

RADHA GOVIND UNIVERSITY
RAMGARH, JHARKHAND

DEPARTMENT OF MATHEMATICS



CHOICE BASED CREDIT SYSTEM CURRICULUM
FOR M. SC. MATHEMATICS
SUBJECT CODE - 017

**FOR POSTGRADUATE COURSES UNDER
RADHA GOVIND UNIVERSITY**

Implemented w.e.f.
Academic Session 2025-26 & onwards

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. I Semester

Course Title	MODERN ALGEBRA	
Type of Course	Theory, Paper I	
Credit	4	
Course Assessment	Internal - 30% [Test – 20 %, Internal assessment -5%, Attendance – 5%] Semester Examination 70%	
Contents of Syllabus		No of Questions
Unit I - Group Theory Groups Finite permutation groups S_5 and A_5 , Normal and Subnormal series, Jordan-Holder theorem, Solvable groups, Nilpotent groups. Group action, orbit -stabilizer theorem, Sylow's theorems (proofs using group actions).		02
Unit II- Linear Algebra Matrix of a linear transformation, Canonical Forms — Similarity of linear transformations. Invariant subspaces. Eigen values and Eigen vectors, Reduction to diagonal, triangular and Jordan forms. The primary decomposition theorem		02
Unit III — Field Extension Field theory-Extension fields, finite extension, Algebraic and transcendental extensions. splitting fields-existence and uniqueness, Separable and inseparable extension. Normal extensions. Perfect fields.		02
Unit IV — Finite Field Finite fields, Theorems on finite fields, Primitive elements. Algebraically closed fields. Automorphism of extensions, Galois extension. Fundamental theorem of Galois Theory.		02
Textbooks* /Reference Books	1. D.S. Dummit, R.M. Foote, <i>Abstract Algebra</i> — John Wiley & Sons (2003) 2. I.N. Herstein. <i>Topics in Algebra</i> , Wiley Eastern Ltd., New Delhi, 1975 3. M. Artin. <i>Algebra</i> , Prentice-Hall of India, 1991. 4. K. Hoffman and R. Kunze (2 nd edition), <i>Linear Algebra</i> , Prentice Hall of India, New Delhi (1997) 5. N.S. Gopala Krishnan, <i>University Algebra</i> , New Age Int. Publ. 6. William J Gilbert, <i>Modern Algebra with Applications</i> , Wiley India, 2005.	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. I Semester

Course Title	Real Analysis	
Type of Course	Theory, Paper II	
Credit	4	
Course Assessment	Internal - 30% [Test – 20 %, Internal assessment -5%, Attendance – 5%] Semester Examination 70%	
Contents of Syllabus		No of Questions
UNIT I: Definition and existence of Reiemann Stieltjes integral Properties of the Integral Integration and differentiation the fundamental theorem of Calculus (Fourier series) Bessels inequality. Perseval theorem, Fourier series representation of functions		02
UNIT II: Sequences and series of functions pointwise and uniforin convergence Cauchy criterion for uniform convergence Weierstrass M test, Abel's and Dirichlet s test for uniform convergence and continuity uniform convergence		02
UNIT III: Riemann Stieltjes integration uniform convergence and differentiation, Weierstarss approximation theorem Power Series uniqueness theorem for power series Abel s and Tauber's theorem		02
UNIT IV: Functions of several variables linear transformation Derivatives in an open subset of R Chain rule Partial derivatives interchange of the order of differentiation Derivatives of higher orders Young theorem Schwartz theorem Taylor's theorem, Inverse function theorem Implicit function theorem Jacobians		02
Textbooks */ Reference Books	1 Walter Rudin Principles of Mathematical Analysis (3rd edition) Mc Graw-Hill. Kogakushu 1976 Internations student edition 2. T.M Apostal Mathematical Analysis, Narosa publishing House New Delhi 1985, 3 Shanti Narain Real Analysis Chand & Co New Delhi. 4 Malik and Arora Mathematical Analysis	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. I Semester

Course Title	Topology	
Type of Course	Theory, Paper III	
Credit	4	
Course Assessment	Internal - 30% [Test – 20 %, Internal assessment -5%, Attendance – 5%] Semester Examination 70%	
Contents of Syllabus		No of Questions
UNIT I Countable and uncountable sets Infinite Sets and the Axiom of Choice (statement only) Cardinal numbers Schroeder Bernstein theorem Cantor s theorem and continuum hypothesis . Zorn's lemma (statement only)		02
UNIT II: Definition and examples of topological spaces closed sets, Closure. Dense subsets. Neighbourhoods Interior exterior and boundary. Accumulation points and derived sets Bases and sub base Subspaces and relative topologies.		02
UNIT III: First and Second countable spaces Lindelof's theorem separable spaces, second countability and separability separation axioms To T1, T2 T3 T4 their Characterizations and basic properties. Urysohn' Lemma. Tietze extension theorem.		02
UNIT IV Compactness, continuous functions and compact sets. Basic property of compactness Compactness and finite intersection property Tychonoff's Theorem connected and disconnected spaces and their basic properties,		02
Textbooks */ Reference Books	1. K D Joshi : Introduction to General topology, Wiley eastern Ltd. 1963 2. J L Kelly – General Topology, Van Nostrand, Reinhold Co. New York, 1995. 3. W J Pervin- Foundation of general Topology, Academic Press Inc New York 1964. 4. K K Jha – Advance General Topology, Nav Bharat Prakashan Delhi 5. G F Simmons – Introduction to Topology and Modern Analysis, Mc Graw Hill.	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. I Semester

Course Title	Complex Analysis	
Type of Course	Theory, Paper IV	
Credit	4	
Course Assessment	Internal - 30% [Test – 20 %, Internal assessment -5%, Attendance – 5%] Semester Examination 70%	
Contents of Syllabus		No of Questions
UNIT I: Complex Integration, Cauchy Goursat's theorem, Cauchy's Integral formula, Higher Order Derivative, Morera's Theorem, Cauchy's inequality, Liouville's theorem.		02
UNIT II The fundamental theorem of Algebra, Taylor's theorem, Maximum modulus principle, Schwarz Lemma, Laurent's series.		02
UNIT III Isolated singularities, Meromorphic function, the argument principle, Rouché's theorem, Poles and zeroes, fundamental theorem, residues, Cauchy Residue Theorem, Evaluation of integrals.		02
UNIT IV Bilinear transformation, their properties and classification, Definition and examples of conformal mapping. Analytic continuation uniqueness of direct analytic continuation, uniqueness of analytic continuation along a curve, Power series, method of analytic continuation.		02
Textbooks* /Reference Books	<ol style="list-style-type: none"> 1. L V Ahlfors – Complex Analysis, Mc Graw Hill, 1979 2. S Lang Complex Analysis, Addison Wesley 1977. 3. Walter Rudin, Real and Complex Analysis, Mc Graw Hill Co 1966. 4. E C Titchmarsh – The theory of functions, Oxford University Press, London. 5. S Ponnusamy – foundation of Complex analysis, Narosa Publishing House, 1997. 6. Shanti Narain – Complex variables 	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. II Semester

Course Title	Basic Computer and Programming in ‘C’	
Type of Course	Theory, Paper V	
Credit	4	
Course Assessment	Internal - 30% [Test – 20 %, Internal assessment -5%, Attendance – 5%] Semester Examination 70% [40% Theory, 30% Practical]	
Contents of Syllabus		No of Questions
UNIT I: INTRODUCTION TO COMPUTERS: Block Diagram of computer, Functioning of computer ,Generations of computer, Classification of computers, Characteristics , Advantage and Limitations of Computers. Computer memory, Primary and Secondary , Types of Primary memory.		02
UNIT II Number system, Decimal , Binary, Octal, Hexadecimal, number system, features and covariance , binary arithmetic , ASCII and EBCDIC codes. ALGORITHM AND FLOW CHART : Algorithm for problem solving , an introduction, properties of an algorithm, classification, algorithm logic , flow chart.		02
UNIT III C- programming : An overview of programming , programming language classification, History of C, Importance of C , basic structure of C, program, executing a C program, compiling and linking . Scalar Data Type → Declaration, different types of integers, different kinds of Integer constant, Floating Point Types initialization mixing types enumeration types, the void data type, Tydefs, find the address of an object, pointers.		02
UNIT IV Operation and expressions, Operatus, Introduction, Orthometric operators, rational operators, logical operators, assignment operators, Increment and decrement operators, Bit wise operators. Arithmetic expressions, Evaluation of expression, precedence of arithmetic operator. Control flow, conditional branching, The Switch statement, Looping, Nested loops, the ‘ brake and continue’ statement. The Go to statement. Infinite loops, arrays and pointers, declaring an array, Arrays and memory. Initializing array. Multidimensional arrays.		02
PRACTICALS <ol style="list-style-type: none"> 1. Programme of bisection method, 2. Programme of false poisson method, 3. Programme of Newton – Rapson’s method 4. Simpson’s $\frac{1}{3}$ rd rule. 5. Gauss’s Elimination method. 6. Gauss seidal method. 7. Numerical differentiation 8. Lagrange’s interpolation formulae. 9. Newton’s Interpolation Formula. 10. Euler’s method for first order ordinary differential equation 		

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. II Semester

Course Title	Differential Equation and Special Functions		
Type of Course	Theory, Paper VI		
Credit	4		
Course Assessment	Internal - 30% [Test – 20 %, Internal assessment -5%, Attendance – 5%] Semester Examination 70%		
Contents of Syllabus			No of Questions
UNIT I Introduction to Generalized Hyper geometric function, Differential Equations satisfied by pFq. Saclhut ‘Z’ theorem, Whipples theorem, Dixon’s theorem, Integrals involving generalized hyper geometric functions. Contiguous function relations, Kummer’s theorem, ramanujan’s theorem.			02
UNIT II Introduction to Hermite Polynomials, Recurrence Relation, Orthogonal properties, expansion of polynomials, Generating functions, Rodrigue’s formula for Hermite Polynomials.			02
UNIT III Introduction to Laguerre’s Polynomials, recurrence relations, generating functions, Rodrigue’s formula and Orthogonality. Expamry special results, Laguerre’s associated differential equations. More generating functions.			02
UNIT IV Introducion to Jacobi Polynomials, Generating functions, Rodrigue’s formula and Orthogonality, Introduction of Elliptic function. Properties. Weierstrass ellipite, Jacobian theta function, Zeroes of Theta function.			02
Textbooks */ Reference Books	<ol style="list-style-type: none"> 1. W T Reid – Ordinary Differential Equations, John Wiley & Sons NY (1971). 2. E A Coddington and Levinson – Theory of Ordinary Differential Equations, Mc Graw Hill NY (1955) 3. Sneddon I N (1961) – Special Functions of Mathematical Physics and Chemistry; Oliver and Boyd, Edinburg 4. Bell W W (1966) – Special functions for Scientific and Engineers, D Van Nontrand Conv. Ltd. London. 5. Rainville, E D (1960) Special Functions, Macmillan, New York. 		

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. II Semester

Course Title	Differential Geometry and Tensor Calculus	
Type of Course	Theory, Paper VII	
Credit	4	
Course Assessment	Internal - 30% [Test – 20 %, Internal assessment -5%, Attendance – 5%] Semester Examination 70%	
Contents of Syllabus		No of Questions
UNIT I Space curves-curvature and torsion. Serret- Frenet formula. Circular helix, the circle of curvature. Osculating sphere, Bertrand curves.		02
UNIT II Curves on a surface-parametric curves. fundamental magnitude, curvature of normal section. Principal directions and principal curvatures, lines of curvature, Rodrigues formula. Dupin's theorem, theorem of Euler, Conjugate directions and Asymptotic lines.		02
UNIT III One parameter family of surfaces Envelope the edge of regression, Developables associated with space curves. Geodesics-differential equation of Geodesic. Torsion of a Geodesic.		02
UNIT IV Tensors, Tensor Algebra, Quotient theorem. Metric Tensor, Angle between two vectors.		02
Textbooks */ Reference Books	References : 1. J. N. Sharma and A.R. Vasistha, Differential Geometry. 2. C.E. Weatherburn. Differential geometry of three dimensions. 3. P.P. Gupta & G.S. Malik. Three dimensional differential geometry. 4. C.E. Weatherburn. Tensor calculus. 5. R.S. Mishra, Tensor Calculus and Riemanian Geometry.	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. II Semester

Course Title	Analytical Dynamics and Gravitation	
Type of Course	Theory, Paper VIII	
Credit	4	
Course Assessment	Internal - 30% Test – 20 %, Internal assessment -5%, Attendance – 5% Semester Examination 70%	
Contents of Syllabus		No of Questions
UNIT I Generalized coordinates Holonomic and Non-holonomic systems. Scleronomic and Rheonomic systems. Generalized potential. Lagrange's equations of first kind. Lagrange's equations of second kind. Energy equation of conservative fields.		02
UNIT II Hamilton's variables, Hamilton canonical equations. Cyclic coordinates Routh's equations, Jacobi-Poisson Theorem. Fundamental lemma of calculus of variations. Motivating problems of calculus of variations. Shortest distance. Minimum surface of revolution. Brachstochrone problem, Geodesic.		02
UNIT III Hamilton's Principle, Principle of least action. Jacobi's equations. Hamilton-Jacobi equations. Jacobi theorem. Lagrange brackets and Poisson brackets. Invariance of Lagrange brackets and Poisson brackets under canonical transformations.		02
UNIT IV Gravitation: Attraction and potential of rod, spherical shells and sphere. Laplace and Poisson equations. Work done by self attracting systems. Distributors for a given potential. Equipotential surfaces.		02
Textbooks */ Reference Books	References : <ul style="list-style-type: none"> • H. Goldstein, Classical Mechanics (2nd edition), Narosa Publishing House, New Delhi. • I.M.Gelfand and S.V.Fomin Calculus of variation, prentice Hall. • S.L. Loney, An elementary treatise on Statics, Kalyani Publishers, N. Delhi 1979. • A.S.Ramsey, Newtonian Gravitation. The English Language Book Society and the Cambridge University Press. • N.C. Rana & P.S.Chandra Joag, Classical Mechanics. Tata McGraw Hill 1991. • Lours N. Hand and Jane!, D. Finch, Analytical Mechanics, Cambridge University Press, 199 	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. III Semester

Course Title	Difference Equations	
Type of Course	Theory, Paper IX [A]	
Credit	4	
Course Assessment	Internal - 30% [Test – 20 %, Internal assessment -5%, Attendance – 5%] Semester Examination 70%	
Contents of Syllabus		No of Questions
UNIT I The Calculus of finite differences: Introduction of finite difference — Differences. Differences formulae and problems. Fundamental theorem of difference calculus, properties of the operators A and E, Relation between operator E of finite differences and differential coefficient D of differential calculus. One or more missing terms method I and II, Factorial notation methods of representing any polynomial, Recurrence relations, Leibnitz rule, effect of an error in a tabular value.		02
UNIT II Difference equations : Introduction. definition of difference equation. solution of the difference equations. various type of linear difference equation. differential equation as limit of difference equations. Linearly independent functions. Homogenous difference equation with constant coefficients. Homogenous linear difference equations with variable coefficients. existence and uniqueness theorem.		02
UNIT III Linear difference equation with constant coefficient, method of undetermined coefficient coefficient and special operator method to find particular solution, Solution of linear difference equation with constant coefficient using Variation of parameter, calculation of nth power of a matrix A , matrix method for the solution of system of linear difference equation, generating function technique to solve linear difference equation, applications of difference equations, cobweb phenomenon.		02
UNIT IV Numerical solution of partial differential equations : Boundary — value problem with boundary conditions. Laplace equations, wave equations. Heat equation.		02
Textbooks */ Reference Books	<ul style="list-style-type: none"> Calvin Ahlbrandt and Allan C. Peterson. Discrete Hamiltonian Systems. Difference Equations. Continued Fractions and Riecati Equations. Kluwer. Boston 1996. Kalman Busby and Ross, Discreate Mathematical structure, Pearsion education. S.Elaydi, Difference equation, springer. 	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. III Semester

Course Title	Number Theory	
Type of Course	Theory, Paper IX [B]	
Credit	4	
Course Assessment	Internal - 30% [Test – 20 %, Internal assessment -5%, Attendance – 5%] Semester Examination 70%	
Contents of Syllabus		No of Questions
UNIT I Divisibility theory : Gretest Common divisor, Least common multiple, linear diophantine equation, Fundamental theorem of arithmetic		02
UNIT II Congruences : Residue system, test of divisibility, linear congruences, Chinese Remainder Theorem, polynomial congruences, application in solution of Diophantine equation, Fermat's Little theorem (FLT1), Eulers genaralization of FLT1, Wilson's theorem.		02
UNIT III Arithmetic functions(<i>Eulers ϕ, σ and τ</i>), definitions, examples and their properties, perfect numbers, the Mobius Inversion formula, properties of Mobius function, convolution of arithmetic functions, group properties of arithmetic functions, recurrence functions, Fibonacci numbers and their elementary properties.		02
UNIT IV Quadratic Residues, Quadratic Reciprocity law, Euler's criterion, Legendre symbol and its properties, Gauss Lemma, Jacobi symbol and its properties. Cryptography: some simple cryptosystem, Enciphering matrices, Idea of public key cryptography.		02
Textbooks */ Reference Books	<ul style="list-style-type: none"> Calvin Ahlbrandt and Allan C. Peterson. Discrete Hamiltonian Systems. Difference Equations. Continued Fractions and Riccati Equations. Kluwer. Boston 1996. Kalman Busby and Ross, Discrete Mathematical structure, Pearson education. S. Elaydi, Difference equation, Springer.	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. III Semester

Course Title	Advanced Discrete Mathematics	
Type of Course	Theory, Paper IX [C]	
Credit	4	
Course Assessment	Internal - 30% [Test – 20 %, Internal assessment -5%, Attendance – 5%] Semester Examination 70%	
Contents of Syllabus		No of Questions
UNIT I Language and grammars, Finite state machines with output, Finite state machines with no output, Finite state Machine, Finite state automata, deterministic finite state automata(DFSA), non deterministic finite state automata(NDFSA), transition diagram.		02
UNIT II Equivalence of DFSA and NDFSA, Moor machine, Mealy machine and Turning machine, Languages and regular expressions, Language determined by finite state automaton, grammars.		02
UNIT III Colouring : Vertex colouring, chromatic number, chromatic polynomial, Brooks theorem, edge colouring, chromatic index, map colouring, six colour theorem, Five colour theorem.		02
UNIT IV Hamiltonian graph, Ore's theorem, Dirac' theorem, The Shortest path problem, Dijkstra's algorithm. Hall's marriage, theorem, transversal theory, Alternative proof of Hall's theorem using transversal theory, applications of Hall's theorem.		02
Textbooks */ Reference Books	1. Graph Theory — R. J. Wilson. 2. Kalman Busby and Ross, Discrete mathematical structure, Pearson education. 3. D. S. Malik and M. K. Sen : Discrete mathematical structures : theory and applications; Thomson; Australia; 2004. 4. Edward R. Scheinerman : Mathematics A Discrete Introduction; Thomson Asia Ltd.; Singapore; 2001. 5. Discrete mathematical structure, R.P.Grimaldi, Pearson education.	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. III Semester

Course Title	Functional Analysis	
Type of Course	Theory, Paper X	
Credit	4	
Course Assessment	Internal - 30% Test – 20 %, Internal assessment -5%, Attendance – 5% Semester Examination 70%	
Contents of Syllabus		No of Questions
UNIT I Normed linear spaces. Banach spaces and examples. Quotient space of normed linear spaces and its completeness, equivalent norms.		02
UNIT II Bounded linear transformations, normed linear spaces of bounded linear transformations, dual spaces with examples. Hahn-Banach theorem Open mapping and closed graph theorem, the natural imbedding of N in N^{**} . Reflexive spaces.		02
UNIT III Inner product spaces. Hilbert spaces. Orthonormal Sets. Bessel's inequality. Complete orthonormal sets and Parseval's identity. Projection theorem. Rietz representation theorem Adjoint of an operator on a Hilbert space.		02
UNIT IV Reflexivity of Hilbert spaces. Self-adjoint operators. Positive, normal and unitary operators. Linear transformation & linear functionals		02
Textbooks */ Reference Books	References: <ol style="list-style-type: none"> 1. G.F. Simmons, Topology and modern analysis TMH. 2 G. Bachman and L. Narici, Functional Analysis, Academic Press, 1966. 3 R.E. Edwards, Functional Analysis. Holt Rinehart and Winston, New York 1958. 4 C. Goffman and G. Pedrick. First Course in Functional Analysis, Prentice Hall of India, New Delhi. 1987. 5 E. Kreyszig, Functional analysis with application, John wiley and sons. 	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. III Semester

Course Title	Partial Differential Equations	
Type of Course	Theory, Paper XI	
Credit	4	
Course Assessment	Internal - 30% [Test – 20 %, Internal assessment -5%, Attendance – 5%] Semester Examination 70%	
Contents of Syllabus		No of Questions
UNIT I Laplace equation — Fundamental solutions of two and three dimensional Laplace equation in Cartesian form. Properties of Harmonic functions. Boundary value problems.		02
UNIT II Heat equation — Derivation and fundamental solution of one dimensional Heat equation in Cartesian form. Application problems.		02
UNIT III Wave equation — Derivation and fundamental solution of one dimensional wave equation in Cartesian form. Application problems.		02
UNIT IV Solutions of p.d.e. using Separation of variables, Fourier transform and Laplace transform, Green's function and solutions of boundary value problems.		02
Textbooks */ Reference Books	References : 1. L.C. Evans, Partial Differential Equations, Graduate Studies in Mathematics, Volume 19, AMS, 1998. 2 I.N. Sneddon, Use of integrals transforms McGraw Hill. 3 P. Prasad and R. Ravindran ; Partial Differential equation. 4 K. Sankar Rao, Partial differential equation, new age.	

DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. III Semester

Course Title	Fluid Mechanics	
Type of Course	Theory, Paper XII	
Credit	4	
Course Assessment	Internal - 30% [Test – 20 %, Internal assessment -5%, Attendance – 5%] Semester Examination 70%	
Contents of Syllabus		No of Questions
UNIT I Kinematics — Lagrangian and Eulerian methods. Equation of continuity in different coordinate system. Boundary surfaces. Stream lines. Path lines and streak lines. Velocity potential, Irrotational and rotational motions. Vortex lines.		02
UNIT II: Equations of Motion — Lagrange 's and Euler's equations of motion. Bernoulli's theorem. Equation of motion by flux method. Impulsive actions. Stream function Irrotational motion.		02
UNIT III: Complex velocity potential. Sources, sinks doublets and their images in two dimension. Conformal mapping. Milne-Thomson circle theorem.		02
UNIT IV: Two-dimensional Irrotational motion produced by motion of circular, co-axial and elliptic cylinders in an infinite mass of liquid. Theorem of Blasius. Motion of a sphere through a liquid at rest at infinity. Liquid streaming past a fixed sphere. Equation of motion of a sphere.		02
Textbooks */ Reference Books	1. W.H.Besaint & A. S. Ramsey. A Treatise on Hydro mechanics. Part II. CBS Publishers. Delhi. 1988. 2. G.K. Batchelor. An Introduction of Fluid Mechanics. Foundation Books. New Delhi. 1994. 3. F. Choriton. Textbook of Fluid Dynamics. C.B.S. Publishers. Delhi 1985. 4. Fluid mechanics — Bansal. 5. Fluid dynamics, M.D. Raisinghania, S.Chand Publication.	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. IV Semester

Course Title	Fuzzy Sets And Their Applications	
Type of Course	Theory, Paper XIII [A]	
Credit	4	
Course Assessment	Internal - 30% [Test – 20 %, Internal assessment -5%, Attendance – 5%] Semester Examination 70%	
Contents of Syllabus		No of Questions
UNIT I Definitions — level sets. Convex fuzzy sets. Basic operations on fuzzy sets. Types of fuzzy sets. Cartesian products. Algebraic products. Bounded sum and difference. T-norms and t-conorms. The Extension Principle — The Zadeh's extension principle. Image and inverse image of fuzzy sets. Fuzzy numbers. Elements of fuzzy arithmetic.		02
UNIT II Fuzzy Relations and Fuzzy Graphs — Fuzzy relations on fuzzy sets. Composition of fuzzy relations. Fuzzy relation equations. Fuzzy graph. Similarity relation		02
UNIT III Possibility Theory — Fuzzy measures. Evidence theory. Necessity measure. Possibility measure. Possibility distribution. Possibility theory and fuzzy sets. Possibility theory versus probability theory. Fuzzy Logic — An overview of classical logic. Multivalued logics. Fuzzy propositions. Fuzzy quantifiers. Linguistic variables and hedges. Inference from conditional fuzzy propositions. the compositional rule of inference.		02
UNIT IV An Introduction to Fuzzy Control-Fuzzy controllers. Fuzzy rule base. Fuzzy inference engine. Fuzzification. Defuzzification and the various defuzzification methods (the center of area, the center of maxima, and the mean of maxima methods). Decision making in Fuzzy Environment-Individual decision making. Multiperson decision making. Multicriteria decision making. Multistage decision making. Fuzzy ranking methods. Fuzzy linear programming.		02
Textbooks */ Reference Books	<ul style="list-style-type: none"> H.J. Zimmermann : Fuzzy set theory and its Applications. Allied Publishers Ltd. New Delhi. 1991. 	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. IV Semester

Course Title	Algebraic Topology	
Type of Course	Theory, Paper XIII [B]	
Credit	4	
Course Assessment	Internal - 30% [Test – 20 %, Internal assessment -5%, Attendance – 5%] Semester Examination 70%	
Contents of Syllabus		
UNIT I Fundamental group functo. homotopy of maps between topological spaces. homotopy equivalence. contractible and simply connected spaces. fundamental groups of S and $S^1 \times S^1$ etc. Calculation of fundamental group of S. $N>1$ using Van Kampen's theorem. fundamental groups of a topological group. Brouwer's fixed point theorem. fundamental theorem of algebra. vector fields on planner sets. Frobenius theorem for 3 x 3 matrices.		02
UNIT II Covering spaces. unique path lifting theorem. covering homotopy theorems. group of covering transformations. criteria of lifting of maps in terms of fundamental groups. universal covering. its existence. special cases of manifolds and topological groups. Singular homology, reduced homology. Eilenberg Steenrod axioms of homology (no proof for homotopy invariance axiom decision axiom and exact segnence axiom) and theory application. relation between fundamental group and first homology.		02
UNIT III Calculation of homology of S. Brouwer's fixed point theorem for $f : E^n \rightarrow E$. application spheres. vector fields. Mayer-Vietoris sequence (without proof) & its applications. Singular cohomology modules. Kronecker product. connecting homomorphism. contra-functoriality of singular cohomology modules. naturality of connecting homomorphism. exact cohomology sequence of pair. homotopy invariance. excision properties. cohomology of a point. Mayer vietoris sequence and its application in computation of cohomology of S^n . RP^n . CP^n torus. compact surface of genus g and non-orientable compact surface.		02
UNIT IV Compact connected 2-manifolds. their orientabiligy and non-orientabiligy. examples. connected sum. construction of projective space and Klein's bottle from a square. Klien's bottle as union of two Mobius strips. canonical of sphere. torus and projective plannes. Klin's bottle as union of two Mobius strips. triangulation of compact surfaces. Classification theorem for compact surfaces. connected sum of tours and projective plans as the connected sum of three projective planes. Euler characteristic as a topological invariant of compact surfaces. connected sum formula. 2-manofolds with boundary and their classifications. Euler characteristic of a bordered surface, models of compact bordered surfaces in R^3 .		02
Textbooks */ Reference Books	References : • James R. Munkres. Topology — A first Course. Prentice Hall of India Pvt. Ltd., New Delhi, 1978.	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. IV Semester

Course Title	Mechanics of Solids	
Type of Course	Theory, Paper XIV [A]	
Credit	4	
Course Assessment	Internal - 30% [Test – 20 %, Internal assessment -5%, Attendance – 5%] Semester Examination 70%	
Contents of Syllabus		No of Questions
UNIT I Analysis off Strain-Affine transformation. Infinite simal affine deformation. Geometrical interpretation of the components of stain. Strain quadric of Cauchy. Principal strains and invariants. General infinite simal deformation. Saint-Venant's equations of Compatibility. Finite deformations.		02
UNIT II Analysis of Stress-Stress tensor. Equations of equilibrium. Transformation of coordinates. Stress qudric of Cauchy. Principal stress and invariants. Maximum normal and shear stresses.		02
UNIT III Equations of Elasticity. Generalized Hooke's law. Homogeneous isotropic media. Elasticity moduli for isotropic media. Elasticity moduli for isotropic media. Equilibrium and dynamic equations for an isotropic elastic solid. Strain energy function and its connection with Hooke's law. Uniqueness of solution Beltrami-Michell compatibility equations. Saint-Venant's principle. Torsion-Torsion of cylindrical bars. Tortional rigidity. Torsion and stress functions. Lines of shearing stress. Simple problems — Plane stress. Generalized plane stress. Airy stress function. General solution of Biharmonic equation. Stresses and displacements in terms of complex potentials. Simple problems. Stress function appropriate to problems of plane stress problems of semi-infinite solids with displacements or stresses prescribed on the plane boundary.		02
UNIT IV Waves-Propagation of waves in an isotropic elastic solid medium. Waves of dilation and distortion. Plane waves. Elastic surface waves such as Rayleigh and Love waves. Variational methods — Theorems of minimum potential energy. Theorem of minimum complementary energy. Reciprocal theorem of Betti and Rayleigh. Deflection of elastic string central line of a beam and elastic membrane. Torsion of cylinders. Variational problem related to biharmonic equation. Solution of Euler's equation by Ritz. Galerkin and Kantorovich methods.		02
Textbooks */ Reference Books	References : <ul style="list-style-type: none"> • I.S. Sokolnikoff, Mathematical Theory of Elasticity. Tata McGraw-Hill Publishing Company Ltd., New Delhi. 1977. • A. E. Love. A Treatise on the Mathematical Theory of Elasticity. Cambridge University Press. London. 1963. • Y.C. Fung Foundations of Solid Mechanics. Prentice Hall, New Delhi. 1965. 1. S. Timoshenko and N. Goodier. Theory of Elasticity, McGraw Hill, New York 1970	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. IV Semester

Course Title	Operations Research	
Type of Course	Theory, Paper XIV [B]	
Credit	4	
Course Assessment	Internal - 30% [Test – 20 %, Internal assessment -5%, Attendance – 5%] Semester Examination 70%	
Contents of Syllabus		No of Questions
UNIT I Sequencing: Introduction, sequencing problem with n-jobs and two machines. optimal sequencing problems with n-jobs and three machine. Problems with n-jobs and m-machine, graphical solution.		02
UNIT II Replacement Problems : Introduction, replacement of item that Deteriorate with time, Replacement of items whose maintenance costs change with time and the value of money remains same during the period. replacement of items whose maintenance costs increase with time and the value of money also changes with time. replacement of items that fail completely, individual replacement policy, group replacement policy. Queuing theory : Introduction, characteristics of queuing system, queue discipline, symbols etc. Poisson process and exponential distribution, properties of Poisson process, classification of queues. definition of transient and steady state, model (M/M/L) (Din Fo), (M/M/I) (SIRO) (M/M/I) (MFIFO).		02
UNIT III Non-Linear programming — Introduction, definitions of general non-linear programming problems, problems of constrained maxima and minima; necessary and sufficient conditions for non-linear programming problems, Hessian — matrix, Lagrangian functions with Lagrangian multiplier. constraints are not all equality constraints. sufficiency of saddle point problem. Kuhn-Tucker condition.		02
UNIT IV Non-linear programming techniques — Introduction of GMPP & GN 1 PP its sanction by Wolfe's method. Beale's method.		02
Textbooks */ Reference Books	References : <ol style="list-style-type: none"> 1. F.S. Hillier and G. J. Lieberman. Introduction to Operations Research (Sixth Edition). McGraw Hill International Edition. Industrial Engineering Series. 1995 (This book comes with a CD containing tutorial software). 2. G. Hadley, Linear Programming. Narosa Publishing House. 1995. 3. G. Haadly. Nonlinear and Dynamic Programming. Addisor-Wisely. Reading Mass. 4. Kanti Swarup, P.K.Gupta and Man Mohan, Operations Research, Sultan Chand & Sons, New Delhi. 5. S. S. Rao. Optimization Theory and Applications. Wiley Eastern Ltd., New Delhi. 	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. IV Semester

Course Title	Differentiable Structures On A Manifold	
Type of Course	Theory, Paper XIV [C]	
Credit	4	
Course Assessment	Internal - 30% Test – 20 %, Internal assessment -5%, Attendance – 5% Semester Examination 70%	
Contents of Syllabus		No of Questions
UNIT I Almost Hermite manifolds. Riemannian Almost analytic vector fields. Curvature tensor. Linear connections. Kahler manifolds. Affine Connections. Holomorphic sectional curvature. Curvature tensor. Almost Analytic Vector fields		02
UNIT II Nearly Kahler manifolds. Curvature identities. Constant Holomorphic sectional curvature. Almost analytic Vector Fields.		02
UNIT III Almost Kahler manifolds. Analytic vector fields. Conformal transformation. Curvature identities, Almost Contact Metric manifolds — Almost Grayan manifolds. K-Contact Riemannian manifolds. Sasakian manifolds. Cosymplectic manifolds.		02
UNIT IV Submanifolds of almost Hermite and Kahler manifolds. Sub-manifolds of almost contact metric manifolds. CR-Submanifolds of Kahler manifolds and Sasakian manifolds. The integrability of distributions.		02
Textbooks */ Reference Books	References : R.S. Mishra. Structures on a differentiable manifold and their applications. Chadrama Prakashan. Allahabad, 1984.	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. IV Semester

Course Title	Information Theory	
Type of Course	Theory, Paper XIV [D]	
Credit	4	
Course Assessment	Internal - 30% [Test – 20 %, Internal assessment -5%, Attendance – 5%] Semester Examination 70%	
Contents of Syllabus		No of Questions
UNIT I Measures of information. Axioms for a measure of uncertainty. The Shannon entropy and its properties. Joint and conditional entropies. Transformation and its properties. Noiseless coding — ingredients of noiseless coding problem. Uniquely decipherable codes. Necessary and sufficient condition for the existence of instantaneous codes. Construction of optimal codes.		02
UNIT II Discrete memory less channel. Classification of channels. Information processed by a channel. Calculation of channel capacity. Decoding schemes. The ideal observer. The fundamental theorem of Information theory and its strong and weak converses		02
UNIT III Continuous channels — The time- discrete Gaussian channel. Uncertainty of an absolutely continuous random variable. The converse to the coding theorem for time-discrete Gaussian channel. The time-continuous Gaussian channel. Band-limited channels.		02
UNIT IV Information functions, the fundamental equation of information, information functions continuous at the origin, nonnegative bounded information functions, measurable information functions and entropy. Axiomatic characterizations of the Shannon entropy due to Tverberg and Leo. The general solution of the fundamental equation of information. Derivations and their role in the study of information functions. The branching property. Some characterizations of the Shannon entropy based upon the branching property. Entropies with the sum property. The Shannon inequality. Sub additive. additive entropies.		02
Textbooks/ Reference Books	References : 1. R. Ash. Information Theory, Inter science Publishers. New York 1965. 2. F.M.Reza. An introduction to information Theory. Mc Graw-Hill Book Company inc. 1961. 3. J. Aczel and Z. Daroczy. On measures of information and their characterizations. Academic press. New York	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. IV Semester

Course Title	Integral Transforms	
Type of Course	Theory, Paper XV [A]	
Credit	4	
Course Assessment	Internal - 30% [Test – 20 %, Internal assessment -5%, Attendance – 5%] Semester Examination 70%	
Contents of Syllabus		No of Questions
UNIT I Fundamental Formulae-The Laplace Transform-Definition Region of convergence. abscissa of convergence, absolute convergence, Uniform convergence of Laplace Transform. Complex Inversion formula. The Stieltje transform-Elementary properties of the transform. Relation to the Laplace transform. Complex Inversion formulae.		02
UNIT II The Fourier transform :Dirichlet's conditions. Definition of Fourier transform. Fourier Sine Transform, Fourier cosine transform. Inversion theorem for complex fourier transform. Definition of convolution and convolution theorem for Fourier transforms. Parseval's identity of Fourier transforms.		02
UNIT III The Mellintrans form : Definition of Mellin transform and its properties. Mellin transforms of derivatives and certain integral expressions.		02
UNIT IV Hankel Transform : Definition of Hankel transform and its elementary properties. Inversion formula for the Hankel transform. Hankel transform of derivatives, Parseval's theorem.		02
Textbooks */ Reference Books	1. The Laplace Transforms - D.V.Widder 2. Use of Integral Transforms Sneddon	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. IV Semester

Course Title	Algebraic Coding Theory	
Type of Course	Theory, Paper XV [B]	
Credit	4	
Course Assessment	Internal - 30% [Test – 20 %, Internal assessment -5%, Attendance – 5%] Semester Examination 70%	
Contents of Syllabus		No of Questions
UNIT I Coding theory, Introduction, examples, Important code parameters, Correcting and detecting errors, Sphere-packing bound, Gilbert-Varshamov bound, Singleton bound.		02
UNIT II Linear codes: Vector spaces over finite fields, Linear codes, Binary linear, Hamming weight, Bases of linear codes, Generator matrix and parity check matrix		02
UNIT III Equivalence of linear codes, Encoding with a linear code, Decoding of linear codes, Cosets, Nearest neighbour decoding for linear codes, Syndrom decoding.		02
UNIT IV Cyclic codes: Definitions, Generator and parity check polynomials, Generator and parity check, matrices, Decoding of cyclic codes, Burst-error-correcting codes. Reed-Solomon codes. Some special cyclic codes: BCH codes, RS codes, Definitions, Parameters of BCH codes, Decoding of BCH codes. Reed-Muller Codes. Maximum-distance Separable (MDS) Codes. Generator and Parity-check matrices of MDS Code. Weight Distribution of MDS Code. MDS codes from RS codes. Codes derived from Hadamard Matrices.		02
Textbooks */ Reference Books	1. R.Hill, A first course in coding theory, Oxford University Press 2. F. MacWilliams and N. Sloane, The Theory of error correcting codes, North Holland Publishing Company, Amsterdam. 3. San Ling and Chaoxing, Coding Theory- A First Course. 4. Applied Abstract Algebra - Lidl and Pilz 2nd Edition. 5. Todd K. Moon, Error Correction Coding, Wiley India	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. IV Semester

Course Title	Mathematic of Finance and Insurance	
Type of Course	Theory, Paper XV [C]	
Credit	4	
Course Assessment	Internal - 30% [Test – 20 %, Internal assessment -5%, Attendance – 5%] Semester Examination 70%	
Contents of Syllabus		No of Questions
UNIT I Prerequisite — Application of Mathematics and Finance & Insurance Optional Paper BMG 1 304 (a & b) F) Financial Derivatives — An Introduction : Types of Financial Derivatives — Forwards and Futures : Options and its kind : and SWAPS. The Arbitrage Theorem and Introduction to portfolio Selection and Capital Market Theory — Static and Continuous — Time Model.		02
UNIT II Pricing by Arbitrage — A Single — Period Option Pricing Model: Multi Pricing Model-Cox-Ross-Rubinstein Model : Bounds on Option Prices. The Dynamics of Derivative Prices-Stochastic Differential Equations (SDEs) — Major Models of SDEs. Linear Constant Coefficient SDEs: Geometric SDEs : Square Root Process: Mean Reverting Process and Ornstein-Uhlenbeck Process. Martingale Measure and Risk-Neutral Probabilities : Pricing of Binomial Options with equivalent martingale measures.		02
UNIT III The Black-Scholes Option Pricing Model- Using no arbitrage approach, limiting case of Binomial Option Pricing and Risk-Neutral probabilities. The American Option Pricing-Extended Trading Strategies; Analysis of American Put Options: early exercise premium and relation to free boundary problems. Concepts from Insurance : Introduction : The Claim Number Process : The Claim Size Process: Solvability of the Portfolio: Reinsurance and Ruin Problem. Premium and Ordering of Risks-Premium Calculation Principles and Ordering Distributions.		02
UNIT IV Distributions of Aggregate Claim Amount-Individual and Collective Model: Compound Distributions : Claim Number of Distributions: Recursive Computation Methods: Lundberg Bounds and Approximation by Compound Distributions. Risk Processes-Time-Dependent Risk Models: Poisson Arrival Processes : Ruin Probabilities and Bounds Asymptotic and Approximation. Time Dependent Risk Models — Ruin Problems and Computations of Ruin Functions; Dual Queuing Model : Risk Models in Continuous Time and Numerical Evaluation of Ruin Functions.		02
Textbooks */ Reference Books	<ul style="list-style-type: none"> • John C. Hull, Options. Futures and other derivatives. Prentice Hall of India Pvt. Ltd. • Sheldon M. Ross. An Introduction to Mathematical Finance. Cambridge University Press. 	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. IV Semester

Course Title	Applied Statistics	
Type of Course	Theory, Paper XV [D]	
Credit	4	
Course Assessment	Internal - 30% [Test – 20 %, Internal assessment -5%, Attendance – 5%] Semester Examination 70%	
Contents of Syllabus		No of Questions
UNIT I Demand analysis. price elasticity and demand. partial elasticity of demand. Lontieg's method. Pigou's method. Engle's curve and Engle's law. Paretv's law of income distribution, curves of concentration.		02
UNIT II Analysis of Variance. One way classification, statistical analysis of the mode.Design experiment-statistical analysis of C.R.D. (Completely randomized design) least square estimates of effects. exception of sum of squares. randomized block design (R.B.D.) statistical analysis of R.B.D. for one observation per experiment unit. Variance of estimates. expectation of sum of squares. efficiency of R.B.D. relative to C.R.D.		02
UNIT III Design of sample survey. Principle steps in a sample survey sampling and non-sampling error. types of sampling. selection of a simple random sample, simple random sampling, stratified random sampling. Psychological and educational statistics — scaling of scores on a test. percentile scores, scaling of rankings, scaling of normal probability curves. scaling of ratings in terms of normal curve, reliability of test scars, error variance, index of reliability, parallel test method of determining test reliability.		02
UNIT IV Vital Statistics. uses of vital statistics, methods of obtaining vital statistics, measurement of population , measurement of mortality, crude death rate (C.D.R.) specific death rate (SDR). specific rate, life table or (Mortality table). abridged life table, fertility measurement of population growth.		02
Textbooks */ Reference Books	<ul style="list-style-type: none"> • Fundamental of Applied Statistics — S.C.Gupta& V. K. Kappor • Statistical Method — S.P. Gupta • An Introduction to statistical method — S.B.Gupta 	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. IV Semester

Course Title	Boundary Layer Theory	
Type of Course	Theory, Paper XV [E]	
Credit	4	
Course Assessment	Internal - 30% Test – 20 %, Internal assessment -5%, Attendance – 5% Semester Examination 70%	
Contents of Syllabus		No of Questions
UNIT I Exact solution of Navier-Stoke's equation — flow between two concentric rotating cylinders. Hiemenz flow. flow due to lane wall suddenly set in motion, flow due to an oscillating wall.		02
UNIT II Theory of very slow motion — flow past a sphere. (Stroke's flow). Flow past a sphere (Osseen'sflow), Lubrication Theory. Theory of laminar boundary layer (a) two dimensional boundary layer equation for flow over a plane wall, boundary layer on a flat plate. (Blassius-Topler solution).		02
UNIT III Characteristic of boundary layer parameters. (b) Similar solution of the boundary layer equation. boundary layer. How past a wedge boundary layer along the wall of a convergent channel. boundary layer on a symmetrically placed cylinder and body of evolution.		02
UNIT IV Boundary layer control in laminar flow — methods of boundary layer control in laminar flow, boundary layer suction.		02
Textbooks */ Reference Books	<ul style="list-style-type: none"> • Boundary layer theory —Slicsting. • Foundation of fluid dynamics S.W. Yuan, Prentice Hall of India (F) 	

RADHA GOVIND UNIVERSITY, RAMGARH
DEPARTMENT OF MATHEMATICS
Syllabus of M.A./M.Sc. IV Semester

Course Title	Dissertation
Type of Course	PROJECT, PAPER XVI
Credit	4
Course Assessment	100%
Contents of Syllabus	
Topic should be selected from any of the Special Papers.	