Maharaja Surajmal Brij University
Bharatpur (Raj)

SYLLABUS

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

(Semester Scheme)

Based on Choice Based Credit System (CBCS)

SEMESTER I & II

Session 2020-21

As per UGC guidelines and decision taken in the Academic Council of the university the syllabus has been reduced by 30% only for the session 2020-21.

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

Only For Session
2020-21

(Total number of pages-11)

Maharaja Surajmal Brij University, Bharatpur (Raj)

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

Syllabus

Scheme of Examination:- There shall be twenty papers in four semesters of two years duration and five papers in each semester. In first and second semesters all five papers are compulsory. In third and fourth semesters 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 7 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 vill contain TWO questions and each question will have two subparts. Student has to attempt one question from each unit . Each question is of 14 marks.

FIRST SEMESTER

Five Compulsory Papers

Course Code	Course Title	Teaching hrs / weak	Credits	Periodical Tests	Attendance/Seminars	Term Exams	Max Marks
MC1.1	Advanced Abstract Algebra	6	4	20	10	70	100
MC1.2	Real Analysis	6	4	20	10	70	100
MC1.3	Differential Equations	6	4	20	10	70	100
MC1.4	Differential Geometry	6	4	20	10	70	100
MC1.5	Space Dynamics	6	4	20	10	70	100
	Total Marks & Credits		**24**	.....	.....	.....	**500**

SECOND SEMESTER

Five Compulsory Papers

Course Code	Course Title	Teaching hrs / weak	Credits	Periodical Tests	Attendance/Seminars	Term Test	Max Marks
MC2.1	Advanced Linear Algebra	6	4	20	10	70	100
MC2.2	Topology	6	4	20	10	70	100
MC2.3	Calculus of Variations and Special Functions	6	4	20	10	70	100
MC2.4	Reimannian Geometry and Tensor Analysis	6	4	20	10	70	100
MC2.5	Operations Research	6	4	20	10	70	100
	Total Marks & Credits		**24**	.....	.....	.....	**500**

M. A./M. Sc. Semester-I Examination Dec-2020

Paper – I : MC 1.1

Advanced Abstract Algebra

Theory Paper

Teaching : 6 hours/weak

Maximum Marks 70

Exam Duration: 3 Hours

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 7 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 14 marks.*

Unit-I: Normal Subgroups- Normalizer, Commutators, Derived subgroups, Conjugate class, conjugate subgroup, Quotient Groups. Homomorphism - Homomorphism and Isomorphism Theorems, Diamond isomorphism theorem.

Unit-II : Normal Series, Solvable groups, Zassenhaus Lemma. Composition Series, Maximal Normal Subgroup, Refinement Theorem, Jordan-Holder theorem. p-groups, Class Equation, Cauchy's theorems, Sylow theorems.

Unit- III : 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.

Unit- IV : 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.

****

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

Paper – II : MC 1.2

Real Analysis

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

Exam Duration: 3 Hours **Maximum Marks 70**

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 7 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 ofsubpart 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 14 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.

Unit-II : Measurable functions- Definition, properties of measurable functions , operations of measurable functions, pointwise and uniform convergence of the sequence of measurable functions, Lebesgue theorem, Convergence in measure, F Reisz theorem, Weierstrass's theorem on the approximation of continuous functions by polynomials.

Unit-III : 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, Lebesgue monotone convergence theorem, Countable additivity of Lebesgue integral, Lebesgue integral of an arbitrary function and summability of Lebesgue integral.

Unit-IV : Summability of Lebesgue integral- Space of summable functions, Space of square summable functions, Orthonormal system, Fourier series, Reisz-Fischer theorem.

****

Paper – III : MC 1.3

Differential Equations

Teaching : 6 hours/week **Theory Paper**

Exam Duration: 3 Hours **Maximum Marks 70**

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 7 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. Eachquestion 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 14 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.

Unit-II : Series solution- ordinary and singular point, radius of convergence, series solution near a singular point, method of differentiation, Cauchy-Euler equation, solution near a regular singular point (method of Frobenius).

Unit-III : Partial differential equations of second order with variable coefficient -Monge's method, Canonical forms Classification of second order linear partial differential equations.

Unit-IV : 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. Method of separation of variables-Laplace, Wave, and diffusion equations.

****

Paper – IV : MC 1.4

Differential Geometry

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

Exam Duration: 3 Hours **Maximum Marks 70**

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 7 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 2marks. 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 14 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.

Unit-II : Envelops and Developable Surfaces- Envelope of one and two parameter family of surfaces, edge of regression, ruled surfaces, necessary and sufficient condition that a surface $z = f(x, y)$ should represent a developable surface; tangent, principal normal and binormal surfaces. Metric of a surface- first, second and third fundamental forms , Fundamental magnitudes of some important surfaces.

Unit-III : 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.

Unit-IV : Conjugate directions, Asymptotic lines, differential equation and theorems of asymptotic lines, curvature and torsion of asymptotic lines, Beltrami-Enneper's theorem,. Gauss's formulae, Gauss characteristic equation, Wiengarten formulae, Mainardi-Codazzi equations, Fundamental existence theorem for surfaces, Gaussian curvature and mean curvature for a parallel surface.

****

Paper – V : MC 1.5

Space Dynamics

Teaching : 7 hours/weak **Theory Paper**

Exam Duration: 3 Hours **Maximum Marks 70**

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 7 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 14 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.

Unit-II : Motion of a rigid body in two dimensions under finite forces- equation of motion, friction, pure rolling, slipping of rods, motion when one of the body is fixed, motion on a horizontal plane. Conservation of momentum- principle of conservation of linear momentum, principle of conservation of angular momentum.

Unit-III : 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. Hamilton's equations of motion, Hamilton's Principle and Principle of Least action.

Unit- IV : 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. Motion of top.

****

M. A./M. Sc. Semester-II Examination May-2021

Paper – I : MC 2.1

Advanced Linear Algebra

Teaching : 7 hours/weak **Theory Paper**

Exam Duration: 3 Hours **Maximum Marks 70**

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 7 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 14 marks.*

Unit-I : 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.

Unit-II : Matrices- Matrices of linear transformations, Matrices of composition maps, Matrices of Dual maps, change of basis, similarity of matrices, trace of matrix, invertible matrices, invariance, reducibility, projections, adjoint or transpose of linear transformations, adjoint of projections.

Unit-III : 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.

Unit-IV : 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, normal operators, Spectral theorem.

****

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

Paper – II : MC 2.2

Topology

Teaching : 6 hours/week **Theory Paper**

Exam Duration: 3 Hours **Maximum Marks 70**

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 7 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 14 marks.*

Unit-I : 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 .

Unit-II : 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, Sequence convergence of a set, Cluster point, subnet, Isotone mapping.

Unit-III : 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 related to topological property, Urysohn's lemma, Tietze extension theorem. Compact and locally compact spaces.

Unit IV : Product and Quotient spaces: Product topology, Projection maps, Tychonoff topology, Embedding, Tychonoff cube, Hausdorff maximal principle, Alexander sub base lemma, Tychonoff's one point Compactification, Stone-Cesh Compactificatiopn theorem Connected and Locally connected spaces.

****

Paper – III : MC 2.3

Calculus of Variations and Special Functions

Teaching : 6 hours/weak
Exam Duration: 3 Hours

Theory Paper
Maximum Marks 70

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 7 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 14 marks.*

Unit-I : 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.

Unit-II : 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, orthogonal properties of Legendre's polynomial, recurrence relations, Christoffel's expansion, Christoffel's summation formula, Beltrami's result, Zeros of $P_n(x)$, Legendre polynomial $Q_n(x)$, recurrence relations , relation between $P_n(x)$ and $Q_n(x)$, properties of $Q_n(x)$.

Unit-III : 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.

Unit-IV : 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, orthogonal property, recurrence relations.

****

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

Paper – IV : MC 2.4

Reimannian Geometry and Tensor Analysis

Teaching : 6 hours/weak
Exam Duration: 3 Hours

Theory Paper
Maximum Marks 70

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 7 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 14 marks.*

Unit-I : Geodesic :- 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, Geodesic coordinates and geodesic parallels.

Unit-II : Tensors-Introduction, Kronecker delta, Contravariant and Covariant tensors, symmetric tensors, algebraic operations with tensors, contraction of tensors , quotient law of Riemannian space, Metric tensor, indicator.

Unit-III : Christoffel's Symbols and Covariant Differetiation- Christoffel' symbols and their properties, Covariant differentiation of tensors, intrinsic derivative, Ricci's theorem, divergence of a vector. Geodesic, Euler's condition, differential equation of geodesic.

Unit-IV : Parallelism of vectors- parallelism in subspace, Fundamental theorem of local Riemannian Geometry, Riemann-Christoffel tensor and its properties, Ricci's Tensor, Covariant curvature tensor, Bianchi Identity, Flat space, Einstein Space, Schur's theorem.

****

Paper – V : MC 2.5

Operations Research

Teaching : 6 hours/weak
Exam Duration: 3 Hours

Theory Paper
Maximum Marks 70

Note :- 1. *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 7 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 14 marks.*

2. *Scientific calculator is to be permitted for mathematical calculations.*

Unit-I : Problems of Replacement- Introduction, concept of present value, replacement models and their solutions, mortality tables, group replacement method, staffing problems.

Unit-II : Inventory Control- Introduction, Classification of inventory models, Deterministic models, Economic lot-size models, production lot-size models, quantity discount, deterministic models with shortages, fixed time model, lost sales shortages.

Unit-III : 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), M/M/c :(N/FIFO).

Unit-IV : 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, algebraic method, Solution of two person zero-sum game by transforming into l. p. p. using Simplex method.

****