New syllabus (IDOL) for M.A/M.Sc in Mathematics.

(semester system effective from 2010)

The M.A/ M.Sc IDOL syllabus has been restructured for the semester system on the basis of the guidelines of the UGC. There are four semesters in two years; each semester comprising of five papers. In the third semester 3 papers are common to all and the other two papers are optional. In the 4^{th} semester two papers are common and three papers are optional. Questions will be set from each unit, proper weightage will be given unit wise and marks from each unit is shown accordingly. In each paper there will be an internal assessment of 20 marks.

Semester I

Paper- M101: Real Analysis and Lebesgue Measure

Paper-M102: Topology .

Paper-M103: Algebra

Paper-M104: Differential Equation.

Paper-M105: Tensor and Mechanics

Semester II

Paper- M201: Complex Analysis

Paper-M202: Functional Analysis

Paper-M203: Hydrodynamics

Paper-M204: Mathematical Methods.

Paper-M205: Operation Research

Semester III

Paper- M301: Computer Programming in C (theory and Practical)

Paper-M302: Number Theory

Paper-M303: Continuum Mechanics

Paper-M304 Algebra II/Space Dynamics

(Optional):

Paper-M305: Special Theory of Relativity /Mathematical Logic

(Optional):

Semester IV

Paper- M401: Graph Theory

Paper-M402: Numerical Analysis

Paper-M403: Functional Analysis II/ Fluid Dynamics

Paper-M404: Mathematical Statistics /Dynamical System.

Paper-M405: Fuzzy Sets and their Applications/General Theory of Relativity and Cosmology.

Detailed Course Structure

Semester I

M101: Real Analysis and Lebesgue Measure

Unit 1:(Marks-20)

Uniform convergence at an interval. Cauchy's criterion. Test for uniform convergence. Properties of uniformly convergent sequences and series of functions. Uniform convergence and continuity. Integration, differentiation weirstrass approximation theorem (Statement only) and its application. Uniqueness theorem for power series. Abel's and Tauber's theorem. Fundamental properties.

Unit 2:(Marks-20)

Function of bounded variation, continuity, Differentiation, their continuity and monotonicity. Definition and Existence of R-S integral, properties of R-S integral integration and differentiation, fundamental theorem of calculus.

Unit3:(Marks-20)

Lebesgue outer measure, Measurable sets and properties. Borel sets and their measurability characterization of measurable sets, Non-measurable sets, Measurable function, Properties, Operation of measurable function, sets of measure zero.

Unit 4:(Marks-20)

Lebesgue integral, Lebesgue integral of a bounded function, comparison of Riemann integral and Lebesgue integral. Integral of non negative measurable function, General Lebesgue integral. Convergence of Lebesgue integral, Bounded convergence theorem (statement only) Monotone Convergence theorem (statement only), Lebesgue Convergence theorem (statement only).

Text Books:

1. Malik and Arora-Mathematical Analysis
2. IIL. Royden-Real analysis, Prentice Hall of India.

Reference Books:

1. W.Rudin, Principles of mathematical Analysis, 3rd Edition, McGraw Hill

2. Real analysis-Goldberg

3. Real Analysis-Dipak Chatterjee, Prentice Hall of India

4. Jain and Gupta-Lebesgue Measure and integration, Willey Eastern Ltd

M102: Topology

Unit 1:(marks-20) Metric Space:
Convergence of sequences, completeness, Bair's theorem, continuous mappings, spaces of continuous function's Euclidean and unitary spaces.
Unit 2:**(marks-10)**Topological Space:
Continuity and homeomorphism, subspace, bases and sub bases. Weak topologies.
Unit 3:(marks-20)Compactness:
Compact spaces, product spaces, Tychonoff's theorem and locally compact spaces. Compactness for metric spaces, Ascoli's theorem.
Unit 4(marks-20)Separations:
TI-space and Hausdorff spaces, Completely regular spaces and normal spaces, Urysohn's lemma and Tietze extension theorem.
Unit 5:(marks-10) Connectedness:
Connected spaces, components of a space, totally disconnected spaces, locally connected spaces.
Books Recommended:
Simmons G.F. : Introduction to Topology and Modem Analysis, McGraw Hill

M103: Algebra

Unit1:(marks-20)
Direct product and Direct sums of Groups, Decomposable groups, Normal and Subnormal series of groups, Composition series, Jordan Holder theorem, solvable groups.
Unit2;(marks-20)
Divisibility in Commutative rings, PID, UFD and their properties, Eisenstein's irreducibility criterion.
Unit3:(marks-20)
Field theory-Extension fields ,Algebraic and Transcendental, Splitting field, perfect fields, Finite fields (Moore's theorem etc.). Construction by ruler and compass, elements of Galois theory.
Unit4:(marks-20)
Canonical forms, similarity of linear transformations, Invariant subspaces, Reduction to triangular forms, nilpotent transformations, index of nil potency, invariants of a nilpotent Transformation, Primary decomposition theorem, Jordan blocks and Jordan forms.
Text Books:
1. S.Singh and Zameruddin-Modern Algebra
2. Hoffman and Kunz-Linear Algebra
Reference Books:
1. I.N.Herstein-Topic in Algebra
2. C.Musili-Rings and modules
3.D.S. Malik, J.N.Mordien, M.K.Sen-Fundamental of Abstract Algebra.

4. K.B.Dutta-Matrix and linear algebra.
5.Liner Algebra-S.Liptestuz. Schaum's outline series TMH.

M104: Differential Equation.

Unit1:marks-20)

Solution of 2^{nd} order differential equations with variable coefficients including method of variation of parameters.

Statement only Existence theorem of 1^{st} order equation, Statements of existence theorems for system of 1^{st} order equations and for nth order differential equations, Wronskian.

Unit2:(marks-20)

Method of series solution of 2^{nd} order differential equations with particular reference to legendre. Bessel and Gauss.

Simultaneous differential equations and total differential equations.

Unit3:(marks-20)

Origin of partial differential equations of 1^{st} order, LaGrange's method of solving 1^{st} order linear partial differential equations. Particular solutions under various prescribed conditions. Linear homogeneous equations with more than two independent variables.

Unit4:(marks-20)

Char pit's method of solving non-linear 1^{st} order partial differential equations. Complete Integrals. Standard forms of non-linear 1^{st} order partial differential equations.

Books Recommended:

1. Theory and problems of differential equations-Frank Ayres Jr. Schaum's Outline Series,McGraw Hill.
2. Advance Differential Equations-Raisinghannia
3. Partial Diffrential Equation-Gupta Malik and Mittal Pragati Prakashan

M105Tensors & Mechanics

Unit1:(marks-10)

Transformation of coordinates, summation convention, Kronecker delta, definition of tensors covariant, contra variant and mixed tensor, Cartesian tensors, rank of a tensor, symmetric and antisymmetric tensors, outer and inner product of tensors, contraction, quotient law.

Riemannian space, metric tensor, fundamental tensors, associate tensors, magnitude of a vector, angle between two vectors Parametric curves.

Unit2:(marks-10)

Christoffel's three-index symbols (or brackets) and properties, covariant differentiation of tensors, divergence and curl of a vector and gradient of a scalar.

Intrinsic derivatives, curvature of a curve, parallel displacement of vectors.

Unit3:(marks-10)

Forces in three dimension and general conditions of equilibrium, Poisot's central axis, wrench, cylindroids.

Unit4(marks-10)

Virtual works, bending moments, equilibrium of slightly elastic beams, general equations of a bent rod, equations of three moments, work done in bending a rod.

Unit5:(marks-10)

Newton's laws and inertial frame of reference, general equations of motions, conservative force fields, general principle of conservation of energy, linear momentum and angular momentum.

Unit6:(marks-10)

Motion in two dimensions, motion under a central force with particular reference to inverse square law of force, Kepler's laws of planetary motions, two body problem, motion in resisting medium and motion when the mass varies.

Unit7:(marks-10)

Motion in three dimensions, velocity and acceleration in cylindrical and spherical polar coordinates, motion on cylindrical spherical and conical surfaces.

Unit8:(marks-10)

Revision of moments and general equations of motion of rigid body, motion in two dimensions under finite and impulsive forces, expression for K.E.; motion about a fixed axis.

Books recommended:

Tensors;

1. Agarwal D.C.: Tensor Calculus of Riemainan geometry.

2. Ayers: Vectors and introduction to Tensor
3. Jeffreys and Jeffreys; Cartesian Tensor
4. Lass: Vector and Tensor Analysis
5. Sharma G.C. and Singh S.K.: A. Text Book of Tensor and Riemannian Geometry.
6. Weatherburn: Riemannian Geometry

Statics:

1. Lamb: Statics(CUP
2. Loney: Statics(CUP)
3. Ramsey: Statics(Cup)
4. Tyagi, Nand and Sharma: Statics, Krishna Prakashan mandir

Dyanamics:

1. Chorlton; Text Books of dynamics, Van Nostrand
2.Goldstein: Classical mechanics, Addison Wesley.
3. Loney S.K.: Dynamics of a particle and of rigid bodies (CUP)
4. Ramsey: Dyanamics PartII
5. Singe and Griffith: Principles of mechanics, McGraw Hill
6. Spiegel M: Dyabanamics Part II.

M201Complex Analysis

Unit1(Marks-20)

Analytic functions:

The Cauchy Riemann equations, harmonic functions, elementary function's many valued functions.

Analytic functions as mappings:

Isogonal and conformal Transormations. Bilinear transformations: geometrical inversion, coaxial circles, invariance of the cross-ratio. Fixed points of a bilinear transformation; some special bilinear transformations, e.g. real axis on itself, unit circle on itself, real axis on the unit circle etc.

Branch point and branch lines, concept of the Riemann Surface.

Unit2: (Marks-20)

Complex Integration

Integral along oriented curve, Cauchy's theorem, the Cauchy-Goursat theorem; Cauchy's integral and functions defined by integrals, the derivatives of a regular function; Morera's theorem, Cauchy's inequality, Liouville's theorem; Maximum modulus principle.

Unit3: (Marks-20)

Power series:

Taylor's and Laurent's theorem: Zeros and singularities, their classification, poles and zeros of meromorphic functions.

The argument theorem, "Rouche's theorem, location of roots of equations.

Unit4: : (Marks-20)

The Calculus of Residues:

The residue theorem: evaluation of integrals by contour integration, special theorems used in evaluating integrals.

Books Recommended:

Phillips E.C.: Function of a Complex Variable, Oliver and Boyd.

Shanti Narayan : theory of Functions of a complex Variables, S. Chand and Co.

Spiegel Murry R: Theory and Problems of Complex variables, Scheum's Outline Series TMH.

M202 Functional Analysis

Unit1: (Marks -20)

Banach Space:

Definitions and some examples, Basic properties, continuous linear transformation, finite demensional normed linear spaces.

Unit2:(Marks-20)

Hahn-Banach theorem, natural embedding of NLS*, open mapping theorem, closed graph theorem, Banach Steinhaus theorem, conjugate of an operator.

Unit3:(Marks-20)

Hilbert Spaces:

Definition and simple properties, orthogonal complement, orthogonal sets, conjugate space H*, adjoint of an operator, self adjoint of an operator, normal and unitary operator projection.

Unit4:(Marks-20)

Finite-dimensional spectral Theory:

Spectrum of an operator, spectral theorem.

Books recommended:

Simmons G.F.: Introduction to Topology and Modern Analysis, McGraw Hill

Books for reference:

Lahiri, B.K.: Functional Analysis

Limaye, B.V.: Functionla Analysis

M203 Hydrodynamics

Unit 1 (Marks-20): Kinematics of fluid motion: Path lines stream lines equations of continuity equation of motion and their integrals boundary conditions . Impulsive motions. Analysis of fluid motion and general theory of irrotational motion.

Unit 2 (Marks-20):Motion in a plane: Use of Complex potential. Source. Sink doublet. Method of images. The Circle theorem. The theorem of Blasius. Motion past circular cylinder.

Unit3:(Marks-20)Motion in space: Motion past a sphere axisymmetric motion. Stoke's stream function and its use.

Unit 4(Marks-20): Vortex motion : Properties of vortex filament motion due to rectilinear vortex and a system of vortices motion of a vortex filament due to the influence of others. Ranking vortex.

Text Books:

1. Continuum Mechanics -G.E.Mase. Schaum's outline series. McGraw Hill Book Company.

2. A Treatise on Hydromechanics. Part II. W.H.Besant and A.S. Ramsay. CBS Publishers. Delhi.

3. Text Book of Fluid Dynamics-Frank Chorlton. C.B.S Publishers. Delhi.

Reference books:

1. Mathematical Theory of Continuum Mechanics-R. Chatterjee. Narosa Publishing House. Noe Delhi.

2. An Introduction to Fluid Mechanics-G.K.Batchelor. Foundation Books. New Delhi.

3. Hydrodynamics-M.D. Raisinghania S. Chand and Co. Limited.

M204: Mathematical Methods

Unit1: (Marks-20) Lap lace "Transform with application to the solution of differential equations.

Unit2: (Marks-20)Fourier Transform: Fourier Integral Transform, Application of Fourier Transform to ordinary and partial differential equations of initial and boundary value problems.

Unit3(Marks-20)

Integral equations: Solution of Linear Integral Equations, Fredholm's Integral Equations with separable kernels, Voltera's Integral Equations

Unit4(Marks-20)

Method of successive Approximations, Fredholm's method, Voltera's method.

Books recommended:

The Mathematics of Physics and Chemistry, by Margenue and Murphy.

Methods of Applied Mathematics by Francis B. Hilderbrand.

Fourier Transforms, by Ian N. Sneddon

Theory and Problems of Laplace transforms, by M.R. Spiegel.

M205Operations Research

Unit-1 (Marks-10) History and Development of Operations Research. Operation Research and its Scope Necessity of Operation Research in Industry and Management. General idea of queuing problem-Markovian and non Markovian queues. Queuing theory

and its operating characteristic queuing model-M/M/1. M/M/K. General equations of the models.

Unit-2(Marks-10). **:** Simulation: Theory of simulation. Monte Carlo method application to the problems of replacement and maintenance inventory, queuing and financial problems.

Unit-3. (Marks-20). Linear Programming: Simplex method. Theory of the simplex Method Duality and sensitivity Analysis. Other Algorithms for Linear Programming Dual Simplex Method. Integer programming-Branch and Bound technique. Conceept of cutting plane. Gomory's all integer cutting plane method.

Applications to Industrial Problems:- Optimal product mix and activity levels. Petroleum refinery operations Blending problems. Economic interpretation of dual linear programming problems. Input-output analysis.

Unit-4: (Marks-10). Transportation and Assignment Problems.

Unit-5: (Marks-10). New York Analysis- Shortest Path Problem. Minimum Spanning Tree Problem. Maximum Flow Problem, Minimum Cost Flow Problem. Network simplex Method. Project Planning and Control with PERT-CPM .

Unit 6: (Marks-20). Nonlineear Programming : One and Multi-Unconstrained Optimization. Fuhn-Tucker Conditions for Constrained Optimization. Quardratic Programming. Separable Programming Convex Programming Non-convex Programming.

Text Books:

1. Kanti Swarup.P.K. Gupta and Manmohan: Operations Research. S.Chand and Co.

2. H.A.Taha.Operations Research-An introduction. Macmillan Publishing Co. Inc. New York.

Reference Books:

1. FS Hillier and GJLiberman. Introduction to Operations Research (Sixth Edition). McGraw Hill International Edition. Industrial Engineering Series. 1995 (This book comes with a CD containing tutuorial software)

2. P.K.Gupta and D.S. Hira: Operations Research-An Introduction S.Chand and Co.

M301Computer Programming in C

Unit 1(Marks-20). An Overview of Programming:)

The basic model of computation, Algorithms, Flow charts, programming languages, compilation, linking and loading, efficiency and analysis of algorithms.

C Essentials: Character set, variables and identifiers, built in data types, operators and expressions, constants, type conversions, basic input/put operations, anatomy of a C program.

Unit 2. (marks-20) Control Flow:

Conditional branching, The switch statement, looping, nested loops, the break and continue statements, the goto statement, infinite loops.

Unit 3(marks-20). Arrays, Pointers and Functions:

Declaration, initialization, pointer arithmetic. Basics of functions, passing arguments, declaration and calls, return values.

SAMPLE PROGRAMS FOR PRACTICAL (MARKS-20)

To evaluate an arithmetic expression. To find GCD, Factorial. Fibonacci series. Prime number generation. Reversing digits of an integer. Finding square root of a number. To find the roots of a quadratic equation. To find the greatest and smallest of a finite set of numbers. To find the sum of different algebraic and trigonometric series. Addition, subtraction and multiplication of matrices.

Books recommended:

Rajaraman V.: Computer Oriented Numerical methods, Prentice Hall of India, New Delhi.

Balaguruswamy E.: ANSIC.

Kernighan W. and

Ritchie D.K.: The C programming Language, PHI.

M302Number theory)

Unit 1. (Marks-20)

: Divisibility and the primes: Principle of mathematical induction, least common multiple, greatest common divisor. Euclidean algorithm, prime numbers, unique factorization theorem)

Unit 2: . (Marks-20)Congruences: Operations of congruences, Residue sets mod m, Euler's theorem, order of a mod m, linear congruences, the theorems of Fermat and Wilson, The Chinese Reminder theorem, Polynomial congruences.

Unit 3: . (Marks-20)Quardratic Residues: Primitive roots, Indices, quardratic residuce mod m, Euler's criterion, The Legendre sybmbol, The law of quadratic reciprocity. The Jacobi symbol.

Unit 4: . (Marks-20)Arthmetic functions and some Diophantine equations: Multiplicative Arithmetic functions, τ and σ functions, Mobius function, Euler's function, The inversion formula. Linear Diophantine equations, equations of the form $x^2+y^2=z^2$, related equations, Representation of a number by sum of two of four squares.

Books recommended:

Burton D.M.: Elementary Number Theory, Universal Book stall, New Delhi

M303Continuum Mechanics

Unit1(Marks-20) Analysis of Stress: The continuum concept. Homogeneity isotropy mass density. Cauchy's stress principle. Stress tensor. Equations of equilibrium. Stress quaric of Cauchy. Principal stresses. Stress invariants. Deviator and spherical stress tensors.

Unit 2 (Marks-20) Analysis of Strain: Lagrangian and Eularian descriptions. Deformation tensors. Finite strain tensor. Small deformation theory. Linear strain tensors and physical interpretation. Stress ratio and finite strain interpretation strain quardric of Cauchy. Principal strains. Strain invariants. Spherical and Deviator strain components. Equations of Compatibility.

Unit 3 (Marks-20)Motion: Material derivatives path lines and stream lines. Rate of deformation and Vortiety with their physical interpretation. Material derivatives of

volume. Surface and line elements. Volume surface and line integrals. Fundamental laws of continuum Mechanics.

Unit 4 (Marks-20)Constitutive equations of Continuum Mechanics: Linear elasticity. Generalized Hook's Law. Strain energy function. Elastic constants for isotropic homogeneous materials. Elaststatic and Elastodynamic problems.

Fluids: Viscous Stress tensor. Barotropic flow : Stokesian fluids. Newtonian fluids. Navier stokes equations. Irrotational flow. Perfect fluids. Bernoulis equation. Circulation.

Text Books:

1. Continuum Mechanics -G.E.Mase. Schaum's outline series. McGraw Hill Book Company.

1. Mathematical Theory of Continuum Mechanics-R. Chatterjee. Narosa Publishing House. Noe Delhi.

M304 Algebra II

(Optional):

Unit 1: (Marks-20)

Posets and lattices, Modular, Distributive lattices, Direct product (sum) of an infinite family of groups. Structure theorems for finitely generated abelian groupsUnit 2: Sylow's theorem and its applications. (Marks-20)

Unit 2(Marks-20)

: Free abelian groups, free groups, free products of groups, representation of a group.

Unit 3(Marks-20)

: Modules, submodules, Direct product and direct sum of modules, prime ideals in commutative rings, complete ring of quotients of a commutative rings.

Unit 4(Marks-20)

: Primitive rings, Radical, completely reducible module and rings, Artinian and Noetherian rings and modules.

Text/Reference Books:

1. Theory of groups-M.Hall
2. Lecutes of rings and modules-J Lambek
3. Modern Algebra- Singh and Zameeruddin, Vikas Publ House
4. Lattices and Bollean Algebra-V.K. Sarma, Vikas Publ House.
5. Basic Abstract Algebra- Bhattacharyya, Jain and Nagpaul, CUP, 1997
6. Infinite Abelian group- L Fuch, Academic Press

M304 Space Dynamics (Optional)

Unit-1 Basic formulae of a spherical triangle-The Two-body problem: The motion of the centre of mass . The relative motion. Kepler's equation. Solution by Hamilton Jacobi Theory. The Determination of Orbits: Laplace's Gauss Methods. (Marks-20)

Unit-2: The Three Body problem: general Three Body Problem. Restricted Three Body Problem. Jacobi integral. Curves of zero velocity. Stationary solutions and their stability. The n-body problem: The motion of the centre of Mass. Calssical integrals. (Marks-20)

Unit-3. Perturbation : Osculating orbit, perturbing forces. Secular and Periodie perturbations, Lagrange's planetary Equations on terms of perturbing forces and in terms of perturbed Hamiltonian. Motion of the moon-The perturbing forces. Perturbation of Keplerian elements of the moon by the sun. (Marks-20)

Unit-4 Flight Mechanics: Rocket performance in a vacuum, vertically ascending paths. Gravity twin trajectories. Multi-stage rocket in a vacuum. Definitions pertinent to single stage rocket. Performance limitations of single stage rockets. Definitions pertinent to multi stage rockets. Analysis of multi-stage rockets neglecting gravity. Analysis of multi-stage rockets including gravity. (Marks-20)

Unit-5 Rocket performance with aerodynamic forces. Short-range non-lifting missiles. Ascent of a sounding rocket. Some approximate performance of rocket powered air-craft. (Marks-20)

Text Books

1. Fundamentals of Celestial Mechanics. The Macmillan Company. 1962 J.M.A.Danby
2. Clestial Mechanics. The Macmillan Company. 1958-E. Finaly. Freundlich.
3. Orbital Dynamics of Space Vehicles. Prentice Hall INC. Engle Wood Cliff. New Jersey 1963-Ralph Deutsch.

Reference Books

1. An Introduction of Clestial Mechanics. Intersciences Publishers. INC 1960-Theodre E. Sterne.
2. Flight Mechanics Vol 1. Theory of flight paths. Addision Wiley Publishing Company INC.1962-Angelo Miele.

M305 Special Theory of Relativity(Optional)

Unit 1: Inertial and non-inertial frames, Geometry of Newtonian mechanics, Galilean Transformations, Back-ground of the fundamental postulates of the special theory of relativity, Lorentz transformation. Relativistic concept of space and time and relativity of motion, Geometrical interpretation of Lorentz transformation as a rotation. Lorentz transformation as a group. (Marks-20)

Unit 2: Relativistic addition law of velocities and its interpretation in terms of Robb's rapidity, Invariance of sped of light, consequences of Lorentz transformation eg (I) Lorentz Fitzgerald contraction (ii) Time dilation (iii) Simultaneity of events, Proper length and proper time, Application in problems. Transformation of acceleration(Marks-20)

Unit-3: Relativistic mechnics. Variation of mass with velocity, Transformation of mass, force and density Equivalence of mass and energy, Transformation of momentum and energy, Energy momentum vector. Applications in problems, Relativistic Lagrangian and Hamiltonian. (Marks-20)

Unit-4: Minkowaki's space, Geometircal representation of simultaneity, Contraction and dilation, space like and time like intervals, position. Four vectors, Four velocity, Four forces and Four momentums, Relativistic equations of motion, Covariant four-dimensional formulation of the laws of mechanics. (Marks-20)

Unit-5 Electrodynamics: Fundamentals of electrodynamics, Transformation of differential operators, D' Alembert operator, Drivation of Maxwell's equation, Electromagnetic potentials and Lorentz condition, Lorentz face, Lorentz transformations of space and time in four-vector form, Transformations of charge and current density,. Invariance of Maxwell's equations, Transformation equations of electric field strength and magnetic field induction components, Invariance of E^2-$H^2$and E.H. (Marks-20)

Books

1. Introduction to special Relativity, Wiley Eastern Lt. (1990) Robert Resnick
2. The Mathematical Theory of relativity, Cambridge University Press 1965 A S Eddington.
3. Relativistic Mechanics (Theory of Relativity) Pragati Prakashan, 2000-Satya Prasash

M305 Mathematical Logic (Optional)

Unit1(Marks-20):Informal statement calculus: Statements and connectives, truth functions and truth-tables, normal forms, adequate sets of connectives, arguments and validity.

Unit 2 (Marks-20): Formal statement calculus: Formal definitions of Proof. Theorem and Deduction the formal theory L of statement calculus the deduction theorem and its converse.

Unit 3(Marks-20) Adequacy theorem for 1: Valuation in L. tautology in L. the Soundness theorem. Extensions of L. consistency of an extension the adequacy theorem of L.

Unit 4(Marks-20) Informal predicate Calculus: Symbolism of predicate calculus. First order language interpretation truth values of well-formed formulas satisfaction and truth. Formal Predicate Calculus: Predicate Calculus as a formal theory the adequacy theorem of K.

Unit 5(Marks-20): Mathematical Systems: First order systems with equality the theory of groups first order arithmetic formal set theory consistency and models.

Books:

Text Book: Logic for Mathematics by A.G. Hamilton

Ref Book: Introduction of Mathematical Logic by Elliot Mendelson

M401Graph theory

Unit 1: . (Marks-20)Graphs, subgraphs, walk, paths, cycles and components, intersection of graphs, Degrees, Degree sequence. Threes, spanning tree, cycles, cocycles. Cycle space. Cocycle space, connectivity, cut vertices, cut edges, blocks., connectivity parameters, Menger's theorems.

Unit-2: (Marks-20) Eulerian and Traversible graphs: Characterization theorems, characterization attempts for Hamiltonian graphs, two necessary and sufficient conditions of a graph to be Hamiltonian, Factorisations, Basic concepts, 1- factorizat5ion, 2-factorization, coverings, critical points, and lines.

Unit-3: (Marks-20) Planarity: Subdivision of graph, identification of vertices, plane and planar graph, outer planar graph, Euler's polyhedron formula, Kuratowski's theorems, Genus, thickness, coarseness and crossing number of a graph.

Unit-4: (Marks-20) Algebraic graph theory: Adjacency matrix and spectrum of graphs, vertex, partition and the spectrum.

Text Books:

1Harary: Graph Theory, NAROSA Publishing Co.

2.Algebraic Graph Theory

M402Numerical Analysis

Unit1: Interpolation formulae(marks-20)

Unit 2. Numerical Differentiation and Integration (marks-20)

Numerical Differentiation and Integration, Simpson's rule, Weddle's central difference formula, quadrature formula, Gauss's quadrature formula, Euler's formula for summation and quadrature.

Unit 2. Solution of Algebraic and Transcendental Equations: (marks-20)

Numerical Solutions of Algebraic and Transcendental Equations, Solutions by the method of iteration and the Newton-Raphson method, cases of repeated roots.

Unit 3. Linear Equations: (marks-20)

Direct method for solving systems of linear equations (Gauss Elimination, LU decomposition, Cholesky decomposition), iterative methods (Jacobi, Gauss-Seidel, Relaxation methods).

Text Books:

Houscholder A.S.: Principles of Numbrical Analysis, McGraw Hill, New York.

Jain M.K.: Numerical Analysis for scientists and Engineers, S.Publishers.

Kung: Numerical Analysis, McGraw Hill Book Co.

Niyogi P. : Numerical Analysis and Algorithms, Tata McGraw Hill

Rajaraman V.: Computer Oriented Numerical methods, Prentice Hall of India, New Delhi.

M403 Fluid Dynamics (Optional)

Unit 1(Marks-20) Waves: Long wave and surface wave stationary wave. Energy of the waves. Waves between different media. Group velocity Dynamical significance of Group velocity. Surface tension and Capillary waves. Effect of Surface tension in water waves.

Unit 2 (Marks-20) : Viscous fluid motion: Navier-Stokes equation of motion rate of change of vorticity and circulation rate of dissipation of energy. Diffusion of a viscous filament.

Unit 3 (Marks-20): Exact solution of Navier Stokes Equation: Flow between plates. Flow through a pipe (circular elliptic). Suddenly accelerated plane wall. Flow near an Oscillating flat plate. Circular motion through cylinders.

Stoke's linearization process. Flow past a sphere. Whitehead paradix and Stoke's paradox. Oseen's approximation.

Unit 4(Marks-20): Laminar Boundary Layer Theory: General outline of Boundary layer flow. Boundary layer thickness. Displacement thickness. Energy thickness. Flow along a flat plate at zero incidence . Similarity solution and Blasius solution for flow about a flat plate.

Karman's momentum integral equation. Energy integral equation. Pohlhausen solution of momentum integral equation.

Two dimensional Boundary layer equations for flow over a curved surface. Blasius solution for flow past a cylindrical surface phenomenon of separation.

Text Books:

1. Hydrodynamics- Horace Lamb. Cambridge University Press.
2. Theoretical Hydrodynamics: I.M.Milne Thomson. McMillan Company.
3. Boundary Layer Theory: H. Schliehting Translated by J.Kertin. McGraw Hill Book 'Company Inc. New York.

Reference Books:

1. Modern development of Fluid Dynamics. Voll-S.Goldstein. Dover publication. New York.

2 An Introduction to Fluid Dynamics G.K.Batchelor. Functions

M403 Functional Analysis II (Optional)

Unit-1 Vector topologies: Examples First properties Mazur's and Eidelheit's separation theorems Metrizable vector topologies. (Marks-15)

Unit-2 The Open Mapping Theorem: The closed graph Theorem and the uniform Boundedness Principle for F-spaces. Topologies induced by families of functions. Weak and Weak* topologies. Compactness. Adjooint operator . Projection and complementation. (Marks-15)

Unit-3 Convexity: The Hahn- Banach theorem for locally convex spaces. The Banach Alauglu Theorem for topological vector spaces. Krein-Milman theorem. Milman theorem. (Marks-15)

Unit-4 Definition of Banach Algebra and Examples Singluar and Non singular elements. The Abstract index. The spectrum of an element. Gelfand Formula. Multiplicative. Linear Function. And the maximal ideal space. Gleason Kahane Zelazko Theorem. (Marks-15)

Unit-5 The Gelfand Transforms. The spectral Mapping Theorem. Isomentric Gelfand Tranform. Maximal ideal spaces for Dise Algebra and the Algebra 1_1(%).(Marks-10)

Unit-6 (·* algebras-Definition and Examples, Self Adjoint. Unitary normed positive and projection elements in (·*-algebras, Commutative (·*-algebras.(·*-Homomorphisms. Representation of Commutative (·*- algebras. Subalgebras and the spectrum. The spectrum theorem. The Continuous functional Calculus . Positive linear functionals and slates in (·*- Algebras, The GNS Construction. (Marks-10)

Text Books

1. Megginson Robert E-An introduction to Banach space theory. Springer verlag.
2. W . Rudin-Functional Analysis Tata McGraw Hills.
3. E.E.Bonsall and J.Duncan-Complete Normed Algebras. Springer verlag

Reference Book

1. Folland. Garald B-Real Analysis Modern Techniques and their applications (John Wiky)

M404Mathematical statistics

Unit1(marks-16)

Probability: Mathematical and statistical definitions. Discrete Samplespace, Axiomatic approach, Theorems of Total and Compound probability, Repeated Trials, Baye's

theorem. Random Variable and its distribution, Mathematical Expectaions, Expectation of sum and product of random variables, Expectation of functions of random variables. Distribution of more than one random variables. Tshebysheff's lemma. Weak law of large numbers. Theorems of Markoff and Khintchine, Bernouilli's and Poisson's theorems. Characteristic function. Probability generating unctions, Central limit theorem.

Unit2(marks-16)

Binomial distribution, Posson, distribution, Normal distribution, Hypergemetric distribution, Multionomial distributions, Betta and Gamma distribution, Pearsonia system of vurves, derivation of the differential equations and its solutions yielding curves of types, I,II,III and IV. Bivariate Normal distribution. Regression and Correlation (including Multiple, partial and Interclass correlation)

Unit3(marks-16)

Principle of least squares of curve fitting (including orthogonal polynomials).

Unit4(marks-16)

Theory of sampling: Random and simple, random sampling, idea of sampling distribution, large sample test, Exact sampling distribution – and T,F,Z and X^2(with derivations) and associated tests of significance.

Unit5(marks-16) (marks-20)

Estimation: Requirement of a good estimator, Method of maximum likelihood (including Cramer-Rao inequality)

Books Recommended:

1. An introduction to Probability theory and its Application by W.Feler
2. An Introduction to Mathematical Probability, by J.V. Uspensky.
3. Correlation and Frequency curves, by Elderton.
4.Modern Probability and its Application by Ferzen
5. Probability Theory by M. Leeve.
6. Mathematical Methods of Statistics by H. Cramer.
7. Linear Statistical Interference and its Application by C.R. Raw.
8. The Advance Theory of Statistics by Kendell and Smart
9. Sampling Method by Cox and Cochrun
10. Sampling Survey of Murphy

11. Sampling Survey by F. Yats

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M404 Dynamical systems and Fractal Geometry

Unit1Nonlinear oscillators-Conservative system. Hamiltonian system. Various types of Oscillators in nonlinear system. Solutions of nonlinear differential equations
(Marks-10

Unit2:Orbit of a map, fixed point, equilibrium point, periodic point, circular map, configuration space and phase space.

Origin of bifurcation, Stability of a fixed point, equilibrium point, Concept of limit cycle and torus, (Marks-10)

Unit3:Hyperbolicity. Quadratic map. Period doubling phenomenon, Feigenbaum's Universal constant (Marks-10)

Unit4: Turning point, transcritical, pitch fork, Hopfbifurcation.

Phenemenon of losing stability, Quasiperiodic motion. Topological study of nonlinear differential equations, Poincare map. (Marks-10)

Unit5: Randomness of orbits of a dynamical system. Chaos. Starange attractors. Various roots to chaos. Onset mechanism of turbulence. (Marks-10)

Text Book:

1. Robert C. Hilborn: Non linear Dynamics and Chaos

2. D.K. Arrowsmith, Introduction to dynamical systems, Cambridge University press, 1990

Reference Books:

1. V.L.Arnold: Dynamical systems V bifurcation theory and catastrophy Theory, Springer Verlag, 1992.

2. Robert L Devany: An introduction to Chaotic Dynamical Systems, Addision-Wesley Publishing Co. Inc.1989

Fractal Geometry

Unit6:Construction of the middle third Cantor set, Von Koch Curve, Sierpinski gasket, self similar fractals with different similarity ratio, Julia Set, measure and mass distribution. Housdorff measure, scaling property, effect of general transformations on Housdorff measure, Housdorff dimension and its properties, s-sets, calculation of

Housdorff dimention and its properties, s-sets, calculation of Housdorff dimension in simple cases. (Marks-15)

Unit7:UnitMeasurement of a set at scale d, box dimension, its equivalent versions, properties of box dimension, box dimension of middle third cantor set and other simple sets, some other definitions of dimension, upper estimate of box dimension, mass distribution principle, generalized cantor set and its dimension. (Marks-15)

Text Book:

1. Kenneth Falconer: Fractal Geometry, John Wiley and sons, 1995
2. M.F. Barnsley: Fractals everywhere, A.P. 1988

Reference Book:

1. K.J.Falconer: The Geometry of Fractal sets, Cambridge University Press, 1985.

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2. Books. New Delhi.
3. Hydrodynamics-Raisinghannia.

M405 General Theory of Relativity and Cosmology (Optional):

Unit1-Geodesics, Derivation of the equation of geodesics, Geodesic co-ordinates, intrinsic derivatives, First Curvature, Parallel transport, parallel vectors. Related theorems of intrinsic derivatives and parallel displacement. (Marks-20)

Unit 2 Riemann Christoffel Curvature tensors and their properties, Riciitensor, Bianchi identities, Einstein tensor Divergence of Einstein tensor, Condition of Flat Space, Riemann Curvature, (Marks-15)

Unit-3 Theory of gravitation, principle of covariance and equivalence, geodesic principle, Simple consequences of the principle of equivalence (i) the equality of inertial and gravitational masses(ii) effect of gravitational potential on the rate of a clock, (iii) The clock paradox, the energy momentum tensor, Energy momentum tensor in case of a perfect fluid, conservation of energy and Momentum.(Marks-15)

Unit-4 The gravitational fluid in empty space in presence of matter and energy. Newtonian equation of motion as an approximation of geodesic equations, . Poission's equation as an approximation of Einstein field equation, Schwarzschid exterior solution and its isotropic form, planertry orbits and analogues of Kepler's laws in general relativity. Relation between M and m, Isotropic co-ordinates. The three crucial' tests (i)

The advancee of perihelion (ii) Bending of light rays in a gravitational field (iii) Gravitational red-shift in spectral lines. Schawarzachid interior solutions., Boundary conditions. (Marks-15)

Unit-5 Cosmology, Mach principle, Einstein modified field equations with cosmological term, Static cosmological models of Einstein and de-sitter, their derivations, properties and comparision with the actural universe. Huble's Law, cosmological principles, Wely's postulates. Non-static cosmological models. Derivation of Robertson": Walker metric, Redshift, Redshift versus distance relation Angular size versus red: shift relation and source counts in R.W space time. (Marks-15)

Text Books

1. The Mathematical Theory of Relativity, Cambridge Univesity Press-1965-A.S. Eddington.
2. A First course in general relativity, Cambridge University Press, 1990-B.F. Shutz.
3. The Theory of Relativity-C.Moller
4. An Introduction to Riemannian Geometry and Tensor Calculus, - G.,E. Weatherburn. Cambridge University Press, 1950.

M 405 Fuzzy Sets and their application (Optional)

Unit 1 Fuzzy sets: Basic Definitions. D-level sets. Convex fuzzy sets. Basic operations on Fuzzy sets. Types of Fuzzy sets. Cartesian products. Algebraic products Bounded sum and difference. T-conoroms. (Marks-10)

Unit-2 Extcusion Principle: the Zadeh extension principle Image and inverse image of fuzzy sets. Fuzzy numbers. Elements of Fuzzy Arithmetic. (Marks-10)

Unit-3 Fuzzy relations and Fuzzy Graphs: Fuzzy relations and fuzzy sets. Composition of Fuzzy relations. Min-max composition and its properties. Fuzzy equivalence relations. Fuzzy compatiability relations. Fuzzy relation equations. Fuzzy graphs, Similarity relation. (Marks-10)

Unit-4 Possibility Theory: Fuzzy measures. Evidence theory. Necessity measure. Probability measure. Possiblity distribution. Possibility theory and fuzzy sets. Possibility theory versus probability theory. (Marks-10)

Unit-5 Fuzzy Logic: An overview of classical logic. Multivalued logic. Fuzzy propositions. Fuzzy quantifiers. Linguistic variable and hedges. Inference from

conditohnal fuzzy propositions, the compositional rule of inference. Appliction in Vivil, Mechanical and Industrial Engineering. (Marks-10)

Unit-6 Approximate reasoning: An overview of fuzzy expert system . Fuzzy implications and their selection. Multiconditional approximate reasoning. The role of fuzzy relation equation. (Marks-10)

Unit-7 Introduction to fuzzy control: Fuzzy controllers. Fuzzy rule base. Fuzzy inference engine. Fuzzification. Defuzzification and the various Defuzzification methods (the centre of area, the centre of maxima and the mean of maxima methods). Introduction of Fuzzy Neural Network, Autometa and Dynamical Systems: (Marks-10)

Unit-8 Decision making in Fuzzy environment: Individual decision making. Multiperson decision makding. Multicriteria decision making. Multi stage decision making. Fuzzy ranking methods. Fuzzy linear programming . Application in Medicine and Economics. (Marks-10)

Text Books:

1. G.J.Klir and B. Yuan-Fuzzy sets and Fuzzy Logic, Theory and Applications, Prentiee Hall of India, 1995.
2. H.J.Zimmermann-Fuzzy set theory and its application, Allied Publishers Ltd. 1991.