GOVERNMENT ARTS COLLEGE (AUTONOMOUS)

KUMBAKONAM 612 002

Re - accredited With 'A' Grade by NAAC & Affiliated to Bharathidasan University

DEPARTMENT OF MATHEMATICS

(Effective for those admitted from 2017-2018 onwards)

SYLLABI

M.Sc., MATHEMATICS

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.

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M.Sc., MATHEMATICS

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SEMESTER - I

CC 1 - ALGEBRA

Subject Code: 17P1M1	Credits: 4	External Marks: 75	Hours: 6

Objectives: ***To enable the students to***

1. *Understand the various concepts in Group theory, Ring theory, Vector Spaces and Modules.*
2. *Solve problems in these areas.*
3. *Provide a strong foundation in the abstract* approach.

UNIT I: **GROUP THEORY:** Another Counting principle - Sylow's theorem.

UNIT II: **RING THEORY:** More Ideals and Quotient Rings – The Field of Quotients of an integral domain – Euclidean rings – A Particular Euclidean Ring.

UNIT III: **POLYNOMIAL RINGS:** Polynomial Rings – Polynomials over the rational field – Polynomial rings over commutative rings.

UNIT IV: Dual spaces - modules - Extension Fields.

UNIT V: Roots of Polynomials –More about roots - The Elements of Galois Theory.

TEXT BOOK: TOPICS IN ALGEBRA by I. N. HERSTEIN, 2nd edition, John Wiley & sons publications.

UNIT I : Chapter 2: 2.11 & 2.12
UNIT II : Chapter 3: 3.5 to 3.8
UNIT III : Chapter 3: 3.9 to 3.11
UNIT IV : Chapter 4: 4.3 & 4.5 Chapter 5: 5.1
UNIT V : Chapter 5: 5.3, 5.5 & 5.6

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SEMESTER - I
CC 2 - REAL ANALYSIS

Subject Code: 17P1M2	Credits: 4	External Marks: 75	Hours: 6

Objectives:

To enable the students to

1. *Provide a Comprehensive idea about the principles of real analysis.*
2. *Understand the concepts of Metric Spaces, Continuity, Differentiation and Riemann Stieltjes Integrals*
3. *Apply the above Concepts to new situations.*
4. *Develop the right approach towards research in analysis.*

UNIT I: **BASIC TOPOLOGY** :Finite, countable and uncountable sets - metric Spaces - Compact sets – perfect sets - connected sets.

UNIT II: **Continuity:** Limits of Functions – Continuous Functions – Continuity and Compactness – Continuity and Connectedness – Discontinuities – Monotonic functions.
Differentiation: The derivative of a real function – Mean value Theorems – Continuity of derivatives – L'Hospital's Rule – Taylor's Theorem.

UNIT III: **RIEMANN – STIELTJES INTEGRALS** : Definition and existence of the integral – properties of the integral - Integration and differentiation- Integration of vector valued functions – Rectifiable curves.

UNIT IV: **SEQUENCES AND SERIES OF FUNCTIONS:** Uniform convergence – Uniform convergence and Continuity – Uniform Convergence and integration – Uniform Convergence and differentiation - Equicontinuous families of functions – The Stone-Weierstrass theorem.

UNIT V: **FUNCTIONS OF SEVERAL VARIABLES:** Functions of several variables: Linear Transformations - Differentiation – The Contraction Principle – The Inverse Function Theorem - The Implicit Function Theorem.

TEXT BOOK: PRINCIPLES OF MATHEMATICAL ANALYSIS BY WALTER RUDIN (III Edn)

UNIT I : Chapter 2
UNIT II : Chapter 4 and 5 (omit 5.16 to 5.19)
UNIT III : Chapter 6
UNIT IV : Chapter 7 : Section 7.7 to 7.27
UNIT V : Chapter 9 : Section 9.1 to 9.29

Books for reference:

1. Mathematical Analysis : T. M. APOSTOL (Addision Wesley)
2. Real Analysis : H. L. ROYDEN (Mac millan II Edn)

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SEMESTER - I
CC 3 - ORDINARY DIFFERENTIAL EQUATIONS

Subject Code: 17P1M3	Credits: 4	External Marks: 75	Hours: 6

OBJECTIVES

To enable the Students to

1. *develop skills to find Solutions of homogenous ,non homogenous equations and homogeneous equations with analytic co-efficients.*
2. *be familiar with Legendre, Euler and Bessel equations.*
3. *know the method of solving partial differential equations using Cauchy, Charpit and Jacobi methods.*
4. *acquire the knowledge of solving second order partial differential equations.*
5. *understand Laplace equations and Boundary value problems.*

UNIT I: The general solution of the homogeneous equation–the use of a known solution to find another - the method of variation of parameters–series solutions of first order equations.

UNIT II: Second order linear equations – ordinary points - Regular singular points - regular singular points(continued) – Gauss's Hyper geometric equation – Legendre polynomials – properties of Legendre Polynomials.

UNIT III: Bessel functions – Gamma functions – Properties of Bessel functions – System of first order equation : Linear system – Homogeneous linear system with constant co-efficients.

UNIT IV: Oscillation Theory and Boundary value problems : Qualitative Properties of Solutions – The Sturm Comparison Theorem – Eigen values, Eigen functions and the Vibrating String.

UNIT V: Critical points and stability for linear systems – Stability by Liapunov's direct method – Simple critical points of nonlinear systems.

TEXT BOOK:

Differential Equations with Application and Historical notes by George F. Simmons.

UNIT I : Chapter 3 Sec15,16, 19 ; Chapter 5 Sec 27;
UNIT II : Chapter 5 Sec 28,29,30,31; Chapter 8 sec 44,45;
UNIT III : Chapter 8 Sec 46, 47; Chapter 10 Sec 55, 56;
UNIT IV : Chapter 4 Sec 24, 25; Chapter 7 Sec 40;
UNIT V : Chapter 11 Sec 60,61,62.

REFERENCE BOOKS

1. Prasad,P and Renuka ,R.,"Partial Differential Equations", Wiley eastern Ltd., NewDelhi, 1987.

2. Raisinghania ,M.D., "Differential Equations", S .chand and Co .Ltd., New Delhi,2007

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SEMESTER - I
CC 4 - STOCHASTIC PROCESSES

Subject Code: 17P1M4	Credits: 4	External Marks: 75	Hours: 6

Objectives:
To enable the students to

1. Understand the Concepts of Markov Chains and Markov processes.
2. Study the applications of stochastic processes in Queuing and Reliability.
3. Understand the basic Concepts of renewal processes and its applications.
4. Develop ability in students to apply Stochastic Models to real life problems.

UNIT I: **STOCHASTIC PROCESSES: SOME NOTIONS:** Introduction – Specification of stochastic processes – Stationary processes.
MARKOV CHAINS: Definition and examples – Higher transition probabilities- Generalization of independent Bernoulli trials: Sequence of chain dependent trials.

UNIT II: **MARKOV CHAINS continued:** Classification of states and chains – Determination of Higher transition probabilities – Stability of a Markov system – Markov chains with denumearable number of states – Reducible chains - Markov chains with continuous space.

UNIT III: **MARKOV PROCESSES WITH DISCRETE STATE SPACE:** Poisson process – Poisson process and related distributions.

UNIT IV: **RENEWAL PROCESSES AND THEORY:** Renewal Process – Renewal Processes in continuous time – Renewal equation – Stopping time: Wald's equation - Renewal Theorems.

UNIT V: **STATIONARY PROCESSES IN QUEUEING AND RELIABILITY:** Queueing systems:General concepts – The queueing model M/M/1:Steady state behaviour – Transient behavior of M/M/1 model – Birth and death process in queueing theory: Multichannel models – Non birth and death queueing process: Bulk queues.

TEXT BOOK: STOCHASTIC PROCESSES by J.MEDHI, 2nd edition
UNIT I : Chapter2: 2.1 to 2.3 Chapter3: 3.1 to 3.3
UNIT II : Chapter3: 3.4 to 3.6, 3.8, 3.9, 3.11
UNIT III : Chapter4: 4.1 to 4.2
UNIT IV : Chapter6: 6.1 to 6.5
UNIT V : Chapter8: 10.1 to 10.5

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SEMESTER - I
CC 5 - METHODS OF APPLIED MATHEMATICS

Subject Code: 17P1M5	Credits: 4	External Marks: 75	Hours: 6

Objectives:

To enable the students to

1. *Acquire knowledge and develop interest in Applied Mathematics.*
2. *Know about Calculus of Variations.*
3. *Understand various methods involved in Fourier Transforms.*
4. *Understand the theory and applications of Initial and Boundary value problems.*

UNIT I: **VARIATIONS PROBLEMS** : Maxima and Minima – The simplest case – Illustrative Examples – Natural Boundary Conditions and transition conditions – The variational Notation.

UNIT II: **GREEN'S FUNCTION** :Introduction – Relations between differential and integral Equations – The Green's function – Fredholm equations with separable kernels – Illustrative Example.

UNIT III: **HILBERT SCHMIDT THEORY** : Hilbert-Schmidt Theory – Iterative Methods for solving equations of the second kind – The Neumann series – Fredholm Theory – Singular Integral Equations – Special devices.

UNIT IV: **FOURIER TRANSFORMS** : Inversion formula for complex Fourier transform – Fourie Cosine and Sine Transforms–linearity property – Change of scale property – Shifting property – modulation and Convolution theorems – problems.

UNIT V: **APPLICATION OF FOURIER TRANSFORM IN INITIAL AND BOUNDARY VALUE PROBLEMS** : Application of infinite Fourier transforms Choice of infinite sine or cosine transforms – Application of finite Fourier transforms – Finite Fourier transform of partial derivatives – Choice of finite sine or cosine transforms.

TEXT BOOK:

1. **METHODS OF APPLIED MATHEMATICS – By FRANCIS B. HILDEBRAND (II EDN)**
2. **INTEGRAL TRANSFORMS – BY A.R. VASISTA AND R . K. GUPTA. (KRISHNA PRAKASHAN MANDIR LTD)**

UNIT I : Chapter 2 : 2.1 to 2.5 (Text book I)
UNIT II : Chapter 3 : 3.1 to 3.3 & 3.6 to 3.7 (Text book I)
UNIT III: Chapter 3 : 3.8 to 3.13 (Text book I)
UNIT IV : Chapter 6 : FULL (Text book II)
UNIT V : Chapter 8 : FULL (Text book II)

BOOK FOR REFERNCE:

INTEGRAL TRANSFORMS – BY DR. J.K. GOYAL AND K.P. GUPTA – (PRAGATI PRAKASHAN – MEERUT)

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SEMESTER - II

CC 6 - LINEAR ALGEBRA

Subject Code: 17P2M6	Credits: 5	External Marks: 75	Hours: 6

Objectives:

To enable the students to

1. *Understand the various concepts in Group theory, Ring theory, Vector Spaces and Modules.*
2. *Solve problems in these areas.*
3. *Provide a strong foundation in the abstract approach.*

UNIT I: Vector spaces: Vector spaces - Subspaces- Bases and Dimension- Coordinates. Linear transformations: Linear transformations -The algebra of linear Transformation.

UNIT II: Isomorphism - Representation of Linear Transformations by Matrices- Linear functionals- The double dual- The transpose of a linear transformation.

UNIT III: Polynomials: Algebras -The algebra of polynomials-Lagrange interpolation-Polynomial Ideals-the prime factorization of a polynomial.

UNIT IV: Determinants: Commutative rings- Determinant functions- Permutations and the uniqueness of determinants-Additional properties of determinants. Elementary canonical forms: Introduction - Characteristic values- Annihilating Polynomials.

UNIT-V: Invariant subspaces - Simultaneous triangulation and simultaneous diagonalization – Direct-sum Decompositions -Invariant Direct Sums – The primary Decomposition theorem –.

TEXT BOOK:

Kenneth Hoffman and Ray Kunze., Linear Algebra second Edition, prentice – Hall of India private Limited, New Delhi 1971.

UNIT I : Chapter 2 (Section 2.1 to 2.4) Chapter 3 (Sec 3.1 to 3.2)
UNIT II : Chapter 3 (Sec 3.3 to 3.7)
UNIT III : Chapter 4
UNIT IV : Chapter 5 (Section 5.1 to 5.4) 6 (Section 6.1 to 6.3)
UNIT V : Chapter 6 (Section 6.4 to 6.8)

REFERENCES:

[1] "TOPICS IN ALGEBRA "By I. N. HERSTEIN, WILEY EASTERN LIMITED,NEW DELHI, 1975.
[2] I.S.LUTHER and I.B.S. PASSI , ALGEBRA VOLUME II, RINGS, NAROSA PUBLISHING HOUSE 1999.
[3] N.JACOBSON BASIC ALGEBRA VOLUMES I& II , FREEMAN.1980 (ALSO PUBLISHED BY HINDUSTAN PUBLISHING COMPANY)

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SEMESTER - II

CC 7 - COMPLEX ANALYSIS

Subject Code: 17P2M7	Credits: 5	External Marks: 75	Hours: 6

Objectives:

To enable the students to

1. Understand analytic functions, Cauchy's theorems and Residue theory.
2. Solve problem in these areas.
3. Know about Integral functions uniform Convergence of power series expansions and infinite products.
4. Develop the right approach towards research in complex analysis.

UNIT I: **Analytic functions as mappings : Elementary Point Set Topology:** Sets and Elements – Metric Spaces – Connectedness – Compactness – Continuous Functions – Topological Spaces; **Conformality:** Arcs and Closed Curves – Analytic Functions in Regions – Conformal Mapping – Length and Area; **Linear Transformations:**The Linear Group – The Cross Ratio – Symmetry.

UNIT II: **Complex integration: Fundamental Theorems**: Line Integrals – Rectifiable Arcs – Line Integrals as Functions of Arcs – Cauchy's Theorem for a Rectangle – Cauchy's Theorem in a Disk; **Cauchy's Integral Formula:** The Index of a Point with Respect to a Closed Curve – The Integral Formula – Higher Derivatives.

UNIT III: **Local Properties of Analytic Functions**: Removable Singularities - Taylor's Theorem – Zeros and Poles – The Local Mapping – The Maximum Principle.

UNIT IV: **The General Form of Cauchy's Theorem:** Chains and Cycles – Simple Connectivity – Homology – The General Statement of Cauchy's Theorem – Proof of Cauchy's Theorem – Locally Exact Differentials – Multiply Connected Regions; **The Calculus of Residues:** The Residue Theorem – The Argument Principle – Evaluation of Definite Integrals.

UNIT V: **Harmonic Functions:** Definition and Basic Properties – The Mean-value Property –Poisson's Formula – Schwarz's Theorem – The Reflection Principle; **Power series Expansions**:Weierstrass's Theorem – The Taylor Series – The Laurent Series.

TEXT BOOK Lars V. Ahlfors, Complex Analysis, Third Ed. McGraw-Hill Book Company, Tokyo,1979.

UNIT – I Chapter 3: Sec 1, 2 and Sec 3: 3.1-3.3
UNIT – II Chapter 4: Sec 1 and 2
UNIT – III Chapter 4: Sec 3
UNIT – IV Chapter 4: Sec 4 and 5
UNIT – V Chapter 4: Sec 6 and Chapter 5: Sec 1

REFERENCES

1. Serge Lang, Complex Analysis, Addison Wesley, 1977.
2. S.Ponnusamy,Foundations of Complex Analysis,Narosa Publishing House,New Delhi,1997.
3. Karunakaran, Complex Analysis,Alpha Science international Ltd,Second edition,2005.

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SEMESTER - II

CC 8 - PROGRAMMING IN C++

Subject Code: 17P2M8	Credits: 4	External Marks: 75	Hours: 6

Objectives:

To enable the students to

1. Learn Object oriented programming concepts such as data abstraction operator overloading, inheritance polymorphism and use them in programming.
2. Prepare the students for software development.
3. To evolve from procedure oriented programming to object oriented programming.

UNIT I: **Principles of object oriented programming :**Object oriented programming paradigm – Basic concepts of object oriented programming . **Beginning with C++: A**pplications of C++ - Structure of C++ program. **Tokens, Expressions and control structures:** Identifiers and constants – Declaration of variables.

UNIT II : **Functions in C++:** Function prototyping – Default arguments – Recursion - Function overloading – Friend and virtual functions – math library functions

UNIT III: **Classes and objects:** Defining member functions – Nesting member function – friendly functions – Local classes. **Constructors and destructors: C**onstructors –Constructors with default argument – Constructing two dimensional arrays – destructors.

UNIT IV: **Operator overloading and type conversions:** Defininig operator overloading – Overloading binary operators – Manipulation of strings using operators – Rules for overloading operators – Type conversions.

UNIT V : **Inheritance : Extending classes** –Defining derived classes – Multiple inheritance – abstract classes – Constructors in derived classes. **Pointers, virtual functions and polymorphisms:** Pointers – Pointers to derived objects – Pointers to derives classes - Virtual functions – virtual constructors and destructors.

TEXT BOOK: 'OBJECT ORIENTED PROGRAMMING WITH C++' By E.Balagurusamy, Tata Mcgrawhill Publishing Company limited.

UNIT I : Chapter 1 to 3
UNIT II : Chapter 4
UNIT III : Chapter 5 & 6
UNIT IV : Chapter 7
UNIT V : Chapters 8 & 9

Books for reference:

Turbo C++ - by ROBERT LAFORE, Galgotia Publications.

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SEMESTER - II

EC 1 - CLASSICAL DYNAMICS

Subject Code: 17P2M9EC	Credits: 5	External Marks: 75	Hours: 6

Objectives:

To enable the students to

1. *Learn various concepts in classical dynamics.*
2. *Understand the Lagrange's function of classical dynamics and its applications.*
3. *Acquire and develop knowledge in applied mathematics.*
4. *Increase their capability to perform better in UGC , CSIR and SLET Examinations.*

UNIT I: Introductory concepts: The mechanical systems - Generalized coordinates – Constraints – Virtual work.

UNIT II: Energy and momentum. Lagrange's equations: Derivation of Lagrange's Equations – Examples.

UNIT III: Integrals of the motion .Special applications of Lagrange's Equations – Rayleigh's Dissipation function.

UNIT IV: Impulsive motion. Hamilton's equations: Hamilton's Principle – Hamilton's Equations.

UNIT V: Other variational Principles - Hamilton's Principles Function – The Hamilton -Jacobi Equation – Separability.

TEXT BOOK: CLASSICAL DYNAMICS – By DONALD T. GREENWOOD

UNIT I : Chapter 1: 1.1 to 1.4
UNIT II : Chapter 1: 1.5 & Chapter 2: 2.1,2.2
UNIT III: Chapter 2: 2.3 & Chapter 3: 3.1
UNIT IV: Chapter 3: 3.2 & Chapter 4: 4.1 & 4.2
UNIT V : Chapter 4: 4.3 & Chapter 5: 5.1 to 5.3.

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SEMESTER - II

EC 2 - PARTIAL DIFFERENTIAL EQUATIONS

Subject Code: 17P2M10EC	Credits: 5	External Marks: 75	Hours: 6

Objectives:

To enable the students to

1. *To give an in-depth knowledge of solving partial differential equations and apply them in scientific and engineering problems.*
2. *To study the other aspects of PDE*

UNIT I: **Partial differential equations of the first order :** Partial differential equations- origins 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 -Nonlinear Partial differential equations of the first order.

UNIT II: Cauchy's method of characteristics - compatible systems of first order equations -Charpit's method - Special types of first order equations - Solutions satisfying given Conditions - Jacobi's method.

UNIT III: **Partial differential equations of the second order :** The origin of second order equations–second order equations in Physics – Higher order equations in Physics - Linear partial differential equations with constant co-efficients - Equations with variable coefficients - Characteristic curves of second order equations

UNIT IV: Characteristics of equations in three variables- The solution of Linear Hyperbolic Equations - Separation of variables - The method of Integral Transforms – Non Linear equations of the second order.

Unit V: **Laplace's equation :** Elementary solutions of Laplace's equations - Families of equipotential Surfaces - Boundary value problems- Separation of variables – Problems with Axial Symmetry.

TEXT BOOK:

Ian N. Sneddon,Elements of Partial differential equations**,** Dover Publication –INC, New York, 2006.

UNIT I : Chapter II Sections 1 to 7
UNIT II : Chapter II Sections 8 to 13
UNIT III : Chapter III Sections 1 to 6
UNIT IV : Chapter III Sections 7 to 11
UNIT V : Chapter IV Sections 2 to 6

REFERENCES

1. **M.D.Raisinghania**, Advanced Differential Equations , S.Chand and company Ltd.,New Delhi,2001.
2. **E.T.Copson,** Partial Differential Equations, Cambridge University Presson

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SEMESTER - III

CC 9 - TOPOLOGY

Subject Code: 17P3M11	Credits: 5	External Marks: 75	Hours: 6

Objectives:

To enable the students to

1. *Understand the meanings of various terms involved in Topology.*
2. *Introduce various spaces namely complete metric spaces, compact, connected, normal and regular spaces and their properties.*
3. *To solve problems in these areas.*
4. *Participate in various competitive examinations.*

UNIT I: Topological spaces – basis for a topology – the order topology – the product topology on X xY - The subspace topology – closed sets and limits points.

UNIT II: Continuous functions - The product topology – The metric topology – The metric topology continued.

UNIT III: Connected spaces- connected subspaces of the Real line - Compact spaces – compact subspaces of the Real line .

UNIT IV : The countability axioms – The Seperation axioms- Normal spaces - The Urysohn lemma – The Urysohn metrization theorem

.

UNIT V: The Tychonoff theorem – The Stone-cech Compactificaion – Complete metric spaces – Compactness in metric spaces..

TEXT BOOK: **TOPOLOGY – By R. MUNKRES second edition**

UNIT I : Chapter2: Sec 12 to 17
UNIT II : Chapter2: Sec 18 to 21
UNIT III : Chapter3: Sec 23 to 27 (except 25)
UNIT IV : Chapter4: Sec 30 to 34
UNIT V : Chapter4: Sec 37 &38 Chapter 7: Sec 43 & 45

Books for reference:

1. G.F. SIMMONS : Introduction to topology and modern analysis
2. J. DUGUNDJI : Topology
3. J.G.HOCKING AND YOUNG : Topology

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SEMESTER - III

CC 10 - DIFFERENTIAL GEOMETRY

Subject Code: 17P3M12	Credits: 5	External Marks: 75	Hours: 6

Objectives

1. *To introduce the notion of surfaces and their properties.*
2. *To study geodesics and differential geometry of surfaces.*

UNIT I: THE THEORY OF SPACE CURVES:

Introductory remarks about space curves -Definitions - Arc length– Tangent, normal and binormal –curvature and torsion -contact between curves and surfaces-tangent surface,involutes and evolutes-Intrinsic equations, fundamental Existence Theorem for space curves-Helices.

UNIT II: LOCAL INTRINSIC PROPERTIES OF A SURFACE:

Definition of a surface - curves on a surface - SurfaceS of revolution - Helicoids -Metric-Direction coefficients - families of curves- Isometric correspondence- Intrinsic properties.

UNIT III: GEODESICS:

Geodesics - Canonical geodesic equations - Normal property of geodesics- Existence Theorems - Geodesic parallels - Geodesics curvature- Gauss- Bonnet Theorem - Gaussian curvature- surface of constant curvature.

UNIT IV: LOCAL NON-INTRINSIC PROPERTIES OF A SURFACE:

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

UNIT V: DIFFERENTIAL GEOMETRY OF SURFACES IN THE LARGE:

Introduction - Compact surfaces whose points are umblics - Hilbert's lemma - Compact surfaces of constant Gaussian or mean curvature - Complete surfaces - characterization of complete surfaces - Hilbert's Theorem -Conjugate points on geodesics.

TEXT BOOK:

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

UNIT – I : Chapter 1: Sections 1 to 9.
UNIT – II : Chapter 2: Sections 1 to 9.
UNIT – III : Chapter 2: Sections 10 to 18.
UNIT – IV : Chapter 3: Sections 1 to 8.
UNIT – V : Chapter 4: Sections 1 to 8

REFERENCES

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

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SEMESTER - III

CC 11 - PRACTICALS IN MATHEMATICA

Subject Code: 17P3M13	Credits: 4	External Marks: 60	Hours: 6

Objectives:

To enable the students to

1. Write programmes to solve mathematical problems.

2. Prepare for software development.

UNIT I: Introduction to Mathematica

Running Mathematical – Numerical Calculations – Building Up calculations – Using the Mathematics system – Algebraic calculations – Symbolic Mathematics – Numerical Mathematics.

UNITII: Functions Programs – Lists – Graphics – Input and Outputs in Notebooks – The structure of Graphics.

UNIT III: Advanced Mathematics in Mathematica

Mathematical Functions –Algebraic Manipulating Equations–Calculus.

UNIT IV: Series, Limits and Residues – Linear Algebra – Constructing matrices – Getting pieces of matrices –scalars, Vectors and Matrices – Operations on scalars, vectors and matrices – Multiplying Vectors and matrices – Matrix inversion – Basic matrix operations – Solving linear systems – Eigen values and Eigen vectors.

UNIT V: Numerical operations on data – Curve fitting – Approximate functions and Interpolation – Fourier Transforms.Numerical operations on functions – Numerical Integration – Numerical evaluation of sums and products – Numerical Solution of Polynomial equations – Numerical root finding – Numerical solutions of Differential equations.

TEXT BOOK:

Stephen Wolfram, **The Mathematica Book**, Fifth Edition, Cambridge University Press,2003

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SEMESTER - III

EC 3 - GRAPH THEORY

Subject Code: 17P3M14EC	Credits: 5	External Marks: 75	Hours: 6

Objectives: To enable the students to

1. *Understand the concepts of graph theory and to motivate them to do research.*
2. *Deal with elementary concepts such as trees , Eulerian, Hamiltonian graphs , matching, vertex and edge coloring, and planar graphs.*
3. *Formulate real life problems into graph theoretic models.*
4. *Acquire skills to participate in competitive examinations.*

UNIT I : **GRAPHS AND SUBGRAPHS** - Graphs and Simple graphs – graph isomorphism – The incidence and Adjacency matrices – Subgraphs – Vertex Degrees – Paths and connections – Cycles.
TREES-Trees – cut edges and bonds – Cut vertices – Cayley's formula.

UNIT II : **CONNECTIVITY**-Connectivity – Blocks – Construction of Reliable Communication networks.
EULER TOUR AND HAMILTONIAN CYCLES – Euler tours – Hamilton cycles – The Chinese postman problem –The traveling salesman problem.

UNIT III: **MATCHINGS**- Matchings – Matchings and Coverings in Bipartite Graphs- Perfect Matchings.
EDGE COLOURINGS – Edge chromatic Number – Vizing's theorem.

UNIT IV: **INDEPENDENT SETS & CLIQUES** – Independent sets – Ramsey's theorem – Turan's theorem.
VERTEX COLOURINGS: Chromatic Number – Brooks' Theorem – Hajos' conjecture – Chromatic polynomials.

UNIT V: **PLANAR GRAPHS** – Plane and planar graphs – Dual graphs – Euler's Formula– Bridges- Kuratowski's Theorem – The five Colour Theorem.

TEXT BOOK:

GRAPH THEORY WITH APPLICATIONS by J.A. BONDY and U.S.R. MURTHY'

UNIT I : Chapters 1&2: 1.1 – 1.7 & 2.1 – 2.4
UNIT II : Chapters 3&4 :3.1 – 3.3 & 4.1 – 4.4
UNIT III : Chapters 5&6 : 5.1 – 5.3 & 6.1, 6.2
UNIT IV : Chapters 7&8: 7.1 – 7.3 & 8.1 – 8.4
UNIT V : Chapter 9: 9.1- 9.6.

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M.Sc., MATHEMATICS

(Effective for those admitted from 2017-2018 onwards)

SEMESTER - III

EC 4 - OPTIMIZATION TECHNIQUES

Subject Code: 17P3M15EC	Credits: 5	External Marks: 75	Hours: 6

Objectives: To enable the students to

1. *Understand and apply some of the Techniques of Operations Research.*
2. *Introduces the advanced level topics in Linear Programming and Non linear programming, Integer and Dynamic programming problems.*
3. *Participate in various competitive examinations.*

UNIT I: Duality Theory and its Applications - The dual simplex method - Revised simplex method.

UNIT II: **Integer Programming Problem:** Introduction – Gomory's All – I.P.P. method – Construction ofGomory's constraints- Fractional cut method- All integer - Fractional cut method- mixed integer – Branch and Bound method.

UNIT III: **Dynamic Programming:** Introduction–The Recursive Equation Approach – Characteristics of Dynamic programming – Dynamic programming Algorithm – Solution of Discrete D.P.P – Some Applications - Solution to L.P.P by Dynamic Programming..

UNIT IV: **Simulation**: Introduction – methodology of simulation – Simulation models – Event type simulation - Generation of Random numbers – Monte Carlo simulation.

UNIT V: **Non- Linear Programming:** Introduction – Formulating a non-linear programming problem - General Non-linear Programming problem – Constrained optimization with equality constraints - Constrained optimization with inequality constraints. **Non Linear programming methods:** Introduction - Graphical solution – Kuhn – Tucker conditions with non-negative constraints.

TEXT BOOK:

OPERATIONS RESEARCH BY KANTHI SWARUP, P.K.GUPTA, MANMOHAN. (ELEVENTH EDITION)

UNIT – 1 : Chapter 5 : Sec 5.1 to 5.7,5.9; Chapter 9: Sec 9.1 and 9.2
UNIT – 2 : Chapter 7 : Sec 7.1 to 7.6
UNIT – 3 : Chapter 13 : Sec 13.1 to 13.5, 13.7
UNIT – 4 : Chapter 23 : Sec 23.1 to 23.7
UNIT – 5 : Chapter 24 : Sec 24.1 to 24.5 Chapter 25: Sec 25.1 to 25.3

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SEMESTER - IV
CC 12 - FUNCTIONAL ANALYSIS

Subject Code: 17P4M16	Credits: 5	External Marks: 75	Hours: 6

Objectives:
To enable the students to

1. *Understand the basic concepts and theorems in functional analysis.*
2. *Know the concepts of Banach Spaces, Hilbert Spaces and Bounded linear functionals.*
3. *Acquire knowledge in Operator theory and Projections for the above spaces.*
4. *Develop right approach towards research* in Functional analysis.

UNIT I: **BANACH SPACES**: The definition and some examples – Continuous Linear transformations – The Hahn Banach Theorem – The natural imbedding of N in N** - The open mapping Theorem – The conjugate of an operator.

UNIT II: **HILBERT SPACES**: The definition and simple properties – Orthogonal complements- Orthonormal sets – The conjugate space H*.

UNIT III: **OPERATORS ON BANACH AND HILBERT SPACES.** The adjoint of an operator – Self adjoint operators – Normal and unitary operators.

UNIT IV: Projections . **Finite dimensional spectral theory:** Matrices – Determinants and the spectrum of an operator - the Spectral Theorem.

UNIT V: **GENERAL PRELIMINARIES ON BANACH ALGEBRAS**: The definition and some examples – Regular and Singular Elements – Topological Divisors of Zero – The spectrum – The Formula for the spectral Radius.

TEXT BOOK:
'INTRODUCTION TO TOPOLOGY AND MODERN ANALYSIS' by G.F. SIMMONS

UNIT I : Chapter 9 : 46 to 51
UNIT II : Chapter 10 : 52 - 55
UNIT III : Chapter 10 : 56 - 58
UNIT IV : Chapter 10 : 59, Chapter11 :60 - 62
UNIT V : Chapter 12 :64 - 68

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SEMESTER - IV

CC 13 - MEASURE THEORY AND INTEGRATION

Subject Code: 17P4M17	Credits: 5	External Marks: 75	Hours: 6

Objectives:

1. *To generalize the concept of integration using measures.*
2. *To develop the concept of analysis in abstract situations.*

UNIT I: **Measure on the real line:** Lebesgue outer measure - Measurable sets –Regularity – Measurable functions – Borel and Lebesgue Measurability.

UNIT II: **Integration of functions of a real variable:** Integration of non negative functions – The general integral – Integration of series.

UNIT III: **Abstract measure space:** Measures and outer measures – Completion of a measure - Measure spaces – Integration with respect to a measure.

UNIT IV: **Convergence :** Convergence in measure – Almost uniform convergence – Signed measures and the Hahn decomposition.

UNIT V: The Jordan decomposition – The Radon-Nikodym theorem – Measurability in a product space.

TEXT BOOK:

Measure Theory and Integration, G. de Barra, New Age International Publishers, New Delhi, Reprint 2011

UNIT I **:** Chapter 2: Sections 2.1 to 2.5
UNIT II : Chapter 3: Sections 3.1 to 3.3
UNIT III : Chapter 5: Sections 5.1 , 5.4, 5.5, 5.6
UNIT IV : Chapter 7: Sections 7.1, 7.2 and Chapter 8: Sections 8.1
UNIT V : Chapter 8: Sections 8.2, 8.3 and Chapter 10:Section 10.1

BOOKS FOR REFERENCE

1. Real Analysis, H.L. Royden, Third Edition, PrenticeHall of India, New Delhi, 2001
2. Real and Complex Analysis, Walter Rudin, Mc-Graw Hill Book Company, New York, 1970.

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SEMESTER - IV

CC 14 - NUMBER THEORY

Subject Code: 17P4M18	Credits: 4	External Marks: 75	Hours: 6

Objectives:

To enable the students to

1. *Sharpen their logical thinking and appreciate the beautiful results in number theory.*
2. *Acquire and develop self study habits.*
3. *Develop right approach towards research in number theory.*

UNIT I: Fundamentals of congruences : Basic properties of congruences – Residue Systems - Riffling. Solving congruences: Linear congruences – The theorems of Fermat and Wilson revisited – The Chinese Remainder theorem – Polynomial Congruences.

UNIT II: Arithmetic functions: Combinatorial study of $\phi(n)$ – Formulae for D(n) and $\sigma(n)$ - Multiplicative Arithmetic functions – The Mobius Inversion formula.Primitive roots: Properties of reduced Residue systems – Primitive roots Modulo P.

UNIT III: Quadratic Residues: Euler's criterion – The Legendre symbol – The Quadratic reciprocity law – Applications of Quadratic Reciprocity law. Distributions of Quadratic Residues: Consecutive Residues and non residues.

UNIT IV: Sums of squares :Sums of two squares – Sums of Four Squares. Elementary partition theory: Introduction - Graphical representation – Euler's partition theorem – Searching for partition Identities.

UNIT V: Partition generating Functions: Infinite Products as Generating functions – Identities between Infinite series and Products. PartitionIdentities: History and Introduction – Euler's Pentagonal Number Theorem – The Roger's Ramanujan Identities.

TEXT BOOK: 'NUMBER THEORY By E. ANDREWS'

UNIT I : Chapters 4&5.
UNIT II : Chapters 6 &7.
UNIT III : Chapters 9 & 10 (Omit 10.2)
UNIT IV : Chapters 11 & 12.
UNIT V : Chapters 13 & 14(omit 14.4 & 14.5).

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SEMESTER - IV

EC 5 - PROBABILITY AND STATISTICS

Subject Code: 17P4M19EC	Credits: 4	External Marks: 75	Hours: 6

Objectives: To enable the students to

1. *Understand and apply different concepts of Probability and Statistics.*
2. *Participate in various competitive examinations*

UNIT I: Probability and Distribution: Introduction – Set theory – The probability set function – Conditional probability and independence – Random variables of the discrete type – Random variables of the continuous type – properties of the distribution function – expectation of random variable – some special expectations – Chebyshev's Inequadity.

UNIT II: Multivariate Distributions: Distributions of two random variables – conditional distributions and expectations – the correlation coefficient – Independent random variables – extension to several random variables.

UNIT III: Some special Distributions: The Binomial and related distributions – The Poisson distribution– The Gamma and Chi-square distributions – The Normal distributions – The Bivariate Normal distribution.

UNIT IV: Distributions of functions of Random variables: Sampling theory – transformations of variables of the discrete type – transformations of variables of the continuous type – the Beta, t and F distributions – extensions of the change – of – variable technique – the distributions of order statistics – the moment generating – function, Techniques the distributions of $\bar{X}$ and ns^2/σ^2 – expectations of functions of random variables

UNIT V: Limiting Distribution: Convergence in distribution – convergence in probability – Limiting Moment Generating functions – the Central Limit theorem – Some theorems on Limiting Distributions.

TEXT BOOK:

Introduction to Mathematical Statistics, (Fifth edition) by Robert V.Hogg and AllenT. Craig Pearson Education Asia.
Chapters I, II, III, IV (Omit 4.10) & V.

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SEMESTER - IV
PW - PROJECT WORK

Subject Code: 17P4MPW	Credits: 4	External Marks: 80	Hours:6