B.Sc. MATHEMATICS

(Effective from the academic year 2024 - 2025)

Vision of the Department:

To enhance the logical reasoning, analytical thinking and problem-solving skills of the students and prepare them to be lifelong learners who will be socially responsible to navigate the complexities of a rapidly changing society.

Objectives:

- To provide an in-depth knowledge in Mathematics.
- To acquire skill and competency in practical.
- To expose the students to the recent trends in Mathematics and related sciences.
- To motivate the students for life-long learning and train students towards research.
- To train economically backward students and make them eligible for higher education and job opportunities.
- To tap out the talents through extracurricular and co-curricular activities.
- To get sensitized to social and environmental realities.

Eligibility for admission to B.Sc. Mathematics:

- A pass in higher secondary with Mathematics, Physics, Chemistry and Biology (Category I).
- A pass in higher secondary with Mathematics, Physics, Chemistry and Computer Science (Category II).

Allied Subjects:

1. Physics
2. Mathematical Statistics

Eligibility to take Allied Subjects:

Students who belong to category I and II are eligible to take both the Allied papers.

Highlights of the Revamped Curriculum:

- Student-centric, meeting the demands of industry & society, incorporating industrial components, hands-on training, skill enhancement modules, industrial project, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the core components and incorporating application-oriented content wherever required.

- The Core subjects include latest developments in the education and scientific front, practical training, catering to the needs of stakeholders with research aptitude.

- The curriculum is designed to strengthen the industry-academia interface and provide more job opportunities for the students.

- The Internship during the second-year vacation will help the students gain valuable work experience that connects classroom knowledge to real world experience and to narrow down and focus on the career path.

- State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature are incorporated as Elective and Skill Enhancement Courses, covering conventional topics to the application oriented.

Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome / Benefits
I	**Foundation Course in Mathematics** To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning Mathematics and its concepts.	• Instil confidence among students • Create interest for the subject
II, III & IV	**Skill Enhancement papers** (Discipline centric/ Generic / Entrepreneurial)	• Industry ready graduates • Skilled human resource • Students are equipped with essential skills to make them employable
		• Entrepreneurial skill training will provide an opportunity for independent livelihood • Generates self – employment • Create small scale entrepreneurs • Skill training to girls leads to women empowerment
		• Discipline centric skill will improve the technical knowhow of solving real life problems
I, II, III, IV, V & VI	Elective papers- An open choice of topics categorized under Generic and Discipline Centric	• Strengthening the domain knowledge • Introducing the stakeholders to the state-of art techniques from the

		streams of multi-disciplinary, cross disciplinary and inter disciplinary nature • Emerging topics related to industry are introduced to facilitate advanced learning in the respective domains
II Year Vacation activity	Internship / Industrial Training	• Practical training at the Industry/ Educational institutions, enable the students gain professional experience and become responsible citizens.
VI Semester	Introduction of Professional Competency component	• 'General Awareness for Competitive Examinations' caters to the needs of the aspirants towards most sought - after services of the nation viz, UPSC, ISS, CDS, NDA, Banking Services, CAT, TNPSC group services, etc.

Skills acquired from the Courses	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

TANSCHE BASED PROGRAMME STRUCTURE FOR B.Sc. MATHEMATICS
(For the candidates admitted from the academic year 2024-2025)

Sem	Part	Category	Course Code	Course Title	Hours/ Week	Exam Hours		Credits	Marks
						Th	Pr		
I	I	Tamil/ Language	ULTAA24	Tamil Paper – I	5	3	-	3	40+60
	II	English	UENGA24	English Paper – I	6	3	-	3	40+60
	III	Core Course I	UCMAA24	Algebra and Trigonometry	4	3	-	4	40+60
		Core Course II	UCMAB24	Differential Calculus	4	3	-	4	40+60
		Generic Elective I	UAPHA24	Allied Physics - I	4	3	-	3	40+60
			UAPHB24	Allied Physics Practical	2	-	3	2	40+60
	IV	Foundation Course (FC)	UFMA24	FC: Bridge Mathematics	2	2	-	2	40+60
		Skill Enhancement Course (SEC-1)	USMA124	SEC: Office Automation	2	-	2	2	100
		Value Education	UVEDA22*	Value Education	1	-	-	-	-
				Total	**30**			**23**	**800**
II	I	Tamil/ Language	ULTAB24	Tamil Paper – II	6	3	-	3	40+60
	II	English	UENGB24	English Paper – II	5	3	-	3	40+60
	III	Core Course III	UCMAC24	Analytical Geometry (Two & Three Dimensions)	4	3	-	4	40+60
		Core Course IV	UCMAD24	Integral Calculus	4	3	-	4	40+60
		Generic Elective II	UAPHC24	Allied Physics - II	4	3	-	3	40+60
			UAPHD24	Allied Physics Practical	2	-	3	2	40+60
	IV	Skill Enhancement Course (SEC-2)	USMA224	SEC: Computational Mathematics	2	-	2	2	100
		Skill Enhancement Course (SEC-3)	USMA324	SEC: Problem Solving Techniques	2	-	2	2	100
		Value Education	UVEDA22**	Value Education	1	-	-	-	-
				Total	**30**			**21**	**800**
III	I	Tamil/ Language	ULTAC24	Tamil Paper - III	5	3	-	3	40+60
	II	English	UENGC24	English Paper - III	6	3	-	3	40+60
	III	Core Course V	UCMAE24	Vector Calculus and its Applications	5	3	-	5	40+60
		Core Course VI	UCMAF24	Differential Equations and Applications	5	3	-	5	40+60
		Discipline Specific Elective I	UAMSA24	Allied III: Mathematical Statistics	4	3	-	3	40+60
	IV	Skill Enhancement Course (SEC-4)	USMA424	SEC: Statistics with R	2	-	2	2	100
		Skill Enhancement Course (SEC-5)	USMA524	SEC: Quick Math-I	1	1	-	1	100
		EVS	UNEVS24*	Environmental Studies	1	-	-	-	-
		Value Education	UVEDA22***	Value Education	1	-	-	-	-
				Total	**30**			**22**	700

Sem	Part	Category	*Course Code*	Course Title	Hours/ Week	Exam Hours		Credits	Marks
						Th	Pr		
IV	I	Tamil/ Language	ULTAD24	Tamil Paper - IV	6	3	-	3	40+60
	II	English	UENGD24	English Paper - IV	5	3	-	3	40+60
	III	Core Course VII	UCMAG24	Industrial Statistics	5	3	-	5	40+60
		Core Course VIII	UCMAH24	Elements of Mathematical Analysis	5	3	-	5	40+60
		Discipline Specific Elective II	UANMA24	Allied IV: Numerical Methods and Transforms	4	3	-	4	40+60
	IV	Skill Enhancement Course (SEC-6)	USMA624	Numerical Methods Practical	2	3	-	2	100
		Skill Enhancement Course (SEC-7)	USMA724	Quick Math-II	1	1	-	1	100
		EVS	UNEVS24	Environmental Studies	1	2	-	2	40+60
		Value Education	UVEDA22****	Value Education	1	-	-	-	-
				Total	**30**			**25**	800
V	III	Core Course IX	UCMAI24	Abstract Algebra	5	3	-	4	40+60
		Core Course X	UCMAJ24	Real Analysis	5	3	-	4	40+60
		Core Course XI	UCMAK24	Mathematical Modeling	5	3	-	4	40+60
		Core Course XII	UCMAL24	Optimization Techniques	5	3	-	4	40+60
		Discipline Specific Elective III	UEMAA24 / UEMAB24	Graph Theory and Applications / Number Theory	4	3	-	3	40+60
		Generic Elective III	UEMAC24	Programming in C	3	3	-	2	40+60
			UEMAD24	Elective Practical : C	2	-	3	1	40+60
	IV	Value Education	UVEDA22*****	Value Education	1	-	-	-	-
		Summer Internship/Industrial Training	UIMA24	Internship	-	-	-	2	100
				Total	**30**			**24**	**800**
VI	III	Core Course XIII	UCMAL24	Linear Algebra	6	3	-	4	40+60
		Core Course XIV	UCMAM24	Complex Analysis	6	3	-	4	40+60
		Core Course XV	UCMAN24	Mechanics	6	3	-	4	40+60
		Discipline Specific Elective IV	UEMAE24 / UEMAF24	Fuzzy Sets & its Applications / Discrete Mathematics	4	3	-	3	40+60
		Generic Elective IV	UEMAG24	Object Oriented Programming Using C++	3	3	-	2	40+60
			UEMAH24	Elective Practical :C++	2	-	3	1	40+60
		Professional Competency (SEC-8)	UPMA24	Mathematics for Completive Examinations	2	2	-	2	40+60
	IV		UVEDA22	Value Education	1		-	2	40+60
	V	Extension Activities			-	-	-	1	-
				Total	**30**			**23**	**800**
				Grand Total				**140**	**4800/ 4600**

- Any one course of the following to be completed during III semester (15 hours teaching and 15 hours activities):
  i) Fundamentals of Computer and MS Office (Computer Science & B.C.A)
    - Advanced Excel
    - Multimedia Using Flash
    - Photoshop
  ii) Health and Fitness (Physical Education)

Methods of Evaluation						
S. No.	**Category**	**Assessment Tool**	**Maximum Marks**	**Exam Theory**	**Weightage**	
1	Core Courses/Generic & Discipline Specific Electives/Allied	I Continuous Assessment (ICA)	50	1 ½ h	35	40
		II Continuous Assessment (IICA)	50	1 ½ h		
		Innovative Component (IC)	5	-	5	
		End Semester Examination	100	3 h		60
2	Foundation Course/Professional Competency	I Continuous Assessment (ICA)	30	1 h	35	40
		II Continuous Assessment (IICA)	30	1 h		
		Innovative Component (IC)	5	-	5	
		End Semester Examination	60	2 h		60
3	EVS	Continuous Assessment (IICA)	25	1 h		40
		Innovative Component (IC)	25	-		
		End Semester Examination	60	2 h		60

Activity-based Assessment for Skill Enhancement Courses:

Activity 1 for Unit I: (Nature of Activity-Lab practice) – 20 marks
Activity 2 for Unit II: (Nature of Activity-Lab practice) – 20 marks
Activity 3 for Unit III: (Nature of Activity-Lab practice) – 20 marks
Activity 4 for Unit IV: (Nature of Activity-Lab practice) – 20 marks
Activity 5 for Unit V: (Nature of Activity-Lab practice) – 20 marks

Nature of Activity – Field visit/Industrial visit/Project (individual or group)/Exhibits/Model making/Hands on training/Lab practice/Product making/Extempore/Block and Tackle/Debate/Report writing/Case study/Interpretation of data or results/Transcription/Quiz (LMS)/Problem solving/ Designing/Role play/Start-up proposal/Research proposal/Poster presentation/Oral presentation (live or video recorded)/Survey (Field or Online)/Group discussion/Problem solving/Problem formulation/Interviews/Concept mapping/Mind mapping /Promoting public awareness etc.

Record of Assessment will be maintained by the course instructors and verified by the Head of the department.

Cognitive Levels of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, short summary or overview
Application (K3)	Suggest idea/concept with examples, suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

PROGRAMME OUTCOMES (PO)

On completion of the UG Programme, the students will be able to:

PO1: Attain knowledge and understand the principles and concepts in the respective discipline.

PO2: Acquire and apply analytical, critical and creative thinking, and problem solving skills

PO3: Effectively communicate general and discipline-specific information, ideas and opinions.

PO4: Appreciate biodiversity and enhance eco-consciousness for sustainable development of the society.

PO5: Emulate positive social values and exercise leadership qualities and team work.

PO6: Pursue higher knowledge, qualify professionally, enhance entrepreneurial skills and contribute towards the needs of the society.

PROGRAMME SPECIFIC OUTCOMES (PSO)

On completion of the UG Programme in Chemistry, the students will be able to:

PSO1: Disciplinary knowledge

Capability to demonstrate comprehensive knowledge of Mathematics and understand one or more disciplines which form a part of an undergraduate programme of study.

PSO2: Communication skills

i. Ability to communicate various concepts of mathematics effectively using examples and their geometrical visualizations.
ii. Ability to use mathematics as a precise language of communication in other branches of human knowledge and communicate long standing unsolved problems in mathematics.
iii. Ability to show the importance of mathematics as precursor to various scientific developments since the beginning of the civilization.

iv. Ability to explain the development of mathematics in the civilizational context and its role as queen of all sciences.

PSO3: Critical thinking

Ability to employ critical thinking in understanding the concepts in every area of Mathematics.

PSO4: Analytical thinking

Ability to analyze the results and apply them in various problems appearing in different branches of mathematics.

PSO5: Problem solving

i. Capability to solve problems in computer graphics using concepts of linear algebra.
ii. Capability to solve various models such as growth and decay models, radioactive decay model, drug assimilation, LCR circuits and population models using techniques of differential equations.
iii. Ability to solve linear system of equations, linear programming problems & network flow problems.
iv. Ability to provide new solutions using the domain knowledge of mathematics.

PSO6: Digital literacy

i. Capability to understand and apply the programming concepts of C and C++ to mathematical investigations and problem solving.

ii. Capability to understand and apply the programming concepts of R to statistical investigations and problem solving.

PSO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
PSO1	H	H	H	M	L	H
PSO2	H	H	H	L	M	H
PSO3	H	H	H	L	M	H
PSO4	H	H	H	M	L	H
PSO5	H	H	H	M	L	H
PSO6	H	H	H	M	H	H

(L-Low (1), M-Moderate (2), H-High (3))

Consolidated Semester wise and Component wise Credit distribution

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part I	3	3	3	3	-	-	12
Part II	3	3	3	3	-	-	12
Part III	13	13	13	14	22	18	93
Part IV	4	4	3	5	2	4	22
Part V	-	-	-	-	-	1	1
Other	-	-	2	-	-	-	2
Total	23	23	23	25	24	23	**142**

Part I, II, and Part III components will be separately considered for CGPA calculation and classification for the undergraduate programme and the other components. IV, V must be completed during the duration of the programme as per the norms, to be eligible for obtaining the UG degree.

<table>
<tr><td>Title of the Course</td><td colspan="8">ALGEBRA AND TRIGONOMETRY</td></tr>
<tr><td>Paper No.</td><td colspan="8">Core I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>4</td><td>Course Code</td><td colspan="2">UCMAA24</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="3">4</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="8">• Basic ideas on the Theory of Equations, Matrices and Number Theory.
• Knowledge to find expansions of trigonometry functions, solve theoretical and applied problems.</td></tr>
<tr><td>Course Outline</td><td colspan="8">UNIT I (12 hours) (K1, K2, K3 & K4)
Theory of Equations
1.1 Reciprocal Equations
1.2 Standard forms
1.3 Increasing the roots of a given equation
1.4 Decreasing the roots of a given equation
1.5 Removal of terms
1.6 Approximate solutions of roots of polynomials by Horner’s method</td></tr>
<tr><td></td><td colspan="8">Unit II (12 hours) (K1, K2, K3 & K4)
Series
2.1 Summation of Series – Introduction
2.2 Summation of Series: Binomial
2.3 Summation of Series: Exponential
2.4 Summation of Series: Logarithmic series (Theorems without proof)
2.5 Problems on Summation of Series
2.6 Approximations</td></tr>
<tr><td></td><td colspan="8">UNIT III (12 hours) (K1, K2, K3 & K4)
Matrices
3.1 Characteristic equation
3.2 Eigen values and Eigen Vectors
3.3 Similar matrices - Cayley – Hamilton Theorem (Statement only)
3.4 Finding powers of a square matrix
3.5 Inverse of a square matrix up to order 3
3.6 Diagonalization of a square matrix</td></tr>
</table>

	UNIT IV (12 hours) (K1, K2, K3 & K4) **Expansions of Trigonometric Function** 4.1 Expansions of sin nθ in powers of sinθ, cosθ 4.2 Expansions of cos nθ in powers of sinθ, cosθ 4.3 Expansion of tan nθ in terms of tan θ 4.4 Expansions of $\cos^n\theta$, $\sin^n\theta$, $\cos^m\theta\sin^n\theta$ 4.5 Expansions of $\tan(\theta_1+\theta_2+,\ldots,+\theta_n)$ 4.6 Expansions of sinθ, cosθ and tanθ in terms of θ
	UNIT V (12 hours) (K1, K2, K3 & K4) **Hyperbolic Functions** 5.1 Formulae, properties of Hyperbolic Functions 5.2 Relation between hyperbolic and circular functions 5.3 Inverse Hyperbolic functions 5.4 Formulae, properties of Inverse hyperbolic functions 5.5 Logarithm of complex quantities 5.6 Summation of trigonometric series
Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	1. T.K. Manickavachagom Pillay and others - Algebra -Volumes I and II – S.Viswanathan Printers and Publishers Pvt. Ltd., Chennai – Copyright 2013. 2. S. Narayanan and T. K. Manickavachagom Pillay – Trigonometry – S. Viswanathan Printers and Publishers Pvt. Ltd., Chennai - Reprint 2006.
ReferenceBooks	1. W.S. Burnstine and A.W. Panton, Theory of equations 2. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007 3. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005 4. C. V. Durell and A. Robson, Advanced Trigonometry, Courier Corporation, 2003 5. J. Stewart, L. Redlin, and S. Watson, Algebra and Trigonometry, Cengage Learning, 2012.
Website and e-learning source	1. https://nptel.ac.in 2. www.coursera.org 3. https://swayam.gov.in/

Course Outcomes:

On completion of the course, the students should be able to

CO1: Classify and Solve reciprocal equations.

CO2: Find the sum of binomial, exponential and logarithmic series.

CO3: Find Eigen values, eigen vectors, verify Cayley – Hamilton theorem and diagonalize a given matrix.

CO4: Expand the powers and multiples of trigonometric functions in terms of sine and cosine

CO5: Determine relationship between circular and hyperbolic functions and the summation of trigonometric series

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	L	H
CO2	H	H	H	M	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

CO	PSO					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	M	L	H	L
CO2	H	H	H	M	H	L
CO3	M	M	H	H	H	L
CO4	H	M	M	H	H	L
CO5	H	H	M	M	H	L

<table>
<tr><td>Title of the Course</td><td colspan="7">DIFFERENTIAL CALCULUS</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">UCMAB24</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">• To gain the basic skills of differentiation, successive differentiation, and their applications.
• To gain the basic knowledge on the notions of curvature, evolutes, involutes and polar co-ordinates and in solving related problems.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (12 hours) (K1, K2, K3 & K4)
Successive Differentiation
1.1 Introduction (Review of basic concepts)
1.2 The n^{th} derivative - Standard results
1.3 Fractional expressions
1.4 Trigonometrical transformation
1.5 Formation of equations involving derivatives
1.6 Leibnitz formula for the n^{th} derivative of a product</td></tr>
<tr><td></td><td colspan="7">UNIT II (12 hours) (K1, K2, K3 & K4)
Partial Differentiation
.1 Partial derivatives
2.2 Successive partial derivatives
2.3 Function of a function rule
2.4 Function of a function rule (Continued)
2.5 Total differential coefficient - A special case
2.6 Implicit Functions</td></tr>
<tr><td></td><td colspan="7">UNIT III (12 hours) (K1, K2, K3 & K4)
Partial Differentiation (Continued)
3.1 Homogeneous functions
3.2 Partial derivatives of a function of two variables
3.3 Maxima and Minima of functions of two variables
3.4 Maxima and Minima of functions of two variables (Continued)
3.5 Lagrange’s method of undetermined multipliers
3.6 Lagrange’s method of undetermined multipliers (Continued)</td></tr>
</table>

	UNIT IV (12 hours) (K1, K2, K3 & K4) **Curvature** 4.1 Definition of Curvature 4.2 Radius of Curvature in Cartesian coordinates 4.3 Radius of Curvature in Polar Co-ordinates 4.4 Centre of Curvature 4.5 Circle of Curvature 4.6 Evolutes and Involutes
	UNIT V (12 hours) (K1, K2, K3 & K4) **Envelope** 5.1 **E**nvelope – Definition 4.2 Method of finding the envelope 4.3 Envelope of one parameter family of curves 4.4 Envelope of one parameter family of curves (Continued) 4.5 Envelope of two parameter family of curves 4.6 Application of Envelope of family of curves
Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	S. Narayanan and Manickavachagom Pillai T.K - Calculus (Volume I,II&III) - S. Viswanathan Printers and Publishers Pvt. Ltd., Chennai - Reprint 2009.
ReferenceBooks	1. N.P. Bali - Differential Calculus - Volume I - Lakshmi Publication - 3rd Edition 2000 2. P.R.Vittal - Calculus - Margham Publications - Reprint 2005. 3. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002. 4. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2010. 5. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007. 6.
Website and e-learning source	1. https://nptel.ac.in/ 2. www.coursera.org 3. https://swayam.gov.in

Course Outcomes:

On completion of the course, the students should be able to

CO1: Find the nth derivative, form equations involving derivatives & apply Leibnitz formula
CO2: Find the partial derivative and total derivative coefficient
CO3: Determine maxima and minima of functions of two variables and to use the Lagrange's method of undetermined multipliers
CO4: Find the envelope of a given family of curves
CO5: Find the evolutes & involutes, & to find the radius of curvature using polar co-ordinates

	PO					
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

	PSO					
CO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	H	L
CO2	H	M	H	M	H	L
CO3	H	H	M	M	H	L
CO4	H	M	M	M	H	L
CO5	H	M	H	H	H	L

<table>
<tr><td>Title of the Course</td><td colspan="7">FC: BRIDGE MATHEMATICS</td></tr>
<tr><td>Paper No.</td><td colspan="7">FC</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Foundation Course</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">UFMA24</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td>-</td><td colspan="3">-</td><td colspan="2">2</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">• To bridge the gap and facilitate transition from higher secondary to tertiary education
• To instil confidence among stakeholders and inculcate interest for Mathematics</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (6 hours)
Algebra: Binomial theorem, General term, middle term, problems based on these concepts</td></tr>
<tr><td></td><td colspan="7">Unit II (6 hours)
Sequences and series (Progressions)-Fundamental principle of counting-Factorial n</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (6 hours)
Permutations and combinations-Derivation of formulae and their connections-simple applications-combinations with repetitions-arrangements within groups-formation of groups</td></tr>
<tr><td></td><td colspan="7">UNIT-IV: (6 hours)
Trigonometry: Introduction to trigonometric ratios, proof of sin(A+B), cos(A+B), tan(A+B) formulae, multiple and sub multiple angles, sin(2A), cos(2A), tan(2A) etc., transformations sum into product and product into sum formulae, inverse trigonometric functions, sine rule and cosine rule.</td></tr>
<tr><td></td><td colspan="7">UNIT-V(6 hours)
Calculus: Limits, standard formulae and problems, differentiation, first principle, uv rule, u/v rule, methods of differentiation, application of derivatives, integration - product rule and substitution method.</td></tr>
<tr><td colspan="3">Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)</td><td colspan="5">Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved
(To be discussed during the Tutorial hours)</td></tr>
<tr><td>Recommended Text</td><td colspan="7">1. NCERT class XI and XII text books.
2. Any State Board Mathematics text books of class XI and XII</td></tr>
</table>

Website and e-learning source	1. https://nptel.ac.in 2. www.coursera.org 3. https://swayam.gov.in/

Course Outcomes:

On completion of the course, the students should be able to

CO1: Understand the operators of finite differences and express any value of y in terms of the forward differences of y_0 and the backward differences of y_n.
CO2: Apply interpolating techniques for equal intervals by Newton's method.
CO3: Apply central difference formulae to get the intermediate values of given data.
CO4: Apply interpolating techniques for unequal intervals by divided difference formula and Lagrange's interpolation formula.
CO5: Evaluate the gradient at any point of a graph using numerical differentiation and find the area under curved surface, velocity, etc. using numerical integration.

	PO					
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	L	H
CO2	H	H	H	M	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

	PSO					
CO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	M	M	H	L
CO2	H	H	M	H	H	L
CO3	H	H	M	H	H	L
CO4	H	H	M	H	H	L
CO5	H	H	M	M	H	L

<table>
<tr><td>Title of the Course</td><td colspan="7">SKILL ENHANCEMENT COURSE: OFFICE AUTOMATION</td></tr>
<tr><td>Paper No.</td><td colspan="7">SEC 1</td></tr>
<tr><td>Category</td><td>Skill Enhancement Course</td><td>Year
Semester</td><td>II
III</td><td>Credits</td><td>2</td><td>Course Code</td><td>USMA124</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture
-</td><td>Tutorial
-</td><td colspan="2">Lab Practice
2</td><td colspan="2">Total
2</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">• To introduce a highly practice oriented course rather than regular class room teaching.
• To introduce Computer Skills for students and to enhance their skills in preparing Word, Excel and Power point presentations</td></tr>
<tr><td>Course Outline</td><td colspan="7">1. Introductory concepts: Hardware and Software - Memory unit – CPU- Input Devices: Keyboard, Mouse and Scanner. Output devices: Monitor, Printer. Introduction to Operating systems
2. Word Processing: File menu operations - Editing text – tools, formatting, bullets and numbering - Spell Checker - Document formatting – Paragraph alignment, indentation, headers and footers, printing – Preview, options, merge.
3. Spreadsheets: Excel – opening, entering text and data, formatting, navigating; Formulas – entering, handling and copying
4. Charts – creating, formatting and printing, analysis tables, preparation of financial statements, introduction to data analytics.
5. Power point: Introduction to Power point - Features – Understanding slide typecasting & viewing slides – creating slide shows.
6. Applying special object – including objects & pictures - Slide transition – Animation effects, audio inclusion, timers.</td></tr>
<tr><td colspan="4">Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)</td><td colspan="4">Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved
(To be discussed during the Tutorial hours)</td></tr>
<tr><td>Recommended Text</td><td colspan="7">Peter Norton, “Introduction to Computers” –Tata McGraw-Hill, 7th Edition, 2017</td></tr>
<tr><td>ReferenceBooks</td><td colspan="7">Jennifer Ackerman Kettel, Guy Hat-Davis, Curt Simmons, “Microsoft 2003”, Tata McGraw- Hill.</td></tr>
<tr><td>Website and e-learning source</td><td colspan="7">1. https://nptel.ac.in/
2. www.coursera.org
3. https://swayam.gov.in</td></tr>
</table>

Course Outcomes:

On completion of the course, the students should be able to

CO1: Understand the basics of computer systems and its components
CO2: Understand and apply the basic concepts of a word processing package
CO3: Understand and apply the basic concepts of electronic spreadsheet software
CO4: Understand and apply the basic concepts of database management system
CO5: Understand and create a presentation using PowerPoint tool.

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

CO	PSO					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	L	H
CO2	H	M	H	M	M	H
CO3	H	M	H	M	M	H
CO4	H	H	H	H	H	H
CO5	H	M	H	H	L	H

<table>
<tr><td>Title of the Course</td><td colspan="7">ANALYTICAL GEOMETRY (Two & Three Dimensions)</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>4</td><td>Course Code</td><td>UCMAC24</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">• To gain necessary skills to analyse characteristics and properties of two- and three-dimensional geometric shapes.
• To present mathematical arguments about geometric relationships.
To solve real world problems on geometry and its applications</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (12 hours) (K1, K2, K3 & K4)
Conics
1.1 Pole, Polar
1.2 Conjugate points and conjugate lines
1.3 Diameters
1.4 Conjugate diameters of an ellipse
1.5 Semi diameters
1.6 Conjugate diameters of hyperbola</td></tr>
<tr><td></td><td colspan="7">UNIT II (12 hours) (K1, K2, K3 & K4)
Conics (continued)
2.1 Polar coordinates
2.2 General polar equation of a straight line
2.3 Polar equation of a circle given a diameter
2.4 Equation of a straight line, circle, conic
2.5 Equation of chord, tangent, normal
2.6 Equations of the asymptotes of a hyperbola</td></tr>
<tr><td></td><td colspan="7">UNIT-III (12 hours) (K1, K2, K3 & K4)
Planes
3.1 Planes
3.2 System of Planes
3.3 System of Planes (Continued0
3.4 Length of the perpendicular plane
3.5 Projection
3.6 Orthogonal projection</td></tr>
</table>

	UNIT-IV: (12 hours) (K1, K2, K3 & K4) **Planes and Lines** 4.1 Representation of line 4.2 Angle between a line and a plane 4.3 Co – planar lines 4.4 Shortest distance between two skew lines 4.5 Length of the perpendicular line 4.6 Intersection of three planes
	UNIT-V: (12 hours) (K1, K2, K3 & K4) **Sphere** 5.1 Equation of a sphere-general equation 5.2 Section of a sphere by a plane 5.3 Equation of the circle 5.4 Tangent plane- angle of intersection of two spheres 5.5 Condition for the orthogonality 5.6 Radical plane
Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	1. P.Duraipandian, Laxmi Duraipandian and D.Muhilan - Analytical Geometry 2 Dimensional, Emerald Publishers,1997. 2. Robert J. T. Bell, Co-ordinate Geometry of Three Dimensions,1923.
ReferenceBooks	1. Calculus and Analytical Geometry, G.B. Thomas and R. L. Finny, Pearson Publication, 9th Edition, 2010. 2. Robert C. Yates, Analytic Geometry with Calculus, Prentice Hall, Inc., New York, 1961. 3. Earl W. Swokowski and Jeffery A. Cole, Algebra and Trigonometry with Analytic Geometry, Twelfth Edition, Brooks/Cole, Cengage Learning, CA, USA, 2010. 4. William H. McCrea, Analytical Geometry of Three Dimensions, Dover Publications, Inc, New York, 2006. 5. John F. Randelph, Calculus and Analytic Geometry, Wadsworth Publishing Company, CA, USA, 1969. 6. Ralph Palmer Agnew, Analytic Geometry and Calculus with Vectors, McGraw-Hill Book Company, Inc. New York, 1962.
Website and e-learning source	1. https://nptel.ac.in 2. www.coursera.org 3. https://swayam.gov.in/

Course Outcomes:.

On completion of the course, the students should be able to

CO1: Find pole, polar for conics, diameters, conjugate diameters for ellipse and hyperbola

CO2: Find the polar equations of straight line and circle, equations of chord, tangent and normal and to find the asymptotes of hyperbola.

CO3: Explain in detail the system of Planes

CO4: Explain in detail the system of Straight lines

CO5: Explain in detail the system of Spheres

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	L	H
CO2	H	H	H	M	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	M	L	H	L
CO2	H	H	H	M	H	L
CO3	M	M	H	H	H	L
CO4	H	M	M	H	H	L
CO5	H	H	M	M	H	L

<table>
<tr><td>Title of the Course</td><td colspan="7">INTEGRAL CALCULUS</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">UCMAD24</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">• Knowledge on integration and its geometrical applications, double, triple integrals and improper integrals.
• Knowledge about Beta and Gamma functions and their applications.
• Skills to Determine Fourier series expansions.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (12 hours) (K1, K2, K3 & K4)
Integration
1.1 Reduction formulae
1.2 Types, integration of product of powers of algebraic functions
1.3 Integration of product of powers of trigonometric functions
1.4 integration of product of powers of algebraic and logarithmic functions
1.5 Bernoulli’s formula
1.6 Feyman’s technique of integration</td></tr>
<tr><td></td><td colspan="7">Unit II (12 hours) (K1, K2, K3 & K4)
Double Integrals
2.1 Definition of double integrals
2.2 Evaluation of double integrals in Cartesian coordinates
2.3 Evaluation of double integrals in Cartesian coordinates (Continued)
2.4 Double integrals in polar coordinates
2.5 Double integrals in polar coordinates (Continued)
2.6 Change of order of integration</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (12 hours) (K1, K2, K3 & K4)
Triple integrals
3.1 Definition of Triple integrals
3.2 Evaluation of triple integrals in Cartesian coordinates
3.3 Evaluation of triple integrals in polar coordinates
3.4 Areas of curved surfaces
3.5 Areas of curved surfaces (Continued)
3.6 Change of variables – Jacobian</td></tr>
</table>

	UNIT IV: (12 hours) (K1, K2, K3 & K4) **Beta and Gamma functions** 4.1 Beta and Gamma functions – infinite integral – definitions 4.2 Recurrence formula of Gamma functions 4.3 Properties of Beta and Gamma functions 4.4 Properties of Beta and Gamma functions (Continued) 4.5 Relation between Beta and Gamma functions 4.6 Applications of Beta and Gamma functions
	UNIT-V: (12 hours) (K1, K2, K3 & K4) **Geometric Applications of Integral calculus** 5.1 Areas under plane curves in Cartesian coordinates 5.2 Areas under plane curves in Cartesian coordinates (Continued) 5.3 Area of a closed curve 5.4 Area of a closed curve (Continued) 5.5 Areas in polar coordinates 5.6 Areas in polar coordinates (Continued)

Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)

Recommended Text	S. Narayanan and Manickavachagom Pillai T.K - Calculus (Volume I,II&III) - S. Viswanathan Printers and Publishers Pvt. Ltd., Chennai - Reprint 2009.
ReferenceBooks	1. N.P. Bali - Integral Calculus - Lakshmi Publication – Fifth Edition - 1985 2. P. R. Vittal - Calculus - Margham Publications - Reprint 2005. 3. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002. 4. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007. 5. D. Chatterjee, Integral Calculus and Differential Equations, Tata-McGraw Hill Publishing Company Ltd. 6. P. Dyke, An Introduction to Laplace Transforms and Fourier Series, Springer Undergraduate Mathematics Series, 2001 (second edition).
Website and e-learning source	1.https://nptel.ac.in/ 2. www.coursera.org 3. https://swayam.gov.in

Course Outcomes:

On completion of the course, the students should be able to

CO1: Determine the integrals of algebraic, trigonometric and logarithmic functions and to find the reduction formulae

CO2: Evaluate double and triple integrals and problems using change of order of integration

CO3: Solve multiple integrals and to find the areas of curved surfaces and volumes of solids of revolution

CO4: Explain beta and gamma functions and to use them in solving problems of integration

CO5: Explain Geometric and Physical applications of integral calculus.

	PSO					
CO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	H	L
CO2	H	M	H	M	H	L
CO3	H	H	M	M	H	L
CO4	H	M	M	M	H	L
CO5	H	M	H	H	H	L

	PO					
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

<table>
<tr><td>Title of the Course</td><td colspan="7">SKILL ENHANCEMENT COURSE: COMPUTATIONAL MATHEMATICS</td></tr>
<tr><td>Paper No.</td><td colspan="7">SEC 2</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Skill Enhancement Course</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">USMA224</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="2">2</td><td colspan="3">2</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">• To introduce students to the concept of basic programming, thereby enhancing the logical thinking of the students with regard to programming.
• To train the students to apply the programming concepts of SCILAB to mathematical investigations and problem solving.
To construct the ability of students to work independently and do in-depth study of various notions of programming</td></tr>
<tr><td>Course Outline</td><td colspan="7">1. Finding the roots of polynomial equations and system of equations
2. Testing consistency of system of equations
3. Finding sum of infinite series
4. Successive Differentiation of single variable function
5. Partial derivatives
6. Finding Maxima and Minima</td></tr>
<tr><td colspan="3">Extended Professional Component (isa part of internal component only, not to be included in theexternal examination question paper)</td><td colspan="5">Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved
(To be discussed during the Tutorial hours)</td></tr>
<tr><td>Recommended Text</td><td colspan="7">1. Introduction to Scilab, Michael Baudin From Scilab Consortin, 2010 Chapters 1 to 8 (Book Freely Downloadable in Internet)
2. Plotting Using Scilab – Anopen Source Document www.openeering.com</td></tr>
<tr><td>ReferenceBooks</td><td colspan="7">1. Modeling and Simulation in Scilab, Stephen L. Campbell, Jean-Philippe Chancelier and Ramine Nikoukhah.
2. An Introduction to Scilab from a Matlab User’s Point of View by Eike Rietsch.
3. Advanced Programming in Scilab, Chetana Jain, Narosa Publishing House, New Delhi</td></tr>
<tr><td>Website and e-learning source</td><td colspan="7">1. https://nptel.ac.in/
2. www.coursera.org
3. https://swayam.gov.in</td></tr>
</table>

Course Outcomes:

On completion of the course, the students should be able to

CO1: Implement programs to find the roots of equations

CO2: Write programs to test the consistency of system of equations

CO3: Finding sum of infinite series using programming concepts

CO4: Perform Successive differentiation and Partial differential using programs

CO5: Use programs to find maxima and minima

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

CO	PSO					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	L	H
CO2	H	M	H	M	M	H
CO3	H	M	H	M	M	H
CO4	H	H	H	H	H	H
CO5	H	M	H	H	L	H

<table>
<tr><td>Title of the Course</td><td colspan="7">SKILL ENHANCEMENT COURSE: PROBLEM SOLVING TECHNIQUES</td></tr>
<tr><td>Paper No.</td><td colspan="7">SEC 3</td></tr>
<tr><td>Category</td><td>Skill Enhancement Course</td><td>Year
Semester</td><td>I
II</td><td>Credits</td><td>2</td><td>Course Code</td><td>USMA324</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture
-</td><td>Tutorial
-</td><td colspan="3">Lab Practice
2</td><td>Total
2</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">The aim of this course is to practice mathematics in software</td></tr>
<tr><td>Course Outline</td><td colspan="7">1. Integration of single variable functions.
2. Double Integration
3. Triple Integration
4. Finding Radius of curvature.
5. Visualization of functions in 2D.
6. Visualization of three dimensional mathematical objects.</td></tr>
<tr><td colspan="3">Extended Professional Component (isa part of internal component only, not to be included in theexternal examination question paper)</td><td colspan="5">Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved
(To be discussed during the Tutorial hours)</td></tr>
<tr><td>Recommended Text</td><td colspan="7">1. Introduction to Scilab, Michael Baudin From Scilab Consortin, 2010 Chapters 1 to 8 (Book Freely Downloadable in Internet)
2. Plotting Using Scilab – Anopen Source Document www.openeering.com</td></tr>
<tr><td>ReferenceBooks</td><td colspan="7">1. Modeling and Simulation in Scilab, Stephen L. Campbell, Jean-Philippe Chancelier and Ramine Nikoukhah.
2. An Introduction to Scilab from a Matlab User's Point of View by Eike Rietsch.
3. Advanced Programming in Scilab, Chetana Jain, Narosa Publishing House, New Delhi.</td></tr>
<tr><td>Website and e-learning source</td><td colspan="7">http://ndl.iitkgp.ac.in
http://ocw.mit.edu
http://mathforum.org</td></tr>
</table>

Course Outcomes:

On completion of the course, the students should be able to

CO1: Integrate a function of single variable using Mathematical software.

CO2: perform Double Integration using Mathematical software

CO3: perform Triple Integration using Mathematical software

CO4: find Radius of Curvature using Mathematical software

CO5: Visualizing 2D and 3D figures using Mathematical software

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

CO	PSO					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	L	H
CO2	H	M	H	M	L	H
CO3	H	M	H	M	L	H
CO4	H	H	H	H	L	H
CO5	H	M	H	H	L	H

<table>
<tr><td>Title of the Course</td><td colspan="7">VECTOR CALCULUS AND ITS APPLICATIONS</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">UCMAE24</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe Course</td><td colspan="7">• To know about differentiation of vectors, differential operators and derivatives of vector functions.
• To acquire skills in evaluating line, surface and volume integrals.
• To understand and analyze the physical applications of derivatives of vectors.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (15 hours) (K1, K2, K3 & K4)
Differentiation of Vectors
1.1 Vector and Scalar Point Function
1.2 Derivative of a Vector
1.3 Derivative of a Sum of Vectors
1.4 Derivative of a Product of a Scalar and a Vector Point Function
1.5 Derivative of a Scalar Product
1.6 Derivative of a Vector Product</td></tr>
<tr><td></td><td colspan="7">UNIT II (15 hours) (K1, K2, K3 & K4)
Differentiation of Vectors (Continued)
2.1 Vector Operator ‘del’
2.2 Gradient of a Scalar Point Function
2.3 Divergence of a vector
2.4 Curl of a vector
2.5 Solenoidal Vector
2.6 Irrotational Vector</td></tr>
<tr><td></td><td colspan="7">UNIT III (15 hours) (K1, K2, K3 & K4)
Vector Identities and Integration of Vectors
3.1 Laplacian Operator
3.2 Vector Identities
3.3 Vector Identities Contd.
3.4 Definition of Line Integral
3.5 Problems on Line Integral
3.6 Work done by a Force</td></tr>
</table>

	UNIT IV (15 hours) (K1, K2, K3 & K4) **Integration of Vectors (Continued)** 4.1 Definition of Surface Integral 4.2 Problems on Surface Integral 4.3 Problems on Surface Integral Contd. 4.4 Definition of Volume Integral 4.5 Problems on Volume Integral 4.6 Problems on Volume Integral Contd.
	UNIT V (15 hours) (K1, K2, K3 & K4) **Integral Theorems** 5.1 Gauss's Divergence Theorem-Verification 5.2 Application of Gauss's Divergence Theorem 5.3 Stoke's Theorem-Verification 5.4 Application of Stoke's Theorem 5.5 Green's Theorem in Two Dimensions-Verification 5.6 Applications of Green's Theorem in Two Dimensions
Extended Professional Component (isa part of internal component only, not to be included in theexternal examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	1. P. Duraipandian and Lakshmi Duraipandian – Vector Analysis – Emerald Publishers, Reprint 1998.
ReferenceBooks	1. S. Narayanan and T. K. Manickavachagom Pillay-Vector Algebra and Analysis-S. Viswanathan Publishers, 1991. 2. J.C. Susan-Vector Calculus-Pearson Education, Boston, 4th Edition, 2012. 3. A. Gorguis-Vector Calculus for College Students-Xilbius Corporation, 2014. 4. J.E. Marsden and A. Tromba-Vector Calculus-W.H. Freeman, New York, 5th Edition, 1988. 5. P. R. Vittal and V. Malini-Vector Analysis-Margham Publications, Chennai, Reprint 2009.
Website and e-learning source	1. https://nptel.ac.in/ 2. www.coursera.org 3. https://swayam.gov.in

Course Outcomes:

On completion of the course, the students should be able to

CO1: Find the derivative of vector, sum of vectors, product of scalar and vector point function and determine the derivatives of scalar and vector products.

CO2: Apply the operator 'del' and explain solenoidal and irrotational vectors.

CO3: Solve simple line integrals.

CO4: Solve surface integrals and volume integrals.

CO5: Verify the theorems of Gauss's, Stoke's and Green's (Two Dimensions).

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO 6
CO1	H	H	H	L	L	M
CO2	H	H	H	L	L	M
CO3	H	H	H	L	L	M
CO4	H	H	H	L	L	M
CO5	H	H	H	L	L	M

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO 6
CO1	H	M	H	H	M	L
CO2	H	M	H	H	M	L
CO3	H	M	H	H	M	L
CO4	H	M	H	H	M	L
CO5	H	M	H	H	M	L

<table>
<tr><td>Title of the Course</td><td colspan="7">DIFFERENTIAL EQUATIONS AND APPLICATIONS</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">UCMAF24</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• Knowledge about the methods of solving Ordinary and Partial Differential Equations.
• The understanding of how Differential Equations can be used as a powerful tool in solving problems in science.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (15 hours) (K1, K2, K3 & K4)
First Order Ordinary Differential Equations
1.1 Introduction and Definitions of Differential Equations
1.2 First order higher degree
1.3 Solvable for p, x and y
1.4 Solving Clairaut’s form
1.5 Exact differential equations
1.6 Total differential equations Pdx + Qdy + Rdz = 0</td></tr>
<tr><td></td><td colspan="7">UNIT II (15 hours) (K1, K2, K3 & K4)
Second Order Ordinary Differential Equations
2.1 Introduction of Second order differential equations
2.2 Solution of Second order equations with constant coefficients
2.3 Finding P.I for e^{ax}cosmx and e^{ax}sinmx (m is a positive constant)
2.4 Finding P.I for $e^{ax}x^m$ (m is a positive constant)
2.5 Second order differential equations with variable coefficients
2.6 Method of variation of parameters</td></tr>
<tr><td></td><td colspan="7">UNIT III (15 hours) (K1, K2, K3 & K4)
Partial Differential Equations
3.1 Basic Definitions
3.2 Formation of P.D.E by eliminating arbitrary constants
3.3 Formation of P.D.E by eliminating arbitrary functions
3.4 Definitions of Complete, Singular and general integral
3.5 Solution of equations of standard types: f(p,q) = 0; $f_1(x,p) = f_2(y,p)$
3.6 Solution of equations of standard types: f(x,p,q) = 0; f(y,p,q) = 0; f(z,p,q) =0;</td></tr>
</table>

	UNIT IV (15 hours) (K1, K2, K3 & K4) **Partial Differential Equations** (Continued) 4.1 Solution of PDE in Clairaut's form 4.2 Solution of PDE in Clairaut's form (Continued) 4.3 Solution of PDE by Lagrange's method 4.4 Solution of PDE by Lagrange's method (Continued) 4.3 Charpit's method 4.6 Charpit's method (Continued)
	UNIT V (15 hours) (K1, K2, K3 & K4) **Simultaneous Differential Equations** 5.1 Simultaneous linear differential equations with constant co-efficients - Introduction 5.2 Simultaneous linear differential equations with constant co-efficients - Method of Elimination 5.3 Simultaneous linear differential equations with constant co-efficients- Method of Differentiation 5.4 Solution of dx/P=dy/Q=dz/R -Introduction 5.5 Solving dx/P=dy/Q=dz/R 5.6 Solving dx/P=dy/Q=dz/R (Continued)
Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	1. S. Naryanan and T.K. Manickavachagom Pillai – Calculus Vol. III – S. Viswanathan Printers and Publishers Pvt. Ltd., Chennai, 2012. 2. M. K. Venkataraman and Manorama Sridhar - Differential Equations and Laplace Transform - First Edition - 2004
ReferenceBooks	1. Sundrapandian, V. Ordinary and Partial Differential Equations, Tata McGraw Hill Education Pvt.Ltd. New Delhi, 2013 2. P.R.Vittal - Differential equations, Fourier and Laplace Transforms and Probability - Margham Publication – Third Edition, 2002. 3. Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984. 4. I. Sneddon, Elements of Partial Differential Equations, McGraw-Hill, International Edition, 1967. 5. G.F. Simmons, Differential equations with applications and historical notes, 2nd Ed, Tata Mcgraw Hill Publications, 1991.
Website and e-learning source	1. https://nptel.ac.in 2. www.coursera.org 3. https://swayam.gov.in/

Course Outcomes:

On completion of the course, the students should be able to

CO1: Determine solutions of homogeneous equations, non-homogeneous equations of degree

CO2: Find the solutions of equations of first order but not of higher degree and to Determine particular integrals of algebraic, exponential, trigonometric functions and their products

CO3: Form a PDE by eliminating arbitrary constants and arbitrary functions

CO4: Find complete, singular and general integrals, to solve Lagrange's equations

CO5: Find solutions of simultaneous linear differential equations, linear equations of second order and to find solutions using the method of variations of parameters

	PO					
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

	PSO					
CO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	H	L
CO2	H	M	H	M	H	L
CO3	H	H	M	M	H	L
CO4	H	M	M	M	H	L
CO5	H	M	H	H	H	L

<table>
<tr><td>Title of the Course</td><td colspan="7">ALLIED III: MATHEMATICAL STATISTICS</td></tr>
<tr><td>Paper No.</td><td colspan="7">Discipline Specific Elective I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Discipline Specific Elective</td><td>Year</td><td>II</td><td>Credits</td><td>3</td><td>Course Code</td><td>UAMSA24</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">• To study Statistics from a purely mathematical standpoint using Probability Theory as well as other branches of Mathematics.
• To understand the concepts of random variables and probability functions.
• To demonstrate knowledge of probability and the standard statistical distributions.
• To recognize the fundamental meanings of correlation and regression.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (12 hours) (K1, K2, K3 & K4)
Theory of Probability
1.1 Definition of probability and basics
1.2 Independence of events
1.3 Addition theorem
1.4 Conditional probability
1.5 Multiplication law of probability
1.6 Bayes’ theorem</td></tr>
<tr><td></td><td colspan="7">UNIT II (12 hours) (K1, K2, K3 & K4)
Random Variables
2.1 Discrete and continuous random variables - Probability distribution and distribution function
2.2 Definition of two-dimensional random variable
2.3 Probability distribution
2.4 Probability density function
2.5 Marginal distribution
2.6 Conditional distribution</td></tr>
<tr><td></td><td colspan="7">UNIT III (12 hours) (K1, K2, K3 & K4)
Characteristics of Random Variables
3.1 Mathematical expectation and properties
3.2 Variance, Standard deviation
3.3 Mean deviation
3.4 Tchebychev's inequality
3.5 Raw and central moments and relation between them
3.6 Moment generating function (mgf) and properties of mgf</td></tr>
</table>

	UNIT IV (12 hours) (K1, K2, K3 & K4) **Standard Distributions** 4.1 Binomial distribution 4.2 Binomial distribution (Continued) 4.3 Poisson distribution 4.4 Poisson distribution (Continued) 4.5 Normal distribution 4.6 Normal distribution (Continued)
	UNIT V (12 hours) (K1, K2, K3 & K4) **Correlation and Regression** 5.1 Correlation, types of correlation and Karl Pearson's coefficient of correlation 5.2 Properties of correlation coefficient 5.3 Spearman's rank correlation coefficient 5.4 Computation of correlation and rank correlation coefficient for raw data 5.5 Computation of correlation and rank correlation coefficient for grouped data 5.6 Regression lines definition, derivation, angle between regression lines, regression coefficient properties
Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	S. P. Gupta - Statistical Methods - Sultan Chand & Sons, New Delhi, 2nd Edition, 2020.
ReferenceBooks	1. Hogg R.V. and Craig, A.T.- Introduction to Mathematical Statistics – Macmillan, 4th Edition 1998. 2. Mood, A.M., Graybill, F.A. and Boes, D.G.- Introduction to Theory of Statistics - McGraw Hill Publication,3rd Edition 1974. 3. Snedecor G.W., Cochran W.G. - Statistical Methods - Oxford and IBH - 6th Edition 1967. 4. Hoel P.G. - Introduction to Mathematical Statistics – Wiley, 4th Edition 1971. 5. Wilks S.S. - Elementary Statistical Analysis - Oxford and IBH. Reprint 1971.
Website and e-learning source	1. https://nptel.ac.in/ 2. www.coursera.org 3. https://swayam.gov.in/

Course Outcomes:

On completion of the course, the students should be able to

CO1: Comprehend the fundamentals of probability.
CO2: Know about random variables of one and two dimensions.
CO3: Learn about the measures of central tendency and concepts of moments.
CO4: Acquire knowledge about discrete and continuous distributions.
CO5: Apply correlation and regression for the investigation of relationship between the variables.

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	L	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	M	H	H	H	L
CO2	H	H	H	H	H	M
CO3	H	M	H	H	H	L
CO4	H	H	H	H	H	M
CO5	H	H	M	H	H	L

<table>
<tr><td>Title of the Course</td><td colspan="7">SKILL ENHANCEMENT COURSE: STATISTICS WITH R</td></tr>
<tr><td>Paper No.</td><td colspan="7">SEC 4</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Skill Enhancement Course</td><td>Year</td><td>II</td><td>Credits</td><td>2</td><td>Course Code</td><td>USMA424</td></tr>
<tr><td>Semester</td><td>IV</td><td colspan="4"></td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>-</td><td>-</td><td colspan="3">2</td><td colspan="2">2</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">The course aims at giving an overall view of the
• To introduce students to the concept of basic R programming, thereby enhancing the logical thinking of the students with regard to programming.
• To train the students to apply the programming concepts of R to statistical investigations and problem solving.</td></tr>
<tr><td>Course Outline</td><td colspan="7">1. To demonstrate arithmetic, vector, array, matrix and data frame operations
2. To represent data in graphs(scatterplot, line graph, bar plot, pie chart)
3. To find correlation coefficient and linear regression lines
4. To demonstrate fitting probability distributions (binomial, Poisson, Normal)
5. To perform z-test for 2 means, z-test for 2 proportions and Chi-Square Test for Independence of Attributes
6. To perform analysis of variance (CRD)</td></tr>
<tr><td colspan="4">Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)</td><td colspan="4">Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved
(To be discussed during the Tutorial hours)</td></tr>
<tr><td>Recommended Text</td><td colspan="7">1. The R Book-Michael J. Crawley-Imperial College London at Silwood Park, UK, Second Edition, A John Wiley & Sons, Ltd., Publication, 2013.
2. An Introduction to R-Notes on R: A Programming Environment for Data Analysis and Graphics W. N. Venables, D. M. Smith and the R Core Team-(Version 3.6.3), 2020.</td></tr>
<tr><td>ReferenceBooks</td><td colspan="7">1. The Art of R Programming A Tour of Statistical Software Design-Norman Matloff, No Starch Press, San Francisco, 2011.
2. Introduction to Statistics with R - Anne Segonds-Pichon, Babraham Bioinformatics, 2015.
3. R for Dummies, Andrie de Vries and Joris Meys, 2nd Edition, John Wiley & Sons, Inc., 2015.</td></tr>
</table>

Website and e-learning source	1. https://nptel.ac.in/ 2. www.coursera.org 3. https://spoken-tutorial.org

Course Outcomes:

On completion of the course, the students should be able to

CO1: Familiarize the basics of programming in R such as vectors, arrays, data frames, etc.
CO2: Represent data and Interpret results through graphical tools in R.
CO3: Compute correlation coefficient and linear regression using R
CO4: Fit standard distributions using R.
CO5: Understand and apply the programming concepts of R to perform tests of significance and analysis of variance.

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

CO	PSO					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	L	H
CO2	H	M	H	M	L	H
CO3	H	M	H	M	L	H
CO4	H	H	H	H	L	H
CO5	H	M	H	H	L	H

<table>
<tr><td>Title of the Course</td><td colspan="7">SKILL ENHANCEMENT COURSE: QUICK MATH - I</td></tr>
<tr><td>Paper No.</td><td colspan="7">SEC 5</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Skill Enhancement Course</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">1</td><td rowspan="2">Course Code</td><td rowspan="2">USMA524</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>1</td><td>-</td><td colspan="2">-</td><td colspan="3">1</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">The course aims at giving an overall view of the
• To revitalize the basic knowledge of mathematics and problem-solving skills.
• To enhance logical, analytical, and critical thinking of learners.
• To help the students to prepare for various competitive examinations.</td></tr>
<tr><td>Course Outline</td><td colspan="7">1. Mental Maths - Addition, Subtraction
2. Mental Maths – Multiplication
3. Mental Maths – Division
4. Divisibility, Fractions, Squares, Cubes
5. Square Roots and Cube Roots
6. Factorization</td></tr>
<tr><td colspan="3">Extended Professional Component (isa part of internal component only, not to be included in theexternal examination question paper)</td><td colspan="5">Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved
(To be discussed during the Tutorial hours)</td></tr>
<tr><td>Recommended Text</td><td colspan="7">1. Secrets of Mental Math: The Mathemagician’s Guide to Lighting Calculation and Amazing math Tricks, Arthur Benjamin and Michael Shermer, 2006.
2. Barlow’s Tables of Squares, Cubes, Square Roots, Cube Roots, and Reciprocals, L.J. Comrie, Kessinger Publishing, 2010.</td></tr>
<tr><td>ReferenceBooks</td><td colspan="7">Magical Book on Quicker Maths, M. Tyra, Publisher: BSC, 1st Edition, 2018</td></tr>
<tr><td>Website and e-learning source</td><td colspan="7">4. https://nptel.ac.in
5. www.coursera.org
6. https://swayam.gov.in/</td></tr>
<tr><td colspan="8">Course Outcomes:

On completion of the course, the students should be able to

CO1: Develop the skills to do quick addition and subtraction</td></tr>
</table>

CO2: Perform Multiplication through quick techniques

CO3: Perform division through quick techniques

CO4: Understand the quick methods for Divisibility, Fractions, Squares, Cubes

CO5: Perform Quick factorization

	PO					
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

	PSO					
CO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	H	L
CO2	H	M	H	M	H	L
CO3	H	M	H	M	H	L
CO4	H	H	H	H	L	L
CO5	H	M	H	H	L	L

<table>
<tr><td>Title of the Course</td><td colspan="7">INDUSTRIAL STATISTICS</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core VII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">UCMAG24</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">The course aims at giving an overall view of the
• To provide a sound foundation in basic topics of modern statistical inference.
• To study the concept of likelihood and derive the likelihood and associated functions of interest for simple models.
• To construct confidence intervals for unknown parameters.
• To demonstrate understanding of how to design experiments and surveys for efficiency.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (15 hours) (K1, K2, K3 & K4)
Sampling Distributions
1.1 Parameter and statistic - Sampling distribution - Standard error
1.2 Sampling distribution of statistics
1.3 Chi-square distribution -p.d.f derivation, moment generating function
1.4 Chi-square distribution (continued) mean, variance, additive property
1.5 Student’s t distribution – moments - limiting form of t distribution
1.6 F distribution – mean, variance</td></tr>
<tr><td></td><td colspan="7">Unit II (15 hours) (K1, K2, K3 & K4)
Parametric Estimation
2.1 Point estimation, Concept of unbiasedness, consistency, efficiency and sufficiency
2.2 Cramer Rao Inequality – Rao-Blackwell Theorem
2.3 Methods of estimation
2.4 Method of moments
2.5 Interval Estimation - Confidence interval for mean - difference in means – proportion - difference in proportions
2.6 Interval Estimation for variance using normal, t and Chi-square distributions</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (15 hours) (K1, K2, K3 & K4)
Tests of Significance
3.1 Tests of significance – definitions
3.2 Tests of significance for large samples for mean
3.3 Tests of significance for large samples for standard deviation
3.4 Tests of significance for small samples – t, χ^2 test for mean and variance
3.5 Test of significance for small samples - F test for mean
3.6 Test of significance for small samples - F test for variance</td></tr>
</table>

	UNIT-IV: (15 hours) (K1, K2, K3 & K4) **Chi Square Tests** 4.1 Chi-square test of goodness of fit 4.2 Chi-square test of goodness of fit (Continued) 4.3 Attributes 4.4 Coefficient of association 4.5 Contingency tables 4.6 Chi-square test for independence of attributes
	UNIT-V: (15 hours) (K1, K2, K3 & K4) **Analysis of Variance** 5.1Analysis of variance-one-way and two-way classification 5.2 Basic principles of design of experiments 5.3 Randomization – Replication - Randomized Block Design 5.4 Randomized block design 5.5 Completely Randomized block design 5.6 Latin Square Design
Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	S. P. Gupta - Statistical Methods - Sultan Chand & Sons, New Delhi, 2nd Edition, 2020.
ReferenceBooks	1. Hogg R.V. and Craig, A.T. - Introduction to Mathematical Statistics, Macmillan, 4th Edition 1998. 2. Mood, A.M., Graybill, F.A. and Boes, D.G.- Introduction to Theory of Statistics - McGraw Hill Publication, 3rd Edition 1974. 3. Snedecor G.W., Cochran W.G. - Statistical Methods - Oxford and IBH -6th Edition 1967. 4. Hoel P.G. - Introduction to Mathematical Statistics – Wiley, 4th Edition 1971. 5. Wilks S.S. - Elementary Statistical Analysis - Oxford and IBH Reprint 1971.
Website and e-learning source	1. https://nptel.ac.in/ 2. www.coursera.org 3. https://spoken-tutorial.org
Course Outcomes: **On completion of the course, the students should be able to** **CO1:** Know the basic concepts of some advanced distributions. **CO2:** Apply estimation theory to estimate the values of parameters. **CO3:** Use appropriate sampling distributions for testing of hypothesis. **CO4:** Apply chi-square test to find out the significant difference between expected and observed frequencies in one or more categories. **CO5:** Use F-test to compare statistical model that has been fitted to a data that best fits the population from which the data was sampled.	

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	L	M	H
CO2	H	H	H	L	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	M	H	H	H	L
CO2	H	L	H	H	H	M
CO3	H	M	H	H	H	L
CO4	H	L	H	H	H	M
CO5	H	M	H	H	H	H

<table>
<tr><td>Title of the Course</td><td colspan="7">ELEMENTS OF MATHEMATICAL ANALYSIS</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core VIII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">UCMAH24</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">The course aims at giving an overall view of the
• To create an interest and to deepen the knowledge of students in concepts of real analysis.
• To familiarize the students to concepts of sequences, limits of sequences, limits of functions and continuity.
• To introduce the concepts of convergent, divergent and bounded sets.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (15 hours) (K1, K2, K3 & K4)
Functions and Real Numbers
1.1 Functions
1.2 Real valued functions
1.3 Equivalence – Countability
1.4 Real Numbers
1.5 Lease upper bounds
1.6 Greatest lower bounds</td></tr>
<tr><td></td><td colspan="7">UNIT II (15 hours) (K1, K2, K3 & K4)
Sequences of Real numbers
2.1 Definition of sequence and subsequence
2.2 Limit of sequence
2.3 Convergent sequence
2.4 Divergent sequence
2.5 Bounded sequence
2.6 Monotone sequence</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (15 hours) (K1, K2, K3 & K4)
Sequences (continued) and Series of Real Numbers
3.1 Operations on convergent sequence
3.2 Operations on divergent sequence
3.3 Convergence and divergence of Series
3.4 Convergence and divergence of Series (Continued)
3.5 Series with non-negative terms
3.6 Alternating series</td></tr>
</table>

	UNIT-IV: (15 hours) (K1, K2, K3 & K4) **Limits and Continuity of Metric Spaces** 4.1 Conditional convergence and absolute convergence 4.2 Limits and continuity of metric space 4.3 Limits and continuity of metric space (Continued) 4.4 Limit of a function on the real line 4.4 Metric spaces 4.5 Limits in metric spaces
	UNIT-V: (15 hours) (K1, K2, K3 & K4) **Continuous Functions on Metric Spaces** 5.1 Functions continuous at a point on the real line 5.2 Theorems on continuous function 5.3 Reformulation 5.4 Functions continuous on metric space 5.5 Theorems on continuity of metric space 5.6 Theorems on continuity of metric space (Continued)
Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	1. Richard R. Goldberg – Methods of Real Analysis – Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Indian Edition, 2020.
ReferenceBooks	1. Tom M,.Apostol - Mathematics Analysis , 2nd Edition – Narosa Publishing House – 1997. 2. Dr. K. ChandrasekarRao, Dr. K.S. Narayanan – Real Analysis Valume II, 2nd Edition – Viswanathan Publishers, 2008. 3. D. Somasundaram and B. Choudhray – A First Course in Mathematical Analysis, 1st Edition – Narosa Publishing House, 1999.
Website and e-learning source	1. https://nptel.ac.in 2. www.coursera.org 3. https://swayam.gov.in/

Course Outcomes:

On completion of the course, the students should be able to

CO1: Know the basic properties of the real line and real number system.
CO2: Understand the fundamentals of sequences and to calculate their limits.
CO3: Recognize the arithmetic properties of convergence and divergence of sequence and series.
CO4: Learn the properties of metric space and its type.
CO5: Know about continuous function and its reformulation.

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	L	M	H
CO2	H	H	H	L	M	H
CO3	H	H	H	M	L	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	M	L	H	L
CO2	H	H	M	M	H	L
CO3	H	M	H	H	H	L
CO4	H	M	H	H	H	L
CO5	H	H	H	M	H	L

<table>
<tr><td>Title of the Course</td><td colspan="7">ALLIED IV: NUMERICAL METHODS AND TRANSFORMS</td></tr>
<tr><td>Paper No.</td><td colspan="7"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Allied</td><td>Year</td><td>II</td><td>Credits</td><td>4</td><td>Course Code</td><td>UANMA24</td></tr>
<tr><td>Semester</td><td>IV</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">The course aims at giving an overall view of the
• To apply numerical methods and obtain the approximate solutions to mathematical problems.
• To introduce various concepts of Transforms.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (12 hours) (K1, K2, K3 & K4)

Interpolation with Equal Intervals
1.1 Forward Difference Interpolation
1.2 Gregory-Newton forward interpolation (for equal intervals)
1.3 Backward Difference Interpolation
1.4 Gregory-Newton Backward interpolation (for equal intervals)
1.5 Equidistant terms with one or more missing values
1.6 Central Difference Interpolation-Stirling’s Interrpolation</td></tr>
<tr><td></td><td colspan="7">UNIT II (12 hours) (K1, K2, K3 & K4)
Interpolation with Unequal Intervals
2.1 Divided differences
2.2 Properties of divided differences
2.3 Relation between divided differences and forward differences
2.4 Newton’s divided difference interpolation
2.5 Lagrange’s interpolation
2.6 Different forms of Lagrange’s interpolation</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (12 hours) (K1, K2, K3 & K4)
Numerical Differentiation and Integration
3.1 Newton’s forward difference interpolation to get the derivative
3.2 Newton’s Backward difference interpolation to get the derivative
3.3 Derivative using Stirling’s Interpolation
3.4 A general quadrature formula for equidistant ordinates
3.5 Trapezoidal rule
3.6 Simpson’s one-third rule and Simpson’s three-eighth rule.</td></tr>
</table>

	UNIT-IV: (12 hours) (K1, K2, K3 & K4) **Z – Transform** 4.1 Z – transform-introduction 4.2 Properties of Z-transform 4.3 Z – transform of some basic functions 4.4 Inverse Z transform 4.5 Convolution theorem (without Proof) 4.6 Solution of linear difference equations with constant coefficients using Z-transform
	UNIT-V: (12 hours) (K1, K2, K3 & K4) **Laplace Transform** 5.1 Laplace Transform -Introduction 5.2 Transforms of elementary functions 5.3 Properties of Laplace Transform 5.4 Laplace Transforms of derivatives 5.5 Laplace Transforms of integrals 5.6 Periodic function of Laplace transforms.
Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	1. T. Veerarajan – Transforms and Partial Differential Equations- Tata McGraw Hill Education Pvt Limited, New Delhi – Third Edition, 2012. 2. M. K. Venkataraman and Manorama Sridhar - Differential Equations and Laplace Transform - First Edition – 2004. 3. P. Kandasamy, K. Thilagavathy and K. Gunavathy- Numerical Methods-S.Chand publication-Revised Edition 2014.
ReferenceBooks	1. P. R. Vittal - Differential equations, Fourier and Laplace Transforms and Probability - Margham Publication – Third Edition, 2002. 2. P.R. Vittal - Allied Mathematics – Margham Publications - Third Edition, 2002. 3. P. Kandasamy and K. Thilagavathi - Allied Mathematics Volume I and Volume II - S.Chand and Co, New Delhi, 2004. 4. Dr. A. Singaravelu – Numerical Methods – Meenakshi Agency - 120, Pushpa Nagar Medavakkam, Chennai, Revised Edition: Dec 2007. 5. R. Gupta – Numerical Analysis, Laxmi Publishing Ltd., New Delhi - Revised Edition, 2001.
Website and e-learning source	1. https://nptel.ac.in 2. www.coursera.org 3. https://swayam.gov.in/

Course Outcomes:

On completion of the course, the students should be able to

CO1: Understand Numerical Interpolation with Equal Intervals
CO2: Understand Numerical Interpolation with Unequal Intervals
CO3: Understand Numerical Differentiation and Integration
CO4: Understand the basic concepts of Z -Transforms.
CO5: Understand the basic concepts of Laplace Transforms.

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	L	L	M
CO2	H	H	H	L	L	M
CO3	H	H	H	L	L	M
CO4	H	H	H	L	L	M
CO5	H	H	H	L	L	M

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	M	M	H	L
CO2	H	H	M	H	H	L
CO3	H	H	M	H	H	L
CO4	H	H	M	H	H	L
CO5	H	H	M	M	H	L

<table>
<tr><td>Title of the Course</td><td colspan="7">SKILL ENHANCEMENT COURSE: NUMERICAL METHODS PRACTICAL</td></tr>
<tr><td>Paper No.</td><td colspan="7">SEC 6</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Skill Enhancement Course</td><td>Year</td><td>II</td><td>Credits</td><td>2</td><td>Course Code</td><td>USMA624</td></tr>
<tr><td>Semester</td><td>IV</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">2</td><td colspan="2">-</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">The aim of this course is to practice mathematics in software.</td></tr>
<tr><td>Course Outline</td><td colspan="7">1. Computing expressions
2. Operations on Vectors
3. Operations on Sets
4. Permutation and Combinations
5. Polynomial Interpolation.
6. Matrix Manipulation.</td></tr>
<tr><td colspan="3">Extended Professional Component (isa part of internal component only, not to be included in theexternal examination question paper)</td><td colspan="5">Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved
(To be discussed during the Tutorial hours)</td></tr>
<tr><td>Recommended Text</td><td colspan="7">1. Introduction to Scilab, Michael Baudin From Scilab Consortin, 2010 Chapters 1 to 8.
2. Plotting Using Scilab – Anopen Source Document www.openeering.com</td></tr>
<tr><td>ReferenceBooks</td><td colspan="7">1. Modeling and Simulation in Scilab, Stephen L. Campbell, Jean-Philippe Chancelier and Ramine Nikoukhah.
2. An Introduction to Scilab from a Matlab User's Point of View by Eike Rietsch.
3. Advanced Programming in Scilab, Chetana Jain, Narosa Publishing House, New Delhi.</td></tr>
<tr><td>Website and e-learning source</td><td colspan="7">http://ndl.iitkgp.ac.in

http://ocw.mit.edu

http://mathforum.org</td></tr>
</table>

Course Outcomes:

On completion of the course, the students should be able to

CO1: Solve Mathematical Problems using Mathematical software's.
CO2: Understand the knowledge of application of mathematics.
CO3: Understand the concept of set theory.
CO4: Compute permutation and combinations.
CO5: Analyze polynomial interpolations.

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	H	L	H
CO2	H	M	H	M	L	H
CO3	H	M	H	M	L	H
CO4	H	H	H	H	L	H
CO5	H	M	H	H	L	H

<table>
<tr><td>Title of the Course</td><td colspan="7">SKILL ENHANCEMENT COURSE: QUICK MATH - II</td></tr>
<tr><td>Paper No.</td><td colspan="7">SEC 7</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Skill Enhancement Course</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">1</td><td rowspan="2">Course Code</td><td rowspan="2">USMA724</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>1</td><td>-</td><td colspan="2">-</td><td colspan="3">1</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">The course aims at giving an overall view of the
• To revitalize the basic knowledge of mathematics and problem-solving skills.
• To enhance logical, analytical, and critical thinking of learners.
• To help the students to prepare for various competitive examinations.</td></tr>
<tr><td>Course Outline</td><td colspan="7">7. Percentage tricks
8. Simplification tricks
9. Average tricks
10. Number Series
11. Profit and Loss
12. Quadratic Equations</td></tr>
<tr><td colspan="3">Extended Professional Component (isa part of internal component only, not to be included in theexternal examination question paper)</td><td colspan="5">Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved
(To be discussed during the Tutorial hours)</td></tr>
<tr><td>Recommended Text</td><td colspan="7">Secrets behind faster Calculations, Praveen Tyagi, GK Publishers, 2018</td></tr>
<tr><td>ReferenceBooks</td><td colspan="7">3. Secrets of Mental Math: The Mathemagician’s Guide to Lighting Calculation and Amazing math Tricks, Arthur Benjamin and Michael Shermer, 2006.
2. Magical Book on Quicker Maths, M. Tyra, Publisher: BSC, 1st Edition, 2018</td></tr>
<tr><td>Website and e-learning source</td><td colspan="7">7. https://nptel.ac.in
8. www.coursera.org
9. https://swayam.gov.in/</td></tr>
</table>

Course Outcomes:

On completion of the course, the students should be able to

CO1: Apply percentage concepts effectively

CO2: Apply simplification concepts effectively

CO3: Apply average concepts effectively

CO4: Understand Number series patterns and Profit and Loss concepts

CO5: Analyze Quadratic Equations

CO	PSO					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	H	L
CO2	H	M	H	M	H	L
CO3	H	M	H	M	H	L
CO4	H	H	H	H	L	L
CO5	H	M	H	H	L	L

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

<table>
<tr><td>Title of the Course</td><td colspan="7">ABSTRACT ALGEBRA</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core IX</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">UCMAI24</td></tr>
<tr><td>Semester</td><td>V</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe Course</td><td colspan="7">• To introduce the concepts of abstract algebra.
• To enable understanding of fundamental algebraic structures.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (15 hours) (K1, K2, K3 & K4)

Group Theory

1.1 Definition of a Group
1.2 Examples of Groups
1.3 Some Preliminary Lemmas
1.4 Subgroups
1.5 Lagrange’s Theorem, Corollaries to Lagrange’s Theorem
1.6 A Counting Principle
1.7</td></tr>
<tr><td></td><td colspan="7">UNIT II (15 hours) (K1, K2, K3 & K4)

Group Theory (Continued)

2.1 Normal Subgroups
2.2 Quotient Groups
2.3 Homomorphisms
2.4 Kernel of a Homomorphism
2.5 Isomorphisms
2.6 Theorems on Isomorphism</td></tr>
<tr><td></td><td colspan="7">UNIT III (15 hours) (K1, K2, K3 & K4)

Group Theory (Continued)

3.1 Automorphisms
3.2 Automorphisms (Continued)
3.3 Cayley’s Theorem
3.4 Permutation Groups
3.5 Cycles and Transpositions
3.6 Even and Odd Permutations</td></tr>
</table>

	UNIT IV (15 hours) (K1, K2, K3 & K4) **Ring Theory** 4.1 Definition of a Ring 4.2 Examples of Ring 4.3 Some Special Classes of Rings 4.4 Integral Domain 4.5 Homomorphisms and Isomorphisms 4.6 Ideals and Quotients Rings
	UNIT V (15 hours) (K1, K2, K3 & K4) **Ring Theory (Continued)** 5.1 Ideals and Quotients Rings (Continued) 5.2 Maximal Ideals 5.3 The field of Quotients of an Integral Domain 5.4 Euclidean Rings 5.5 Euclidean Rings (Continued) 5.6 Unique Factorisation Theorem
Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	I. N. Herstein – Topics in Algebra – John Wiley & Sons, Inc., Second Edition, 2006.
ReferenceBooks	1. S. Arumugam and A. Thangapandi Issac – Modern Algebra - Scitech Publications (India) Pvt. Ltd., 3rd Edition, Reprint, 2005. 2. S.G. Venkatachalapathy – Modern Algebra – Margham Publications, 2003. 3. M.L.Santiago -Modern Algebra, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2002.
Website and e-learning source	1. https://nptel.ac.in/ 2. www.coursera.org/ 3. https://swayam.gov.in/

Course Outcomes:

On completion of the course, the students should be able to

CO1: Understand the concepts of groups and sub groups.
CO2: Know about normal subgroups, quotient groups, homomorphisms and isomorphisms.
CO3: Understand the concepts of automorphisms for constructing new groups from the given groups.
CO4: Have knowledge on concepts of ring theory.
CO5: Understand the concepts of maximal ideals and Euclidean rings.

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO 6
CO1	H	H	H	L	L	M
CO2	H	H	H	L	L	M
CO3	H	H	H	L	L	M
CO4	H	H	H	L	L	M
CO5	H	H	H	L	L	M

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO 6
CO1	H	M	H	H	M	L
CO2	H	M	H	H	M	L
CO3	H	M	H	H	M	L
CO4	H	M	H	H	M	L
CO5	H	M	H	H	M	L

<table>
<tr><td>Title of the Course</td><td colspan="7">REAL ANALYSIS</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core X</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">UCMAJ24</td></tr>
<tr><td>Semester</td><td>V</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">• To create an interest and to deepen the knowledge of students in concepts of real analysis.
• To make the students think logically and objectively.
• To make the students understand the concepts of connectedness, Compactness, Completeness of Metric spaces.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (15 hours) (K1, K2, K3 & K4)
Continuity and Connectedness
1.1 Open sets
1.2 Open sets (Continued)
1.3 Closed sets
1.4 Closed sets (Continued)
1.5 Discontinuous function on R^1
1.6 Connected sets</td></tr>
<tr><td></td><td colspan="7">Unit II (15 hours) (K1, K2, K3 & K4)
Completeness and Compactness
2.1 Bounded sets and totally bounded sets
2.2 Complete metric space
2.3 Compact metric space
2.4 Continuous functions on a compact metric space
2.5 Continuity of inverse functions
2.6 Uniform continuity</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (15 hours) (K1, K2, K3 & K4)
The Riemann Integral
3.1 Sets of measure zero
3.2 Definition of Riemann upper sum and lower sum
3.3 Definition of the Riemann integral
3.4 Existence of the Riemann integral
3.5 Theorems on Riemann integral
3.6 Properties of the Riemann integral</td></tr>
</table>

	UNIT-IV: (15 hours) (K1, K2, K3 & K4) **The Lebesgue Integral** 4.1 Length of open sets and closed sets 4.2 Inner and Outer measure 4.3 Measurable sets 4.4 Properties of measurable sets 4.5 Theorems on measurable sets 4.6 Symmetric difference and its theorem
	UNIT-V: (15 hours) (K1, K2, K3 & K4) **The Lebesgue Integral (Continued)** 5.1 Definition and example of Measurable functions 5.2 Theorems on measurable functions 5.3 Definition and existence of the Lebesgue integral for bounded function 5.4 Theorems on Lebesgue integral 5.5 Properties of the Lebesgue integral for bounded measurable functions 5.6 Relationship between Riemann and Lebesgue integral
Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	1. Richard R.Goldberg – Methods of Real Analysis – Oxford & IBH Publishing Co. Pvt., Ltd., New Delhi, Indian Edition, 2020.
ReferenceBooks	1. Principles of Mathematical Analysis by Walter Rudin, Tata McGraw Hill Education, Third edition (1 July 2017). 2. Mathematical Analysis Tom M A postal, Narosa Publishing House, 2nd edition (1974), Addison-Wesley publishing company, New Delhi
Website and e-learning source	1. https://nptel.ac.in 2. www.coursera.org 3. https://swayam.gov.in/

Course Outcomes:

On completion of the course, the students should be able to

CO1: Explain the concepts of Continuous and Discontinuous functions, open and close sets, Connectedness, Completeness and Compactness.

CO2: Explain the concepts of bounded and totally bounded sets, continuity of inverse functions and Uniform continuity

CO3: Define the sets of measure zero, to Explain about the existence and properties of Riemann integral.

CO4: Assimilate the concept of partition on an interval in Riemann Integral and understand about lebesgue Integrability.

CO5: Acquire knowledge about measurable functions and their properties.

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	L	L	H
CO2	H	H	H	L	L	H
CO3	H	H	H	M	L	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	M	M	M	L
CO2	H	H	H	M	H	L
CO3	H	M	H	M	H	L
CO4	H	M	M	H	H	L
CO5	H	H	M	M	H	L

<table>
<tr><td>Title of the Course</td><td colspan="7">MATHEMATICAL MODELING</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core XI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td>Credits</td><td>4</td><td>Course Code</td><td>UCMAK24</td></tr>
<tr><td>Semester</td><td>V</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">• Construction and Analysis of Mathematical models found in real life problems
• Modeling through differential and difference equations</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (15 hours) (K1, K2, K3 & K4)
Mathematical Modelling

1.1 Simple situations requiring mathematical modelling
1.2 The Technique of Mathematical Modelling
1.3 Classification of Mathematical Modelling
1.4 Classification of Mathematical Modelling (Continued)
1.5 Characteristics of mathematical models
1.6 Characteristics of mathematical models (Continued)</td></tr>
<tr><td></td><td colspan="7">Unit II (15 hours) (K1, K2, K3 & K4)
Mathematical Modelling through differential equations

2.1 Linear Growth and Decay Models
2.2 Linear Growth and Decay Models (Continued)
2.3 Non-Linear growth and decay models
2.4 Non-Linear growth and decay models (Continued)
2.5 Compartment models
2.6 Compartment models (Continued)</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (15 hours) (K1, K2, K3 & K4)
Mathematical Modelling through system of ordinary differential equations of first order

3.1 Prey-predator models
3.2 Competition models
3.3 Multispecies models
3.4 A Simple Epidemic Model
3.5 A Susceptible-Infected- Susceptible (SIS) Model
3.6 SIS model with constant number of carriers</td></tr>
</table>

	UNIT-IV: (15 hours) (K1, K2, K3 & K4) **Introduction to difference equations** 4.1 The need for Mathematical Modelling through Difference Equations- Some Simple Models 4.2 Basic theory of Linear Difference Equations with constant coefficients-The linear Difference Equation 4.3 The Complementary function 4.4 The Particular solution 4.5 Obtaining the Complementary Function by use of Matrices 4.6 Solution of a system of Linear Homogeneous Difference Equations with Constant Coefficients
	UNIT-V: (15 hours) (K1, K2, K3 & K4) **Mathematical Modelling through difference equations** 5.1 The Harrod Model 5.2 The Harrod Model (Continued) 5.3 The Cobweb model 5.4 The Cobweb model (Continued) 5.5 Application to Actuarial Science 5.6 Application to Actuarial Science (Continued)
Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	J N Kapur, Mathematical Modeling, New Age International publishers (2009)
ReferenceBooks	1. Mathematical Modeling by Bimalk. Mishra and Dipak K.Satpathi. Ane Books Pvt. Ltd(1 Januuary 2009) 2. Mathematical Modeling Models, Analysis and Applications, by Sandip Banerjee, CRC Press, Taylor & Francis group, 2014 3. Mathematical Modeling applications with Geogebra by Jonas Hall & Thomas Ligefjard, John Wiley & Sons, 2017
Website and e-learning source	1. https://nptel.ac.in/ 2. www.coursera.org 3. https://swayam.gov.in

Course Outcomes:

On completion of the course, the students should be able to

CO1: Explain simple situations requiring Mathematical Modeling and to Determine the characteristics of such models

CO2: Model using differential equations in-terms of linear growth and Decay models

CO3: Model using systems of ordinary differential equations of first order, to discuss about various models under the categories 'Epidemics' and 'Medicine'

CO4: Explain in detail about difference equations

CO5: Model using difference equations.

	PSO					
CO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	H	L
CO2	H	M	H	M	H	L
CO3	H	H	M	M	H	L
CO4	H	M	M	M	H	L
CO5	H	M	H	H	H	L

	PO					
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

<table>
<tr><td>Title of the Course</td><td colspan="7">OPTIMIZATION TECHNIQUES</td></tr>
<tr><td>Paper No.</td><td colspan="7">CORE XII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">CORE</td><td>Year</td><td>II</td><td>Credits</td><td>4</td><td>Course Code</td><td>UCMAL24</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe Course</td><td colspan="7">• To apply problem-solving skills to real-life situations.
• To develop logical and analytical skills.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (15 hours) (K1, K2, K3 & K4)
Linear Programming
1.1 Introduction
1.2 Scope of OR
1.3 Formulation of Linear Programming Problem
1.4 Graphical Method
1.5 Standard Form of LPP
1.6 Simplex Method</td></tr>
<tr><td></td><td colspan="7">UNIT II (15 hours) (K1, K2, K3 & K4)
Transportation Model
2.1 Introduction – Mathematical Formulation
2.2 Finding Initial Basic Feasible Solution-North West Corner Rule
2.3 Matrix Minima Method
2.4 Vogel’s Approximation Method – Optimality Test – MODI Method
2.5 Unbalanced Transportation Problem
2.6 Maximization Problem</td></tr>
<tr><td></td><td colspan="7">UNIT III (15 hours) (K1, K2, K3 & K4)
Assignment Model
3.1 Assignment Problem-Mathematical Formulation of the Assignment Problem
3.2 Hungarian Method-Solution to Assignment Problem
3.3 Unbalanced Assignment Problem
3.4 Maximization Assignment Problem
3.5 Travelling Salesman Problem – Mathematical Formulation
3.6 Solution to Travelling Salesman Problem</td></tr>
</table>

	UNIT IV (15 hours) (K1, K2, K3 & K4) **Game Theory** 4.1 Introduction – Characteristics of Games – Definitions 4.2 The Maximin-Minimax Principle 4.3 Two-Person Zero-Sum Games with Saddle Point 4.4 Two-Person Zero-Sum Games without Saddle Point (Mixed Strategies)-Algebraic Method 4.5 Method of Dominance 4.6 Graphical Method for 2xn or mx2 Games (without saddle point)
	UNIT-V: (15 hours) (K1, K2, K3 & K4) **PERT and CPM** 5.1 Introduction – Network Diagram Representation 5.2 Time Calculations and Critical Path in Network Analysis 5.3 Time Calculations and Critical Path in Network Analysis (Continued) 5.4 Determination of Floats and Slack Times 5.5 Critical Path Method (CPM) 5.6 Program Evaluation and Review Technique (PERT)
Extended Professional Component (isa part of internal component only, not to be included in theexternal examination question paper)	Questions related to the above topics from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	1. P.K. Gupta and D.S. Hira – Problems in Operations Research, 1st Edition – Chand and Company Ltd., 2010.
ReferenceBooks	1. S. Kalavathy – Operations Research, 2nd Edition – Vikas Publications Ltd., 2002. 2. S. J. Venkatesan – Operations Research, 3rd Edition – J S Publications, Printed by Udayam Offsets, Chennai, 1999. 3. V.K. Kapoor – Operations Research, 5th Edition – Sultan Chand and Sons, Educational Publishers, New Delhi, Revised Reprint, 1996.
Website and e-learning source	1. https://nptel.ac.in/ 2. www.coursera.org 3. https://swayam.gov.in

Course Outcomes:

On completion of the course, the students should be able to

CO1: Translate the real-world problems into linear programming problems and obtain solutions.

CO2: Apply the transportation problem techniques for the optimization of cost.

CO3: Solve the assignment problem which deals with the allocation of various sources to various destinations on one-to-one basis.

CO4: Find the optimum strategies of the players and the value of the 2-person games.

CO5: Perform network planning using PERT & CPM techniques which provide a methodology for planning and controlling of a project.

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO 6
CO1	H	H	H	L	L	H
CO2	H	H	H	L	L	H
CO3	H	H	H	L	L	H
CO4	H	H	H	L	L	H
CO5	H	H	H	L	L	H

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO 6
CO1	H	M	H	H	M	L
CO2	H	M	H	H	M	L
CO3	H	M	H	H	M	L
CO4	H	M	H	H	M	L
CO5	H	M	H	H	M	L

<table>
<tr><td>Title of the Course</td><td colspan="7">GRAPH THEORY AND APPLICATIONS</td></tr>
<tr><td>Paper No.</td><td colspan="7">Discipline Specific Elective III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Discipline Specific Elective</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">UEMAA24</td></tr>
<tr><td>Semester</td><td>V</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">• To introduce the students to the beautiful and elegant theory of graphs.
• To study and develop the concepts of different graphs.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (12 hours) (K1, K2, K3 & K4)
Graphs and Subgraphs
1.1 Introduction to Graphs - Subgraphs
1.2 Degree of a vertex
1.3 Isomorphism of graphs
1.4 Independent sets and coverings
1.5 Intersection graphs and line graphs
1.6 Operations on graphs.</td></tr>
<tr><td></td><td colspan="7">Unit II (12 hours) (K1, K2, K3 & K4)
Connectedness and components
2.1 Walks, Trails and Paths
2.2 Connectedness and components - cut point
2.3 Bridge
2.4 Block
2.5 Vertex Connectivity
2.6 Edge Connectivity</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (12 hours) (K1, K2, K3 & K4)
Trees
3.1 Tree – Introduction
3.2 Forest
3.3 Equivalent property of tree
3.4 Spanning tree
3.5 Centre of a tree
3.6 Results in Centre of a tree</td></tr>
</table>

	UNIT-IV: (12 hours) (K1, K2, K3 & K4) **Eulerian and Hamiltonian graphs** 4.1 Eulerian graphs 4.2 Equivalent property of Eulerian graphs 4.3 Hamiltonian graphs 4.4 Property of Hamiltonian graphs 4.5 Simple problems in Hamiltonian graphs 4.6 Algorithm
	UNIT-V: (12 hours) (K1, K2, K3 & K4) **Planarity** 5.1 Planarity-Introduction 5.2 Planarity-Definition 5.3 Simple Problems in Planarity 5.4 Planarity properties 5.5 Characterization of planar graph 5.6 Theorems on Planarity graph
Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	S. Arumugam and S. Ramachandran, Invitation to Graph Theory, SITECH Publications, India Pvt. Ltd., 2006 2.J.A.Bondy and U.S.R. Murthy, Graph Theory with Applications, Macmillon, London, 2008.
ReferenceBooks	1.S.Kumaravelu, Susheela Kumaravelu, Graph Theory, SKV Publishers, Sivakasi, 1999. 2. S.A.Choudham, A First Course in Graph Theory, Macmillan India Ltd, 2000. 3. Robin J. Wilson, Introduction to Graph Theory, Prentice Hall, 2012. 4. Harray, Graph Theory, Narosa Publication, 1998.
Website and e-learning source	1. www.coursera.org/ 2. https://nptel.ac.in/ 3. https://swayam.gov.in/

Course Outcomes:

On completion of the course, the students should be able to

CO1: Understand the basic graph theory concepts

CO2: Analyze the connectedness in graphs using vertices and edges.

CO3: Identify the uniqueness of paths using tree concepts.

CO4: Acquire wide knowledge of mathematical principles of graphs

CO5: Understand the emerging research topics based on graphs

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	M	H	H	L
CO2	H	H	H	M	L	H
CO3	H	H	H	H	H	M
CO4	H	H	M	L	H	H
CO5	H	H	M	H	H	L

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	L	L	H
CO2	H	H	H	L	L	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

<table>
<tr><td>Title of the Course</td><td colspan="7">NUMBER THEORY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Discipline Specific Elective IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Discipline Specific Elective</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">UEMAB24</td></tr>
<tr><td>Semester</td><td>V</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3"></td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">1. To introduce students to the concept of number theory, thereby enhancing the logical thinking of the students with regard to applications in security systems.
2. To construct the ability of students to work independently and do in-depth study of various notions of number theory.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (12 hours) (K1, K2, K3 & K4)
Distribution of Primes and Theory of Congruencies
1.1 Linear Diophantine equation, Prime counting function
1.1 Prime number theorem, Goldbach conjecture
1.2 Twin-prime conjecture, Odd perfect numbers conjecture
1.4 Fermat and Mersenne primes, Congruence relation and its properties
1.5 Linear congruence and Chinese remainder theorem
1.6 Fermat's little theorem, Wilson's theorem.</td></tr>
<tr><td></td><td colspan="7">Unit II (12 hours) (K1, K2, K3 & K4)
Number Theoretic Functions
2.1 Number theoretic functions for sum and number of divisors
2.2 Multiplicative function
2.3 The Möbius inversion formula
2.4 Greatest integer function
2.5 Euler’s phi-function and properties
2.6 Euler’s theorem</td></tr>
<tr><td></td><td colspan="7">UNIT III: (12 hours) (K1, K2, K)
Primitive Roots
3.1 Order of an integer modulo n
3.2 Primitive roots for primes
3.3 Composite numbers having primitive roots
3.4 Definition of quadratic residue of an odd prime
3.5 Euler’s criterion
3.6 Problems</td></tr>
</table>

	UNIT IV: (12 hours) (K1, K2, K3 & K4) **Quadratic Reciprocity Law** 4.1 The Legendre symbol and its properties 4.1 The Legendre symbol and its properties-problems 4.2 Quadratic reciprocity 4.4 Quadratic reciprocity – problems 4.5 Quadratic congruencies with composite moduli 4.6 Quadratic congruencies with composite moduli –problems
	UNIT-V: (12 hours) (K1, K2, K3 & K4) **Applications** 5.1 Public key encryption 5.2 Public key encryption (continued) 5.3 RSA encryption and decryption 5.4 RSA encryption and decryption (Continued) 5.5 RSA encryption and decryption with applications in security systems 5.6 RSA encryption and decryption with applications in security systems (Continued)
ExtendedProfessionalComponent(isapartofinternalcomponentonly,nottobeincludedintheexternal examination Question paper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/JAM/TNPSCandotherstobesolved (To be discussed during the Tutorial hours)
Recommended Text	David M. Burton -Elementary Number Theory, 7th edition, McGraw-Hill., 2007.
Reference Books	1. Gareth A. Jones & J. Mary Jones -Elementary Number Theory. Springer, 2005. 2. Neville Robbins - Beginning Number Theory, 2nd edition, Narosa, 2007. 3. I.Niven - An Introduction to the Theory of Numbers, 5th edition, John Wiley & Sons, 2012. 4. 5. Neal Koblitz - A Course in Number Theory and Cryptography, 2nd edition, Springer-Verlag. 1994.
Websiteande-learningsource	1. https://nptel.ac.in 2. www.coursera.org 3. https://swayam.gov.in/

Course Outcomes:

On completionofthecourse,thestudentsshouldbeableto

The learners will be able to

CO1: Learn about some important results in the theory of numbers including the prime number theorem, Chinese remainder theorem, Wilson's theorem and their consequences.

CO2: Learn about number theoretic functions, modular arithmetic and their applications.

CO3: Familiarize with modular arithmetic and find primitive roots of prime and composite numbers.

CO4: Know about open problems in number theory, namely, the Goldbach conjecture and twin-prime conjecture.

CO5: Apply public crypto systems, in particular, RSA.

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	M	H	M	L
CO2	H	H	M	M	H	L
CO3	H	H	M	H	H	L
CO4	H	H	M	H	M	L
CO5	H	H	M	M	M	L

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	L	L	H
CO2	H	H	H	L	L	H
CO3	H	H	H	M	L	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

<table>
<tr><td>Title of the Course</td><td colspan="7">PROGRAMMING IN C</td></tr>
<tr><td>Paper No.</td><td colspan="7">Generic Elective III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Generic Elective</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">UEMAC24</td></tr>
<tr><td>Semester</td><td>V</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td></td><td colspan="3"></td><td colspan="2">3</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">1. Thinking of the students with regard to programming.
2. To train the students to apply the programming concepts of C to mathematical investigations and problem solving.
3. To enhance the ability of students to work independently and do in-depth study of various notions of programming.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (9 hours) (K1, K2, K3 & K4)
Overview of C, Constants, Variables and Data types

1.1 Basic Structure of C programs – Character set
1.2 C tokens – Keywords and Identifiers
1.3 Constants – Variables
1.4 Data types – Declaration of variables
1.5 Assigning values to variables
1.6 Defining symbolic constants – Declaring a variable as constant</td></tr>
<tr><td></td><td colspan="7">Unit II (9 hours) (K1, K2, K3 & K4)
Operators, Expressions, Managing Input and Output Operations

2.1Introduction-Arithmetic Operators-Relational Operators-Logical Operators
2.2 Assignment Operators - Increment and Decrement Operators
2.3 Conditional Operators - Bitwise Operators – Special Operators
2.4 Type Conversions in Expressions
2.5 Operator Precedence and Associativity
2.6 Formatted Input-Formatted Output</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (9 hours) (K1, K2, K3 & K4)
Decision Making and Branching, Decision Making and Looping
3.1 Introduction - Decision Making with IF Statement
3.2 Simple IF – IF ELSE - Nesting of IF ELSE statements
3.3 The ELSE IF Ladder - The SWITCH statement
3.4 The conditional (? :) operator- The GOTO statement
3.5 Introduction - The WHILE statement – The DO statement
3.6 The FOR statement - Jumps in LOOPS</td></tr>
</table>

	UNIT-IV: (9 hours) (K1, K2, K3 & K4) **Arrays and User-Defined Functions** 4.1 Introduction – One Dimensional Array 4.2 Declaration and Initialization of One Dimensional Array 4.3 Two Dimensional Arrays - Initializing Two Dimensional Arrays 4.4 Introduction – Need for User-defined functions 4.5 Elements of user-defined functions – Definition of functions – Return values and their types 4.6 Function calls – Function declaration - Nesting of functions – Recursion.
	UNIT-V: (9 hours) (K1, K2, K3 & K4) **Structures and Unions, Pointers** 5.1 Introduction-Defining a structure-Declaring structure variables-Accessing structure members 5.2 Structure initialization-copying and comparing structure variables 5.3 Operations on individual members -Unions 5.4 Understanding Pointers – Accessing the address of a variable – Declaring pointer variables 5.5 Initialization of pointer variables-Accessing a variable through its pointer 5.6 Chain of pointers
Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	1. E. Balagurusamy, Programming in ANSI C, 8th Edition, McGraw Hill Education Private Limited, New Delhi, India, 2022.
ReferenceBooks	1. Ashok N. Kamathne, Programming with C, Pearson Publication, 2009. 2. C: The Complete Reference, Herb Schildt, 4th Edition, Tata McGraw Hill Publishers, 2017 3. Let Us C: Authentic guide to C programming language, Yashavant Kanetkar, (18th Edition), BPB Publications, 2021
Website and e-learning source	1. https://nptel.ac.in/ 2. www.coursera.org 3. https://swayam.gov.in

Course Outcomes:

On completion of the course, the students should be able to

CO1: Understand the basics of programming in C such as tokens, data types, operators etc.
CO2: Use the Decision making-branching and looping statements in C programming.
CO3: Handle the concept of arrays and the concept of the user defined functions.
CO4: Express the uses of structures and pointers
CO5: Understand and apply the programming concepts of C to problem solving.

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	H	L	H
CO2	H	M	H	M	M	H
CO3	H	M	H	M	M	H
CO4	H	H	H	H	L	H
CO5	H	M	H	H	L	H

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE PRACTICAL: C</td></tr>
<tr><td>Paper No.</td><td colspan="7">Generic Elective III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Generic Elective</td><td>Year</td><td>III</td><td>Credits</td><td>1</td><td>Course Code</td><td>UEMAD24</td></tr>
<tr><td>Semester</td><td>V</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td></td><td colspan="3">2</td><td colspan="2">2</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">• To introduce students to the concept of basic programming, thereby enhancing the logical thinking of the students with regard to programming.
• To train the students to apply the programming concepts of C to mathematical investigations and problem solving.</td></tr>
<tr><td>Course Outline</td><td colspan="7">Simple Programs:
a) Sum of ‘n’ natural numbers.
b) Quadratic Equation
c) Simple Interest
d) Mean, Standard deviation and Variance.
e) Generating Prime numbers.
f) Largest of three numbers.
Summation of Series:
a) Sin(x)
b) Cos(x)
Recursion:
a) nPr and nCr
b) GCD of two numbers.
Matrix Manipulation:
a) Addition and Subtraction
b) Transpose.
Sorting and Searching:
a) Bubble sort (simple program)
b) Binary search and Median
Structures:
Grades of students of a class using structure</td></tr>
<tr><td colspan="4">Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)</td><td colspan="4">Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved
(To be discussed during the Tutorial hours)</td></tr>
<tr><td>Recommended Text</td><td colspan="7">E. Balagurusamy, Programming in ANSI C, 8th Edition, McGraw Hill Education Private Limited, New Delhi, India, 2022.</td></tr>
</table>

ReferenceBooks	1. Ashok N. Kamathne –Programming with C- Pearson publication, 2009. 2. C: The Complete Reference, Herb Schildt, 4th Edition, Tata McGraw Hill Publishers, 2017 3. Let Us C: Authentic guide to C programming language, Yashavant Kanetkar, (18th Edition), BPB Publications, 2021
Website and e-learning source	1. https://nptel.ac.in/ 2. www.coursera.org 3. https://swayam.gov.in

Course Outcomes:

On completion of the course, the students should be able to

CO1: Implement programs with branching and looping statements.
CO2: Write programs that perform operations using derived data types and functions.
CO3: Demonstrate a thorough understanding of arrays by designing and implementing programs that search and sort arrays.
CO4: Perform Matrix operations using C.
CO5: Use structures and pointers in C programs

	PSO					
CO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	L	H
CO2	H	M	H	M	M	H
CO3	H	M	H	M	M	H
CO4	H	H	H	H	H	H
CO5	H	M	H	H	L	H

	PO					
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

<table>
<tr><td>Title of the Course</td><td colspan="7">LINEAR ALGEBRA</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core XIII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td>Credits</td><td>4</td><td>Course Code</td><td>UCMAL24</td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td>Total</td></tr>
<tr><td></td><td>5</td><td>1</td><td colspan="3">-</td><td>6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe Course</td><td colspan="7">• To introduce the concepts of linear algebra.
• To familiarize the concepts of linear transformations and their matrices.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (18 hours) (K1, K2, K3 & K4)
Vector Spaces
1.1 Definition and Examples of Vector Space
1.2 Subspaces and Homomorphisms
1.3 Quotient Spaces, Internal and External Direct Sum
1.4 Linear Span, Linear Independence
1.5 Basis, Properties of Basis
1.6 Dimensions of a Vector Space</td></tr>
<tr><td></td><td colspan="7">UNIT II (18 hours) (K1, K2, K3 & K4)
Vector Spaces (Continued)
2.1 Dual Spaces – Hom (V, W), Hom (V, V) and Hom (V, F)
2.2 Definition and Examples of Inner Product Space
2.3 Norm of a Vector and Schwarz Inequality
2.4 Orthogonal Vectors and Orthogonal Complement
2.5 Orthonormal Sets
2.6 Gram-Schmidt Orthogonalization Process</td></tr>
<tr><td></td><td colspan="7">UNIT III (18 hours) (K1, K2, K3 & K4)
Linear Transformations
3.1 Definition of Algebra and Linear Transformations
3.2 Minimal polynomial for Linear Transformations
3.3 Regular and Singular Linear Transformations
3.4 Range and Rank of a Linear Transformation
3.5 Characteristic Roots of a Linear Transformation
3.6 Characteristic Vectors</td></tr>
</table>

	UNIT IV (18 hours) (K1, K2, K3 & K4) **Linear Transformations (Continued)** 4.1 Definition of Matrix of a Linear Transformation 4.2 Computation of Matrices of Linear Transformation 4.3 Isomorphism of A(V) onto F_n 4.4 Computation of the Matrix of a Linear Transformation from a Known Basis 4.5 Similar Linear Transformations 4.6 Triangular Form
	UNIT V (18 hours) (K1, K2, K3 & K4) **Linear Transformations (Continued)** 5.1 Trace of a Matrix and Properties 5.2 Trace of a Linear Transformation 5.3 Transpose of a Matrix and Properties 5.4 Determinants – Definition and Properties 5.5 Cramer's Rule 5.6 Cayley-Hamilton Theorem
Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	I.N. Herstein – Topics in Algebra – John Wiley & Sons, Inc., Second Edition, 2006.
ReferenceBooks	1. J.N. Sharma and A.R. Vashistha – Linear Algebra, Krishna Prakash Nanda, 1981. 2. Lloyd R.Jaisingh, Frank Ayres – Abstract Algebra - Schaum's outlines – Tata McGraw Hill Publishing Company Limited, New Delhi, 2005. 3. M.L.Santiago – Modern Algebra, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2002.
Website and e-learning source	1. https://nptel.ac.in/ 2. www.coursera.org/ 3. https://swayam.gov.in/

Course Outcomes:

On completion of the course, the students should be able to

CO1: Understand the concepts of linear span, basis, linear dependence and independence.

CO2: Analyze the concepts of dual spaces in vector space and inner product space.

CO3: Understand the concepts of linear transformation, characteristic roots and characteristic vectors.

CO4: Obtain the matrix for linear transformations.

CO5: Acquire knowledge about determinants, trace and transpose by linear transformations.

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO 6
CO1	H	M	H	H	M	L
CO2	H	M	H	H	M	L
CO3	H	M	H	H	M	L
CO4	H	M	H	H	M	L
CO5	H	M	H	H	M	L

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO 6
CO1	H	H	H	L	L	M
CO2	H	H	H	L	L	M
CO3	H	H	H	L	L	M
CO4	H	H	H	L	L	M
CO5	H	H	H	L	L	M

<table>
<tr><td>Title of the Course</td><td colspan="7">COMPLEX ANALYSIS</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core XIV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">UCMAM24</td></tr>
<tr><td>Semester</td><td>V</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">_</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">1. To introduce the fundamental ideas of the functions of complex variable
2. To impart the basic knowledge of holomorphic functions, Cauchy’s integral formula and the residue theorem</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (18 hours) (K1, K2, K3 & K4)
Analytic Functions

1.1 Regions in the Complex Plane
1.2 Limits
1.3 Theorems on limits
1.4 Continuity
1.5 Derivatives
1.6 C-R Equations</td></tr>
<tr><td></td><td colspan="7">Unit II (18 hours) (K1, K2, K3 & K4)
Mappings by Elementary Functions

2.1 Mapping
2.2 Bilinear transformations
2.3 Cross-Ratio -Theorems and problems
2.4 Linear Transformation$w = \frac{1}{z}$, problems
2.5 Transformation$W = \sqrt{z}\,, W = e^z, W = sinz$ and $W = cosz$
2.6 Linear fractional transformations – An Implicit Form</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (18 hours) (K1, K2, K3,K4)
Complex Integration
3.1Definite integrals, Line and Contour Integrals – Examples
3.2 Cauchy’s Theorem Cauchy – Goursat Theorem
3.3 Cauchy integral formula
3.4 Derivatives of analytic functions – Morera’s Theorem
3.5 Cauchy’s in-equality
3.6 Liouville’s theorem and the Fundamental theorem of algebra</td></tr>
</table>

	UNIT-IV: (18 hours) (K1, K2, K3 & K4) **Series** 4.1 Convergence of sequence and series 4.2 Convergence of series 4.3 Taylor series – Examples 4.4 Laurent series – Examples 4.5 Absolute and uniform convergence of power series 4.6 uniform convergence of power series
	UNIT-V: (18 hours) (K1, K2, K3 & K4) **Residues and Poles** 5.1 Zeros of analytic functions 5.2 Singularities, Types of Singularities 5.3 Theorem Riemann's Theorem – Weistrass 5.4 Residues – Residue theorems 5.5 Residues at poles – Zeros and poles of order m 5.6 Two types of integrals involving Sines and Cosines
ExtendedProfessionalComponent(isapartofinternalcomponentonly,nottobeincludedintheexternal examination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/JAM/TNPSCandotherstobesolved (To be discussed during the Tutorial hours)
Recommended Text	. R. V.Churchill and J.W. Brown- Complex Variables and Applications- McGraw Hill Publishing Company, New york, 6th Edition, 1996.
ReferenceBooks	1. P. Duraipandian & Lakshmi DuraiPandian- Complex Analysis, The National publishing Co., 1980, Reprint 2001. 2. S. Narayanan &Manicavachagom Pillay- Complex Analysis, S.V. Publications, 3rd Edition. 1985. 3. J.N. Sharma - Functions of a Complex Variable - Krishna PrakashanMandir, Meerut, U.P. Revised Edition 1978.
Website and e-learning source	1. https://nptel.ac.in 2. www.coursera.org 3. https://swayam.gov.in/

Course Outcomes:

On completion of the course, the students should be able to

CO1: Know to define and give some of the important properties of complex analytic functions.

CO2: Learn certain elementary functions with special reference to the correspondence between certain portions of the z-plane and w-plane as determined by the relation between the function w and the independent variable z.

CO3: Become familiar with the integrals of analytic functions where many properties from calculus

is carried over to complex case.
CO4:. Expand the concept of sequence and series which plays a major part of calculus to the complex domain.
CO5: Learn to compute residues, which allow the determination of general contour integrals

CO	PSO					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	M	H	H	L
CO2	H	M	L	H	H	L
CO3	H	H	M	H	H	L
CO4	H	H	M	H	H	L
CO5	H	L	M	H	H	L

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	L	L	H
CO2	H	H	H	L	L	H
CO3	H	H	H	M	L	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

<table>
<tr><td>Title of the Course</td><td colspan="8">MECHANICS</td></tr>
<tr><td>Paper No.</td><td colspan="8">Core XV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td>Credits</td><td>4</td><td>Course Code</td><td colspan="2">UCMAN24</td></tr>
<tr><td>Semester</td><td>VI</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3"></td><td colspan="3">6</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="8">The course aims at giving an overall view of the
• To develop broad knowledge of Statics and understanding of definitions, concepts, principles and theorems.
• To develop balanced knowledge of Dynamics and understanding of definitions, concepts, principles and theorems in Dynamics.
• To enhance the ability of learners to apply the knowledge and skills acquired by them during the course to solve specific theoretical and applied problems in Dynamics.</td></tr>
<tr><td>Course Outline</td><td colspan="8">UNIT I (18 hours) (K1, K2, K3 & K4)
Force
1.1 Newton’s Laws of motion
1.2 Force
1.3 Resultant of two forces on a particle – Book works
1.4 Resultant of two forces on a particle – Problems
1.5 Resultant of three forces related to a triangle acting at a point
1.6 Resultant of several forces acting on a particle
(Chapter 2: Sections 2.1, 2.1.1, 2.2, 2.2.1, 2.2.2; Omit 2.1.2)</td></tr>
<tr><td></td><td colspan="8">Unit II (18 hours) (K1, K2, K3 & K4)
Forces on a Rigid Body

2.1 Equilibrium of a particle under three forces
2.2 Triangle of forces-Polygon of forces
2.3 Lami’s theorem
2.4 Equilibrium of a particle under several forces
2.5 Equilibrium of a particle – Problems
2.6 Moment of a force – Moment of a force about a line – Scalar moment
(Chapter 3: Sections 3.1, 3.1.1, 3.1.2, Chapter 4: Sections 4.1, 4.1.1, 4.1.2.).</td></tr>
<tr><td></td><td colspan="8">Unit III (18 hours) (K1, K2, K3 & K4)
Friction
3.1 Types of forces – Friction – Definitions
3.2 Laws of friction
3.3 Limiting equilibrium of a particle on an inclined plane – Book Works
3.4 Limiting equilibrium of a particle on an inclined plane – Problems
3.5 Problems involving frictional forces
3.6 Problems involving frictional forces
(Chapter 2: Section 2.1.2, Chapter 3: Section 3.2, Chapter 5: Section 5.2; Omit 5.2.1)</td></tr>
</table>

	UNIT-IV: (18 hours) (K1, K2, K3 & K4) **Projectiles** 4.1 Forces on a projectile 4.2 Displacement as a combination of vertical and horizontal displacements 4.3Nature of a trajectory – Results pertaining to the motion of a projectile - Maximum horizontal range for a given velocity 4.4 Projectiles- Problems 4.5 Projectile projected on an inclined plane 4.6 Maximum range on an inclined plane (Chapter 13: Sections 13.1, 13.1.1, 13.1.2, 13.1.3, 13.1.4, 13.2, 13.2.1; Omit 13.1.5, 13.1.6)
	UNIT- V: (18 hours) (K1, K2, K3 & K4) **Central Orbit** 5.1 Central orbit 5.2 Differential Equation of a central orbit 5.3 Laws of a central force 5.4 Methods to find the central orbits 5.5 Central orbit - Problems 5.6 Central orbit - Problems (Chapter 16: Sections 16.2, 16.2.1, 16.2.2, 16.2.3)
Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	). Durai Pandian, Laxmi Durai Pandian, Muthamizh Jayapragasam - Mechanics – S. Chand Publishing, 6th Edition, 2015.
ReferenceBooks	1. K. Viswanatha Naik & M. S. Kasi – Dynamics – Emerald Publication, 1st Edition, 1987. 2. M. K. Venkatraman – Dynamics – Agasthiar Publication, 9th Edition, 1999. 3. A Ruina and R. Pradap, Introduction to Statics and Dynamics, Oxford University Press, 2014
Website and e-learning source	**e-Resources:** 1. https://nptel.ac.in/ 2. www.coursera.org 3. https://swayam.gov.in

Course Outcomes:

On completion of the course, the students should be able to

CO1: Familiarize with subject matter, which has been the single center, to which mathematicians, physicists, astronomers, and engineers were drawn together.

CO2: Understand necessary conditions for the equilibrium of particles acted upon by various forces and learn the principle of virtual work for a system of coplanar forces acting on a rigid body.

CO3: Understand static friction that exists between a stationary object and the surface On which it is resting and apply the knowledge and skills to solve specific theoretical and applied problems.

CO4: Understand simple harmonic motion and projectiles.

CO5: Demonstrate methods to locate central orbits.

CO	PSO					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	H	L
CO2	H	M	H	M	H	L
CO3	H	M	H	M	H	L
CO4	H	H	H	H	H	L
CO5	H	H	H	H	M	L

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	H	H	L
CO2	H	M	H	M	H	L
CO3	H	M	H	M	H	L
CO4	H	H	H	H	H	L
CO5	H	H	H	H	M	L

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE: FUZZY SETS AND ITS APPLICATIONS</td></tr>
<tr><td>Paper No.</td><td colspan="7">Discipline Specific Elective IV</td></tr>
<tr><td>Category</td><td>Discipline Specific Elective</td><td>Year
Semester</td><td>III
IV</td><td>Credits</td><td>3</td><td>Course Code</td><td>UEMAE24</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>4</td><td></td><td colspan="3"></td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">The course aims at giving an overall view of the
• To explain the emergence of fuzzy set from an historical perspective.
• To introduce the basic concepts of the existing research topic fuzzy sets.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (12 hours) (K1, K2, K3 & K4)
Fuzzy Sets
1.1 Sets – A brief introduction
1.2 Fuzzy Sets: Introduction and definition
1.3 Types of Fuzzy Sets
1.4 General definitions
1.5 Properties of fuzzy sets
1.6 Other important operations</td></tr>
<tr><td></td><td colspan="7">Unit II (12 hours) (K1, K2, K3 & K4)
Operation on Fuzzy Sets
2.1 Further operations on Fuzzy sets
2.2 T – Norms and T – Co-norms
2.3 Union and Intersection by Hamacher and Yager
2.4 Extension principal for Fuzzy sets
2.5 Extension principal for Fuzzy sets
2.6 Aggregation Operations</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (12 hours) (K1, K2, K3 & K4)
Fuzzy Graphs and Fuzzy Relation

3.1 Fuzzy Graphs
3.2 Fuzzy Relations 3.3 Composition of Fuzzy Relations
3.4 Properties of Fuzzy Binary Relations
3.5 Path in a finite fuzzy graph
3.6 Fuzzy preorder relations</td></tr>
</table>

	UNIT-IV: (12 hours) (K1, K2, K3 & K4) **Fuzzy Graph and Fuzzy Relation** 4.1 Similitude Relation 4.2 Antisymmetric and Fuzzy Order Relation 4.3 Dissimilitude Relation 4.4 Resemblance Relation 4.5 Various properties of Similitude and Resemblance Relation 4.6 Various properties of Fuzzy Perfect Order Relations
	UNIT-V: (12 hours) (K1, K2, K3 & K4) **Decision Making in Fuzzy Environment** 1.1 Introduction 1.2 Individual Decision Making 1.3 Mult person Decision Making 1.4 Multicriteria Decision Making 1.5 Fuzzy Ranking Method 1.6 Fuzzy Linear Programming
Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	1. Sudhir k. Pundir and Rimple Pundir- Fuzzy Sets and their Application- Pragati Prakashan Educational Publishers, Meerut, 2013. 2. A. Kaufmann, L.A. Zadeh and D.L. Swanson – Introduction to the Theory of Fuzzy Subsets – Academic Press, New York, 1975.
ReferenceBooks	1. George J. Klir and Bo Yuan -Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall of India Pvt. Ltd., New Delhi, 2000. 2. Zimmerman H.J. - Fuzzy Set Theory and its Applications, Allied Publishers Ltd., Second Edition, 1996.
Website and e-learning source	4. https://nptel.ac.in 5. www.coursera.org 6. https://swayam.gov.in/

Course Outcomes:

On completion of the course, the students should be able to

CO1: Distinguish between classical crisp set and fuzzy set using characteristic function and membership function respectively.

CO2: Understand the operations on the fuzzy set which are generalization of crisp set operations.

CO3: Represent the notion of fuzzy relational and fuzzy graph based upon the max-min composition.

CO4: Different types of relationships with its graphical representations.

CO5: Know about the application of fuzzy sets in decision making environment.

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	L	L	H
CO2	H	H	H	L	L	H
CO3	H	H	H	M	L	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	M	L	H	L
CO2	H	H	M	M	H	L
CO3	H	H	M	H	H	L
CO4	H	H	H	H	H	L
CO5	H	H	L	M	H	L

<table>
<tr><td>Title of the Course</td><td colspan="7">ELETIVE: DISCRETE MATHEMATICS</td></tr>
<tr><td>Paper No.</td><td colspan="7">Discipline Specific Elective VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Discipline Specific Elective</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">UEMAF24</td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td></td><td colspan="3"></td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">1. To introduce students to the concept of basic discrete mathematics, thereby enhancing the logical thinking of the students with regard to discrete domain.
2. To train the students in the applications of the discrete mathematical structures.
3. To construct the ability of students to work independently and do in-depth study of various notions of discrete mathematics.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (12 hours) (K1, K2, K3 & K4)
Partially Ordered Sets
1.1 Definitions, examples and basic properties of partially ordered sets (poset)
1.2 Order isomorphism, Hasse diagrams
1.3 Dual of a poset, Duality principle
1.4 Maximal and minimal elements
1.5 Least upper bound and greatest upper bound
1.6 Building new poset, Maps between posets</td></tr>
<tr><td></td><td colspan="7">Unit II (12 hours) (K1, K2, K3 & K4)
Lattices
2.1 Lattices as posets
2.2 Lattices as algebraic structures
2.3 Sub lattices
2.4 Products and homomorphisms – Definitions and examples
2.5 Properties of modular and distributive lattices
2.6 Complemented, relatively complemented and sectionally complemented lattices</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (12 hours) (K1, K2, K3 & K4)
Boolean Algebras and Switching Circuits
3.1 Boolean algebras, De Morgan’s laws
3.2 Boolean homomorphism, Representation theorem
3.3 Boolean polynomials, Boolean polynomial functions
3.4 Disjunctive and conjunctive normal forms
3.5 Minimal forms of Boolean polynomials
3.6 Quine-McCluskey method, Karnaugh diagrams, Switching circuits</td></tr>
</table>

	UNIT-IV: (12 hours) (K1, K2, K3 & K4) **Finite-State and Turing Machines** 4.1 Finite-state machines with outputs 4.2 Finite-state machines with no output 4.3 Deterministic finite-state automaton 4.4 Nondeterministic finite-state automaton 4.5 Turing machines – Definitions 4.6 Turing machines - examples and computations
	UNIT-V: (12 hours) (K1, K2, K3 & K4) **Graphs** 5.1 Definition, examples and basic properties of graphs 5.2 Königsberg bridge problem 5.3 Subgraphs – Pseudographs - Complete graphs - Bipartite graphs 5.4 Isomorphism of graphs - Paths and circuits - Eulerian circuits - Hamiltonian cycles 5.5 Adjacency matrix - Weighted graph - Travelling salesman problem 5.6 Shortest path and Dijkstra's algorithm
ExtendedProfessionalComponent(isapartofinternalcomponentonly,nottobeincludedintheexternal examination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/JAM/TNPSCandotherstobesolved (TobediscussedduringtheTutorialhours)
Recommended Text	1. B. A. Davey & H. A. Priestley (2002). Introduction to Lattices and Order (2nd edition). Cambridge University Press. 2. Edgar G. Goodaire& Michael M. Parmenter (2018). Discrete Mathematics with Graph Theory (3rd edition).Pearson Education.
ReferenceBooks	1. Rudolf Lidl& Günter Pilz (1998). Applied Abstract Algebra (2nd edition). Springer. 2. Kenneth H. Rosen (2012). Discrete Mathematics and its Applications**:** With Combinatorics and Graph Theory (7th edition).McGraw-Hill. 3. C. L. Liu (1985). Elements of Discrete Mathematics (2nd edition). McGraw-Hill.
Websiteande-learningsource	1. https://nptel.ac.in 2. www.coursera.org 3. https://swayam.gov.in/

Course Outcomes:

CO1: Learn about partially ordered sets
CO2: Understand lattices and their types
CO3: Understand Boolean algebra and Boolean functions, logic gates, switching circuits and their applications.
CO4: Solve real-life problems using finite-state and Turing machines.
CO5: Assimilate various graph theoretic concepts and familiarize with their applications.

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	L	L	H
CO2	H	H	H	L	L	H
CO3	H	H	H	M	L	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	M	M	M	L
CO2	H	H	H	M	H	L
CO3	H	M	H	M	H	L
CO4	H	M	M	H	H	L
CO5	H	H	M	M	H	L

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE: OBJECT ORIENTED PROGRAMMING USING C++</td></tr>
<tr><td>Paper No.</td><td colspan="7">Generic Elective VIII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Generic Elective</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">UEMAG24</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td></td><td colspan="3"></td><td colspan="2">3</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">The course aims at giving an overall view of the
• To introduce students to the concept of object-oriented programming with C++, thereby enhancing the logical thinking of the students with regard to programming.
• To train the students to apply the programming concepts of C++ to mathematical investigations and problem solving.
• To construct the ability of students to work independently and do in-depth study of various notions of programming.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (9 hours) (K1, K2, K3 & K4)
Principles of OOP and Introduction to C++, Tokens
1.1 Basic concepts of object-oriented programming – Benefits of OOP
1.2 Structure of C++ Program - Tokens - Keywords
1.3 Identifiers and constants
1.4 Basic data types- Symbolic constants
1.5 Type compatibility - Declaration of variables
1.6 Dynamic Initialization of variables</td></tr>
<tr><td></td><td colspan="7">Unit II (9 hours) (K1, K2, K3 & K4)
Operators, Expressions and Control Structures
2.1 Operators in C++ - Scope Resolution Operator
2.2 Member Dereferencing operators – Memory management operators
2.3 Manipulators – Type cast operator
2.4 Expressions and their types
2.5 Special assignment expressions
2.6 Implicit conversions – Operator overloading</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (9 hours) (K1, K2, K3 & K4)
Functions in C++, Classes, and Objects
3.1 Introduction- Function Prototyping-Call by reference -Return by reference
3.2 Inline Functions-Default arguments-const arguments-Function overloading
3.3 Specifying a class-Defining member functions
3.4 Making an outside function inline-Nesting of member functions -Private member functions
3.5 Arrays of objects - Objects as function arguments
3.6 Friendly functions – Returning objects – const member functions</td></tr>
</table>

	UNIT-IV: (9 hours) (K1, K2, K3 & K4) **Constructors and Destructors, Operator Overloading** 4.1Introduction – Constructors 4.2 Parameterized constructors – Multiple constructors in a class 4.3 Constructors with default arguments – Copy constructor 4.4 const objects – Destructors 4.5 Defining operator overloading 4.6 Overloading unary operators-Overloading binary operators
	UNIT-V: (9 hours) (K1, K2, K3 & K4) **Inheritance, Pointers, Managing console I/O Operations** 5.1 Introduction – Defining derived classes. 5.2 Single inheritance -Making a private member inheritable. 5.3 Multiple inheritance 5.4 Pointers – Pointers to Objects 5.5 Unformatted I/O Operations 5.6 Formatted console I/O operations
Extended Professional Component (isa part of internal component only, not to beincluded in theexternal examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	E. Balagurusamy, Object Oriented Programming with C++, 8th Edition, McGraw Hill Education Private Ltd, New Delhi, India, 2022.
ReferenceBooks	1. Robert Lafore – Object Oriented Programming in Microsoft C++ - Galgotia Publication, Fourth Edition, 2009. 2. Herbert Schildt – The Complete Reference C++, Tata McGraw Hill Publication, 4th Edition, 2002. 3. Object Oriented Programming in C++, Robert Lafore, 4th Edition, Pearson Publications, 2008.
Website and e-learning source	1. https://nptel.ac.in/ 2. www.coursera.org 3. https://swayam.gov.in

Course Outcomes:

On completion of the course, the students should be able to

CO1: Understand the basics of programming in C++ such as tokens, data types, operators etc.

CO2: Use the Decision making-branching and looping statements in C++ programming.

CO3: Handle the concept of arrays and the concept of the user define functions.

CO4: Express the uses of structures and pointers.

CO5: Understand and apply the programming concepts of C to problem solving.

CO	PSO					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	L	H
CO2	H	M	H	M	M	H
CO3	H	M	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	M	H	M	H	H

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE PRACTICAL: C++</td></tr>
<tr><td>Paper No.</td><td colspan="7"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2"></td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">1</td><td rowspan="2">Course Code</td><td rowspan="2">UEMAH24</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td></td><td colspan="3">2</td><td colspan="2">2</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">The course aims at giving an overall view of the
• To introduce students to the concept of basic programming, thereby enhancing the logical thinking of the students with regard to programming.
• To train the students to apply the programming concepts of C to mathematical investigations and problem solving.
• To enhance the ability of students to work independently and do in-depth study of various notions of programming.</td></tr>
<tr><td>Course Outline</td><td colspan="7">1. Simple program using class and object.
2. Find largest of three numbers using all types of constructors.
3. Calculation of Mean and Standard Deviation.
4. Selection sort.
5. Product of matrices.
6. String manipulation.
7. Operator overloading (Unary)
8. Arrays of Object.
9. Function Overloading.
10. Implementing Inheritance. (Multiple)</td></tr>
<tr><td colspan="3">Extended Professional Component (isa part of internal component only, not to be included in theexternal examination question paper)</td><td colspan="5">Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved
(To be discussed during the Tutorial hours)</td></tr>
<tr><td>Recommended Text</td><td colspan="7">E. Balagurusamy, Object Oriented Programming with C++, 8th Edition, Tata McGraw – Hill Education Private Ltd. New Delhi, India, 2022.</td></tr>
<tr><td>ReferenceBooks</td><td colspan="7">1. Robert Lafore – Object Oriented Programming in Microsoft C++ - Galgotia Publication, Fourth Edition, 2009.
2. Herbert Schildt – The Complete Reference C++, Tata McGraw Hill Publication, 4th Edition, 2002.
3. Object Oriented Programming in C++, Robert Lafore, 4th Edition, Pearson Publications, 2008.</td></tr>
</table>

Website and e-learning source	1. https://nptel.ac.in/ 2. www.coursera.org 3. https://swayam.gov.in

Course Outcomes:

On completion of the course, the students should be able to

CO1: Implement programs with class and constructors.

CO2: Write programs that perform operations using derived data types and functions.

CO3: Demonstrate a thorough understanding of arrays by designing and implementing programs that search and sort arrays.

CO4: Use inheritance properties that promote code reuse in C++.

CO5: Overload functions and operators in C++.

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

CO	PSO					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	L	H
CO2	H	M	H	M	M	H
CO3	H	M	H	M	M	H
CO4	H	H	H	H	L	H
CO5	H	M	H	H	L	H

<table>
<tr><td>Title of the Course</td><td colspan="7">MATHEMATICS FOR COMPETITIVE EXAMINATIONS</td></tr>
<tr><td>Paper No.</td><td colspan="7">SEC 8</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Professional Competency</td><td>Year</td><td>III</td><td>Credits</td><td>2</td><td rowspan="2">Course Code</td><td rowspan="2">UPMA24</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td></td><td colspan="3"></td><td colspan="2">2</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher Secondary Mathematics</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">The course aims at giving an overall view of the
• To revitalize the basic knowledge of mathematics and problem-solving skills.
• To enhance logical, analytical, and critical thinking of learners.
• To help the learners to acquire satisfactory competency using verbal and nonverbal reasoning
• To help the students to prepare for various competitive examinations.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I (6 hours) (K1, K2, K3 & K4)
Numerical Ability

Numbers, H.C.F. & L.C.M. of Numbers, Simplification, Decimal Fractions, Square Roots & Cube Roots, Averages, Percentage, Ratio and Proportion.</td></tr>
<tr><td></td><td colspan="7">Unit II (6 hours) (K1, K2, K3 & K4)
Numerical Ability (Continued)

Ages, Time and Work, Time and Distance, Profit and Loss, Simple Interest, Compound Interest, Permutation & Combination, Probability</td></tr>
<tr><td></td><td colspan="7">UNIT-III: (6 hours) (K1, K2, K3 & K4)
Data Interpretation
Tabulation, Bar Graphs, Pie Charts</td></tr>
<tr><td></td><td colspan="7">UNIT-IV: (6 hours) (K1, K2, K3 & K4)
Verbal Reasoning

Series, Blood Relations, Puzzles</td></tr>
<tr><td></td><td colspan="7">UNIT-V: (6 hours) (K1, K2, K3 & K4)
Verbal Reasoning (Continued)

Direction Sense Test, Alphabet test, Ranking and Time sequence test</td></tr>
</table>

Extended Professional Component (isa part of internal component only, not to be included in theexternal examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	1. Dr. R. S. Aggarwal – A Modern Approach to Verbal and Non-Verbal Reasoning –Revised Edition – 2019 – S. Chand and Co. 2. Dr. R. S. Aggarwal – Quantitative Aptitude – Seventh Edition – S. Chand and Co., 2019
ReferenceBooks	1. AbhijitGuha, Quantitative Aptitude for Competitive Examinations, McGraw Education Series, 5th Edition 2019 2. Dinesh Khattar, Quantitative Aptitude for Competitive Examinations, Pearson India, Edition 2019. 3. Sarvesh K. Verma, Quantitative Aptitude Quantum CAT 2018, Arihant publication, Edition 2018.
Website and e-learning source	1. https://nptel.ac.in/ 2. www.coursera.org 3. www.indiabix.com

Course Outcomes:

On completion of the course, the students should be able to

CO1: Gain critical thinking and numerical ability to solve problems.
CO2: Apply the concepts of quantitative aptitude to solve real life problems.
CO3: Interpret and use data represented in different forms.
CO4: Reason out verbally and non-verbally.
CO5: Write various competitive exams for higher studies and jobs

CO	PSO					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	H	H	H	H	L
CO2	H	M	H	M	H	L
CO3	H	M	H	M	H	L
CO4	H	H	H	H	L	L
CO5	H	M	H	H	L	L

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H