SESSION-2022-23

(1)

Maharaja Surajmal Brij University
Bharatpur (Raj)

SYLLABUS

M.Sc. (Mathematics)

(Semester Scheme)

Based on Choice Based Credit System (CBCS)

First & Second Semester

Session 2021-22

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 2021-22.

(Mr. Munesh Kumar)

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

Session 2021-22

(Total number of pages-12)

(Raj Bihari Soni)

SESSION-2022-23 (2)

Maharaja Surajmal Brij University, Bharatpur (Raj)

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 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.

FIRST SEMESTER

Five Compulsory Papers

Course Code	Course Title	Teaching hrs / weak	Credits	Periodical Tests	Attendance/Seminars	Term Exams	Max Marks
MC101	Advanced Abstract Algebra	6	4	20	10	70	100
MC102	Real Analysis	6	4	20	10	70	100
MC103	Differential Equations	6	4	20	10	70	100
MC104	Differential Geometry	6	4	20	10	70	100
MC105	Dynamics of Rigid Bodies	6	4	20	10	70	100
	Total Marks & Credits		**20**	.....	.....	.....	**500**

SECOND SEMESTER

Five Compulsory Papers

Course Code	Course Title	Teaching hrs / weak	Credits	Periodical Tests	Attendance/Seminars	Term Test	Max Marks
MC201	Advanced Linear Algebra	6	4	20	10	70	100
MC202	Topology	6	4	20	10	70	100
MC203	Calculus of Variations and Special Functions	6	4	20	10	70	100
MC204	Reimannian Geometry and Tensor Analysis	6	4	20	10	70	100
MC205	Operations Research	6	4	20	10	70	100
	Total Marks & Credits		**20**	.....	.....	.....	**500**

(Mr. Mukesh Kumar)

Session 2021-22

अकादमिक प्रभारी
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भरतपुर (राज.)

SESSION-2022-23 (3)

M. Sc. Semester-I Examination Dec-2020

Paper – I : MC 101

Advanced Abstract Algebra

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 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.

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भरतपुर (राज.)

मुनेश कुमार
(Mr. Mnneshkumar)

Session 2021-22

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

Raj Bihari Soni

SESSION-2022-23

Paper – II : MC 102

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 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 : 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.

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मुनेश कुमार
(Mr. Munesh Kumar)

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

अकादमिक प्रभारी

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SESSION-2022-23

Paper – III : MC 103

Differential Equations

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. 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.

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भरतपुर (राज.)

(Mr. Munesh Kumar)

Session 2021-22

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SESSION-2022-23 (6)

Paper – IV : MC 104

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.

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भरतपुर (राज.)

(Mr. Munesh Kumar)

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Session 2021-22

अकादमिक प्रभारी
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भरतपुर (राज.)

(Dal Bihari Soni)

Paper – V: MC 105 SESSION-2022-23

Dynamics of Rigid Bodies

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 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.

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भरतपुर (राज.)

(Mr. Mukesh Kumar)

Session 2021-22

(Prof Bihari Soni)

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय

SESSION-2022-23

M. Sc. Semester-II Examination May-2021

Paper – I : MC 201

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.

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भरतपुर (राज.)

(Mr. Munesh Kumar)

Session 2021-22

Dr. Bihari Soni

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SESSION-2022-23

Paper – II : MC 202

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.

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(Mr. Munesh Kumar)

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

Session 2021-22

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

(Dr. Rishi Pal Singh)

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SESSION-2022-23

Paper – III : MC 203

Calculus of Variations and Special Functions

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 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.

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महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

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(Mr. Mukesh Kumar)

Session 2021-22

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

Prof Rihani Devi

SESSION-2022-23 (11)

Paper – IV : MC 204

Reimannian Geometry and Tensor 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 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 : 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, 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.

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महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

(Mr. Munesh Kumar)

Session 2021-22

Session 2021-22

महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर

(Raj Bihari Soni)

Paper – V: MC 205 SESSION-2022-23 (12)

Operations Research

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

Exam Duration: 3 Hours **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.

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

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(Mr. Ramesh Kumar)

Session 2021-22

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय-12)
भरतपुर (राज.)

SESSION-2022-23 (13)

Maharaja Surajmal Brij University, Bharatpur (Raj)

Syllabus

M. Sc. (Mathematics)

(Semester Scheme)

Based on Choice Based Credit System (CBCS)

Third & Fourth Semester

Session 2021-22

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 2021-22.

Note: - Students offering optional papers MO303, MO304, MO305, MO306, MO307, MO308 in third semester will offer optional papers MO403, MO404, MO405, MO406, MO407, MO408 respectively in fourth semester. Thus prerequisite of the papers MO403 is MO303; MO404 is MO304, for MO405 is MO305, for MO406 is MO306, for MO407 is MO307 and for MO408 is MO308.

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 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.

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महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

(Mr. Mukesh Kumar)

Session 2021-22

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

(Total number of Pages-10)

Maharaja Surajmal Brij University, Bharatpur (Raj)

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

Syllabus

THIRD SEMESTER

Course Code	Course Title	Teaching hrs / weak	Credits	Periodical Tests	Attendance/ Seminars	Term Exams	Max Marks
	COMPULSORY PAPERS	----	----	------	------	------	-------
MC301	Functional Analysis	6	4	20	10	70	100
MC302	Hydrodynamics	6	4	20	10	70	100
	OPTIONAL PAPERS						
MO303	Mathematical Programming I	6	4	20	10	70	100
MO304	Mathematical Theory and Statistics I	6	4	20	10	70	100
MO305	Combinatorics and Graph Theory I	6	4	20	10	70	100
MO306	Integral Transforms	6	4	20	10	70	100
MO307	Relativistic Mechanics	6	4	20	10	70	100
MO308	Computational Techniques	6	4	20	10	70	100
	Total Marks & Credits		20	.....	.....	.....	500

FOURTH SEMESTER

Course Code	Course Title	Teaching hrs / weak	Credits	Periodical Tests	Attendance /Seminars	Term Test	Max Marks
	COMPULSORY PAPERS						
MC401	Operator Theory and Calculus in Banach Spaces	6	4	20	10	70	100
MC402	Viscous Fluid Dynamics	6	4	20	10	70	100
	OPTIONAL PAPERS						
MO403	Mathematical Programming II	6	4	20	10	70	100
MO404	Mathematical Theory and Statistics II	6	4	20	10	70	100
MO405	Graph Theory II	6	4	20	10	70	100
MO406	Integral Equations	6	4	20	10	70	100
MO407	General Relativity and Cosmology	6	4	20	10	70	100
MO408	Dissertation and Viva-voce	6	4	20	10	70	100
	Total Marks & Credits		20	.....	.....	.....	500

मुनेश कुमार
(Mr. Munesh Kumar)

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Session 2021-2

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भरतपुर (राज.)

Raj Bihari Joshi

SESSION-2022-23 (13)

M.Sc. Mathematics Third Semester Syllabus

Paper – I: MC 301

Functional Analysis

Teaching: 6 hours/weak | **Theory Paper**
Exam Duration: 3 Hours | **Maximum Marks 70**

Unit-I: Normed Linear Space – Topological properties of Normed linear spaces, Equivalent norm, Quotient Normed linear spaces.

Unit-II: Banach Spaces: Banach spaces and examples. Bounded linear transformations, Normed linear space of bounded linear transformation.

Unit- III: Open Mapping theorem, Closed graph theorem, Uniform boundedness principle, Conjugate of an operator, Uniform boundedness theorem.

Unit- IV: Inner product space, Hilbert space and its properties, Orthogonality and functional in Hilbert space, Pythagorean theorem, Projection theorem, Orthonormal sets, Bessel's inequality, Complete orthonormal sets.

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Paper – II: MC 302

Hydrodynamics

Teaching : 6 hours/weak | **Theory Paper**
Exam Duration: 3 Hours | **Maximum Marks 70**

Unit-I: Kinematics- Approaches of study, Lagrangian and Eulerian methods, Equation of continuity by Eulerian Method (in Vector form, Cartesian Coordinates, Spherical polar coordinates, Cylindrical coordinates), Boundary Surface, Stream lines, path lines and streak lines.

Unit-II: Equation of Motion- Euler's dynamical equation of motion, Bernoulli's equations and its application.

Unit-III: Motion in two dimension- Stream function, Complex potential, Stagnation point, sources, sinks, doublets, Images in two dimensions.

Unit-IV: Motion of a sphere – Motion of a sphere through an infinite mass of a liquid at rest, Liquid steaming past a fixed sphere, Equation of motion of a sphere, Pressure distribution on a sphere, Concentric sphere(initial motion). Rectilinear Vortices (vortex motion) – vorticity, vortex line, vortex tube, Helmholtz's vorticity theorem.

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(Mr. Mukesh Kumar)

Session 2021-22

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भरतपुर (राज.)

(16)

Paper – III: MO 303

Mathematical Programming I

SESSION-2022-23

Teachin: 6 hours/weak | **Theory Paper**
Exam Duration: 3 Hours | **Maximum Marks 70**

Unit –I: Separating and supporting hyperplane theorems, Revised simplex methods to solve linear programming problems.

Unit-I: **Integer programming:** Gomory's algorithm for all and mixed integer programming problems, Branch and bound algorithm.

Unit-III: **Separable programming:** Piecewise linear approximations to non linear function, Reduction of separable programming problem to LPP, Separable programming algorithm.

Unit-IV: **Dynamic Programming:** Introduction, Bellman Principle of optimality, solution of problems with finite number of stages

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Paper – IV: MO 304

Mathematical Theory of Statistics-I

Teaching : 6 hours/weak | **Theory Paper**
Exam Duration: 3 Hours | **Maximum Marks 70**

Unit-I: **Sample Space,** combination of events, Statistical independence, Conditional probability, Bay's repeated trials, Random Variable, Distribution function.

Unit-II: **Mathematical expectation**: Generating function, Continuous probability distribution, Characteristic function, Fourier's inversion, Chebyshev and Kolmogorovea's inequality.

Unit-III: Negative and Cauchy's Method of least squares and curve fitting.

Unit-IV: Correlation and regression coefficients, Association of attributes, Interpolation, Introduction Newton-Gregory theorem, Newton, Lagrange.

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(Mr. Manish Kumar)

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Session 2021-22

Rahul Bihari Soni

Paper – V: MO 305

Combinatorics and Graph theory -I

Teaching : 6 hours/weak **Theory Paper**
Exam Duration: 3 Hours **Maximum Marks 70**

Unit-I: Combinatorics - Counting of sets and multi-sets, binomial and multinomial numbers, unordered section with repetitions, selection without repetition. Counting objects and functions. Functions and the Pigeonhole Principle.

Unit-II: Discrete numeric functions and combinatorial problems. Generating function and recursions. Power series and their algebraic properties. Homogeneous recursions

Unit-III: Graphs- Basic terminology, simple graphs, multi graphs, weighted graphs, Walk and connectedness, Paths and circuits, Shortest paths in weighted graphs, Eulerian paths and circuits,

Unit-IV: Travelling salesman problem, operations on graphs. Trees- Trees, rooted trees, path-lengths in rooted trees, spanning trees.

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Paper – VI: MO 306

Integral Transforms

Teaching: 6 hours/weak **Theory Paper**
Exam Duration: 3 Hours **Maximum Marks 70**

Unit-I: Laplace Transforms: Definitions and its properties, Rules of manipulations. Laplace transform of derivatives and integrals. Properties of inverse Laplace transform, Convolution Theorem.

Unit-II: Fourier Transform –Definitions and Properties of Fourier Sine, Cosine and Complex transforms, Convolution theorem, Inversion Theorem.

Unit-III: Mellin Transform Definition and properties of Mellin transform, Mellin transform of derivatives and integrals, Inversions theorem.

Unit IV: Hankel Transform- Definition and properties of Hankel transform. Hankel transform of derivatives. Inversions theorem.

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(Mr. Munesh Kumar)

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Session 2021-22

Paper– VII: MO 307

Relativistic Mechanics

Teaching : 6 hours/week **Theory Paper**
Exam Duration: 3 Hours **Maximum Marks 70**

Unit-I: Relative character of space and time, Principle of relativity and its postulates, Derivation of special Lorentz transformation equation, Composition of parallel velocities.

Unit-II: Simultaneity, Relativistic transformation formulae for velocity, Lorentz contraction factor, Particle acceleration, Velocity of light as fundamental velocity.

Unit-III: Variation of mass with velocity, Equivalence of mass and energy, Transformation formula for mass, momentum and energy, problem of Conservation of mass, Momentum and energy.

Unit IV: Minkowski's Space, space-like, time-like, and light –like intervals, Null cone, Relativity and Causality, Proper time, Word line of a Particle.

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Paper– VIII: MO 308

Computational Techniques

Teaching : 6 hours/weak **Theory Paper**
Exam Duration: 3 Hours **Maximum Marks 70**

Remark: Scientific calculator is to be permitted for numerical calculation.

Unit-I: **Numerical Solution of algebraic and transcendental equation:** Iteration methods, Acceleration of convergence, Chebyshev method, Muller's methods, methods of multiple and complex roots, Newton- Raphson methods for simultaneous equations, Convergence of iteration process in the case of several unknowns, Polynomial equation: real and complex roots. Synthetic division, Graeffe's root squaring methods.

Unit-II : **Solution of system simultaneous linear equations:** LU factorizations methods, Doolitle's, Crout's and Cholesky's partition methods, Methods of successive approximation. **Eigen Value Problem:** Basic properties of Eigen values and Eigen Vectors, Power methods, Method for finding all eigen values of a matrix.

Unit-III: **Numerical Solutions of Ordinary Differential Equation:** Taylors Series methods, Picard methods, Runge-Kutta methods upto fourth order, multi-step method, Predictor and Correctors method.

Unit-IV: **Boundary Value Problems of Ordinary Differential Equation:** Boundary value problems (BVP's), Shooting methods, finites difference methods.

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(Mr. Mukesh Kumar)

Session 2021-22

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SESSION-2022-23

M.Sc. Mathematics Fourth Semester Syllabus

Paper – I: MC 401

Operator theory and Calculus in Banach Space

Teaching: 6 hours/weak
Exam Duration: 3 Hours

Theory Paper
Maximum Marks 70

Unit-I: Adjoint of an operator on a Hilbert Space, Self adjoint, Normal and Unitary operator and their properties, Projection on a Hilbert space, Invariance, Reducibility, Orthogonal Projections.

Unit-II: The Space of Continuous functions, Stone-Weierstrass's Approximation theorem, Equicontinous sets, Derivatives of a continuous map from to an open subset of a Banach Space to a Banach Space, Rules of differentiation, Derivatives of a composite function.

Unit-III: Partial derivatives and Jacobian Matrix, Continuously differentiable map, Higher derivatives, Taylor's Theorem and Taylor's Formula.

Unit-IV: Fixed point theorem, Inversion Function theorem, Implicit function theorem, Step function, Regulated function, primitives and integrals, Differentiation under the integral sign Riemann integral of function of real variable with values in Normed Linear space, Solution of differential equation in Normed Linear space.

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Paper- II: MC 402

Viscous Fluid Dynamics

Teaching : 6 hours/weak
Exam Duration: 3 Hours

Theory Paper
Maximum Marks 70

Unit-I: <u>Theory of Stress and Strain:</u> Viscosity, stress, stress vector and stress tensor, Principal stresses, principal directions stress tensor, strain, normal and shearing strain, Stoke's law of friction, Thermal conductivity and generalised law of heat conduction, Equation of State and continuity, Naveir- Stoke's equation of motion.

Unit-II: Dynamical Similarity Inspectional and dimensional analysis, Bukingham theorem and its applications, non dimensional parameters and their physical significance, Reynolds number, Froude number, Mach number, Prandtl number, Eckart number, Grashoff number, Brickmann number, non- dimensional coefficient. Exact solution of Naveir- Stoke's equations steady incompressible flow with constant fluid properties, Flow between parallel plates.

Unit-III: Flow in a circular pipe (Hagen Poisueille flow), Flow in a tube of uniform cross section, Flow between two concentric rotating cylinders, Flow in convergent and divergent channels Stagnations points flows, Homann flow, Flow due to rotating disc, variable velocity, plane couette flow.

Unit-IV: Unsteady incompressible flow with constant fluid properties, Flow due to an accelerated plane wall, Flow due to plane wall suddenly set in motion, Flow due to an oscillating plane wall, starting flow in a plane Couette motion, starting flow in a pipe, Steady compressible flow, plane Couette flow with transpiration cooling, Theory of very slow motion, Stoke and ocean's flow past a sphere.

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Paper- III: MO 403
Mathematical Programming-II

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

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

Unit-I: Convex Function, Quadratic forms, Constrained problem of maxima and minima Lagrange's Method.

Unit-II: Nonlinear programming and its fundamental ingredients, Kuhn Tucker necessary and sufficient conditions.

Unit-III: Quadratic programming, Kuhn Tucker conditions, Wolfe's methods.

Unit-IV: Beale's method to solve QPP, Geometric arithmetic inequality, Necessary conditions for optimality.

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Paper- IV: MO 404
Mathematical Theory of Statistics-II

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

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

Unit-I: Index number, Introduction, Price relatives, Quantity relatives, Value relatives , Link and Chain relatives. Aggregate methods, Fisher's ideal index, Change of the base of the index numbers, Elementary sampling theory, Distribution of means of samples for binomial, Cauchy.

Unit-II: Exact distribution of χ^2 and t, Statistics in samples from a normal population, their simple properties and application, Elementary statistical theory of estimation, Fisher's criterion for the estimator.

Unit-III: Consistent Efficient and sufficient estimators, methods of maximum likelihood, maximum likelihood estimator, other method of estimation, Methods of moments, minimum variance.

Unit-IV: Test of significance and difference between two means and two standard deviations for the large samples with modification of small samples and taken from normal population.

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Session 2021-22

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Paper- V: MO 405
Graph theory –II

Teaching : 6 hours/weak | **Theory Paper**
Exam Duration: 3 Hours | **Maximum Marks 70**

Unit-I: Cut Sets- Cut Sets, cut vertices, fundamental cut sets, connectivity and separativity networks flows..

Unit-II: Planar graphs- Combinatorial and Geometric graphs, Kuratowski's graphs, Euler's formula, Detections of planarity, Geometric Dual.

Unit-III: Graphs colouring, Vertex colouring, Edge colouring and Map colouring, Chromatic number, Chromatic polynomials.

Unit-IV: Digraphs- Binary relation, Directed graphs and directed trees, Arborescence, Polish notation method, Tournaments, Counting and labelled trees- Caley's theorem, Counting methods.

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Paper- VI: MO 406
Integral Equation

Teaching : 6 hours/weak | **Theory Paper**
Exam Duration: 3 Hours | **Maximum Marks 70**

Unit-I: Linear Integral Equation: Definition and classification, Conversion of initial and boundary value problems to the integral equations. Eigen values and Eigen function.

Unit-II: Solution of Fredholm and Volterra integral equations of second kind by methods of successive substitutions and successive approximations, Resolvent kernel and its results.

Unit-III: Integral Equation with Symmetric kernels: Orthogonal system of functions, Fundamental properties of Eigen values and Eigen function for symmetric kernels. Expansion in eigen functions and bilinear forms. Hilbert- Schmidt theorem

Unit-IV: Solution of Volterra integral equation of second kind with convolution type kernels by Laplace transforms, Solution of singular integral equations by Fourier transform. Classical Fredholm Theory- Fredholm theorems.

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SESSION-2022-23

Paper-VII: MO 407
Relativity and Cosmology

Teaching: 6 hours/weak | **Theory Paper**
Exam Duration: 3 Hours | **Maximum Marks 70**

Unit-I: Mach's Principal, Newtonian approximation of equation of motion, Einstein's field equation for matter and empty space, Reduction of Einstein's field equation to Poisson's equation.

Unit-II: Schwarzschild exterior metric, its isotropic form, Singularity and singularities in the Schwarzschild exterior metric derivative of the formula $GM=mc^2$, Mass of sum in gravitational unit.

Unit-III: Three crucial tests in general relativity and their detailed descriptions, Analogues of Kepler's law in general relativity, Trace of Einstein tensor, Energy- momentum tensor and its expression for perfect fluid, Schwarzschild interior matrix and boundary condition.

Unit-IV: Lorentz invariance of Maxwell's equation in empty space, Lorentz force on charged particle, Energy- momentum tensor for electro- magnetic field. Einstein's field equation with cosmological term, Static cosmology models (Einstein & de-Sitter models) with physical and geometrical properties, Non- static form of de- Sitter line elements and Red shift in the metric, Einstein space, Hubble's law, Weyl's postulate.

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Paper- VIII: MO 408
Dissertation and Viva-voce
(For regular students only)

Maximum Marks 70 (Dissertation- 35 marks and Viva-voce -35 marks)
Internal Assessment- 30 marks.

Dissertation: A dissertation is to be written by each regular student on the topic of his interest under the supervision of an Assistant Professor/ Associate Professor/ Professor. It should depict the current development subject chosen. The dissertation is to be send for evaluation to an external examiner. Maximum marks for the evaluation of the thesis are 35.

Viva-voce: The viva-voce is to be conducted by inviting the external examiner. The Maximum marks of the viva-voce are 35.

Internal Assessment: The internal assessment is to be done by concern teacher

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Session 2021-22

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