves. To receive the extra credit, students must provide their MOOC course completion certificate at the end of the second year.

Skill Enhancement courses (SEC) offered by the Mathematics Department
1. Office Automation and ICT tools - Practical
2. Numerical Analysis Practical using SCILAB
3. Data Analytics Practical with Python
4. Mathematical documentations using LATEX - Practical

Extra Disciplinary Course (EDC) offered by the Mathematics Department: "Mathematics for Life and Social Sciences"   .

A.VEERIYA VANDAYAR MEMORIAL SRI PUSHPAM COLLEGE (AUTONOMOUS),POONDI, THANJAVUR DIST.
(NAAC Re-Accredited with A grade in 4th cycle)
Question Pattern for UG and PG Programmes
(For the students admitted from 2023 – 2024 onwards)

Bloom's Taxonomy based Assessment pattern

Bloom's category	Section	Choice	Marks	Total
K1 to K6	A	Compulsory	10 x 2 = 20	75
	B	Either / Or	5 x 5 = 25	
	C	3 out of 5	3 x 10 = 30	

OBE QUESTION PATTERN

Total Marks: 75

CO	K Level	Q. No.	Questions
SECTION – A (10 x 2 = 20) **Answer All the questions** (Two Questions from each units)
		1.	
		2.	
		3.	
		4.	
		5.	
		6.	
		7.	
		8.	
		9.	
		10.	
SECTION – B (5 x 5 = 25) **Answer All the questions** (One Question from each unit)
		11(a).	
(OR)
		11(b).	
		12(a).	
(OR)
		12(b).	
		13(a).	
(OR)
		13(b).	
		14(a).	
(OR)
		14(b).	
		15(a).	
(OR)
		15(b).	
SECTION – C (3 x 10 = 30) **Answer ANY THREE questions** (One Question from each unit)
		16.	
		17.	
		18.	
		19.	
		20.	

Bloom's Taxonomy Action Verbs

K1 Remember	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create
• Choose	• Associate	• Apply	• Advertise	• Agree	• Adapt
• Copy	• Classify	• Build	• Appraise	• Appraise	• Build
• Define	• Compare	• Calculate	• Analyze	• Assess	• Change
• Describe	• Contrast	• Change	• Assume	• Award	• Choose
• Discover	• Convert	• Choose	• Break down	• Choose	• Combine
• Duplicate	• Demonstrate	• Complete	• Categorize	• Compare	• Compile
• Enumerate	• Describe	• Construct	• Classify	• Conclude	• Compose
• Examine	• Differentiate	• Demonstrate	• Compare	• Convince	• Construct
• Find	• Discuss	• Develop	• Conclusion	• Criteria	• Create
• How	• Distinguish	• Discover	• Connect	• Criticize	• Design
• Identify	• Estimate	• Dramatize	• Contrast	• Decide	• Develop
• Label	• Explain	• Experiment	• Differentiate	• Deduct	• Discuss
• List	• Express	• Identify	• Discover	• Defend	• Elaborate
• Locate	• Extend	• Interview	• Dissect	• Determine	• Estimate
• Match	• Identify	• Interpret	• Distinguish	• Discriminate	• Formulate
• Memorize	• Illustrate	• Illustrate	• Discriminate	• Estimate	• Generalize
• Name	• Indicate	• Make use of	• Divide	• Evaluate	• Hypothesize
• Omit	• Infer	• Manipulate	• Examine	• Explain	• Imagine
• Recall	• Interpret	• Model	• Explain	• Find errors	• Improve
• Recognize	• Outline	• Modify	• Function	• Grade	• Integrate
• Relate	• Paraphrase	• Organize	• Inference	• Importance	• Invent
• Select	• Predict	• Paint	• Inspect	• Influence	• Make up
• Show	• Relate	• Plan	• List	• Interpret	• Maximize
• Spell	• Rephrase	• Prepare	• Motive	• Judge	• Minimize
• State	• Show	• Produce	• Order	• Justify	• Modify
• Tabulate	• Summarize	• Relate	• Point out	• Mark	• Originate
• Tell	• Translate	• Select	• Prioritize	• Measure	• Organize
• What		• Show	• Relationships	• Order	• Plan
• When		• Sketch	• Select	• Predict	• Predict
• Where		• Solve	• Separate	• Prioritize	• Prepare
• Which		• Use	• Simplify	• Prove	• Produce
• Who		• Utilize	• Subdivide	• Rank	• Propose
• Why			• Survey	• Rate	• Rearrange
			• Take part in	• Recommend	• Rewrite
			• Test for	• Reframe	• Role-play
			• Theme	• Select	• Solution
				• Summarize	• Solve
				• Support	• Substitute

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	**23P1MAC1**	**LINEAR ALGEBRA**	**5**	**4**

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented		Relevant to national need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are:

1. To understand the basic concepts of linear algebra
2. To acquire skills in the techniques of linear algebra
3. To demonstrate the underlying principles

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**Systems of Linear Equations, Vector Spaces:** A motivating Example – Systems of Linear Equations – Vector Spaces – Definition and Examples – Vector Subspaces - Basis and Dimension of a vector space.	15
II	**Lines and Quotient Spaces, Linear Transformations:** Definition of a line – Affine Spaces – Quotient Space – Linear Transformation – Representation of Linear Maps by Matrices – Kernel and image of a Linear Transformation – Linear Isomorphism–Geometric Ideas and Some Loose Ends – Some special Linear Transformations.	15
III	**Inner Product Spaces:** Inner Product Spaces – Orthogonality – Some Geometric Applications – Orthogonal Projection onto a Line – Orthonormal Basis – Orthogonal complements and Projections.	15
IV	**Determinants:** 2×2 Determinant as Area of a Parallelogram – Determinant and its Properties – Computation of Determinants – Basic results on Determinants – Orientation and Vector Product.	15
V	**Diagonalization:** Rotation of Axes of Conics – Eigen Values and Eigen Vectors – Diagonalization of Symmetric Matrices *Self-study*: Conics and Quadrics – Computational Examples.*	15

*Note: Questions may be asked from the *Self-study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

Textbook:
Linear Algebra – A Geometric Approach, S. Kumaresan, PHI Learning Pvt. Ltd., 2000.

Unit	Chapter	Sections
I	I	Sec: 1.1 - 1.2
	II	Sec: 2.1 - 2.3
II	III	Sec: 3.1 - 3.3
	IV	Sec: 4.1 - 4.6
III	V	Sec: 5.1 - 5.6
IV	VI	Sec: 6.1 – 6.5
V	VII	Sec: 7.1 – 7.3

General References:
1. K. Hoffman and R. Kunze, Linear Algebra, Second Edition, PHI, New Delhi, 1975.
2. Jin Ho Kwak, Linear Algebra, Second Edition, Birkhäuser, 2004.
3. R.A. Beezer, A First Course in Linear Algebra, Congruent Press, Washington, 2004.

Web resources:
1. http://asian-university.org/wp-content/uploads/2018/02/Linear-Algebra_Fall18.pdf
[Asian women university]
2. http://people.math.harvard.edu/~knill/teaching/math21b2010/21b_text.pdf
[Harvard University

Pedagogy: Teaching / Learning methods:
Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar. Library, Net Surfing, NPTEL Course Materials, Use of Mathematical software.

Course Outcomes
On the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	State definitions and relevant theorems	**K1, K2**
CO2	Evaluate solutions of systems of linear equations and determinants	**K5**
CO3	Solve eigen value problems	**K3**
CO4	Apply the principles of matrix algebra to linear transformations	**K3, K4**
CO5	Construct orthonormal basis for an inner product space	**K6**

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	3	3	2	1
CO2	2	2	3	3	3	3	2	2	1
CO3	3	2	3	1	3	3	2	3	2
CO4	2	1	3	2	3	3	3	2	2
CO5	3	3	2	3	3	3	3	3	1

3 - Strongly Correlated; 2 - Moderately Correlated;
1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	23P1MAC2	**REAL ANALYSIS**	5	4

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need		Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are:

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

SYLLABUS		
Unit	**Content**	**No. of Hours**
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. **Infinite Series :** Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series.	15
II	**The Riemann - Stieltjes Integral** - Introduction - Notation - 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.	15
III	**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.	15

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. **Power series** - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem *Self-Study*:* Abel's limit theorem - Tauber's theorem	15
V	**Sequences of Functions** – Pointwise 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 Convergence and Term-by-term Integration - Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series - Mean convergence.	15

*Note: Questions may be asked from the *Self-Study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

Textbook:

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

Unit	Chapter	Sections
I	6 8	Sections 6.1 to 6.8 Sections 8.8, 8.15, 8.17, 8.18
II	7	Sections 7.1 to 7.14
III	7	Sections 7.15 to 7.26
IV	8 9	Sections 8.20, 8.21 to 8.26 Sections 9.14 9.15, 9.19, 9.20
V	9	Sections 9.1 to 9.6, 9.8,9.9,9.10,9.11, 9.13

General References:
1. Bartle, R.G. *Real Analysis*, John Wiley and Sons Inc., 1976.
2. Rudin,W. *Principles of Mathematical Analysis*, 3rd Edition. McGraw Hill Company, New York, 1976.
3. Malik,S.C. and Savita Arora. *Mathematical Anslysis*, Wiley Eastern Limited.New Delhi, 1991.
4. Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, 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*, Pearson Education, (Indian print) 2003..

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

Pedagogy: Teaching / Learning methods:

Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar. Library, Net Surfing, NPTEL Course Materials, Use of Mathematical software

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Analyze and evaluate functions of bounded variation and Rectifiable Curves.	K4, K5
CO2	Describe the concept of Riemann-Stieltjes integral and its properties.	K3
CO3	Demonstrate the concept of step function, upper function, Lebesgue function and their integrals.	K3
CO4	Construct various mathematical proofs using the properties of Lebesgue integrals and establish the Levi monotone convergence theorem.	K6
CO5	Formulate the concept and properties of inner products, norms and measurable functions.	K1, K2

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
    K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	3	2	1
CO2	2	1	3	1	3	3	3	2	1
CO3	3	2	3	1	3	3	3	2	1
CO4	1	2	3	2	3	3	3	2	1
CO5	3	1	2	3	3	3	3	2	1

3 - Strongly Correlated;   2 - Moderately Correlated;
1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	23P1MAC3	**ORDINARY DIFFERENTIAL EQUATIONS**	5	4

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need		Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are:

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

SYLLABUS		
Unit	**Content**	No. of Hours
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.	15
II	**Linear equations with constant coefficients** Homogeneous and non-homogeneous equation of order n –Initial value problems- Annihilator method to solve non-homogeneous equation-Algebra of constant coefficient operators.	15
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.	15
IV	**Linear equation with regular singular points** Euler equation – Second order equations with regular singular points – Exceptional cases *Self-Study*:* Bessel Equation.	15

	Existence and uniqueness of solutions to first order equations:	
V	Equation with variable separated – Exact equation – method of successive approximations – the Lipschitz condition – convergence of the successive approximations and the existence theorem.	15

*Note: Questions may be asked from the *Self-Study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

Textbook:

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

Unit	Chapter	Sections
I	2	Sections 1 to 6
II	2	Sections 7 to 12.
III	3	Sections 1 to 8
IV	4	Sections 1 to 4 and 6
V	5	Sections 1 to 6

General References:
1. Williams E. Boyce and Richard C. DI Prima, *Elementary differential equations and boundary value problems*, John Wiley and 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..

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

Pedagogy: Teaching / Learning methods:
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Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Establish the qualitative behavior of solutions of systems of differential equations .	K1, K2
CO2	Recognize the physical phenomena modeled by differential equations and dynamical systems.	K5
CO3	Analyze solutions using appropriate methods and give examples.	K3, K4
CO4	Formulate Green's function for boundary value problems.	K3
CO5	Understand and use various theoretical ideas and results that underlie the mathematics in this course	K6

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	3	2	1
CO2	2	1	3	1	3	3	3	2	1
CO3	3	2	3	1	3	3	3	2	1
CO4	1	2	3	2	3	3	3	2	1
CO5	3	1	2	3	3	3	3	2	1

3 - Strongly Correlated;   2 - Moderately Correlated;
1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	23P1MAEL1A	**Major Elective – I NUMBER THEORY AND CRYPTOGRAPHY**	5	3

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to national need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to regional need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are:

1. To provide Techniques for keeping information secret.
2. To impart some Techniques for determining the information has not been tampered with.
3. To explain fundamentals of cryptography and its application to network security.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**Cryptography:** Some simple Cryptosystems: Basic notions – Digraph transformation – Enciphering Matrices – Linear algebra modulo.	15
II	**Public Key:** Idea of Public Key Cryptography: Classical versus public key – Authentication – Hash function – Key exchange – Probabilistic encryption – RSA – Discrete Log: Diffle-Hellman key exchange system – Massey-Omura cryptosystem – ELGamel cryptosystem – Digital signature standard *Self-Study*: Algorithms for finding discrete logs in finite fields.	15
III	**Primality:** Pseudoprimes: Definitions and Propositions – The rho method.	15
IV	**Factoring:** Fermat factorization and factor bases – Factor base algorithm – Heuristic time estimate – Continued Fraction Method – Continued fraction factoring algorithm.	15
V	**Elliptic Curves:** Basic Facts - Elliptic curve Cryptosystems: Discrete Log on E – Analog of Diffle-Hellman key exchange – Analog of Massey-Omura – Analog of ELGamel cryptosystems - Elliptic curve factorization: Pollard's p-1 method.	15

*Note: Questions may be asked from the *Self-Study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

Textbook:

N. Koblitz, *"A Course in Number Theory and Cryptography"*, *Second edition, Springer-Verlag, New York, 2014.*

Unit	Chapter	Sections
I	III	Sec 1-2 (Pages 54-74)
II	IV	Sec 1-3 (Pages 83-103)
III	V	Sec 1-2 (Pages 126-134, 138-142)
IV	V	Sec 3-4 (Pages 143-159)
V	VI	Sec 1-3 (Pages 166-182, 191-192)

References:

1. *D.R.Stinson, "Cryptography", CRC Press, New York, 1995.*
2. *A.J Meneze, P.R.Oorche and S.A Vans ton " Hand book of applied Cryptography", Crc Press New York, 1995.*
3. *William Stallings, "Cryptograpy and Network Security Principles and Practice" Prentice Hall, Fifth Edition, New Delhi, 2011.*

Web resources:

1. http://abel.harvard.edu/quals/index.html [Havard University]
2. https://www-wp.maths.cam.ac.uk/documents/schedules.pdf/ [Cambridge University]

Pedagogy: Teaching / Learning methods

Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar. Library, Net Surfing, NPTEL Course Materials, Use of Mathematical software

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	classify the symmetric encryption techniques.	K2,K3,K4
CO2	illustrate various public key cryptographic techniques.	K1,K2
CO3	apply the knowledge of Cryptography to attain a good mathematical maturity and enables to build mathematical thinking and skill	K3,K4
CO4	create, select and apply appropriate number theoretic techniques such as primes, greatest integer functions in Cryptography to use in real life problems.	K3,K4,K6
CO5	identify the challenging problems in modern mathematics and find their appropriate solutions	K4,K5

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;

K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	3	3	3	2
CO2	2	1	2	3	3	3	2	3	3
CO3	1	2	3	3	3	3	3	2	1
CO4	3	2	3	3	2	3	3	3	3
CO5	3	1	3	2	3	3	1	3	3

3 - Strongly Correlated; 2 - Moderately Correlated;

1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	23P1MAEL1B	**Major Elective – I** **FORMAL LANGUAGES AND AUTOMATA THEORY**	5	3

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented		Relevant to national need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are:

➢ To introduce concepts in automata theory and theory of computation
➢ To teach different formal language classes and their relationships
➢ To teach grammars and recognizers for different formal languages
➢ To prove or disprove theorems in automata theory using its properties
➢ To impart the decidability and intractability of computational problems

	SYLLABUS	
Unit	**Content**	**No. of Hours**
I	The theory of Automata- Definition of an Automaton- Description of a finite Automaton- Transition system- properties of transition functions- Acceptability of a string by a finite automaton- Non deterministic finite state Machine- The Equivalence of DFA and NDFA- Mealy and Moore Models- Minimisation of finite Automata.	15
II	Formal Language- Basic definition and examples- Chomsky classification of Languages- Language and their relation- Recursive and Recursively Enumerable sets- operations on Languages- Languages and Automata	15
III	Regular Sets and Regular Grammars- Regular expression- Finite automaton and regular expressions- Pumping Lemma for Regular Sets- Application of Pumping Lemma.	15
IV	Context- free Languages- Context- free languages and derivation Trees- Ambiguity in context- free grammars- Simplification of context- free grammars- Normal forms for context- free Grammars.	15
V	Push down Automata- Basic definitions- Acceptance by Pda- Push Down automata and context- free Languages- *Self-Study**: Parsing and Pushdown Automata.	15

*Note: Questions may be asked from the *Self-Study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

Textbook:

"Theory of Computer Science" (Automata, Languages and Computation) *K.L.P Mishra and N. Chandrasekaran -Prentice Hall of India Private Limited- New Delhi.*

Unit	Chapter	Sections
I	2	Sec 2.1-2.9
II	3	Sec 3.1-3.6
III	4	Sec 4.1-4.4
IV	5	Sec 5.1-5.4
V	6	Sec 6.1-6.4

References:
1. Davis. M., sigal R., Weyuker E. J.(1994). Computability, Complexity, and Languages: Fundamentals of Theoretical Computer Science (2nd Edn). Academic Press.
2. Eitan G (1989). An Introduction to the Theory of Computation. Computer Science Press.
3. Harrison. M. A. (1978). Introduction to Formal Language Theory. Addison – Wisely.

Web resources:
https://books.google.com/books/about/Theory_of_Computer_Science.html?id=bmlUBudVqoMC#v=onepage&q&f=false
https://www.pdfdrive.com/kpl-mishra-e33467643.html.

Pedagogy: Teaching / Learning methods
Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar. Library, Net Surfing, NPTEL Course Materials, Use of Mathematical software

Course Outcomes

CO Number	CO Statement	Cognitive Level
CO1	After completion of the course, students will be able to explore the theoretical foundations of computer science from the perspective of formal languages and classify machines by their power to recognize languages.	**K2,K3,K4**
CO2	differentiate regular, context-free and recursively enumerable languages.	**K1,K2**
CO3	gain the knowledge of basic kinds of finite automata and their capabilities.	**K3,K4**
CO4	know different formal language classes and their relationships	**K3,K4,K6**
CO5	Know the Concept of automata languages	**K4,K5**

Cognitive Level: **K1 -** Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	2
CO2	2	3	2	3	2	3	3	3	2
CO3	1	3	2	3	3	3	3	2	3
CO4	3	2	3	2	3	1	3	3	3
CO5	3	3	3	1	3	3	3	2	1

3 - Strongly Correlated;   2 - Moderately Correlated;
1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	23P1MAEL2A	**Major Elective – II** **STOCHASTIC PROCESSES**	5	3

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented		Relevant to national need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are:

1. To introduce the basic concepts of Stochastic models.
2. To explain the real life models such as Birth- Death processes.
3. To provide a good understanding of the key concepts of stochastic processes in various settings.

	SYLLABUS	
Unit	**Content**	**No. of Hours**
I	**Random Variable and Stochastic Processes**: - Generating Function-Laplace Tranform-Stochastic Processes	15
II	**MarkovChains:** Definition and Examples-Higher Transition Probabilities. Generalisation of Independent Bernoulli Trials:Sequence of Chain- Dependent Trials	15
III	**Markov Chain**: Classification of States and Chains - Determination of Higher Transition Probabilities-Stability of a Markov System.	15
IV	**Markov Processes with Discrete State Space: Poisson Process and Extensions:** Poisson Process– Poisson Process and Related Distribution.	15
V	**Markov Processes with Discrete State Space: Poisson Process and Extensions**: Generalisations of Poisson Process– Yule – Furry process - Birth and Death Process *Self-study*: Yule – Furry process*	15

*Note: Questions may be asked from the ***Self-Study*** content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

Textbook:

STOCHASTIC PROCESSES, Fourth Edition– J. MEDHI *-New Age International Publishers, 2015*

Unit	Chapter	Sections
I	1	Sec 1.1-1.2 and 1.5(pages :1-19 and 49-51)
II	2	Sec 2.1-2.3 (Pages 62-78)
III	2	Sec 2.4-2.6 (Pages 78-99)
IV	3	Sec 3.1-3.2 (Pages138-155)
V	3	Sec 3.3-3.4(Pages 155-170)

References:
1. First course in Stochastic process by Samuel karlin.
2. Stochastic process by Srinivasan and Menta.

Web resources:
1. https://mast.queensu.ca/~stat455/syllabus/syllabus.pdf [Queen's University, Canada]
2. https://ocw.mit.edu/courses/mathematics/18-445-introduction-to-stochastic-processes-spring-2015/syllabus/ [Massachusetts Institute of Technology, USA]

Pedagogy: Teaching / Learning methods
Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar. Library, Net Surfing, NPTEL Course Materials, Use of Mathematical software

Course Outcomes
On the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	understand the definition of a stochastic process and in particular a markov process.	K2,K3,K4
CO2	calculate absorption probabilities and the expected time to absorption for Markov chains	K1,K2
CO3	critically evaluate simulation results with respect to relevant measure.	K3,K4
CO4	understand discrete time and finite state space; discrete time and countable state space; continuous time and countable state space.	K3,K4,K6
CO5	extend their knowledge to pursue research in this field	K4,K5

Cognitive Level: **K1 -** Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3	3	3	2
CO2	2	3	2	3	3	3	2	1	2
CO3	3	2	1	3	2	3	3	2	3
CO4	3	3	3	2	3	1	2	3	3
CO5	1	2	3	1	3	3	3	2	1

3 - Strongly Correlated;   2 - Moderately Correlated;
1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	23P1MAEL2B	**Major Elective – II FLUID DYNAMICS**	5	3

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need		Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are:

> ➢ To introduce the behavior of fluids in motion.
> ➢ To explain application of complex analysis in the analysis of fluid flows.
> ➢ To give fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.
> ➢ To provide hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	Real fluids and ideals fluid –velocity of a fluids at a point-Streamlines and path lines: steady and unsteady flows-the velocity potential-The velocity vector-local and particle rates of change -The Equations of continuity – Worked examples –Accelerations of a fluids –Pressure at a point in a fluid at rest-Pressure at a point in moving fluids-Conditions at a Boundary of two invisid immiscible fluids –Euler's equations of motions-Bernoulli's equation-worked examples.	18
II	Some flows involving axial symmetry –some special two-Dimensional Flows-impulsive Motion. Some three-dimensional flows: Introductions – sources, sinks and doublets –images in a rigid infinite plane- Axi-symmetric Flows: stokes stream functions.	18
III	Some two-Dimensional Flows: meaning of a two-Dimensional flow-Use of cylindrical polar coordinates –The steam function –The complex potential for two Dimensional, irrotational, incompressible flow –complex velocity potentials for standard two-dimensional flows-some worked examples –The Milne-Thomson circle theorem and applications –The theorem of Blasius.	18

IV	The use of conformal transformation and Hydro dynamical Aspects – stress components in real fluids –relations between Cartesian components of stress- Transnational motion of fluid element –The rate of strains Quadric and principal stresses-Some further properties of the rate of strains quadric-stress Analysis in fluid motion-Relations between stress and rate of strain- *Self-Study*: The coefficient of viscosity and laminar flow – the Navier-stokes equation of motion.	18
V	Some solvable problems in viscous flow-steady viscous flow in tubes of uniform cross section –Diffusion of vorticity –Energy. Dissipation due to viscosity –steady flow past a fixed sphere –Dimensional Analysis; Reynolds Number-prandtl's Boundary layer.	18

*Note: Questions may be asked from the *Self-Study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

Textbook:

    Fluids dynamics by F.Chorlton(CBS publisher & Distributors, Delhi-110032) 1985.

Unit	Chapter	Sections
I	2	Sections 2.1 to 2.9
	3	Section 3.1 to 3.6
II	3	Sections 3.9 to 3.11
	4	Section 4.1 to 4.3 and 4.5
III	5	Sections 5.1 to 5.9 except 5.7
IV	5	Sections 5.10
	8	Section 8.1 to 8.9
V	8	Sections 8.10 to 8.16

General References:

    Fluids Dynamics –shanti swarup, Krishna prakasanmandir Meerut**.**

Pedagogy: Teaching / Learning methods:

    Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar. Library, Net Surfing, NPTEL Course Materials, Use of Mathematical software

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	understand fluid flow problems and apply laws of conservation to construct mathematical model.	K1, K2
CO2	find mathematical solution of some viscous and in viscoid flow problems	K5,K3
CO3	acquire the knowledge about Kinematics property of fluid elements.	K3, K4
CO4	understand about fluid, its properties and behavior under various conditions of internal and external flows.	K3
CO5	acquire the knowledge to write Polytechnic TRB competitive exam.	K6

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	3	2	3
CO2	2	1	3	1	3	3	3	2	1
CO3	3	2	3	1	3	3	3	2	2
CO4	1	2	3	2	3	3	3	2	1
CO5	3	1	2	3	3	3	3	2	4

3 - Strongly Correlated;   2 - Moderately Correlated;
1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	23P1MASEC1	**Skill Enhancement Course –** **OFFICE AUTOMATION AND ICT TOOLS - PRACTICAL**	3	2

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are:

- To acquire the knowledge of using Spreadsheets.
- To enhance Critical thinking skills.
- To visualize Geometric transformations.

Spread sheet:

1. **Solving Equations**

   1. Using Quadratic Formula
   2. SOLVER,
   3. Graphs
   4. Simple Method
   5. Bisection method

2. **MS – Power Point**

   6. Working with Slides (creating, saving, closing presentation)
   7. Changing slide layout, working fonts and bullets
   8. Inserting and working with clipart.
   9. Applying Transition and animation effect.
   10. Add audio file to the slide and run slide show

Textbook:
1. Michael Alexander, Richard Kusleika, John Walkenbach, "Excel 2019 BIBLE" - WILEY

References:
1. Dinesh Maidasami, "Learning Computer Fundaments, MS Office and Internet & Web Technology", Firewall Media.

Web resources:
1. http://people.stfx.ca/bliengme/SMath
2. http://www.neng.usu.edu/cee/faculty/gurro/SMathStudio.html
3. https://www.structuralbasics.com/getting-started-with-smath/
4. https://wiki.geogebra.org/en/Book

Pedagogy: Teaching / Learning methods:

      Virtual Class room, LCD projector, Guest Lectures, Tutorial, Assignment, Net Surfing, NPTEL Course Materials.

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	numerically solve complex system of equations, Differentiation and Integration.	K3, K5
CO2	construct and understand construction of shapes in order to connect them with related facts.	K2, K3, K6
CO3	work through the concepts together through exploration and visualization.	K3, K5
CO4	automate calculations with units digitally using SMath.	K3, K5
CO5	work with system of equations, Matrices, Vectors and Differential Equations.	K3, K4, K5

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
           K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	3	3	3	2
CO2	3	3	2	2	3	3	3	3	2
CO3	3	3	2	2	3	3	3	3	3
CO4	2	3	3	3	3	3	3	3	2
CO5	3	2	3	2	3	3	3	3	2

    3 - Strongly Correlated; 2 - Moderately Correlated;
    1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	23P1MAAECC1	**Ability Enhancement Compulsory Course - COMMUNICATIVE SKILL AND PERSONALITY DEVELOPMENT**	2	2

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to national need	√	Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to regional need	√	Addresses Human Values	√
		Relevant to Global development need		Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are to:

1. cultivate positive personality traits for successful life.
2. groom Winning Attitude among the learners.
3. assist the learners to identify their own potential and realize their aspirations.
4. enable a holistic development.
5. facilitate optimum means of improving personal performance.

SYLLABUS	
Unit	**Content**
I	1. Personality- Definition. 2. Determinants of Personality. 3. Perceptual Process. 4. Personality Traits. 5. Developing Effective Habits. 6. Self Esteem (Freud and Erikson). 7. Self Appraisal and Self Development. 8. Dos and Don'ts to develop positive self esteem. 9. Interpersonal Relationship. 10. Difference between Aggressive, Submissive and Assertive behaviour. 11. Mind Mapping, Competency Mapping, 360 degree assessment. **12.** Presentation Skills – Opening, ending, Handling nerves, Handling audience, Power Storytelling, Visual aids, Question and answer session
II	1. Projecting Positive Body Language. 2. Conflict Management. 3. Change Management. 4. Stress Management. 5. Time Management. 6. Goal Setting. 7. Assertiveness and Negotiating Skill. 8. Problem Solving Skill. 9. Decision Making Skills.

	10. Leadership Qualities of a Successful Leader. 11. Attitudes – Positive Attitudes. 12. Public Speaking – Engaging, Connecting, and Influencing the audiences. **13.** Employability Skill – Group Discussion, Interview Questions, Psychometric analysis.

Textbook:
1. Andrews, Sudhir. *How to Succeed at Interviews*. 21st (rep) New Delhi:Tata McGrew Hill 1988.
2. Hurlock.E.B (2006) :*Personality Development*, 28th Reprint. New Delhi: Tata McCraw Hill.
3. Kumar, Pravesh. *All about Self Motivation*. New Delhi:Goodwill Publication House. 2005.
4. Preston,David Lawrence.*365 Steps to Self-Confidence*. Mumbai: Jaico Publishers, 2007
5. Stephen.P.Robbins and Timothy. A.Judge: *Organisation Behaviour.*16thEdition.Prentice Hall. 2014

References:
1. Grellet ,Françoise. *Developing Reading Skills*. Cambridge: Cambridge University Press, 2007.
2. Kristine, Brown and Susan Hood.*Academic Encounters Life in Society Reading, Study Skills, Writing*. , New Delhi:Cambridge University Press,2010.
3. Little ,Graham R .*Operations Team Leadership*. Mumbai :Jaico Publishers, 2006 .
4. Nurnberg ,Maxwell and Morris Rosenblum *How to Build a Better Vocabulary*. New York :Warner Books, 1989.
5. O' Connell ,Sue with LousieHashemi.*Cambridge First Certificate: Listening and Speaking* –, Cambridge University Press, Cambridge, 2000.
6. Pfeifer , William Sanborn and T.V.S.Padmaja*Technical Communication : A Practical Approach,* (Sixth edition) New Delhi: Pearson, 2006.
7. Withrow, Jean, Gay Brookers and Martha Cumings .*Inspired to Write*.NewYork:Cambridge University Press, 2004.

Web resources:
https://www.managementstudyguide.com/personality-development.htm
https://www.artofliving.org/in-en/personality-development
https://study.com/academy/lesson/what-is-conflict-management-definition-styles-strategies.html
https://www.hays.com.au/career-advice/upskilling/soft-skills
https://www.skillsyouneed.com/presentation-skills.html

Pedagogy: Teaching / Learning methods
Lecture, Tutorial, Assignment, PPT presentation, Group Discussion, e-content, Seminar, Tasks, Role play, Debate, Group Activities etc.

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	understand the significance of developing progressive and positive personality	**K1,K2**
CO2	gainself confidence and broaden perception of life.	**K3**
CO3	maximize their potential and steer that into their career choice.	**K4**
CO4	enhance one's self image andself esteem.	**K3, K5**
CO5	find a means to achieve excellence and derive fulfilment.	**K6**

Cognitive Level: **K1 -** Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	3	3	3	3
CO2	2	2	3	2	3	3	3	2	3
CO3	1	2	3	3	3	2	3	3	2
CO4	3	2	3	2	2	3	2	3	3
CO5	2	1	3	3	3	3	3	3	1

3 - Strongly Correlated;   2 - Moderately Correlated;
1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2MAC4**	**ADVANCED ALGEBRA**	**5**	**4**

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are:

To study field extension, roots of polynomials, Galois Theory, finite fields, division rings, solvability by radicals and to develop computational skill in abstract algebra.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	Extension fields – Transcendence of e.	15
II	Roots or Polynomials.- More about roots	15
III	Elements of Galois theory.	15
IV	Finite fields - Wedderburn's theorem on finite division rings.	15
V	Solvability by radicals - A theorem of Frobenius - Integral Quaternions and the Four - Square theorem. *Self-study:* Galios groups over the radicals	15

*Note: Questions may be asked from the *Self-study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

Textbook:

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

Unit	Chapter	Sections
I	5	Section 5.1 and 5.2
II	5	Sections 5.3 and 5.5
III	5	Section 5.6
IV	7	Sections 7.1 and 7.2 (Theorem 7.2.1 only)
V	5 7	Section 5.7 (omit Lemma 5.7.1, Lemma 5.7.2 and Theorem 5.7.1) Sections 7.3 and 7.4

General References:

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 Abstract Algebra*, McGraw Hill (International Edition), New York. 1997.
5. N.Jacobson, *Basic Algebra,* Vol. I & II   Hindustan Publishing Company, New Delhi.

Web resources:

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

Pedagogy: Teaching / Learning methods:

Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar. Library, Net Surfing, NPTEL Course Materials, Use of Mathematical software.

<div align="center">Course Outcomes</div>

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

CO Number	CO Statement	Cognitive Level
CO1	Prove theorems applying algebraic ways of thinking	K1, K2
CO2	Connect groups with graphs and understanding about Hamiltonian graphs.	K3
CO3	Compose clear and accurate proofs using the concepts of Galois Theory	K3, K4
CO4	Bring out insight into Abstract Algebra with focus on axiomatic theories.	K3, K4
CO5	Demonstrate knowledge and understanding of fundamental concepts including extension fields, Algebraic extensions, Finite fields, Class equations and Sylow's theorem.	K5, K6

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
                  K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	3	2	1
CO2	2	1	3	1	3	3	3	2	1
CO3	3	2	3	1	3	3	3	2	1
CO4	1	2	3	2	3	3	3	2	1
CO5	3	1	2	3	3	3	3	2	1

3 - Strongly Correlated;   2 - Moderately Correlated;
1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	23P2MAC5	**PARTIAL DIFFERENTIAL EQUATIONS**	5	4

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are:

To classify the second order partial differential equations and to study Cauchy problem, method of separation of variables, boundary value problems

SYLLABUS		
Unit	**Content**	**No. of Hours**
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	15
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 *Self-study*:* Spherical wave equation – Cylindrical wave equation.	15
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	15
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 for a circle and a rectangle.	15
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.	15

*Note: Questions may be asked from the *Self-study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

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

Unit	Chapter	Sections
I	2	Sections 3.1 to 3.6
	3	Sections 4.1 to 4.4
II	4	Sections 5.1 to 5.9
III	6	Sections 7.1 to 7.7
IV	8	Sections 9.1 to 9.9
V	10	Section 11.1 to 11.10

General References:
1. M.M.Smirnov, *Second Order partial Differential Equations*, Leningrad, 1964.
2. I.N.Sneddon, *Elements of Partial Differential Equations,* McGraw Hill, 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, Prentice Hall of India, New Delhi. 2004

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

Pedagogy: Teaching / Learning methods:
    Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar. Library, Net Surfing, NPTEL Course Materials, Use of Mathematical software.

<div align="center">

Course Outcomes
</div>

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

CO Number	CO Statement	Cognitive Level
CO1	To understand and classify second order equations and find general solutions	K1, K2
CO2	To analyse and solve wave equations in different polar coordinates	K4
CO3	To solve Vibrating string problem, Heat conduction problem, to identify and solve Laplace and beam equations	K3, K4
CO4	To apply maximum and minimum principle's and solve Dirichlet, Neumann problems for various boundary conditions	K3, K4
CO5	To apply Green's function and solve Dirichlet, Laplace problems, to apply Helmholtz operation and to solve Higher dimensional problem	K5, K6

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
        K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	3	2	1
CO2	2	1	3	1	3	3	3	2	1
CO3	3	2	3	1	3	3	3	2	1
CO4	1	2	3	2	3	3	3	2	1
CO5	3	1	2	3	3	3	3	2	1

3 - Strongly Correlated;   2 - Moderately Correlated;
1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2MAC6**	**ADVANCED NUMERICAL ANALYSIS**	**5**	**4**

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to national need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to regional need		Addresses Human Values	
		Relevant to Global development need		Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are to:

1. To impart the basic knowledge of numerical techniques for solving systems of linear equations.
2. To provide a theoretical introduction and application of advanced numerical methods for solving different types of problems viz. linear systems, ordinary and partial differential equation arising in various field of applications.
3. To impart analysis and implementation of numerical methods keeping in mind advantages & limitations of these methods.

	SYLLABUS	
Unit	**Content**	**No. of Hours**
I	**Transcendental and Polynomials equations:** Secant and Regula Falsi method –Muller method – Chebyshev method – Birgevieta method – Graeffe's root squaring method. ***Self-Study*:*** *Bisection method*	**15**
II	**System of linear algebraic equation and Eigen values problems:** Jacobi iteration method, Gauss-Seidel iteration method - Successive over relaxation method - Jacobi method for symmetric matrices - Householder's method for symmetric matrices.	**15**
III	**Interpolation and approximation:** Hermite Interpolation – Lagrange bivariate interpolation – Newton's bivariate Interpolation for Equispaced points - Approximation – Least squares approximation – Legendre Polynomials - Chebyshev polynomials.	**15**
IV	**Numerical integration:** Methods based on interpolation – Newton-cotes methods – Open type integration rules – Gauss-Legendre integration methods – Labotto integration method – Radau integration method – Trapezoidal rule – Simpson's rule.	**15**
V	**Ordinary Differential equations:** Euler method – Backward Euler method – Midpoint method – Taylor series method – Runge-kutta methods - Explicit Runge-kutta method: Second order, third order and Fourth order methods.	**15**

*Note: Questions may be asked from the *Self-study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

Textbook:

Numerical methods for Scientific and Engineering computation By M.K.Jain, S.R.K.Iyengar, R.K.Jain, Seventh Multicolor Edition, New Age international (P) Ltd., 2019.

Unit	Chapter	Sections
I	Chapter – 2	Section 2.3, 2.4, 2.9 (Pages: 23-26, 30-38, 86-89, 94-99)
II	Chapter – 3	Section 3.4, 3.7, 3.9 (Pages: 147-164,179-184, 189-193)
III	Chapter – 4	Section 4.5, 4.7, 4.8, 4.9 (Pages: 247-251, 273 -290, 292-298)
IV	Chapter – 5	Section 5.7, 5.8, 5.9(Pages: 349–355, 361–365, 380-389)
V	Chapter – 6	Section 6.3, 6.4(Pages: 425-448)

References:
1. Elementary Numerical Analysis-An algorithmic approach by Samuel D. Conte and Carl de Boor
2. Classical and modern Numerical Analysis, Azmysackleh et al, CRC Press

Web resources:
1. http://abel.harvard.edu/quals/index.html [Havard University]
2. http://acad.uohyd.ac.in/downloads/syllabus/PG/MSMM.pdf [Oxford University]

Pedagogy: Teaching / Learning methods

Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar. Library, Net Surfing, NPTEL Course Materials, Use of Mathematical software.

Course Outcomes
On the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	utilize the tools of the Numerical Mathematics in order to formulate the real-world problems from the view point of numerical mathematics.	K1, K2, K3, K4
CO2	design, analyze and implement of numerical methods for solving different types of problems.	K2, K3, K4
CO3	create, select and apply appropriate numerical techniques with the understanding of their limitations so that any possible modification in these techniques could be carried out in further research	K3, K4, K6
CO4	find appropriate solutions accurately and efficiently	K5
CO5	extend their knowledge to pursue research using this field.	K3, K4, K5

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3
CO2	2	2	3	3	3	3	2	3	3
CO3	3	2	1	3	3	3	3	2	2
CO4	2	3	3	3	2	3	3	3	3
CO5	1	2	3	2	3	3	2	1	2

3 - Strongly Correlated;   2 - Moderately Correlated;
1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	23P2MAEL3A	**Major Elective – III GRAPH THEORY AND APPLICATIONS**	5	3

Nature of the course

Employability Oriented		Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need		Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are:

1. To understand the basic concepts of graph theory
2. To model real life problems using graphs
3. To apply graph theory concepts to solve real life problems

	SYLLABUS	
Unit	**Content**	**No. of Hours**
I	**Graphs and sub graphs, 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 – Cayley's Formula.	15
II	**Connectivity, Euler Tours and Hamilton Cycles:** Connectivity – Edge Connectivity - Blocks – Whitney's Theorem – Euler Tours – Hamilton Cycles – Dirac's Theorem – Closure of a graph – Chvatal's Theorem.	15
III	**Matchings, Edge Colourings:** Matchings – Berge's Theorem – Matchings and Coverings in Bipartite Graphs – Hall's Theorem - Perfect Matchings – Tutte's Theorem – Peterson's Theorem - Edge Chromatic Number – Vizing's Theorem.	15
IV	**Independent Sets and Cliques, Vertex Colouring:** Independent Sets – Gallai's Theorem - Ramsey's Theorem – Ramsey's graph – Erdos's Theorem - Chromatic Number – Critical Graph - Brook's Theorem – Hajos'Conjecture.	15
V	**Planar Graphs:** Plane and Planar Graphs – Planar Embedding of a graph – Stereographic Projection - Dual Graphs – Isomorphic plane graphs with nonisomorphic duals – Euler's Formula – Bridges – The transfer of a bridge - Kuratowski's Theorem. *Self-study*: The five color theorem and the four color conjecture*	15

*Note: Questions may be asked from the *Self-study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

Textbook:
Graph Theory with Applications, *J.A.Bondy and U.S.R.Murty, Macmillan, London, 1976.*

Unit	Chapter	Sections
I	I	Sec: 1.1 - 1.7
	II	Sec: 2.1 - 2.4
II	III	Sec: 3.1 - 3.2
	IV	Sec: 4.1 - 4.2
III	V	Sec: 5.1 - 5.3
	VI	Sec: 6.1 - 6.2
IV	VII	Sec: 7.1 - 7.2
	VIII	Sec: 8.1 - 8.3
V	IX	Sec: 9.1 - 9.5

References:
1. R. Balakrishnan and K. Ranganathan, **A Textbook of Graph Theory**, Springer Verlag, New York, 1999.
2. D.B.West**, Introduction to Graph Theory**, II Ed., PHI, New Delhi, 2007.
3. J. Clark and D.A. Holton, **A First look at Graph Theory**, Allied Publishers, New Delhi, 1995.
4. F. Harary, **Graph Theory**, Addison –Wesley, Reading Mass, 1969.

Web resources:
1. **https://www.zib.de/groetschel/teaching/WS1314/BondyMurtyGTWA.pdf**
2. **https://en.wikipedia.org/wiki/Graph_theory**
3. http://tezu.ernet.in/dmaths/programme/m.sc.syllabus-2019.pdf [Oxford University]
4. https://www-wp.maths.cam.ac.uk/documents/schedules.pdf/ [Cambridge University]

Pedagogy: Teaching / Learning methods:
    Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar. Library, Net Surfing, NPTEL Course Materials, Use of Mathematical software.

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	State definitions and relevant theorems	**K1**
CO2	Construct graph theoretic models for real life problems	**K6**
CO3	Analyze graphs satisfying certain properties	**K4**
CO4	Apply core theoretical knowledge of graph theory to solve problems	**K3, K5**
CO5	Demonstrate the significance of applications of graph theory in other fields	**K2**

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
              K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	3	2	2
CO2	2	2	3	2	3	2	3	3	1
CO3	3	2	3	1	2	3	3	2	1
CO4	2	2	3	2	3	3	3	2	2
CO5	3	1	2	3	3	3	2	2	1

3 - Strongly Correlated;   2 - Moderately Correlated;
1 - Weakly Correlated;   0 – No correlation

Semester	Subject Code	Titles of the Paper	Hours of Teaching / Week	No. of Credits
II	**23P2MAEL3B**	**Major Elective – III** **MATHEMATICAL STATISTICS**	**5**	**3**

Nature of The Course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are:

1. To learn the basic concepts about mathematical approach to find probability.
2. To understand distribution function, Mathematical expectations.
3. To Calculate marginal, conditional distributions.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**Probability and Distributions:** The probability set function – Random variables – distribution function – Mathematical expectation – special mathematical expectations – special mathematical expectations – Chebyshev's inequality. *Self-Study*: Distribution function*	**15**
II	**Multivariate Distributions:** Distributions of two Random variables – conditional distributions and expectations – Independent Random variables – Some special Distributions: The Binomial and Related distributions – The Poisson distribution.	**15**
III	**Some Special Distributions:** The Gamma and Chi-Square distributions – the normal distributions – The Bivariate normal distribution – Distributions of Functions of Random Variables: Sampling theory – Transformations of variables of the discrete Type – Transformation of variables of the continuous type.	**15**
IV	**Distributions of Functions of Random Variables:** The Beta, t and F distributions, - Distributions of order statistics – The moment generating function technique – the distributions of $\overline{x}$ and nS^2/σ^2 - Expectations of functions of Random variables.	**15**
V	**Limiting Distributions:** Convergence in distribution – convergence in Probability – Limiting moment generation functions – The central limit theorem – some theorem on limiting distributions.	**15**

*Note: Questions may be asked from the *Self-study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

Text Book:
> *Introduction to Mathematical Statistics* (Fifth Edition) by Robert V. HOGG, Allen T.Craig

Unit	Chapter(s)	Section(s)	Page (s)
I	I	1.3, 1.5, 1.7, 1.8, 1.9, 1.10	12-17, 28-35, 44-50, 52-56, 57-64, 68-70
II	II	2.1, 2.2, 3.1, 3.2	74-81, 82-90,
	III		116-124, 126-129
III	III	3.3, 3.4, 4.1, 4.2, 4.3	131-136, 138-144, 146-150,
	IV		155-178
IV	IV	4.4, 4.7, 4.8, 4.9	179-184, 193-200, 203-220.
V	V	5.1, 5.3, 5.4, 5.5	233-255.

References:

1 M.Fisz, Probability theory and Mathematical statistics, John Wiley & Sons, New York, 1963.
2. E.J.Dudewiczn and S.N.Mishra, Modern Mathematical Statistics, John Wiley & Sons, New York, 1988.
3. V.N. Rohatgi, An introduction to Probability theory and Mathematical statistics, Wiley Eastern Limited, New Delhi, 1988.

Web resources:
1. https://nptel.ac.in/courses/111/105/111105124/
2. https://nptel.ac.in/courses/111/102/111102134/

Petagogy: Teaching / Learning methods:
> Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar. Library, Net Surfing, NPTEL Course Materials, Use of Mathematical software.
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Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Demonstrate the knowledge of probability and statistical Distributions.	**K1, K2**
CO2	Obtain the probability distributions of transformed variables and various parameters using special distributions.	**K2, K3, K4**
CO3	Analyze the distributions, transformations of viarbales.	**K2, K3, K4**
CO4	Elaborate the concepts of probability in multivariable distribution.	**K3, K5, K6**
CO5	Estimate probability value using central limit theorem.	**K4, K5**

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
 K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	3	3	3	3
CO2	3	2	2	3	2	3	3	3	3
CO3	1	3	3	3	2	2	3	2	1
CO4	2	2	2	2	1	3	1	3	2
CO5	2	2	2	2	3	2	3	2	2

3 - Strongly Correlated;   2 - Moderately Correlated;
1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	23P2MAEL4PL	**Major Elective – IV** **MODELING AND SIMULATION PRACTICAL WITH EXCEL**	5	3

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are:

- To acquire the knowledge of using Spreadsheets.
- To develop skills among the learners of system simulation..
- To make them able to solve real world problems by mathematical approaches.

Content

EXCEL Spread sheets for
1. Simulating a dice roll using random numbers.
2. Analyzing the risk associated with the purchase of a one-dollar lottery ticket that has a 1% chance of winning one million dollars and a 99% chance of losing the dollar invested.
3. Calculating the monthly payments due on a mortgage with a term of 30 years, an annual interest rate of 6.5%, a loan amount of $200,000, and a down-payment of $50,000 using the PMT() financial function.
4. Calculating the contribution of different attendance fees to overall revenues.
5. Finding the weather affecting attendance using Excel.
6. Solving by Euler's method.
7. Solve by secant method.
8. Graphical solution – OR.
9. OR – Assignment problem.
10. Calculating the impact of different entry fees and bets on profits using Excel.
11. Simulating the outcomes of 12 uncertain elements, each with 10 or more possible outcome values.
12. Simulating the random sampling of a fair coin toss.
13. Simulating the process of randomly sampling colorful stones from a large bowl and estimating the distribution of colors using the maximum likelihood method.
14. Calculating the percentage distribution of colorful stones based on a sample size.
15. Calculating the probability of an outcome having values of continuous distribution.

Textbook:
1. Hector Guerrero, "Excel Data Analysis – Modeling and Simulation ",Second Edition, Springer.

References:
1. V.P.Singh, "System Modeling and Simulation", New Age International (P) Ltd., Publishers, 2009

Web resources:
1. https://www.google.com/search?client=firefox-b-d&q=Modelling+and+Simulation+with+EXCEL#fpstate=ive&vld=cid:172e7b25,vid:HwVBi--mE4M
2. https://www.google.com/search?client=firefox-b-d&q=Modelling+and+Simulation+with+EXCEL#fpstate=ive&vld=cid:fb9cf887,vid:DvVBVt0fupA
3. https://www.youtube.com/watch?v=tpIhQuxQeNs
4. https://elearn.daffodilvarsity.edu.bd/course/view.php?id=11362

Pedagogy: Teaching / Learning methods:
        Virtual Class room, LCD projector, Guest Lectures, Tutorial, Assignment, Net Surfing, NPTEL Course Materials.

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	define the different modeling terms by analyzing the system or the data that is present.	**K1, K2**
CO2	learn different mathematical model and their application in simulation.	**K2, K3, K4**
CO3	implement the model and from the results check for the correctness of the assumptions.	**K4, K5, K6**
CO4	analyse the outcomes and make predictions.	**K4, K5**
CO5	evaluate the percentage distribution and probability outcomes.	**K3, K4, K5**

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
            K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	3	3	2	3	2	3	3	3
CO2	3	3	2	3	3	3	3	3	2
CO3	2	3	2	2	3	3	2	3	3
CO4	2	2	3	3	3	3	3	3	3
CO5	3	2	3	2	3	3	3	2	2

        3 - Strongly Correlated;   2 - Moderately Correlated;
        1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	23P2MAEL4B	**Major Elective – IV** **DISCRETE MATHEMATICS**	5	3

Nature of the course

Employability Oriented	√	Relevant to Local need	
Entrepreneurship Oriented		Relevant to regional need	
Skill development Oriented		Relevant to national need	√
Addresses Gender Sensitization		Relevant to Global development need	√
Addresses Environment and Sustainability		Addresses Professional Ethics	
Addresses Human Values			

Course Objectives

The main objectives of this course are to:

> ➢ Throughout the course, students will be expected to demonstrate their understand of Discrete mathematics.
> ➢ To impart the basic knowledge use mathematics correct terminology and notation. Construct correct direct and indirect proofs.
> ➢ 3. To provide a use division into cases in a Proof. Use counter examples. Apply logical reasoning to solve a variety of problems

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	Recurrence relations and generating function: Recurrence-an introduction-polynomials and their evaluations- Recurrence relations- solution of finite order Homogeneous (linear) Relations- Solution of Non-Homogeneiis relations.	15
II	Logic: TF- statements - Connectives- atomic and compound statements - well formed (statement) Formulae - parsing trees.	15
III	Logic: Truth table of a formula- Tautology- Tautological Implications and Equivalence of Formulae. Replacement process- Functionally Complete sets of connectives and Duality law.	15
IV	Lattices: Lattices- Some properties of lattices- New lattices- Modular and distributivelattices. *Self- study*: Boolean Algebra	15
V	Automata and Languages: Finite Automata - definition of Finite automation - Respresentation of finite automation - Acceptability of a string by a finite automation - Languages accepted by a finite automation - Non detwrministic finite automation.	15

*Note: Questions may be asked from the *Self-study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

Textbook:
        "Discrete Mathematics" by *Dr. M. K. Venkatraman, Dr. N. Sridharan, N. Chandrasekeran, the National Publishing Company, 2003.*

Unit	Text Book	Chapter	Sections
I	1	Chapter – 5	Section 1-5(Pages: 5.01-5.19)
II	1	Chapter – 9	Section 1-5(Pages: 9.1-9.20)
III	1	Chapter – 9	Section 6-10(Pages: 9.21-9.42)
IV	1	Chapter–10	Section 1-4(Pages: 10.1-10.27)
V	1	Chapter–12	Section 1-7(Pages: 12.1-12.16)

References:
1. Koleman and Bushy- Discrete mathematical structures, prentice Hall of India, New Delhi- 2002

Web resources:
1.https://explorecourses.stanford.edu/search?q=CS157[Stanford]
2.https://www.cst.cam.ac.uk/teaching/2021/DiscMath[University of Cambridge]

Pedagogy: Teaching / Learning methods
        Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar. Library, Net Surfing, NPTEL Course Materials, Use of Mathematical software.

Course Outcomes
On the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	apply mathematical logic to solve problems. understand sets, relations, functions and discrete structures.	K1, K2, K3, K4
CO2	use logical notations to define and reason about fundamental mathematical concept such as set relations and functions.	K2, K3, K4
CO3	formulate truth table for expressions involving the logical connectives :negation, conjunction, disconjunction, conditional and biconditional.	K3, K4, K6
CO4	find appropriate solutions accurately and efficiently	K5
CO5	extend their knowledge to pursue research using this field.	K3, K4, K5

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
                K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	2	2	3	3
CO2	2	3	2	2	1	2	3	3	3
CO3	3	2	2	3	3	3	3	2	1
CO4	3	3	1	3	2	3	1	3	1
CO5	1	2	3	2	2	2	3	2	3

        3 - Strongly Correlated;   2 - Moderately Correlated;
        1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	23P2MASEC2	**Skill Enhancement Course – NUMERICAL ANALYSIS PRACTICAL USING SCILAB**	3	2

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need		Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are:

> ➢ to give practical knowledge about MATLAB programming using SCILAB.
> ➢ to teach MATLAB command window and script files and how to use them in programming.
> ➢ to teach MATLAB Programming to get the solution of Numerical problems.

SYLLABUS CONTENT

1. Linear Regression
2. Trapezoidal rule of integration
3. Simpson's 1/3 rule of Integration
4. Newton Raphson method
5. Bisection method
6. Gauss Elimination method
7. Gauss seidal method
8. Lagrange Interpolation
9. Trigonometry Operations
10. Matrix Operations
11. Fibonacci series
12. Control structure
13. Logarithmic plot
14. Draw Lines Joining the Points in 2D Plot
15. Multiple plots on the same axis

Textbook:

1. ***"MATLAB An Introduction with Application"*** *by Amos Gilat, John Wiley & Sons, Singapore, 2011.*

References:
1. *"Introduction To Matlab For Engineering Students", David Houcque Northwestern University, (version 1.2, August 2005)*
2. *"Getting Started with MATLAB – A Quick Introduction for Scientists and Engineers" by R. Pratap, Oxford University Press, New Delhi, 2010.*
3. *"Introduction to MATLAB® for Engineers", William J. Palm III, University of Rhode Island, Mc Graw Hill, Third Edition, 2011.*

Web resources:
1. https://nptel.ac.in/courses/122106033
2. https://www.youtube.com/watch?v=83S48Fs9WhY
3. https://archive.nptel.ac.in/courses/103/106/103106118/
4. https://www.youtube.com/watch?v=qpZUQTjFk6Q

Pedagogy: Teaching / Learning methods:

Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar. Library, Net Surfing, NPTEL Course Materials, Use of Mathematical software.

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Understanding the MATLAB programming and apply to numerical integration problems.	K2, K3
CO2	Apply the knowledge of mathematical software MATLAB to solve real world problems efficiently.	K1, K3
CO3	Evaluate the Trigonometry problem and also analyze the control structure case problems.	K4, K5
CO4	Create the matrix operation problems and Apply the inverse method problems.	K3, K6
CO5	Extend their knowledge to pursue research using MATLAB	K6

Cognitive Level: K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	3	3	2
CO2	2	3	3	3	3	3	3	3	3
CO3	3	2	2	1	2	3	3	3	1
CO4	3	1	2	2	3	1	2	1	3
CO5	1	2	3	2	3	2	2	3	2

3 - Strongly Correlated;   2 - Moderately Correlated;
1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2MAAECC2**	**Ability Enhancement Compulsory Course - Language Lab**	**2**	**2**

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to national need	√	Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to regional need	√	Addresses Human Values	√
		Relevant to Global development need		Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are to:

To facilitate computer-assisted multi-media instruction enabling individualized and independent language learning
To sensitize students to the nuances of English speech sounds, word accent, intonation and rhythm
To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking
To improve the fluency of students in spoken English and neutralize their mother tongue influence
To train students to use language appropriately for public speaking and Interviews

Unit – I LSRW

Listening Skills: Introduction to Phonetics – Speech Sounds – Vowels and Consonants, Listen to News, poem, songs, Motivational speech, stories, movies, interesting facts, sign of zodiac, dialogues, idioms, dictation – Common errors

Speaking Skills: Stress, Intonation, Homophone, Silent Letters, Greetings, Small Talk, Telephone English, Role Play, Tongue Twisters, Welcome Speech & Vote of Thanks, Compering, Declamation, Sing Along, Brain Storming, JAM (Just A Minute)

Reading Skills: Reading test, Skit, Proof Reading, Oral Reading Fluency, Reading Stories,

Writing Skills: learn English Grammar through Tamil Translation, Reading Comprehension-short stories, informational passages, Advanced Critical reading – Intelligence Augmentation, Dialogues, Sentence Completion, Word Definition, Classic Analogy Bridges, Sentence Analogies, Same Sound, Divided Syllables, Finish the Story, Answering the questions, Practical Writing, Making a formal Argument, Free Writing, Using Precise Language

Unit – II Career and Soft Skills

Career Skills: Body Language (BL) : BL Interview, BL Model, BL Tips, Business English, Communication skills, GD, Interview Skills

Soft Skills: Assertiveness, Creativity, Critical Thinking and Problem Solving, Empathy, Enthusiasm and attitude, Goal Setting, Great interviews, Negotiation Skills, Personality Development, Professionalism, Self Esteem, Stress Management, Team Building, Time Management, Motivation and Attitude, Interpersonal relationship and skills, Networking,

Reference:
1. Materials prepared by the Department of English for Writing skills
2. Soft Skills – Know Yourself and know the world, Dr.K.Alex, Chand Publications, 3rd revised edition 2014
3. Software : Express Pro Lite

The **Language Lab** focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations both in formal and informal contexts.

Learning Outcomes: Students will be able to attain
☝ Better understanding of nuances of English language through audio- visual experience and group activities
☝ Neutralization of accent for intelligibility
☝ Speaking skills with clarity and confidence which in turn enhances their employability skills

Minimum Requirement of infrastructural facilities for Language Lab:

1. Computer Assisted Language Learning (CALL) Lab:
The **Computer Assisted Language Learning Lab** has to accommodate 40 students with 40 systems, with one Master Console, LAN facility and English language learning software for self- study by students.

System Requirement (Hardware component):
Computer network with LAN facility (minimum 40 systems with multimedia) with the following specifications:
i) Computers with Suitable Configuration
ii)High Fidelity Headphones

2. Interactive Communication Skills (ICS) Lab:
The **Interactive Communication Skills Lab:** A Spacious room with movable chairs and audio-visual aids with a Public-Address System, a LCD and a projector etc.

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	23P3MAC7	**COMPLEX ANALYSIS**	6	4

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to national need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to regional need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are to:

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

	SYLLABUS	
Unit	**Content**	**No. of Hours**
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 *Self-study**: The local Mapping – The Maximum Principle.	18
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.	18
III	**Evaluation of Definite Integrals and Harmonic Functions** Evaluation of definite integrals - Definition of Harmonic function and basic properties - Mean value property - Poisson formula.	18
IV	**Harmonic Functions and Power Series Expansions:** Schwarz theorem - The reflection principle - Weierstrass theorem – Taylor's Series – Laurent series .	18
V	**Partial Fractions and Entire Functions:** Partial fractions - Infinite products – Canonical products – Gamma Function- Jensen's formula – Hadamard's Theorem	18

*Note: Questions may be asked from the *Self-study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

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

Unit	Chapter	Sections
I	4	Section 2 : 2.1 to 2.3
	4	Section 3 : 3.1 to 3.2
II	4	Section 4 : 4.1 to 4.4
	4	Section 5: 5.1 and 5.2
III	4	Section 5 : 5.3
	4	Sections 6 : 6.1 to 6.3
IV	4	Sections 6.4 and 6.5
	5	Sections 1.1 to 1.3
V	5	Sections 2.1 to 2.4
	5	Sections 3.1 and 3.2

References:
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.

Web resources:
  http://mathforum.org,
  http://ocw.mit.edu/ocwweb/Mathematics,
  http://www.opensource.org ,
   http://en.wikipedia.org
Pedagogy: Teaching / Learning methods
  Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar. Library, Net Surfing, NPTEL Course Materials, Use of Mathematical software.

<div align="center">

Course Outcomes
</div>

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

CO Number	CO Statement	Cognitive Level
CO1	Analyze and evaluate local properties of analytical functions and definite integrals.	**K4, K5**
CO2	Describe the concept of definite integral and harmonic functions.	**K1, K2, K3**
CO3	Demonstrate the concept of the general form of Cauchy's theorem	**K3, K4, K6**
CO4	Develop Taylor and Laurent series .	**K3**
CO5	Explain the infinite products, canonical products and jensen's formula	**K3, K4, K5**

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
    K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	3	2	1
CO2	2	1	3	1	3	3	3	2	1
CO3	3	2	3	1	3	3	3	2	1
CO4	1	2	3	2	3	3	3	2	1
CO5	3	1	2	3	3	3	3	2	1

3 - Strongly Correlated;   2 - Moderately Correlated;
1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	**23P3MAC8**	**TOPOLOGY**	**5**	**4**

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to national need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to regional need	√	Addresses Human Values	
		Relevant to Global development need		Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are to:

study topological spaces, continuous functions, connectedness, compactness, countability and separation axioms.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**Topological spaces :** Topological spaces – Basis for a topology – The order topology – The product topology on $X \times Y$ – The subspace topology – Closed sets and limit points.	**15**
II	**Continuous functions:** Continuous functions – the product topology – The metric topology. *Self-study*: The Quotient topology	**15**
III	**Connectedness:** Connected spaces- connected subspaces of the Real line – Components and local connectedness.	**15**
IV	**Compactness :** Compact spaces – compact subspaces of the Real line – Limit Point Compactness – Local Compactness.	**15**
V	**Countability and Separation Axiom:** The Countability Axioms – The separation Axioms – Normal spaces – The Urysohn Lemma – The Urysohn metrization Theorem – The Tietz extension theorem.	**15**

*Note: Questions may be asked from the *Self-study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

Textbook:

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

Unit	Chapter	Sections
I	2	Sections 2.1 – 2.6
II	2	Sections 2.7 – 2.9
III	3	Sections 3.1 – 3.4
IV	3	Sections 3.5 – 3.8
V	4	Sections 4.1 – 4.4

References:
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

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

Pedagogy: Teaching / Learning methods

Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar. Library, Net Surfing, NPTEL Course Materials, Use of Mathematical software.

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Define and illustrate the concept of topological spaces and the basic definitions of open sets, neighbourhood, interior, exterior, closure and their axioms for defining topological space.	**K1, K3**
CO2	Understand continuity, compactness, connectedness, homeomorphism and topological properties.	**K1, K2,**
CO3	Analyze and apply the topological concepts in Functional Analysis.	**K3, K4, K6**
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.	**K3**
CO5	Develop qualitative tools to characterize connectedness, compactness, second countable, Hausdorff and develop tools to identify when two are equivalent(homeomorphic).	**K3, K4, K5**

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	3	2	1
CO2	2	1	3	1	3	2	3	2	1
CO3	3	2	3	1	3	3	2	3	2
CO4	1	2	3	2	3	3	3	3	2
CO5	3	1	2	3	3	3	3	2	1

3 - Strongly Correlated;   2 - Moderately Correlated;
1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	23P3MAC9	**MATHEMATICAL PYTHON**	5	4

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to national need		Addresses Environment and Sustainability	
Skill development Oriented		Relevant to regional need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are to:

1. introduce a useful scripting language
2. learn how to work with various data formats within Python
3. teach how to use lists, tuples and dictionaries in Python programs

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**Introduction to Python**: Introduction – Python Overview – Getting Started with Python –Comments – Python Identifiers – Reserved Keywords – Variables – Standard Data Types-**Operators:** Types of Operators - Statement and Expressions – String Operations.	15
II	Control Statements – Iteration While Statement – Input from Keyboard. **Functions:** Functions introduction – Built-in Functions – Composition of Functions – User defined Functions - Parameters and Arguments – Function Calls- The return statement – Python Recursive Functions.	15
III	**Strings and Lists:** Introduction about Strings and Lists- Strings - Lists. **Tuples and Dictionaries:** Tuples – Dictionaries.	15
IV	**Visualizing Data with Graphs:** Understanding the Cartesian Coordinate Plane – Working with List and Tuples – Creating Graphs with Matplotlib – Plotting with Formulas.	15
V	**Describing Data with Statistics:** Finding the Mean – Finding the Median – Finding the Mode and Creating a Frequency Table. **Algebra and Symbolic Math with SymPy:** Defining Symbols and Symbolic Operations – Working with Expressions – Solving Equations – Plotting using SymPy. *Self-Study*:* Measuring the Dispersion – Calculating the Correlation between Two Data Sets – Scatter Plots.	15

*Note: Questions may be asked from the *Self-study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

Textbook:

1. E. Balagurusamy, **"INTRODUCTION TO COMPUTING AND PROBLEM SOLVING USING PYTHON "**, McGraw-Hill Education (India) Private Limited, 1st edition (2017).
2. Amit Saha, **"DOING MATH WITH PYTHON**", 1st edition, no starch press.

Unit	Text Book	Chapter	Sections
I	1	3	3.1-3.11 Pg.no. (36 - 64)
II	1	3	3.13-3.15 Pg. no. (65 - 74)
		4	4.1-4.8 Pg. no. (82 - 98)
III	1	5	5.1-5.2 Pg.no. (112 - 132)
		6	6.1-6.2 Pg.no. (148 - 166)
IV	2	2	Pg.no. (43 - 73)
V	2	3	Pg.no. (82 - 93)
		4	Pg.no. (117 - 139)

References:

1. Fabio Nelli,"Python Data Analytics", Apress, Second Edition.
2. H. P. Langtangen, "A Primer on Scientific Programming with Python", Second edition, Springer, 2016.
3. Ashok Namdev Kamthane, , Amit Ashok Kamthane, "Programming and Problem Solving with Python", McGraw-Hill Education (India) Private Limited, Secon edition (2017).
4. Thomas Nield, "Essential Math for Data Science", O'Reilly Media (2022).

Web resources:

1. https://fangohr.github.io/python/book/Introduction-to-Python-for-Computational-Science-and-Engineering.pdf
2. https://sites.google.com/a/aicte-india.org/swayamrepo/big-data-analytics-for-smart-grid
3. https://youtu.be/sbGO9l83Ewg
4. https://wesmckinney.com/book/plotting-and-visualization.html

Pedagogy: Teaching / Learning methods

Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar. Library, Net Surfing, NPTEL Course Materials, Use of Mathematical software.

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	have an intermediate skill level of Python programming.	K2, K3
CO2	understand and apply the basic principles of Python programming	K2, K3
CO3	perform descriptive statistics, solve Equations and Expressions using Python.	K3, K4, K5
CO4	create data visualizations	K6
CO5	Get employability in developing coding, websites and software, task automation, data analytics and data visualization	K6

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	2
CO2	2	3	2	3	3	3	2	3	3
CO3	3	2	3	1	2	3	3	2	1
CO4	1	3	3	3	3	2	1	3	1
CO5	3	3	1	3	1	3	3	2	3

3 - Strongly Correlated;   2 - Moderately Correlated;
1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	23P3MACIM	**Core Industry Module – MATHEMATICS OF FINANCE AND INSURANCE**	5	3

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need		Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are:

The focus is on mathematical theory and modelling, drawing from the disciplines of Geometric Brownian Motion as a Limit of Simpler Models, Relations between Interest Rates and Present Value Analysis, Value at Risk and Conditional Value at Risk and to develop models for Stochastic Order Relations and Pricing Approximations via Multiperiod Binomial Models.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**Brownian Motion and Geometric Brownian Motion:** Brownian Motion - Brownian Motion as a Limit of Simpler Models - Geometric Brownian Motion - Geometric Brownian Motion as a Limit of Simpler Models - The Maximum Variable - The Cameron-Martin Theorem. **Interest Rates and Present Value Analysis:** Interest Rates - Present Value Analysis - Rate of Return - Continuously Varying Interest Rates.	15
II	**The Arbitrage Theorem:** The Arbitrage Theorem - The Multiperiod Binomial Model - Proof of the Arbitrage Theorem. **The Black–Scholes Formula**: Introduction - The Black–Scholes Formula - Properties of the Black–Scholes Option Cost - The Delta Hedging Arbitrage Strategy - Some Derivations - The Black–Scholes Formula - The Partial Derivatives. *** Self Study:** European Put Options**.**	15
III	**Valuing by Expected Utility:** Limitations of Arbitrage Pricing - Valuing Investments by Expected Utility - The Portfolio Selection Problem - Estimating Covariances - Value at Risk and Conditional Value at Risk - The Capital Assets Pricing Model - Rates of Return: Single-Period and Geometric Brownian Motion.	15

IV	**Stochastic Order Relations:** First-Order Stochastic Dominance - Using Coupling to Show Stochastic Dominance - Likelihood Ratio Ordering - A Single Period Investment Problem – Second Order Dominance - Normal Random Variables - More on Second Order Dominance	15
V	**Exotic Options:** Introduction - Barrier Options - Asian and Lookback Options - Monte Carlo Simulation - Pricing Exotic Options by Simulation - More Efficient Simulation Estimators - Options with Nonlinear Payoffs - Pricing Approximations via Multiperiod Binomial Models - Continuous Time Approximations of Barrier and Lookback Options.	15

*Note: Questions may be asked from the *Self-Study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

Textbook:
        1. Sheldon M. Ross, "An Elementary Introduction to Mathematical Finance", Third Edition, University of Southern California, Cambridge University Press, 2011.

Unit	Chapter	Sections
I	3 & 4	Sections 3.1 – 3.5 (Pages 34 – 46) & Sections 4.1 – 4.4 (Pages 48 - 67)
II	6 & 7	Sections 6.1 – 6.3 (Pages 92 -101) & Sections 7.1 -7.6 (Pages 106 – 127)
III	9	Sections 9.1 – 9.6 (Pages 165 – 189)
IV	10	Sections 10.1 – 10.5 (Pages 193 - 210)
V	13	Sections 13.1 – 13.9 (Pages 247 – 262)

General References:
  1. Salih N. Nettci, An introduction to the Mathematics of Financial Derivatives, Academic Press, Inc.
  2. Robert J.Ellicott and P.Ekkehardkopp, Mathematics of Financial Markets, Springer-Verlag, New York
  3. John C.Hull, Options, Futures and Other Derivatives, Prentice Hall of India Private Limited

Web resources:
  1. https://archive.nptel.ac.in/courses/111/103/111103126/
  2. https://www.youtube.com/watch?v=CffjpwKc_X4
  3. https://www.youtube.com/watch?v=lzMQ3hZqtp0

Pedagogy: Teaching / Learning methods:
        Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar, Library, Net Surfing, NPTEL Course Materials.

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Create and evaluate simple models for the Brownian Motion and Geometric Brownian Motion.	K5, K6
CO2	Understanding the Black–Scholes Option Cost models and applying the Multiperiod Binomial Model problems.	K2, K3
CO3	Analyzing the Value at Risk and Conditional Value at Risk models problems.	K3, K4
CO4	Evaluate a Single Period Investment Problem	K5
CO5	Design, build, investigate and evaluate Continuous Time Approximations of Barrier and Lookback Option methods.	K5

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	2	3	3	3
CO2	3	2	3	3	3	2	3	2	2
CO3	3	3	3	2	3	3	3	2	3
CO4	3	2	2	2	3	3	3	3	3
CO5	3	3	2	3	2	2	3	3	2

3 - Strongly Correlated;   2 - Moderately Correlated;
1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	23P3MAEDC	**Extra Disciplinary Course- MATHEMATICS FOR LIFE AND SOCIAL SCIENCES**	4	3

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need		Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are:

➢ to discuss various methods of Interpolation
➢ to provide a theoretical introduction and implementation of advanced optimization techniques in order to get best results from a set of several possible solutions of different problems viz. Assigment Problem, Replacement problem, game theory.

	SYLLABUS	
Unit	**Content**	**No. of Hours**
I	Interpolation with unequal intervals: Newton's divided difference formula - Lagrange's interpolation formula and inverse interpolation. (Only simple Problems)	**12**
II	Assignment problems - Assignment Algorithm – *Self-Study*: Assignment Algorithm*	**12**
III	Replacement problems (Only simple Problems)	**12**
IV	Decision Analysis- Decision Making problem – Decisions under uncertainty	**12**
V	Game Theory – Two person zero sum games – Graphical solution of 2xn and mx2 Games	**12**

*Note: Questions may be asked from the *Self-study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

Textbook:

1. **Numerical Methods** – P. Kandasamy, K. Thilagavathy, K. Gunavathy, S.Chand
2. **Operation Research 12th Edition 2004:** KanthiSwarap, P.K. Gupta and Manmohan, Sultan Chanda and sons, New Delhi

Unit	Text Book	Chapter	Sections
I	1	8	Sec: 8.5, 8.7 (pages 263-264,266-278)
II	2	11	Sec: 11.1 to 11.4(pages : 295-311)
III	2	18	Sec: 18.1 to18.3(pages 477-494)
IV	2	16	Sec: 16.1 to 16.5(pages 415-422)
V	2	17	Sec: 17.1 to 17.6(pages 443-456)

References:
1. *S.S. Sastry Introductory Methods of Numerical Analysis Prentice Hall of India 2000.*
2. *H.A. Taha Operation Research Prentice Hall of India 1995.*

Web resources:
1. https://web.stanford.edu/group/sisl/k12/optimization/#!index.md
   [Stanford University]

Pedagogy: Teaching / Learning methods
    Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar. Library, Net Surfing, NPTEL Course Materials, Use of Mathematical software.

Course Outcomes
On the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	Identity problems in Interpolation with equal and unequal intervals .	K2,K3,K4
CO2	Illustrate various Assigment problems.	K1,K2
CO3	understand the various techniques to solve Replacement Problems.	K3,K4
CO4	Extend their knowledge of basic optimization techniques to do interesting research work on Decision analysis	K3,K4,K6
CO5	Identify the challenging problems in modern mathematics and find their appropriate solutions	K4,K5

Cognitive Level: **K1 -** Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
                         K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3	3	3	3
CO2	2	2	3	3	2	3	3	3	3
CO3	3	2	3	3	2	1	3	2	3
CO4	1	3	2	2	3	2	1	3	3
CO5	3	2	3	1	1	3	3	3	3

    3 - Strongly Correlated;   2 - Moderately Correlated;
    1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	23P3MASEC3	**Skill Enhancement course – DATA ANALYTICS PRACTICAL WITH PYTHON**	3	2

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to national need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to regional need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are to:

1. learn how to design and program Python applications
2. impart the knowledge to create data visualization
3. teach to navigate practically through a data science carrier.

S. No.	Syllabus Content
1.	Write a Python program to a) Create a list and perform the following methods 1) insert() 2) remove() 3) append() 4) len() 5) pop() 6)clear(). b) Create a dictionary and apply the following methods 1) Print the dictionary items 2) access items 3) useget() 4)change values 5) use len().
2.	Write a python program to create a simple calculator.
3.	Write a python program to demonstrate the string methods.
4.	Write a python program to demonstrate the built-in list methods.
5.	Write a python program to define a function that prints a tuple whose values are the Cube of numbers between 1 1nd 10.
6.	**MATRIX OPERATIONS**: Write a Python program to do the following operations: Library: NumPy a) Create multi-dimensional arrays and find its shape and dimension b) Create a matrix full of zeros and ones c) Reshape and flatten data in the array d) Append data vertically and horizontally e) Apply indexing and slicing on array
7.	**LINEAR ALGEBRA ON MATRICES** Write a Python program to do the following operations: Library: NumPy a) Dot and matrix product of two arrays b) Compute the Eigen values of a matrix c) Solve a linear matrix equation such as $3 * x_0 + x_1 = 9$, $x_0 + 2 * x_1 = 8$ d) Compute the multiplicative inverse of a matrix e) Compute the rank of a matrix f) Compute the determinant of an array.
8.	**UNDERSTANDING DATA:** Write a Python program to do the following operations: Data set: brain_size.csv Library: Pandas a) Loading data from CSV file

	b) Compute the basic statistics of given data - shape, no. of columns, mean c) Splitting a data frame on values of categorical variables d) Visualize data using Scatter plot.
9.	**CLASSIFICATION – LOGISTIC REGRESSION:** Classification of Bank Marketing Data The data is related with direct marketing campaigns of a Portuguese banking institution. The marketing campaigns were based on phone calls. Often, more than one contact to the same client was required, in order to access if the product (bank term deposit) would be ('yes') or not ('no') subscribed. The dataset provides the bank customers information. It includes 41,188 records and 21 fields. The classification goal is to predict whether the client will subscribe (1/0) to a term deposit (variable y). Libraries: Pandas, NumPy, Sklearn, Seaborn Write a python program to a) Explore data and visualize each attribute b) Predict the test set results and find the accuracy of the model c) Visualize the confusion matrix d) Compute precision, recall, F-measure and support.
10.	**CLASSIFICATION – BAYESIAN NETWORK:** Predicting Loan Defaulters : A bank is concerned about the potential for loans not to be repaid. If previous loan default data can be used to predict which potential customers are liable to have problems repaying loans, these "bad risk" customers can either be declined a loan or offered alternative products. Dataset: The stream named bayes_bankloan.str, which references the data file named bankloan.sav. These files are available from the Demos directory of any IBM® SPSS® Modeler installation and can be accessed from the IBM SPSS Modeler program group on the Windows Start menu. The bayes_bankloan.str file is in the streams directory. a) Build Bayesian network model using existing loan default data b) Visualize Tree Augmented Naïve Bayes model a) Predict potential future defaulters, and looks at three different Bayesian network model types (TAN, Markov, Markov-FS) to establish the better predicting model.

Textbook:
1. E. Balagurusamy, "Introduction to Computing and Problem-Solving using Python ", McGraw-Hill Education (India) Private Limited, 1st edition (2017).
2. Thomas Nield, "Essential Math for Data Science", O'Reilly Media (2022).

References:
1. Fabio Nelli,"Python Data Analytics", Apress, Second Edition.
2. H. P. Langtangen, "A Primer on Scientific Programming with Python", Second edition, Springer, 2016.
3. Ashok Namdev Kamthane, , Amit Ashok Kamthane, "Programming and Problem Solving with Python", McGraw-Hill Education (India) Private Limited, Secon edition (2017).

Web resources:
1. **https://www.packtpub.com/product/python-data-analytics-and-visualization/9781788290098**
2. **https://youtu.be/oCoQm7Ro_ME**
3. **https://in.docs.wps.com/module/common/loadPlatform/?sid=sIFmo8KshhLiAoAY**

Pedagogy: Teaching / Learning methods

Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar. Library, Net Surfing, NPTEL Course Materials, Use of Mathematical software.

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	identify and apply machine learning algorithms.	**K2, K3**
CO2	use Python code and libraries to explore essential mathematical concepts.	**K3**
CO3	manipulate vectors and matrices	**K3, K5**
CO4	design and develop network applications using Python.	**K6**
CO5	understand and summarize different file handling operations	**K2, K4**

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	2
CO2	2	3	2	3	3	3	2	3	3
CO3	3	2	3	1	2	3	3	2	1
CO4	1	3	3	3	3	2	1	3	1
CO5	3	3	1	3	1	3	3	2	3

3 - Strongly Correlated;   2 - Moderately Correlated;
1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	23P3MAAECC3	Ability Enhancement Compulsory Course - RESEARCH METHODOLOGY	2	2

Nature of the course

Employability Oriented		Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are:

1. To enable the students to write research reports and thesis
2. To enhance the techniques of scientific documentation
3. To create awareness about research tools like citations and bibliographies

SYLLABUS		
Unit	Content	No. of Hours
I	**Tables, figures and paper format** Tables and figures – General issues – Tables - Figures – Paper format and submission – General format requirements – Format requirements for specific elements.	15
II	**Source Citation** General introduction to citation practices – Reasons for citing your sources – The requirements of citation – Two citation styles – Citation of electronic sources – Preparation of citations – A word on citation software – Bibliography Style: The basic form – Basic Patterns – Bibliographies – Notes – Short forms for notes.	15

Textbook:

     Kate L. Turabian, *A manual for writers of research papers, theses and dissertations* (seventh edition) The University of Chicago Press, Chicago, 2007.

Unit	Chapter	Sections
I	26	Sections 26.1 to 26.3
	Appendix	Sections A.1 to A.2
II	15	Sections 15.1 to 15.6
	16	Sections 16.1 to 16.4

General References:

1. Jonathan Anderson and Millicent Poole, Assignment and thesis writing, Fourth Edition, Wiley eastern ltd, 2002.
2. C. R. Kothari, Research Methodology – Methods and Techniques, Second Edition, New age international publishers, New Delhi, 2004.

Web resources:
1. http://jcs.edu.au/wp-content/uploads/2016/09/A-manual-for-writers-of-research-papers-theses-and-dissertations.pdf
2. https://www.academia.edu/43821533/Research_Methodology_by_C_R_Kothari
3. https://www.cambridgescholars.com/resources/pdfs/978-1-5275-3681-4-sample.pdf

Pedagogy: Teaching / Learning methods:
Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar. Library, Net Surfing, Use of Mathematical software.

Course Outcomes
On the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	Produce their thesis in good quality	K6
CO2	Prepare a research Proposal	K6
CO3	Apply appropriate research tools	K3
CO4	Summarize their findings and compile their thesis	K2, K5
CO5	Find suitable source of information and acknowledge them in their research report	K1

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	3	2	1
CO2	2	2	3	2	3	3	3	2	1
CO3	3	2	3	1	3	3	2	3	2
CO4	3	2	1	2	3	3	3	2	1
CO5	3	1	2	3	3	3	3	2	1

3 - Strongly Correlated;   2 - Moderately Correlated;
1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
IV	23P4MAC10	**FUNCTIONAL ANALYSIS**	5	4

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to national need		Addresses Environment and Sustainability	
Skill development Oriented		Relevant to regional need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are 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.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**UNIT-I :**Banach Spaces: The definition and some examples – Continuous linear transformations – The Hahn-Banach theorem – The natural imbedding of N in N^{**}- The open mapping theorem – The conjugate of an Operator.	15
II	**UNIT-II :**Hilbert Spaces: The definition and some simple properties– Orthogonal complements–Ortho normal sets–The conjugate space H^* - The adjoint of an operator – self-adjoint operators. *Self-study* *: Normal and unitary operators – Projections.	15
III	**UNIT-III :** Finite-Dimensional Spectral Theory: Matrices – Determinants and the spectrum of an operator –The spectral theorem.	15
IV	**UNIT-IV :** General Preliminaries on Banach Algebras**:** The definition and some examples – Regular and singular elements – Topological divisors of zero – The spectrum – The formula for the spectral radius– The radical and semi-simplicity.	15
V	**UNIT-V:** The Structure of Commutative Banach Algebras: The Gelfand mapping – Application of the formula $r(x) = \lim \|x^n\|^{1/n}$ – Involutions in Banach algebras-The Gelfand-Neumark theorem.	15

*Note: Questions may be asked from the *Self-study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

Textbook:

G.F.Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Education (India) Private Limited, New Delhi, 1963.

Unit	Chapter	Sections
I	9	Sections 46-51
II	10	Sections 52-57
III	11	Sections 60-62
IV	12	Sections 64-69
V	13	Sections 70-73

References:

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.

Web resources:

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

Pedagogy: Teaching / Learning methods

Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar. Library, Net Surfing, NPTEL Course Materials, Use of Mathematical software.

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Understand the Banach spaces and Transformations on Banach Spaces	**K1, K2**
CO2	Prove Hahn Banach theorem and open mapping theorem.	**K2, K3**
CO3	Describe operators and fundamental theorems.	**K3, K4,**
CO4	Validate orthogonal and orthonormal sets	**K5**
CO5	Analyze and establish the regular and singular elements	**K4, K6**

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	3	2	1
CO2	2	1	3	1	3	3	3	2	1
CO3	3	2	3	1	3	3	3	2	1
CO4	1	2	3	2	3	3	3	2	1
CO5	3	1	2	3	3	3	3	2	1

3 - Strongly Correlated;   2 - Moderately Correlated;
1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
IV	23P4MAC11	**DIFFERENTIAL GEOMETRY**	5	4

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to national need		Addresses Environment and Sustainability	
Skill development Oriented		Relevant to regional need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are to:

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

Unit	Content	No. of Hours
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- Helices.	15
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.	15
III	**Geodesics:** Geodesics – Canonical geodesic equations – Normal property of geodesics- Existence Theorems – Geodesic parallels – Geodesics curvature- Gauss- Bonnet Theorem – Gaussian curvature- *Self-study* *: Surface of constant curvature.	15
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.	15
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.	15

*Note: Questions may be asked from the *Self-study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

Textbook:

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

Unit	Chapter	Sections
I	I	Sections 1 to 9.
II	II	Sections 1 to 9.
III	II	Sections 10 to 17.
IV	III	Sections 1 to 8.
V	IV	Sections 1 to 8.

References:
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.

Web resources:
   http://mathforum.org,
   http://ocw.mit.edu/ocwweb/Mathematics,
   http://www.opensource.org,
   www.physicsforum.com

Pedagogy: Teaching / Learning methods
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Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Explain space curves, Curves between surfaces, metrics on a surface, fundamental form of a surface and Geodesics.	**K1, K2**
CO2	Evaluate these concepts with related examples.	**K3, K5**
CO3	Compose problems on geodesics.	**K3, K4,**
CO4	Recognize applicability of developable.	**K5**
CO5	Construct and analyze the problems on curvature and minimal surfaces	**K4, K6**

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
         K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	3	2	1
CO2	2	1	3	1	3	3	3	2	1
CO3	3	2	3	1	3	3	3	2	1
CO4	1	2	3	2	3	3	3	2	1
CO5	3	1	2	3	3	3	3	2	1

   3 - Strongly Correlated;   2 - Moderately Correlated;
   1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
IV	23P4MAC12	**MECHANICS**	5	4

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to national need		Addresses Environment and Sustainability	
Skill development Oriented		Relevant to regional need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are to:

study mechanical systems under generalized coordinate systems, virtual work, energy and momentum, to study mechanics developed by Newton, Langrange, Hamilton Jacobi and Theory of Relativity due to Einstein.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**UNIT-I :** Mechanical Systems : The Mechanical system- Generalised coordinates – Constraints - Virtual work - Energy and Momentum	15
II	**UNIT-II :** Lagrange's Equations: Derivation of Lagrange's equations- Examples- Integrals of motion. *Self-study*: Natural systems, Liouville's system*	15
III	**UNIT-III** : Hamilton's Equations : Hamilton's Principle - Hamilton's Equation - Other variational principle.	15
IV	**UNIT – IV :** Hamilton-Jacobi Theory : Hamilton Principle function – Hamilton-Jacobi Equation - Separability	15
V	**UNIT-V :** Canonical Transformation : Differential forms and generating functions – Special Transformations– Lagrange and Poisson brackets.	15

*Note: Questions may be asked from the *Self-study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

Textbook:
    D. Greenwood, *Classical Dynamics*, Prentice Hall of India, New Delhi, 1985.

Unit	Chapter	Sections
I	1	Sections 1.1 to 1.5
II	2	Sections 2.1 to 2.3
III	4	Sections 4.1 to 4.3
IV	5	Sections 5.1 to 5.3
V	6	Sections 6.1, 6.2 and 6.3

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

Web resources:
  http://mathforum.org,
  http://ocw.mit.edu/ocwweb/Mathematics,
  http://www.opensource.org,
  www.physicsforum.com

Pedagogy: Teaching / Learning methods
Chalk and Board, Virtual Class room, LCD projector, Video Conference, Guest Lectures, Tutorial, Assignment, Seminar. Library, Net Surfing, NPTEL Course Materials, Use of Mathematical software.

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Demonstrate the knowledge of core principles in mechanics.	K1, K2
CO2	Interpret and consider complex problems of classical dynamics in a systematic way.	K3, K5
CO3	Apply the variation principle for real physical situations	K3, K4,
CO4	Explore different applications of these concepts in the mechanical and electromagnetic fields.	K5
CO5	Describe and apply the concept of Angular momentum, Kinetic energy and Moment of inertia of a particle	K3, K6

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	3	2	1
CO2	2	1	3	1	3	3	3	2	1
CO3	3	2	3	1	3	3	3	2	1
CO4	1	2	3	2	3	3	3	2	1
CO5	3	1	2	3	3	3	3	2	1

3 - Strongly Correlated;   2 - Moderately Correlated;
1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
IV	23P4MAEL5A	**Major Elective – V** **RESOURCE MANAGEMENT TECHNIQUES**	5	3

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are to:

1. To introduce basic optimization techniques in order to get best results from a set of several possible solutions of different problems like unconstrained and constrained problems etc.
2. To teach the formulation of real world phenomena from its physical considerations and implementation of optimization algorithms for solving these problems.
3. To equip the knowledge of various types of Queuing Problem

Unit	Content	No. of Hours
I	**Sequencing problems:** Introduction – Optimal sequence algorithm – n jobs and two machines – n jobs and m machines – solved problems – two job and m machines. *Self-Study***:** Maintenance Scheduling, Network Scheduling	15
II	**Dynamic programming**: Introduction - Recursive relationship – Dynamic programming algorithms – solved problems – Solution of L.P.P. by Dynamic programming.	15
III	**Replacement Theory:** Introduction – Replacement policy for equipment which deteriorates gradually – Replacement of items that fail suddenly – Problems in mortality and staffing – Solved problems.	15
IV	**Queuing Theory:** Introduction – Classification of Queues - Queuing Problems - (M/M/1): (∞/FCFS) – (M/M/1): (N/FCFS) – (M/M/C): (∞/FCFS) – (M/M/C): (N/FCFS) – solved problems of the above types.	15
V	**Inventory Control**: Introduction – Deterministic models – purchasing problem with no shortages – production problems with no shortages - purchasing problem with shortages – production problems with shortages – EOQ system of ordering – Purchase problem with price breaks – Probabilistic models – solved problems.	15

*Note: Questions may be asked from the *Self-study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

Textbook:

Problem in operations Research, PK Gupta & ManMohan, Fourteenth Edition, Sulthan Chand & Sons, New Delhi, 2014.

Unit	Chapter	Pages
I	Chapter 17	383 – 399
II	Chapter 18	409 – 428
III	Chapter 24	619 – 630
IV	Chapter 22	535 – 556
V	Chapter 23	571 – 600

References:
1. *Operations Research – An Introduction – H.A. Taha – Prentice Hall Publication.*
2. *Operations Research – S.D. Sharma – Kedarnath Ramnath & Co.,*
3. *Operations Research – PK. Gupta and D.S. Hira – Sultan Chand & Sons.*
4. *Operations Research – Pathak H. K, Pradeep K Joshi and Sharma. C, Shree Shiksha Sahitya Prakashan, Meerut, Second edition, 2022*

Web resources:
1. http://www.drps.ed.ac.uk/18-19/dpt/cxmath11194.htm [The University of Edinburgh]
2. maths.cam.ac.uk/undergrad/files/schedules.pdf [University of Cambridge]

Pedagogy: Teaching / Learning methods
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Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	formulate an optimization problem from its physical consideration.	**K2, K3**
CO2	select and implement an appropriate optimization technique keeping in mind its limitations in order to solve a particular optimization problem.	**K1, K3, K4**
CO3	construct and analyze priority queuing systems	**K4, K5**
CO4	extend their knowledge of basic optimization techniques to do interesting research work on these types of optimization techniques.	**K2, K3**
CO5	acquire the knowledge to write NET/ SET/ PG TRB competitive exams	**K5, K6**

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
          K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	3	3	3
CO2	2	1	3	1	3	3	2	3	3
CO3	3	2	2	1	2	3	3	2	3
CO4	1	2	3	2	3	2	3	1	2
CO5	3	1	2	3	3	1	2	2	1

     3 - Strongly Correlated;   2 - Moderately Correlated;
     1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
IV	23P4MAEL5B	**Major Elective – V** **DESIGN AND ANALYSIS OF ALGORITHMS**	5	3

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are to:

➢ impart the knowledge of design analysis of algorithms which is the core of computer science.
➢ teach the asymptotic performance of algorithms.
➢ demonstrate a familiarity with major algorithms and data structures.
➢ teach important algorithmic design paradigms and methods of analysis.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**Introduction:** What is an algorithm? - Algorithm specification- Performance analysis- Randomized algorithms.	15
II	**Elementary data structures:** Stacks and Queues- Trees- Dictionaries- Priority Queues- Graph representations.	15
III	**Design of algorithm methods:** Divided- And- Conquer- General method- Binary search- finding the maximum and minimum in a set of items- Merge sort- Quick sort.	15
IV	**Design of algorithm methods continuation:** The Greedy method- The general method- Tree vertex Splitting Problem- Tree traversal and search techniques- Techniques for Binary trees- Techniques for Graphs- Breadth first search and depth first search traversal- Connected components and spanning trees- Backtracking- General method- the 8- Queens Problem *Self-study*:* Branch and Bound method- Travelling sales person algorithm.	15
V	**Algebraic problems:** Algebraic problems- The general method- Evaluation and Interpolation- The Fast Fourier transform- Modular arithmetic- Even faster evaluation and interpolation	15

*Note: Questions may be asked from the *Self-study* content for only CIA test (Mid and End semesters) and **NOT** for the external (Semester Examinations)

Textbook:

     Fundamentals of Computer Algorithm, Eills Horowitz, SartajShani and Sanguthevar Rajasekaran, Galgotia Publications Pvt Ltd, 2000.

Unit	Chapter	Sections
I	1	sections; 1.1, 1.2, 1.3.1 to 1.3.4, 1.4.1 to 1.4.3
II	2	section: 2.1 to 2.4, 2.6
III	3	sections 3.1 to 3.5
IV	4 6 7 8	sections 4.1, 4.3 sections 6.1 to 6.3 sections 7.1, 7.2 sections 8.1, 8.3
V	9	sections 9.1 to 9.5

References:
1. *Aho A.V., Hopcroft, J.E. and Ullman, J.D.: The Design and Analysis of Computer Algorithms. Additor Wesley Reading Mass (1974)*
2. *Goodman, S.E and Hedetniemi, S.T.: Introduction to the design and analysis of algorithms (McGraw Hill international Edition 1987).*

Web resources:
   http://mathforum.org,
   http://ocw.mit.edu/ocwweb/Mathematics,
   http://www.opensource.org,
   www.physicsforum.com

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Course Outcomes
On the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	formulate an optimization problem from its physical consideration.	**K2, K3**
CO2	select and implement an appropriate optimization technique keeping in mind its limitations in order to solve a particular optimization problem.	**K1, K3, K4**
CO3	construct and analyze priority queuing systems	**K4, K5**
CO4	extend their knowledge of basic optimization techniques to do interesting research work on these types of optimization techniques.	**K2, K3**
CO5	acquire the knowledge to write NET/ SET/ PG TRB competitive exams	**K5, K6**

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
   K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	3	3	3
CO2	2	1	3	1	3	3	2	3	3
CO3	3	2	2	1	2	3	3	2	3
CO4	1	2	3	2	3	2	3	1	2
CO5	3	1	2	3	3	1	2	2	1

   3 - Strongly Correlated;   2 - Moderately Correlated;
   1 - Weakly Correlated;   0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
IV	23P4MASEC4	**Skill Enhancement course – MATHEMATICAL DOCUMENTATIONS USING LATEX - PRACTICAL**	3	2

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented		Relevant to national need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are:

1. To understand the features of LaTeX, for the preparation of high quality documents
2. To handle mathematical symbols and equations in a document easily
3. To make scientific articles and project reports

SYLLABUS		
S. No.	**Content**	**No. of Hours**
1	Installation of Miktex and Texstudio	3
2	Document class, Page style and Page numbering	3
3	Formatting lengths, Parts of a document and dividing a document	3
4	Table of contents, Index and Glossary	3
5	Making lists	3
6	Rows, Columns and Keeping tabs	3
7	Tables	3
8	Equations, Symbols and Operators	3
9	Matrices, dots and Delimiters	3
10	Designer Theorems	3
11	The figure environment	3
12	Creating a bibliographic database	3

13	Cross references	3
14	Footnotes, Margin pars and Endnotes	3
15	Creating a research report	3

References:
1. Latex tutorials – a primer, Indian Tex users group (Edited by E. Krishnan), 2003
2. Stefan Kottwitz, Latex – Beginner's guide, Packt Publishing, Birmingham, Mumbai, 2011

Web resources:
1. http://www.gang.umass.edu/~franz/latexmanual.pdf
2. https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf

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Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Create high-quality and professional looking documents	K6
CO2	Use Latex to type complicated mathematical equations	K3
CO3	Design texts, articles and books for business and science	K6
CO4	Choose appropriate commands to design the documents	K5
CO5	Demonstrate the significance of Latex in preparing documents	K2

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
           K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	1	3	2	3	3	3	2	1
CO2	2	2	3	2	3	3	3	2	2
CO3	3	2	3	1	3	3	2	3	1
CO4	3	2	1	2	3	2	3	2	2
CO5	3	2	2	3	1	3	3	2	1

   3 - Strongly Correlated;   2 - Moderately Correlated;
   1 - Weakly Correlated;   0 – No correlation