A.VEERIYA VANDAYAR MEMORIAL

SRI PUSHPAM COLLEGE (AUTONOMOUS)

POONDI-613 503, THANJAVUR (DT)

SYLLABUS

M.Sc., Mathematics

(From 2020 - 2021 onwards)

Programme Outcome of M.Sc. Mathematics

PO1 **Provide comprehensive curriculum to groom the students into qualitative scientific manpower**

PO2 **Carry outknowledgeinpureandappliedmathematics.**

PO3 **Equipsthestudentstofacemodernchallengesinmathematics.**

PO4 **GainathoroughknowledgeinpreparingthemselvesfortheCSIRandSET examinations.**

PO5 **Inculcate the curiosity for mathematics in students and to prepare them for future research.**

ProgrammeSpecificOutcome ofM.Sc.Mathematics

PSO1Gainknowledgeofadvancedmodelsandmethodsofmathematics.

PSO2Abletosolveproblemsinadvancedareasofnumericalanalysis, linearalgebraandrealanalysis.

PSO3Analyzeandwritelogicalargumentstoprovemathematicalconcepts.

PSO4Developspecificskillsinindependentlyanalyzing,modelingandsolvingproblemsat ahighlevel of abstraction.

PSO5Gainaresearch-orientedlearningthatdevelopsanalyticalanintegrative problem-solvingapproach.

M.Sc. MATHEMATICS (2020 – 2021)

S. No.	Semester	Category	Paper Code	Title of the Paper	Maximum Marks			Minimum Marks for Pass			Hours /Week	Credits
					CIA	EE	Total	CIA	EE	Total		
1	I	Core	20P1MAC1	Algebra	25	75	100	10	30	50	6	5
2		Core	20P1MAC2	Real Analysis	25	75	100	10	30	50	6	5
3		Core	20P1MAC3	Ordinary Differential Equations	25	75	100	10	30	50	6	5
4		Core	20P1MAC4	Stochastic Processes	25	75	100	10	30	50	6	4
5		Elective	20P1MAE1A 20P1MAE1B	Classical Dynamics (or) Fluid Dynamics	25	75	100	10	30	50	6	4
6	II	Core	20P2MAC5	Linear Algebra	25	75	100	10	30	50	5	4
7		Core	20P2MAC6	Advanced Complex Analysis	25	75	100	10	30	50	5	4
8		Core	20P2MAC7	Partial Differential Equations	25	75	100	10	30	50	5	4
9		Core	20P2MAC8	Mathematical methods	25	75	100	10	30	50	5	4
10		Core	20P3MAC9	Optimization Techniques	25	75	100	10	30	50	5	4
11		Elective	20P2MAE2A 20P2MAE2B	Mathematical Probability (or) Mathematical Modeling	25	75	100	10	30	50	5	4
		Extra Credit	-	MOOC (Massive open online course– I)	-	-	-	-	-	-	-	-
12	III	Core	20P3MAC10	General Topology	25	75	100	10	30	50	5	4
13		Core	20P3MAC11	Differential Geometry	25	75	100	10	30	50	5	4
14		Core	20P3MAC12	Graph Theory and its application	25	75	100	10	30	50	5	4
15		Core	20P3MAC13	MATLAB Programming	25	75	100	10	30	50	5	4
16		Core-Practical	20P3MACPL	Computer Programming Practical	40	60	100	10	30	50	5	2
17		EDC	20P3MAEDC	Applicable Mathematical Techniques	25	75	100	16	24	50	4	-
			20P4_CPD	Communicative skill and Personality Development (N.S)	-	-	-	-	-	-	1	-
		Extra Credit	-	(MOOC) Massive open online course - II								
18	IV	Core	20P4MAC14	Functional Analysis	25	75	100	10	30	50	6	5
19		Core	20P4MAC15	Measure and integration	25	75	100	10	30	50	6	5
20		Core	20P4MAC16	Cryptography	25	75	100	10	30	50	6	5
21		Elective	20P4MAE3A 20P4MAE3B	Advanced Numerical Analysis (or) Design and Analysis of Algorithms	25	75	100	10	30	50	6	4
22			20P4MACN	Comprehension	-	-	100	-	-	-	5	2
23			20P4MAPR	Project	-	-	100	-	-	-	-	4
			20P4_CPD	Communicative Skill & Personality Development (N.S)	-	-	-	-	-	-	1	-

EDC- **Title** (offered by Dept of Maths) - "Applicable Mathematical Techniques"

List of Core Options: 1.Advanced Real Analysis

2. Number Theory
3. Combinatorial Mathematics
4. Geometric Function Theory

M.Sc. MATHEMATICS (2020– 2021)

Nature of Course	Total No. Of Courses	Total Marks	Total Credits	Classification
Core	17	1700	72	✓
Elective	3	300	12	✓
E.D.C	1	100	---	✓
Project	1	100	4	x
Comprehension	1	100	2	✓
Soft skill using Language lab	--	--	---	X
Total	**23**	**2300**	**90**	

GRADING OF COURSE PERFORMANCE (10 POINT SCALE)

Aggregate Marks	Grade	Grade Point
96 and above	S+	10
91-95	S	9.5
86-90	D++	9.0
81-85	D+	9.0
76-80	D	8.0
71-75	A++	7.5
66-70	A+	7.0
61-65	A	6.5
56-60	B	6.0
50-55	C	6.5

Comprehensive Knowledge Test: Objective type question pattern with 100 compulsory questions carrying 100 marks to be answered in 3 Hours with 2 credits. The portion is entire core courses.

Industrial Internship: Students have to undergoIn-Plant training in Industry or Organization where any process related to Mathematics is going on. The period of training should be minimum 10 days. Students have to submit the report of the training underwent with the certificate from the concerned authority of the Industry / Organization.

Industrial Visit: Students have to attach a report on the Industrial visit made with the counter signature of Staff in charge for the Industrial visit while submitting the Project / Industrial Internship report

MOOC: Massive Open Online Course is introduced in the second and third semester as an extra credit course from this academic year 2020-2021.Students can avail any one or more of the courses available in MOOC to equip their skill and knowledge themselves.

Field Visit / Industrial Visit / Hands on Training Programme having minimum 15 hours of contact time as Extra credit course is introduced for I year PG students to gain experiential learning.
Evaluation of the visit report will be held at the end of II Semester

Components of Evaluation	
Internal Marks	40
External Marks	60
Total	100

A.VEERIYA VANDAYAR MEMORIAL SRI PUSHPAM COLLEGE

(AUTONOMOUS),POONDI, THANJAVUR DIST.

Question Pattern for UG and PG Programmes for students to be admitted during 2020 – 2021 and afterwards

Total Marks: 75

QUESTION PATTERN

SECTION – A
(Question 1 to 10)

10 x 2 = 20 Marks

1. Short Answer Questions
2. Two Questions from each units (All are answerable)

SECTION – B
(Question 11 to 15)

5 x 5 = 25 Marks

1. 5 Paragraph type questions with "either / or" type choice.
2. One question from each unit of the Syllabus.
3. Answer all the questions.

SECTION – C
(Question 16 to 20)

3 x 10 = 30 Marks

1. 5 Essay type questions – any three are answerable.
2. One questions from each unit of the Syllabus.

Semester	Subject code	Title of the paper	Hours of Teaching/ Week	No.of Credits
I	**20P1MAC1**	**Core - ALGEBRA**	**6**	**5**

Objectives:

- To teach the concepts of Fields and Sylow's theorems
- To explain Fundamental Theorem of Finite Abelian Groups
- To teach various types of integral domains and extensions fields and its properties
- To teach Galois Theory and solvability.

Unit I **18 Hrs**

Group Theory: Sylow's theorem –Direct Products-Finite Abelian groups.

Unit II **18 Hrs**

Ring theory: Polynomial Rings-polynomials over the Rational Fields-polynomial Rings over Commutative Rings-Modules.

Unit III **18 Hrs**

Fields: Extension fields-Roots of polynomials-More about roots.

Unit IV **18 Hrs**

Fields: The Elements of Galois theory - Finite fields

Unit V **18 Hrs**

Linear transformations: The Algebra of Linear transformations - Characteristic roots - Hermition, Unitary and normal transformations.

Course Outcomes: After completion of the course, students will be able to

- prove and explain concepts from advanced algebra.
- utilize the class equation and Sylow theorems to solve related problems.
- gain highly developed reasoning ability.
- create, select and apply appropriate algebraic structures such as finitely generated abelian groups, Ideals, Fields to explore the existing results.
- acquire the knowledge to write NET/ SET/ PG TRB / Polytechnic TRB competitive exams.

Text Book:

Topics in Algebra, I.N. Herstein, *2nd Edition-Wiley Eastern Limited-1975.*

Unit I : Chapter 2 (2.12 to 2.14) Pages: 91 – 115
Unit II : Chapter 3 (3.9 to 3.11), Chapter 4(4.5) Pages: 153–166, 201 – 205
Unit III : Chapter 5 (5.1, 5.3, 5.5) Pages: 207 – 214, 219 – 226, 232 - *236*
Unit IV : Chapter 5 (5.6), Chapter 7(7.1) Pages: 237 – 249, 355 - 360
Unit V : Chapter 6 (6.1, 6.2, 6.10) Pages: 269 – 272, 336 – 348

General References:

1. *Algebra: Serge Lang*
2. *Modern Algebra: Vander worden vol.1& vol.2.Objective.*

General References Links:

1. https://www-wp.maths.cam.ac.uk/documents/schedules.pdf/,kl
[University of Cambridge]
2. http://cus.ac.in/images/content/static/Syllabus/Sch_Phy_Scs/Mathematics_PG_.pdf[Chicago University]

Semester	Subject Code	Titles of the Paper	Hours of Teaching / Week	No. of Credits
I	**20P1MAC2**	**Core- REAL ANALYSIS**	**6**	**5**

Objectives:

- To introduce various concepts related to real numbers, differentiation and integration.
- To impart mean value theorems and convergence of series of functions.
- To provide a deeper understanding of fundamental concepts viz. metric spaces, continuous functions, sequences and series of numbers as well as functions, and the Riemann-Stieltjes integral etc.
- Toprovide theoretical foundation of the above concepts and it will cultivate the mathematical logics and skills to the students.

Unit I **18 Hrs**

Basic Topology: Metric spaces – Neighborhood – open sets – closed sets – compact sets – perfect sets – Contour sets – connected sets.

Unit II **18 Hrs**

Continuity: Limits of Functions – Continuous functions – Continuity and compactness – continuity and connectedness – Discontinuities – Monotonic functions.

Unit III **18 Hrs**

Differentiation: The Derivative of a real function – Mean Value Theorem – the continuity of derivatives - L' Hospital's Rule – Derivatives of higher order – Taylors Theorem.

Unit IV **18 Hrs**

The Riemann Stieltje's Integral: Definition – Existence of integral – properties of integral – Integration and differentiation – Rectifiable curves.

Unit V **18 Hrs**

Sequences and Series: Uniform convergence - Uniform convergence and continuity - Uniform convergence and differentiation - Uniform convergence and integration – Equicontinuous – Family of functions – the Stone Wierstrass theorem.

Course Outcomes: After completion of the course, students will be able to

- apply the knowledge of concepts of real analysis in order to study theoretical development of different mathematical techniques and their applications.
- identify challenging problems in real variable theory and find their appropriate solutions.
- deal with axiomatic structure of metric spaces and generalize the concepts of sequences and series and continuous functions in metric spaces.
- use the theory of Riemann-Stieltjes integral in solving definite integrals arising in different fields of science and engineering.
- extend their knowledge of real variable theory for further exploration of the subject and also understand the basis for further studies such as Functional Analysis and Topology.

Text Book:

Principles of Mathematical Analysis, Walter Rudin*, Third Edition, Mcgraw Hill, 1976*

Unit I : Chapter II (Sec. 2.15 – 2.47)
Unit II : Chapter IV (Sec. 4.1 – 4.30)
Unit III: Chapter V (Sec. 5.1 – 5.15)
Unit IV : Chapter VI (Sec. 6.1 – 6.22, 6.26, 6.27)
Unit V : Chapter VII (Sec. 7.1 – 7.26)

General References:

1. Principles of Real Analysis, S.C. Malik
2. Methods of Real Analysis, Richard &Golburg
3. Introduction to Real Analysis, Third Edition, R. G. Bartle and D. R. Sherbert, Wiley India Pvt. Ltd, 2012.

General References Links:

1. https://ocw.mit.edu/courses/mathematics/18-100c-real-analysis-fall-2012/syllabus/[Massachusetts Institute of Technology, USA]
2. https://www.umu.se/en/education/syllabus/5ma182/ [Umea University, Sweden]

Semester	Subject code	Title of the paper	Hours of Teaching/ Week	No.of Credits
I	**20P1MAC3**	**Core – ORDINARY DIFFERENTIAL EQUATIONS**	**6**	**5**

Objectives:

- To introduce ordinary differential equations and fundamental theorems for existence and uniqueness.
- To explain analytic techniques in computing the solutions of various ordinary differential equations appearing in various fields of science and technology.
- To teach the various types of boundary value problems.

Unit I **18 Hrs**

Systems of linear Differential equations: Systems of first order equations – Existence and uniqueness theorem – Fundamental Matrix-Non – homogeneous linear systems – linear systems with constant coefficients.

Unit II **18 Hrs**

Existence and Uniqueness of solutions: Preliminaries – successive approximations - Picard's theorem – Non uniqueness of solutions – continuation and dependence on initial conditions – Existence of solutions in the large.

Unit III **18Hrs**

Oscillations of second order equations: Fundamental results - Strurm's comparison theorem – Elementary linear oscillations - comparison theorem of Hille-Winter –Oscillation of $x'' + a(t)x=0$ - Elementary nonlinear oscillations.

Unit IV **18 Hrs**

Boundary Value Problems: Introduction - Sturm-Liouville Problem - Green's functions - Non-existence of solutions - Picard's theorem.

Unit V **18 Hrs**

Behaviour of solution of Linear differential equation: n^{th} order equations – Elementary critical points - Critical points of nonlinear systems-linear systems with constant coefficients - linear systems with variable coefficients

Course Outcomes: After completion of the course, students will be able to

- visualize and manipulate ODEs in graphical, numerical, and symbolic form.
- explore some of the basic theory of linear ODEs
- recognize certain basic types of higher-order linear ODEs for which exact solutions may be obtainedand apply the corresponding methods of solution.
- explain the concepts of existence and uniqueness of solutions
- acquire the knowledge to write NET/ SET/ PG TRB competitive exams.

Text Book:

Ordinary Differential equations and stability theory *– S. G. Deo& V. Ragavendra*

Unit I : Chapter 4 (Sec: 4.1 – 4.6)
Unit II : Chapter 5 (Sec: 5.2 – 5.7)
Unit III: Chapter 6 (Sec: 6.1 – 6.6)
Unit IV : Chapter 7 (Sec: 7.1 – 7.5)
Unit V : Chapter 8 (Sec: 8.2 – 8.6)

General References:

1. *Differential equations with applications and historical notes –George F Simmons Tata McGraw Hill Ltd New Delhi 1972.*
2. *Theory of ordinary differential equations EA coddington, N .Levinson-tata McGraw Hill New Delhi 1982.*

General References Links:

1. https://www.valpo.edu/mathematics-statistics/files/2017/10/MATH-270-Master-Syllabus.pdf [Valparaiso University, USA]
2. https://ocw.mit.edu/courses/mathematics/18-03sc-differential-equations-fall-2011/syllabus/ [Massachusetts Institute of Technology, USA]

Semester	Subject Code	Title of the paper	Hours of Teaching /Week	No. of Credits
I	**20P1MAC4**	**CORE - STOCHASTIC PROCESSES**	**6**	**4**

Objectives:

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

Unit-I 18 Hrs

Random Variable and Stochastic Processes: - Generating Function-Laplace Tranform-Stochastic Processes.

Unit – II 18 Hrs

MarkovChains: Definition and Examples-Higher Transition Probabilities.

Generalisation of Independent Bernoulli Trials:Sequence of Chain- Dependent Trials

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Unit –III 18 Hrs

Markov Chain:Classification of States and Chains - Determination of Higher Transition Probabilities-Stability of a Markov System

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Unit – IV 18 Hrs

Markov Processes with Discrete State Space:Poisson Process and Extensions: Poisson Process– Poisson Process and Related Distribution.

Unit – V 18 Hrs

Markov Processes with Discrete State Space:Poisson Process and Extensions: Generalisations of Poisson Process– Birth and Death Process

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Course Outcomes:After completion of the course, students will be able to

- understand the definition of a stochastic process and in particular a markov process.
- calculate absorption probabilities and the expected time to absorption for Markov chains
- critically evaluate simulation results with respect to relevant measure.
- understand discrete time and finite state space; discrete time and countable state space; continuous time and countable state space.
- extend their knowledge to pursue research in this field

Text Book:

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

Unit I	:	Chapters 1.1 to 1.2 and 1.5 Pages (1-19 and 49-51)
Unit II	:	Chapters 2.1 to 2.3 Pages(62-78)
Unit III	:	Chapters 2.4 to 2.6 Pages (78-99)
Unit IV	:	Chapters 3.1 to 3.2 Pages (138-155)
Unit V	:	Chapters 3.3 to 3.4 Pages (155-170)

General References:

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

General References Links:

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

Semester	Subject Code	Title of the paper	Hours of Teaching/ Week	No.of Credits
I	**20P1MAEL1A**	**Elective - CLASSICAL DYNAMICS**	**6**	**4**

Objectives:

- To afford an opportunity to master many of mathematics techniques.
- To develop the understanding of moments of inertia and its applications in the dynamics of a rigid body rotating about a fixed point, concept of geometrical equations and Lagrange's equations of motion of a rigid body, principles of Hamiltonian, Liouville's Theorem
- To introduce Lagrange equations and its applications.

Unit I **18 Hrs**

Introductory Concepts: The mechanical systems - Generalized Coordinates- Constraints –Virtual work – Principle of virtual work – D'Alemberts principle – Examples – Generalized force - Example

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Unit II **18 Hrs**

Lagrange's Equations: Derivation of Lagrange's Equations – Examples –Integral of the motion – Ignorable coordinates – the Routhian function – example – Lioville's system – examples.

Unit III **18 Hrs**

Special Applications of Lagrange's Equations: RAYLEIGH'S Dissipation Function - impulsive motion - Gyroscopic systems – small motions – Gyroscopic stability – examples.

Unit IV **18 Hrs**

Hamilton's Equations: Hamilton's principle – Hamilton's equations - other variational principles – Principle of least action – example.

Unit V **18 Hrs**

Hamilton's Principal function – the canonical integral – Pfaffian forms - The Hamilton-Jacobi Equation - Jacobi's theorem - example.

Course Outcomes: After completion of the course, students will be able to

- develop critical thinking and problem solving skills.
- interpret complex and difficult problems of classical dynamics in a systematic way
- apply the variation principle for real physical situations
- identify the existing symmetries and the corresponding integrals of motion and analyze the qualitative nature of dynamics
- explore problem solving skills in competitive exams like CSIR-NET/SET/ Polytechnic TRB

Text Book

"CLASSCIAL DYNAMICS" – DONALD T. GREENWOOD*, Prentice Hall of India Private Ltd New Delhi - 110001(1979)*

Unit I	:	Chapter 1-sec 1.1, 1.2, 1.3, 1.4
Unit II	:	Chapter 2-sec 2.1, 2.2, 2.3
Unit III	:	Chapter 3 –sec 3.1, 3.2, 3.3
Unit IV	:	Chapter 4 –sec 4.1, 4.2, 4.3
Unit V	:	Chapter 5-sec 5.1, 5.2

General References:

Herbert Goldstein" Classical Mechanics" Second Edition Narosa Publishing House-New Delhi.

General References Links:

1. https://ocw.mit.edu/courses/physics/8-223-classical-mechanics-ii-january-iap-2017/syllabus/ [Massachusetts Institute of Technology, USA]
2. https://web.uri.edu/physics/coursephy-520-classical-dynamics/ [The University of Rhode Island, USA]

Semester	Subject code	Title of the paper	Hours of Teaching/ Week	No.of Credits
I	**20P1MAEL1B**	**Elective – FLUID DYNAMICS**	**6**	**4**

Objectives:

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

Unit I **18 Hrs**

Real fluids and ideals fluid –velocity of a fluids at a point-Streamlines and path lines: steady and unsteady flows-the velocity potential-The velocity vector-local and particle rates of change -The Equations of continuity –Worked examples –Accelerations of a fluids – Pressure at a point in a fluid at rest-Pressure at a point in moving fluids-Conditions at a Boundary of two invisid immiscible fluids –Euler's equations of motions-Bernoulli's equation-worked examples.

Unit II **18 Hrs**

Some flows involving axial symmetry –some special two-Dimensional Flows-impulsive Motion. Some three-dimensional flows: Introductions –sources, sinks and doublets –images in a rigid infinite plane- Axi-symmetric Flows: stokes stream functions.

Unit III **18 Hrs**

Some two-Dimensional Flows: meaning of a two-Dimensional flow-Use of cylindrical polar coordinates –The steam function –The complex potential for two Dimensional, irrotational, incompressible flow –complex velocity potentials for standard two-dimensional flows-some worked examples –The Milne-Thomson circle theorem and applications –The theorem of Blasius.

Unit IV **18 Hrs**

The use of conformal transformation and Hydro dynamical Aspects –stress components in real fluids –relations between Cartesian components of stress- Transnational motion of fluid element –The rate of strains Quadric and principal stresses-Some further properties of the rate of strains quadric-stress Analysis in fluid motion-Relations between stress and rate of strain-The coefficient of viscosity and laminar flow – the Navier-stokes equation of motion.

Unit V **18 Hrs**

Some solvable problems in viscous flow-steady viscous flow in tubes of uniform cross section –Diffusion of vorticity –Energy. Dissipation due to viscosity –steady flow past a fixed sphere –Dimensional Analysis; Reynolds Number-prandtl's Boundary layer.

Course Outcomes: After completion of the course, students will be able to

- understand fluid flow problems and apply laws of conservation to construct mathematical model.
- find mathematical solution of some viscous and inviscoid flow problems
- acquire the knowledge about Kinematics property of fluid elements.
- understand about fluid, its properties and behavior under various conditions of internal and external flows.
- acquire the knowledge to write Polytechnic TRB competitive exam.

Text Book:

Fluids dynamicsby F.Chorlton*(CBS publisher & Distributors, Delhi-110032) 1985.*

Unit I : Chapter 2.sec 2.1 to 2.9 and chapter 3.sec 3.1 to 3.6

Unit II : Chapter 3.sec 3.9 to 3.11 and chapter 4.sec 4.1, 4.2,4.3,4.5

Unit III : Chapter 5 sec 5.1 to 5.9 except 5.7

Unit IV: Chapter 5 sec 5.10 and chapter 8: Sec 8.1 to 8.9

Unit V : Chapter 8 sec 8.10 to 8.16General References:

Fluids Dynamics *–shanti swarup, Krishna prakasanmandir Meerut 1984*

Semester	Subject Code	Titles of the Paper	Hours of Teaching / Week	No. of Credits
II	**20P2MAC5**	**Core- LINEAR ALGEBRA**	**5**	**4**

Objectives:

- To discuss various decompositions of vector spaces and linear transformations on vector spaces.
- To explain diagonalizable operator on a vector space and characterizations of it using the minimal and characteristic polynomials.
- To introduce different classes of linear operators on inner product spaces and to study their structures.
- To explain the concepts of bilinear and quadratic forms on vector spaces.

Unit I: **15 Hrs**

Systems of Linear Equations, Vector Spaces: A motivating Example – Systems of Linear Equations – Vector Spaces – Definition and Examples – Vector Subspaces - Basis and Dimension of a vector space.

Unit II: **15 Hrs**

Lines and Quotient Spaces, Linear Transformations: Definition of a line – Affine Spaces – Quotient Space – Linear Transformation – Representation of Linear Maps by Matrices – Kernel and image of a Linear Transformation – Linear Isomorphism – Geometric Ideas and Some Loose Ends – Some special Linear Transformations.

Unit III: **15 Hrs**

Inner Product Spaces: Inner Product Spaces – Orthogonality – Some Geometric Applications – Orthogonal Projection onto a Line – Orthonormal Basis – Orthogonal complements and Projections – Linear Functionals and Hyperplanes – Orthogonal Transformations – Reflections and Orthogonal Maps of the Plane.

Unit IV: **15 Hrs**

Determinants: 2×2 Determinant as Area of a Parallelogram – Determinant and its Properties – Computation of Determinants – Basic results on Determinants – Orientation and Vector Product.

Unit V: **15 Hrs**

Diagonalization, Classification of Quadrics: Rotation of Axes of Conics – Eigen Values and Eigen Vectors – Diagonalization of Symmetric Matrices – Conics and Quadrics – Computational Examples.

Course Outcomes: After completion of the course, students will be able to

- demonstrate competence with the basic of linear algebra.
- decompose a vector space into a sum of invariant subspaces and a linear transformation into a direct sum of induced operators.
- construct the matrix of a bilinear form and to find index, rank and signature of a bilinear form.
- understand different classes of linear operators on inner product spaces andstudy their structures.
- acquire the knowledge to write NET/ SET/ PG TRB competitive exams.

Text Book:

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

Unit I : Chapter 1, 2.
Unit II : Chapter 3, 4.
Unit III: Chapter 5.
Unit IV : Chapter 6.
Unit V : Chapter 7, 8.

General References:

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

General References Links:

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

Semester	Subject Code	Titles of the Paper	Hours of Teaching / Week	No. of Credits
II	**20P2MAC6**	**Core – ADVANCED COMPLEX ANALYSIS**	**5**	**4**

Objectives:

- To enable the students to understand further deeper topics of Complex Analysis
- To provide basic topics needed for students to pursue research in pure Mathematics.
- To introduce the students to the fascinating world of complex analysis which is different from analysis of real variable.

Unit I **15 Hrs**

Harmonic functions: Definition and Basic properties – Mean-value property - Poisson's formula - Schwartz's theorem -the Reflection principle. **Power series Expansion**: Weiertrass's theorem-Taylor series –Laurent's series:

Unit II **15 Hrs**

Partial fractional and Factorization: partial fractions–infinite products. Canonical products –Gamma function – Stirling's formula.

Unit III **15 Hrs**

Normal Families: Equicontinuity - Normality and compactness – Arzela's theorem – Families of analytic functions - classical Definition. **The Reimann mapping theorem**: statement and proof - Boundary behavior - Use of the Reflection principle - Analytic arcs.

Unit IV **15 Hrs**

A Closer look at Harmonic functions: Functions with the mean value property – Harnack's principle. **The Dirichlet problem**: Sub harmonic Functions - solution of Dirichlet's problem.

Unit V **15 Hrs**

Simply Periodic Functions: Representation by exponentials – Fourier Development – Functions of finite order. **Doubly Periodic functions:** The period module – Unimodular transformations – The canonical Basis - General properties of Elliptic Functions. **The Weisertrass theory**: Weierstrass p-function - Functions $\zeta(z)$ and $\sigma(z)$ – differential Equation.

Course Outcomes: After completion of the course, students will be able to

- understand necessary knowledge and skills
- handle mathematical operations, analyses and problem solving which involves complex numbers.
- understand topological and geometric properties of the complex plane
- analyze how the complex numbers provide a satisfying extension of the real numbers
- learn some techniques of complex analysis that make practical problems easy.

Text Book:

"Complex Analysis –An Introduction to the theory of Analytic Functions of one complex variables" Lars V. AHLFORS - *third Edition, (1979), McGraw-Hill book company-New Delhi.*

Unit I : Chapter 4 – sec: 6.1 to 6.5(page 162 – 173),
Chapter 5 - Sec: 1.1 to 1.3 (Page 175 – 186)
Unit II : Chapter 5 – sec: 2.1 to 2.5 (Page 187 – 206)
Unit III: Chapter 5 – sec: 5.1 to 5.5 (Page 219 - 227)
Chapter6 – sec: 1.1 to 1.4 (Page 229 - 235)
Unit IV : Chapter 6 – Sec: 3.1 to 3.2, 4.1 to 4.2 (Page 241 – 251)
Unit V : Chapter7–Sec:1.1 to 1.3, sec:2.1 to 2.4, Sec:3.1 to 3.3(Page 263 – 276)

General References:

1. *John B.Conway (1980)"Functional of one complex variable"-Narosa Publishing House; New Delhi.*
2. *Thomas m. Macrobert (1966)," Functional of a complex variable"-Macmillan and Co.,Let.,New York.*

General References Links:

1. http://mitwpu.edu.in/wp-content/uploads/2018/01/M.Sc-Maths-2.pdf [Cambridge University]
2. http://abel.harvard.edu/quals/index.html [Havard University]

Semester	Subject code	Title of the paper	Hours of Teaching/ Week	No.of Credits
II	**20P2MAC7**	**Core - PARTIAL DIFFERENTIAL EQUATION**	**5**	**4**

Objectives:

- To introduce the notion of partial differential equations.
- To introduce first and higher order partial differential equations and their classification.
- To explain various analytic methods for computing the solutions of various partial differential equations.

Unit I **15 Hrs**

Partial Differential Equations of first order: Partial Differential Equations – Cauchy's problem for First order Equations - linear Equations of the first Order - Integral surfaces passing through a given curve - surfaces orthogonal to a given system of surfaces - compatible systems of First order Equations.

Unit II **15 Hrs**

Charpit's Method - Jacobi's method - **Partial Differential Equations of second order:** Linear Partial Differential Equations with constant coefficients - Equations with Variable coefficients - Separation of Variables.

Unit III **15 Hrs**

Laplace's Equation: Elementary Solutions of Laplace's Equation - Families of Equipotential Surfaces – Boundary Value Problems - Separation of Variables - The theory of Green's Function for Laplace's Equations.

Unit IV **15 Hrs**

The Wave equation: The occurrence of the wave equation in Physics -Elementary solutions of the one-dimensional wave equation - vibrating membranes: Application of the calculus of variations - General solutions of the wave equation.

Unit V **15 Hrs**

The Diffusion Equation: The resolution of Boundary value problems for the Diffusion Equation - Elementary solutions of the Diffusion Equation - Separation of Variables – The use of Green's functions.

Course Outcomes: After completion of the course, students will be able to

- apply the knowledge of PDE to the general structure of modelling solution.
- understand the formation and solution of some significant PDEs like wave equation, heat equation and diffusion equation.
- apply the knowledge of PDEs and their solutions in order to understand physical phenomena.
- explain various applications of partial differential equations in real physical phenomenon like wave equation of string, diffusion equations and heat flow equations.
- Acquire the knowledge to write NET/ SET/ PG TRB competitive exams.

Text Book:

***Elements of Partial Differential equations**, **Ian Sneddon**, International Student edition*

Unit I	:	Chapter 2: sec. 2.1, 2.3 to 2.6, 2.9
Unit II	:	Chapter 2: sec. 2.10, 2.11
		Chapter 3: sec. 3.4, 3.5, 3.9
Unit III	:	Chapter 4: sec. 4.2, to 4.5, 4.8
Unit IV	:	Chapter 5: sec. 5 1 to 5.2, 5.4, 5.6
Unit V	:	Chapter 6: sec. 6.2 to 6.4, 6.6

General References:

1. Partial Differential Equation3rd Edition, John F., Narosa 1979.
2. Introduction to partial Differential Equation second Edition, K.SankaraRao, Prentice-Hall of India 2005.

General References Links:

1. http://mitwpu.edu.in/wp-content/uploads/2018/01/M.Sc-Maths-2.pdf [Cambridge University]
2. https://www.ucl.ac.uk/maths/sites/maths/files/math0065-mathgmol.advancedmm.techniques.pdf [UCL London University]

Semester	Subject code	Title of the paper	Hours of Teaching/ Week	No. of Credits
II	**20P2MAC8**	**Core –MATHEMATICAL METHODS**	**5**	**4**

Objectives:

- To introduce the notion of Fourier Transform and its properties.
- To acquaint the students with the knowledge of mathematical techniques frequently applied in various branches of engineering and sciences.
- To equip the students with the mathematical background required for the development of such techniques.

Unit I **15 Hrs**

Fourier transform – integral formula – complex transform – cosine – sine – transform property – linearity change of scale, shifting – modulation theorem – Finite Fourier Transforms – Finite Fourier sine and cosine transform – Inversion formula for sine and cosine transform.

Unit II **15 Hrs**

Calculus of Variations – Variation and its properties – Euler's equation – Functional of the form – Functionals dependent on higher order derivatives and several independent variables – variational problems in Parametric form

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Unit III **15 Hrs**

Linear integral equations – Definition of Regularity conditions – special kinds of kernels – Eigenvalues and Eigen functions – convolution integral – The inner or scalar product of two functions – reduction to a system of Algebraic Equations – Examples (Except Fredholm Alternative theorem).

Unit IV **15 Hrs**

Method of successive approximations – Iterative scheme–Examples– Volterra integral Equation–Examples–some results about the Resolvent Kernel– Examples.

Unit V **15 Hrs**

Application to ordinary differential equations – Initial value problems – Examples - boundary value problems – examples – singular integral equations – The Abel integral equations – Examples.

Course Outcomes: After completion of the course, students will be able to

- solve various types of Fourier Transforms.
- solve integral-differential equations of Fredholm and Volterra type.
- understand the properties of various kinds of integral equations.
- develop their attitude towards problem solving.
- extend their knowledge to pursue research in this field.

Textbook:

1. *For unit I,* ***Integral transforms*** *– A.R. Vasistha and R.K. Gupta, Krishna Prakashan media (P) Ltd, Meerut (2002)*
2. *For unit II,* ***Differential Equations and Calculus of variations*** *– L. Elsgolts, Mir Publications, Moscow. (1980)*
3. *For unit III, IV, V,* ***Linear Integral Equations Theory and Techniques*** *– Ram Kanwal, Academic Press (1971).*

   Unit I : Chapter 6 (sections 6.3 to 6.15), Pages: 176 – 194
   Unit II : Chapter 6(sections 6.1 and 6.6)
   Unit III: Chapter 1 and 2 (Sections 2.1 to 2.4 only)
   Unit IV: Chapter 3
   Unit V : Chapter 5 (sections 5.1, 5.2, 5.3) Chapter 8 (sections 8.1, 8.2).

General References:

Mathematical methods, M.C.Potter and J.Goldberg, Prentice Hall of India, New Delhi. 1988.

General References Links:

1. http://acad.uohyd.ac.in/downloads/syllabus/PG/MSMM.pdf [Oxford university]
2. http://tezu.ernet.in/dmaths/programme/m.sc.syllabus-2019.pdf [Oxford university]

Semester	Subject code	Title of the paper	Hours of Teaching/ Week	No. of Credits
II	**20P2MAC9**	**Core – OPTIMIZATION TECHNIQUES**	**5**	**4**

Objectives:

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

Unit I **15 Hrs**

Sequencing problems: Introduction – Optimal sequence algorithm – n jobs and two machines – n jobs and m machines – solved problems – two job and m machines.

Unit II **15 Hrs**

Dynamic programming: The recursive equation approach – characteristics of Dynamic programming – Dynamic programming algorithms – The solution of L.P.P. by Dynamic programming.

Unit III **15 Hrs**

Non-Linear Programming Problem: General Non-LPP – Problems of Constrained maxima and minima – graphical solution – Kuhn Tucker Condition (non negative constraints) – Quadratic Programming – Wolfe's modified simplex method.

Unit IV **15 Hrs**

Queuing Theory: Queuing Problems: Introduction – classification of queues – The queuing Problems of type: (M/M/1): (∞/FCFS) – (M/M/1): (N/FCFS) – (M/M/C): (∞/FCFS) – (M/M/C): (N/FCFS).

Unit V **15 Hrs**

Inventory Control: Introduction – Deterministic models – purchasing problem with no shortages – production problems with no shortages - purchasing problem with shortages – production problems with shortages – EOQ system of ordering – Purchase problem with price breaks – Probability models – solved problems.

Course Outcomes: After completion of the course, students will be able to

- formulate an optimization problem from its physical consideration.
- select and implement an appropriate optimization technique keeping in mind its limitations in order to solve a particular optimization problem.
- Know the necessary and sufficient conditions to solve constrained and unconstrained optimization
- understand theoretical foundation and implementation of similar type optimization techniques available in the scientific literature.
- extend their knowledge of basic optimization techniques to do interesting research work on these types of optimization techniques.
- Construct and analyze priority queuing systems

Text Book:

Problem in operations Research, *PK Gupta &ManMohan, Thirteenth Edition*

Unit - I: Chapter 17 (Pages: 355 – 371)
Unit - II : Chapter 18 (pages 379 – 399)
Unit - III : Chapter 25, 26 (pages 609 – 623, 627 - 636)
Unit - IV : Chapter 22 (pages 495 – 510)
Unit - V : Chapter 23 (pages 529 – 550)

General References:

1. Operations Research – An Introduction – H.A. Taha – Prentice Hall Publication.
2. Operations Research – S.D. Sharma – KedarnathRamnath& Co.,
3. Operation Research – PK. Gupta and D.S. Hira – Sultan Chand & Sons.

General References Links:

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

Semester	Subject code	Title of the paper	Hours of Teaching/ Week	No.of Credits
II	**20P2MAEL2A**	**Elective – MATHEMATICAL PROBABILITY**	**5**	**4**

Objectives:

- To explain probability concepts in formulating and study real life situation.
- To provide a solution for real life problems using the various elements probability, probability density function, moments, probability calculation etc.
- To explain the concepts of convergence in solving many real life applications for further improvement and modification.

UNIT I **15 Hrs**

Measure theory-Classes of sets – Monotone class theorem - Probability measures and their distribution functions.

UNIT II **15 Hrs**

Random Variables –Expectation-Independence-General Definitions-Properties of mathematical expectation-Independence.

UNIT III **15 Hrs**

Convergence Concept-Various modes of convergence –Almost sure convergence – Borel-Cantelli lemma-Vague convergence-continuation –Uniform integrability –convergence of moments.

UNIT IV **15 Hrs**

Law of large numbers and random series-simple limits theorem's –weak law of large numbers-convergence of series –strong law of large numbers.

UNIT V **15 Hrs**

Characteristic function-General properties-convolutions-Uniqueness and inversion-convergence theorems.

Course Outcomes: After completion of the course, students will be able to

- understand the concept of Bayes theorem.
- understand and use the probability concepts in formulating and study real life situation.
- know the basic knowledge of fundamental probability concepts including random variables.
- acquire the knowledge of weak and strong law of Large numbers.
- extend their knowledge to pursue research using this field.

Text Book

A course in Probability Theory-Second Edition by Kai Lai Chung, Academic Press, New York *(1974)*

Unit I	:	Chapter 2
Unit II	:	Chapter 3
Unit III	:	Chapter 4
Unit IV	:	Chapter 5 (sec 5.1 to 5.4 only)
Unit V	:	Chapter 6 (sec 6.1 to 6.3 only)

General Reference:

Modern Probability theory –BR.Bhat, Willy Eastern Limited (1989).

General References Links:

1. https://www2.stat.duke.edu/courses/Fall17/sta711/ [Duke University]
2. https://www.umu.se/en/education/syllabus/5ms052/ [Umea University]

Semester	Subject code	Title of the paper	Hours of Teaching/ Week	No.of Credits
II	**20P2MAEL2B**	**Elective - MATHEMATICAL MODELLING**	**5**	**4**

Objectives:

- To discuss population Models.
- To enable students to build mathematical models of real-world systems, analyze them and make predictions about behaviour of these systems.
- To impart with examples taken from physics, biology, chemistry, economics and other fields.
- To explain various modelling techniques to create mathematical description of thesystems.

Unit I **15 Hrs**

Microbial population models, single-species, non –age-structured population models.

Unit II **15 Hrs**

Age-structured population models.

Unit III **15 Hrs**

Epidemic models.

Unit IV **15 Hrs**

Models in genetics.

Unit V **15 Hrs**

Mathematical models in Pharmacokinetics

Course Outcomes: After completion of the course, students will be able to

- analysis specific problems and identity the appropriate model.
- explain the essential features of a good model and discuss the benefits of using a mathematical model. Identify some simple real-life problems that can be solved using mathematical models,
- model the problem(s), solve the resulting problem, and interpret the solution.
- mention and discuss some applications of mathematical modelling in solving problems
- extend their knowledge to pursue research using this field.

Text Book:

Mathematical models in Biology and Medicine*By J.N Kapur, Affiliated East –West Press Pvt. Ltd., New Delhi*

Unit I	:	Chapter 2,3
Unit II	:	Chapter 4
Unit III	:	Chapter 8
Unit IV	:	Chapter 9
Unit V	:	Chapter 10

General References:

1. *Mathematical Modelling J.N Kapur Wiley Eastern Ltd New Delhi.*
2. *Theory of Ordinary Differential Equations with Equations with applications in biology and Engineering Ahmad &MohanaRao Affiliated East-West Pvt Ltd New Delhi, (1999)*

Semester	Subject code	Title of the paper	Hours of Teaching/ Week	No.of Credits
III	**20P3MAC10**	**Core - GENERAL TOPOLOGY**	**5**	**4**

Objectives:

- To provide the knowledge of Topological Spaces and their importance.
- To acquaint the students with the concept of Homeomorphism and the topological properties
- To impart important mathematical concepts which can be generalized in topological spaces, so that students may learn and appreciate the nature of abstract Mathematics.

Unit I **15 Hrs**

Topological spaces –Basis for a Topology –order Topology –Product topology on XxY –subspace Topology-closed sets and limits points.

Unit II **15 Hrs**

Continuous functions -Product topology- Metric Topology-Metric Topology (continued).

Unit III **15 Hrs**

Connected Spaces – Connected sets in the Real line-Components and Path Components-Local Connectedness – Compact Spaces.

Unit IV **15 Hrs**

Compact sets n the Real line – Limit point Compactness – Local Compactness – Accountability Axioms.

Unit V **15 Hrs**

The Separation Axioms - Urysohn Lemma – UrysohnMetrization theorem.

Course Outcomes: After completion of the course, students will be able to

- explain the concept of Basis, create new topological spaces by using subspace.
- use the concept of continuity, compactness, connectedness, homeomorphism and topological properties.
- acquire the knowledge to explain how points of space are separated by open sets, Hausdroff spaces and their importance.
- serves the foundations for future study in analysis, in Geometry and in Algebraic Topology.
- acquire knowledge to write Polytechnic TRB competitive exam.

Text Book:

"Topology-A First Course - James R. Munkres Prentice-Hall of India Private limited New Delhi (1975)

Unit I : Chapter 2 (Section 2.1 to 2.6)
Unit II : Chapter 2 (Sections 2.7 to 2.10)
Unit III : Chapter 3 (Sections 3.1 to 3.5)
Unit IV : Chapter 3 (sections 3.6 to 3.8)
Unit V : Chapter 4 (Section 4.2 to 4.4)

General References:

Introduction to general topology S.T. Hu Tata Mcgraw hill Company New Delhi 1979.

General References Links:

1. https://mafiadoc.com/queue%20post.graduate-syallubus-in-mathematics-the-university-5980aa661723ddf.56290c39.html [Oliver & Boyd London]
2. http://acad.uohyd.ac.in/downloads/syllabus/PG/MSMM.pdf [Oxford University]

Semester	Subject code	Title of the paper	Hours of Teaching/ Week	No.of Credits
III	**20P3MAC11**	**Core - DIFFERENTIAL GEOMETRY**	**5**	**4**

Objectives:

- To impart fundamental concepts of the theory of curves and surfaces.
- To make students familiar with the basic concepts of differential geometry
- To teach geometry of curves and spaces using the methods of differential calculus.

Unit I **15 Hrs**

Analytic representation –Arc length, tangent –Osculating Plane-Curvature –Torsion-Formulas of Frenet-contact-Natural Equations –Helices.

Unit II **15 Hrs**

General Solution of the natural equations-Evolutes and involutes –Analytical representation –First fundamental Form-Normal, tangent plane.

Unit III **15 Hrs**

Developable surfaces-second fundamental form, Meusnier's theorem-Euler's theorem –Dupin'sindicatrix-Some surfaces –A Geometrical interpretation of asymptotic and curvature lines.

Unit IV **15 Hrs**

The equations of Gauss Wiengarten –The theorem of Gauss and the equations of Codazzi-curvilinear coordinates in space-Some applications of the Gauss and the codazzi equations-The fundamental theorems of surface theory. (Proof of the theorem is omitted)

Unit V **15 Hrs**

Geodesic (tangential) curvatures – Geodesics - Geodesic coordinates.

Course Outcomes: After completion of the course, students will be able to

- understand the basic concepts and results related to space curves, tangents, normals and surfaces.
- explain the geometry of different types of curves and spaces.
- understand principal directions and curvatures, asymptotic lines and various properties of curves and surfaces.
- acquire the knowledge about Geodesics and its properties and theorems.
- acquire the Knowledge to write PGTRB examination.

Text Book:

Lectures on Classical Differential Geometry *– D.J. Struik, Addition – Wesley Publishing Company*

Unit I : Chapter 1 (Sections: 1.1 to 1.9), Pages: 1 – 35
Unit II: Chapter 1 (Sections: 1.10, 1.11, 2.1 to 2.3) Pages: 36 – 46, 55 – 65
Unit III: Chapter 2 (Sections: 2.4 to 2.9) Pages: 66 – 96
Unit IV: Chapter 3 (Sections: 3.1 to 3.6) Pages: 105 – 124
Unit V: Chapter 4 (Section: 4.1-4.3) Pages: 127 – 140

General References:

1. *An introduction to differential geometry T.J.willmore Oxford University press Bombay 1989.*
2. *Three dimensional differential geometry PP.Gupta& G.S. Malik, pragtiprakasan. Meerut 1981.*

General References Links:

1. https://collegedunia.com/courses/masters-of-science-msc.mathematics [Oxford University]
2. https://mafiadoc.com/queue%20post.graduate-syallubus-in-mathematics-the-university-5980aa661723ddf.56290c39.html [Oliver & Boyd, London]

Semester	Subject Code	Titles of the Paper	Hours of Teaching / Week	No. of Credits
III	**20P3MAC12**	**Core – GRAPH THEORY AND ITS APPLICATIONS**	**5**	**4**

Objectives:

- To teach the concepts of Planarity including Euler identity.
- To discuss the importance of the concepts of Matchings and Colourings.
- To teach Euler line, Euler graph and necessary and sufficient conditions for a graph to be an Euler graph.
- To explain Hamiltonian paths, cycles, trees and properties of a tree.

Unit I **15 Hrs**

Graphs and sub graphs, Trees: Graphs and simple graphs – Graph isomorphism – The incidence and adjacency matrices – Subgraphs – Vertex Degrees – Paths and Connection – Cycles – Trees – Cut edges and Bonds – Cut vertices – Cayley's Formula.

Unit II **15 Hrs**

Connectivity, Euler Tours and Hamilton Cycles: Connectivity – Blocks – Construction of Reliable Communication Networks – Euler Tours – Hamilton Cycles.

Unit III **15 Hrs**

Matchings, Edge Colourings: Matchings – Matchings and Coverings in Bipartite Graphs – Perfect Matchings – The Personnel Assignment Problem – The Optimal Assignment Problem – Edge Chromatic Number – Vizing's Theorem – The Timetabling Problem.

Unit IV **15 Hrs**

Independent Sets and Cliques, Vertex Colouring: Independent Sets – Ramsey's Theorem – Chromatic Number – Brook's Theorem – Hajos'Cnjecture – Chromatic Polynomials – Girth and Chromatic Number – A Storage Problem.

Unit V **15 Hrs**

Planar Graphs: Plane and Planar Graphs – Dual Graphs – Euler's Formula – Bridges – Kuratowski's Theorem – The Five-colourThorem and the Four-Colour Conjecture – Nonhamiltonian Planar Graphs

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Course Outcomes: After completion of the course, students will be able to

- know the applications of graphs in various communication networks
- understand the concept of Matchings and colorings.
- apply this knowledge to solve realistic problem in real life.
- extend their knowledge to pursue research using this field.
- acquire knowledge to write Polytechnic TRB exam.

Text Book:

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

Unit I : Chapter I (Sec: 1.1 - 1.7),
Chapter II (Sec: 2.1 - 2.4)

Unit II : Chapter III (Sec: 3.1 - 3.3),
Chapter IV (Sec: 4.1 - 4.2)

Unit III: Chapter V (Sec: 5.1 - 5.5),
Chapter VI (Sec: 6.1 - 6.3)

Unit IV: Chapter VII (Sec: 7.1 - 7.2),
Chapter VIII (Sec: 8.1 - 8.6)

Unit V : Chapter IX (Sec: 9.1 - 9.7)

General References:

1. R. Balakrishnan and K. Ranganathan, **A Textbook of Graph Theory**, Springer Verlag, New York, 1999.
2. D.B.West**, Introduction to Graph Theory**, II Ed., PHI, New Delhi, 2007.

General References Links:

1. http://tezu.ernet.in/dmaths/programme/m.sc.syllabus-2019.pdf [Oxford University]
2. https://www-wp.maths.cam.ac.uk/documents/schedules.pdf/ [Cambridge University]

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	**20P3MAC13**	**Core -MATLAB PROGRAMMING**	**5**	**4**

Objectives:

- To teach MATLAB commands and how to use them in programming.
- To solve many problems in different mathematical subjects, especially in numerical analysis and other subjects which connected to computer-oriented mathematics.
- To explain the concepts of polynomials and curve fitting

Unit – I **15 Hrs**

Starting with MATLAB: StartingMATLAB, MATLAB windows - working in the command window - arithmetic operations with scalars - display formats - elementary math built-in functions - defining scalar variables - useful commands for managing variables - script files - examples of MATLAB applications - **Creating arrays:** creating a one-dimensional array - creating a two-dimensional array - notes about variables in MATLAB - the transpose operator

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Unit – II **15 hrs**

Mathematical operations with arrays: array addressing - using a colon : in addressing arrays - adding elements to existing variables - deleting elements - built-in functions for handling arrays - strings and strings as variables - Mathematical operations with arrays:addition and subtraction - array multiplication - array division - element-by-element operations - using arrays in MATLAB built-in math functions - built-in functions for analyzing arrays - generation of random numbers - examples of MATLAB applications

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Unit – III **15 Hrs**

Programming in MATLAB: relational and logical operators - conditional statements - the switch-case statement – loops - nested loops and nested conditional statements - the break and continue commands - examples of MATLAB applications

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Unit – IV **15 hrs**

Two-dimensional plots: the plot command - the *fplot*command - plotting multiple graphs in the same plot - formatting a plot - plots with logarithmic axes - plots with error bars - plots with special graphics – histograms - polar plots - putting multiple plots on the same page - multiple figure windows - examples of MATLAB applications

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Unit – V **15 hrs**

Polynomials and curve fitting: polynomials - curve fitting - **Applications in numerical analysis:** numerical integration - ordinary differential equations - examples of MATLAB applications (upto sample problem 9-4).

Course Outcomes: After completion of the course, students will be able to

- understand the basics of MATLAB
- break a complex task up into smaller, simpler tasks
- tabulate the results and analyze.
- apply in Numerical Analysis.
- extend their knowledge to pursue research using MATLAB.

Text Book:

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

Unit – I	:	Chapter 1: Sec. 1.1 – 1.9(Pages: 1 – 27)
		Chapter 2: Sec. 2.1 – 2.4 (Pages: 35 – 41)
Unit – II	:	Chapter 2: Sec. 2.5 – 2.10 (Pages: 42 – 55)
		Chapter 3: Sec. 3.1 – 3.8 (Pages: 63 – 86)
Unit – III	:	Chapter 6: Sec. 6.1 – 6.7 (Pages: 173 – 209)
Unit – IV	:	Chapter 5: Sec. 5.1 – 5.12 (Pages: 133 – 163)
Unit – V	:	Chapter 8: Sec. 8.1 – 8.2 (Pages: 261 – 274)
		Chapter 9: Sec. 9.3 – 9.5 (Pages:300 – 309)

Reference Books:

1. *Getting Started with MATLAB – A Quick Introduction for Scientists and Engineers"* by **R. Pratap**, Oxford University Press, New Delhi, 2006.
2. "*Introduction to Matlab 7 for Engineers"* by **W.J. Palm,** McGraw-Hill Education, New York, 2005.
3. "*Introduction to MATLAB 7"* by **D. M. Etter, D. C. Kuncicky and H.Moore**, Prentice Hall, New Jersy, 2004.

General References Links:

1. https://www.unibocconi.eu/wps/wcm/connect/52a12ff9-62bd-49db-9f2b-042a2b9f3ab5/AI22+-+Introduction+to+MATLAB+-+Scheda.pdf?MOD=AJPERES&CVID=mYAhkEt [UniversitàBocconi, Italia]
2. https://www.google.com/url?sa=t&source=web&rct=j&url=https://ocw.mit.edu/courses/mathematics/18-s997-introduction-to-matlab-programming-fall-2011/syllabus/&ved=2ahUKEwjVitnQ9trqAhW1zDgGHaCSBcwQFjAAegQIBxAC&usg=AOvVaw3uHbpm2yq9w3kDSJUZYAda&cshid=1595217214079 [Massachusetts Institute of Technology(MIT]

Semester	Subject code	Title of the paper	Hours of Teaching/ Week	No.of Credits
III	**20P3MACPL**	**Core – Computer Programming Practical**	**5**	**2**

Objectives:

- To give practical knowledge about MATLAB programming.
- To teach MATLAB commands and how to use them in programming.
- To teach MATLAB Programming to get the solution of Numerical problems.

List of MATLAB Programmes:

1. Arithmetic operations
2. Logical operations
3. Control structure
4. Matrix operations
5. Fibonacci series
6. Draw lines joining the points in 2D plot
7. Multiple plots on the same axis
8. Logarithmic plot
9. Bisection method
10. Newton's method

Course Outcomes: After completion of the course, students will be able to

- apply the knowledge of mathematical software MATLAB to solve real world problems efficiently.
- utilize the symbolic tools for handling different mathematical problems.
- design and analyze their own computer codes of mathematical methods.
- understand and modify existing codes in scientific computing based on the use of different loops and conditional structures.
- extend their knowledge to pursue research using MATLAB.

Reference Books:

1. *"MATLAB An Introduction with Application" by* **Amos Gilat,** John Wiley & Sons, Singapore, 2011.
2. *"Getting Started with MATLAB – A Quick Introduction for Scientists and Engineers"* by **R. Pratap**, Oxford University Press, New Delhi, 2006.
3. "*Introduction to Matlab 7 for Engineers"* by **W.J. Palm,** McGraw-Hill Education, New York, 2005.
4. "*Introduction to MATLAB 7"* by **D. M. Etter, D. C. Kuncicky and H.Moore**, Prentice Hall, New Jersy, 2004.

Semester	Subject Code	Title of the Paper	House of Teaching / Week	No.of Credits
III	**20P3MAEDC**	**Extra Disciplinary Course- Applicable Mathematical Techniques**	**4**	**-**

Objectives:

- To teach various methods of Interpolation
- To discuss various real-life problems like Replacement problems and Decision Analysis
- To introduce the concept of Assignment problems and Game Theory.

Unit I **12 Hrs**

Interpolation with unequal intervals: Newton's divided difference formula - Lagrange's interpolation formula and inverse interpolation. (Only simple Problems)

Unit II **12 Hrs**

Assignment problems

Unit III **12 Hrs**

Replacement problems (Only simple Problems)

Unit IV **12 Hrs**

Decision Analysis

Unit- V **12 Hrs**

Game Theory

Course Outcomes: After completion of the course, students will be able to

- formulate an optimization problem from its physical consideration
- acquire the knowledge and skills of optimization techniques.
- solve Replacement problems.
- understand the concept of Interpolation
- apply these theories to various real life problems

Text Book:

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

Unit I : Chapter - 8 (Sec: 8.5, 8.7)
Unit II : Chapter - 11 (Sec: 11.1 to 11.4)
Unit III : Chapter - 18 (Sec: 18.1 to18.3)
Unit IV : Chapter - 16 (Sec: 16.1 to 16.5)
Unit V : Chapter - 17 (Sec: 17.1 to 17.6)

General Reference:

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

Semester	Subject Code	Title of the paper	Hours of Teaching/ Week	No. of Credits
IV	**20P4MAC14**	**Core - FUNCTIONAL ANALYSIS**	**6**	**5**

Objectives:

- To familiarise with the basic tools of Functional Analysis
- To explain about Banach spaces and Hahn Banach theorem.
- To teach functional analysis in real life problems.

Unit-I **18 Hrs**

Banach spaces, equivalent norms, and Factors spaces: The Holder's and Minkowski inequalities-Banach spaces and Examples-The completion of Normed Linear Spaces-Generated Subspaces and Closed Subspaces- Equivalent norms and Reisz theorem- Factors spaces.

Unit II **18 Hrs**

Commutative Convergence, Hilbert spaces and Bessel's Inequality. Commutative convergence - Norms and inner products on Cartesian productsof normedand Inner products spaces–Hilbert Spaces–A Non-Separable Hilbert space–Bessel's inequality-some results from L2$(0, 2\pi)$ - Riesz –Fischer Theorem–Complete Orthonormal sets–Parseval's identity-A complete Orthonormal set for $L_2(0, 2\pi)$

Unit III **18 Hrs**

Complete orthonormal sets: Complete orthonormal sets and parseval's identity–the cardinality of complete orthonormal sets-A Note on the structure of Hilbert spaces–closed surfaces and projection theorem for Hilbert's spaces. **Hahn–Banach Theorem:** A Hahn–Banach Theorem-bounded linear functional–the conjucate space.

Unit IV **18 Hrs**

Consequences of the Hahn Banach theorem: some consequences of the Hahn Banach theorem–the second conjugate space–the conjugate space of l_p–the Riesz representation theorem for linear functional on a Hilbert space–reflexivity of Hilbert spaces.

Unit V **18 Hrs**

The Conjugate space of C [a, b]: A Representation theorem for bounded linear functional on C [a, b]–A list of some spaces and their conjugate spaces–**Weak Convergence and Bounded linear Transformation:** Weak convergence–Bounded linear transformation.

Course Outcomes: After completion of the course, students will be able to

- explain the fundamental concepts of functional analysis and their role in modern mathematics.
- utilize the concepts of functional analysis, for example continuous and bounded operators, normed spaces, Hilbert spaces and to study the behavior of different mathematical expressions arising in science and engineering.
- understand and apply fundamental theorems from the theory of normed and Banach spaces.
- extend their knowledge to pursue research using this field.
- acquire the knowledge to write NET/ SET/ PG TRB/Polytechnic TRB competitive exams.

Text Book:

"Functional Analysis", George Bachman and Lawrence Narici Academic press, New York–1966.

Unit I : Chapter 8 (8.1 to 8.6) Pages: 109 - 129
Unit II : Chapter 9(9.1 to 9.9) Pages: 136 - 157
Unit III : Chapter10(10.1 to 10.4), Chapter 11(11.1 to 11.3) Pages:162–172,176-187
Unit IV : Chapter12 (12.1 to 12.5) Pages: 197–214
Unit V : Chapter 13, 14 (13.1 to 13.2, 14.1 to14.2) Pages: 216 – 227, 230 - 243

General References:

1. Bose,S.C. Introduction to functional Analysis, Macmillan India Limited, Delhi, 1992.
2. Walter Rudin: Functional Analysis. Tata McGraw Hill Publishing Co., News Delhi, 1995
3. Simmons G.F: Introduction to Topology & Modern Analysis, International Student Edition McGraw Hill Kogakusha Ltd., 1963.

General References Links:

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

Semester	Subject code	Title of the paper	Hours of Teaching/ Week	No.of Credits
IV	**20P4MAC15**	**Core – MEASURE & INTEGRATION**	**6**	**5**

Objectives:

- To teach theory of functions of real variable from a classical point of view.
- To teach Lebesgue measure and Lebesgue integral.
- To introduce the extension of a measure L_p spaces.

Unit I **18 Hrs**

Measurable sets measure of a bounded open set-measure of a bounded closed set-outer and inner measure of a bounded set – measureable sets-Measure as invariants under isometrics - Class of measurable sets - Vitali's theorem.

Unit II **18 Hrs**

Measure functions: -definition and properties of measurable functions-Sequences of measurable functions - Structure of measurable functions - Theorems of weierstrass.

Unit III **18 Hrs**

Lebesque integral of a bounded function: - Definition of Lebesque integral - Fundamental properties of the integral – passage to the limit under the integral sign - Comparison of Riemann and Lebeque integrals - Reconstruction of the primitive function.

Unit IV **18 Hrs**

Summable functions integral of a Non-negative Measurable function – Summable functions of arbitrary sign - Passage to the limit under the integral sign.

Unit V **18 Hrs**

Square Summable functions: - Inequalities – Norms-Mean Convergence -Orthogonal systems - The space l_2 – linearily independent systems - Spaces L_p and l_p.

Course Outcomes: After completion of the course, students will be able to

- understand the concept of Lebesgue measure, measurable sets and approximation of a measurable function.
- prove various convergence theorems and know its applications.
- understand the absolutely continuous functions and functions of bounded variation.
- apply Holders and Minkowski inequalities in L_p spaces.
- acquire the knowledge to write Polytechnic TRB competitive exam.

Text Book:

"Theory of functions of a real variable", *I.P.natanson, Frederick Ungar Publishing Co., New York 1964.*

Unit I : Chapter 3- secs 1 to 6, 8
Unit II : Chapter 4- secs 1 to 5
Unit III : Chapter 5- secs 1 to 5
Unit IV : Chapter 6 secs 1 to 3
Unit V : Chapter 7 sec 1 to 6

General References:

1. *P.R.Halmos"Measure theory", Springer –Verlac 1974.*
2. *T.Hawkins,"Lebseque Theory of integration-its Origin and development" Chelsea* Publishing Co New York 1975.
3. H.L.Royden "Real Analysis Prentice Hall India Ltd.New Delhi 1995.

General References Links:

1. http://collegecatalog.uchicago.edu/search/?P=MATH%2027100 [University of Chicago]

2. https://www.umu.se/en/education/syllabus/5ma068/[Umea University, Sweden]

Semester	Subject code	Title of the paper	Hours of Teaching/ Week	No.of Credits
IV	**20P4MAC16**	**Core – CRYPTOGRAPHY**	**6**	**5**

Objectives:

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

Unit I **18 Hrs**

Simple Cryptosystems-Enciphering Matrices

Unit II **18 Hrs**

Idea of Public Key Cryptography-RSA-Discrete Log.

Unit III **18 Hrs**

Knap- sack Pseudoprimes- Rho method.

Unit IV **18 Hrs**

Fermat factorization and factor bases- Continued Fraction Method.

Unit V **18 Hrs**

Basic Facts- Elliptic curve Cryptosystems-Elliptic curve factorization.

Course Outcomes: After completion of the course, students will be able to

- classify the symmetric encryption techniques.
- illustrate various public key cryptographic techniques.
- apply the knowledge of Cryptography to attain a good mathematical maturity and enables to build mathematical thinking and skill
- create, select and apply appropriate number theoretic techniques such as primes, greatest integer functions in Cryptography to use in real life problems.
- identify the challenging problems in modern mathematics and find their appropriate solutions

Text Book:

"A Course in Number Theory and Cryptography", *N. Koblitz, Springer-Verag, New York, 1987.*

Unit I : Chapter III, Sec 1-2 (Pages 53-79)
Unit II : Chapter IV, Sec 1-3 (Pages 81-106)
Unit III : Chapter IV, Sec 4 and Chapter V, Sec 1-2 (Pages 107-130)
Unit IV : Chapter V, Sec 3-4 (Pages 131-149)
Unit V : Chapter VI, Sec 1-3 (Pages 150-179)

General References:

1. *D.R.Stinson, "Cryptography", CRC Press, New York, 1995.*
2. *A.J Meneze, P.R.Oorche and S.A Vans ton " hand book of applied Cryptography", Crc Press New York, 1995.*

General References Links:

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

Semester	Subject Code	Title of the Paper	Hours of Teaching /Week	No. of Credits
IV	**20P4MAEL3A**	**Elective - ADVANCED NUMERICAL ANALYSIS**	**6**	**4**

Objectives:

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

Unit I **18 Hrs**

Transcendental and Polynomials equations: Bisection method – Secant method – Newton Raphson method – Muller method – Chebyshev method – Birgevieta method – Graeffe's root squaring method.

Unit II **18 Hrs**

System of linear algebraic equation and Eigen values problems: Jacobi iteration method, Gauss – Seidel iteration method - Successive over relaxation method - Eigen values and vectors: Jacobi method, Given's method and Householder transformation for symmetric matrices.

Unit III **18 Hrs**

Interpolation and approximation: Hermite Interpolation – Lagrange bivariate interpolation – Newton's bivariate Interpolation for equispaced points - Approximations – Least squares approximation – Gram-Schmidt orthogonalizing process – Legendre Polynomials - Chebyshev polynomials.

Unit IV **18 Hrs**

Numerical integration; methods based on interpolation – Newton-cotes methods – trapezoidal rule – Simpson's rule - open type integration rules – Gauss-Legendre integration methods – Labotto integration method – Radau integration method – Gauss Chebyshev integration methods.

Unit V **18 Hrs**

Ordinary Differential equations: Euler method – Backward Euler method – midpoint method – Taylor series method – Runge-kutta methods : Explicit Runge-kutta method.

Course Outcomes: After completion of the course, students will be able to

- utilize the tools of the Numerical Mathematics in order to formulate the real-world problems from the view point of numerical mathematics.
- design, analyze and implement of numerical methods for solving different types of problems.
- create, select and apply appropriate numerical techniques with the understanding of their limitations so that any possible modification in these techniques could be carried out in further research.
- find appropriate solutions accurately and efficiently.
- extend their knowledge to pursue research using this field.

Text Book:

Numerical methods for Scientific and Engineering computation *By M.K.Jain, S.R.K.Iyengar, R.K.Jain, VII Multicolor Edition.*

Unit I : Chapter–2: Section 2.2, 2.3, 2.4, 2.9 (Pages: 20-38, 86-89, 94-99)
Unit II : Chapter– 3: Section 3.4, 3.7, 3.8, 3.9 (Pages: 146-164,179-193)
Unit III : Chapter–4: Section 4.5, 4.7, 4.8, 4.9 (Pages: 247-251, 273 -298)
Unit IV : Chapter-5:Section 5.6, 5.7, 5.8 (Pages: 348–355, 361–369, 380-388)
Unit V: Chapter – 6: Section 6.3 (Pages: 425-448)

General References Links:

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

Semester	Subject Code	Title of the Paper	House of Teaching / Week	No.of Credits
IV	**20P4MAEL3B**	**Elective – DESIGN AND ANALYSIS OF ALGORITHMS**	**6**	**4**

Objectives:

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

Unit I **18 Hrs**

Introduction: What is an algorithm? - Algorithm specification- Performance analysis- Randomized algorithms.

Unit II **18 Hrs**

Elementary data structures: Stacks and Queues- Trees- Dictionaries- Priority Queues- Graph representations.

Unit III **18 Hrs**

Design of algorithm methods: Divided- And- Conquer- General method- Binary search- finding the maximum and minimum in a set of items- Merge sort- Quick sort.

Unit IV **18 Hrs**

Design of algorithm methods continuation: The Greedy method- The general method- Tree vertex Splitting Problem- Tree traversal and search techniques- Techniques for Binary trees- Techniques for Graphs- Breadth first search and depth first search traversal- Connected components and spanning trees- Backtracking- General method- the 8- Queens Problem- Branch and Bound method- Travelling sales person algorithm.

Unit V **18 Hrs**

Algebraic problems: Algebraic problems- The general method- Evaluation and Interpolation- The Fast Fourier transform- Modular arithmetic- Even faster evaluation and interpolation.

Course Outcomes: After completion of the course, students will be able to

- demonstrate a familiarity with major algorithms and data structures.
- appreciate the requirements of algorithm analysis.
- understand the concepts behind divide and conquer; greedy technique, backtracking and dynamic programming after going through this course.
- understand the concept behind NP-completeness.
- hands on experience in implementing these strategies on machine.

Text Book:

Fundamentals of Computer Algorithm, *Eills Horowitz, SartajShani and SanguthevarRajasekaran, Galgotia Publications Pvt Ltd, 2000.*

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

Books for Reference:

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

Semester	Subject code	Title of the paper	Hours of Teaching/ week	No.of Credits
-	**-**	**Core Optional – Advanced REAL ANALYSIS**	**5**	**4**

Objectives:

- To discuss the basic concepts of topology and illustrate with examples.
- To teach domain knowledge for Riemann - Stieltjes integral.
- To explain the sequences and series of functions with the examples.

Unit I **18 Hrs**

Riemann –Stieltjes. Integral: Introduction –Notation-The definition of the Riemann-Stieltjes Integral-Linear Properties-Integration by parts-Change of variable in a Riemann – integral –step functions as integrators –Reduction of a Riemann–Stieltjes integral to a finite sum-Euler's summation formula-monotonically increasing integrators. Upper and lower integrals – Additive and linearity properties of upper and lower integrals-Riemann's Condition-Comparison theorems –Integrators of bounded variation.

Unit II **18 Hrs**

Riemann –Stieltjes. Integral: Sufficient conditions for existence of Riemann –Stieltjes integrals-Necessary conditions for existence of Riemann –Stieltjes integral-Mean value Theorems for Riemann-Stieltjes integrals-the integrals as a functions of the interval-Second fundamental theorem of integrals calculus-Change of variable Riemann integral-Second Mean value Theorem for Riemann integrals-Riemann –Stieltjes integrals depending on a parameter-Differentiation under the integral sign-interchanging the order of integration.

Unit III **18 Hrs**

Infinite Series and Infinite Products: Introduction –Convergent and divergent sequences of complex numbers-Limit superior and limit inferior of a real-valued sequence-monotonic sequences of real numbers-Infinite series-inserting and removing parantheses-Alternating Series-Absolute and conditional convergence-Real and imaginary parts of a complex series-Tests for convergence of series with positive terms. The geometric series- The integral test –The big oh and little oh notation –The ratio test and the root test-Dirichlet's test and Abel's test.

Unit IV **18 Hrs**

Sequences of Functions: -Point wise convergence of sequences of functions –examples of sequences of real –valued functions-Definition of uniforms convergence-Uniform convergence and continuity –The cauchy condition for uniform convergence–Uniform convergence of infinite series of functions-Uniform convergence and Riemann–Stieltjesintergration-uniformly convergent sequences that can be integrated term by term-Uniform convergence and differentiation-sufficient conditions for uniform convergence of a series.

Unit V **18 Hrs**

The Lebesgue integral: 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 Lebesgueintegrable functions on a general interval – Basic properties of Lebesgue integral – Lebesgue integration and sets of measure zero – The Levi monotone convergence theorem – The Lebesgue dominated convergence theorem.

Course Outcomes: After completion of the course, students will be able to

- demonstrate and understanding of the theory of sequences and series, continuity, differentiation and integration.
- analyze the abstract ideas and various methods in mathematical analysis and apply in practical problems.
- construct the mathematical proofs for various results and evaluate problems on the concepts learned.
- analyze the linear properties of Riemann Stieltijes integral and the application of the fundamental theorems of integration
- acquire the knowledge for the competitive exams like CSIR NET/SET.

Text Book:

Mathematical Analysis,Tom M. Apostol, *2 edn, Narosa, New Delhi, 1985*

Unit I : Chapter 7 (7.1-7.15)
Unit II : Chapter 7 (7.16-7.25)
Unit III : Chapter 8 (8.1-8.15)
Unit IV: Chapter 9 (9.1-9.6, 9.8-9.11)
Unit V : Chapter 10 (10.1-10.10)

General References:

1. *I.I. HIRSCHMAN "infinite series". Holt.Rinehart and Winston, Newyork 1962.*
2. *K. Knopp," Theory and applications of infinite series", Hafner, newyork, 1948.*
3. *Woll.J.W"functions of several variables Harcourt brace and world, Newyork 966.*
4. *Keotelman.H."Modern Theories of Integration "Oxford university press 1937*

Semester	Subject code	Title of the paper	Hours of Teaching/ Week	No.of Credits
-	**-**	**Core Optional - NUMBER THEORY**	**4**	**3**

Objectives:

- To introduce the theoretical concepts of Number theory.
- To enlighten the students with the knowledge on number theory.
- To teach the basic theory of the integers, prime numbers and their primitive roots, the theory of congruence, quadratic reciprocity law and number theoretic functions, Fermat's last theorem.

Unit I **18 Hrs**

Fundamentals ofCongruences: Basic propertiesof Congruences – Residue–Riffling. Solving Congruences: linear Congruences – the Theorems of Fermat and Wilson Revisited – the Chinese remainder Theorem – Polynomial Congruences.

Unit II **18 Hrs**

Arithmetic functions: Combinatorial Study of ϕ (n) – Formulae for d(n) and σ(n)- Multiplicative arithmetic functions – The Mobius inversion formula. Primitive roots: Properties of reduced residue systems – Primitive roots modulo p.

Unit III **18 Hrs**

Quadratic residues: Euler's Criterion-the Legendre symbol- the quadratic Reciprocity law – Applications ofthe Quadratic reciprocity law. Distribution of Quadratic residues: Consecutive residues and non-residues-consecutive triples of Quadratic residues

Unit IV **18 Hrs**

Sums of squares: Sums oftwo squares- Sums offour squares. Elementary partition theory: Introduction - graphical representation – Euler's partition theorem – searching for partition identities.

Unit V **(Self Study)** **18 Hrs**

Partition generating functions: Infinite products asgenerating functions- Identities between infinite series and products. Partition identities: History and introduction – Euler's Pentagonal number theorem- The Roger's Ramanujan identities- series and product identities.

Course Outcomes: After completion of the course, students will be able to

- effectively express the concepts and results of number theory.
- utilize the congruences, Chinese remainder theorem, indices, residue classes, Legendre symbols to solve different related problems.
- literate in the language and notation of number theory.
- understand the concept of n-colour partitions
- extend their knowledge to pursue research using this field.

Text Book:

"Number Theory" by George E.Anderews, Hindustan Publishing Corporation(India) Delhi - 110 007 (1989).

Unit I : Chapters IV and V
Unit II : Chapters VI and VII
Unit III : Chapters XI and X
Unit IV : Chapters XI and XII
Unit V : Chapters XIII and XIV

General References:

1. Analytic Number Theory - *Tom. M.Apostal*
2. Introduction to theory of Number - *G.H.Hardy and E.M.Wright.*
3. Basic Number Theory - *S.B.Malilk*
4. Elements of Number Theory - *S.Kumaravelu and SusheelaKumaravelu.*

Semester	Subject code	Title of the paper	Hours of Teaching/ Week	No.of Credits
-	**-**	**Core Optional - Combinatorial Mathematics**	**6**	**5**

Objectives:

- To teach structures to represent mathematical functions.
- To teach combinatorial tools commonly used to analyze structures.
- To explain fundamental combinatorial structures that appear in various fields of mathematics and computer science.

Unit I **18 Hrs**

Basic combinatorial numbers.

Unit II **18 Hrs**

Generating functions and Recurrence relations symmetric functions.

Unit III **18 Hrs**

Multinomials- Inclusion and exclusion principles- permutations with forbidden positions.

Unit IV **18 Hrs**

Necklace problem and Burnsides' Lemma- Cycle Index of a permutations group.

Unit V **18 Hrs**

Polya's theorems and their immediate applications- Binary operations on permutations groups.

Course Outcomes: After completion of the course, students will be able to

- prove the existence or non-existence of the object, compute the number of such objects, and understand their underlying structure.
- understand the combinatorial tools to model and analyze practical problems in various areas.
- identify, formulate, and solve problems in mathematics, including proof- writing.
- understand and deal with enumerative problems.
- extend their knowledge to pursue research using this field.

Text Book

Combinatorics theory and applications by V. Krishnamurthy.

Unit I : Chapter I (Pages 1-15)
Unit II : Chapter I (Pages 26- 61)
Unit III : Chapter I (Pages 66- 98)
Unit IV : Chapter II (Pages 99- 121)
Unit V : Chapter II (Pages 122-159)

General Reference:

Introductory Combinatorics- Kenneth P. Bogart- Pitman Publishing Inc, Mashfield, Massachusetts.

Semester	Subject Code	Title of the Paper	House of Teaching / Week	No.of Credits
-	-	**Core Optional - Geometric Function Theory**	**6**	**5**

Objectives:

- To explain the basic concepts of univalent functions.
- To teach the concepts ofconvex and star like functions.
- To impart the knowledge of mapping properties.

Unit I **18Hrs**

Geometric function theory. Basic principles- Local mapping properties- Normal families- Extremal problems- The Riemann mapping theorem- Analytic continuation- Harmonic and sub harmonic functions- Green's function- positive Harmonic functions.

Unit II **18 Hrs**

Elementary theory of univalent functions. Introduction- the Area theorem- Growth and Distortion theorems- coefficient Estimates.

Unit III **18 Hrs**

Convex and star like function- close- to- convex functions- spiral like functions.

Unit IV **18 Hrs**

Typically Real functions- A Primitive variation Method- growth of Integral Means- odd univalent functions- Asymptotic Biber back conjecture.

Unit V **18 Hrs**

Sub ordination. Basic principles- coefficient Inequalities- sharpened forms of the Schwarz - Lemma- Majorization- Univalent subordinate functions.

Course Outcomes: After completion of the course, students will be able to

- understand the concepts of subordination.
- acquire the knowledge to pursue research in Mathematics.
- know convex and star like functions.

Text Book:

Geometric Function Theory *by Peter L. Duren.*

Unit I	:	Chapter-1 (1.1- 1.9)
Unit II	:	Chapter- 2 (2.1- 2.4)
Unit III	:	Chapter-2 (2.5- 2.7)
Unit IV	:	Chapter-2 (2.8- 2.12)
Unit V	:	Chapter- 6 (6.1- 6.5)

COMMUNICATION SKILL AND PERSONALITY DEVELOPMENT

SEMESTER	SUBJECT CODE	TITLE	HOURS OF TEACHING/ WEEK	NO OF CREDITS
IV	20P4-CPD	Communication Skill and Personality Development	1	

COURSE OBJECTIVES:

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

UNIT 1

1. Personality- Definition.
2. Determinants of Personality.
3. Perceptual Process.
4. Personality Traits.
5. Developing Effective Habits.
6. Self Esteem (Freud and Erikson).
7. Self Appraisal and Self Development
8. Dos and Don'ts to develop positive self esteem.
9. Interpersonal Relationship.
10. Difference between Aggressive, Submissive and Assertive behaviour.
11. Mind Mapping, Competency Mapping, 360 degree assessment.
12. Presentation Skills – Opening, ending, Handling nerves, Handling audience, Power Storytelling, Visual aids, Question and answer session

UNIT 2

1. Projecting Positive Body Language.
2. Conflict Management.
3. Change Management.
4. Stress Management.
5. Time Management.
6. Goal Setting.
7. Assertiveness and Negotiating Skill.
8. Problem Solving Skill.
9. Decision Making Skills.
10. Leadership Qualities of a Successful Leader.
11. Attitudes – Positive Attitudes.

12. Public Speaking – Engaging, Connecting, and Influencing the audiences.
13. Employability Skill – Group Discussion, Interview Questions, Psychometric analysis.

COURSE OUTCOMES:

After completion of the course, Students will be able to:

- Gain self confidence and broaden perception of life.
- Maximize their potential and steer that into their career choice.
- Enhance one's self image & self esteem.
- Find a means to achieve excellence and derive fulfilment.

References:

Hurlock.E.B (2006) : Personality Development, 28th Reprint. New Delhi: Tata McCraw Hill.

Stephen.P.Robbins and Timothy. A.Judge (2014) : Organisation Behaviour.16th Edition.Prentice Hall.

Andrews, Sudhir. How to Succeed at Interviews. 21st (rep) New Delhi.Tata McGrew Hill 1988.

Lucas, Stephen. Art of Publication. New Delhi. Tata McGrew Hill. 2001.

Kumar, Pravesh. All about Self Motivation. New Delhi. Goodwill Publication House. 2005.

EXTRA DISCIPLINARY COURSES

Sl. No.	Subject Code	Title of the Paper	Department
1.	20P3HYEDC	**INDIAN ADMINISTRATION**	History
2.	20P3ECEDC	**ISSUES IN INDIAN ECONOMY**	Economics
3.	20P3TAEDC	***தமிழ்மொழி வரலாறு***	Tamil
4.	20P3ENEDC	**SHAKESPEARE STUDIES**	English
5.	20P3CMEDC	**ENTREPRENEURIAL DEVELOPMENT**	Commerce
6.	20P3MAEDC	**APPLICABLE MATHEMATICAL TECHNIQUES**	Mathematics
7.	20P3PHEDC	**FUNDAMENTALS OF NANOTECHNOLOGY**	Physics
8.	20P3CHEDC	**CHEMISTRY IN EVERY DAY LIFE**	Chemistry
9.	20P3BOEDC	**MEDICAL BOTANY AND PHARMACOGNOSY**	Botany
10.	20P3MBEDC	**MUSHROOM TECHNOLOGY**	Microbiology
11.	20P3ZOEDC	**CLINICAL LAB TECHNOLOGY**	Zoology
12.	20P3BTEDC	**RECENT TRENDS IN BIOTECHNOLOGY**	Biotechnology
13.	20P3CSEDC 20P3ITEDC	**E-LEARNING TECHNOLOGIES**	Computer Science
14.	20P3LSEDC	**DOCUMENTATION CENTERS IN INDIA**	Library and Information Science

Semester	Course Code	Title of the Course	Hours of Teaching /Week	No. of Credits
III	**20P3HYEDC**	**Extra Disciplinary Courses – Indian Administration**	**5**	**--**

Objectives:

1. To know the evolution of Indian Administration.
2. To prepare the students for the competitive examination.
3. To give up-to-date knowledge on Indian administration.
4. To trace economic planning of India, through which the students may get practical knowledge on budget, etc.
5. To expose the state administration and the latest issues like Lok Ayukt and LokPal through which the students may get awareness about the latest issues.

Unit I ***Hrs 15***

The evolution of Indian administration: Structure and Functions–Mauryan and Mughal legacy; British Indian system: Company's experiments–Warren Hastings, Lord Cornwallis, Lord Hastings and Lord Dalhousie; Administrative consolidation since 1861 – Famine policy - Financial, Police and judicial administration.

Unit II ***Hrs 15***

Indian Administration since 1950: Parliamentary Democracy–Federation–Structure of Central Administration–Central Secretariat–Cabinet Secretariat, Ministries–Department of Boards.

Unit III ***Hrs 15***

Machinery for planning: Plan formulation at the National level – National Development Council – Planning Commission – Public undertaking – Controls of Public expenditure.

Unit IV ***Hrs 15***

State Administration–Executives–Secretariat–Chief Secretary–Directorates–District and Local Administration–District Rural Development Agency–Special development programmes.

Unit V ***Hrs 15***

Center-State relations – Public services – Police and Judicial administration – Lok Ayukt – Lok Pal – issues on Indian administration – Integrity in administration – Administrative reforms.

General References:

1. Altekar, A.S., State and Government in Ancient India, 1958.
2. Bhambri, C.H., Public Administration in India.
3. Vidya Bhushan, Indian Administration, Delhi, 2000.
4. Vishnoo Bhagawan & Vidhya Bhushan., Indian Administration, New Delhi, 1996.

Course Outcome: The students have clearly understood about the evolution of Indian Administration, State and Central administration, police and judicial administration, Centre State relations, etc.

Semester	Subject code	Title of paper	Hours of Teaching / Week	No. of Credit
III	**20P3ECEDC**	**Extra Disciplinary Courses – Issues in Indian Economy**	**4**	**-**

Objective:

- This Elective paper is offered to the Non-Economics Students to make them familiar with the recent trends in Indian Economy. The syllabus is framed accordingly with the Civil Service Examination.

Course Outcomes

- To understand the status of Indian economy before the reforms
- To assess the rationale of introducing reforms in India
- To familiarize with the package of LPG
- to get insight on the recent trends in EXIM policy

Unit I **Hrs 15**

Economic development and growth – determinants of growth and development – Market Economy – Indian Economy – a shift form mixed economy to Market economy – Reform measures introduced in India – First and second generation reforms – (Brief out line)

Unit-II **Hrs 15**

Economic reforms in India – background, rational – implementation – Trade policy – Industrial policy – exchange rate and capital market reforms

Unit-III **Hrs 15**

Dis-investment of public enterprises – rational – changing profile of PSUs comparison of public and private sector

Unit-IV **Hrs 15**

Privatization – Meaning and scope – Globalization – impact on India – foreign capital – Types FDI and FII, Policies and pattern.

Unit-V **Hrs 15**

Foreign Trade – Exim Policies – Recent exim policy – BOP- Trends in BOP – Economic reforms and BOP.

References:

Uma kapila – Indian Economy (Issues in Development and Planning and Sectoral aspects) Fifth Edition, 2006-07, Academic Foundation, New Delhi

Datt Ruddar &

Sundharam K.P.M. - Indian Economy (2007)

Misrapuri - Indian Economy

Semester	Subject Code	Title of the Paper	Hours of Teaching/Week	No. of Credits
III	**20P3TAEDC**	**கூடுதல் சிறப்புப் பாடம்: தமிழ்மொழி வரலாறு**	**4**	**-**

கூறு: 1 இந்திய மொழிக் குடும்பங்கள் நேரம்: 12

இந்தோ ஆரிய மொழிகள் - ஆஸ்டிக் மொழிகள் - சீன திபெத்திய மொழிகள் - திராவிட மொழிக் குடும்பம் - டாக்டர் கால்டுவெல், திராவிட மொழிகளின் சிறப்பியல்புகள் - தென் திராவிட மொழிகள் - தென் திராவிட மொழிகளில் தமிழ் - நடுத்திராவிட மொழிகள் - வட திராவிட மொழிகள்.

கூறு: 2 தமிழ் நேரம்: 12

தமிழ் என்பதன் வடிவம் பற்றியும் பொருள் பற்றியும் பல்வேறு செய்திகள் - பெயரெச்சங்கள் - வினையெச்சம் - சங்க இலக்கியத்தில் வினையெச்சங்கள் - தொல்காப்பிய உரைகாரர்களும் வினையெச்சங்களும்.

கூறு: 3 நேரம்: 12

தமிழ் எழுத்தின் தோற்றமும் வளர்ச்சியும் - ஆய்வெழுத்து இராசியெழுத்து, நாள், எழுத்து - ஓவியம், பானை ஓடுகள், இலங்கை முத்திரை முதலானவற்றில் காணப்படும் உருவ எழுத்துகள் - வட்டெழுத்து, பண்டைத் தமிழ் எழுத்து. தமிழ்மொழி வரலாறு: தமிழின் தொல் வரலாறு, தமிழ்மொழி வரலாறு - பழந்தமிழ்க் காலம், இடைத்தமிழ்.

கூறு: 4 நேரம்: 12

தொல்காப்பியமும் ஒலியியலும் - தொல்காப்பியமும் சொல்லியலும் - தமிழ் ஒலிகளின் பிறப்பு விளக்கம் - புணர்ச்சி வகை. தமிழ் உருபனியலும் தொடரியலும் - தலைமை இலக்கணக் கூறுகள் - தொடரமைப்பு இலக்கணம். பெயர்த்தொடர் அமைப்புகள்: மொழியின் பெருமை - எழுத்தும் பேச்சும் - கிளை மொழிகள் தோற்றம் - இலக்கியக் கிளைமொழி- வட்டாரக்கிளை மொழிகள்.

கூறு: 5 நேரம்:12

தமிழ் வளர்ச்சி - தமிழ் ஆட்சிமொழி வரலாறு - தமிழ் கல்விமொழி வரலாறு - கலைச் சொல்லாக்கம் - அறிவியல் தமிழ் வளர்ச்சி-உலகத் தமிழ் மாநாடுகள்- உலக அரங்கில் தமிழ் - தமிழ் அமைப்புகள்- உலகத் தமிழாராய்ச்சி நிறுவனம் - தமிழ்ப்பல்கலைக் கழகம்-செம்மொழி ஆய்வுமையம் - அயல் மாநிலங்களில் தமிழ்.

பார்வை நூல்கள்:

1. *தமிழ் வரலாறு - தேவநேயன். ஞா.*
2. *தமிழ் மொழி வரலாறு - பரிதிமாற்கலைஞர்*
3. *பழந்தமிழ் - இலக்குவனார் . சி*
4. *தமிழ் வரலாறு - குணா*
5. *தமிழ் மொழி வரலாறு - தமிழ் வளர்ச்சி இயக்ககம்*
6. *ஆட்சித் தமிழ் - புதுவை மொழியியல் பண்பாட்டுக் கழக வெளியீடு*
7. *இந்திய ஆட்சிப்பணி வழிகாட்டி - முனைவர் ெர. குமரன்.*
8. *உலகத்தமிழ் மாநாடுகள் - சாலை இளந்திரையன்*
9. *தாய்மொழியில் படிக்க வைப்போம் - NCBH வெளியீடு.*
10. *தமிழ் ஆட்சி மொழி வரலாறு - தமிழ்ப்பல்கலைக்கழகம்.*
11. *தமிழ் ஆட்சிமொழி வரலாறு - தெ.பொ.மீ.*
12. *தமிழ் மொழி வரலாறு - சக்திவேல்*

Semester	Course Code	Title of the Course	Hours of Teaching / Week	No. of Credits
III	**20P3ENEDC**	**Extra Disciplinary Course - Shakespeare Studies**	**4**	

Objective

- To initiate the non English majoring students to study Shakespeare's plays, and his sonnets.

Outcome

- Gaining appreciative and analytical understanding of Shakespeare's dramas and sonnets.
- Achieving potentiality to situate and relate Shakespeare's wisdom in various current disciplines and media cultures.
- Obtaining a profound perspectives on handling racism, class divisions, gender roles, crime, love, war, death betrayal, hope, loyalty etc., derived from the works

Unit – I

Shakespeare's Sonnets 1, 18, 29, 33, 35, 65 and 130

Unit – II

The Merchant of Venice

Unit – III

Henry IV, Part I

Unit – IV

Othello

Unit – V

Antony and Cleopatra

References:

- Bates, Jonathan. *The Genius of Shakespeare.* London: Picador, 1997.
- Leishman, J.B. *The Theme and Variation in Shakespeare's sonnets.* London: Routledge, 2005.

Semester	Subject Code	Title of the paper	Hours of Teaching/ Week	No. of Credits
III	**20P3CMEDC**	**Entrepreneurial Development**	**4**	**-**

Objective:

- To make the students to become a successful entrepreneur and to know the process involved in entrepreneurship.

Course Outcome:

- Learn the incentives and subsidies provided to budding entrepreneurs and Become familiar with institutions offering various forms of assistances.

Unit - I

Entrepreneurship - Nature and Characteristics of an Entrepreneur - Difference between Entrepreneur and Manager - Qualities, Types, and Functions of an Entrepreneur - Role of Entrepreneur in Economic Development.

Unit - II

Business Ideas - Sources of Idea - Idea Processing and Selection - Start up Process - Project Identification and Selection - Project Formulation - Project Appraisal.

Unit - III

Factory Design and Layout - Importance - Factors affecting Factory Design - Factory Layout - Objectives - Types - Consideration in Designing Layout - Design Requirements.

Unit - IV

Institutions Assisting to Entrepreneurs - NSIC - SIDCO - SSIB - DIC – TIIC – KVIC – TCO – ITCOT - Commercial Banks and New Entrepreneurial Development Agency.

Unit - V

Entrepreneurship Development Programmes - Need - Objectives - Institutional efforts in Developing Entrepreneurship – Evaluation of EDPs – Problems in the conduct of EDPs – Suggestions to make EDPs effective – Planning EDPs - Role of SISI, SIPCOT and SIDBI – Recent Development in Small Enterprises in India – Government rules and regulations – Rural Entrepreneurship – Need for Rural Entrepreneurship Problems – SHGs and Rural Development – MUDRA Banking /MSME Loans.

Text book:

1. C.B.Gupta., N.P.Srinivasan, (2018), Entrepreneurial Development, Sultan Chand & Sons, New Delhi.

Reference Books

1. Khanka S.S., (2019) Entrepreneurial Development, S.Chand & Co, New Delhi.
2. Saravanavel, P. (2016), Entrepreneurial Development, Principles, Policies and Programmes, Ess Pee Kay Publishing House, Tanjore.
3. Renu Arora, Sood S.K., (2018)Fundamentals of Entrepreneurship and Small Business, Kalyani Publications, Ludhiana.
4. Jayashree Suresh, (2019)Entrepreneurial Development, Margham Publications, Chennai.

Semester	Subject Code	Title of the Paper	House of Teaching / Week	No.of Credits
III	**20P3MAEDC**	**Extra Disciplinary Course- Applicable Mathematical Techniques**	**4**	**-**

Objectives:

- To discuss various methods of Interpolation

Out comes: After studying this course the student will be able to

- Student will demonstrate the ability to solve financial math problem.

Unit I **12 Hrs**

Interpolation with unequal intervals: Newton's divided difference formula - Lagrange's interpolation formula and inverse interpolation. (Only simple Problems)

Unit II **12 Hrs**

Assignment problems

Unit III **12 Hrs**

Replacement problems (Only simple Problems)

Unit IV **12 Hrs**

Decision Analysis

Unit- V **12 Hrs**

Game Theory

Text Book:

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

   Unit I : Chapter - 8 (Sec: 8.5, 8.7)

   Unit II : Chapter - 11 (Sec: 11.1 to 11.4)

   Unit III : Chapter - 18 (Sec: 18.1 to18.3)

   Unit IV : Chapter - 16 (Sec: 16.1 to 16.5)

   Unit V : Chapter - 17 (Sec: 17.1 to 17.6)

General Reference:

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

Semester	Subject Code	Title of the paper	Hours of Teaching / Week	No. of Credits
III	**20P3PHEDC**	**Extra Disciplinary Course- Fundamentals of Nanotechnology**	**4**	**-**

Unit – I Introduction to Nanotechnology

Nanotechnology – Definitions - History of nanotechnology – Nanomaterials: classification – zero, one and two dimensional nanomaterials – Classification based on the composition of materials (metal, semiconductor, ceramic, polymeric and carbon-based nanomaterials) - Properties of nanomaterials – Surface area to volume ratio (S.A/V) – Quantum dots - Challenges in nanotechnology.

Unit – II Preparation Methods

Top-down and Bottom-up approaches – Top down methods: Ball milling - Electron beam lithography – Advantages – Limitations. Bottom-up methods: Vacuum evaporation - Sputter deposition process - Laser ablation

– Advantages – Limitations.

Unit – III Fullerenes

Fullerenes – Types of fullerenes – Bucky ball/Buckminster fullerene - Carbon nano tubes (CNTs) - Single walled CNTs – Multi walled CNTs – Differences – mechanical and electrical properties of CNTs - preparation of CNTs – Plasma discharge method – Applications.

Unit – IV Characterization Techniques

Construction, working principle, merits and demerits of X-ray diffractometer - Scanning Electron Microscope (SEM) – Atomic Force Microscope (AFM) - UV-Vis–NIR double beam spectro photometer – Energy dispersive X-ray analysis (EDAX) .

Unit – V Applications

Nanoelectronics – Nanophotonics – Nanomaterials in energy conversion and storage – Nanomaterials as antibacterial agents – Nanomaterials as photocatalysts – Nanomaterial in industrial applications – Bio-medical applications : Targeted drug delivery – Nanomaterial based radiation therapy – Photodynamic therapy (PDT) – Bio imaging.

Books for Study

1. K. Ravichandran, K. Swaminathan, P.K. Praseetha, P. Kavitha, Introduction to Nanotechnology, JAZYM publications.
2. M.Ratner.et al., Nanotechnology; A Gentle intro Practices – hall ISBN 0-13-101400-5, 2003.
3. Nanotechnology; Basic Science and Emergining Technologies, CRC Press

Books for Reference

1. Charles P.Poole Jr and Frank J.Owens. "Introduction to Nanotechnology" Wiley, 2003.
2. A. S. Edelstien and R.C. Cornmarata, Nanomaterials; synthesis, Properties and Applications, 2ed, Iop (U.K), 1996.

Semester	Subject code	Title of the paper	Hours of Teaching/ Week	No. of Credits
III	**20P3CHEDC**	**Extra Disciplinary Course - Chemistry in Every Day Life**	**4**	

OBJECTIVES

Students learn about the scientific and chemical principles underlying in everyday life.

- Students learn about the cleaning agents and water chemistry,
- Students understand about the food chemistry,
- Students shall learn about the cosmetic and their effect in health aspects
- Students shall know about the green chemistry and their significance for clean environments
- Students learn about the nano technology and their importance.

Unit-I

Cleaning agents - manufacture and uses of soaps, detergents, baking powder, shampoo, washing powder and bleaching powder **Water –** uses of water Characteristics' of water, soft water and hard water - removal of hardness – ion exchange method. Reverse osmosis method, Water pollution, causes and prevention.

Unit-II

Food – importance – spoilages – causes, preservation – additives – colouring and flavouring agents, beverages. Soft drinks aerated water – manufacturing – mineral water. Fruits, vegetables, dairy product – storage, preservation. Minerals in food and anti oxidants. Preparation of fruit Jam and pickle.

Unit-III

Cosmetics – Face powder – constituents, uses – side – effects. Nail polish, hair dye – composition and side effects. Tooth powder – lotions. Preparation of phenyl, liquid blue and incense sticks.

Unit-IV

Basic concepts of Green chemistry and its significance in day to day life. Polymers – Classification – Types of polymerization – plastics – classification – types of plastics – PVC, Teflon, PET, Bakelite – Rubber – Natural and synthetic – Bunas rubber, Butyl Rubber. Vulcanization of rubber, neoprene rubber, Plastic pollution and prevention.

Unit-V

Basic concepts of Nano Technology and its importance in day to day life.

Dyes – importance of food colours – PFA (Prevention of Food Adulteration Act) Natural dyes – Synthetic Classification importances – Uses of the following Synthetic dyes - Direct dyes, acid dye, Basic dye, mordant dye, Reactive dye, Disperse dye, Fastness – Light and Washing. Application of dyes in food, paper, plastic and lather.

COURSE OUTCOME:

- Students should able to learn about the cleaning agents and water chemistry,
- Students should able to understand about the food chemistry,
- Students should able to learn about the cosmetic
- Students shoud able to know about the green chemistry
- Students should able to learn about the nano technology

References:

1. Norrish Shreave. R. and Joseph A. Brink Jr Chemical Process Industries, McGraw Hill, Industrial Book Company London 1978.
2. Brain A.C.S. Reinhold, Production and properties of Industrial chemicals 11th Ed, John Wiley & Sons, New York.
3. Burgh, A. Fermentation Industries, Inter science, 4th Ed, 1983, A *Inter science*, New York.
4. Ramani,V. Alex, Food Chemistry(2009),MJP publishers.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	**20P3BOEDC**	**Extra Disciplinary Course – Medicinal Botany and Pharmacognosy**	**4**	**-**

Objectives

- To enable the students to identify local medicinal plants.
- To enable the students to prepare herbal medicines for curing human ailments.
- To impart knowledge to students on Botany and Phyto chemistry of medicinal plants.

Unit I

Medicinal Botany: Definition, Introduction, History, – Classification – Common medicinal plants cultivation, storage, collection and habitats of medicinal plants (*Catharanthus, Coleus*, *Aloe*) – Importance of medicinal plants.

Unit II

Indian systems of medicine – AYUSH - Siddha, Ayurveda, Homeopathy and Unani – Indigenous medicinal plants – Useful parts –Chemical constituents – medicinal uses – medicinal plant drugs.

Unit III

Herbal medicines for human ailments – Heart, kidney, liver, eye, skin, hair, stomach problems, diabetics, blood pressure, headache, cough, cold, fever, digestive problems, joint pains and wounds.

Unit IV

Pharmacognosy – History, Introduction, commercial drugs, crude drugs – classification of drugs – Chemistry of drug and drug evaluation of natural products.

Unit V

Drug adulteration and detection – Substitution – Detection of Adulterations - Elementary knowledge on alkaloids and flavonoids – Preparation of herbal oil, herbal tooth powder, herbal soup, herbal immune boosters.

Books for Reference

- Kumar, N.C., (1993). An introduction to Medical Botany and Pharmacognosy.
- Shah, S.C. and Quadry (1990). A text book of Pharmacognosy.
- Nadkarni, (1981). Indian MateriaMedica.
- Jain, S.K., (1980). Indian Medicinal Plants.
- Balu, S., Murugan, R. and Pandiyan, P., (2005). Herbal Technology.

Outcome

After completion of this course, students would be able to

- Understand the various Indian system of medicine
- Learn about the vital role of herbal medicines for human ailments
- Outline and classify the crud drugs
- Trained about drugs adulteration and direction

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	**20P3MBEDC**	**Extra Disciplinary Course – Mushroom Technology**	**4**	**-**

Objectives

- To know the various types of edible mushroom and their nutritional value.
- To understand the methods of cultivation of mushrooms.
- To know the types of food prepared from mushroom and their importance in human health.
- Marketing of mushrooms in India and abroad.
- Mushroom cultivation unit visit- mandatory –Neighbouring District –one day.

Unit I

Introduction – history – scope of edible mushroom cultivation – Types of edible mushrooms available in India – *Calocybeindica, Volvariellavolvacea, Pleurotuscitrinopileatus*, and *Agaricusbisporus.*

Unit II

Pure culture – preparation of medium (PDA and Oatmeal agar medium) sterilization – preparation of test tube slants to store mother culture – culturing of *Pleurotus*mycelium on petriplates, preparation of mother spawn in saline bottle and polypropylene bag and their multiplication.

Unit III

Cultivation Technology: Infra structure – Mushroom bed preparation – paddy straw, sugarcane thrash, maize straw, banana leaves. Factors affecting the mushroom bed preparation – Low cost technology. Composting technology in Mushroom production.

Unit IV

Storage and nutrition: Short-term storage (Refrigeration – upto 24 hours) Long term Storage (canning, pickles, papads), drying, storage in salt solutions. Nutritive value – proteins – amino acids, mineral elements – Carbohydrates, Crude fibre content – Vitamins.

Unit V

Food Preparation – Types of food prepared from mushroom; Soup, Cutlet, Omlette, Samosa, Pickles, Curry – Research Centres – National level and Regional level – Cost benefit ratio – Marketing in India and abroad, Export value.

Books for Reference:-

- Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayaranjan, R., (1991). Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
- Swaminathan, M., (1960). Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No.88, Mysore Road, Bangalore 560 018.
- Tewari, Pankaj Kapoor, S.C., (1988). Mushroom Cultivation, Mittal Publications, Delhi.
- Nita Bahi (1984-1988). Handbook of Mushrooms, II Ed, Vol. I & II.
- Paul Stamets, J.S and Chilton J.s (2004). Mushroom cultivation. A practical guide to graining mushroom at home Agarikon Press.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	**20P3ZOEDC**	**Extra Disciplinary Course – Clinical Lab Technology**	**4**	**-**

Objectives:

1. To study the various sterilization techniques.
2. To know the disposal of waste.
3. To identify the blood group and urine sugar.
4. To identify the bacteria and fungus.
5. To know the various diagnostic equipment.

Unit I **12 Hrs**

Scope for study of Clinical Technology. Sterilization – Methods of Sterilization – Dry heat method – Wet heat method – Chemical method of sterilization – Disposal of hospital wastes and infected material - Disinfection laboratory glassware and equipments.

Unit II **12 Hrs**

Composition of blood–ABO blood typing–Rh blood typing–Blood cells counting – Total erythrocyte count, total WBC count and differential count – Sugar level in Blood – Hypoglycemia, Hyperglycemia conditions. Composition of urine – Physical characters of urine–Method of urine analysis for sugars.

Unit III **12 Hrs**

Analysis of Semen, Sputum and stool, Identification of blood parasites, Bacterial culture in NA medium, Fungal culture in PDA medium, Histological study of cells – Histological procedure for the preparation of tissue slides.

Unit IV **12 Hrs**

Diagnostic equipment and apparatus – ECG, EEG, Colorimeter, pH meter, PCR, laminar airflow inoculation chamber, Binocular microscope and Incubator.

Unit V **12 Hrs**

Immuno techniques – ELISA, HLA typing, VDRL Test.

Viral , bacterial and fungal diseases, First aid- definition and types and applications

Reference:

1. Medical Laboratory Technology (1994) (4th edition), By Ramik Sood, Jaypee Brother Medical Publishers (P) Ltd., New Delhi 110 002.
2. Medical Laboratory Technology, K.M. Samuel.
3. Clinical Pharmacology (1987), by Dr. Lawrance and P.N. Bennett (Sixth Edition), ELBS, English Language Book Society, Churchil Livingstone, England.
4. District Laboratory Practice in Tropical countries, part I, By Mouica Cheesbrough, Cambridge Las Priced Edition, Cambridge University Press, Cambridge, U.K.
5. Basic Clinical Paraitology (1993), W.Harold Brown and A.Franklin Neva (5th edition), Prntice Hall Internation Edition.
6. Biological Chemistry – Leringer.

7. Human Physiology by Pearse.
8. The Biology of Animal Paraistes (1984), Cheng, T.Toppan C9 Ltd., Japan.
9. Medical Laboratory Technology: A procedure manual for routine diagnostic tests Volume – I-II By Kanai, L.Mukherjee, Tata McGraw – Hill Publishers, New Delhi.
10. Basic Clinical Paraitology 5th Edn, Harrold, W.Harold Brown and A. Franklin Neva-prentice Hall Internation Editions, U.S.A.

Web Links:

https://www.sunydutchess.edu/academics/catalog/current/courses/medical_laboratory_tech/index.pdf(Dutchess Community College, New York).
https://www.sunydutchess.edu/academics/catalog/current/programs/medicalandalliedhealth/mlt.pdf(Dutchess Community College, New York).
https://makautwb.ac.in/syllabus/BSc%20(Medical%20Lab%20Technology)28.02.2018.pdf

Course Outcome

- Pare the way for basic idea of various aseptic technique.
- Understanding the significance of waste disposal.
- Knowledge on Blood grouping and Blood sugar & urine sugar level.
- Gaining knowledge on culture of Bacteria, fungi and expertise on histological slide preparation.
- Operation technique of Diagnostic apparatus.
- Understanding for various immune techniques.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	**20P3BTEDC**	**Extra Disciplinary Course – Trends in Biotechnology**	**4**	**-**

Objectives:

1. To study the concept and scope of Biotechnology.
2. To Understand r-DNA Technology.
3. To aware the programmes of cell culture, preparations of hormones and vaccines, transgenic animals and human genome project.
4. To study the Bioprocess technology and their applications.
5. To study the Environment Biotechnology and aware the biodiversity and their conservation.

Unit I **Hrs12**

Biotechnology – Introduction and Scope of Biotechnology – Gene Cloning, Cell –free protein production – Production of Health care Products, Medical and Forensic application (RFLP, RAPD, DNA finger printing). Applications of PCR and LCR in disease diagnosis.

Unit II **Hrs12**

Nuclear transplantation, Transgenic Animals Development and uses – mice, goat, fish and sheep. Tendered meat production. Transgenic Plant: Insect resistance, fungus resistance, virus resistance, drought, cold resistance, saline resistance, Transgenic plant with vitamin A, Gene Production of therapeutic antibodies and edible vaccine.

Unit III **Hrs12**

Bioprocess technology – Scope – Fermentor –Bioprocess products: Organic acids – Citric acid, Lactic acid, acetic acid. Antibiotics – Wide and Narrow specxtrum antibiotics. Aminoacids – Glutamic acid, Lysine, Isoleucine, Aspartic acid and Proline. Production of SCP. Enzyme Production – Amylase, Pectinase and Cellulase. Dairy products and Biofuel production.

Unit IV **Hrs12**

Biofertilizers – N_2 fixing microbes (Azolla, Azatobacter, Azospirillum) for use in Agriculture – A. tumifasciens for crop improvement – Biopesticides. Biopolymer and its Application – Biosensor and its application – Bioleaching- Biomining – Biotechnology in oil recovery – Bioremediation of Xenobiotics – superbug – its application. Biodegradation.

Unit V **Hrs12**

Regulations of Biosafety: possible dangers of GEO, Biohazards of rDNA technology. National and International biosafety guidelines, Primary and secondary containments and implementation. Web based information of biosafety on GMO.

Reference:

1. Dubey, R.C. – A Text Book of Biotechnology, S. Chand & Co., Ltd, New Delhi, 1996.
2. Gupta, P.K. – Elements of Biotechnology, Rastogi and Co., Meerut, 1994.
3. Kumar, H.F. A text book on Biotechnology, Affiliated East & West Press Pvt., Ltd, N-Delhi.
4. D.Balasubramanian *et. al.,* - Concepts in Biotechnology.
5. Singh, R.S. – Introductory Biotechnology, Central book deport, Allahabad.
6. Primrose, R. – Molecular Biotechnolgoy, ASM Press.
7. Lick, E.R. and Pastenak – J.J. Molecular Biotechnology.
8. Ignachimuthu – Plant biotechnology, Oxford IBH Publishers, New Delhi.
9. Ranga – Fishery Biotechnology.
10. Primrose, R. – Molecular Biotechnology, ASM Press.
11. Purohit – A Text Book of Biotechnology, Agrobions, Jodhpur.

Semester	Subject code	Title of the course	Hours of Teaching/ Week	No. of Credits
III	**20P3CSEDC/ 20P3ITEDC**	**Extra Disciplinary Course- E-Learning Technologies**	**4**	**-**

Objective

- To learn the various E-learning approaches and components.
- To understand the types of design models of E-Learning.
- To explore the models for E-learning courseware development.
- To learn about E-learning authoring tools.
- To know about evaluation and management of E-learning solutions.

UNIT I INTRODUCTION

Need for E-Learning – Approaches of E-Learning – Components of E-Learning – Synchronous and Asynchronous Modes of Learning – Quality of E-Learning – Blended Learning: Activities, Team and Technology – Work Flow to Produce and Deliver E-Learning Content – Basics of Design Thinking.

UNIT II DESIGNING E-LEARNING COURSE CONTENT

Design Models of E-Learning – Identifying and Organizing E-Learning Course Content: Needs Analysis – Analyzing the Target Audience – Identifying Course Content – Defining Learning Objectives – Defining the Course Sequence – Defining Instructional Methods – Defining Evaluation and Delivery Strategies – Case Study.

UNIT III CREATING INTERACTIVE CONTENT

Preparing Content: Tips for Content Development and Language Style – Creating Storyboards: Structure of an Interactive E-Lesson – Techniques for Presenting Content – Adding Examples – Integrating Multimedia Elements – Adding Examples – Developing Practice and Assessment Tests – Adding Additional Resources– Courseware Development Authoring Tools – Types of Authoring Tools – Selecting an Authoring Tool

UNIT IV LEARNING PLATFORMS

Types of Learning Platforms – Proprietary Vs. Open – Source LMS – LMS Vs LCMS – Internally Handled and Hosted LMS – LMS Solutions – Functional Areas of LMS.

UNIT V COURSE DELIVERY AND EVALUATION

Components of an Instructor-Led or Facilitated Course – Planning and Documenting Activities – Facilitating Learners Activities – E-Learning Methods and Delivery Formats – Using Communication Tools for E-Learning – Course Evaluation.

REFERENCES:

1. Clark, R. C. and Mayer, R. E, "eLearning and the Science of Instruction", Third Edition, John Wiley, 2016.
2. Means, B., Toyama, Y., and Murphy, R, "Evaluation of Evidence – Based Practices in Online Learning: A Meta – Analysis and Review of Online Learning Studies", Centre for Learning Technologies, 2010.
3. Crews, T. B., Sheth, S. N., and Horne, T. M, "Understanding the Learning Personalities of Successful Online Students", Educause Review, 2014.
4. Johnny Schneider, "Understanding Design Thinking, Lean and Agile", O'Riley Media, 2011.
5. Madhuri Dubey, "Effective E – learning Design, Development and Delivery", University Press, 2011.

Course Outcomes:

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

- Distinguish the phases of activities in the models of E-learning.
- Identify appropriate instructional methods and delivery strategies.
- Choose appropriate E-learning authoring tools, Create interactive E-Learning courseware, Evaluate the E-learning courseware, Manage the E-learning courseware.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	**20P3LSEDC**	**Extra Disciplinary course Documentation Centers in India**	**4**	**-**

Objectives:

- To promote and support adoption of standards in library operations.
- To coordinate with other regional, national & international network for exchange of information and documents

Unit I

Components of information systems-Libraries, Documentation centers, Information centers.

Unit II

Data banks, Information analysis centers, Referral centers, Clearing Houses, Reprographic and translation centers-Their function and services.

Unit III

National Information systems: DESIDOC, NASSDOC, SENDOC, NISCAIR and INFLIBNET.

Unit IV

Information Aggregators, Databases Proquest, EBscohost, J-gate, POPLINE, Shodhganga, NDL,.

Unit V

Information products and series – Newsletters, House Bulletins in – house Journals, state of art reports, digest and Technical Digest.

Outcome:

The students shall be able to:

- Know the standards in library operations.
- Understand the regional, national & international network for exchange of information and documents

Reference:

1. Date, C.J. An Introduction to Database System, ed.7, Delhi: Pearson Education (Singapore), 2002
2. Desai, Bipin C. An Introduction to Database System, New Delhi, Galgetia, 2001
3. Karts Henry F, DBS Computer, New Delhi, McGraw Hill, 2000.
4. Raghu Ramakrishnan, DBMSS, New Delhi, McGraw Hill, 2000.
5. Gangadharaiah G, Management of Information Products and Services in University Libraries, Common Wealth, New Delhi, 2012.