Maharaja Surajmal Brij University
Bharatpur (Raj)

SYLLABUS

M. A./M. Sc. (Mathematics)

(*Annual Scheme*)

Session 2020-21

M. A. /M. Sc. (Previous) Examination 2021 onwards

( )
Dean, Faculty of Science
Chairman, BOS (Mathematics)

Only For Session
2020-21

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

Maharaja Surajmal Brij University, Bharatpur (Raj)

M. A./M.Sc. (Mathematics)

Syllabus

Scheme of Examination:- There shall be ten papers in two years duration and five papers in each year. In first year all five papers are compulsory. In the final year two papers shall be compulsory and three papers shall be optional(elective).

The syllabus of each paper is divided into four units. There shall be two parts in the question paper. Part 'A' of the question paper shall contain FIRST question which is compulsory. The first question shall contain 10 subparts consisting of very short answer type questions based on the knowledge, understanding and applications of the topics covering the syllabus of all four units. Each question of subpart will carry 2 marks. Part 'B' of the question paper shall be divided into FOUR units . Each unit will contain TWO questions and each question will have two subparts. Student has to attempt one question from each unit . Each question is of 20 marks.

M. A./M. Sc. (Previous) Examination 2021 & onwards

Five Compulsory Papers

Total Max Marks 500 for regular and non-collegiate students.

Paper	Name of paper	Teaching hrs per weak	Exam Duration	Max. Marks
I	Advanced Abstract Algebra	6	3	100
II	Real Analysis and Topology	6	3	100
III	Differential Equations and Special Functions	6	3	100
IV	Differential Geometry and Tensor Analysis	6	3	100
V	Dynamics of Rigid Bodies and Operations Research	6	3	100

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Paper – I

Advanced Abstract Algebra

Teaching : 6 hours per weak **Theory Paper**

Exam Duration: 3 Hours **Maximum Marks 100**

Note :- *The syllabus of this paper is divided into four units. There shall be two parts in the question paper. Part 'A' of the question paper shall contain FIRST question which is compulsory The first question shall contain 10 subparts consisting of very short answer type questions based on the knowledge, understanding and applications of the topics covering the syllabus of all four units. Each question of subpart will carry 2 marks. Part 'B' of the question paper shall be divided into FOUR units . Each unit will contain TWO questions and each question will have two subparts. Student has to attempt one question from each unit . Each question is of 20 marks.*

Unit-I: Normal Subgroups- Normalizer, Commutators, Derived subgroups, Conjugate class, conjugate subgroup, Quotient Groups. Homomorphism - Homomorphism and Isomorphism Theorems, Diamond isomorphism theorem, Butterfly Lemma, Direct product of groups (external and internal). Normal Series, Solvable groups, Zassenhaus Lemma. Composition Series, Maximal Normal Subgroup,

Unit- II : Factorization of Integral Domains- Prime element, Composite element, Euclidean Algorithm for polynomials, Einstein's Theorem, Euclidean rings, Euclidean domains, Unique Factorisation Theorem. Field Theory- Extension fields, Algebraic and Transcendental Extensions, Separable and Inseparable Extensions, Normal Extensions, Splitting Fields. Galios Theory- The elements of Galios Theory, Automorphism of extensions, Fundamental theorem of Galios Theory, Solution of polynomial equations by radicals, Insolvability of general equation of degree five by radicals.

Unit-III : Linear Transformations on Vector Spaces- Rank and Nullity of linear transformation, Sylvester's theorem, algebra of linear transformations, Linear functionals, Dual Spaces, Dual basis and their properties, Dual maps, Annihilator. Matrices- Matrices of linear transformations, Matrices of composition maps, Matrices of Dual maps, change of basis, similarity of matrices, trace of matrix,

Unit-IV : Determinants- Determinants of matrices and its computations, existence and uniqueness of determinants, Cramer rule, cofactor expansion formula, characteristic polynomial, eigen values and eigen vectors, Cayley-Hamilton theorem, diagonalisable operator and matrices, minimal polynomial, minimal equation. Inner product spaces- Schwarz inequality, normed vector space, matrix of inner product, conjugate transpose of matrix, Hermitian matrix, orthogonality, Pythagoras theorem, complete orthonormal set, Gram-Schmdt orthogonalization theorem , Bessel's inequality, orthogonal complements, linear maps on inner product spaces, adjoint of a linear transformation, principal axis theorem,

Paper – II

Real Analysis and Topology

Teaching : 6 hours per weak **Theory Paper**

Exam Duration: 3 Hours **Maximum Marks 100**

Note :- *The syllabus of this paper is divided into four units. There shall be two parts in the question paper. Part 'A' of the question paper shall contain FIRST question which is compulsory. The first question shall contain 10 subparts consisting of very short answer type questions based on the knowledge, understanding and applications of the topics covering the syllabus of all four units. Each question of subpart will carry 2 marks. Part 'B' of the question paper shall be divided into FOUR units . Each unit will contain TWO questions and each question will have two subparts . Student has to attempt one question from each unit. Each question is of 20 marks.*

Unit-I : Algebra and algebras of sets- algebras generated by a class of sub sets, Borel sets, Cantor set, Lebesgue- Concept of Lebesgue outer measure, inner measure, Countable sub additivity of outer measure, Measurable sets, properties of measurable sets, Non measurable sets. Measurable functions- Definition, properties of measurable functions , operations of measurable functions, pointwise and uniform convergence of the sequence of measurable functions, Egorov's theorem, Lebesgue theorem,

Unit-II : Lebesgue Integration- Lebesgue integral and its comparison with Reimann integral, properties of Lebesgue integral of bounded measurable functions, Lebesgue theorem on the passage to the limit under the sign of integral for bounded measurable functions. Lebesgue integral of non negative measurable functions, Fatou's lemma, Lebesgue monotone convergence theorem, Countable additivity of Lebesgue integral, Lebesgue integral of an arbitrary function and summability of Lebesgue integral, Lebesgue dominated convergence theorem. Summability of Lebesgue integral- Space of summable functions, Space of square summable functions, Orthonormal system, Fourier series, Reisz-Fischer theorem.

Unit-III : Topological spaces : Topology, T-open sets, sub spaces, open sets and closed sets, neighbourhood system, closure, interior, limit point, relative topology, co-finite topology, upper limit topology, intersection of topological spaces, Kuratowsky theorem, metric spaces, Bases , sub-bases and countability. Continuous mappings: Continuity, Sequentially continuous functions, Homeomorphism, Topological properties, Open and Closed maps, Uniform continuity, product invariant, restriction maps, isometry, Nets and Convergence: directed sets, Residual subsets, Co-final subsets,

Unit-IV : Separation axioms(T_0, T_1, T_2, T_3, T_4), normal spaces, regular spaces, Tychonoff space, Completely normal, Huasdorff space, Problems related to hereditary property, Problems

and locally compact spaces, continuity and compactness. Product and Quotient spaces: Product topology, Projection maps, Tychonoff topology, Embedding, Tychonoff cube, Hausdorff maximal principle, Alexander sub base lemma,

Paper – III

Differential Equations and Special Functions

Teaching : 6 hours per weak **Theory Paper**

Exam Duration: 3 Hours **Maximum Marks 100**

Note :- *The syllabus of this paper is divided into four units. There shall be two parts in the question paper. Part 'A' of the question paper shall contain FIRST question which is compulsory The first question shall contain 10 subparts consisting of very short answer type questions based on the knowledge, understanding and applications of the topics covering the syllabus of all four units. Each question of subpart will carry 2 marks. Part 'B' of the question paper shall be divided into FOUR units . Each unit will contain TWO questions and each question will have two subparts. Student has to attempt one question from each unit . Each question is of 20 marks.*

Unit–I : Non-linear differential equations of particular forms, Riccati's equation- general solution and the solution when one, two or three particular solutions are known, equations not containing y directly, equations not containing x directly. Total differential equations- necessary and sufficient conditions, methods of solution, geometric meaning of total differential equation.

Unit-II : Partial differential equations of second order with variable coefficient -Monge's method, Canonical forms. Classification of second order linear partial differential equations, Cauchy's problem. Boundary value problem- eigen values and eigen functions, Sturm-Liouville boundary value problems, orthogonality of eigen functions, normalised eigen functions, Non-homogeneous boundary value problems.

Unit-III : Calculus of Variation- Functionals, Euler-Lagrange differential equation for an extremal, variational problems with several dependent variables, variational problems involving several independent variables, isoperimetric problems and isoperimetric conditions, geodesic problems, variational problems involving constraints, Variational problems with moving boundaries, applications of calculus of variation to the problems of mechanics. Legendre's Function of first and second kind- Legendre equation and its solution, Legendre functions $P_n(x)$ and $Q_n(x)$, generating function, Laplace's integrals for $P_n(x)$, Rodrigue's formula,

Christoffel's summation formula, Beltrami's result,

Unit-IV : Bessel's Function- Bessel's equation and its solution, Bessel's function $J_n(x)$, recurrence formulae, generating function, integral expression for Bessel's function, addition formula for Bessel's function, orthogonal property, Fourier-Bessel expansion,

Gauss-Hypergeometric equation and its solution- hypergeometric function, integral representation, Guass's theorem, Vandermonde's theorem, Kumar's theorem, confluent hypergeometric equation and its solution, confluent hypergeometric function. Hermite differential equation and its solution, Hermite polynomials, generating function,

Paper – IV

Differential Geometry

Teaching : 6 hours per weak **Theory Paper**

Exam Duration: 3 Hours **Maximum Marks 100**

Note :- *The syllabus of this paper is divided into four units. There shall be two parts in the question paper. Part 'A' of the question paper shall contain FIRST question which is compulsory The first question shall contain 10 subparts consisting of very short answer type questions based on the knowledge, understanding and applications of the topics covering the syllabus of all four units. Each question of subpart will carry 2 marks. Part 'B' of the question paper shall be divided into FOUR units . Each unit will contain TWO question and each question will have two subparts. Student has to attempt one question from each unit . Each question is of 20 marks.*

Unit-I : Curves in Space- class of a curve, tangent line, length of space curve, order of contact of a curve and surface, inflexional tangent, osculating plane, principal normal and binormal, Curvature and torsion, Frenet-Serret's formulae, osculating circle and sphere,

. Envelops and Developable Surfaces- Envelope of one and two parameter family of surfaces, edge of regression, ruled surfaces,

Metric of a surface- first, second and third fundamental forms . Fundamental magnitudes of some important surfaces.

Unit-II : Curves on surfaces- parametric curves on surfaces, direction coefficient , angle between two tangential directions, orthogonal trajectory, condition that$Pdu^2 + 2Qdudv + Rdv^2 = 0$ may represent orthogonal family of curves. Normal curvature and curvature of normal section, Meunier's theorem, principal directions and principal curvatures, mean curvature, Gaussian curvature, minimal surface, Lines of curvatures, Euler's theorem, Dapin's theorem, Rodrigues formula, Joachimsthal's theorem, Relation between fundamental forms. Conjugate directions, Asymptotic lines, differential equation and theorems of asymptotic lines, curvature and torsion of asymptotic lines, Beltrami-Enneper's theorem,.

Unit-III : Geodesics- Introduction, differential equation of geodesic, canonical equation, Geodesic on a surface of revolution, Geodesic on conoidal surface, geodesic on a developable surface, geodesic on conicoids, Geodesic curvature, Lioville's formula for geodesic curvature, Bonnet's formula for geodesic, Torsion of a geodesic, Bonnet's formula for torsion, Gauss-Bonnet's theorem, Joachimsthal Theorem,

Introduction, Kronecker delta, Contravariant and Covariant tensors, symmetric tensors, algebraic operations with tensors, contraction of tensors , quotient law of tensors, relative tensor, Riemannian space, Metric tensor, indicator,

Unit-IV : Christoffel's Symbols and Covariant Differetiation- Christoffel' symbols and their properties, Covariant differentiation of tensors, intrinsic derivative, Ricci's theorem, divergence of a vector. Curvature of a curve, Geodesic, Euler's condition, differential equation of geodesic, geodesic coordinates. Parallelism of vectors- parallelism in subspace, Fundamental theorem of local Riemannian Geometry, Riemann-Christoffel tensor and its properties, Ricci's Tensor,

Paper – V

Dynamics of Rigid Bodies and Operations Research

Teaching : 6 hours per weak **Theory Paper**

Exam Duration: 3 Hours **Maximum Marks 100**

Note :- *The syllabus of this paper is divided into four units. There shall be two parts in the question paper. Part 'A' of the question paper shall contain FIRST question which is compulsory The first question shall contain 10 subparts consisting of very short answer type questions based on the knowledge, understanding and applications of the topics covering the syllabus of all four units. Each question of subpart will carry 2 marks. Part 'B' of the question paper shall be divided into FOUR units . Each unit will contain TWO questions and each question will have two subparts. Student has to attempt one question from each unit. Each question is of 20 marks.*

Unit-I : D'Alembert's Principle- General equations of motion of a rigid body, motion of centre of inertia, motion relative to centre of inertia. Motion about a fixed axis- Moment of momentum of a body about the fixed axis, moment of effective force about the axis, equation of motion, Compound Pendulum, Centre of Percussion.

Unit-II : Lagrange's Equations of Motion- generalised coordinates, degree of freedom, holonomic system, Lagrange's equations of motion for finite forces, Lagrange's function, small oscillations, normal coordinates, Lagrange's equations of motion for impulsive forces. Hamilton's equations of motion, Hamilton's Principle and Principle of Least action. Motion in three dimensions- Rigid body moving with one fixed point, moving axes and fixed axes, Euler's dynamical equations of motion, instantaneous axis, motion under no forces,

Unit-III : Problems of Replacement- Introduction, concept of present value, replacement models and their solutions, Inventory Control- Introduction, Classification of inventory models, Deterministic models, Economic lot-size models, production lot-size models, quantity discount,

Unit-IV : Queueing Theory- Introduction, Components of queueing system, Classification of queues and their problems, Steady, transient and explosive states, distribution of arrivals and service times, queue models, M/M/1 :(infinite/ FIFO), M/M/1(N/FIFO), M/M/c :(infinity/FIFO), Game Theory- Introduction, Description of games, Maximin and minimax principles, Saddle point, Dominance in games, Solution of rectangular games, Solution of 2x2 game without saddle point, Solution of two person zero sum 2xn game, graphical method,

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