THIRUVALLUVARUNIVERSITY

SERKKADU

VELLORE- 632115

M.Sc. Mathematics –2022-2023 onwards

Programme Objectives:

1. Developthestudentwithcriticalthinkingandanalyticskills.
2. Enhancetheknowledgeofstudentsforpursuinghigherstudies.
3. Providein-depthknowledgetodesignthemathematicalmodelsinreallifeproblems.
4. Expertisethestudentstoexcelintheirprofessionalcareer.
5. Providethestudentstounderstandthemathematicalconceptsvisually.

ProgrammeEducationalObjectives:

1. ProvideastrongfoundationinpureandappliedMathematics.
2. Motivatethestudentstopursuehigherstudies.
3. Preparethestudentstoworkeffectivelyina group orindividually.
4. Enrichthestudenttofollowtheethicalandprofessionalvaluestoservethecommunity.
5. Encouragethestudentforlifelonglearning.

Programme Specific Outcomes:

1. UnderstandthetheoreticalknowledgeofMathematicalconcepts.
2. Developtheproblemssolvingskills.
3. Collaboratewith themulti-disciplinaryareas.
4. CreativelyapplyingtheknowledgeofMathematicsinselectedreallifesituations.
5. Appreciatetheemphasisgivenonteachingthemathematicalconceptsthroughcounterexamples.
6. Gettheknowledgeofinter-disciplinaryapproach oflearning.
7. DeveloptheskilltosolveproblemswhichappearinthevariousexaminationslikeCSIR-NET,SET,IAS, etc
8. InculcatethecreativeanddevelopresearchlevelthinkinginthefieldofpureandappliedMathematics.
9. Encouragetogo forhigherlearninginresearch.
10. Understandtheethicalvaluesandhumanvaluestoappreciatetheculturaldiversityandpromotethesocial harmony.

Programme Outcomes:

1. Acquirein-depthknowledgeofMathematicsboth intheoryandapplication.
2. Identifymathematicalandcomputationalmethodsinordertosolvecomprehensiveproblems.
3. Recognizethevariousspecializedareasofadvancedmathematicsanditsapplications.
4. Analyzeandinterpretdatatocreateanddesignnewknowledgefor complexproblems.
5. Developthemathematicalmodelsfortheapplicationsofmathematicsinreallifesituations.
6. Exhibitthepotentialtoeffectivelyaccomplishtasksindependentlyandasamemberorleaderindiverseteams,and in multidisciplinarysettings.
7. Developtheskillstocrackthevariouscompetitiveexamination.
8. Abilitytoengageinlife-longlearninginthecontextoftherapiddevelopmentsinthefield.
9. Demonstratetheabilitytowritedissertations,reports,makeeffectivepresentationsanddocumentation.
10. Commitmenttoprofessionalethicsandsocialresponsibilities.

THIRUVALLUVARUNIVERSITY
MASTEROFSCIENCE
(Witheffectfrom2022–2023)

TheCourseofStudyandtheSchemeofExamination

@CompulsoryCourses don'tchangethiscategory. Number ofcore papers &Practicalmaybe changed

Sl. No.	*Study Components*		*ins. hrs / week*	*Credit*	*Title of the Paper*	*Maximum Marks*		
	Course Title					*CIA*	*Uni. Exam*	*Total*
SEMESTER I								
	Core		6	5	Algebra-I	25	75	100
			6	5	Real Analysis –I	25	75	100
			6	4	Ordinary Differential Equations	25	75	100
Internal Elective for same major students (Choose any one)								
	@ Core Elective	**Paper-1**	6	3	A. Probability Theory B. Mechanics C. Graph Theory	25	75	100
External Elective for other major students (Inter/multi disciplinary papers)								
	@ Open Elective	**Paper-1**	6	3	A. Basic Mathematics B. Mathematical Foundations C. Mathematical Modeling	25	75	100
			30	**20**				
SEMESTER II						*CIA*	*Uni. Exam*	*Total*
	Core		6	5	Algebra-II	25	75	100
			6	5	Real Analysis –II	25	75	100
			6	4	Partial Differential Equations	25	75	100
Internal Elective for same major students (Choose any one)								
	@ Core Elective	**Paper-2**	5	3	A.Mathematical Statistics B. Fuzzy Set Theory C. Difference Equations	25	75	100
External Elective for other major students (Inter/multi disciplinary papers)								
	@ Open Elective	**Paper-2**	5	3	A. Fundamentals of Insurance B. Numerical Methods C. Fundamentals of Business Statistics	25	75	100
	@ Compulsory Paper		2	2	**Human Rights & Duties**	25	75	100
			30	**22**				

Sl. No.	*Study Components*		*ins. hrs / week*	*Credit*	*Title of the Paper*	*Maximum Marks*		
	Course Title					*CIA*	*Uni. Exam*	*Total*
SEMESTER III								
	Core		6	6	Complex Analysis –I	25	75	100
			6	5	Topology	25	75	100
			6	5	Differential Geometry	25	75	100
Internal Elective for same major students (Choose any one)								
	@ Core Elective	**Paper-3**	6	3	A. LaTeX B. Discrete Mathematics C. Operations Research	25	75	100
External Elective for other major students (Inter/multi disciplinary papers)								
	@ Open Elective	**Paper-3**	6	3	A. Mathematical Biology B. Quantitative Techniques C. SCILAB	25	75	100
	@MOOC Courses		-	2				100
	@Field Study			**2**		**100**		**100**
			30	**26**				
SEMESTER IV						*CIA*	*Uni. Exam*	*Total*
	Core		5	4	Complex Analysis –II	25	75	100
			5	4	Fluid Dynamics	25	75	100
			5	5	Functional Analysis	25	75	100
	@ Core	Project Compulsory	5	5	Project with *viva voce*	100 (75 Project +25 viva)		100
Internal Elective for same major students (Choose any one)								
	@Core Elective	Paper-4	5	3	A. Number Theory and Cryptography B. Advanced Numerical Analysis C. Calculus of Variations and Integral Equations	25	75	100
External Elective for other major students (Inter/multi disciplinary papers)								
	@ Open Elective (Non-Major)	**Paper-4**	5	3	A. Mathematical Economics B.Entrepreneurial Development C. Programming in C++	25	75	100
			30	**24**				
			120	**92**				

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115
M.Sc. Mathematics – 2022 - 2023 onwards

Semester : I	**Paper type : Core**	**Credit : 5**
Paper code :	**Name of the Paper : Algebra-I**	
Hours of Teaching:90 hrs		

Course Objectives:

The objective of this course are to:

1. Study and develop the concept of group action and learn Sylow's theorem and its applications.
2. Introducing structure theorem on abelian group and studying its applications.
3. Get the knowledge on algebraic structure Modules and its properties
4. Understand canonical forms of linear transformations.
5. Demonstrate insight into Linear algebra with focus on properties of matrix of transformations.

Course Outcomes:

After successful completion on the course the student will be able to

CO1 Demonstrate ability to think group actions critically by Cayley's theorem and apply the Sylow's theorems to describe the structure of certain finite abelian groups

CO2 Understand the concept of the internal and external direct product of groups. Also, apply the structure theorem on abelian groups to find the non-isomorphic abelian groups of certain orders.

CO3 Check the irreducibility of given polynomial in the defined Field

CO4 Know about Module and, difference between the Algebraic structures, Vector space and Module.

CO5 Acquire the knowledge of the Linear transformation in canonical forms. Also, the matrix form of linear transformation and its properties.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	No	Yes	No
2	Yes	Yes	No	No	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit – 1 Group Theory 18 hours

Another counting principle - class equation for finite groups and its applications - Sylow's theorems (For theorem 2.12.1, Only First proof)

Chapter 2: Sections 2.11 and 2.12

Unit – 2 Group Theory (Continuation) 18 hours

Direct products - Finite abelian groups

Chapter 2: Sections 2.13 and 2.14 (Only Theorem 2.14.1))

Unit – 3 Ring Theory 18 hours

Polynomial Rings – Polynomials over the Rational Field

Chapter 3: Sections 3.9 to 3.10

Unit – 4 Modules and Linear Transformations 18 hours

Modules –LinearTransformations: Nilpotent transformations - Jordan form - rational canonical form.

Chapter 4: Section 4.5

Chapter 6: Sections 6.5to 6.7

Unit – 5 Linear Transformations 18 hours

Hermitian, unitary, normal transformations, real quadratic form.

Chapter 6: Sections 6.10 and 6.11

Text book:

I.N. Herstein, Topics in Algebra, 2nd Edition. Wiley.1975

Reference Books:

1. D.S.Dummit and R.M.Foote. Abstract Algebra. Wiley 2003
2. M. Artin, Algebra, Prentice Hall of India, 1991
3. J.A. Gallian. Contemporary Abstract Algebra. 4th Edition. Narosa Publishing 2011
4. P.B.Battacharya, S.K.Jain, and S.R.Nagpaul, Basic Abstract Algebra(II Edition) Cambridge University Press, 1997.(Indian Edition)
5. I.S. Luther and I.B.S. Passi, Algebra, Vol.I – Groups(1996), Vol. II Rings, Narosa Publishing House, New Delhi, 1999.
6. L. Smith, Linear transformation: Example and Applications. In: Linear Algebra, Undergraduate texts in Mathematics, Springer, New york. NY, 1998.

E-Materials:

https://nptel.ac.in/courses/111108098/

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	S	M	S	S	S
CO2	S	S	M	M	M	S	M	S	S	S
CO3	S	S	M	M	S	S	M	S	S	S
CO4	S	S	M	M	S	S	M	S	S	S
CO5	S	S	M	M	S	S	M	S	S	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115

M.Sc. Mathematics – 2022 - 2023 onwards

Semester : I **Paper type : Core** **Credit : 5**

Paper code : **Name of the Paper : RealAnalysis– I**

Hours of Teaching:90 hrs

CourseObjectives:

Theobjectives of the courseis to

1. Workcomfortablywithfunctionsofbounded variation
2. StudytheRiemann-StieltjesIntegration
3. Expertise the students to excel in integration under integral sign.
4. Get the knowledge about theconvergenceofinfiniteseries,infiniteproductanduniformconvergenceandits interplaybetweenvarious limiting operations.
5. Provide the students to understands uniform convergence and continuity of functions.

Course Outcomes:

After successful completion on the course the student will be able to

CO1 Understandtheconceptoffunctionsofboundedvariation.

CO2 Acquires knowledge on Riemann Stieltjes integration andtosolveitsrelatedproblems.

CO3 Work effectively in integration under integral sign.

CO4 Provide a strong foundation in the study of the convergence of infinite series, infinite product and uniform convergence and its interplay between various limiting operations.

CO5 Know about the convergence of sequences of functions.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	Yes	No
2	Yes	Yes	Yes	No	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit – 1 FunctionsofBoundedVariation 18 hours

Introduction-Propertiesofmonotonicfunctions-Functionsofboundedvariation–Totalvariation-Additivepropertyoftotalvariation-Totalvariationon[a,x]asafunctionofx-Functionsofboundedvariationexpressedasthedifferenceoftwoincreasingfunctions-Continuousfunctions of bounded variation.

Chapter6 : Sections 6.1to 6.8

Unit – 2 TheRiemann-StieltjesIntegral 18 hours

Introduction-Notation-ThedefinitionoftheRiemann-Stieltjesintegral–LinearProperties-Integrationbyparts-ChangeofvariableinaRiemann-Stieltjesintegral-ReductiontoaRiemannIntegral-Euler'ssummationformula-Monotonicallyincreasingintegrators,Upperandlowerintegrals-Additiveandlinearitypropertiesofupperandlowerintegrals -Riemann's condition-Comparison Theorems

Chapter 7 : Sections 7.1 to7.14

Unit – 3 TheRiemann-StieltjesIntegral(Contd.) 18 hours

IntegratorsofboundedvariationSufficientconditionsfortheexistenceofRiemannStieltjesintegrals-NecessaryconditionsfortheexistenceofRiemann-StieltjesintegralsMeanvaluetheoremsforRiemann-Stieltjesintegrals-Theintegralsasafunctionoftheinterval-Secondfundamentaltheoremofintegralcalculus-ChangeofvariableinaRiemannintegral-SecondMeanValueTheoremforRiemannintegral-Riemann-Stieltjesintegralsdependingonaparameter-Differentiation under theintegral sign.

Chapter7: Sections 7.15 to7.24

Unit – 4 InfiniteSeriesandInfiniteProducts 18 hours

Absoluteandconditionalconvergence-Dirichlet'stestandAbel'stest–Rearrangementofseries-Riemann'stheoremonconditionallyconvergentseries.Doublesequences-Doubleseries-Rearrangementtheoremfordoubleseries-Asufficientconditionforequalityofiteratedseries -Multiplicationofseries-Cesarosummability–Infinite products.

Chapter8: Sections 8.8,8.15, 8.17, 8.18, 8.20,8.21 to 8.26

Unit – 5 Sequenceof Functions 18 hours

Pointwise convergence of sequences of functions - Examples of sequences of real - valuedfunctions - Definition of uniform convergence - Uniform convergence and continuity - TheCauchy condition for uniform convergence - Uniform convergence of infinite series offunctions - Uniform convergence and Riemann - Stieltjes integration - Uniform convergenceanddifferentiation-Sufficientconditionforuniformconvergenceofaseries-Meanconvergence.**Chapter9 :** Sections9.1 to 9.6, 9.8,9.10,9.11, 9.13

Text Book:

TomM.Apostol:MathematicalAnalysis,2ndEdition,Addison-WesleyPublishingCompanyInc. NewYork,(1997).

ReferenceBooks:

1. R.G. Bartle,Real Analysis,(1976), JohnWileyandsonsInc.
2. W.Rudin,PrincipleofMathematicalAnalysis(1976),McGrawHillCompany,NewYork.
3. S.C.MalikandSavitaArora,MathematicalAnalysis(1991),WileyEasternLimited,NewDelhi.
4. SanjayAroraandBansiLal,IntroductiontoRealAnalysis(1991),SatyaPrakashan,NewDelhi.
5. A.L.GuptaandN.R.Gupta, PrincipleofRealAnalysis (2003),PearsonEducation.

E-Materials

https://mathworld.wolfram.com/
https://onlinecourses.nptel.ac.in/noc21_ma63/preview
https://ocw.mit.edu/courses/mathematics/18-100a-introduction-to-analysis-fall-2012/

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	S	S	S	M
CO2	S	S	M	M	S	M	S	S	S	M
CO3	S	S	M	M	S	M	S	S	S	M
CO4	S	S	M	M	S	M	S	S	S	M
CO5	S	S	M	M	S	M	S	S	S	M

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

M.Sc. Mathematics – 2022 - 2023 onwards

Semester : I **Paper type : Core** **Credit : 4**

Paper code : **Name of the Paper : Ordinary Differential Equations**

Hours of Teaching:90 hrs

Course Objectives:

The main objectives of this course are to:

1. Understand the theory and methods of Ordinary Differential Equations (ODEs).
2. Apply and solve ODEs applications from various emerging technologies.
3. Know about the concepts and solving methods of Second and n^{th}order linear differential equations.
4. Study the concepts and solving methods of differential equations with variable coefficients and regular singular point.
5. Examine the existence and uniqueness of solutions of differential equations.

Course Outcomes:

After successful completion of the course the student will be able to

CO1 Analyze the methods of second order homogeneous and non-homogeneous equations.

CO2 Apply and solve the higher order homogeneous and non-homogeneousequations.

CO3 Define the methods to solve linear equations with variable coefficients.

CO4 Discuss the linear equations with regular singular points.

CO5 Construct the solutions for first order equations.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	Yes	No
2	Yes	Yes	Yes	No	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	No	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	No

Unit – 1 Linear Equations with Constant Coefficients 18 hours

Second order homogeneous equations - Initial value problems for second order - Linear dependence and independence - A formula for the Wronskian - The non - homogeneous equation of order two.

Chapter 2: Sections 1 to 6

Unit – 2 Linear Equations with Constant Coefficients (Continuation) 18 hours

Homogeneous equations of order n - Initial value problems for order n - equations with real constants - Non-homogeneous equations of order n - Annihilator method - Algebra of constant coefficient operators.

Chapter 2: Sections 7 to 12

Unit – 3 Linear Equations with Variable Coefficients 18 hours

Initial value problems - Existence and Uniqueness theorems - Solutions to solve a non-homogeneous equation – The Wronskian and linear independence - Reduction of the order of homogeneous equations - Homogeneous equation with analytic coefficients – The Legendre-Equation.

Chapter 3: Sections 1 to 8

Unit – 4 Linear Equations with Regular Singular Points 18 hours

Euler equation - Second order equations with regular singular points - general and exceptional cases - Bessel equation.

Chapter 4: Sections 1 to 4 and 6 to 8

Unit – 5 Existence and Uniqueness of Solutions to First Order Equations 18 hours

Equation with variables separated - Exact equations - The method of successive approximations - The Lipschitz condition - Convergence of the successive approximations.

Chapter 5: Sections 1 to 6

Text Book:

Earl A. Coddington, An introduction to ordinary differential equations (Indian Reprint), Prentice- Hall of India Ltd., New Delhi, 2009.

Reference Books:

1. Williams E. Boyce and Richard C. DI Prima, Elementary differential equations and boundary value problems, John Wiley and sons, New York, 1967.
2. George F Simmons, Differential equations with applications and historical notes, Tata McGraw Hill, New Delhi, 1974.
3. W.T.Reid, Ordinary differential equations, John Wiley and sons, New York, 1971.
4. M.D.Raisinghania, Advanced differential equations, S.Chand & Company Ltd.,New Delhi, 2001.
5. N.N. Lebedev, Special functions and their applications, Prentice Hall of India, New Delhi, 1965.

E-Materials:

1. https://nptel.ac.in/courses/111104031
2. https://nptel.ac.in/courses/122107037
3. https://ocw.mit.edu/courses/mathematics/18-03-differential-equations-spring-2010/
4. https://nptel.ac.in/courses/111108081/
5. https://ocw.mit.edu/courses/mathematics/18-034-honors-differential-equations-spring-2009/syllabus/

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	S	S	M	L
CO2	S	S	M	L	S	M	S	S	M	M
CO3	S	S	M	S	M	S	M	M	M	S
CO4	S	S	M	M	M	S	M	M	M	S
CO5	S	S	M	L	S	S	S	S	M	M

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115
M.Sc. Mathematics – 2022 - 2023 onwards

Semester : I **Paper type : Core Elective** **Credit : 3**

Paper code : **Name of the Paper : Probability Theory**

Hours of Teaching:90 hrs

Course Objectives:

The main objectives of this course are to:

1. Study basic notions of experiments, events, probability, random variables andprobabilitydistributions.
2. Acquire knowledge on variousparametersandmeasuresoftheprobabilitydistributions.
3. Educatethecharacteristic functionsanditsproperties.
4. Inculcatethespecialtypes ofdiscreteand continuousprobabilitydistributions.
5. Learnthestrongtheoreticalbackgroundaboutthelimittheoremsanditsconsequences

Course Outcomes:

After successful completion of the course the student will be able to

CO1 Analyze the basics of probability and random variables.

CO2 Understand to handle parameters of the distribution.

CO3 Define the properties and functionalities of characteristic functions.

CO4 Discuss the various special probability distributions.

CO5 Construct the solutions for real time applications using limits theorem.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	No	Yes	Yes
2	Yes	Yes	Yes	No	Yes	No
3	No	Yes	Yes	Yes	Yes	No
4	No	Yes	Yes	Yes	Yes	No
5	No	Yes	Yes	Yes	Yes	Yes

Unit – 1 ProbabilityandRandomVariables 18 hours

RandomExperiments–SampleSpace–RandomEvents–ProbabilityAxioms–Conditional Probability – Mutual Exclusive Events – Independent Events – Addition andProduct Theorems on Probability – Theorem of Total Probability – Baye's Theorem –Random Variables – Probability Mass and Density Functions – Distribution Function – JointDistribution– MarginalDistribution– Conditional Distribution– Independent RandomVariables – Functions of Random Variables.

Chapter 1 : Sections 1.1 to 1.7

Chapter 2: Sections2.1 to 2.9

Unit – 2 Parameters of theDistribution 18 hours

Mathematical Expectation – Moments – The Chebyshev Inequality – Absolute Moments –Order Parameters – Moments of Random Vectors – Regression of the First and SecondTypes.

Chapter3 : Sections3.1 to 3.8

Unit – 3 CharacteristicFunctions 18 hours

Properties of Characteristic Functions – Characteristic Functions and Moments – Semi-Invariants – Characteristic Function of the Sum of the Independent Random Variables – DeterminationofDistributionFunctionbytheCharacteristicFunction– CharacteristicFunctionofMultidimensionalRandomVectors–ProbabilityGeneratingFunctions.

Chapter4 : Sections4.1 to 4.7

Unit – 4 SpecialProbabilityDistributions 18 hours

Discrete Probability Distributions: One Point – Two Point – Bernoulli Trails – Binomial – Poisson – Polya – Hypergeometric Distributions – Continuous Probability Distributions:Uniform– Normal – Gamma – Beta– Cauchy–LaplaceDistributions.

Chapter5 : Sections5.1 to 5.10

Unit – 5 LimitTheorems 18 hours

StochasticConvergence–BernoulliLawofLargeNumbers– ConvergenceofSequenceofDistributionFunctions –Levy-CramerTheorems– ThedeMoivre-Laplace Theorem –

The Lindeberg-Levy Theorem – LapunovTheroem.

Text Book:

M.Fisz,*ProbabilityTheoryandMathematicalStatistics*,3rdEdition,JohnWileyandSonsInc., New York, 1963.

ReferenceBooks:

1. R.B.Ash,*Real AnalysisandProbability*, AcademicPress,New York,1972.
2. K.L.Chung,*ACourseinProbability*,2nd Edition,AcademicPress,New York,1974.
3. R.Durrett,*Probability:TheoryandExamples*,5thEdition,CambridgeUniversityPress,New York, 2019.
4. V.K.RohatgiandA.K.Md.EhsanesSaleh,*AnIntroductiontoProbabilityTheoryandMathematicalStatistics*, 2nd Edition, WileyEasternLtd., NewDelhi, 1988.
5. B.R.Bhat,*ModernProbabilityTheory–AnIntroductoryTextbook*,4thEdition,NewAgeInternational Pvt.Ltd., New Delhi,2014.

E-Materials:

1. https://ocw.mit.edu/resources/res-6-012-introduction-to-probability-spring-2018/
2. https://www.coursera.org/learn/introductiontoprobability
3. https://swayam.gov.in/nd1_noc20_ma18/preview
4. https://onlinecourses.nptel.ac.in/noc21_ma24/preview

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	S	M	M	M	M
CO2	S	S	S	S	M	S	M	M	S	M
CO3	S	S	S	S	M	M	M	S	M	M
CO4	S	S	M	M	S	M	M	S	S	S
CO5	S	S	M	S	M	M	M	S	S	S

* PO – Programme Outcome, CO – Course OutcomesL

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115

M.Sc. Mathematics – 2022 - 2023 onwards

Semester : I **Paper type : Core Elective** **Credit : 3**

Paper code : **Name of the Paper : Mechanics**

Hours of Teaching:90 hrs

CourseObjectives:

The main objectivesof this courseare to:

1. Understand mechanicalsystemsunder generalizedcoordinatesystems.
2. Apply mechanics techniques in virtual work.
3. Develop the students ability to deal with Energyandmomentum.
4. Look at the conceptof Hamilton,Lagrange.
5. Discuss the CanonicalTransformation.

CourseOutcomes

Afterthesuccessfulcompletionofthiscourse the students willbeableto:

CO1 Explain the basics concepts of mechanicalsystemsundergeneralized coordinatesystems.

CO2 Identify the Lagrange's equations and its application.

CO3 Derive the Hamilton Equation.

CO4 Analyze the Hamilton'sPrinciple and Hamilton-JacobiEquationandseparability.

CO5 Discuss the LagrangeandPoissonbrackets.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	Yes	No
2	Yes	Yes	Yes	No	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Unit – 1 MechanicalSystems 18 hours

TheMechanicalsystem-Generalizedcoordinates- Constraints-Virtualwork–EnergyandMomentum.

Chapter1: Sections 1.1 to 1.5

Unit – 2 Lagrange's Equations 18 hours

Derivation of Lagrange's equations- Examples - Integrals of motion.

Chapter 2: Sections2.1 to 2.3

Unit – 3 Hamilton'sEquations 18 hours

Hamilton's Principle - Hamilton's Equation - Other variational principle.

Chapter4: Sections 4.1 to 4.3

Unit – 4 Hamilton-JacobiTheory 18 hours

Hamilton Principal function - Hamilton-Jacobi Equation – Separability.

Chapter5: Sections 5.1 to 5.3

Unit – 5 CanonicalTransformation 18 hours

Differential forms and generating functions - Lagrange and Poisson brackets.

Chapter 6: Sections6.1 and 6.3

Text Book:

D.T.Greenwood,*ClassicalDynamics*,PrenticeHallof India,NewDelhi,1985.

ReferenceBooks:

1. H.Goldstein,*ClassicalMechanics*,(2ndEdition)NarosaPublishingHouse,NewDelhi.
2. N.C.RaneandP.S.C.Joag, *ClassicalMechanics*,TataMcGrawHill,1991.
3. J.L.Synge and B.A.Griffth, *Principles of Mechanics* (3rd Edition) McGraw HillBookCo., New York, 1970.

E-Materials:

https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall-2014/

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	L	M	S	L	S	L
CO2	M	S	M	S	S	L	M	S	L	M
CO3	S	S	M	S	M	L	S	S	M	L
CO4	M	L	M	L	S	M	M	L	L	S
CO5	S	S	M	S	L	M	M	S	L	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115
M.Sc. Mathematics – 2022 - 2023 onwards

Semester : I **Paper type : Core Elective** **Credit : 3**

Paper code : **Name of the Paper : Graph theory**

Hours of Teaching: 90 hrs

Course Objectives:

The main objective of this course are to:

1. Formally study and develop the basic concepts of Graphs.
2. Familiar with the notion and properties of varied types of graphs.
3. Understand concepts that helps to model real life situations into graphs.
4. Formulate and prove central theorems about trees, matching, connectivity, coloring and planarity of graphs.
5. Learn the proving techniques that are existing in each and every section of the unit and, motivate to do research in various fields of Graph theory.

CourseOutcomes

Afterthesuccessfulcompletionofthiscourse the students willbeableto:

CO1 Grasp features and properties of various types of graphs.

CO2 Demonstrate capacity of illustration for mathematical reasoning through analyzing, providing and explaining concepts of Eulerian circuits and Hamiltonicity in graphs.

CO3 Understand the definitions and properties of matching and independent sets.

CO4 Apply the concepts of graphs to model them in real life situations.

CO5 Explicate the applications of planarity and colorability.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	No	Yes	No
2	Yes	Yes	Yes	No	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	Yes

Unit – 1 Graphs, Subgraphs And Trees 18 hours

Graphs - Graph Isomorphism - The Incidence and Adjacency Matrices - Subgraphs - Vertex Degrees - Paths and Connection - Cycles - Trees - Cut Edges and Bonds - Cut Vertices- Cayley's formula- Application: The shortest path problem.

Chapter 1: Sections 1.1 to 1.8

Chapter 2: Sections 2.1 to 2.4

Unit – 2 Connectivity, Euler Tours and Hamilton Cycles 18 hours

Connectivity - Blocks - Euler tours - Hamilton Cycles. Application: The travelling Salesman Problem.

Chapter 3: Sections 3.1 to 3.3

Chapter 4: Sections 4.1 to 4.2

Unit – 3 Matchings, Edge Colourings 18 hours

Matchings - Matchings and Coverings in Bipartite Graphs –Perfect matchings- Edge Colourings: Edge Chromatic Number - Vizing's Theorem. Application: Optimal Assignment Problem.

Chapter 5: Sections 5.1 to 5.3, 5.5

Chapter 6: Sections 6.1 to 6.2

Unit – 4 Independent Sets And Cliques, Vertex Colourings 18 hours

Independent sets - Ramsey's Theorem – Vertex Colourings: Chromatic Number - Brooks' Theorem – Hajos Conjecture- Chromoatic polynomial.

Chapter 7: Sections 7.1 to 7.2

Chapter 8: Sections 8.1 to 8.2, 8.4

Unit – 5 Planar Graphs 18 hours

Plane and planar Graphs - Dual graphs - Euler's Formula - The Five-Colour Theorem and the Four-Colour Conjecture- Directed graphs.

Chapter 9: Sections 9.1 to 9.6 and 10.1

Text Book:

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

Reference books:

1. Narsingh Deo, Graph Theory with applications to engineering and computerscience, Prentice Hall of India, New Delhi,2001
2. G.Chartrand and L.Lesniak, Graphs and Digraphs, Chapman and Hall, CRC, Fourth Edition, 2005
3. R.J. Wilson, *Introduction to Graph Theory*, Pearson Education, 4th Edition, 2004,Indian Print.
4. S. A. Choudum, *A First Course in Graph Theory*, MacMillan India Ltd. 1987.
5. J. Clark and D.A. Holton , *A First look at Graph Theory,* Allied Publishers, NewDelhi, 1995.
6. A. Gibbons, *Algorithmic Graph Theory*, Cambridge University Press, Cambridge,1989.

E- Materials:

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

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	S	S	S	S	S
CO2	S	S	M	M	S	S	S	S	S	S
CO3	S	S	M	M	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115
M.Sc. Mathematics – 2022 - 2023 onwards

Semester : I **Paper type:OpenElective** **Credit : 3**

Paper code : **Name of the Paper : BasicMathematics**

Hours of Teaching: 90 hrs

CourseObjectives:

The main objective of this course are to:

1. Studyexponentialandlogarithmicseries.
2. Understandaboutmatricesanditsapplications.
3. Formulateandsolvethepartialdifferentialequations.
4. Discuss the properties of Laplace and inverse Laplace transformation.
5. Learnthe expansiontechniquesofFourierseries.

CourseOutcomes:

Aftersuccessfulcompletionofthecoursethe student willbeableto

CO1 Evaluate the exponentialandlogarithmicseries.

CO2 Explainaboutmatricesanditsapplications.

CO3 Solvethepartialdifferentialequations.

CO4 Solvethedifferentialequations using Laplacetransform.

CO5 Analysethetechniques of Fourierseries.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	Yes	No
2	Yes	Yes	No	No	Yes	No
3	Yes	Yes	Yes	No	Yes	No
4	Yes	Yes	No	No	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit – 1 ExponentialandLogarithmicseries 18 hours

Exponentialseries–Logarithmicseries

Chapter 1: Section1.1–1.2

Unit – 2 Matrices 18 hours

Determinantofamatrix–Characteristicequationofamatrix–Characteristicvectorsofamatrix–Cayley-HamiltonTheorem–Inverseof amatrix.

Chapter4: Section4.1–4.5

Unit – 3 PartialDifferentialEquations 18 hours

Elimination of arbitrary constants – Elimination of arbitrary functions – Standard forms – Lagrange'sEquations.

Chapter9: Section 9.1 – 9.4

Unit – 4 Laplacetransforms 18 hours

PropertiesofLaplacetransform–InverseLaplacetransform–PartialFractions.

Chapter10: Section 10.1 – 10.3

Unit – 5 FourierSeries 18 hours

Properties of Integration – Odd and Even Functions – Half Range Fourier Series.

Chapter11: Section11.1 – 11.3

Text Book:

G.BrittoAntonyXavier,V.Balaji,S.U.VasanthaKumar,B.Govindan,MathematicalSciences, JayalakshmiPublications, 2-e,2015.

ReferenceBooks:

1. P. Balasubramaniyam,K.G. Subramanian,AncillaryMathematics,Volume–I,TataMcGrawHill publishingcompanylimited, NewDelhi,1996.
2. P.DuraiPandian,S.UdayaBaskaran,AlliedMathematics,Volume–I,Muhilpublishers,1st Edition, Chennai, 1997.
3. P.KandsamyandK.Thilagavathy,AlliedMathematicsvolume–I,Volume–II,S.Chand&Company, New Delhi, 2004.
4. ShantiNarayan,P.K.Mittal,DifferentialCalculus, S.Chand&Co,NewDelhi,2005.
5. A.Singaravelu,AlliedMathematics,MeenakshiAgency,Chennai,2001.
6. P.R.Vittal,AlliedMathematics,MarghamPublications,Chennai,1999.

E-Materials:

http://mathforum.org/library/drmath/sets/elem_2d

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	S	S	S	L	S
CO2	S	S	M	M	S	S	S	S	L	S
CO3	S	S	M	M	S	S	S	S	M	S
CO4	S	S	M	M	S	S	S	S	M	S
CO5	S	S	M	M	S	S	S	S	M	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115
M.Sc. Mathematics – 2022 - 2023 onwards

Semester : I **Paper type : Open Elective** **Credit : 3**

Paper code : **Name of the Paper : Mathematical Foundations**

Hours of Teaching: 90 hrs

CourseObjectives:

The main objective of this course are to

1. Study the logicaloperators ,Propositional function, quantifiers, rules of inference.
2. Understand about fundamental mathematical concepts such as sets, relations, functions and compositionof functions
3. Know the typesof binaryoperations and boolean algebra.
4. Formulateandsolvethe differentiation and applications of differentiation
5. Acquire the knowledge of two dimensional analytical geometry

CourseOutcomes:

Aftersuccessfulcompletionofthecoursethe student willbeableto

CO1 Applymathematicallogicaloperators.

CO2 Improveknowledgeinset theory, functions with someproblems.

CO3 Classify the typesof binaryoperations and know about the boolean algebra.

CO4 Solveproblemsonapplicationsofdifferentiation

CO5 Evaluate problems on Straight lines, circles and conics.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	No	Yes	No
2	Yes	Yes	No	No	Yes	Yes
3	Yes	Yes	No	Yes	Yes	No
4	Yes	Yes	No	No	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	No

Unit – 1 SymbolicLogic 18 hours

Proposition,Logicaloperators,conjunction,disjunction,negation,conditionalandBi-conditionaloperators,converse,inverse,contrapositive,logicallyequivalent,tautologyand contradiction,Argumentsandvalidityofargument.

Chapter1: Sections 1.1–1.5

Unit – 2 SetTheory 18 hours

Set,Setoperations,Venndiagram,Propertiesofsets,numberofelementsinaset,Cartesianproduct,relation& functions,Relation:Equivalencerelation.Equivalenceclass,PartiallyandTotallyorderedsets,Functions :Types ofFunctions,CompositionofFunctions.

Chapter2: Sections 2.1–2.8

Unit – 3 Binary Operations 18 hours

TypesofBinaryoperations:Commutative,Associative,Distributiveandidentity,Booleanalgebra:properti es,Permutationsandcombinations.

Chapter3: Sections 3.1–3.3

Unit – 4 Differentiation 18 hours

Simple problem using standard limits, $\lim_{x\to a}\frac{x^n-a^n}{x-a}$, $\lim_{x\to 0}\frac{\sin x}{x}$, $\lim_{x\to 0}\frac{\tan x}{x}$, $\lim_{x\to 0}e^x$, $\lim_{n\to 0}\frac{(1+1/n)^n}{n}$, $\lim_{n\to 0}(1+n)^{1/n}$, Differentiation, successivedifferentiation,Leibnitztheorem,partialDifferentiation,Applications of differentiation, Tangent and normal, angle between two curves, Maximum and minimum values [second derivative test], curvature and radius of curvature [Cartesian coordinates], Envelopes.

Chapter 4: Sections 4.1 – 4.9

Unit – 5 TwoDimensionalAnalyticalGeometry 18 hours

Straight lines – pair of straight lines – circles – System of Circles – Conics [parabola, Ellipseand Hyperbola].

Chapter 5: Sections 5.1 – 5.5

Text Book:

U.Rizwan,MathematicalFoundationsVolumeI,NelliapparPublications,Chennai2017.

ReferenceBooks:

1. P.R.Vittal,MathematicalFoundations,MarghamPublication,Chennai.
2. V.Sundaram &others,DiscreteMathematicalFoundations,A.P.Publication,Sirkali
3. P.Duraipandian&Others,AnalyticalGeometryof2and3Dimensions,EmeraldPublication 1992 Reprint.

E-Materials:

http://www.mathfoundation.com

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	L	S	S	M	S
CO2	S	S	M	M	S	M	S	M	M	S
CO3	S	S	M	M	S	S	S	S	M	S
CO4	S	S	S	L	S	S	S	S	M	S
CO5	S	S	S	S	M	S	S	S	M	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115

M.Sc. Mathematics – 2022 - 2023 onwards

Semester : I **Paper type : OpenElective** **Credit : 3**

Paper code : **Name of the Paper : MathematicalModeling**

Hours of Teaching:90 hrs

Course objective:

The main objective of this course are to

1. Provide an introduction to modeling and simulation.
2. Solve and interpret real life problems using different Mathematical perspectives.
3. Apply the Mathematical Modeling through difference equations.
4. Develop the Mathematical modeling through Graphs.
5. To have a proper understanding of calculus of variations and Dynamics Programming.

Course Learning outcomes:

After the successful completion of this course, the students will be able to:

CO1 Understand concept of modeling and simulation.

CO2 Crete mathematical models of real world problems.

CO3 Explain the population dynamics and genetics.

CO4 Mathematical models using mathematical techniques.

CO5 Discuss the calculus Variations and Dynamic Programming.

Matching table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	Yes	No
2	Yes	Yes	Yes	No	Yes	No
3	Yes	Yes	Yes	No	Yes	No
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Unit – 1 Mathematical Modelling through Systems of Ordinary differential Equations of the First Order **18 hours**

Mathematicalmodellinginpopulationdynamics,Mathematicalmodelling ofepidemicsthrough systems of ordinary differential equations of first order – Mathematical Models inMedicine, Arms Race, Battles and international Trade in terms of Systemsof ordinarydifferential equations - Mathematical modelling in dynamics through systems of ordinarydifferentialequations of first order.

Chapter 3: Sections 3.1, 3.2,3.5 and 3.6

Unit – 2 Mathematical Modellingthroughdifferenceequations **18 hours**

The need for Mathematical modelling through difference equations - some simple models - Basictheoryoflineardifferenceequationswithconstantcoefficients-Mathematicalmodellingthrough difference equations in economicsandfinance.

Chapter5: Sections 5.1to 5.3

Unit – 3 Mathematical Modellingthroughdifferenceequations(contd.) **18 hours**

Mathematical modelling through difference equations in population dynamics and genetics.Mathematical Modelling through difference equations in probability theory. Miscellaneousexamplesof Mathematicalmodellingthroughdifferenceequations.

Chapter 5: Sections 5.4 to5.6

Unit – 4 Mathematical modellingthroughGraphs **18 hours**

Situations that can be modeled through graphs - Mathematical models in terms of directedgraphs - Mathematical models in terms of signed graphs – Mathematical models in terms ofweightedgraphs.

Chapter7: Sections 7.1 to 7.4

Unit – 5 MathematicalModellingthroughcalculusofVariationsand DynamicProgramming **18 hours**

Optimizationprinciplesandtechniques-Mathematicalmodellingthroughcalculusofvariations-MathematicalModellingthroughdynamicprogramming.

Chapter9: Sections 9.1to9.3

Text Book:

J.N.Kapur,MathematicalModelling,WilleyEastern Limited,Reprint,2000.

ReferenceBooks:

1. D.J.G.JamesandJ.J.Macdonald,CasestudiesinMathematicalModelling,StanlyThames,Cheltonham.
2. M.CrossandA.O.Moscrcadini,TheartofMathematicalModelling,EllisHarwoodandJohn Wiley.
3. C.Dyson,Elvery,PrinciplesofMathematicalModelling,AcademicPress,NewYork.
4. D.N.Burghes,ModellingwithDifferenceEquations,EllisHarwoodandJohnWiley.

E-Materials:

http://www.mathfoundation.com

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	S	M	S	L	S	L
CO2	M	S	M	S	M	L	M	L	L	S
CO3	S	L	S	M	S	L	M	S	L	M
CO4	M	S	M	S	S	M	L	S	M	S
CO5	S	L	M	S	M	M	L	M	L	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115
M.Sc. Mathematics – 2022 - 2023 onwards

Semester : II **Paper type : Core** **Credit : 5**

Paper code : **Name of the Paper : Algebra-II**

Hours of Teaching:90 hrs

Course Objective:

The main objective of this course are to :

1. Attain depth knowledge about extension field and its types.
2. Study the concepts of existence of extension fields of polynomials over polynomial rings.
3. Understand Galois theory and develop Galois groups.
4. Know more about the finite fields and solvable groups.
5. Learn the important theorems related to division rings and its application.

Course Learning Outcomes:

After successful completion on the course the student will be able to:

CO1 Understand fundamental concepts including extension fields, Algebraic extensions and Algebraic numbers.

CO2 Determine existence and properties of extension fields of polynomials

CO3 Demonstrate capacity of illustration for mathematical reasoning through analyzing, proving and explaining concepts from filed extensions and Galois theory

CO4 Apply knowledge of solvability of radicals over polynomials on finite fields

CO5 Analyze the theorems related to division rings to apply them on relevant fields

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	Yes	No
2	Yes	Yes	No	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit – 1 Field Theory **18 hours**

Extension fields - Transcendence of ‘e’.

Chapter 5: Section 5.1 and 5.2

Unit – 2 Polynomials and Roots **18 hours**

Roots of Polynomials- More about roots.

Chapter 5: Sections 5.3 and 5.5

Unit – 3 Galois theory **18 hours**

Elements of Galois theory.

Chapter 5: Section 5.6

Unit – 4 Finite Fields **18 hours**

Solvability by Radicals - Finite fields - Wedderburn's theorem on finite division rings.

Chapter 5: Section 5.7

Chapter 7: Sections 7.1 and 7.2 (Only Theorem 7.2.1)

Unit – 5 Solvability by Radicals **18 hours**

A theorem of Frobenius - Integral Quaternions and the Four -Square theorem.

Chapter 7 : Sections 7.3 and 7.4

Text Book:

I.N. Herstein, Topics in Algebra, 2nd Edition. Wiley.1975

Reference Books:

1. D.S.Dummit and R.M.Foote. Abstract Algebra. Wiley 2003.
2. M. Artin,Algebra, Prentice Hall of India, 1991.
3. J.A. Gallian. Contemporary Abstract Algebra. 4th Edition. Narosa Publishing 2011.
4. P.B.Battacharya, S.K.Jain and S.R.Nagpaul, Basic Abstract Algebra(II Edition) Cambridge University Press, 1997.(Indian Edition)
5. I.S. Luther and I.B.S.Passi, Algebra, Vol.I – Groups(1996), Vol. II Rings, Narosa Publishing House, New Delhi, 1999.
6. Rudolf Lidl and Gunter Pilz, Applied Abstract Algebra, Second Indian Reprint 2006, Springer Verlag, Newyork.
7. L. Smith(1998). Linear transformation: Example and Applications. In: Linear Algebra, Undergraduate texts in Mathematics, Springer, Newyork.

E-Materials:

1. https://www.jmilne.org->FTe6
2. http://www.math.iitb.ac.in/~srg/Lecnotes/galois_des.html
3. https://www.jmilne.org>math
4. https://nptel.ac.in/courses/111108098/ (Video Lecture)

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	M	S	S	S	S
CO2	S	S	M	M	M	S	S	S	S	S
CO3	S	S	M	M	M	M	S	S	S	S
CO4	S	S	M	M	M	S	S	S	S	S
CO5	S	S	M	M	M	M	S	S	S	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115
M.Sc. Mathematics – 2022 - 2023 onwards

Semester : II **Paper type : Core** **Credit : 5**

Paper code : **Name of the Paper : Real Analysis-II**

Hours of Teaching:90 hrs

CourseObjectives:

Theobjectives of the courseis to

1. know the Lebesgue Integral
2. understand the concept of Riesz-Fischer theorem
3. studyFourierSeriesand Integralsindepth
4. understandtheconcepts of multivariable calculus.
5. acquire knowledgeabout implicit functions and the extremum values of functions.

Course Outcomes:

After successful completion on the course the student will be able to

CO1 know about the properties of Lebesgue integrals and establish the Levi monotone convergence theorem.

CO2 develop the properties of inner products, norms and measurable functions.

CO3 understand the concept of FourierSeriesand Integrals.

CO4 acquire the knowledge of multivariable calculus.

CO5 enrich the students to work effectively on implicit functions and the extremum valuesof functions.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	No	Yes	No

Unit – 1 Lebesgue Integral **18 hours**

Introduction- The integral of a step function – Monotonic sequences of step functions – Upper functions and their integrals – Riemann-Integrable functions as examples of upper functions – The class of Lebesgue– Integrable functions on a general interval – Basic properties of the Lebesgue integral – Lebesgue integration and sets of measure zero – The Levi monotone convergence theorems-Lebesgue Dominated Convergence Theorem.

Chapter 10: Sections 10.1 to 10.10

Unit – 2 Lebesgue Integral Contd. **18 hours**

Lebesgue integrals on unbounded intervals as limits of integrals on bounded intervals –Improper Riemann integrals – Measurable functions – Continuity of functions defined byLebesgue integrals – Differentiation under the integral sign – Inner products and norms – The set L^2 (I) of square–integrable functions – The set L^2 (I) as a semi-metric space – A convergence theorem for series of functions in L^2(I) – The Riesz-Fischer theorem.

Chapter 10: Sections 10.12 to 10.16, 10.21 to 10.25

Unit – 3 FourierSeries andFourierIntegrals **18 hours**

Introduction–Orthogonalsystemoffunctions–Thetheoremonbestapproximation–
TheFourierseriesoffunctionrelativetoanorthonormalsystem–PropertiesofFourierCoefficients–
TheRiesz-FischerTheorem–Theconvergenceandrepresentationproblemsfortrigonometricseries–
TheReimann-LebesgueLemma–TheDirichletIntegrals–
AnIntegralrepresentationforthepartialsumsofFourierseries–Reimann'slocalizationtheorem–
SufficientconditionsforconvergenceofaFourierSeriesataparticularpoint–
CesarosummabilityofFourierseries–ConsequencesofFejes'stheorem–
TheWeiestrassapproximationtheorem.

Chapter11: Sections11.1 to 11.15

Unit – 4 MultivariableDifferentialCalculus 18 hours

Introduction–TheDirectionalderivative–Directionalderivativeandcontinuity–Thetotalderivative–Thetotalderivativeexpressedintermsofpartialderivatives–AnApplicationstoComplex–ValuedFunctions-Thematrixoflinearfunction–TheJacobianmatrix–Thechainrule–Matrixformofchainrule–Themean-valuetheoremfordifferentiablefunctions–Asufficientconditionfordifferentiability–Asufficientconditionforequalityofmixedpartial derivatives– Taylor'stheorem forfunctionsof R^ntoR^1.

Chapter12: Sections 12.1 to12.14

Unit – 5 ImplicitFunctionsandExtremumProblems 18 hours

Introduction-Functionswithnon-zeroJacobiandeterminants–Theinversefunctiontheorem–TheImplicitfunctionTheorem–Extremaofrealvaluedfunctionsofonevariableandseveralvariables–Extremumproblemswithsideconditions.

Chapter13: Sections13.1 to 13.7

Text Book:

TomM.Apostol,MathematicalAnalysis(SecondEdition)(1981),Addison–WesleyPublishingCompanyInc.New York.

ReferenceBooks:

1. J.C.Burkill, TheLebesgue Integral(1951),Cambridge UniversityPress.
2. M.E.Munroe,MeasureAndIntegration (1971), Addison–Wiley.
3. H.L.Roydon,RealAnalysis(1988),MacmillanPub.Company,NewYork.
4. W.Rudin,PrinciplesofMathematicalAnalysis(1979),McGrawHillCompany,NewYork.
5. S.C.MalikandSavitaArora,MathematicalAnalysis(1991),WileyEasternLimited,NewDelhi.
6. SanjayArora andBansiLal,SatyaPrakashan,IntroductionTo RealAnalysis,(1991),NewDelhi.

E-Materials:

https://onlinecourses.nptel.ac.in/noc21_ma63/preview

https://mathworld.wolfram.com/

https://ocw.mit.edu/courses/mathematics/18-100b-analysis-i-fall-2010/

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	S	S	S	M
CO2	S	S	M	M	S	M	S	S	S	M
CO3	S	S	M	M	S	M	S	S	S	M
CO4	S	S	M	M	S	M	S	S	S	M
CO5	S	S	M	M	S	M	S	S	S	M

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115
M.Sc. Mathematics – 2022 - 2023 onwards

Semester : II **Paper type : Core** **Credit : 4**

Paper code : **Name of the Paper : Partial Differential Equations**

Hours of Teaching:90 hrs

Course Objectives:

The main objective of this course are to:

1. Understand the theory and methods of Partial Differential Equations (PDEs).
2. Apply and solve PDEs applications from various emerging technologies.
3. Provide solution for First and second order partial differential equations.
4. Introduce the concepts and solving methods of Elliptical, paraboloid, hyperbolic differential equations.
5. Examine the existence and uniqueness of solutions of differential equations.

Course Outcomes:

After successful completion of the course the student will be able to

CO1 Analyze the methods for first order partial differential equations.

CO2 Understand the fundamentals of second order partial differential equations.

CO3 Define the methods to solve elliptical differential equations.

CO4 Discuss the formation and solutions of paraboloid differential equations.

CO5 Construct the solutions for hyperbolic differential equations and identifythe research problem where PDE can be used to model the problem.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	No	Yes	No
2	Yes	Yes	Yes	No	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	Yes

Unit – 1 Partial Differential Equations of First Order 18 hours

Formation and solutions of first order PDE – Integral surfaces – The Cauchy problem for first order equation –Orthogonal surfaces – First order non-linear equations – characteristics– compatible systems of first order equations - Charpit's method.

Chapter 0: Sections 0.4 to0.11. (omit 0.11.1))

Unit – 2 Fundamentals of Second Order PDE 18 hours

Introduction – classification of second order PDE – canonical forms – Adjoint operators.

Chapter 1: Sections 1.1 to 1.4

Unit – 3 Elliptic Differential Equations 18 hours

Derivation of Laplace and Poisson equations – Boundary value problem – Separation of variables – Dirichlet's and Newmann problems for a rectangle – Solution of Laplace equation in Cylindrical and spherical coordinates.

Chapter 2: Sections 2.1, 2.2, 2.5 to 2.7,2.11 to 2.12

Unit – 4 Parabolic Differential Equations 18 hours

Formation and elementary solution of diffusion equation with boundary conditions – Dirac-Delta function – Separation of variable method - Solution of diffusion equation in cylindrical and spherical coordinates.

Chapter 3: Sections 3.1 to 3.7

Unit – 5 Hyperbolic Differential Equations 18 hours

Derivation and solution of 1-D wave equation by canonical reduction – Initial Value Problem ; D'Alembert's solution – IVP and BVP for 2-D wave equation – Periodic solution for 1-D wave equation in cylindrical and spherical coordinates systems –Uniqueness of the solution for 1-D wave equation – Duhamel's principle.

Chapter 4: Sections 4.1 to 4.4, 4.7 to 4.9, 4.11 and 4.12

Text Book:

K.Sankara Rao, Introduction to Partial differential equations (Third edition), Prentice-Hall of India Ltd., New Delhi, 2016.

Reference Books:

1. I.N. Sneddon, Elements of partial differential equations, McGraw Hill book company, Singapore, 1957
2. R. Dennemeyer, Introduction to partial differential equations and boundary value problems, McGraw Hill, New York, 1968.
3. R.C. McOwen, Partial differential equations, 2nd edition, Pearson education, New Delhi, 2005.
4. M.D.Raisinghania, Advanced differential equations, S.Chand& Company Ltd. New Delhi, 2001.
5. N.N. Lebedev, Special functions and their applications, Prentice Hall of India, New Delhi, 1965.

E-Materials:

1. https://nptel.ac.in/courses/111103021/
2. onlinecourses.nptel.ac.in › noc21_ma18
3. onlinecourses.nptel.ac.in › noc22_ma28
4. onlinecourses.nptel.ac.in › noc21_ma33

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	S	M	S	M	M
CO2	S	S	M	M	M	S	M	S	M	S
CO3	S	S	S	M	M	S	S	M	M	S
CO4	S	S	S	M	M	M	S	M	M	S
CO5	S	S	S	M	M	M	S	M	M	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115
M.Sc. Mathematics – 2022 - 2023 onwards

Semester : II **Paper type : Core Elective** **Credit : 3**

Paper code : **Name of the Paper : Mathematical Statistics**

Hours of Teaching: 75 hrs

Course Objectives:

The main objective of this course are to:

1 Introduce the basic notions of sample, population, sample moments and their functions.

2 Give an insight about the parametric and non-parametric tests for small and large samples.

3 Educate the various measures of estimation theory

4 Inculcate the concepts of ANOVA and testing of hypothesis.

5 Indoctrinate the strong background about the sequential analysis and its consequences.

Course Outcomes:

After successful completion on the course the student will be able to

CO1 Know the basic notions of sample, population, sample moments and their functions.

CO2 Comprehend the parametric and non-parametric tests for small and large samples.

CO3 Understand the various measures of estimation theory.

CO4 Acquire the knowledge in the concept of ANOVA and, apply them in real life situations for testing of hypothesis.

CO5 Procure the strong background about the sequential analysis and its consequences

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	Yes	Yes	No
2	Yes	Yes	No	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit – 1 Sample Moments and Their Functions 15 hours

Notion of a Sample and a Statistic – Distribution of the Arithmetic Mean of IndependentNormally Distributed Random Variables – The Chi-Square Distribution – The Distributionof the Statistics – Student's t-Distribution – Fisher's Z-Distribution – Snedecor's F Distribution– Distribution of Sample Mean from Non-Normal Populations.

Chapter 9: Sections: 9.1–9.8

Unit – 2 Significance Tests 15 hours

Kolmogorov Theorem – Smirnov Theorem – The Concept of a Statistical Test – ParametricTests for Small Samples and Large Samples – Chi-Square Test – Tests of Kolmogorov andSmirnov Type – The Wald-Wolfovitz and Wilcoxon-Mann-Whitney Tests – Independence Tests by Contingency Tables.

Chapter 10: Sections: 10.11

Chapter 12: Sections:12.1–12.7

Unit – 3 Estimation Theory 15 hours

Preliminary Notion – Consistent Estimaties – Unbiased Estimates – Sufficiency of anEstimate – Efficiency of an Estimate – Asymptotically Most Efficient Estimates – Methodsof Finding Estimates– Confidence Interval.

Chapter 13: Sections: 13.1–13.8

Unit – 4 Analysis of Variance and Hypotheses Testing 15 hours

ANOVA Test: One-Way Classification and Two-Way Classification. Hypotheses Testing:The Power Functions and OC Function – Most Powerful Test – Uniformly Most PowerfulTest – Unbiased Test.

Chapter 15: Sections 15.1–15.2

Chapter 16: Sections 16.1–16.5

Unit – 5 Elements of Sequential Analysis 15 hours

SPRT – Auxiliary Theorem – Wald's Fundamental Identity – OC Function and SPRT – TheExpected Value of (n) – Determination of A and B – Testing a Hypothesis Concerning pof Zero-One Distribution – Testing a Hypothesis Concerning the Expected Value m of aNormal Population.

Chapter 17: Sections: 17.1–17.9

Text Book:

M. Fisz, Probability Theory and Mathematical Statistics, 3rd Edition,John Wileyand Sons Inc., New York, 1963.

Reference Books:

1. V.K. Rohatgi and A.K.Md.E. Saleh, An Introduction to Probability Theory andMathematical Statistics, 2nd Edition, Wiley Eastern Ltd., New Delhi, 1988.
2. E.J. Dudewicz and S.N. Mishra, Modern Mathematical Statistics, John Wiley andSons, New York, 1988.
3. G.G. Roussas, A First Course in Mathematical Statistics, 2nd Edition, AcademicPress, USA, 1997.
4. B.L.V.D. Waerden, Mathematical Statistics, Springer-Verlag, New York, 1969.
5. R.E. Walpole, R.H. Myers, S.L. Mayers and K. Ye, Probability and Statistics forEngineers and Scientists, 9th Edition, Pearson Education Inc., 2012.

E-Materials:

1. https://ocw.mit.edu/courses/18-655-mathematical-statistics-spring-2016/
2. https://dspace.mit.edu/bitstream/handle/1721.1/96865/18-175-fall-2008/contents/lecture-notes/index.htm
3. https://swayam.gov.in/nd1_noc20_ma19/preview
4. http://mathworld.wolfram.com

Mapping with Learning Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	M	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115

M.Sc. Mathematics – 2022 - 2023 onwards

Semester : II **Paper type : Core Elective** **Credit : 3**

Paper code : **Name of the Paper : Fuzzy Set Theory**

Hours of Teaching: 75hrs

Course Objectives:

The main objective of this course are to

1. Introduce Fuzzy sets.
2. Define some operations on Fuzzy sets.
3. Understand the properties of Fuzzy sets.
4. Discuss about the operations on Fuzzy sets.
5. Calculate the arithmetic operations on Fuzzy numbers.

Course Outcomes:

After successful completion on the course the student will be able to

CO1 Understand the basic concepts of Fuzzy Sets.

CO2 Discuss the Fuzzy sets versus crisp sets.

CO3 Analyze the operations on Fuzzy sets and Fuzzy complements.

CO4 Acquire the knowledge of various combination of operations.

CO5 Apply the concepts of Fuzzy mathematics in real life situation.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	No	No
2	Yes	Yes	No	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	No	Yes	Yes

Unit – 1 From Classical (Crisp) Sets to Fuzzy Sets 15 hours

Introduction – Crisp sets: An overview – Fuzzy sets – Basic types – Basic concepts – Characteristics – Significance of the paradigm shift.

Chapter 1: Sections 1.1 to 1.5

Unit – 2 Fuzzy Sets Versus Crisp Sets 15 hours

Additional properties of α - Cuts – Representation of Fuzzy sets – Extension principle for Fuzzy sets.

Chapter 2: Sections 2.1 to 2.3

Unit – 3 Operations on Fuzzy Sets 15 hours

Types of Operation – Fuzzy complements – Fuzzy intersection – t-norms

Chapter 3: Sections 3.1 to 3.3

Unit – 4 Operations on Fuzzy Sets 15 hours

Fuzzy unions – t conorms – Combinations of operations – Aggregation operations.

Chapter 3: Sections 3.4 to 3.6

Unit – 5 Fuzzy Arithmetic 15 hours

Fuzzy numbers – Linguistic Variables – Arithmetic operation on intervals – Arithmetic operation on Fuzzy numbers.

Chapter 4: Sections 4.1 to 4.4

Text book :

G. J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic : Theory and Applications, PHI, New Delhi, 2005.

Reference Books:

1. H. J. Zimmerman, Fuzzy Set Theory and its Applications, Allied Publishers, 1996.
2. A. Kaufman, Introduction to the theory of Fuzzy Subsets, Academic Press, 1975.
3. V. Novak, Fuzzy Sets and their Applications, Adam Hilger, Bristol, 1969.

E-Materials:

http://nptel.ac.in/courses/105108081/module9/lecture36/lecture.pdf

Mapping with Learning Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	L	S	S	L	L
CO2	S	S	M	M	S	L	S	S	L	L
CO3	S	S	M	M	S	L	S	S	L	L
CO4	S	S	M	M	S	L	S	S	L	M
CO5	S	S	S	S	S	L	S	S	M	M

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115

M.Sc. Mathematics – 2022 - 2023 onwards

Semester : II **Paper type : Core Elective** **Credit : 3**

Paper code : **Name of the Paper : Difference Equations**

Hours of Teaching:75hrs

Course Objectives:

The main objectives of the course are to

1. To provide basic knowledge about the discretization process, the discrete version of difference equations.
2. Understand the Linear periodic systems.
3. Develop the students ability todifferenceequationsusingZ-transforms.
4. To enable to use of OscillationTheory.
5. Study oscillation and asymptotic behavior of solutions of certain classes of difference equations.

CourseLearningOutcomes:

Afterthesuccessfulcompletionofthiscourse,the students willbeableto:

CO1 Solveproblemson Linear DifferenceEquationsofHigherorder.

CO2 Understand thesystemofLinearDifference Equations.

CO3 Apply Z-transformtechniques indifference equations.

CO4 Explain onOscillation Theory.

CO5 Discuss onAsymptoticBehaviorofDifferenceEquation.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	Yes	No
2	Yes	Yes	Yes	No	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Unit – 1 LinearDifferenceEquationsof Higherorder 15 hours

DifferenceCalculus-GeneralTheoryofLinearDifferenceEquations-LinearHomogeneous Equations with Constant coefficients – Non-homogeneous equations: Methodof Undetermined Coefficients, the method of variation of constants - Limiting behavior ofSolutions.

Chapter2: Sections 2.1 to 2.5

Unit – 2 Systemof LinearDifferenceEquations 15 hours

Autonomous Systems - The Basic Theory - The Jordan form - Linear periodic systems.

Chapter3: Sections3.1to 3.4

Unit – 3 TheZ-transformMethod 15 hours

DefinitionsandExamples,PropertiesofZ-transform-TheInverseZ-transformandSolutions of Difference Equations: Power series method, partial fraction method, the inverseintegral method - Volterra Difference Equation of convolution type - Volterra Systems.

Chapter6: Sections 6.1to 6.3, 6.5

Unit – 4 OscillationTheory 15 hours

Three-termdifferenceEquations–Self-AdjointSecondOrderEquations-NonlinearDifference Equations.

Chapter7: Sections7.1 to 7.3

Unit – 5 AsymptoticBehaviourof DifferenceEquation 15 hours

Tools of Approximation - Poincare's Theorem - Asymptotically Diagonal Systems – High-Order Difference Equations - Second Order Difference Equations.

Chapter 8: Sections 8.1to 8.5

Text Book:

SaberN.Elaydi,*AnIntroductiontoDifferenceEquations*,ThirdEdition,SpringerVerlag,New York, 2005(FirstIndian Reprint 2008).

ReferenceBooks:

1. RonaldE.Mickens,*DifferenceEquationsTheory,ApplicationsandAdvancedTopics*,Third Edition, CRC Press, NewYork, 2015.
2. R.P.Agarwal., *DifferenceEquationsandInequalities*,MarcelDekker,1999.
3. S.Goldberg,*IntroductiontoDifferenceEquations*,DoverPublications,1986

4. V.LakshmikanthamandTrigiante,*TheoryofDifferenceEquationsNumericalMethodsand Applications*,Second Edition, AcademicPress, New York,1988.
5. WalterG.Kelly,AllanC.Peterson,*DifferenceEquations,AnIntroductionwithApplications*, Academic Press, NewYork, 2001(FirstIndianReprint2006).

E-Materials:

1. http://people.math.aau.dk/~matarne/11-imat/notes2011a.pdf,
2. http://pj.freefaculty.org/guides/stat/Math/DifferenceEquations/DifferenceEquations-guide.pdf

Mapping with Learning Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	L	M	S	L	S	L
CO2	M	S	M	S	S	M	M	S	L	M
CO3	S	S	L	S	L	S	S	M	L	L
CO4	M	L	M	L	S	M	M	S	M	S
CO5	S	M	S	S	M	L	M	L	L	M

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115

M.Sc. Mathematics – 2022 - 2023 onwards

Semester : II **Paper type : Open Elective** **Credit : 3**

Paper code : **Name of the Paper : Fundamentals of Insurance**

Hours of Teaching:75hrs

Course Objectives:

The main objective of this course are to:

1 Introduce the concept of insurance.

2 Study about the Life Insurance and claims.

3 Understand the concepts of Fire and Marine insurance.

4 Know about motor and other insurances.

5 Get the knowledge of getting job in insurance companies.

Course Outcomes

After successful completion on the course the student will be able to

CO1 understand the principles and regulations of Insurance

CO2 analyse the benefits of life insurance policies

CO3 discuss the fire and marine insurance and its benefits

CO4 analyse the various insurance sectors

CO5 Understand the duties of an insurance agent and procedure to get license.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	No	No	No
2	Yes	Yes	Yes	No	No	No
3	Yes	Yes	Yes	Yes	No	No
4	Yes	Yes	Yes	Yes	No	No
5	Yes	Yes	Yes	Yes	No	No

Unit – 1 **Introduction to Insurance** **15 hours**

Meaning, Definition of insurance- General principles of insurance - Types of insurance life, fire and marine-Difference between life and other types of insurance, Growth & Development of Indian insurance industry- Regulations of insurance business and the emerging scenario.

Unit – 2 **Life Insurance** **15 hours**

Introduction to life insurance : Features of life insurance-Essentials of life insurance, Different types of life policies- Annuities, Formation of life insurance contracts-Assignment and nominations- Lapses and revivals of policies. Surrender value, paid up value, Loans-Claims-Procedure for claims- Settlement of claims- Death and Maturity.

Unit – 3 **Fire and Marine Insurance** **15 hours**

Fire Insurance- Fire insurance contracts- Fire insurance coverage- Policies for stocks- Rate fixation in fire insurance- Settlement of claims. Marine Insurance- Functions- Marine perils-Types of marine policiesClauses in general use-Warranties and conditions- proximate cause-subrogation and conciliation - Reinsurance- Double insurance-Types of marine losses.

Unit – 4 **Miscellaneous Insurance** **15 hours**

Motor insurance - Employer's liability insurance- Personal accident and sickness insurance - Aviation insurance- Burglary insurance- Fidelity guarantee insurance- Engineering insurancecattle insurance- Crop insurance.

Unit – 5 **Role of Insurance Agent** **15 hours**

Procedure for becoming an Agent- Pre-requisite for obtaining a license- Duration of license-Cancellation of license- Termination of agency - Code of Conduct- Functions of the Agent.

Text book :

1. Fundamentals of Insurance - Dr. Periyasamy, Himalaya Publishing Pvt Ltd, Mumbai.
2. Insurance principles and practice - Moorthy. A , Margham publications, Chennai.
3. Fundamentals of insurance - Dr. P. K. Guptha, Margham publications, Chennai

Reference Books:

1 Insurance principles and practice- Periasamy. P, Margham publications, Chennai

2 Insurance principles and practice - Mishra. M. N, Sultan Chand & Sons, NewDelhi

3 Insurance principles and practice- Balu. V. &Premilan, Margham publications, Chennai

E-Materials:

- https://ocw.mit.edu/courses/economics/14-73-the-challenge-of-world-poverty-spring-2011/video-lectures/lecture-15-risk-and-insurance/
- https://ocw.mit.edu/courses/economics/14-73-the-challenge-of-world-poverty-spring-2011/video-lectures/lecture-16-insurance/

Mapping with Learning outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	L	M	S	S	S	S	L	M
CO2	M	M	M	M	S	S	S	S	L	M
CO3	M	L	L	S	S	S	S	S	L	M
CO4	M	M	L	M	S	S	S	S	L	M
CO5	S	M	M	S	S	S	S	S	L	M

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115

M.Sc. Mathematics – 2022 - 2023 onwards

Semester : II **Paper type : Open Elective** **Credit : 3**

Paper code : **Name of the Paper : NumericalMethods**

Hours of Teaching: 75hrs

CourseObjectives:

Theobjectivesof the courseisto

1. Understandtheconceptof solving algebraic and transcendental equations.
2. Studythevarious methodsto obtaininterpolation withequaland unequalintervals.
3. Get knowledge about numerical differentiation.
4. Demonstrate the numerical integration.
5. Solvethe ordinary differentialequationsusingvariousnumerical methods.

Course Outcomes:

After successful completion on the course the student will be able to

CO1 Solve algebraic and transcendental equations.

CO2 Acquire the knowledge of interpolation for equal and unequal intervals.

CO3 Enrich the students to work effectively on numerical differentiation.

CO4 Providesa foundation in the study of numerical integration.

CO5 Knows to solve ordinary differential equations using various numericalmethods.

Matching Table

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit – 1 Solutionofnumericalalgebraicandtranscendental Equations 15 hours

Bisection method – Iteration Method – Newton-Raphson methodSolutionof simultaneouslinear algebraicequations:Gausseliminationmethod–Gauss-Jordaneliminationmethod– GaussJacobimethod–GaussSeidel method – Simple Problems.

Chapter3: Sections 3.1,3.1.1, 3.2, 3.4

Chapter4: Sections4.1, 4.2,4.2.1, 4.8, 4.9.

Unit – 2 Interpolation 15 hours

Introduction – Newton's forward and backward formulae – Central differences – Gaussforward and backward formulae – Stirling's formula – Divided differences – Properties – Relationsbetweendivideddifferencesandforwarddifferences-Newton'sdivideddifferencesformula– Lagrange'sformula.

Chapter6: Sections 6.1,6.2, 6.3

Chapter7: Sections 7.1,7.3, 7.4, 7.5

Chapter8: Sections 8.2, 8.3,8.4, 8.5, 8.7

Unit – 3 NumericalDifferentiation 15 hours

Newton'sforwardandbackwardformulaetocomputethederivatives–Derivativeusing Stirling's formulae – to find maxima and minima of the function given the tabularvalues. **Chapter9:** Sections 9.2,9.3, 9.4, 9.6

Unit – 4 NumericalIntegration 15 hours

Newton – Cote's formula – Trapezoidal rule – Simpson's 1/3rd and 3/8th rules – Weddle rule.**Chapter9:** Sections 9.8, 9.9, 9.13, 9.14, 9.15

Unit – 5 Numericalsolutionofordinarydifferentialequations 15 hours

Euler'smethod–ImprovedEuler'smethod-Modified Euler'smethod-Runge-Kutta method (Fourth orderonly).

Chapter11: Sections 11.9, 11.10, 11.11, 11.12, 11.13.

Text Book:

Kandasamy. P, Thilagavathi. K and Gunavathi. K "Numerical methods" – S. ChandandCompanyLtd, NewDelhi– ThirdRevised Edition 2016.

ReferenceBooks:

1. Venkataraman M. K.,"Numerical Methods in Science and Engineering" NationalPublishingcompanyV Edition 1999.
2. Sankara Rao K., "Numerical Methods for Scientists and Engineers" 2nd EditionPrenticeHallIndia 2004.
3. GuptaB.D.,NumericalAnalysis,KonarkPublishersPvt. Ltd.

E-Materials:

1. http://nptel.ac.in/courses/122102009/
2. http://www.math.ust.hk/~machas/numerical-methods.pdf
3. https://mathworld.wolfram.com/

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	S	S	S	S
CO2	S	S	M	M	S	M	S	S	S	S
CO3	S	S	M	M	S	M	S	S	S	S
CO4	S	S	M	M	S	M	S	S	S	S
CO5	S	S	M	M	S	M	S	S	S	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115

M.Sc. Mathematics – 2022 - 2023 onwards

Semester : II **Paper type : Open Elective** **Credit : 3**

Paper code : **Name of the Paper : FundamentalsofBusinessStatistics**

Hours of Teaching: 75hrs

CourseObjectives:

The main objective of this course are to:

1 Provide basic knowledge of the origin and evolution of Statistics

2 Applystatisticaltechniquesforinterpretinganddrawingconclusionforbusiness problems.

3 Develop the students ability to deal with numerical and quantitative issues in business

4 Enable the use of statistical, graphical and algebraic techniques where ever relevant

5 Have a proper understanding of Statistical applications in Economics and Management.

CourseOutcomes

Aftersuccessfulcompletionofthecoursethe student willbeableto

CO1 ClassifyaboutthePartialandMultiple Correlation

CO2 Explainthebasicconcepts ofProbabilityandTheoreticalDistributions

CO3 Identifythe educatedguess(hypothesis)

CO4 Analyzethestatisticalinferences-TestofHypothesis,Chisquareand goodness of Fit and F-Test

CO5 Discuss and designtheAnalysisofVariance

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	No	Yes	No
2	Yes	Yes	No	No	Yes	No
3	Yes	Yes	Yes	No	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	No	Yes	Yes	Yes

Unit – 1 PartialandMultipleCorrelation 15 hours

Introduction-PartialCorrelation–MultipleCorrelation–MultipleRegressionAnalysis–ReliabilityofEstimates-MiscellaneousIllustrations

Volume–II:Chapter9: Pages:1109to1135

Unit – 2 Theoryof ProbabilityandTheoreticalDistributions 15 hours

Introduction–ProbabilityDefined–ImportanceoftheConceptofProbability–CalculationofProbability–TheoremsofProbability-ConditionalProbability-Bayes'theorem–ProbabilityDistribution–BinomialDistribution-PoissonDistribution.

Volume–II:Chapter1: Pages:751to770and774to788;

Chapter2: Pages:806to823,826to833and 858 to 879

Unit – 3 StatisticalInference-TestofHypothesis 15 hours

Introduction–SamplingErrorandSamplingDistribution–Estimation–TestofSignificanceforLargeSamples–TestofSignificanceforSmallSamples-MiscellaneousIllustrations.

Volume–II: Chapter 3: Pages: 882 to 951)

Unit – 4 ChisquareandGoodnessofFit 15 hours

Introduction-Chisquaredefined–ConditionsofAdditiveChi-SquareTest–Yate'sCorrections-UsesofChi-SquareTest–AdditivePropertyofChi-Square–Chi-SquareTestforSpecifiedValueofPopulationVariance–MiscellaneousIllustrations.

Volume–II:Chapter 4: Pages: 953to 1003

Unit – 5 F-Testand AnalysisofVariance 15 hours

The F TestortheVarianceRatioTest–ApplicationF Test–AnalysisofVariance–AssumptionsInAnalysisofVariance–TechniqueofAnalysisofVariance–Codingdata–AnalysisofVarianceinTwo-WayClassificationModel.

Volume–II:Chapter5: Pages:1006 to 1038

Text Book:

S.P.Gupta,StatisticalMethods,SultanChand&Sons,NewDelhi,2009.

ReferenceBooks:

1. S.C.GuptaandV.K.Kapoor,FundamentalsofMathematicalStatistics,11-e,SultanChand&Sons, NewDelhi, 2004.
2. S.P.Gupta&M.P.Gupta,BusinessStatistics,14th enlargededition,SultanChand&Sons, Educational publishers, New Delhi, reprint 2007.
3. RichardILevinandDavidS.Rubit,StatisticsforManagement,Seventhedition,PearsonEducation, NewDelhi, 2002.
4. P.R.Vittal,BusinessMathematicsandStatistics,MarghamPublications,Sixthrevisededition, 2011.

E-Materials:

http://mathworld.wolfram.com

Mapping with Learning Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	L	S	S	S	M	S
CO2	S	S	M	M	S	S	S	S	M	S
CO3	S	S	M	S	S	S	S	S	M	S
CO4	S	S	S	M	M	S	S	S	M	S
CO5	S	S	M	M	S	S	S	S	M	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632 115
M.Sc. Mathematics – 2022-2023 Onwards

Semester : III **Paper Type : Core** **Credit : 6**

Paper Code : **Name of the Paper : Complex Analysis – I**

Hours of Teaching : 90 Hours

Course Objectives

The objectives of this course are to

1 Introduce the notions of differentiability, analyticity and power series.

2 Discuss the complex integration, Cauchy theorem and its properties.

3 Educate the conformal mappings and Mobius transformations.

4 Inculcate the concepts of maximum principle, Schwarz's lemma and Liouville's theorem.

5 Indoctrinate the singularities and its classification.

Course Outcomes

After the successful completion of this course, the students will be able to

CO1 Understand the notions of differentiability, analyticity, power series and its consequences.

CO2 Comprehend the complex integration, Cauchy theorem and its properties.

CO3 Know the conformal mappings and Mobius transformations.

CO4 Acquire the concepts of maximum principle, Schwarz's lemma and Liouville's theorem.

CO5 Procure the singularities and its classification.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	No	No
2	Yes	Yes	Yes	No	Yes	No
3	Yes	Yes	Yes	Yes	No	No
4	Yes	Yes	Yes	No	No	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit – 1: Analytic Functions and Power Series **18 Hours**

Differentiability and Cauchy-Riemann Equations – Harmonic Functions – Power Series as an Analytic Function – Exponential and Trigonometric Functions – Logarithmic Functions – Inverse Functions.

Chapter 3: Sections: 3.1 to 3.6

Unit – 2: Complex Integration **18 Hours**

Curves in the Complex Plane – Properties of Complex Line Integrals – Cauchy-Goursat Theorem – Consequence of Simply Connectivity – Winding Number or Index of a Curve – Cauchy Integral Formula – Taylor's Theorem – Zeros of Analytic Functions – Laurent Series.

Chapter 4: Sections: 4.1 to 4.5, 4.7, 4.10 to 4.12

Unit – 3: Conformal Mappings and Mobius Transformations **18 Hours**

Principle of Conformal Mapping – Basic Properties of Mobius Maps – Fixed Points and Mobius Maps – Triples to Triples under Mobius Maps – The Cross-Ratio and its Invariance Property – Conformal Self-maps of Disks and Half-planes.

Chapter 5: Sections: 5.1 to 5.6

Unit – 4: Maximum Principle, Schwarz's Lemma and Liouville's Theorem **18 Hours**

Maximum Modulus Principle - Hadamard's Three Circles/Lines Theorems - Schwarz's Lemma and its Consequences - Liouville's Theorem - Doubly Periodic Entire Function - Fundamental Theorem of Algebra - Zeros of Certain Polynomials.

Chapter 6: Sections: 6.1 to 6.7

Unit – 5: Classification of Singularities **18 Hours**

Isolated and Non-isolated Singularities – Removable Singularities – Poles – Further Illustrations through Laurent's Series – Isolated Singularities at Infinity – Meromorphic Functions – Essential Singularities and Picard's theorem.

Chapter 7: Sections: 7.1 to 7.7

Text Book:

S. Ponnusamy, *Foundations of Complex Analysis*, Second Edition, Narosa Publishing House, New Delhi, 2012.

Reference Books:

1. Lars V. Ahlfors, *Complex Analysis*, 3rd Edition, McGraw-Hill Inc., New York, 1979.
2. J.W. Brown and R.V. Churchill, *Complex Variables and Applications*, 8th Edition, McGraw-Hill Higher Education, New York, 2009.
3. J.B. Conway, *Functions of One Complex Variable*, 2nd Edition, Narosa Publishing House, New Delhi, 1996.
4. V. Karunakaran, *Complex Analysis*, 2nd Edition, Narosa Publishing House, New Delhi, 2005.
5. H.A. Priestley, *Introduction to Complex Analysis*, 2nd Edition, Oxford University Press Inc., New York, 2005.

E-Materials:

1. https://nptel.ac.in/courses/111106141
2. https://ocw.mit.edu/courses/mathematics/18-04-complex-variables-with-applications-spring-2018/
3. https://www.coursera.org/learn/complex-analysis

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	S	S	S	S	S
CO2	S	S	M	M	M	S	S	S	S	S
CO3	S	S	M	M	M	S	S	S	S	S
CO4	S	S	M	M	M	S	S	S	S	S
CO5	S	S	M	M	M	S	S	S	S	S

*PO – Programme Outcome, CO – Course Outcome.

*S – Strong, M – Medium, L – Low.

THIRUVALLUVAR UNIVERSITY, VELLORE – 632 115

M.Sc. Mathematics – 2022-2023 Onwards

Semester : III	**Paper Type : Core**	**Credit : 5**
Paper Code :	**Name of the Paper : Topology**	
Hours of Teaching : 90 Hours		

Course Objectives

The objectives of this course are to

1. Introduce the mathematical analysis of open and closed sets and the significance of the topological spaces.
2. Discuss about the continuous functions on topological spaces, product topology and topology induced by the metric.
3. Educate the connected spaces, connected subspaces, components and local connectedness.
4. Inculcate the notions of compactness, compact subspaces, limit point compactness and local compactness.
5. Indoctrinate the strong theoretical background about the countability axioms, the separation axioms and the consequences theorems.

Course Outcomes

After the successful completion of this course, the students will be able to

CO1 Know the basics on open and closed sets and the significance of the topological spaces.

CO2 Comprehend the continuous functions on topological spaces, product topology and topology induced by the metric.

CO3 Understand the connected spaces, connected subspaces, components and local connectedness.

CO4 Acquire the notions of compactness, compact subspaces, limit point compactness and local compactness.

CO5 Procure the strong theoretical background about the count ability axioms, the separation axioms and the consequences theorems.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	No	No
2	Yes	Yes	Yes	Yes	No	No
3	Yes	Yes	Yes	Yes	No	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit–1 : Topological Spaces **18 Hours**

Topological Spaces – Basis for a Topology – The Order Topology – The Product Topology on $X \times Y$ – The Subspace Topology – Closed Sets and Limit Points.

Chapter 2: Sections 12–17

Unit–2 : Continuous Functions **18 Hours**

Continuous Functions – The Product Topology – The Metric Topology.

Chapter 2: Sections 18–21

Unit–3 : Connectedness **18 Hours**

Connected Spaces – Connected Subspaces of the Real Line – Components and Local Connectedness.

Chapter 3: Sections 23–25

Unit–4 : Compactness **18 Hours**

Compact Spaces – Compact Subspaces of the Real Line – Limit Point Compactness – Local Compactness.

Chapter 3: Sections 26–29

Unit–5 : Countability and Separation Axioms **18 Hours**

The Countability Axioms – The Separation Axioms – Normal Spaces – The Urysohn Lemma – TheUrysohnMetrization Theorem – The Tietz Extension Theorem.

Chapter 4: Sections 30–35

Text Books:

James R. Munkres, *Topology*, 2nd Edition, Pearson Education Pvt. Ltd., Delhi, 2002.

Reference Books:

1. J. Dugundji, *Topology*, Prentice Hall of India Pvt. Ltd., New Delhi, 1975.
2. G.F. Simmons, *Introduction to Topology and Modern Analysis*, McGraw Hill Education, New York, 1963.
3. J.L. Kelley, *General Topology*, Van Nostrand Reinhold Company, New York, 1955.
4. L.A. Steen and J.A. Seebach, *Counterexamples in Topology*, Holt, Rinechart and Winston, New York, 1970.
5. S. Willard, *General Topology*, Addison–Wesley Publishing Company, USA, 1970.

E-Materials:

1. https://ocw.mit.edu/courses/mathematics/18-901-introduction-to-topology-fall-2004/index.htm
2. https://ocw.mit.edu/courses/mathematics/18-904-seminar-in-topology-spring-2011/index.htm
3. https://swayam.gov.in/nd2_cec20_ma12/preview

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	S	S	S	S	S
CO2	S	S	M	M	M	S	S	S	S	S
CO3	S	S	M	M	M	S	S	S	S	S
CO4	S	S	M	M	M	S	S	S	S	S
CO5	S	S	M	M	M	S	S	S	S	S

*PO – Programme Outcome, CO – Course Outcome.

*S – Strong, M – Medium, L – Low.

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115

M.Sc. Mathematics – 2022 - 2023 onwards

Semester : III **Paper type : Core** **Credit : 5**

Paper code : **Name of the Paper : Differential Geometry**

Hours of Teaching:90 hrs

Course Objectives:

The main objective of this course are to:

1 Introduce space curves and its characterizations.

2 Study properties of curves on surfaces.

3 Understand the concepts of Geodesics and canonical Geodesics equations.

4 Teach some type of special surfaces such as Developable and Minimal surfaces.

5 Get the knowledge on differential geometry of surfaces.

Course Outcomes

After successful completion on the course the student will be able to

CO1 Understand the concept of a space curve and compute its curvature and torsion.

CO2 Acquire the knowledge of curves on a surfaceand its intrinsic properties.

CO3 Analyze the geodesics and its normal properties and also familiar with Gauss Bonnet Theorem.

CO4 Determine the second fundamental form and developable associated with space curves.

CO5 Know Hilbert's Lemma and the fundamental existence theorem for surface theory.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	Yes	No
2	Yes	Yes	No	No	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit - 1 Space Curves 18 hours

Definition of a space curve – Arc length – Tangent – Normal and binormal – Curvature and torsion – Contact between curves and surfaces – Tangent surface – Involutes and evolutes – intrinsic equations – Fundamental existence theorem for space curve – Helices.

Chapter 1: Sections 1 to 9

Unit - 2 Intrinsic Properties of a Surface 18 hours

Definition of a surface – Curves on a surface – Surface of revolution – Helicoids – Metric – Direction coefficients – Families of curves – Isometric correspondence – Intrinsic properties.**Chapter 2:** Sections 1 to 9

Unit - 3 Geodesics 18 hours

Geodesics – Canonical geodesic equations – Normal properties of geodesics – Existence theorem – Geodesic parallels – Geodesic curvatures – Gauss Bonnet theorem – Gaussian curvature – Surface of constant curvature.

Chapter 2: Sections 10 to 18

Unit - 4 Non–Intrinsic Properties of a Surface 18 hours

The second fundamental form – Principal curvature – Lines of curvature – Developable – Developable associated with space curves and with curves on surface – Minimal surfaces –Ruled surfaces.

Chapter 3: Sections 1 to 8

Unit - 5 Differential Geometry of Surfaces 18 hours

Fundamental equations of surface theory – Fundamental existence theorem for surfaces – Compact surfaces whose points are umbilics– Hilbert's lemma – Compact surfaces of constant curvature – Complete surfaces.

Chapter 3: Sections 9 to 11

Chapter 4: Sections 1 to 5

Text book :

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

Reference Books:

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

E-Materials:

http://www.math.ku.dk/noter/filer/geom1.pdf

Mapping with Learning outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	L	M	S	L	S	S	L	M
CO2	S	S	M	L	S	L	S	S	M	M
CO3	S	S	M	M	S	L	S	S	M	M
CO4	S	S	M	M	S	L	S	S	M	M
CO5	S	S	M	M	S	L	S	S	M	M

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115

M.Sc. Mathematics – 2022 - 2023 onwards

Semester : III **Paper type : Core Elective** **Credit : 3**

Paper code : **Name of the Paper : LaTeX**

Hours of Teaching: 90hrs

Course Objectives:

The main objective of this course are to:

1 Inculcate the computer knowledge.

2 Introduce the LaTeXsoftware

3 Train in the Preparation of Project and dissertations using LaTex.

4 Educate the Latex coding.

5 Understand the concepts of Cross References, Footnotes, Margin pars and Endnotes

Course Outcomes

After successful completion on the course the student will be able to

CO1 Understand the basic LaTeX document and the e-contents.

CO2 Construct the structures of contents, index, glossary and text.

CO3 Create the type setting equations

CO4 Discuss several types of boxes and floats.

CO5 Prepare the basic documentation

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	No	Yes
2	Yes	Yes	Yes	No	No	Yes
3	Yes	Yes	No	No	No	Yes
4	Yes	Yes	No	No	No	Yes
5	Yes	Yes	Yes	No	No	Yes

Unit - 1 **Basic Document and Bibliography** **18 hours**

Whats is LATEX – Simple typesetting – Fonts Type size – Document class – page style – page numbering – Formatting lengths – parts of a document – Dividing the document – what next? – Introduction – natbib – The BIBTEX program – BIBTEX Style files – Creating a bibliographic database.

Chapter: 1 to 4

Unit - 2 **Contents, Index, Glossary, Text, Row and Column** **18 hours**

Table of contents – Index – Glossary. Borrowed words – Poetry in typing – Making lists – When order matters – Description and definitions.

Chapter: 5 to 6

Unit - 3 **Typesetting Equations and Theorems** **18 hours**

Keeping tabs – Tables – The basics – Custom commands – More on mathematics – mathematics miscellany – New operations– The many fact of mathematics – Symbols – Theory in LATEX – Designer theorem-the amsthm package – Housekeeping.

Chapter: 7 to 9

Unit - 4 **Several Kinds of boxes and Floats,** **18 hours**

LR boxes – Paragraph boxes – Paragraph boxes with specific height – Nested boxes – Role boxes – The figure environment – The table environment.

Chapter: 10 to 11

Unit - 5 **Cross References in LATEX, Footnotes, Marginpars and Endnotes** **18 hours**

Why cross reference? – Let LATEX do it – Pointing to a page-the package varioref – Pointing outside-the package xr – Lost the keys? Use lables.tex – Footnotes – Marginal notes – Endnotes.

Chapter: 12 to 13

Text book :

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

www.tug.org.in

Reference Books:

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

E-Materials:

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

Mapping with Learning outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	L	L	M	S	L	S	S	M
CO2	S	M	L	M	M	L	L	S	S	M
CO3	S	L	L	M	L	L	L	S	S	M
CO4	S	L	L	L	M	L	L	S	S	M
CO5	S	L	L	M	L	L	L	S	S	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632 115

M.Sc. Mathematics – 2022-2023 Onwards

Semester : III **Paper Type : Core Elective** **Credit : 3**

Paper Code : **Name of the Paper : Discrete Mathematics**

Hours of Teaching : 90 Hours

Course Objectives

The objectives of this course are to

1 Introduce the algebraic structures of lattices and Boolean algebra.

2 Construct the switching circuits with applications.

3 Educate the finite fields and its mathematics properties.

4 Inculcate the polynomials over finite fields, Irreducibility and factorization of polynomials.

5 Indoctrinate the coding theory with the linear and cyclic codes.

Course Outcomes

After the successful completion of this course, the students will be able to

CO1 Know the algebraic structures of lattices and Boolean algebra, and sketch the minimization of Boolean polynomials.

CO2 Model the switching circuits with applications.

CO3 Understand the finite fields and its mathematics properties.

CO4 Acquire the notions of the polynomials over finite fields, Irreducibility and factorization of polynomials.

CO5 Apply the coding theory with the linear and cyclic codes in cryptography.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	No	No	No
3	Yes	Yes	No	Yes	Yes	No
4	Yes	Yes	No	Yes	Yes	No
5	Yes	Yes	Yes	No	No	No

Unit-1: Lattices **18 hours**

Properties and Examples of Lattices – Distributive Lattices – Boolean Algebras – Boolean Polynomials - Minimal Forms of Boolean Polynomials.

Chapter 1: Sections 1–6

Unit-2 : Applications of Lattices **18 hours**

Switching Circuits – Applications of Switching Circuits.

Chapter 2: Sections 7–8

Unit-3 : Finite Fields **18 hours**

Finite Fields.

Chapter 3: Sections 13

Unit-4 : Polynomials **18 hours**

Irreducible Polynomials over Finite Fields - Factorization of Polynomials over Finite Fields.

Chapter 3: Sections 14–15

Unit -5: Coding Theory **18 hours**

Linear Codes – Cyclic Codes.

Chapter 4: Sections 17–18

Text Books:

Rudolf Lidl and Gunter Pilz, *Applied Abstract Algebra*, 2nd Indian Reprint, Springer Verlag, NewYork, 2006.

Reference Books:

1. A.Gill,*Applied Algebra for Computer Science*, Prentice Hall Inc., New Jersey.
2. J.L.Gersting, *Mathematical Structures for Computer Science*, 3rdEdn., ComputerScience Press, New York.
3. S.Wiitala,*Discrete Mathematics - A Unified Approach*, McGraw Hill Book Co.

E-Materials:

1. http://www.discrete-math-hub.com/resources-and-help.html
2. https://onlinecourses.nptel.ac.in/noc22_cs123/preview
3. https://onlinecourses.nptel.ac.in/noc22_cs85/preview

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	S	S	S	S	S
CO2	S	S	M	M	S	S	S	S	S	S
CO3	S	S	M	M	M	S	S	S	S	S
CO4	S	S	M	M	M	S	S	S	S	S
CO5	S	S	M	M	S	S	S	S	S	S

*PO – Programme Outcome, CO – Course Outcome.

*S – Strong, M – Medium, L – Low.

THIRUVALLUVAR UNIVERSITY, VELLORE – 632 115

M.Sc. Mathematics – 2022-2023 Onwards

Semester : III **Paper Type : Core Elective** **Credit : 3**

Paper Code : **Name of the Paper : Operations Research**

Hours of Teaching : 90 Hours

Course Objectives

Theobjectives ofthecourseis to

1. Understand the steps in decisiontheoryandtreeanalysis
2. Make distinctions among various types of replacement and maintenance techniques.
3. Solve an LPP using dynamic programming approach..
4. Use differential calculus based methods to obtain the optimal solutions.
5. Derive and use Kuhn-Tucker conditions necessary for optimal vaule of an objective function.

Course Outcomes:

After successful completion on the course the student will be able to

CO1 Make decision under various decision-making environments.

CO2 Acquire the knowledge of replacement analysis in handling problems like staffing problem and equipment renewal problem etc.

CO3 Work effectively on Dynamic Programming models and their applications in solving Decision problem.

CO4 Provide a strong foundation in distinction between local, global and inflection extreme points.

CO5 Solve non-linear programming problems.

Matching Table :

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit-1: Decision Theory **18 Hours**

Steps in Decision theory Approach – Types of Decision Making Environments –DecisionMaking Under Uncertainty – Decision Making under Risk – Posterior Probabilities andBayesianAnalysis– DecisionTreeAnalysis– DecisionMakingwith Utilities.

Chapter11: Sections 11.1to 11.8

Unit-2: Replacement and Maintenance Models **18 Hours**

FailureMechanismofitems–ReplacementofItemsDeteriorateswithTime–Replacementofitems that fail completely– other ReplacementProblems

Chapter17: Sections 17.1 to 17.5

Unit-3: Dynamic Programming **18 Hours**

Introduction – Dynamic Programming Terminology – Developing Optimal Decision Policy – Dynamic Programming under Certainty – Dynamic Programming Approach for Solving LPP.

Chapter 22: Sections 22.1 to 22.5

Unit-4: Classical Optimization Methods **18 Hours**

Introduction - Unconstrained Optimization - Constrained multivariable Optimization with inequality constraints – Problems.

Chapter 23: Sections 23.1 to 23.4

Unit-5: Non-Linear Programming Methods **18 Hours**

Introduction - General NLPP – Graphical Solution -Quadratic Programming – Problems.

Chapter 24: Sections 24.1 to 24.4

Text Book:

J.K.Sharma,OperationsResearch Theory and Applications (SixthEdition), Trinity Press, Laxmi Publications Pvt. Ltd., NewDelhi, Reprint 2017.

ReferenceBooks:

1. F.S.HillierandJ.Lieberman,IntroductionToOperationsResearch,(Eighthedition),TataMc Graw Hill PublishingCompany, New Delhi, 2006.
2. C.Beightler,D.Phillips,andB.Wilde,FoundationsofOptimization,(Secondedition),Prenti ceHall New York, 1979.

3. M.S.Bazaraa,J.J.Jarvis,and H.D.Sharall, JohnWileyand sons,New York,1990.
4. D.GrossandC.M.Harris,FundamentalsOfQueuingTheory[3rdEdition],WileyandSons, New York, 1998.
5. HamdyA.Taha,OperationsResearch,(Sixthedition),Prentice–HallofIndiaPrivateLimited,NewDelhi.

E-Materials:

https://onlinecourses.nptel.ac.in/noc19_ma29/prev

https://archive.nptel.ac.in/courses/111/107/111107104/

https://onlinecourses.nptel.ac.in/noc21_mg74/preview

https://mathworld.wolfram.com/topics/Optimization.html

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	S	S	S	S
CO2	S	S	M	M	S	M	S	S	S	S
CO3	S	S	M	M	S	M	S	S	S	S
CO4	S	S	M	M	S	M	S	S	S	S
CO5	S	S	M	M	S	M	S	S	S	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115

M.Sc. Mathematics – 2022 - 2023 onwards

Semester : III **Paper type : Open Elective** **Credit : 3**

Paper code : **Name of the Paper : Mathematical Biology**

Hours of Teaching : 90 Hours

CourseObjectives:

The main objectivesof the courseareto

1. Understand and knowthediscretepopulationgrowthmodels.
2. Develop the Model forthe Distributionofdrugsinthebody
3. Apply the Model for the Spread of Technological Innovations
4. Studythecontinuousgrowthmodelsand qualitativebehaviorofpopulations
5. Knowthemathematicalmodelsin epidemiology.

CourseLearningOutcomes

Afterthesuccessfulcompletionofthiscourse,the students willbeableto:

CO1 Formulatethemathematicalmodelsforrealworldproblems

CO2 Understanding theconceptsofDiscretePopulationGrowthModels

CO3 DiscusstheContinuous Growth Models

CO4 Explain the Logistic Model with Harvesting

CO5 Analyze the Qualitative behavior of Populations and Mathematical Models in Epidemiology.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Unit-1:DiscretePopulationGrowthModels **18 hours**

Arithmetic Growth Model - Geometric Growth Model - Generalizations – Age StructuredPopulations.

Chapter2: Sections 2.2 to 2.5

Unit-2:ContinuousGrowthModels **18hours**

TheLinearModel-The ExponentialModel-Model forthe Distributionofdrugsinthebody CoalitionModels.

Chapter3: Sections 3.2 to 3.5

Unit-3:ContinuousGrowthModels(contd.) **18 hours**

Environmental Resistance - A Model for the Spread of Technological Innovations - TheGomertzModel -BertalanffyGrowth Model.

Chapter3: Sections 3.8 to 3.11

Unit-4:Qualitativebehaviorof Populations

18hours Auton omous Equations - Steady and Equilibrium State - Stability of Equilibrium State -Logistic Model with Harvesting - Fixed Points and their stability - The Logistic Map.

Chapter5: Sections 5.2 to 5.7

Unit-5:MathematicalModelsinEpidemiology **18hours**

Plant Epidemics - Some features of Human Epidemics - A Simple Deterministic EpidemicModel-A moreGeneralEpidemic: SIR Disease.

Chapter7: Sections 7.2 to 7.5

Text Book:

C.R.Ranganathan, AFirstCourseinMathematicalModelsofPopulationGrowth(withMATLABProgram), AssociatedPublishingCompany,NewDelhi,2006.

ReferenceBooks:

1. Pundir,BioMathematics,APragatiEdition, 2006.
2. J.N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East-WestPressPvt.Ltd., NewDelhi, 1985.
3. Nicolas F. Britton, Essential Mathematical Biology, Springer InternationalEdition,FirstIndianreprint, 2004.

4. Murray,MathematicalBiology,Springer InternationalEdition,FirstIndianreprint,2004.

E-Materials:

1. https://www.smb.org/
2. https://web.archive.org/web/20080827161431/http://www.biostatsresearch.com/repository/

Mapping with Learning Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	S	M	S	M	S	L
CO2	M	M	M	S	S	L	M	S	L	M
CO3	S	M	S	S	L	L	S	L	M	L
CO4	S	M	S	L	M	M	M	S	L	S
CO5	S	S	M	L	S	M	M	L	L	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115

M.Sc. Mathematics – 2022 - 2023 onwards

Semester : III **Paper type : Open Elective** **Credit : 3**

Paper code : **Name of the Paper : QuantitativeTechniques**

Hours of Teaching: 90hrs

CourseObjectives:

Theobjectives of the courseis to

1. Studythe linearprogrammingproblem and its solving method.
2. Understandthetransportationproblem as a linear programming problem.
3. Understand the concept of assignmentproblem.
4. Understand the concept of inventory control.
5. Know about the network analysis and its solution methods,PERT andCPM.

Course Outcomes:

After successful completion on the course the student will be able to

CO1 Understand the concept of LPP and its solution.

CO2 Acquire the knowledge of transportation problems.

CO3 Work effectively on assignment models.

CO4 Provides a strong foundation in the study of thecharacteristics of inventory controls.

CO5 Use PERT-CPMtechniqueforprojectmanagement network problems.

Matching Table :

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit–1:LinearProgrammingProblem **18 hours**

Introduction–GraphicalSolutionMethod–SomeExceptionalCases–GeneralLinearProgrammingProblem–FundamentalPropertiesofSolution–TheComputationalProcedure-SimplexMethod.

Chapter3: Sections3.1to3.4

Chapter4: Sections4.1 to 4.3

Unit– 2:TransportationProblem **18 hours**

Introduction -L.P Formulationof theTransportationProblem– Existence of Solution inT.P – Transportation Table– Solution of a Transportation Problem– Finding InitialBasicFeasibleSolution-Testforoptimality–EconomicInterpretationofu_j'sandv_j's–DegeneracyinTransportationProblem–TransportationAlgorithm(ModiMethod).

Chapter10: Sections 10.1 to 10.3, 10.5, 10.8 to 10.13

Unit–3:Assignment Problem **18 hours**

Introduction-MathematicalFormulationoftheProblem-SolutionMethodsofAssignmentProblem–SpecialCasesinAssignmentProblems–TravellingSalesmanProblem.

Chapter11: Sections 11.1 to 11.4, 11.7

Unit–4:Inventory Control **18hours**

Introduction – Types of Inventories – Reasons for Carrying Inventories – The InventoryDecisions – Objective of Scientific Inventory Control –Costs Associated with Inventories –Factors Affecting with Inventory Control – An inventory Control Problem - DeterministicInventoryproblem withNo shortages.

Chapter 19: Sections 19.1 to 19.10

Unit–5:NetworkschedulingbyPERTandCPM **18 hours**

Introduction–Network:BasicComponents –LogicalSequencing-RulesofNetworkConstruction–ConcurrentActivities–CriticalPathAnalysis–ProbabilityConsiderationsinPERT-Distinction between PERT andCPM.

Chapter25

Text Book:

KantiSwarup,P.K.Gupta,ManMohan,OperationsResearch,SultanChand&Sons,NewDelhi, 2008.

ReferenceBooks

1. P.K.Gupta,OperationsResearch,8-e,KrishnaPrakasamMandir,Meerut,1993.
2. P.K.GuptaandD.S.Hira,OperationsResearch,S.Chand&Company,NewDelhi,2000.
3. J.K.Sharma,OperationsResearchTheoryandApplications,2-e,Mac MillianBusinessBooks, 2003.
4. HamdyA.Taha,OperationsResearch,PearsonEducation,NewDelhi,2002.

E-Materials:

https://mathworld.wolfram.com/

https://nptel.ac.in/courses/112106134

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	S	S	S	S
CO2	S	S	M	M	S	M	S	S	S	S
CO3	S	S	M	M	S	M	S	S	S	S
CO4	S	S	M	M	S	M	S	S	S	S
CO5	S	S	M	M	S	M	S	S	S	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115

M.Sc. Mathematics – 2022 - 2023 onwards

Semester : III **Paper type : Open Elctive** **Credit : 3**

Paper code : **Name of the Paper : SCILAB**

Hours of Teaching: 90hrs

Course Objectives:

The main objective of this course are to:

1 Understand the basic commands

2 Solve the system of equations

3 Construct the plotting lines and data.

4 Evaluate the polynomials

5 Solve the Ordinary differential equations.

Course Outcomes

After successful completion on the course the student will be able to

CO1 Acquire the practical knowledge of SCILAB

CO2 Understand the matrices, vectors in SCILAB

CO3 Visualize the mathematical objects in 2D and 3D

CO4 Acquire the knowledge of polynomials

CO5 Obtain the solution of Ordinary Differential equations

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	Yes	No
2	Yes	Yes	Yes	Yes	Yes	Yes
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	No	Yes	No

Unit-1 Introduction to SciLAbB **18 hours**

Login - Talking between Scilab and the Editor - Basic Commands - Linear Algebra - Loops and Conditionals - Help in Scilab.

Chapter 1: Sections 1.1 to 1.7

Unit-2 Matrix Calculation **18 Hours**

Matrices and Vectors - Solving Equations - Creating Matrices - Systems of Equations.

Chapter 2: Section 2.2

Unit-3 Data and Function Plots **18 hours**

Plotting Lines and Data - Adding a Line - Hints for Good Graphs – Graphs - Function Plotting – Component Arithmetic - Printing Graphs - Saving Graphs.

Chapter 3: Sections 3.2, 3.3

Unit- 4 Polynomials **18 Hours**

Evaluation of Polynomials – Polynomials - Linear Least Squares (Heath Computer Problem).

Chapter 6: Sections 6.2, 6.3, 6.4

Unit-5 Differential Equation **18 Hours**

Differential Equations - Scalar ODE's - Order 2 ODE's .

Chapter 8: Sections 8.2

Text book :

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

Reference Books:

1. Scilab for very beginners, Scilab Enterprises, S.A.S, 143, bis rue Yves Le Coz – 78000 Versailles (France).
2. K. S. Surendran, SCILAB FOR DUMMIES, Version 2.6.
3. Some notes on SCILAB, Universit´e de Nice Sophia-Antipolis.

E-Materials:

https://www.scilab.org/

Mapping with Learning Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	L	S	S	M	L
CO2	S	S	M	L	S	L	S	S	L	M
CO3	S	S	S	S	S	L	S	S	M	L
CO4	S	S	M	M	S	L	S	S	L	L
CO5	S	S	M	S	S	L	S	S	M	L

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632 115

M.Sc. Mathematics – 2022-2023 Onwards

Semester : IV **Paper Type : Core** **Credit : 4**

Paper Code : **Name of the Paper : Complex Analysis – II**

Hours of Teaching : 75 Hours

Course Objectives

The objectives of this course are to

1 Introduce the concepts of residues and its properties.

2 Estimate the contour integrals and its applications.

3 Educate the analytic continuation and Poisson integral formula.

4 Inculcate the representations of meromorphic and entire functions.

5 Indoctrinate the applications of open mapping, Hurwitz and Riemann mapping theorems.

Course Outcomes

After the successful completion of this course, the students will be able to

CO1 Understand the concepts of residues and its properties.

CO2 Evaluate the contour integrals and its applications.

CO3 Know the analytic continuation and Poisson integral formula.

CO4 Acquire the representations of meromorphic and entire functions.

CO5 Procure the applications of open mapping, Hurwitz and Riemann mapping theorems.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	No	No
2	Yes	Yes	Yes	No	Yes	No
3	Yes	Yes	Yes	Yes	No	No
4	Yes	Yes	Yes	Yes	No	No
5	Yes	Yes	Yes	Yes	Yes	No

Unit – 1: Calculus of Residues **15 hours**

Residue at a Finite Point – Residue at the Point at Infinity – Residue Theorem – Number of Zeros and Poles – Rouche's Theorem.

Chapter 7: Sections 7.1 to 7.6

Chapter 8: Sections 8.1 to 8.5

Unit – 2: Evaluation of Certain Integrals **15 hours**

Integrals of three types - Singularities on the Real Axis - Integrals Involving Branch Points - Estimation of Sums.

Chapter 9: Sections 9.1 to 9.6

Unit – 3: Analytic Continuation **15 hours**

Direct Analytic Continuation - Monodromy Theorem - Poisson Integral Formula - Analytic Continuation via Reflection.

Chapter 10: Sections 10.1 to 10.4

Unit – 4: Representation of Meromorphic and Entire Functions **15 hours**

Infinite Sums and Meromorphic Functions - Infinite Product of Complex Numbers - Infinite Products of Analytic Functions - Factorization of Entire Functions - The Gamma Function - The Zeta Function - Jensen's Formula - The Order and the Genus of Entire Functions.

Chapter 11: Sections 11.1 to 11.8

Unit –5: Mapping Theorems **15 hours**

Open Mapping Theorem and Hurwitz' Theorem - Basic Results on Univalent Functions - Normal Families - The Riemann Mapping Theorem - Bieberbach Conjecture - The Bloch-Landau Theorems - Picard's Theorem.

Chapter 12: Sections 12.1 to 12.7

Text Books:

S. Ponnusamy, *Foundations of Complex Analysis*, Second Edition, Narosa Publishing House, New Delhi, 2012.

Reference Books:

1. Lars V. Ahlfors, *Complex Analysis*, 3rd Edition, McGraw-Hill Inc., New York, 1979.
2. J.W. Brown and R.V. Churchill, *Complex Variables and Applications*, 8th Edition, McGraw-Hill Higher Education, New York, 2009.
3. J.B. Conway, *Functions of One Complex Variable*, 2nd Edition, Narosa Publishing House, New Delhi, 1996.
4. V. Karunakaran, *Complex Analysis*, 2nd Edition, Narosa Publishing House, New Delhi, 2005.
5. H.A. Priestley, *Introduction to Complex Analysis*, 2nd Edition, Oxford University Press Inc., New York, 2005.

E-Materials:

1. https://nptel.ac.in/courses/111106141
2. https://ocw.mit.edu/courses/mathematics/18-04-complex-variables-with-applications-spring-2018/
3. https://www.coursera.org/learn/complex-analysis

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	S	S	S	S	S
CO2	S	S	M	M	M	S	S	S	S	S
CO3	S	S	M	M	M	S	S	S	S	S
CO4	S	S	M	M	M	S	S	S	S	S
CO5	S	S	M	M	M	S	S	S	S	S

*PO – Programme Outcome, CO – Course Outcome.

*S – Strong, M – Medium, L – Low.

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115

M.Sc. Mathematics – 2022 - 2023 onwards

Semester : IV **Paper type : Core** **Credit : 4**

Paper code : **Name of the Paper : Fluid Dynamics**

Hours of Teaching: 75hrs

Course Objectives:

The main objective of this course are to:

1 Discuss kinematics of fluids in motion

2 Derive the equations of motion of a fluid

3 Introduce Three dimensional flows

4 Discuss Two dimensional image system

5 Analysis viscous flows

Course Outcomes

After successful completion of the course the student will be able to

CO1 Understand the concepts of kinematics of fluids in motions.

CO2 Find the pressure at a point in a moving fluid.

CO3 Discuss Stokes stream function.

CO4 Analyse complex velocity potential for standard two dimensional flows.

CO5 Derive the Navier – Stokes equations of motion of a Viscous fluid.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	No	No
2	Yes	Yes	Yes	No	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	No	Yes	Yes	No

Unit-1: Kinematics of Fluids in Motion 15 hours

Real fluids and ideal fluids – Velocity of a fluid at a point, Stream lines, path lines, steady and unsteady flows – Velocity potential – The vorticity vector – Local and particle rates of changes – Equations of continuity – Worked examples – Acceleration of a fluid – Conditions at a rigid boundary.

Chapter 2: Sections 2.1 to 2.10

Unit-2: Equations of Motion of Fluid 15 hours

Pressure at a point in a fluid at rest – Pressure at a point in a moving fluid – Conditions at a boundary of two inviscid immiscible fluids – Euler's equation of motion – Discussion of the case of steady motion under conservative body forces.

Chapter 3: Sections 3.1 to 3.7

Unit-3: Some Three Dimensional Flows 15 hours

Introduction – Sources, sinks and doublets – Images in a rigid infinite plane – Axis symmetric flows – Stokes stream function.

Chapter 4: Sections 4.1, 4.2, 4.3, 4.5.

Unit-4: Some Two Dimensional Flows 15 hours

Meaning of two dimensional flow – Use of Cylindrical polar coordinate – The stream function – The complex potential for two dimensional, irrational incompressible flow – Complex velocity potentials for standard two dimensional flows – Some worked examples – Two dimensional image systems – The Milne Thompson circle Theorem.

Chapter 5: Sections 5.1 to 5.8

Unit-5: Viscous Flows 15 hours

Stress components in a real fluid – Relations between Cartesian components of stress – Translational motion of fluid elements – The rate of strain quadric and principal stresses – Some further properties of the rate of strain quadric – Stress analysis in fluid motion – Relation between stress and rate of strain – The co-efficient of viscosity and Laminar flow – The Navier – Stokes equations of motion of a Viscous fluid.

Chapter 8: Sections 8.1 to 8.9

Text book :

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

Reference Books:

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

E-Materials:

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

Mapping With Learning Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	L	L	S	L	S	S	L	M
CO2	S	S	M	M	S	L	S	S	L	M
CO3	S	S	M	M	S	L	S	S	L	L
CO4	S	S	M	S	S	L	S	S	M	L
CO5	S	S	M	M	S	L	S	S	L	M

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115

M.Sc. Mathematics – 2022 - 2023 onwards

Semester : IV **Paper type : Core** **Credit : 5**

Paper code : **Name of the Paper : Functional Analysis**

Hours of Teaching: 75hrs

CourseObjectives:

The main objective of this course are to:

1. Studythedetails of Banach SpacesandContinuous linear transformations
2. Get familiar with concepts of open mapping theorem also understand the propertiesof orthogonal complements.
3. Provide the concept of conjugate space H*, adjoint, self-adjoint, normal andunitaryoperators.
4. Learn and understand thePreliminaries of Banachalgebras
5. Know about the structure of commutative Banach Algebras

CourseOutcomes:

Aftersuccessfulcompletionofthecoursethe student willbeableto

CO1 Analysethe Banachspace withexamples and Able to work comfortably with Continuous linear transformations

CO2 Apply the conjugate operator and acquire the knowledge of openmappingtheorem.

CO3 Discuss about theHilbertspaces.

CO4 Acquire the knowledge of Banach Algebra and Outline of spectral radius.

CO5 Construct the Gelfand-Neumark theorem.

Matching table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	Yes	No	No
2	Yes	Yes	Yes	Yes	No	No
3	Yes	Yes	No	No	Yes	Yes
4	Yes	Yes	No	No	Yes	No
5	No	Yes	No	Yes	No	No

UNIT-I:BanachSpaces **15 hours**

Definition - Some examples - Continuous Linear Transformations - The Hahn -BanachTheorem.

Chapter 9: Sections 46 to 48

UNIT-II:BanachSpacesAnd HilbertSpaces **15 hours**

Open mapping theorem - conjugate of an operator - Definition and some simple properties - Orthogonal complements – Orthonormal.

Chapter 9: Sections 50 and 51

Chapter 10: Sections52, 53 and 54

UNIT-III:HilbertSpace **15 hours**

Conjugate space H* - Adjoint of an operator - Self-adjoint operator - Normal and UnitaryOperators– Projections.

Chapter10: Sections 55,56,57,58 and 59

UNIT-IV: Preliminaries ofBanachAlgebras

15hours Definitio

n and some examples - Regular and single elements - Topological divisors of zero -spectrum-theformulafor thespectral radius-theradical andsemi-simplicity.

Chapter12: Sections 64to 69

UNIT-V:StructureofCommutativeBanach Algebras **15hours**

Gelfandmapping –Applicationsofthe formula $r(x)=\lim\left\|x^n\right\|^{1/n}$ - Involutions inBanachAlgebras-Gelfand-NeumarkTheorem.

Chapter13: Sections 70to73

Text Book:

G.F.Simmons , Introduction to topology and Modern Analysis, McGraw HillInternationalBook Company,NewYork, 1963.

ReferenceBooks:

1. W. Rudin Functional Analysis, Tata McGraw-Hill Publishing Company, New Delhi,1973
2. G.Bachman&L.Narici,FunctionalAnalysis AcademicPress,NewYork, 1966.
3. H.C. Goffman and G.Fedrick, First course in Functional Analysis, Prentice Hall ofIndia, NewDelhi, 1987
4. E. Kreyszig Introductory Functional Analysis with Applications, John wiley& Sons,NewYork.,1978.
5. BalmohanV.Limaye,LinearFunctionalAnalysisforScientistsandEngineers,Springer.

E-Materials

http://www.math.ucdavis.edu/~hunter/book/ch5.pdf

Mapping with Learning Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	S	S	S	M	S
CO2	S	S	M	M	S	S	S	S	M	S
CO3	S	S	M	M	S	S	S	S	M	S
CO4	S	S	M	M	S	S	S	S	M	S
CO5	S	S	M	M	S	S	S	S	M	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115
M.Sc. Mathematics – 2022 - 2023 onwards

Semester : IV **Paper type : Core Elective** **Credit : 3**

Paper code : **Name of the Paper : Number theory and Cryptography**

Hours of Teaching: 75hrs

Course Objectives:

The main objective of this course are to:

1. Demonstrate ability to learn elementary ideas from number theory which will have applications in cryptography.
2. Introduce various cryptosystems and apply them in the necessary fields.
3. Understand the concepts of public key and primality
4. Learn the public key cryptography and RSA algorithm
5. Get the knowledge about Factoring concepts.

Course Outcomes:

After successful completion on the course the student will be able to

CO1 Acquire the knowledge of elementary number theory

CO2 Apply various cryptosystems and understand the concepts of quadratic, residues and reciprocity

CO3 Develop the idea of public key cryptography, RSA Algorithms.

CO4 Solve problems using the continued fraction method and the quadratic sieve method.

CO5 Demonstrate ability to apply concepts of Fermat factorization and factor bases.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	No	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

UNIT–1 Some Topics in Elementary Number Theory 15 hours

Time Estimates for doing arithmetic – Divisibility and Euclidean Algorithm – Congruence's– Some applications to Factoring.

Chapter I

UNIT–2 Cryptography 15 hours

Some simple cryptosystems – Enciphering matrices.

Chapter III

UNIT–3 Quadratic Residues 15 hours

Quadratics – Residues and reciprocity.

Chapter II

UNIT–4 Public Key 15 hours

The idea of Public key Cryptography – RSA – Discrete Law – Knapsack – Zero–Knowledge.**Chapter IV:** Sections 1 to 5

UNIT–5 Primality and Factoring 15 hours

Pseudo–primes – The rho method – Fermat factorization and factor bases – The continued fraction method – The quadratic sieve method.

Chapter V: Sections 1 to 5

Text Book:

Neal Koblitz, A Course in Number Theory And Cryptography, Springer–Verlag, New York,1987.

Reference Books:

1. Niven and Zuckerman, An Introduction to Theory of Numbers, Third Edition, Wiley Eastern Ltd, New Delhi,1976.
2. David M. Burton,Elementary Number Theory, Wm. C. Brown Publishers, Dubuque, Iowa, 1989.
3. K. Ireland and M. Rosen, A Classical Introduction to Modern Number Theory, Springer–Verlag,1972.

E-Materials:

1. http://mathworld.wolfram.com
2. https://ocw.mit.edu/courses/6-042j-mathematics-for-computer-science-fall-2010/resources/lecture-4-number-theory-i/

Mapping with Learning outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	**S**	**S**	**S**	**M**	**M**	**M**	**S**	**S**	**S**	**S**
CO2	**S**	**S**	**S**	**M**	**M**	**S**	**S**	**S**	**S**	**S**
CO3	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**
CO4	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**S**	**S**	**M**	**S**	**M**	**S**	**S**	**S**	**S**

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115
M.Sc. Mathematics – 2022 - 2023 onwards

Semester : IV **Paper type : Core Elective** **Credit : 3**

Paper code : **Name of the Paper : AdvancedNumericalAnalysis**

Hours of Teaching: 75hrs

CourseObjectives:

The main objective of this course are to:

1 Introducethederivationofnumericalmethodswitherroranalysis

2 Studythetranscendental andpolynomialequations

3 Acquire the knowledge of systemoflinear algebraicequations

4 Understandthedifferentiationandintegration

5 Solve problems oninterpolation and ordinarydifferential equations

CourseOutcomes:

Aftersuccessfulcompletionofthecoursethe student willbeableto

CO1 Examinethesolutionsof transcendentalandpolynomialequations

CO2 Understandthesystemof linearalgebraicequations

CO3 Analyse the interpolationandextrapolation

CO4 Evaluatenumericaldifferentiationandintegrations

CO5 Solve the differentialequations bysingle andmulti stepmethods

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	No	Yes	No
2	Yes	Yes	No	No	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	No	Yes	No
5	Yes	Yes	Yes	Yes	Yes	Yes

UNIT–1 TranscendentalandPolynomialEquations 15hours

Iterationmethodsbasedonseconddegreeequation–Rateofconvergence–Iterationmethods– Methods forcomplexroots– Polynomial equations.

Chapter2: Sections 2.4 to 2.8

UNIT–2 Systemof LinearAlgebraicEquations andEigen ValueProblems 15hours

Directmethods–Triangularisation,CholeskyandPartitionmethods–Erroranalysis–Iteration methods – Eigen values and Eigenvectors – Jacobi's method, Given's method,Rutishaughermethodand Power method.

Chapter3: Sections 3.2to 3.5

UNIT–3 InterpolationandApproximation 15hours

HermiteInterpolations–PiecewiseandSplineInterpolation–Bivariateinterpolation–Approximation– Least Squareapproximation– Uniform approximation.

Chapter4: Sections4.5to 4.10

UNIT–4 DifferentiationandIntegration 15hours

NumericalDifferentiation–PartialDifferentiation–NumericalIntegrationmethodsbasedonundetermined coefficients– Doubleintegration.

Chapter5: Sections5.2,5.5, 5.6, 5.8, 5.11

UNIT–5 OrdinaryDifferential Equations 15hours

Numericalmethods–Singlestepmethods–Multistepmethods–Predictor–Correctormethods.

Chapter6: Sections6.2 to 6.5

Text Book:

M.K.Jain,S.R.K.IyengarandR.K.Jain,NumericalMethodsForScientificandEngineeringComputation, 3rdEdition,New AgeInternational,1993.

ReferenceBooks:

1. S.D.CorteanddeBoor,ElementaryNumericalAnalysis– AnAlgorithmicapproach,3rdEdition, McGrawHillInternationalBookCompany, 1980.
2. JamesB.Scarboraugh,NumericalMathematicalAnalysis,Oxford&IBHPublishingCompany,New Delhi.
3. F.B.Hildebrand,IntroductionToNumericalAnalysis,McGrawHill,NewYork,1956.

E-Materials:

1. https://www.math.upenn.edu/~wilf/DeturckWilf.pdf
2. https://web.archive.org/web/20120225082123/http://kr.cs.ait.ac.th/~radok/math/mat7/stepsa.htm
3. https://ocw.mit.edu/courses/mechanical-engineering/2-993j-introduction-to-numerical-analysis-for-engineering-13-002j-spring-2005/

Mapping with Learning outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	S	S	M	S
CO2	S	S	M	M	S	S	S	S	M	M
CO3	S	S	M	S	S	S	S	S	M	S
CO4	S	S	S	M	M	S	S	S	M	M
CO5	S	S	M	M	S	S	S	S	M	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115
M.Sc. Mathematics – 2022 - 2023 onwards

Semester : IV	**Paper type : Core Elective**	**Credit : 3**
Paper code :	**Name of the Paper : Calculusof VariationandIntegral Equations**	
Hours of Teaching: 75hrs		

Course Objectives:

The main objectives of this course are to:

1. Understand theconceptofcalculusofvariationanditsapplications.
2. Introduce the various types of integral equations.
3. Solve variational problems with fixed and moving boundaries.
4. Studythemethodsofsuccessiveapproximationsand Fredholmtheory.
5. AcquireknowledgeonapplicationstoOrdinaryDifferentialEquations.

Course Outcomes:

After successful completion of the course the student will be able to

CO1 Analyze the methods for variational problems with fixed boundaries.

CO2 Apply and solve the variational problems with moving boundaries.

CO3 Define the methods to solve integral equations.

CO4 Discuss the method of successive approximation and Fredholmtheory.

CO5 Identify and Construct the solutions for real time applications.

Matching table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	No	Yes	Yes	No	Yes	No
2	No	Yes	Yes	Yes	Yes	Yes
3	Yes	Yes	Yes	No	Yes	No
4	No	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	Yes

Unit–I:VariationalProblemswith FixedBoundaries **15 hours**

The conceptofVariationand its properties – Euler'sequation– Variationalproblems forfunctionalsoftheform–Functionalsdependentonhigherorderderivatives–Functionalsdependent on Functions of several independent variables– Variational problem in parametricform– Someapplications to problems of mechanics.

Book– 1: Chapter1: Sections 1.1 to 1.7

Unit–II:VariationalProblemswithMovingBoundaries **15 hours**

VariationalproblemwithaMovableboundaryforafunctionaldependentontwofunctions– Onesidedvariations–ReflectionandRefractionofextremals–Diffractionoflightrays.

Book–1:Chapter2: Sections 2.2 to 2.5

Unit–III:IntegralEquations **15hours**

Introduction– Definition–Regularity conditions– Special kindsof Kernels– Eigen valuesand Eigen functions – Convolution integral – Reduction to a system of algebraic equations –Examples– Fredholmalternative–Examples–Anapproximationmethod.

Book–2:Chapter1: Sections 1.1 to1.5

Chapter2: Sections 2.1 to2.5

Unit–IV:MethodofSuccessiveApproximationsandFredholmTheory **15 hours**Methodofsuccessiveapproximations–Iterativescheme–Examples–Volterraintegralequations– Examples–Someresultsabouttheresolventkernel–ThemethodofsolutionofFredholmequation– Fredholmfirsttheorem–Examples.

Book–2:Chapter3: Sections3.1 to3.5

Chapter4: Sections:4.1 to 4.3

Unit–V:ApplicationstoOrdinaryDifferentialEquations **15hours**

Initialvalueproblems–Boundary valueproblems–Examples–Singularintegralequations –TheAbelintegralequations-Examples.

Book–2:Chapter5: Sections5.1to5.3

Chapter8: Sections8.1to8.2

Text Books:

1. A.S.Gupta,*CalculusofVariationswithApplications*,PHI,NewDelhi,2005.
2. Ram P.Kanwal, *Linear Integral Equations*, Theory and Techniques, Academic Press,NewYork,1971.

ReferenceBooks:

1. M.D.Raisinghania,*IntegralEquationsandBoundaryValueProblems*,S.Chand&Co.,NewDelhi, 2007.
2. SudirK.PundirandRimplePundir,*IntegralEquationsandBoundaryValueProblems*,PragatiPrakasam, Meerut.2005.

E–Materials:

1. http://www.maths.ed.ac.uk/~jmf/Teaching/Lectures/CoV.pdf
2. https://archive.nptel.ac.in/courses/111/104/111104025/

Mapping with Learning outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	S	S	M	M	S
CO2	S	S	S	M	S	S	S	M	M	S
CO3	S	S	M	M	M	M	S	M	S	M
CO4	S	S	S	S	S	M	S	M	S	M
CO5	S	S	S	M	S	M	S	M	S	M

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115

M.Sc. Mathematics – 2022 - 2023 onwards

Semester : IV **Paper type : Open Elective** **Credit : 3**

Paper code : **Name of the Paper : Mathematical Economics**

Hours of Teaching: 75hrs

CourseObjectives:

Themain objectives of the course are to

1. Provide basic knowledge of the origin of theoryofFIRM
2. Study the CES Production Function
3. Develop the PerfectCompetition
4. understandabout market equilibrium
5. Discuss the WelfareEconomics

CourseLearningOutcomes

Afterthesuccessfulcompletionofthiscourse,the students willbeableto

CO1 understand the knowledgeof FIRM theoryandperfectcompetition

CO2 Analyzethe CESproduction

CO3 To acquiretheknowledgeofmarket equilibrium

CO4 To control thestabilityof equilibrium

CO5 Discuss thewelfareeconomics, taxes andsubsidies

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	No	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Unit-1:TheTheory of FIRM **15 hours**

Basic Concepts - Optimizing Behavior - Input Demands - Cost Functions – Joint Products - Generalizationto m variables.

Chapter4: Sections 4.1 to4.6

Unit-2:CESProduction **15 hours**

Homogeneous Production functions – CES Production Function.

Chapter5: Sections5.1 and 5.2

Unit-3:PerfectCompetition **15 hours**

Assumptions of Perfect Competition - Demand Functions - Supply Functions –Commodity-Market Equilibrium-An application to Taxation.

Chapter6: Sections 6.1to 6.5

Unit-4:MarketEquilibrium **15hours**

Factor-Market Equilibrium - Existence and Uniqueness of Equilibrium - Stability ofEquilibrium-DynamicEquilibrium withLaggedAdjustment.

Chapter6: Sections 6.6to 6.9

Unit-5:WelfareEconomics **15 hours**

Pareto Optimality - the efficiency of Perfect competition - The efficiency of Imperfectcompetition - External Effects in consumption and Production - Taxes and Subsidies –SocialWelfarefunctions-Thetheoryof SecondBest.

Chapter11: Sections 11.1 to 11.7

Text Book:

JamesM.HendersonandRichard E.Quandt,MicroEconomicTheoryAMathematicalApproach,(3rdEdn.)TataMcGrawHill,NewDelhi,2003.

ReferenceBooks

1. William J. Baumol. Economic Theory and Operations Analysis, Prentice Hall ofIndia, NewDelhi, 1978
2. A.C.Chiang, Fundamental Methods of Mathematical Economics, McGraw Hill,NewYork, 1984
3. Michael D. Intriligator, Mathematical Optimization and Economic Theory,PrenticeHall, New York,1971.

4. A.Kautsoyiannis,ModernMicroeconomics(2ndedn)MacMillan,NewYork,1979

E–Materials:

1. https://curlie.org/Science/Math/Applications/Mathematical_Economics_and_Financial_Mathematics/
2. http://master-economics-qem.univ-paris1.fr/about/?no_cache=1

Mapping with Learning Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	S	M	S	L	S	L
CO2	M	L	M	S	L	S	M	S	L	M
CO3	S	S	L	S	S	L	S	S	M	L
CO4	S	S	M	L	M	M	S	M	L	S
CO5	M	L	M	S	L	M	M	S	L	M

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632115

M.Sc. Mathematics – 2022 - 2023 onwards

Semester : IV **Paper type : Open Elective** **Credit : 3**

Paper code : **Name of the Paper : Entrepreneurial Development**

Hours of Teaching: 75hrs

Course Objective:

The objectives of this course are to

1 Provideanunderstandingofbasicconceptinthe areaof entrepreneurship

2 Exposestudentstotheideageneration,creatingawarenessofbusinessopportunities,andfami liarizingthemwith formalpractices ineffectiveprojectformation.

3 Understand an ProjectManagementandIdeaGeneration

4 Develop the NationalInstituteof Entrepreneurship and Small Business Development

5 Discuss the PMEGP– NEEDS– UYEGP

CourseLearningOutcomes

Afterthesuccessfulcompletionofthiscourse,the students willbeableto

CO1 Understandtheknowledgeofentrepreneurship

CO2 Develop the EntrepreneurialDevelopment

CO3 Analyze the entrepreneurialfinanceandroleofvariousgovernmentagencies

CO4 Develop the idea generation,creatingawarenessofbusinessopportunities,andfamiliarizingthem with formal practices

CO5 Discuss the Government Policies and benefits.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Unit-1:Introduction **15hours**

EntrepreneurandEntrepreneurship–Concept–Definition-ClassificationofEntrepreneurWomen Entrepreneur - Functions of an Entrepreneur - Traits of successful Entrepreneur - EntrepreneursVsProfessionalManagers–RoleofanEntrepreneurinEconomicDevelopment-Future challenges.

Unit-2:EntrepreneurialDevelopment **15 hours**EntrepreneurialDevelopmentProgrammes–Meaning-EvolutionandObjectivesofEDP-Institutionaleffortstodevelop Entrepreneurship-NationalSkillDevelopmentCorporation(NSDC)-RoleofGovernment inOrganisingEDPs-Operational ProblemofEDPs.

Unit-3:ProjectManagementandIdeaGeneration **15 hours**ProjectManagement-ProjectIdentification-ProjectFormulation-ProjectDesignandNetworkAnalysis–OverviewofProjectAppraisal-ProjectReport-IdentificationandSelectionofBusinessOpportunity–IdeaGeneration–OverviewofTechniquesusedforIdeaGeneration.-Individual creativity.

Unit-4:EntrepreneurialFinanceandDevelopmentAgencies **15 hours**SourcesofFinance–CommercialBanksandDevelopmentBanks-RoleofAgenciesinassistingEntrepreneurship-DistrictIndustriesCenters(DIC),SmallIndustriesServiceInstitute(SISI),EntrepreneurshipDevelopmentInstituteofIndia(EDII),NationalInstituteofEntrepreneurship &Small BusinessDevelopment(NIESBUD),NationalEntrepreneurshipDevelopment Board(NEDB).

Unit-5:Government PoliciesandBenefits **15 hours**

TaxBenefits–TaxHolidays–AllowancefordeductingDepreciation–RehabilitationAllowance–Benefits available forMSMEs: PMEGP– NEEDS– UYEGP.

Text Books:

1. Dr.S.S.Khanka,EntrepreneurshipDevelopment- S. Chand&Co.,NewDelhi.
2. JayashreeSuresh,EntrepreneurialDevelopment, MarghamPublication,Chennai.
3. VasantDesa,Dynamics ofEntrepreneurialDevelopment–HimalayaPublication.
4. RobertD.Hisrich,MichaelP.Peters&DeanA.Shepherd,Entrepreneurship, TataMcGraw Hill PublishingCompanyLimited, New Delhi.
5. RavindranathV.Badi&Narayana,Entrepreneurship,VrindaPublication(P)Ltd,New Delhi.

ReferencesBooks:

1. RabindraN.Kanungo,EntrepreneurshipandInnovation,SagePublications,NewDelhi.
2. HoltD.H.,EntrepreneurshipNewVentureCreation.NewDelhi:PrenticeHallofIndia.
3. HisrichR,andPeters,M.,Entrepreneurship.New Delhi:TataMcGrawHill.
4. RajkonwarA.B.,Entrepreneurship,KalyaniPublisher, Ludhiana.
5. Charantimath,Poornima,EntrepreneurshipDevelopmentandSmallBusinessEnterprises,Pearson Education, New Delhi.

E-Materials:

1. http://www.indcom.tn.gov.in/pmegp.html
2. http://www.indcom.tn.gov.in/needs.html
3. http://www.indcom.tn.gov.in/uyegp.html

Mapping with Learning Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	S	M	S	M	S	L
CO2	M	M	M	S	S	L	M	S	L	M
CO3	S	M	S	S	L	L	S	L	M	L
CO4	S	M	S	L	M	M	M	S	L	S
CO5	S	S	M	L	S	M	M	L	L	S

* PO – Programme Outcome, CO – Course Outcomes

* S – Strong, M – Medium, L – Low

THIRUVALLUVAR UNIVERSITY, VELLORE – 632 115

M.Sc. Mathematics – 2022-2023 Onwards

Semester : IV **Paper Type : Open Elective** **Credit : 3**

Paper Code : **Name of the Paper : Programming in C++**

Hours of Teaching: 75hrs

Course Objectives

The objectives of this course are to

1. Introduce the tokens expressions and control structures in C++.
2. Explore the usage of all basic functions in C++.
3. Educate the significance of various types of classes in C++.
4. Inculcate the inheritance structures in C++.
5. Indoctrinate the polymorphism concepts in C++.

Course Outcomes

After the successful completion of this course, the students will be able to

CO1 Know the tokens expressions and control structures in C++.

CO2 Understand the usage of all basic functions in C++.

CO3 Comprehend the significance of various types of classes in C++.

CO4 Acquire the knowledge about the inheritance structures in C++.

CO5 Apply the polymorphism concepts in C++.

Matching Table:

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	Yes	Yes	Yes	No	No	No
2	Yes	Yes	Yes	No	No	No
3	Yes	Yes	Yes	Yes	No	No
4	Yes	Yes	Yes	Yes	No	No
5	Yes	Yes	Yes	Yes	No	No

Unit-1 : Tokens Expressions and Control Structures **15 hours**

Tokens – Keywords – Identifiers and Constants – Basic Data Types – Uses Defined Data Types – Derived Data Types – Symbolic – Operators in C++ – Scope Resolution Operator – Manipolators – Operator Overloading – Control Structures.

Chapter 3: Sections 3.1 – 3.24

Unit-2 : Functions **15 hours**

Characteristic of OOP – Function Prototype – Default Arguments – Inline Functions – Function Overloading – Template Functions.

Chapter 4: Sections 4.2, 4.3, 4.6, 4.7, 4.9

Unit-3 : Classes in C++ **15 hours**

Classes – Constructors and Destructors – Friend functions – Template Classes – New and Delete Operators – Operator Overloading.

Chapter 5: Sections 5.1 – 5.15

Chapter 6: Sections 6.1 – 6.9

Chapter 7: Sections 7.1 – 7.5

Unit-4 : Inheritance **15 hours**

Single Inheritance – Multiple Inheritance – Hierarchical Inheritance – Hybrid Inheritance – Virtual Functions.

Chapter 8: Sections 8.1 – 8.8

Unit-5: **Polymorphism in C++** **15 hours**

Polymorphism.

Chapter 9: Sections 9.6 – 9.7

Text Books:

E. Balagurusamy, *Object Oriented Programming with C++*, 4th Edn., Tata McGraw Hill Publishing Company Ltd., New Delhi, 2001.

Reference Books:

1. E. Balagurusamy, *Numerical Methods*, Tata McGraw Hill Publishing Company Ltd., New Delhi,1999.
2. John H. Mathews, *Numerical Methods for Mathematics, Science and Engineering*, 2nd Edn., Prentice Hall India Pvt. Ltd., 2003.

3. S.S. Sastry, *Introductory to Numerical Methods*, Prentice Hall India Pvt. Ltd., 2000.
4. H.C. Saxena, *Finite Differences and Numerical Analysis*, S. Chand & Company Ltd., New Delhi, 2005.

E-Materials:

1. https://onlinecourses.nptel.ac.in/noc21_cs02/preview
2. https://www.cet.edu.in/noticefiles/285_OOPS%20lecture%20notes%20Complete.pdf
3. https://www.msuniv.ac.in/images/e-content/1.Object%20Oriented%20Programming%20with%20C%20and%20Java.pdf

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	S	S	S	S	S
CO2	S	S	M	M	S	S	S	S	S	S
CO3	S	S	M	M	S	S	S	S	S	S
CO4	S	S	M	M	S	S	S	S	S	S
CO5	S	S	M	M	S	S	S	S	S	S

*PO – Programme Outcome, CO – Course Outcome.

*S – Strong, M – Medium, L – Low.