GONDWANA UNIVERSITY

GADCHIROLI

Proposed Syllabus For

M.Sc. Mathematics

Semester-III and Semester-IV

Under Choice Based Credit System (C.B.C.S.)

With effect from

Academic Year: 2017-18

(Considered and approved in B.O.S.)

Semester III for M.Sc. Program in Mathematics												
Code	Theory / Practical	Teaching scheme (Hours/ Week)		Credits			Examination Scheme					
		Th	Total	Theory	Seminar	Total	Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
								External	Internal Asst.		Th. External	Internal Ass.
Core 11	Paper 11	5	5	4	1	5	3	100	25	125	50	
Core 12	Paper 12	5	5	4	1	5	3	100	25	125	50	
Core 13	Paper 13	5	5	4	1	5	3	100	25	125	50	
Discipline Specific Elective I	Paper 14	5	5	4	1	5	3	100	25	125	50	
Skill Enhancement	Paper 15	5	5	4	1	5	3	100	25	125	50	
	TOTAL	25	25	20	5	25		500	125	625	250	

Semester IV for M.Sc. Program in Mathematics				
Code	Theory / Practical	Teaching scheme (Hours/ Week)	Credits	Examination Scheme

		Th	Total	Theory	Desertion / Project	Total	Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
								External	Internal Asst.		Th. Extern	Internal Ass.
Core 14	Paper 16	5	5	4		5	3	100	25	125	50	
Core 15	Paper 17	5	5	4		5	3	100	25	125	50	
Core 16	Paper 18	5	5	4		5	3	100	25	125	50	
Discipline Specific Elective 2	Paper 19	5	5	4		5	3	100	25	125	50	
Skill Enhancement Course 2	Paper 20	5	5	4		5	3	100	25	125	50	
	TOTAL	25	25	20	5	25		500	125	625	250	

Review writing based Project Work.

Student can carry out review writing Based Project Work on a related topic of the subject / course. It must be a review of topic based on research publications. Student shall refer peer reviewed original research publications and based on findings, write a summary of the same. The pattern of review writing shall be based on reputed reviews published in a standard, peer reviewed journals. On the basis of this work, student must submit the Project Report (typed and properly bound) in one copy (Hard and Soft), prior to commencement of the final Practical / lab/University Examination of Semester IV. The project report shall comprise of Abstract, Introduction, detailed review, Discussion, Summary, Conclusion and, References along with the declaration by the candidate that the work is original and not submitted to any University or Organization for award of the degree and certificate by the supervisor and forwarded through Head / Course-coordinator / Director of the Department / Centre or the Principal of the College.

Review writing based Project Work.

Student can carry out review writing Based Project Work on a related topic of the subject / course. It must be a review of topic based on research publications. Student shall refer peer reviewed original research publications and based on findings, write a summary of the same. The pattern of review writing shall be based on reputed reviews published in a standard, peer reviewed journals. On the basis of this work, student must submit the Project Report (typed and properly bound) in one copy (Hard and Soft), prior to commencement of the final Practical / lab/University Examination of Semester IV. The project report shall comprise of Abstract, Introduction, detailed review, Discussion, Summary, Conclusion and, References along with the declaration by the candidate that the work is original and not submitted to any University or Organization for award of the degree and certificate by the supervisor and forwarded through Head / Course-coordinator / Director of the Department / Centre or the Principal of the College.

Signature of the teacher who taught the examinee Head of the Department

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to be finalized after obtaining information from BOS

Decided by BOS*The supervisors for the Project Work shall be from the following.

A person shall be an approved faculty member in the relevant subject. OR

Scientists of National Laboratories / Regional Research Laboratories/ Experts from R&D in Industry who are approved by competent authority in such facilities by the Union Government / the State Government / Gondwana University / Other Universities recognized by UGC.

The Project Work will carry total 100 marks and will be evaluated by both external and internal examiner in the respective Department / Center / Affiliated College.

The examiners will evaluate the Project Work/Dissertation taking into account the coverage of subject matter, arrangement and presentation, references, etc.

For written Project work	40	Marks – Evaluated jointly by External & Internal examiner
Oral Presentation	20	Marks – Evaluated jointly by External & Internal examiner
For Viva-Voce	20	Marks – Evaluated by External examiner
Internal Assessment	20	Marks – Evaluated by Internal examiner
Total	100	

Seminar

Guidelines for Students, Supervisors and Examiners

In each semester, the student will have to deliver a seminar on any topic relevant to the syllabus / subject encompassing the recent trends and development in that field / subject. The topic of the seminar will be decided at the beginning of each semester in consultation with the supervising teachers. The student has to deliver the seminar which will be followed by discussion. The seminar will be open to all the teachers of the department, invitees, and students.

The students should submit the seminar report typed and properly bound in one copy to the head of the department. The said shall be evaluated by the concerned supervisor / head of the department. The marks of the seminar shall be forwarded to the university within due period

through head of the Department. The record of the seminar should be preserved till the declaration of the final result.

Internal Assessment:

The internal assessment marks shall be awarded by the concerned teacher.

The internal assessment marks shall be sent to the University after the Assessment in the prescribed format.

For the purpose of internal assessment the University Department / College shall conduct any three assignments described below. Best two scores of a student in these tests shall be considered to obtain the internal assessment score of that student.

If the student does not appear for the Practical Exam he shall be declared failed in Practical Examination irrespective of marks obtained in Internal Practical Assessment. However the Internal Practical Assessment marks will be carried forward for his next supplementary Practical Exam.

General guidelines for Internal Assessment are:

The internal assessment marks assigned to each theory paper as mentioned in Appendix 1 shall be awarded on the basis of assignments like class test, attendance, home assignments, study tour, industrial visits, visit to educational institutions and research organizations, field work, group discussions or any other innovative practice / activity.

There shall be three assignments (as described above) per course.

There shall be no separate / extra allotment of work load to the teacher concerned. He/ She shall conduct the internal assessment activity during the regular teaching days / periods as a part of regular teaching activity.

The concerned teacher / department / college shall have to keep the record of all the above activities until six months after the declaration of the results of that semester.

**At the beginning of each semester, every teacher / department / college shall inform his / her students unambiguously the method he / she propose to adopt and the scheme of marking for internal assessment. (Prescribed in syllabus of respective Subjects).

Teacher shall announce the schedule of activity for internal assessment in advance in consultation with HOD / Principal.

**To be included in syllabus by BOS

M.Sc. Mathematics

Semester wise Syllabus

M. Sc. Semester-III

CORE PAPERS

Paper XI Complex Analysis

Paper XII Functional Analysis

Paper XIII Mathematical Methods

CORE ELECTIVE PAPER XIV (Opt any one of the following)

1. Fluid Dynamics I

2. General Relativity I

3. Graph Theory

FOUNDATION PAPER- Paper XV (Opt any one of the following) (Student shall opt for this paper from any other subject other than his /her main subject for post graduation)

1. Operations Research I

2. Elementary Mathematics

3. MATLAB Programming

4. Number Theory

5. Fuzzy Mathematics I

M. Sc. Semester-IV

CORE PPAPERS

Paper-XVI Dynamical Systems

Paper-XVII Partial Differential Equations

Papers XVIII Integral Equations

CORE ELECTIVE PAPER XIX (Opt any one of the following)

1. Fluid Dynamics II

2. General Relativity II

3. Combinatorics

FOUNDATION PAPER- XX (Opt any one of the following) (Student shall opt for this paper from any other subject other than his /her main subject for post graduation)

1. Operations Research II

2. Elementary Discrete Mathematics

3. Coding Theory

4. Financial Mathematics

5. Fuzzy Mathematics II

DETAILED SYLLABUS

M. Sc. Mathematics Semester-III

Paper XI (Complex Analysis)

Unit 1: Impossibility of ordering Complex numbers. Extended complex plane and stereographic projection. Elementary properties and examples of analytic Functions: Power series, analytic functions.
Unit 2: Analytic functions as mappings, Mobius transformations. Power series representation of analytic functions, zeros of an analytic function, index of a closed curve.
Unit 3: Cauchy's theorem and integral formula, the homotopic version of cauchy's theorem and simple connectivity, counting zeros; the open mapping theorem, Goursat's theorem, Classification of singularities, residues, the argument principle.
Unit 4: The maximum principle. Schwarz's lemma. convex functions and Hadamards three circles theorem. Phragmen-Lindelof theorem.
Text Book: Functions of one complex variable: John B. Conway, Second edition, Springer international Student Edition.
Reference Book: Complex Analysis, L.V. Ahlfors. Mc-Graw Hill, 1966.

Paper XII (Functional Analysis)

Unit 1: Normed spaces, Banach spaces, Further properties of normed spaces. Finite dimensional normed spaces and subspaces. Compactness and finite dimension. Bounded and continuous linear operators.
Unit 2: Linear functionals. Normed spaces of operators. Dual spaces. Inner product space. Hilbert space. Further properties of inner product spaces. Orthogonal complements and direct sums. Orthonormal sets and sequences. Total orthonormal sets and sequences.
Unit 3: Representation of functionals on Hilbert spaces. Hilbert adjoint operators, self adjoint, unitary and normal operators. Hahn-Banach Theorem, Hahn-Banach Theorem for complex vector spaces and normed spaces. Reflexive spaces.
Unit 4: Category theorem, Uniform boundedness theorem, strong and weak convergence, Convergence of sequences of operators and functionals. Open mapping theorem, Closed linear operators and closed graph theorem.

Text Book: Introductory Functional Analysis with Applications by E. Kreyszig, John Wiley and Sons.
Reference Books: 1. Introduction to Functional Analysis by A.E. Taylor and D.C. Lay, John Wiley and Sons. 2. Introduction to Topology and Modern Analysis: G.F. Simmons, Mc Graw Hill

Paper XIII (Mathematical Methods)

Unit 1: Fourier integral theorem. Fourier transform. Fourier cosine and sine transform. The convolution integral. Multiple Fourier transform. Solution of partial differential equation by means of Fourier transform.
Unit 2: Calculations of the Laplace transform of some elementary functions. Laplace transform of derivatives. The convolution of two functions. Inverse formula for the Laplace transform. Solutions of ordinary differential equations by Laplace transform.
Unit 3: Finite Fourier transform. Finite Sturm-Liouville transforms. Generalized finite Fourier transform.
Unit 4: Finite Hankel transform. Finite Legendre transform. Finite Mellin transform.
Text Book: The use of integral transforms: I N. Sneddon, Tata Mc Graw Hill Publishing Company Ltd.
References Books: Modern Mathematics For Engineers: Edwin F Beckenbach, Second series, Mc Graw Hill Book Company.

CORE ELECTIVE PAPER XIV (Opt any one of the following)

1.Fluid Dynamics-I

Unit 1: Real fluids and ideal fluids. Velocity of a fluid at a point. Stream lines and path lines. Steady and unsteady flows. Velocity potential. Velocity vector. Local and particle rate of change. Equation of continuity. Acceleration of a fluid. Condition at a rigid boundary. General analysis of fluid motion. Euler's equation of motion. Bernoulli's equation. Worked examples. Discussion of the case of steady motion under conservative body forces. Some further aspects of vortex motion.

Unit 2: Sources, sinks and doublets. Images in a rigid infinite plane. Images in solid spheres. Axisymmetric flows. Stokes' stream function. The complex potential for two-dimensional irrotational, incompressible flow. Complex velocity potential for

standard two dimensional flow. Uniform stream. Line source and line sink. Line doublets. Line vortices. Two dimensional image systems. The Milne-Thomson circle theorem. Circle Theorem. Some applications of circle theorem. Extension of circle theorem. The theorem of Blasius.

Unit 3: The equations of state of a substance, the first law of thermodynamics, internal energy of a gas, functions of state, entropy, Maxwell's thermodynamic relation, Isothermal Adiabatic and Isentropic processes. Compressibility effects in real fluids, the elements of wave motion. One dimensional wave equation, wave equation in two and three dimensions, spherical waves, progressive and stationary waves.

Unit 4: The speed of sound in a gas, equation of motion of a gas. Sonic, subsonic, supersonic flows; isentropic gas flow. Reservoir discharge through a channel of varying section, investigation of maximum mass flow through a nozzle, shock waves, formation of shock waves, elementary analysis of normal shock waves.

Text Book: F. Chorlton, Text book of Fluid Dynamics, CBS Publishers, Delhi 1985.

Reference Books: 1. G.K. Batchelor, An Introduction to fluid Mechanics, Foundation Books, New Delhi 1994.

2. M.D. Raisinghania, fluid Mechanics, S. Chand and Company, Delhi.

2. General Relativity-I

Unit 1: Tensor Algebra, Riemannian geometry, Curvature Tensor: Covariant Curvature tensor, Ricci tensor, Einstein Tensor, The Bianchi identity.

Unit 2: The principle of covariance, The principle of equivalence, Geodesic principle, Newton's equations of motion as an approximation of geodesic equations, Poisson's equations as an approximation to Einstein field equations.

Unit 3: Gravitational field equations in free space, Exterior Schwarzchild's solution and its isotropic form, Birkhoff's theorem, Schwarzchild singularity, planetary orbit, Advance of Perihelion of a planet, Bending of light rays in the gravitational filed, Gravitational Red shift in the spectral lines.

Unit 4: Gravitational field equations for non empty space, Linearization of the field equations, The Weyl's solution of linearized Field equations, Interior Schwarzchild's solution.

Text Book: Introduction to General Relativity: Ronald Adler, Maurice Bezin and Manamen Schiffer, McGraw-Hill Kogakusha Ltd.

References Books: 1. Introduction to theory of relativity, Rosser W.G.V., ELBS(1972).
2. Relativity Special, General and Cosmology, Rindler W., Pub. Oxford University Press (2003).
3. The Classical Theory of Fields By Landau I.D. and Lifshitz E.M., Pub. Pergamon Press (1978).
4. General Theory of Relativity BY T. M. Karade and G. S. Khadekar, Pub. SONU NILU

3. Graph Theory-

Unit 1: Introduction to Graphs and Trees
Graphs, subgraphs, paths, cycles, matrix representation of a graph, fusion, Definition and properties, bridges, spanning trees.

Unit 2: Connectivity and Euler tour
Connector problems, Shortest Path problems, cut vertices and connectivity, Euler tour, Euler Graph, the Chinese postman problem.

Unit 3: Hamiltonian cycles and Planar Graphs
Hamiltonian graphs, Travelling salesman Problem, Planar graphs, Euler's formula, Kuratowski's theorem, Non-Hamiltonian plane graphs, the dual of a plane graph.

Unit 4: Directed Graphs and Networks
Definitions and properties, Tournaments, Traffic flow, The Ford and Fulkerson Algorithm, Separating sets.

Textbook:
A First Look at Graph Theory: John Clark and Derek Allan Holton, Allied Publishers Ltd.
Chapters:-1, 2, 3,5,7,8
Reference Books:-
1) Graph Theory with Applications to Engineering and Computer Science: Narsing Deo, Prentice Hall of India.
2) Graph Theory: F. Harare, Addison Wesley.
3) Introduction to Graph Theory: Douglas B. West, Prentice- Hall, New Delhi (1999)
4) Basic Graph Theory: K. R. Parthasarthy, TataMc Graw- Hill Pub Comp Limited, Delhi.

FOUNDATION COURSE I

FOUNDATION PAPER Paper XV (Opt any one of the following) (Student shall opt for this paper from any other subject other than his /her main subject for post graduation)

1.Operational Research- I

Unit 1: Simplex method, Theory of Simplex method, duality, dual simplex method.
Unit 2: Transportation and Assignment problems.
Unit 3: Two-person Zero-sum games. Games with mixed strategies, graphical solution, solution by linear programming.
Unit 4: Dynamic programming
Text book: Operations Research: Kanti Swarup P.K. Gupta and Man Mohan: Sultan Chand and Sons New Delhi.
Reference books : 1. Linear programming: G. Hadley, Narosa Publishing House1995. 2. Introduction to operations Research: F.S. Hillier and G.J.Lieberman (Sixth Edition), Mc Graw Hill 3. International Edition 1995. 4. Operations Research – In Introduction: H.A Taha, Macmillan publishing company inc, New York

2. Number Theory

Unit 1: Congruences, Solutions Of Congruencs. Chinese Remainder Theorem, Techniques Of Numerical Calculation Public-Key Cryptography.

Unit 2: Prime Power Moduli. Prime Modulus. Primitive Roots And Power Residues, Congruences Of Degree Two.

Unit3: Quadratic Residues, Quadratic Reciprocity, Greatest Integer Function.

Unit4: Arithmetic Functions, Multiplicative Functions, Dirichlet Multiplication. Mobius Inversion Formula. Diophantine Equations. The Equation Ax + By = C, Pythagorean Triangles, Assorted Examples.

Text Book**:**
1. Niven And Zuckerman, An Introduction To The Theory Of Numbers, Wiley Publishers.
Reference Book:
2. David Burton, Elementary Number Theory

3.Elementary Mathematics

Unit 1: Differentiation: Derivative of a constant function, derivative of trigonometric functions, derivative of inverse trigonometric functions, derivative of , hyperbolic function, derivation of parametrically defined functions, logarithmic differentiation.
Unit 2: Integration: Methods of integration, integration by substitution, three important forms of integrals, six important integrals, integration by parts, definite integrals, reduction formulae.
Unit 3: Matrices & Determinant: Transpose of matrix, orthogonal matrices, unitary matrices, Hermitian and Skew-Hermitian matrices, idempotent matrix, Involutory matrix, minors and factors, properties of determinants, determinants-general treatment, symmetric & Skew-symmetric determinant.
Unit 4: Complex Number: Definition, conjugate, modulus and argument, Algebra of complex number (Addition, Subtraction, Multiplication and Division), power and square root of complex number, properties of complex number, Argand diagram, solution of quadratic equation in complex number system.
Text Books: 1. Differential Calculus by Shanti Narayan (Unit 1 & Unit 2) 2. An Introduction to Matrices by S.C. Gupta (Unit 3 & Unit 4)

4. Fuzzy Mathematics-I

Unit 1: Crisp Sets. Fuzzy Sets. Fuzzy sets versus Crisp sets Operations on Fuzzy sets.
Unit 2: Fuzzy Arithmetic.
Unit 3: Fuzzy relations.
Unit 4: Fuzzy relation equations.
Text Book: Fuzzy Sets and Fuzzy Logic, theory and applications. George J. Klir and Bo Yuan, Prentice Hall India.

5. Matlab Programming

Unit 1: Input output of data from Matlab command. File types. Creating, saving and executing the script file. Creating and executing functions file. Working with files and directories.

Unit 2: Matrix manipulation. Creating vectors. Arithmetic operations. Relational operations. Logical operations. Matrix functions. Determinant of matrix. Eiugen values and Eigen vectors. Programming in Matlab: function files, sub functions,

global variations, loops, branches and control flow. Interactive input. Recursion. Publishing a report. Controlling command windows. Command line editing.

Unit 3: Linear Algebra and interpolation: Solving the linear equation. Gaussian elimination, matrix factorization, curve fitting, polynomial curve fitting, least squares curve fitting. General non linear fits. Interpolation.

Unit 4: Differential equations and graphics: First order and second order ODE. Double integration. Roots of polynomial. Two and three dimensional plots. Matlab plotting tools. Mesh and surface plots.

Text Books: 1. Applied numerical Methods using MATLAB: Won Young Yang, Tae-Sang-Chung, John Morris: John Wiley and Sons.
2. Solving ODE's with Matlab: L.F. Shampine, I Gladwell, S. Thompson; Cambridge University Press.
3.Getting Started with MATLAB 7: Rudra Pratap; Oxford Press

DETAILED SYLLABUS

M. Sc. Mathematics Semester IV

Paper XVI Dynamical Systems

Unit 1: Dynamical systems and vector fields. The fundamental theorem. Existence and uniqueness. Continuity of solutions in initial conditions. On extending solutions. Global solutions. The flow of a differential equation.
Unit 2: Nonlinear sinks. Stability. Liapunov function. Gradient systems. Gradients and inner products.
Unit 3: Limit sets, local sections and flow boxes, monotone sequences in planar dynamical systems. The Poincare Bendixson theorem, Applications of Poincare-Bendixson theorem; one species, predator and prey, competing species.
Unit 4: Asymptotic stability of closed orbits, discrete dynamical systems. Stability and closed orbits. Non Autonomous equations and differentiability of flows. Persistence of equilibria, persistence of closed orbits. Structural stability.
Text Book: Differential equations, dynamical systems & linear algebra: M.W. Hirsch & S. Smale, Academic Press, 1975.
Reference Book: Dynamical systems: V.I. Arnold, Springer Verlag, 1992.

Paper XVII Partial Differential Equations

Unit 1: First order partial differential equations in two independent variables and the Cauchy problem. Semilinear and quasi linear equations in two independent variables. First order non linear equations in two independent variables. Complete integral.

Unit 2: Classification of second order partial differential equations. Potential theory and elliptic differential equations (sections 2.1-2.5).

Unit 3: The diffusion equation and parabolic differential equations (sections 3.1-3.4).

Unit 4: The Wave equation (sections 4.1, 4.2, 4.4, 4.8, 4.9)

Text Book: Partial Differential Equations: Phoolan Prasad and Renuka Ravindran; New Age International (P) Limited.

Paper XVIII Integral Equations

Unit 1: Preliminary concepts of integral equations. Some problems which give rise to integral equations. Conversion of ordinary differential equations into integral equations. Classification of linear integral equations. Integro-differential equations.

Unit 2: Fredholm equations. Degenerate kernels. Hermitian and symmetric kernels. The Hilbert- Schmidt theorem. Hermitization and symmetrization of kernels. Solutions of integral equations with Green's function type kernels.

Unit 3: Types of Voltera equations. Resolvent kernel of Voltera equations, Convolution type kernels. Some miscellaneous types of Voltera equations. Non-linear Voltera equations. Fourier integral equations. Laplace integral equations.

Unit 4: Hilbert transform. Finite Hilbert transforms. Miscellaneous integral transforms. Approximate methods of solutions for linear integral equations. Approximate evaluation of Eigen values and Eigen functions.

Text Book: Integral Equations: A short course: LI. G Chambers: International text book company Ltd, 1976.

CORE ELECTIVE PAPER XIX (Opt any one of the following)

1. Fluid Dynamics-II

Unit 1: Stress components in a real fluid, relation between Cartesian components of stress translation motion of fluid elements, the rate of strain quadric and principal stresses, some further properties of the rate of the strain quadric, stress analysis in fluid motion, relation between stress and rate of strain, the coefficient of viscosity and laminar flow, the Navier-Stokes equations of motion of a viscous fluid, some solvable problems in viscous flow, diffusion of vorticity, energy dissipation due to viscosity, steady flow past a fixed sphere.

Unit 2: Nature of magneto-hydrodynamics, Maxwell electromagnetic field equations; Motion at rest, Motion in medium , Equation of motion of conducting fluid, Rate of flow of charge, Simplification of electromagnetic field equation. Magnetic Reynold number; Alfven's theorem, The magnetic body force. Ferraro's Law of Isorotation.

Unit 3: Dynamical similarity, Buckingham Theorem. Renold number. Prandtl's boundary layer, Boundary layer equation in two dimensions, Blasius solutions, Boundary layer thickness, Displacement thickness. Karman integral conditions, Separation of boundary layer flow.

Unit 4: Turbulence: Definition of turbulence and introductory concepts. Equations of motion for turbulent flow. Reynolds Stresses Cylindrical coordinates. Equation for the conservation of a transferable scalar quantity in a turbulent flow. Double correlations between turbulence-velocity components. Change in double velocity correlation with time. Introduction to triple velocity correlations. Features of the double longitudinal and lateral correlations in a homogeneous turbulence. Integral scale of turbulence.

Text Books: 1. Text book of Fluid Dynamics: F. Chorlton; CBS Publishers, Delhi 1985. 2. Fluid Mechanics: Joseph Spurk; Springer. 3. Turbulence by J.O. Hinze, 2nd edition, Mc Graw-Hill, chapter 1 sections 1.1 to 1.7 4. Fluid Mechanics by M.D. Raisinghania, S. Chand and Company, Delhi.

Reference Books: 1. An Introduction to fluid Mechanics: G.K. Batchelor; Foundation Books, New Delhi, 1994. 2. Boundary Layer Theory: H. Schichting; Mc Graw Hill Book Company, New York 1971.

2. Relativity- II

Unit 1: Static cosmological models of Einstein and de Sitter and their derivation and its Properties: (i) The geometry of the Universe (ii) Density and pressure (iii) Motion of test particle (iv) Doppler shift (v) comparison with actual universe, Comparison between Einstein and de-Sitter models.

Unit 2: Cosmological principle, Hubble law, Weyl's postulate,Derivation of Robertson Walker Metric and its properties, Motion of a particle and light rays in FRW model, Red shift, Deceleration parameter and Hubble's constant, Matter Dominated era.

Unit 3: Friedman Model, Fundamental equation of dynamical cosmology, density and pressure of the present universe, Matter dominated era of the universe, critical density, flat, closed and open universe, age of the universe.

Unit 4: Steady state cosmology, Distance measure in cosmology, Comoving distance, Apparent luminosity and luminosity distance, Angular diameter and Lookback time, Galaxy count

Text Books: 1. Relativity, Thermodynamics and Cosmology: Richard C. Tolman, Oxford Press

2. Gravitation and Cosmology : Principles and Applications of the General Theory of Relativity by Steven Weinberg.

3. General Theory of Relativity By T. M. Karade and G. S. Khadekar, Pub. SONU NILU

References Books: 1. The Classical Theory of Fields, By Landau I.D. and Lifshitz E.M., Pub. Pergamon Press (1978).

2. The Theory of Relativity Moller C, Pub. Oxford University Press (1982).

3. Introduction to theory of relativity, Rosser W.G.V., ELBS (1972).

4. Relativity Special, General and Cosmology, Rindler W., Pub. Oxford University Press (2003).

5. Relativity: The General Theory, Synge J.L., North Holland Pub. Comp. (1971).

3. COMBINATORICS

Unit 1: Counting Methods for selections arrangements: Basic counting principles, simple arrangements and selections, arrangements and selection with repetition, distributions, binomial identities, generating permutations and combinations and programming projects.

Unit 2: Generating function: Generating function models, calculating of generating functions, partitions exponential generating functions, a summation method.

Unit 3: Recurrence Relations: Recurrence relation model, divide and conquer relations, solution of inhomogeneous recurrence relation, solution with generating functions.

Unit 4: Inclusion-exclusion: Counting with Venn diagrams inclusion formula, restricted positions and rook polynomials.

Text Books:

1. Alan Tucker, Applied Combinatorics (third edition), John Wiley & sons , New York (1995)
2. V. Krishnamurthy, Combinatorial, Theory and Applications, East West Press, New Delhi (1989) Scientific, (1996)

FONDATION COURSE II

FOUNDATION PAPER XX (Opt any one of the following) (Student shall opt for this paper from any other subject other than his /her main subject for post graduation)

1.Operations Research–II

Unit 1: Integer programming.
Unit 2: Queuing theory and sequencing.
Unit 3: Non- Linear programming- one and multi- Variable unconstrained optimization, KuhnTuckerconditions for constrained optimization.
Unit 4: Quadratic programming, fraction programming and goal programming.

Text book: Kanti-Swarup P.K. Gupta and Man Mohan: Operations Research, Sultan Chand and Sons New Delhi.

Reference books : 1. G. Hadley: Linear programming, Narosa Publishing House1995. 2. 2.F.S. Hillier and G.J.Lieberman: Introduction to operations

Research (Sixth Edition) Mc Graw Hill 3. International Edition 1995. 4. 3.H.A Taha: Operations Research – In Introduction, Macmillan publishing company inc, New York

2.Elementary Discrete Mathematics

Unit 1: Mathematical Logic: Introduction, Proposition, compound Proposition, Proposition and truth tables, logical equivalence, algebra of Proposition, conditional Proposition, converse, contra positive & inverse, bi conditional statement, negation of compound statements, tautologies & contradictions, normal forms, logic in proof.
Unit 2: Lattice: Lattice as partially ordered sets, their properties, lattices as algebraic system, sub lattices, and some special lattices eg. Complete, complemented and distributive lattices.
Unit 3: Boolean algebra and Logic Circuits: Boolean algebra, basic operations, Boolean functions, De-Morgan's theorem, logic gate, sum of products and product of sum forms, normal form, expression of Boolean function as a canonical form, simplification of Boolean expression by algebraic method, Boolean expression form logic & switching network.
Unit 4: Graph Theory: Basic terminology, simple graph, multigraph, degree of a vertex, types of a graph, sub graphs of isomorphic graphs, matrix representation of graphs, Euler's theorem on the existence of Eulerian path & circuits, directed graph, weighted graphs, strong connectivity, chromatic number.
Text Book: Discrete Mathematical structures with applications to computer science by J.P. Tremblay and R. Manohar, McGraw-Hill book company,1997.

3. CODING THEORY

Unit 1: Error detection: correction and decoding: Communication channels, Maximum likelihood decoding, Hamming distance, Nearest neighbor / minimum distance decoding, Distance of a code.
Unit 2: Linear codes: Vector spaces over finite fields, Linear codes, Hamming weight, Bases of linear codes, Generator matrix and parity check matrix, Equivalence of linear codes, Encoding with a linear code, Decoding of linear codes, Cossets, Nearest neighbor decoding for linear codes, Syndrome decoding.
Unit3: Cyclic codes: Definitions, Generator polynomials, Generator and parity check matrices, Decoding of cyclic codes, Burst-error-correcting codes.
Unit4: Some special cyclic codes: BCH codes, Definitions, Parameters of BCH codes, Decoding of BCH codes.
Text Book:

San Ling and Chaoping Xing, Coding Theory- A First Course, Cambridge University Press, First edition.
Scope: Chapters 2,4,6,8.

4. Financial Mathematics

Unit 1: The Measurement of Interest and Solution of Problems in Interest:
Introduction, The accumulation and amount functions, The effective rate of interest, Simple interest, Compound interest, Present value, The effective rate of discount, Nominal rates of interest and discount, Forces of interest and discount, Varying interest, Summary of results. Introduction, The basic problem, Equation of value, Unknown time, Unknown rate of interest, Determining time periods, Practical examples.
Unit 2: Basic Annuities and More General Annuities:
Introduction, Annuity-immediate, Annuity-due, Annuity values on any date, Perpetuities, Unknown time, Unknown rate of interest, Varying interest, Annuities not involving compound interest. Introduction, Differing payment and interest conversion periods, Annuities payable less frequently than interest convertible, Annuities payable more frequently than interest convertible, Continuous annuities, Payments varying in arithmetic progression, Payments varying in geometric progression, More general varying annuities, Continuous varying annuities, Summary of results.
Unit 3: Amortization Schedules and Sinking Funds:
Introduction, Finding the outstanding loan balance, Amortization schedules, Sinking funds, Differing payment periods and interest conversion periods, Varying series of payments, Amortization with continuous payments, Step-rate amounts of principal.
Unit 4: Bonds and Other Securities and Yield Rates:
Introduction, Types of securities, Price of a bond, Premium and discount, Valuation between coupon payment dates, Determination of yields rates, Callable and putable bonds, Serial bonds, some generalizations, other securities, Valuation of securities. Introduction, Discounted cash flow analysis, Uniqueness of the yield rate, Reinvestment rates, Interest measurement of a fund, Time-weighted rates of interest, Portfolio methods and investment year methods, Short sales, Capital budgeting basic technique and other technique.

Text Books:
1. Stephen G. Kellison, The Theory of Interest, 3rd Edition. McGraw Hill International Edition (2009).
2. R. J. Elliott and P. E. Kopp, Mathematics of Financial Markets, Springer (1999).

5. Fuzzy Mathematics-II

Unit 1: Possibility theory
Unit 2: Fuzzy Logic
Unit3: Constructing Fuzzy sets and operations on Fuzzy sets. Approximate reasoning.
Unit4: Fuzzy Systems. Pattern Recognition.

Text Book: Fuzzy Sets and Fuzzy Logic, theory and applications by George J. Klir and Bo Yuan, Prentice Hall, India.