திருவள்ளுவர் பல்கலைக்கழகம்

THIRUVALLUVAR UNIVERSITY

SERKKADU, VELLORE - 632 115

B.Sc. Mathematics

Under

Choice Based Credit System (CBCS)

&

Learning Outcomes Based Curriculum Framework (LOCF)

Effective from the Academic Year

2026 – 2027

U25

Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credits and Hours Distribution System for all Under – Graduate Courses including Lab Hours

FIRST YEAR

	Part	Courses	Credits	Hours / Week
Semester I	Part I	Language – Tamil	3	6
	Part II	English	3	6
	Part III	Core Courses & Elective Courses	11	14
	Part IV	Skill Enhancement Course (SEC – I)	2	2
	Part IV	Disaster Management	2	2
	Total		**21**	**30**

	Part	Courses	Credits	Hours / Week
Semester II	Part I	Language – Tamil	3	6
	Part II	English	3	6
	Part III	Core Courses & Elective Courses	14	16
	Part IV	Skill Enhancement Course (SEC – I)	2	2
	Total		**22**	**30**

SECOND YEAR

	Part	Courses	Credits	Hours / Week
Semester III	Part I	Language – Tamil	3	6
	Part II	English	3	6
	Part III	Core Courses & Elective Courses	11	14
	Part IV	Non Major / Basic Tamil / Advance Tamil	2	2
	Part IV	E.V.S	2	2
	Total		**21**	**30**

	Part	Courses	Credits	Hours / Week
Semester IV	Part I	Language – Tamil	3	6
	Part II	English	3	6
	Part III	Core Courses & Elective Courses	14	16
	Part IV	Non Major / Basic Tamil / Advance Tamil	2	2
	Total		**22**	**30**

THIRD YEAR

	Part	Courses	Credits	Hours / Week
Semester V	Part III	Core Courses & Elective Courses	24	26
	Part IV	Value Education	2	2
	Part IV	Value Added Courses -1 (Common for all UG)	2	2
	Part IV	Internship / Industrial Visit / Field Visit	2	-
	Total		**30**	**30**

	Part	Courses	Credits	Hours / Week
Semester VI	Part III	Core Courses & Elective Courses	21	28
	Part IV	Value Added Courses -2 (Discipline Specific)	2	2
	Part IV	Extension Activity	21	28
	Total		**24**	**30**

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	11	14	11	14	24	21	95
Part IV	4	2	4	2	6	2	20
Part V	-	-	-	-	-	1	1
Total	**22**	**21**	**22**	**21**	**30**	**24**	**140**

Part I, II and III components will be separately taken into account for CGPA calculation and classification for the Undergraduate Programme. Components IV and V must be completed during the duration of the programme as per University norms to become eligible for the award of the degree.

METHODS OF EVALUATION

Internal Evaluation Marks	
Continuous Internal Assessment Tests	20
Assignments, Seminars and Attendance	10
Total	**30**
External Evaluation Marks	
End Semester Examination	70
Total	**100**

METHODS OF ASSESSMENT

Knowledge Level	Description	Nature of Assessment
K1	Recall	Definitions, MCQ, Concept Identification
K2	Understanding	Short Notes, True/False, Explanations
K3	Application	Problem Solving, Illustration with Examples
K4	Analysis	Comparative Study, Interpretation, Mapping
K5	Evaluation	Critical Essays, Justification, Review
K6	Creation	Presentation, Discussion, Project Work

B.SC. MATHEMATICS - CURRICULUM DESIGN

Sem	Part	Course No.	Course Title	Hours / Week	Credits	Internal	External	Total
I	I	LC – I	Language – I	6	3	30	70	100
I	II	ELC – I	English – I	6	3	30	70	100
I	III	CC- I	Algebra & Trigonometry	4	4	30	70	100
I	III	CC- II	Differential Calculus	4	3	30	70	100
I	III	EC-I	Numerical Methods – I	6	4	30	70	100
I	IV	SEC-I	Geo Gebra: Transforming Mathematics with Technology	2	2	30	70	100
I	IV		Disaster Management ***	2	2	30	70	100
Total				**30**	**21**			

Sem	Part	Course No.	Course Title	Hours / Week	Credits	Internal	External	Total
II	I	LC – II	Language – II	6	3	30	70	100
II	II	ELC – II	English - II	6	3	30	70	100
II	III	CC- III	Integral Calculus	5	5	30	70	100
II	III	CC- IV	Three Dimensional Analytical Geometry	5	5	30	70	100
II	III	EC-II	Numerical Methods – II	6	4	30	70	100
II	IV	SEC-II	Maxima: Simplify Symbolic Math	2	2	30	70	100
II	IV	NM-I	NAAN MUDHALVAN	-	2	30	70	100
Total				**30**	**24**			

Sem	Part	Course No.	Course Title	Hours / Week	Credits	Internal	External	Total
III	I	LC – III	Language – III	6	3	30	70	100
III	II	ELC – III	English - III	6	3	30	70	100
III	III	CC- V	Vector Calculus	4	4	30	70	100
III	III	CC- VI	Differential Equations	4	3	30	70	100
III	III	EC-III	Mathematical Statistics – I	6	4	30	70	100
III	IV	NME-I	Mathematics for Competitive Examinations – I	2	2	30	70	100
III	IV		Environmental Studies ***	2	2	30	70	100
III	IV	NM-II	NAAN MUDHALVAN	-	2	30	70	100
Total				**30**	**23**			

Sem	Part	Course No.	Course Title	Hours / Week	Credits	Internal	External	Total
IV	I	LC – IV	Language – IV	6	3	30	70	100
IV	II	ELC – IV	English - IV	6	3	30	70	100
IV	III	CC- VII	Operations Research	5	5	30	70	100
IV	III	CC- VIII	Dynamics	5	5	30	70	100
IV	III	EC-IV	Mathematical Statistics – II	6	4	30	70	100
IV	IV	NME-II	Mathematics for Competitive Examinations – II	2	2	30	70	100
IV	IV	NM-III	NAAN MUDHALVAN	-	2	30	70	100
Total				**30**	**24**			

Sem	Part	Course No.	Course Title	Hours / Week	Credits	Internal	External	Total
V	III	CC- IX	Abstract Algebra	6	6	30	70	100
V	III	CC- X	Real Analysis	6	5	30	70	100
V	III	CC- XI	Complex Analysis – I	5	5	30	70	100
V	III	CC- XII		5	5	30	70	100
V	III	EC-V	Graph Theory and Applications (Elective)	5	3	30	70	100
V	IV	VED ***	Valued Education			30	70	100
V	IV		Internship @	2	-	30	70	100
V	IV	CVAC ***	Common Value Added Courses	2	2	30	70	100
V	IV	NM-IV	NAAN MUDHALVAN	-	2	30	70	100
Total				**30**	**32**			

Sem	Part	Course No.	Course Title	Hours / Week	Credits	Internal	External	Total
VI	III	CC- XIII	Linear Algebra	5	5	30	70	100
VI	III	CC- XIV		5	4	30	70	100
VI	III	CC- XV	Complex Analysis – II	5	4	30	70	100
VI	III	CC- XVI	Project with Viva Voce	6	4	30	70	100
VI	III	EC-VI	Discrete Mathematics (Elective)	3	5	30	70	100
VI	IV	DSVAC	R Language for Statistics	2	2	30	70	100
VI	V	EA	Extension Activity	-	1	-	-	100
VI	IV	NM-V	NAAN MUDHALVAN	-	2	30	70	100
Total				**30**	**26**			

*** Common Paper
@ Internship - Summer vacation at the end of IV semester activity (30 Hrs /2 Weeks)

Complete Syllabi in UGC OBE / LOCF Format – Semester-wise

Choice Based Credit System (CBCS) & Learning Outcomes Based Curriculum Framework (LOCF)

Effective from the Academic Year 2026 – 2027

SEMESTER-WISE COURSE SCHEME

Sem	Part	Paper No.	Course Title	Credits	Hours/Week
I	III	CC – I	Algebra & Trigonometry	4	4
I	III	CC – II	Differential Calculus	4	4
I	III	EC – I	Numerical Methods – I (Elective)	4	6
I	IV	SEC – I	GeoGebra – Practical Only	2	2
II	III	CC – III	Integral Calculus	5	5
II	III	CC – IV	Three Dimensional Analytical Geometry	5	5
II	III	EC – II	Numerical Methods – II with Practical (Elective)	3	6
II	IV	SEC – II	Maxima – Practical Only	2	2
III	III	CC – V	Vector Calculus	4	4
III	III	CC – VI	Differential Equations	4	4
III	III	EC – III	Mathematical Statistics – I (Elective)	4	6
III	IV	NME – I	Mathematics for Competitive Examinations – I	2	2
IV	III	CC – VII	Operations Research	5	5
IV	III	CC – VIII	Dynamics	5	5
IV	III	CC – X	Real Analysis	4	5
IV	III	EC – IV	Mathematical Statistics – II with Practical (Elective)	3	6
IV	IV	SEC (VA)	Python Programming	2	2
IV	IV	NME – II	Mathematics for Competitive Examinations – II	2	2
V	III	CC – IX	Abstract Algebra	5	5
V	III	CC – XI	Complex Analysis – I	5	5
V	III	EC – V	Graph Theory and Applications (Elective)	3	4
V	III	CC – XVI	Project with Viva Voce	4	5
VI	III	CC – XIII	Linear Algebra	5	6
VI	III	CC – XV	Complex Analysis – II	4	5
VI	III	EC – VI	Discrete Mathematics (Elective)	3	5
VI	IV	VA – II	R Language for Statistics	2	2

Note: All syllabi are included in this document in semester-wise order.

— Semester I —

ALGEBRA & TRIGONOMETRY

Paper Number	CC – I	**Course Code**	
Category	Core (Part III)	**Year / Semester**	I Year / Semester I
Credits	4	**Hours / Week**	4
Instructional Hours / Week	**Lecture:** 4 **Tutorial:** 0 **Lab Practice:** 0 **Total:** 4		
Pre-requisite	12th Standard Mathematics		
Objectives	Basic ideas on Theory of Equations, Matrices and Number Theory. Knowledge to find expansions of trigonometric functions and solve applied problems.		

COURSE OUTLINE

Unit	Content
Unit I	**Theory of Equations:** Reciprocal Equations – Standard form – Increasing or decreasing roots – Removal of terms – Approximate solutions by Horner's method – related problems.
Unit II	**Summation of Series:** Binomial, Exponential, Logarithmic Series (Theorems without proof) – Approximations – related problems.
Unit III	**Matrices:** Characteristic equation – Eigenvalues and Eigenvectors – Cayley–Hamilton Theorem – Powers and inverse of a square matrix up to order 3 – Diagonalization – related problems.
Unit IV	**Trigonometric Expansions:** Expansions of $\sin n\theta$, $\cos n\theta$, $\tan n\theta$ – Expansions of $\sin^n\theta$, $\cos^n\theta$ – Expansions of $\sin\theta$, $\cos\theta$, $\tan\theta$ in terms of θ – related problems.
Unit V	**Hyperbolic Functions & Trigonometric Series:** Hyperbolic functions – Relation between circular and hyperbolic functions – Inverse hyperbolic functions – Logarithm of complex quantities – Summation of trigonometric series – related problems.

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics from UPSC / TNPSC / other competitive examinations to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	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, 2007. 3. C.V. Durell and A. Robson, Advanced Trigonometry, Courier Corporation, 2003. 4. J. Stewart, L. Redlin, and S. Watson, Algebra and Trigonometry, Cengage Learning, 2012.
Reference Books	1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
e-Learning / Website	https://nptel.ac.in

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

DIFFERENTIAL CALCULUS

Paper Number	CC – II	**Course Code**	
Category	Core (Part III)	**Year / Semester**	I Year / Semester I
Credits	4	**Hours / Week**	4
Instructional Hours / Week	**Lecture:** 4 **Tutorial:** 0 **Lab Practice:** 0 **Total:** 4		
Pre-requisite	12th Standard Mathematics		
Objectives	The basic skills of differentiation, successive differentiation, and their applications. Basic knowledge on curvature, evolutes, involutes, and polar co-ordinates.		

COURSE OUTLINE

Unit	Content
Unit I	**Successive Differentiation:** Introduction (Review) – The nth derivative – Standard results – Fractional expressions – Trigonometrical transformation – Formation of equations involving derivatives – Leibnitz formula for the nth derivative of a product.
Unit II	**Partial Differentiation:** Partial derivatives – Successive partial derivatives – Function of a function rule – Total differential coefficient – A special case – Implicit functions.
Unit III	**Partial Differentiation (Continued):** Homogeneous functions – Euler's theorem – Maxima and Minima of functions of two variables – Lagrange's method of undetermined multipliers.
Unit IV	**Envelope:** Method of finding the envelope – Another definition of envelope – Envelope of family of curves which are quadratic in the parameter.
Unit V	**Curvature:** Definition of Curvature – Circle, Radius and Centre of Curvature – Evolutes and Involutes – Radius of Curvature in Polar Co-ordinates.

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics from UPSC / TNPSC / other competitive examinations to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002. 2. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2010. 3. M.J. Strauss, G.L. Bradley and K.J. Smith, Calculus, 3rd Ed., Pearson Education, Delhi, 2007.
Reference Books	1. R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer-Verlag, 1989. 2. T. Apostol, Calculus, Volumes I and II. 3. Narayanan and T. Manicavachagom Pillai, S. Viswanathan Printers & Publishers Pvt. Ltd., 2007.
e-Learning / Website	https://nptel.ac.in

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

NUMERICAL METHODS – I

Paper Number	EC – I (Elective)	**Course Code**	
Category	Elective (Part III)	**Year / Semester**	I Year / Semester I
Credits	4	**Hours / Week**	6
Instructional Hours / Week	**Lecture:** 4 **Tutorial:** 0 **Lab Practice:** 2 **Total:** 6		
Pre-requisite	12th Standard Mathematics; Basic knowledge of algebraic equations		
Objectives	To learn methods of solving numerical algebraic and transcendental equations. To study forward and backward differences. To study Newton's divided difference and Lagrange's interpolation formulae.		

COURSE OUTLINE

Unit	Content
Unit I	**Solution of Numerical Algebraic and Transcendental Equations:** Bisection Method – Regula Falsi Method – Newton–Raphson Method. [Chapter 3: Sec 3.1, 3.3, 3.4]
Unit II	**Solutions of Simultaneous Linear Equations:** Gauss Elimination – Gauss–Jordan Elimination – Inversion of Matrix using Gauss Elimination – Gauss–Seidel Method of Iteration. [Chapter 4: Sec 4.1–4.3, 4.9]
Unit III	**Finite Differences:** First Difference – Forward and Backward Differences – Differences of a Polynomial – Factorial Polynomials – Operator E – Relation between Δ, ∇ and E – Missing Value Problems. [Chapter 5: Sec 5.1–5.4]
Unit IV	**Interpolation and Central Differences:** Gregory–Newton Forward and Backward Formulae. Central Differences: Gauss Forward and Backward Formulae – Stirling's Formula – Bessel's Formula. [Chapter 6–7]
Unit V	**Interpolation for Unequal Intervals:** Divided Differences – Newton's Divided Difference Formula – Lagrange's Interpolation Formula – Lagrange's formula of inverse interpolation. [Chapter 8: Sec 8.1–8.3, 8.5–8.7]

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics from UPSC / TNPSC / other competitive examinations to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. P. Kandasamy, K. Thilagavathy and K. Gunavathi (2023), Numerical Methods, S. Chand & Company Ltd., New Delhi.
Reference Books	1. S. Arumugam (2003), Numerical Methods, New Gamma Publishing, Palayamkottai. 2. H.C. Saxena (1991), Finite Differences and Numerical Analysis, S. Chand & Co., Delhi. 3. A. Singaravelu (2004), Numerical Methods, Meenakshi Agency, Chennai. 4. M.K. Venkataraman (1992), Numerical Methods for Science and Engineering, National Publishing Company, Chennai.
e-Learning / Website	https://ocw.mit.edu/courses/22-15-essential-numerical-methods-fall-2014/pages/syllabus/ https://ocw.mit.edu/courses/18-330-introduction-to-numerical-analysis-spring-2004/

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

DSEC – I: GeoGebra: Transforming Mathematics with Technology

Paper Number	SEC – I	**Course Code**	
Category	Skill Enhancement Course (Part IV)	**Year / Semester**	I Year / Semester I
Credits	2	**Hours / Week**	2
Instructional Hours / Week	**Lecture:** 0 **Tutorial:** 0 **Lab Practice:** 2 **Total:** 2		
Pre-requisite	Solid foundation in algebra and geometry; computer proficiency		
Objectives	To introduce students to GeoGebra. To enhance understanding of mathematical concepts and build skills progressively.		
Note	Practical Only		

COURSE OUTLINE

Unit	Content
Unit I	**Introduction to GeoGebra and Matrices:** Introduction to GeoGebra and its applications – Exploring the GeoGebra interface – Creating and manipulating matrices – Matrix operations (addition, multiplication) – Rank and Transpose – Inverse of a matrix.
Unit II	**Trigonometry and GeoGebra:** Trigonometric functions and identities – Graphing trigonometric functions – Using GeoGebra to solve trigonometric equations – Trigonometric applications.
Unit III	**Roots of Polynomials:** Solving polynomial equations – Graphical representation – Finding roots and factors – Maxima and Minima of polynomial equations.
Unit IV	**Limits and Continuity:** Introduction to limits and their graphical representation – Calculating limits – Exploring continuity – Real-world scenarios.
Unit V	**Advanced Topics and Practical Applications:** Further exploration of mathematical concepts – Real-world applications and case studies – Interactive problem-solving.

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics from UPSC / TNPSC / other competitive examinations to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. Online GeoGebra Documentation and tutorials (https://www.geogebra.org). 2. GeoGebra Software: Latest version downloadable free from the GeoGebra website. 3. Course Materials: Lecture notes, slides, and assignments provided by the instructor.
e-Learning / Website	https://spoken-tutorial.org https://swayam.gov.in (Applications of GeoGebra)

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

— Semester II —

INTEGRAL CALCULUS

Paper Number	CC – III	**Course Code**	
Category	Core (Part III)	**Year / Semester**	I Year / Semester II
Credits	5	**Hours / Week**	5
Instructional Hours / Week	**Lecture:** 5 **Tutorial:** 0 **Lab Practice:** 0 **Total:** 5		
Pre-requisite	12th Standard Mathematics		
Objectives	Knowledge on integration and its geometrical applications, double and triple integrals, Beta and Gamma functions, and their applications.		

COURSE OUTLINE

Unit	Content
Unit I	**Reduction Formulae:** Reduction formulae – Types – Integration of powers of algebraic and trigonometric functions – Integration of algebraic and logarithmic function products – Bernoulli's formula – Feynman's technique of integration.
Unit II	**Multiple Integrals:** Definition of double integrals – Evaluation of double integrals – Double integrals in polar coordinates – Change of order of integration.
Unit III	**Triple Integrals and Applications:** Triple integrals – Applications of multiple integrals – Volumes of solids of revolution – Areas of curved surfaces – Change of variables – Jacobian.
Unit IV	**Beta and Gamma Functions:** Beta and Gamma functions – Infinite integral – Definitions – Recurrence formula of Gamma functions – Properties – Relation between Beta and Gamma functions – Applications.
Unit V	**Geometric and Physical Applications:** Geometric and Physical applications of Integral Calculus.

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics from UPSC / TNPSC / other competitive examinations to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002. 2. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007. 3. D. Chatterjee, Integral Calculus and Differential Equations, Tata McGraw Hill. 4. Narayanan and T. Manicavachagom Pillai, S. Viswanathan Printers & Publishers Pvt. Ltd., 2007. 5. P. Dyke, An Introduction to Laplace Transforms and Fourier Series, Springer, 2001.
e-Learning / Website	https://nptel.ac.in

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

THREE DIMENSIONAL ANALYTICAL GEOMETRY

Paper Number	CC – IV	**Course Code**	
Category	Core (Part III)	**Year / Semester**	I Year / Semester II
Credits	5	**Hours / Week**	5
Instructional Hours / Week	**Lecture:** 5 **Tutorial:** 0 **Lab Practice:** 0 **Total:** 5		
Pre-requisite	12th Standard Mathematics		
Objectives	To introduce coordinate axes, direction cosines, and direction ratios. To develop knowledge of plane, straight line, sphere, cone, and cylinder equations.		

COURSE OUTLINE

Unit	Content
Unit I	**The Plane:** General equation of a plane – Normal form – Angle between planes – Plane through three given points – Plane through the line of intersection of two planes.
Unit II	**The Straight Line:** Symmetrical form of a straight line – Image of a point/line with respect to a plane – Length and equation of shortest distance between skew lines – Coplanar lines.
Unit III	**The Sphere:** Equation of the sphere – Length of the tangent – Tangent plane – Section of a sphere by a plane – Orthogonal spheres – Sphere through a given circle.
Unit IV	**The Cone:** Equation of a cone with a given vertex and guiding curve – Cone with vertex at origin – Condition for second-degree equation to represent a cone – Right circular cone – Enveloping cone.
Unit V	**The Cylinder:** Equation of a cylinder with a given generator and guiding curve – Right circular cylinder – Enveloping cylinder – Enveloping cylinder as a limiting form of an enveloping cone.

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics from UPSC / TNPSC / other competitive examinations to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. T.K. Manickavachagom Pillay & others (2004), Analytical Geometry (Three Dimensions), S. Viswanathan Printers & Publishers Pvt. Ltd., Chennai.
Reference Books	1. P. Duraipandian and Laxmi Duraipandian, Analytical Geometry-3D, Emerald Publishers, Chennai, 1975. 2. G.B. Thomas and R.L. Finney, Calculus and Analytic Geometry, Addison Wesley, 9th Ed. 3. P.R. Vittal (2003), Coordinate Geometry, Margham Publishers, Chennai.
e-Learning / Website	https://nptel.ac.in

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

NUMERICAL METHODS – II

Paper Number	EC – II (Elective)	**Course Code**	
Category	Elective (Part III)	**Year / Semester**	I Year / Semester II
Credits	3	**Hours / Week**	6
Instructional Hours / Week	**Lecture:** 4 **Tutorial:** 0 **Lab Practice:** 2 **Total:** 6		
Pre-requisite	Numerical Methods – I; Knowledge of calculus and ordinary differential equations		
Objectives	To evaluate derivatives using Newton's forward and backward differences. To study numerical integration. To evaluate solutions of difference equations. To obtain numerical solutions to ODEs.		

COURSE OUTLINE

Unit	Content
Unit I	**Numerical Differentiation:** Newton's Forward and Backward Differences to compute derivatives – Derivative using Stirling's Formula – Derivative using Divided Differences – Maxima and Minima. [Chapter 9: Sec 9.1–9.6]
Unit II	**Numerical Integration:** General Quadrature Formula – Trapezoidal Rule – Simpson's One-Third Rule – Simpson's Three-Eighth Rule – Weddle's Rule. [Chapter 9: Sec 9.7–9.9, 9.13–9.15]
Unit III	**Difference Equations:** Linear Difference Equations – Homogeneous and Non-Homogeneous Equations with constant coefficients – Particular integrals for a^x, x^m, sin ax, cos ax. [Chapter 10: Sec 10.3–10.6]
Unit IV	**Numerical Solution of ODEs – I:** Taylor's Series Method – Picard's Method. [Chapter 11: Sec 11.5, 11.6, 11.8]
Unit V	**Numerical Solution of ODEs – II:** Euler's Method – Euler's Modified Method – Runge–Kutta Method. [Chapter 11: Sec 11.9, 11.11, 11.13–11.15]

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics from UPSC / TNPSC / other competitive examinations to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. P. Kandasamy, K. Thilagavathy and K. Gunavathi (2023), Numerical Methods, S. Chand & Company Ltd., New Delhi.
Reference Books	1. S. Arumugam (2003), Numerical Methods, New Gamma Publishing, Palayamkottai. 2. H.C. Saxena (1991), Finite Differences and Numerical Analysis, S. Chand & Co., Delhi. 3. A. Singaravelu (2004), Numerical Methods, Meenakshi Agency, Chennai.
e-Learning / Website	https://ocw.mit.edu/courses/22-15-essential-numerical-methods-fall-2014/pages/syllabus/ https://ocw.mit.edu/courses/18-330-introduction-to-numerical-analysis-spring-2004/

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

DSEC – II: Maxima: Simplify Symbolic Math			
Paper Number	SEC – II	**Course Code**	
Category	Skill Enhancement Course (Part IV)	**Year / Semester**	I Year / Semester II
Credits	2	**Hours / Week**	2
Instructional Hours / Week	**Lecture:** 0 **Tutorial:** 0 **Lab Practice:** 2 **Total:** 2		
Pre-requisite	Strong foundation in calculus and algebra; computer proficiency		
Objectives	To gain advanced skills in Maxima. To use Maxima for exploring, researching, and problem-solving in mathematics.		
Note	Practical Only		

COURSE OUTLINE

Unit	Content
Unit I	**Introduction to Maxima:** Overview of Maxima software – Installation and setup – Basic commands and syntax – Using variables and functions – Introduction to symbolic expressions.
Unit II	**Algebraic Manipulations with Maxima:** Simplifying expressions – Expanding and factoring polynomials – Solving equations and inequalities – Manipulating matrices and vectors.
Unit III	**Differentiation with Maxima:** Symbolic differentiation – Chain rule and product rule – Differentiating trigonometric and exponential functions – Higher-order derivatives – Applications.
Unit IV	**Integration with Maxima:** Symbolic integration – Integration techniques (substitution, integration by parts) – Definite and indefinite integrals – Numerical integration.
Unit V	**Ordinary Differential Equations with Maxima:** Introduction to ODEs – First-order ODEs: separable, linear, integrating factor – Second-order ODEs: homogeneous and non-homogeneous – Applications.

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics from UPSC / TNPSC / other competitive examinations to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. Online Maxima Documentation and tutorials (https://maxima.sourceforge.io). 2. Maxima Software: Latest version downloadable free from the official Maxima website.
e-Learning / Website	Maxima, a Computer Algebra System (sourceforge.io) The Maxima Book (sourceforge.io)

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

— Semester III —

VECTOR CALCULUS

Paper Number	CC – V	**Course Code**	
Category	Core (Part III)	**Year / Semester**	II Year / Semester III
Credits	4	**Hours / Week**	4
Instructional Hours / Week	Lecture: 4 Tutorial: 0 Lab Practice: 0 Total: 4		
Pre-requisite	12th Standard Mathematics		
Objectives	Knowledge about differentiation of vectors and differential operators. Skills in evaluating line, surface and volume integrals. Ability to analyze physical applications of derivatives of vectors.		

COURSE OUTLINE

Unit	Content
Unit I	**Vector Differentiation – Basics:** Vector point function – Scalar point function – Derivative of a vector and derivative of a sum of vectors – Derivative of a product of a scalar and a vector point function – Derivative of a scalar product and vector product.
Unit II	**Vector Differential Operators:** The vector operator 'del' – The gradient of a scalar point function – Divergence of a vector – Curl of a vector – Solenoidal and irrotational vectors – Simple applications.
Unit III	**Laplacian Operator and Line Integrals:** Laplacian operator – Vector identities – Line integral – Simple problems.
Unit IV	**Surface and Volume Integrals:** Surface integral – Volume integral – Applications.
Unit V	**Integral Theorems:** Gauss Divergence Theorem – Stokes' Theorem – Green's Theorem in two dimensions.

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. P. Duraipandian and Kayalal Pachaiyappan, Vector Analysis, S. Chand & Co. Ltd.
Reference Books	1. M.D. Raisinghania, Vector Calculus, S. Chand & Company, New Delhi. 2. Shanti Narayan, A Text Book of Vector Calculus, S. Chand & Co., New Delhi. 3. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007.
e-Learning / Website	https://nptel.ac.in

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

DIFFERENTIAL EQUATIONS

Paper Number	CC – VI	**Course Code**	
Category	Core (Part III)	**Year / Semester**	II Year / Semester III
Credits	4	**Hours / Week**	4
Instructional Hours / Week	Lecture: 4 Tutorial: 0 Lab Practice: 0 Total: 4		
Pre-requisite	12th Standard Mathematics		
Objectives	Knowledge about the methods of solving Ordinary and Partial Differential Equations. Understanding of how Differential Equations can be used as a powerful tool in solving problems in science.		

COURSE OUTLINE

Unit	Content
Unit I	**Ordinary Differential Equations:** Variable separable – Homogeneous Equation – Non-Homogeneous Equations of first degree in two variables – Linear Equation – Bernoulli's Equation – Exact differential equations.
Unit II	**Equations of First Order but Not of Higher Degree:** Equation solvable for dy/dx – Equation solvable for y – Equation solvable for x – Clairaut's form – Linear Equations with constant coefficients – Particular integrals of algebraic, exponential, trigonometric functions and their products.
Unit III	**Simultaneous and Second Order Linear ODEs:** Simultaneous linear differential equations – Linear Equations of the Second Order – Complete solution in terms of a known integral – Method of Variation of Parameters.
Unit IV	**Partial Differential Equations:** Formation of PDE by eliminating arbitrary constants and arbitrary functions – Complete integral – Singular integral – General integral – Lagrange's Linear Equations – Simple Applications.
Unit V	**Special Methods for PDEs:** Special methods – Standard forms – Charpit's Method – Simple Applications.

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. T.K. Manicavachagom Pillay, T. Natarajan, K.S. Ganapathy, Calculus Volume-II, S. Viswanathan Printers and Publishers Pvt. Ltd., 2012.
Reference Books	1. D.A. Murray, Introductory Course in Differential Equations, Orient and Longman. 2. H.T.H. Piaggio, Elementary Treatise on Differential Equations, C.B.S Publishers & Distributors, Delhi, 1985. 3. Boyce W.E. and R.C. DiPrima, Elementary Differential Equations and Boundary Value Problems (7th Edn.), John Wiley and Sons, Inc., New York, 2001. 4. Sundarpandian V., Ordinary and Partial Differential Equations, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2013.
e-Learning / Website	https://nptel.ac.in

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

MATHEMATICAL STATISTICS – I

Paper Number	EC – III (Elective)	**Course Code**	
Category	Elective (Part III)	**Year / Semester**	II Year / Semester III
Credits	4	**Hours / Week**	6
Instructional Hours / Week	**Lecture:** 4 **Tutorial:** 0 **Lab Practice:** 2 **Total:** 6		
Pre-requisite	Basic knowledge of set theory and elementary mathematics		
Objectives	To know fundamental concepts of Statistics. To apply Bayes' theorem. To understand expectation, moments, distribution functions. To learn standard distributions.		

COURSE OUTLINE

Unit	Content
Unit I	**Probability Theory:** Axiomatic approach to probability – Theorems on probability – Conditional Probability – Multiplication theorem – Independent events – Bayes' Theorem. [Chapter 3–4]
Unit II	**Random Variables and Mathematical Expectation:** Random Variables (Discrete and Continuous) – Distribution Function – Mathematical Expectation – Expected value of functions – Properties of expectation – Properties of variance – Covariance. [Chapter 5–6]
Unit III	**Generating Functions:** Moment generating function – Characteristic Function – Uniqueness and Inversion Theorem (Statement only) – Chebyshev's Inequality – Simple problems. [Chapter 7]
Unit IV	**Correlation and Regression:** Bivariate Distribution – Correlation – Karl Pearson's Coefficient of Correlation – Rank Correlation – Linear Regression. [Chapter 10–11]
Unit V	**Standard Distributions:** Discrete: Binomial, Poisson, Hyper Geometric, Negative Binomial. Continuous: Normal, Uniform, Exponential distributions. [Chapters 8–9]

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. S.C. Gupta & V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 11th edition, June 2002.
Reference Books	1. Hogg R.V. & Craig A.T. (1998), Introduction to Mathematical Statistics, Macmillan. 2. Mood A.M., Graybill F.A. & Boes D.G. (1974), Introduction to Theory of Statistics, McGraw Hill. 3. Snedecor G.W. & Cochran W.G. (1967), Statistical Methods, Oxford and IBH. 4. Hoel P.G. (1971), Introduction to Mathematical Statistics, Wiley.
e-Learning / Website	https://mathworld.wolfram.com/topics/ProbabilityandStatistics.html https://ocw.mit.edu/courses/18-05-introduction-to-probability-and-statistics-spring-2014/

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

MATHEMATICS FOR COMPETITIVE EXAMINATIONS – I

Paper Number	NME – I	**Course Code**	
Category	Non-Major Elective (Part IV)	**Year / Semester**	III Year / Semester V
Credits	2	**Hours / Week**	2
Instructional Hours / Week	**Lecture:** 2 **Tutorial:** 0 **Lab Practice:** 0 **Total:** 2		
Pre-requisite	10th Standard Mathematics		
Objectives	To analyze and solve real-world problems involving averages. To apply ratio and proportion to solve practical problems. To understand time, work, and efficiency relationships. To solve financial problems using interest formulas. To grasp the fundamental principles of permutations and combinations.		
Note	Offered to B.A./B.Com./B.Sc. students (other than Mathematics). Assessment: Two CAs (40 Obj × 0.5 marks), Assignment 5 marks, Attendance 5 marks. End Semester: 75 objective questions × 1 mark.		

COURSE OUTLINE

Unit	Content
Unit I	**Averages and Problems on Numbers:** Average – Problems on Numbers. [Dr. R.S. Aggarwal, Quantitative Aptitude – Chapters 6, 7]
Unit II	**Ratio and Proportion:** Ratio and Proportion – Problems involving mixtures, scaling, and financial calculations. [Chapter 13]
Unit III	**Time and Work – Time and Distance:** Time and Work – Time and Distance – Efficiency calculations – Real-world applications. [Chapters 17, 18]
Unit IV	**Simple Interest and Compound Interest:** Simple Interest – Compound Interest – Problems involving savings, loans, and investments. [Chapters 22, 23]
Unit V	**Permutations and Combinations:** Permutations and Combinations – Fundamental counting principles – Applications to competitive exam problems. [Chapter 30]

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. Dr. R.S. Aggarwal, Quantitative Aptitude (for Competitive Examinations), Revised Edition, S. Chand and Company Ltd., Ram Nagar, New Delhi, Reprint 2021.
Reference Books	1. R.S. Aggarwal, Objective Arithmetic, S. Chand & Co., New Delhi. 2. Abhijit Guha, Quantitative Aptitude, Tata McGraw-Hill Education, New Delhi.
e-Learning / Website	https://d5ofvi41ggben.cloudfront.net/4966d784-a71b-4c11-b31e-801ee59d95c0-1571828515642-quantitative-aptitude.pdf www.pgaedutech.com/pdfbooks/WorkSheetsQuant.pdf

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

— Semester IV —

OPERATIONS RESEARCH

Paper Number	CC – VII	**Course Code**	
Category	Core (Part III)	**Year / Semester**	II Year / Semester IV
Credits	5	**Hours / Week**	5
Instructional Hours / Week	**Lecture:** 5 **Tutorial:** 0 **Lab Practice:** 0 **Total:** 5		
Pre-requisite	Basic knowledge of linear equations and matrix algebra		
Objectives	To describe the role of mathematical models in OR. To formulate real-life problems as LPPs. To solve LPPs, transportation, assignment, game theory, and simulation problems.		

COURSE OUTLINE

Unit	Content
Unit I	**Linear Programming Problem:** LPP – Mathematical formulation – Graphical solution – Simplex method – Big-M method – Duality – Dual Simplex method (Simple Problems).
Unit II	**Transportation Models:** Definitions – Formulation and solution – Finding initial basic feasible solution (NWCM, LCM, VAM) – Degeneracy – Transportation Algorithm (MODI Method).
Unit III	**Assignment Models:** Definition – Mathematical representation – Comparison with transportation models – Solution using Hungarian method – Variations – Travelling Salesman Problem.
Unit IV	**Game Theory:** Games and Strategies – Two person zero sum games – Maximin–Minimax principle – Saddle points – Games without saddle points – Mixed strategies – Graphic solution of 2×n and m×2 games.
Unit V	**Simulation:** Simulation – Applications – Advantages and disadvantages – Monte Carlo method – Simple problems.

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics from UPSC / TNPSC / other competitive examinations to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. Gupta P.K. and Hira D.S. (2000), Problems in Operations Research, S. Chand & Co., Delhi.
Reference Books	1. J.K. Sharma (2001), Operations Research Theory and Applications, Macmillan, Delhi. 2. Kanti Swaroop, Gupta P.K. and Manmohan (1999), Problems in Operations Research, Sultan Chand & Sons. 3. Taha H.A. (2003), Operations Research, Macmillan Publishing Company, New York. 4. S.J. Venkatesan, Operations Research, J.S. Publishers, Cheyyar – 604407.
e-Learning / Website	https://ocw.mit.edu/courses/6-046j-design-and-analysis-of-algorithms-spring-2015/ https://www.mygreatlearning.com/academy/learn-for-free/courses/linear-programming-examples

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

DYNAMICS

Paper Number	CC – VIII	**Course Code**	
Category	Core (Part III)	**Year / Semester**	II Year / Semester IV
Credits	5	**Hours / Week**	5
Instructional Hours / Week	**Lecture:** 5 **Tutorial:** 0 **Lab Practice:** 0 **Total:** 5		
Pre-requisite	12th Standard Mathematics and Physics		
Objectives	To educate students on forces, velocity, and acceleration. To explain resultant and relative velocity through real-life examples. To demonstrate how mathematics converts physical phenomena into formulae.		

COURSE OUTLINE

Unit	Content
Unit I	**Kinematics and Energy:** Velocity – Relative velocity – Angular velocity – Acceleration – Rectilinear motion with constant acceleration – Relative angular velocity – Work, Power, Energy – Problems.
Unit II	**Simple Harmonic Motion:** Simple Harmonic Motion – Orthogonal projection of uniform circular motion – Composition of two SHMs – Motion of a particle attached to horizontal and vertical spiral springs – Problems.
Unit III	**Projectile Motion:** Motion of a projectile – Nature of a trajectory – Results pertaining to projectile motion – Range on an inclined plane – Maximum range on the inclined plane – Problems.
Unit IV	**Impact and Collision:** Impulsive force – Conservation of linear momentum – Laws of impact – Impact of two smooth spheres – Direct impact – Oblique impact on a smooth plane – Problems.
Unit V	**Moment of Inertia:** Moment of Inertia of simple bodies – Parallel and Perpendicular axes theorems – MI of thin circular ring, circular lamina, solid cylinder, solid sphere, solid cone, spherical shell, thin rod, rectangular lamina, elliptic lamina, parabolic lamina, triangular lamina – Problems.

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics from UPSC / TNPSC / other competitive examinations to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. P. Duraipandian, Laxmi Duraipandian, Muthamizh Jayapragasam, Mechanics, 6th Ed., S. Chand and Company Ltd., 2005.
Reference Books	1. A.V. Dharmapadam (1991), Mechanics, S. Viswanathan Printers & Publishers, Chennai. 2. M.K. Venkatraman (1990), Statics, Rajhans Publications, 16th Edition.
e-Learning / Website	https://nptel.ac.in

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

MATHEMATICAL STATISTICS – II

Paper Number	EC – IV (Elective)	**Course Code**	
Category	Elective (Part III)	**Year / Semester**	II Year / Semester IV
Credits	3	**Hours / Week**	6
Instructional Hours / Week	**Lecture:** 4 **Tutorial:** 0 **Lab Practice:** 2 **Total:** 6		
Pre-requisite	Mathematical Statistics – I		
Objectives	To know statistical investigations and sampling techniques. To learn Chi-square, t, F, and Z distributions. To study methods of estimation and testing of hypotheses. To apply ANOVA techniques.		

COURSE OUTLINE

Unit	Content
Unit I	**Sampling Theory:** Statistical Population – Census and Sampling Survey – Parameter and Statistics – Sampling Distribution and Standard Error – Student's t, chi-square and F distributions – Large sample tests. [Chapter 12]
Unit II	**Tests of Significance:** Large sample tests for proportion, mean, and standard deviation – Exact tests based on t, Chi-square and F distributions – Tests of independence of attributes – Goodness of fit tests. [Chapter 13]
Unit III	**Point Estimation:** Unbiasedness, consistency, efficiency, sufficiency – Cramer–Rao Inequality – Maximum Likelihood Estimation – Method of Moments – t, F, and Z distributions. [Chapter 14]
Unit IV	**Test of Hypothesis:** Null and Alternate Hypothesis – Type I and Type II error – Power of the test – Neyman–Pearson Lemma – Likelihood Ratio Test – Most Powerful Test (Statement only). [Chapters 15–16]
Unit V	**Analysis of Variance and Design of Experiments:** ANOVA – One-way and Two-way Classification – Basic Principles: Randomization, Replication, Local Control – CRD, RBD, and Latin Square Design. [Chapters 17–18]

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics from UPSC / TNPSC / other competitive examinations to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. S.C. Gupta & V.K. Kapoor, Elements of Mathematical Statistics, 3rd revised edition, Sultan Chand & Sons.
Reference Books	1. Hogg R.V. & Craig A.T. (1998), Introduction to Mathematical Statistics, Macmillan. 2. Mood A.M., Graybill F.A. & Boes D.G. (1974), Introduction to Theory of Statistics, McGraw Hill. 3. O. Kempthorne, Design of Experiments. 4. Das and Giri, Design of Experiments, Wiley Eastern.
e-Learning / Website	https://mathworld.wolfram.com/topics/ProbabilityandStatistics.html https://ocw.mit.edu/courses/18-655-mathematical-statistics-spring-2016/

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

MATHEMATICS FOR COMPETITIVE EXAMINATIONS – II

Paper Number	NME – II	**Course Code**	
Category	Non-Major Elective (Part IV)	**Year / Semester**	III Year / Semester VI
Credits	2	**Hours / Week**	2
Instructional Hours / Week	**Lecture:** 2 **Tutorial:** 0 **Lab Practice:** 0 **Total:** 2		
Pre-requisite	10th Standard Mathematics; Mathematics for Competitive Examinations – I		
Objectives	To understand and apply profit, loss, cost price, selling price, and discounts. To solve problems involving trains and crossing times. To analyze calendar and clock problems. To apply principles of probability to basic problems. To interpret and analyze data presented in tables, bar graphs, and charts.		
Note	Offered to B.A./B.Com./B.Sc. students (other than Mathematics). Assessment: Two CAs (40 Obj × 0.5 marks), Assignment 5 marks, Attendance 5 marks. End Semester: 75 objective questions × 1 mark.		

COURSE OUTLINE

Unit	Content
Unit I	**Profit, Loss, and Partnership:** Profit and Loss – Partnership – Cost price, selling price, discount calculations – Real-life financial problems. [Chapters 12, 14]
Unit II	**Boats, Streams, and Trains:** Boats and Streams – Problems on Trains – Relative speed, crossing times, and motion problems. [Chapters 19, 20]
Unit III	**Calendars and Clocks:** Problems on Calendars and Clocks – Odd days, day-finding, clock angle problems. [Chapters 27, 28]
Unit IV	**Probability and True Discount:** Probability – True Discount – Basic probability problems and discount calculations. [Chapters 31, 32]
Unit V	**Data Interpretation:** Data Interpretation Problems – Tabulation – Bar Graphs – Reading and analyzing data tables and charts. [Chapters 36, 37]

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. R.S. Aggarwal, Quantitative Aptitude (for Competitive Examinations), Revised Edition, S. Chand and Company Ltd., Ram Nagar, New Delhi, Reprint 2021.
Reference Books	1. R.S. Aggarwal, Objective Arithmetic, S. Chand & Co., New Delhi. 2. Abhijit Guha, Quantitative Aptitude, Tata McGraw-Hill Education, New Delhi.
e-Learning / Website	www.tcyonline.com/tests/mathematics-competitive-exam https://d5ofvi41ggben.cloudfront.net/4966d784-a71b-4c11-b31e-801ee59d95c0-1571828515642-quantitative-aptitude.pdf

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

MAPPING OF CO WITH PO AND PSO

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	Mean
CO1	2	2	1	3	3	3	1	3	3	3	2	2	2.33
CO2	2	3	2	3	3	3	2	3	3	2	2	2	2.50
CO3	3	2	2	2	3	3	2	3	2	3	3	2	2.50
CO4	2	2	2	3	3	2	3	2	3	2	3	2	2.42

CO5	3	3	2	3	3	2	3	2	3	2	2	2	2.50
CO6	2	3	2	2	2	1	3	2	2	2	2	2	2.09

— Semester V —

ABSTRACT ALGEBRA

Paper Number	CC – IX	**Course Code**	
Category	Core (Part III)	**Year / Semester**	III Year / Semester V
Credits	5	**Hours / Week**	5
Instructional Hours / Week	**Lecture:** 5 **Tutorial:** 0 **Lab Practice:** 0 **Total:** 5		
Pre-requisite	12th Standard Mathematics		
Objectives	Concepts of Sets, Groups, and Rings. Construction, characteristics, and applications of abstract algebraic structures.		

COURSE OUTLINE

Unit	Content
Unit I	**Groups:** Introduction to groups – Subgroups – Cyclic groups and properties – Lagrange's Theorem – A counting principle – Examples.
Unit II	**Normal Subgroups and Homomorphism:** Normal subgroups and quotient groups – Homomorphism – Automorphism – Examples.
Unit III	**Permutation Groups:** Cayley's Theorem – Permutation groups – Examples.
Unit IV	**Rings and Ideals:** Definition and examples of rings – Special classes of rings – Homomorphism of rings – Ideals and quotient rings.
Unit V	**Euclidean Rings and Fields:** The field of quotients of an integral domain – Euclidean rings – The particular Euclidean ring – Examples.

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics from UPSC / TNPSC / other competitive examinations to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. I.N. Herstein, Topics in Algebra, Wiley Eastern Ltd., 2nd Edition (2006).
Reference Books	1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002. 2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011. 3. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa, 1999.
e-Learning / Website	https://nptel.ac.in

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

REAL ANALYSIS – I

Paper Number	CC – X	**Course Code**	
Category	Core (Part III)	**Year / Semester**	III Year / Semester V
Credits	4	**Hours / Week**	5
Instructional Hours / Week	**Lecture:** 5 **Tutorial:** 0 **Lab Practice:** 0 **Total:** 5		
Pre-requisite	12th Standard Mathematics; Basic knowledge of sets, functions, and sequences		
Objectives	To study the real number system and its fundamental properties. To develop depth in point set topology. To identify limits of functions. To differentiate between continuous and uniformly continuous functions. To study derivatives of real-valued functions and associated theorems.		

COURSE OUTLINE

Unit	Content
Unit I	**Real Number System:** Upper bounds, maximum element, least upper bound – The completeness axiom – Some properties of the supremum – Properties of the integers deduced from the completeness axiom – The Archimedean property of the real number system – Absolute values and the triangle inequality – The Cauchy-Schwarz inequality – Similar sets – Finite and infinite sets – Countable and uncountable sets – Uncountability of the real number system – Set algebra – Countable collection of countable sets. [Chapter 1: Sec 1.10–1.14, 1.18, 1.19; Chapter 2: Sec 2.10–2.15]
Unit II	**Point Set Topology:** Introduction to point set – Euclidean space in R^n – Open balls and open sets in R^n – Structure of open sets in R^1 – Closed sets – Adherent points, Accumulation points – Closed sets and adherent points – Bolzano-Weierstrass theorem (Statement only) – Cantor intersection theorem (Statement only). [Chapter 3: Sec 3.1–3.9]
Unit III	**Limits and Continuity:** Introduction to limits – Convergent sequences in a metric space – Cauchy sequences – Complete metric spaces – Limit of a function – Continuous functions – Continuity of composite functions. [Chapter 4: Sec 4.1–4.5, 4.8, 4.9]
Unit IV	**Continuity (Advanced):** Continuity and inverse images of open or closed sets – Functions continuous on compact sets – Topological mappings – Bolzano's theorem – Uniform continuity – Uniform continuity and compact sets. [Chapter 4: Sec 4.12–4.15, 4.19, 4.20]
Unit V	**Derivatives:** Introduction to derivatives – Definition of derivative – Derivatives and continuity – Algebra of derivatives – The chain rule – One-sided derivatives and infinite derivatives – Functions with non-zero derivatives – Zero derivatives and local extrema – Rolle's theorem – The Mean Value theorem for derivatives – Intermediate Value theorem for derivatives. [Chapter 5: Sec 5.1–5.11]

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. Tom M. Apostol, Mathematical Analysis, Indian student second edition, Narosa Publishing House, Chennai, 20th Reprint, 2002.
Reference Books	1. P.N. Arora and Ranjit Singh, First Course in Real Analysis, Third edition, Sultan Chand and Sons Publishers, New Delhi, 1981. 2. S. Arumugam, Modern Analysis, New Gamma Publishers,

	Palayamkottai, 1993. 3. E. Fischer, Intermediate Real Analysis, Springer Verlag, 1983. 4. Robert G. Bartle and Donald R. Sherbert, Introduction to Real Analysis, 2nd edition, John Wiley and Sons, 2000. 5. Richard R. Goldberg, Methods of Real Analysis, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 1970.
e-Learning / Website	www.mathworld.wolfram.com/Analysis.html https://nptel.ac.in https://ocw.mit.edu/courses/18-100b-analysis-i-fall-2010/

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if percentage > 20%); Strength = 2 (if percentage 10%–20%); Strength = 1 (if percentage < 10%). Institutions may arrive at a suitable method.

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO 10	LO 11	LO 12	LO 13	LO 14	LO 15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

COMPLEX ANALYSIS – I

Paper Number	CC – XI	**Course Code**	
Category	Core (Part III)	**Year / Semester**	III Year / Semester V
Credits	5	**Hours / Week**	5
Instructional Hours / Week	**Lecture:** 5 **Tutorial:** 0 **Lab Practice:** 0 **Total:** 5		
Pre-requisite	Real Analysis; Differential and Integral Calculus		
Objectives	To study complex variables and analytic functions. To understand conformal mappings, bilinear transformations, and complex integrals.		

COURSE OUTLINE

Unit	Content
Unit I	**Complex Numbers, Mappings and Limits:** Complex numbers – Algebraic properties – Geometric interpretation – Properties of Moduli – Polar form – Regions in the complex plane – Mappings – Limits – Theorems on Limits. [Ch.1: Sec 1–5, 8; Ch.2: Sec 10–12]
Unit II	**Analytic Functions:** Continuity – Derivatives – Cauchy–Riemann equations – Sufficient conditions – C–R equations in polar form – Properties of analytic functions. [Ch.2: Sec 13–19]
Unit III	**Conformal Mappings:** Harmonic functions – Harmonic conjugate – Conformal mapping – Isogonal mapping – Transformations of harmonic functions. [Ch.2: Sec 20; Ch.8: Sec 74–77]
Unit IV	**Mapping by Elementary Functions:** Transformations $w = z+d$, $w = 1/z$, $w = z^2$, $w = \sqrt{z}$, $w = e^z$, $w = \sin z$ – Bilinear Transformation – Special Bilinear Transformations. [Ch.7: Sec 63–68, 70–71]
Unit V	**Integrals:** Contours – Line Integrals – Cauchy–Goursat's Theorem (without proof) – Cauchy's Integral Formula – Derivatives of Analytic Functions. [Ch.4: Sec 29–33, 38–39]

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics from UPSC / TNPSC / other competitive examinations to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. R.V. Churchill and J.W. Brown (1984), Complex Variables and Applications, McGraw Hill International Book Co., Singapore (Fourth Edition).
Reference Books	1. P. Duraipandian and Laxmi Duraipandian, Complex Analysis, Emerald Publishers, Chennai, 1976. 2. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, New Delhi, 2000. 3. Tyagi B.S., Functions of Complex Variable, 17th Edition, Pragati Prakasham, Meerut, 1992–93.
e-Learning / Website	https://ocw.mit.edu/courses/18-04-complex-variables-with-applications-spring-2018/ https://ocw.mit.edu/courses/18-112-functions-of-a-complex-variable-fall-2008/pages/syllabus/ https://pkalika.in/2019/07/01/complex-analysis/

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

GRAPH THEORY AND APPLICATIONS

Paper Number	EC – V	**Course Code**	
Category	Elective (Part III)	**Year / Semester**	III Year / Semester V
Credits	3	**Hours / Week**	4
Instructional Hours / Week	**Lecture:** 4 **Tutorial:** 0 **Lab Practice:** 0 **Total:** 4		
Pre-requisite	12th Standard Mathematics		
Objectives	To study and develop the concepts of graphs, subgraphs, trees, connectivity, Eulerian graphs, Hamiltonian graphs, matchings, and planar graphs.		

COURSE OUTLINE

Unit	Content
Unit I	**Graphs and Basic Concepts:** Graphs – Degrees – Subgraphs – Isomorphism of graphs – Ramsey Numbers – Independent sets and Coverings. [Sec 2.1–2.6]
Unit II	**Special Graphs and Matrices:** Intersection graphs and line graphs – Matrices (adjacency, incidence) – Operations on graphs – Degree Sequence – Graphic Sequence. [Sec 2.7–2.9, 3.1–3.2]
Unit III	**Connectivity:** Walks, Trails, Paths – Connectedness and Components – Cutpoint, Bridge, Block – Connectivity. [Sec 4.1–4.4]
Unit IV	**Eulerian and Hamiltonian Graphs; Trees:** Eulerian graphs – Hamiltonian graphs – Characterization of Trees – Centre of a Tree. [Sec 5.1–5.2, 6.1–6.2]
Unit V	**Matchings and Planar Graphs:** Matchings – Matchings in Bipartite Graphs – Definition and properties of planar graphs – Characterization of planar graphs. [Sec 7.1–7.2, 8.1–8.2]

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. S. Arumugam and S. Ramachandran, Invitation to Graph Theory, Scitech Publications India Pvt. Ltd., T. Nagar, Chennai.
Reference Books	1. Douglas B. West, Introduction to Graph Theory, Pearson Education, Inc., Pearson Prentice Hall, London. 2. S.A. Choudum, A First Course in Graph Theory, Macmillan India Ltd. 3. Robin J. Wilson, Introduction to Graph Theory, Longman Group Ltd. 4. J.A. Bondy and U.S.R. Murthy, Graph Theory with Applications, Macmillan, London.
e-Learning / Website	https://nptel.ac.in https://www.mathhelp.com/

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

— Semester VI —

LINEAR ALGEBRA

Paper Number	CC – XIII	**Course Code**	
Category	Core (Part III)	**Year / Semester**	III Year / Semester VI
Credits	5	**Hours / Week**	6
Instructional Hours / Week	**Lecture:** 6 **Tutorial:** 0 **Lab Practice:** 0 **Total:** 6		
Pre-requisite	Group and Ring Theory		
Objectives	To introduce concepts of vector spaces and dual spaces. To develop knowledge of linear transformations and their matrix representations. To understand determinants and their properties.		

COURSE OUTLINE

Unit	Content
Unit I	**Vector Spaces:** Vector spaces – Subspaces – Linear dependence and independence – Bases – Dimension – Basic concepts and examples.
Unit II	**Dual Spaces and Inner Product Spaces:** Dual spaces – Annihilator of a subspace – Inner product spaces.
Unit III	**Linear Transformations:** Algebra of linear transformations – Sub-algebra – Minimal polynomial – Invertible transformations – Characteristic roots – Characteristic vectors.
Unit IV	**Matrix Representations:** Matrices – Matrix of a linear transformation and its properties – Canonical forms – Triangular forms – Invariant transformations.
Unit V	**Trace, Transpose, and Determinants:** Trace and Transpose: definition and properties – Jacobson Lemma – Symmetric, skew-symmetric, and adjoint matrices – Determinants – Solving systems of linear equations – Secular equation.

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics from UPSC / TNPSC / other competitive examinations to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. I.N. Herstein (1989), Topics in Algebra, Wiley Eastern Ltd., New Delhi. [Chapters 4 & 6]
Reference Books	1. S. Arumugam (2004), Modern Algebra, Scitech Publications, Chennai. 2. J.B. Fraleigh (1987), A First Course in Algebra, 3rd Ed., Addison Wesley. 3. M.L. Santiago (2002), Modern Algebra, Tata McGraw Hill, New Delhi. 4. Surjeet Singh and Qazi Zameeruddin (1982), Modern Algebra, Vikas Publishing House.
e-Learning / Website	https://www.classcentral.com/course/youtube-vector-spaces-80274 https://wolframalpha.com/examples/mathematics/linear-algebra http://linear.ups.edu/index.html

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

COMPLEX ANALYSIS – II

Paper Number	CC – XV	**Course Code**	
Category	Core (Part III)	**Year / Semester**	III Year / Semester VI
Credits	4	**Hours / Week**	5
Instructional Hours / Week	**Lecture:** 5 **Tutorial:** 0 **Lab Practice:** 0 **Total:** 5		
Pre-requisite	Complex Analysis – I		
Objectives	To gain knowledge of complex integration, Taylor's and Laurent's series, singularities, residues, contour integration, and zeros/poles of analytic functions.		

COURSE OUTLINE

Unit	Content
Unit I	**Integrals (Advanced):** Morera's theorem – Maximum Moduli of functions – The Fundamental Theorem of Algebra – Liouville's theorem – Convergence of sequences and series. [Ch.4: Sec 40–42; Ch.5: Sec 43]
Unit II	**Power Series:** Taylor's theorem – Laurent's theorem – Examples – Integration and differentiation of power series. [Ch.5: Sec 44–46, 49]
Unit III	**Singularities and Residues:** Singularities and classifications – Isolated singularities – Removable singularity – Pole and essential singularity – Residues – Cauchy's Residue Theorem. [Ch.6: Sec 54–57]
Unit IV	**Contour Integration:** Evaluation of improper real integrals – Improper integrals involving trigonometric functions – Simple problems. [Ch.6: Sec 59–61]
Unit V	**Analytic Continuation:** Zeros of analytic functions – Poles and zeros – Essential singular points – Number of zeros and poles – The Argument Principle – Rouché's Theorem. [Ch.5: Sec 53; Ch.12: Sec 106–109]

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics from UPSC / TNPSC / other competitive examinations to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. R.V. Churchill and J.W. Brown (1984), Complex Variables and Applications, McGraw Hill International Book Co., Singapore (Fourth Edition).
Reference Books	1. P. Duraipandian and Laxmi Duraipandian, Complex Analysis, Emerald Publishers, Chennai, 1976. 2. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, New Delhi, 2000. 3. Tyagi B.S., Functions of Complex Variable, 17th Edition, Pragati Prakasham, Meerut, 1992–93.
e-Learning / Website	https://ocw.mit.edu/courses/18-04-complex-variables-with-applications-spring-2018/ https://ocw.mit.edu/courses/18-112-functions-of-a-complex-variable-fall-2008/pages/syllabus/ https://pkalika.in/2019/07/01/complex-analysis/

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

DISCRETE MATHEMATICS

Paper Number	EC – VI	**Course Code**	
Category	Elective (Part III)	**Year / Semester**	III Year / Semester VI
Credits	3	**Hours / Week**	5
Instructional Hours / Week	**Lecture:** 5 **Tutorial:** 0 **Lab Practice:** 0 **Total:** 5		
Pre-requisite	12th Standard Mathematics		
Objectives	To develop mathematical maturity and ability to deal with abstraction. To develop construction and verification of formal logical manipulation. To study recurrence relations, mathematical logic, lattices, and Boolean algebra.		

COURSE OUTLINE

Unit	Content
Unit I	**Recurrence Relations and Generating Functions:** Recurrence – Polynomials and their Evaluations – Recurrence Relations – Solution of Finite Order Homogeneous (linear) Relations – Solutions of Non-homogeneous Relations. [Chapter V, Sections 1–5]
Unit II	**Mathematical Logic:** TF Statements – Connectives – Atomic and Compound Statements – Well-formed Statement Formulae – Truth Table of a Formula – Tautology – Tautological Implications and Equivalence of Formulae. [Chapter IX, Sections 1–8]
Unit III	**Mathematical Logic (Continued):** Replacement Process – Functionally Complete Sets of Connectives and Duality Law – Normal Forms – Principal Normal Forms. [Chapter IX, Sections 9–12]
Unit IV	**Lattices:** Lattices – Some Properties of Lattices – New Lattices – Modular and Distributive Lattices. [Chapter X, Sections 1–4; omit specified examples as noted]
Unit V	**Boolean Algebra:** Boolean Algebra – Boolean Polynomials – Karnaugh Maps (omit K-map for 5 and 6 variables). [Chapter X, Sections 5–7]

Extended Professional Component (Part of Internal Component only; Not to be included in External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved. (To be discussed during the Tutorial hour).

TEXTBOOKS, REFERENCES & E-LEARNING SOURCES

Category	Details
Textbook(s)	1. M.K. Venkataraman, N. Sridharan and N. Chandrasekaran (2003), Discrete Mathematics, The National Publishing Company, Chennai.
Reference Books	1. Oscar Levin, Discrete Mathematics, 3rd Edition, 2016. 2. B.A. Davey & H.A. Priestley (2002), Introduction to Lattices and Order (2nd edition), Cambridge University Press. 3. Kenneth H. Rosen (2012), Discrete Mathematics and its Applications (7th edition), McGraw-Hill. 4. C.L. Liu (1985), Elements of Discrete Mathematics (2nd edition), McGraw-Hill.
e-Learning / Website	https://nptel.ac.in

STEP 4: Internal Assessment Matrix (IAM) for the defined COs

CO	Test I	Test II	Quiz	Assessment I	Assessment II	% Allocation / Strength
CO1	20	–	5	5	5	35% – Strength 3
CO2	20	–	5	4	4	33% – Strength 3
CO3	–	15	5	3	3	26% – Strength 3
CO4	–	15	5	–	–	20% – Strength 2
CO5	10	10	5	–	–	25% – Strength 3
CO6	–	–	–	3	–	3% – Strength 1
Total Marks: 100						

Note: Strength = 3 (if % > 20%); Strength = 2 (if % 10–20%); Strength = 1 (if % < 10%).

STEP 5: Course Articulation Matrix (CAM) – CO vs Learning Outcomes

CO	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO10	LO11	LO12	LO13	LO14	LO15	PAM *
CO1	3	–	–	2	1	–	–	–	–	2	–	–	–	–	1	3
CO2	3	–	–	3	2	–	–	–	–	2	–	–	–	–	–	3
CO3	2	–	–	3	3	–	–	–	–	2	–	–	–	–	–	2
CO4	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	3
CO5	–	–	3	–	2	–	–	3	3	–	–	–	–	–	–	3
CO6	–	3	–	–	–	–	–	–	–	–	–	–	–	–	3	3
PAM	3	3	3	3	3	3	–	3	3	3	3	–	–	–	3	–

** PAM: Program Articulation Matrix | Mapping Strength: 3 = High, 2 = Moderate, 1 = Low, – = No Significant Mapping*

****