UNIVERSITY OF RAJASTHAN
JAIPUR

SYLLABUS

M.A./M.SC. MATHEMATICS
Semester Scheme

I & II Semester  2019-2020
III & IV Semester  2020-2021

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
M.A./M.Sc. Syllabus in Mathematics as per new scheme: credit-based Semester System (Four Semesters in two years) with continuous assessment [30% with non-inclusion in Cumulative Grade point average (CGPA)].

To obtain a Master's Degree M.A./M.Sc. in Mathematics, a candidate is required to earn 120 credits with grade E or higher. For this each Semester will offer 36 credits. To earn credits for a paper, a candidate shall be required to obtain grade E or higher (or equivalent marks percentage) in the theory/practical examination. A candidate has to pass in the continuous assessment (internal) as well as in that paper separately. However, the grade point/marks obtained in the continuous assessment will not be included in Semester Grade Point Average (SGPA). In continuous assessment and End of Semester Examination (EoSE) separate grades will be awarded. The candidate will not be permitted to appear in EoSE of a particular credit (i) if he/she does not meet out 75% attendance requirement, or (ii) he/she fails to secure a Semester Grade Point Average (SGPA) of 1.5 in the continuous assessment.

The Credit Courses have been classified as

a) Compulsory Core Courses (CCC)

b) Elective Core Courses (ECC)

A course is identified by a course code designated by a string of six alphanumeric characters and a course title. In a course code the first three characters of the string indicate the Department offering the course and the later three alphanumeric characters designate a particular course. In the case of compulsory core course the fourth character identifies the semester numeric digit and in case of the elective core courses the fourth character indicates the cluster of specialization. For compulsory or elective theory core courses the fifth character is ‘0’ and for laboratory core course it is ‘1’.

### First Semester

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Subject Code</th>
<th>Course Title</th>
<th>Course Category</th>
<th>Credit</th>
<th>Contact Hours per week</th>
<th>EoSE Duration (Hrs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MAT 701</td>
<td>Algebra-I</td>
<td>CCC</td>
<td>6</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>MAT 702</td>
<td>Real Analysis</td>
<td>CCC</td>
<td>6</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>MAT 703</td>
<td>Differential Equations-I</td>
<td>CCC</td>
<td>6</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>MAT 704</td>
<td>Differential Geometry</td>
<td>ECC</td>
<td>6</td>
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<td>3</td>
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Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
<table>
<thead>
<tr>
<th>S.No.</th>
<th>Subject Code</th>
<th>Course Title</th>
<th>Course Category</th>
<th>Credit Hours/week</th>
<th>Contact Hours per week</th>
<th>EoSE Duration (Hrs.)</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>MAT 801</td>
<td>Algebra-II</td>
<td>CCC</td>
<td>6</td>
<td>6</td>
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<tr>
<td>2.</td>
<td>MAT 802</td>
<td>Topology</td>
<td>CCC</td>
<td>6</td>
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<td>3</td>
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<tr>
<td>3.</td>
<td>MAT 803</td>
<td>Differential Equations-II</td>
<td>CCC</td>
<td>6</td>
<td>6</td>
<td>3</td>
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<tr>
<td>4.</td>
<td>MAT 804</td>
<td>Riemannian Geometry and Tensor Analysis</td>
<td>ECC</td>
<td>6</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>MAT 805</td>
<td>Hydrodynamics</td>
<td>ECC</td>
<td>6</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>MAT 806</td>
<td>Special Functions-II</td>
<td>ECC</td>
<td>6</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total Credits in the Semester</td>
<td></td>
<td></td>
<td></td>
<td>36</td>
</tr>
</tbody>
</table>

**Second Semester**

**EoSE : End of Semester Examination**

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
## Elective Core Courses

### Specialization Clusters

A. CM Continuum Mechanics  
B. BLT Boundary Layer Theory  
C. MP Mathematical Programming  
D. CGT Combinatorics and Graph Theory  
E. RC Relativity and Cosmology  
F. IM Industrial Mathematics  
G. MHD Magnetohydrodynamics  
H. NA Numerical Analysis  
I. CA Computer Applications

<table>
<thead>
<tr>
<th>Elective Course</th>
<th>Specialization</th>
<th>Paper</th>
<th>Prerequisite</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAT A01</td>
<td>CM</td>
<td>Continuum Mechanics-I</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>MAT A02</td>
<td>CM</td>
<td>Continuum Mechanics-II</td>
<td>MAT A01</td>
<td>6</td>
</tr>
<tr>
<td>MAT B01</td>
<td>BLT</td>
<td>Boundary Layer Theory-I</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>MAT B02</td>
<td>BLT</td>
<td>Boundary Layer Theory-II</td>
<td>MAT B01</td>
<td>6</td>
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<tr>
<td>MAT C01</td>
<td>MP</td>
<td>Mathematical Programming-I</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>MAT C02</td>
<td>MP</td>
<td>Mathematical Programming-II</td>
<td>MAT C01</td>
<td>6</td>
</tr>
<tr>
<td>MAT D01</td>
<td>CGT</td>
<td>Combinatorics and Graph Theory-I</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>MAT D02</td>
<td>CGT</td>
<td>Graph Theory-II</td>
<td>MAT D01</td>
<td>6</td>
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<tr>
<td>MAT E01</td>
<td>RC</td>
<td>Relativistic Mechanics</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>MAT E02</td>
<td>RC</td>
<td>General Relativity and Cosmology</td>
<td>MAT E01</td>
<td>6</td>
</tr>
<tr>
<td>MAT F01</td>
<td>IM</td>
<td>Industrial Mathematics-I</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>MAT F02</td>
<td>IM</td>
<td>Industrial Mathematics-II</td>
<td>MAT F01</td>
<td>6</td>
</tr>
<tr>
<td>MAT G01</td>
<td>MHD</td>
<td>Magnetohydrodynamics-I</td>
<td>-</td>
<td>6</td>
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<tr>
<td>MAT G02</td>
<td>MHD</td>
<td>Magnetohydrodynamics-II</td>
<td>MAT G01</td>
<td>6</td>
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<tr>
<td>MAT H01</td>
<td>NA</td>
<td>Numerical Analysis-I</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>MAT H02</td>
<td>NA</td>
<td>Numerical Analysis-II</td>
<td>MAT H01</td>
<td>6</td>
</tr>
<tr>
<td>MAT I01</td>
<td>CA</td>
<td>Computer Applications-Theory</td>
<td>MAT I01</td>
<td>6</td>
</tr>
<tr>
<td>MAT I11</td>
<td>CA</td>
<td>Computer Applications-Practical</td>
<td>MAT I11</td>
<td>6</td>
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### Third Semester

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Subject Code</th>
<th>Course Title</th>
<th>Course Category</th>
<th>Credit</th>
<th>Contact Hours per week</th>
<th>EoSE Duration (Hrs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MAT 901</td>
<td>Functional Analysis-I</td>
<td>CCC</td>
<td>6</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>MAT 902</td>
<td>Viscous Fluid Dynamics-I</td>
<td>CCC</td>
<td>6</td>
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<td>3</td>
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<tr>
<td>3.</td>
<td>MAT 903</td>
<td>Integral Transforms</td>
<td>CCC</td>
<td>6</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

Candidates are required to opt any three elective core courses (6 credits each) from MAT A01, MAT B01, MAT C01, MAT D01, MAT E01, MAT F01, MAT G01, MAT H01, MAT I01.

**Total Credits in the Semester** 36

### Fourth Semester

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Subject Code</th>
<th>Course Title</th>
<th>Course Category</th>
<th>Credit</th>
<th>Contact Hours per week</th>
<th>EoSE Duration (Hrs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MAT X01</td>
<td>Functional Analysis-II</td>
<td>CCC</td>
<td>6</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>MAT X02</td>
<td>Viscous Fluid Dynamics-II</td>
<td>CCC</td>
<td>6</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>MAT X03</td>
<td>Integral Equations</td>
<td>CCC</td>
<td>6</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

Candidates are required to opt the corresponding three elective core courses of same specialization cluster obtained in Semester Third (6 credits each) from MAT A02, MAT B02, MAT C02, MAT D02, MAT E02, MAT F02, MAT G02, MAT H02, MAT I11.

**Total Credits in the Semester** 36

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
MA/M.Sc. Mathematics Examination
Scheme of Examination
Semester I and II

Semester – I

Note: Continuous assessment (internal) will be done by teacher concerned on the basis of test papers, regularity in the class and performance of the candidate. Maximum marks in continuous assessment of each paper is 100.

Paper- 1: MAT 701: Algebra-I
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit-1
Direct product of groups (External and Internal). Isomorphism theorems – Diamond isomorphism theorem, Butterfly Lemma, Conjugate classes (Excluding p-groups). Sylow’s theorems (without proof), Cauchy’s theorem for finite abelian groups.

Unit - 2
Commutators, Derived subgroups. Normal series and Solvable groups, Composition series, Refinement theorem and Jordan-Holder theorem for infinite groups.

Unit - 3

Unit - 4 Galois theory – the elements of Galois theory, Automorphism of extensions, Fundamental theorem of Galois theory, Solutions of polynomial equations by radicals and Insolvability of general equation of degree five by radicals.

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Reference Books:
1. Deepak Chatterjee, Abstract Algebra, Prentice – Hall of India (PHI), New Delhi, 2004

Paper – 2 : MAT 702 : Real Analysis
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max. Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit - 1
Algebra and algebras of sets, Algebras generated by a class of subsets, Borel sets, Lebesgue measure of sets of real numbers, Measurability and Measure of a set, Existence of Non-measurable sets.

Unit - 2
Measurable functions, Realization of non-negative measurable function as limit of an increasing sequence of simple functions, Structure of measurable functions, Convergence in measure, Egoroff’s theorem.

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Jaipur
Unit - 3
Weierstrass’s theorem on the approximation of continuous function by polynomials, Lebesgue integral of bounded measurable functions, Lebesgue theorem on the passage to the limit under the integral sign for bounded measurable functions.

Unit - 4
Summable functions, Space of square summable functions. Fourier series and coefficients, Parseval’s identity, Riesz-Fisher Theorem.

Reference Books:
5. S. Lang, Undergraduate Analysis, Springer-Verlag, New York, 1983.

Paper – 3 : MAT 703 : Differential Equations- I
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Unit - 1
Non-linear ordinary differential equations of particular forms. Riccati’s equation - General solution and the solution when one, two or three particular solutions are known.

Unit - 2
Total Differential equations. Forms and solutions, necessary and sufficient condition, Geometrical Meaning Equation containing three and four variables, total differential equations of second degree.

Unit - 3
Series Solution: Radius of convergence, method of differentiation, Cauchy-Euler equation, Solution near a regular singular point (Method of Frobenius) for different cases, Particular integral and the point at infinity.

Unit - 4
Partial differential equations of second order with variable co-efficients- Monge’s method.

Reference Books:

Paper- 4 : MAT 704 : Differential Geometry
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max. Marks - 100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of...
the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit - 1
Space curves, Tangent, Contact of curve and surface, Osculating plane, Principal normal and Binormal, Curvature, Torsion, Serret-Frenet’s formulae, Osculating circle and Osculating sphere, Existence and Uniqueness theorems, Bertrand curves, Involute and Evolutes.

Unit - 2
Conoids, Inflexional tangents, Singular points, Indicatrix. Ruled surface, Developable surface, Tangent plane to a ruled surface. Necessary and sufficient condition that a surface \( z = f(\xi, \eta) \) should represent a developable surface. Metric of a surface, First, Second and Third fundamental forms. Fundamental magnitudes of some important surfaces, Orthogonal trajectories.

Unit - 3
Normal curvature. Principal directions and Principal curvatures, First curvature, Mean curvature, Gaussian curvature, Radius of curvature of a given section through any point on \( z = f(x,y) \). Lines of curvature, Principal radii, Relation between fundamental forms.

Unit - 4
Asymptotic lines, Differential equation of an asymptotic line, Curvature and Torsion of an asymptotic line. Gauss’s formulae, Gauss’s characteristic equation, Weingarten equations, Mainardi-Codazzi equations. Fundamental existence theorem for surfaces, Parallel surfaces, Gaussian and mean curvature for a parallel surface.

Reference Books:

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Paper- 5 : MAT 705: Dynamics of Rigid Bodies
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit - 1
D’Alembert’s principle. The general equations of motion of a rigid body. Motion of centre of inertia and motion relative to centre of inertia. Motion about a fixed axis.

Unit - 2
The compound pendulum, Centre of percussion. Conservation of momentum (linear and angular) and energy for finite as well as impulsive forces.

Unit - 3
Motion in three dimensions with reference to Euler’s dynamical and geometrical equations. Motion under no forces, Motion under impulsive forces, Motion of a top,

Unit - 4
Lagrange’s equations for holonomous dynamical system, Energy equation for conservative field, Small oscillations, Hamilton’s equations of motion, Hamilton’s principle and principle of least action.

Reference Books:

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Paper – 6 : MAT 706: Calculus of Variation and Special Function-I
Teaching  6 hours per week. (6 credits)
Examination 3 hrs. duration      Theory Paper      Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit - 1
Calculus of variation – Functionals, Variation of a functional and its properties, Variational problems with fixed boundaries, Euler’s equation, Extremals, Functional dependent on several unknown functions and their first order derivatives.

Unit - 2
Functionals dependent on higher order derivatives, Functionals dependent on the function of more than one independent variable. Variational problems in parametric form.

Unit - 3
Gauss hypergeometric function and its properties, Series solution of Gauss hypergeometric equation. Integral representation, Linear and quadratic transformation formulas, Contiguous function relations, Differentiation formulae, Linear relation between the solutions of Gauss hypergeometric equation, Kummer’s confluent hypergeometric function and its properties, Integral representation, Kummer’s first transformation and series solution of Legendre’s equation.

Unit - 4
Legendre polynomials and functions P_n(x) and Q_n(x).

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Reference Books:

Semester – II

Note: 1. Continuous assessment (internal) will be done by teacher concerned on the basis of test papers, regularity in the class and performance of the candidate. Maximum marks in continuous assessment of each paper is 100.

Paper- 1 : MAT 801 : Algebra II
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max. Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit - 1 Linear transformation of vector spaces, Dual spaces, Dual basis and their properties, Dual maps, Annihilator.

Unit - 2
Matrices of linear maps, Matrices of composition maps, Matrices of dual map, Eigen values, Eigen vectors, Rank and Nullity of linear maps and matrices, Invertible matrices, Similar matrices.

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University of Rajasthan
Jaipur
Unit - 3
Determinants of matrices and their computations. Characteristic polynomial, minimal polynomial and eigen values. Real inner product space, Schwartz inequality.

Unit - 4
Orthogonality, Bessel’s inequality, Adjoint, Self adjoint linear transformations and matrices, Orthogonal linear transformation and matrices, Principal Axis Theorem.

Reference Books:
1. Deepak Chatterjee, Abstract Algebra, Prentice – Hall of India (PHI), New Delhi, 2004

Paper – 2 : MAT 802 : Topology
Teaching 6 hours per week. (6 credits)
Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Unit - 1
Topological spaces, Subspaces, Open sets, Closed sets, Neighbourhood system, Bases and sub-bases.

Unit - 2
Continuous mapping and Homeomorphism, Nets, Filters.

Unit - 3
Separation axioms (To, T₁, T₂, T₃, T₄). Compact and locally compact spaces. Continuity and Compactness.

Unit - 4

Reference Books:

Paper 3: MAT 803: Differential Equation-II
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max. Marks 100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Unit - 1
Classification of linear partial differential equation of second order, Canonical forms, Cauchy’s problem of first order partial differential equation.

Unit - 2
Linear homogeneous boundary value problem, Eigen values and eigen functions, Sturm-Liouville boundary value problems, orthogonality of eigen functions, Lagrange’s identity, properties of eigen functions, important theorems of sturm Liouville system, Periodic functions.

Unit - 3

Unit - 4
Green’s Functions: Non-homogeneous Sturm-Liouville boundary value problem (method of Green’s function), Procedure of constructing the Green’s function and solution of boundary value problem, properties of Green’s function, Inhomogeneous boundary conditions, Dirac delta function, Bilinear formula for Green’s function, Modified Green’s function.

Reference Books:

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Paper - 4: MAT 804: Riemannian Geometry and Tensor Analysis
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part 'A' of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part 'B' of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit - 1
Geodesics, Differential equation of a geodesic, Single differential equation of a geodesic, Geodesic on a surface of revolution, Geodesic curvature and torsion, Gauss-Bonnet Theorem.

Unit - 2

Unit - 3
Christoffel symbols and their properties, Covariant differentiation of tensors. Ricci's theorem, Intrinsic derivative, Geodesics, Differential equation of geodesic, Geodesic coordinates, Field of parallel vectors.

Unit - 4
Reference Books:

Paper – 5: MAT 805: Hydrodynamics
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit -1
Kinematics of ideal fluid. Lagrange’s and Euler’s methods. Equation of continuity in Cartesian, cylindrical and spherical polar coordinates. Boundary surface. Stream-lines, path-lines and streak lines, velocity potential, irrotational motion.

Unit -2
Euler’s hydrodynamic equations, Bernoulli’s theorem. Helmholtz equations. Cauchy’s integral.

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Unit – 3
Motion due to impulsive forces. Motion in two-dimensions, Stream function, Complex potential. Sources, Sinks, Doublets, Images in two-dimensions.

Unit – 4
Vortex motion definition, rectilinear vortices, centre of vortices, properties of vortex tube, two vortex filaments, vortex pair, vortex doublet, vortex inside and outside circular cylinder, four vortices, motion of vortex situated at the origin and stream lines.

Reference Books:

Paper-6 : MAT 806 : Special Functions- II
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Unit - 1
Bessel functions $J_n(x)$.

Unit - 2
Hermite polynomials $H_n(x)$, Laguerre and Associated Laguerre polynomials.

Unit - 3
Jacobi Polynomial: Definition and its special cases, Bateman’s generating function, Rodrigue’s formula, orthogonality, recurrence relations, expansion in series of polynomials.

Unit - 4
Chebyshev polynomials $T_n(x)$ and $U_n(x)$: Definition, Solutions of Chebyshev’s equation, expansions, Generating functions, Recurrence relations, Orthogonality.

Reference Books:

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
M.A./M.Sc. Mathematics
Semester Scheme (Semester III and IV)
Semester - III

Note:
Continuous assessment (internal) will be done by teacher concerned on the basis of
test papers, regularity in the class and performance of the candidate Maximum marks
in continuous assessment of each paper is 100.

Paper- 1 : MAT 901 : Functional Analysis- I
Teaching  6 hours per week.  (6 credits)

Examination 3 hrs. duration  Theory Paper  Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five
questions. This paper is divided into four units. There shall be two parts in question
paper. Part ‘A’ of the question paper shall contain first question with 10 subparts
consisting of very short answer type questions based on knowledge, understanding
and applications of the topics covering the syllabus (all four units). Each question of
the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One
question will be set from each unit. Each question will have three parts. Candidates
are required to attempt all four units by taking any two parts from each question of the
unit. All questions carry equal marks.

Unit 1: Subspace of a metric space, Product space, Continuous mappings, Sequence
in a metric space, Convergent, Cauchy sequence. Complete metric space.

Unit – 2
Banach contraction theorem, Baire’s category theorem, compact sets, compact spaces,
Separable metric space and connected metric spaces.

Unit - 3
Normed linear spaces. Quotient space of normed linear spaces and its completeness.
Banach spaces and examples. Bounded linear transformations. Normed linear space of
bounded linear transformations.

Unit – 4
Equivalent norms. Basic properties of finite dimensional normed linear spaces and
graph theorem. Uniform boundness theorem.

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Reference Books:

Paper-2 : MAT 902 : Viscous Fluid Dynamics-I
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration  Theory Paper  Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit – 1
Viscosity, Analysis of stress and rate of strain, Stoke’s law of friction, Thermal conductivity and generalized law of heat conduction, Equations of state and continuity, Navier-Stokes equations of motion.

Unit – 2
Vorticity and circulation, Dynamical similarity, Inspection and dimensional analysis, Buckingham theorem and its application, Non-dimensional parameters and their physical importance: Reynolds number, Froude number, Mach number, Prandtl number, Eckart number, Grashoff number, Brinkmann number, Non – dimensional coefficients: Lift and drag coefficients, Skin friction, Nusselt number, Recovery factor.

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University of Rajasthan
Jaipur
Unit – 3
Exact solutions of Navier – Stokes equations, Velocity distribution for plane couette flow, Plane Poiseuille flow, Generalized plane Couette flow, Hagen- Poiseuille flow, Flow in tubes of uniform cross-sections.

Unit – 4
Flow between two concentric rotating cylinders. Stagnation point flows : Hiemenz flow, Homann flow. Flow due to a rotating disc.

Reference Books:

Paper – 3 : MAT 903 : Integral Transforms
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit – 1

Unit – 2
Unit - 3

Unit – 4

Reference Books:

Optional Papers: (ECC)

Paper – 4 : MAT A01 : Continuum Mechanics – I
Teaching 6 hours per week. (6 credits)
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Unit 1:
Cartesian Tensors, Index notation and transformation laws of Cartesian tensors. Addition, Subtraction and Multiplication of cartesian tensors, Gradient of a scalar function, Divergence of a vector function and Curl of a vector function using the index notation. \( \varepsilon - \delta \) identity. Conservative vector field and concept of a scalar potential function. Stokes, Gauss and Green's theorems.

Unit 2:

Unit 3:

Unit 4
Geometrical meaning of the components of the linear strain tensor, Properties of linear strain tensors. Principal axes, Theory of linear strain. Linear strain components. Rate of strain tensors. The vorticity tensor. Rate of rotation vector and vorticity, Properties of the rate of strain tensor, Rate of cubical dilation.

Reference Books:

Paper – 5 : MAT B01 : Boundary Layer Theory- I
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding

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Jaipur
and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit 1
Derivation of boundary layer equations for two-dimensional flow. Boundary layer along a flat plate (Blasius-Topfer solution). Characteristic boundary layer parameters. Similar solutions.

Unit - 2
Exact solution of the steady state boundary layer equations in two-dimensional flow. Flow past a wedge. Flow along the wall of a convergent channel. Boundary layer separation.

Unit-3

Unit - 4

Reference Books:

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Paper-6: MAT C01 : Mathematical Programming -I
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit – 1
Separating and supporting hyperplane theorems. Revised simplex method to solve Linear Programming problems, Bounded variable problems.

Unit – 2
Integer programming: Gomory’s algorithm for all and mixed integer programming problems, Branch and Bound algorithm; Goal programming: Graphical goal attainment method, Simplex method for GPP.

Unit – 3

Unit - 4

Reference Books:

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Paper – 7: MAT D01 : Combinatorics and Graph Theory- I
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit - 1
Introduction to diagraph, Orientation of a graph, Underlying graph, Parallel edges, Source and Sink, Types of digraphs, Accessibility, Arborescence, Spanning arborescence, Euler digraphs, Handshaking dilemma, Incidence matrix of a digraph, Circuit matrix of a digraph.

Unit - 2
Degree sequences, Graphic sequence, Havel Hakimi Theorem. Matrix representation of graphs except adjacency and incidence matrix.

Unit – 3
Planar graphs Kurotowski’s graphs, Maximal planar graphs, Outer planar graphs, Maximal outer planar graph, Minimally non-outer planar graph, Thikness and Crossing number of bipartite and complete bipartite graph, Euler’s formula, Kuratowski’s theorem.

Unit - 4
Isomorphism, Homomorphism. Graph theory in Network analysis Network flows, Transport networks, Max-flow min-cut-theorem.

Reference Books:
1. N. Deo, Graph Theory, Prentice Hall of India, New Delhi, 2004.
2. C.Vasudev, Graph theory and its application, New Age International Pvt., 2006.
Paper – 8 : MAT E01 : Relativistic Mechanics
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration  Theory Paper  Max. Marks - 100

Note: There shall be five questions in all. Candidates are required to attempt all five
questions. This paper is divided into four units. There shall be two parts in question
paper. Part ‘A’ of the question paper shall contain first question with 10 subparts
consisting of very short answer type questions based on knowledge, understanding
and applications of the topics covering the syllabus (all four units). Each question of
the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One
question will be set from each unit. Each question will have three parts. Candidates
are required to attempt all four units by taking any two parts from each question of the
unit. All questions carry equal marks.

Unit – 1
Relative Character of space and time, Principle of Relativity and its postulates,
Derivation of special Lorentz transformation equations, Composition of Parallel
velocities, Lorentz-Fitzgerald contraction formula, Time dilation.

Unit – 2
Simultaneity, Relativistic transformation formulae for velocity, Lorentz contraction
factor, Particle acceleration, Velocity of light as fundamental velocity, Relativistic
aberration and its deduction to Newtonian theory.

Unit - 3
Variation of mass with velocity, Equivalence of mass and energy, Transformation
formulae for mass, Momentum and energy, Problems on conservation of mass,
Momentum and energy, Relativistic Lagrangian and Hamiltonian.

Unit - 4
Minkowski space, Space-like, Time-like and Light-like intervals, Null cone,
Relativity and Causality, Proper time, World line of a particle. Principles of
Equivalence and General Covariance.

Reference Books:
   Ltd. India, N.Delhi, 1978.
3. P.G. Bergmann, Introduction to the Theory of Relativity, Prentice Hall of
   India, 1969.

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Paper – 9 : MAT F01: Industrial Mathematics- I
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit -1

Unit -2

Unit - 3
Revised Simplex method, Duality in linear programming, Duality and Simplex method.

Unit - 4

Reference Books:

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Paper – 10: MAT G01: Magneto hydrodynamics - I
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit - 1

Unit - 2
Magneto fluiddynamic approximations. Magnetic field equation, Frozen in fluid, Alfvén transverse waves. MHD boundary conditions.

Unit - 3
Inspection and Dimensional analysis, π-products. Reynolds number, Mach number, Prandtl number, Magnetic Reynolds number, Magnetic pressure number, Hartmann number, Magnetic parameter, Magnetic Prandtl number and Nusselt number.

Unit - 4
Hartmann plane Poiseuille flow and plane Couette flow including temperature distribution. MHD flow in a tube of rectangular cross-section. MHD pipe flow. MHD flow in annular channel. MHD flow between two rotating coaxial cylinders.

Reference Books:
Paper – 11 : MAT H01 : Numerical Analysis – I
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit – 1
Iterative methods – Theory of iteration method, Acceleration of the convergence, Chebyshev method, Muler’s method, Methods for multiple and complex roots

Unit - 2
Newton-Raphson method for simultaneous equations, Convergence of iteration process in the case of several unknowns. Solution of polynomial equations – Polynomial equation, Real and complex roots, Synthetic division, the Birge-Vieta, Bairstow and Graeffe’s root squaring method.

Unit - 3
System of simultaneous Equations (Linear)- Direct method, Method of determinant, Gauss-Jordan, LU-Factorizations-Doolittle’s, Crout’s and Cholesky’s. Partition method. Relaxation methods.

Unit - 4
Eigen value problems– Basic properties of eigen values and eigen vector, Power methods, Method for finding all eigen values of a matrix. Jacobi, Givens’ and Rutishauser method. Complex eigen values.

Reference Books:

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Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit – 1
Introduction to computers, Computer organization, Input-output devices, Memory system. Hardware and software. Operating system.

Unit – 2


Unit 4: Programming using Matlab/Mathematica/Maple – Functions, Loops, Conditional Execution, Matrix Multiplication.

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Reference Books:

Semester – IV

Note:
Continuous assessment (internal) will be done by teacher concerned on the basis of test papers, regularity in the class and performance of the candidate Maximum marks in continuous assessment of each paper is 100.

Paper -1: MAT X01: Functional Analysis II and Advanced Calculus

Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part 'A' of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part 'B' of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

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Unit – 1

Unit – 2

Unit – 3

Unit – 4

Reference Books:

Paper – 2: MAT X02 : Viscous Fluid Dynamics II
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of

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the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One
question will be set from each unit. Each question will have three parts. Candidates
are required to attempt all four units by taking any two parts from each question of the
unit. All questions carry equal marks.

Unit – 1
Concept of unsteady flow, Flow due to plane wall suddenly set in the motion (Stokes’
first problem), Flow due to an oscillating plane wall (Stokes’ second problem),
Starting flow in plane Couette motion, Suction/injection through porous wall.

Unit - 2
Equation of energy, Temperature distribution : Between parallel plates, in a pipe,
between two concentric rotating cylinders.

Unit - 3
Variable viscosity plane Couette flow, temperature distribution of plane Couette flow
with transpiration cooling. Theory of very slow motion: Stokes’ and Oseen’s flows
past a sphere.

Unit – 4
Concept of boundary layer, Derivation of velocity and thermal boundary equations in
two-dimensional flow. Boundary layer on flat plate (Balsius-Topfer solution), Simple
solution of thermal boundary layer equation for Pr = 1.

Reference Books:

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Paper – 3: MAT X03 : Integral Equations
Teaching 6 hours per week. (6 credits)
Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part “B” of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit – 1

Unit – 2

Unit – 3

Unit – 4

Reference Books:
Optional Paper (ECC)
Paper – 4 : MAT A02 : Continuum Mechanics – II
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit – 1

Unit – 2
Kinetic equation of state. First and the second law of thermodynamics and dissipation function. Applications (Linear elasticity and Fluids) – Assumptions and basic equations. Generalized Hook’s law for an isotropic homogeneous solid.

Unit – 3

Unit – 4

Reference Books:

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Paper – 5 : MAT B02 : Boundary Layer Theory – II
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration  Theory Paper  Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit -1
Unsteady boundary layers – Method of successive approximations, Boundary layer growth after impulsive start of motion and in accelerated motion, Boundary layer for periodic flow (Pulsatile pressure gradient).

Unit - 2

Unit - 3
Derivation of two-dimensional thermal boundary layer equation for flow over a plane wall. Forced convection in a laminar boundary layer on a flat plate, Crocco’s first and second integrals. Reynolds analogy.

Unit - 4

Reference Books:

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Paper – 6 : MAT C02 : Mathematical Programming - II
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit – 1
Convex function, Quadratic forms, constrained problem of maxima and minima, Lagrangian method, Non-linear programming: Formulation and Graphical method.

Unit – 2
Non-linear programming and its fundamental ingredients, Khun-Tucker necessary and sufficient conditions; Saddle point, Saddle-point theorems.

Unit – 3
Quadratic Programming: Kuhn-Tucker conditions, Wolfe method, Duality in Quadratic Programming.

Unit – 4
Beals method to solve QPP, Geometric Programming: Formulation, geometric arithmetic inequality, necessary conditions of optimality.

Reference Books:
Paper - 7: MAT D02: Graph Theory - II
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max. Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part 'A' of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part 'B' of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit - 1
Cut set and Cut vertices, Cut set and bridge, fundamental cut sets, Connectivity and Severability, Vector spaces of graphs.

Unit - 2
Coloring: Graph coloring, Vertex coloring, Edge coloring, Properly coloring of a graph, Chromatic polynomial, Decomposition theorem, Four colour theorem, The five colour theorem.

Unit - 3
Enumeration of graphs:
Types of enumeration, Labeled graphs, Counting labeled trees, Rooted labeled trees, Enumeration of graphs, Partitions, Generating functions, Counting unlabeled trees, Rooted unlabeled trees, Permutation, Composition of permutation, Pólya's theorem, Burnside's lemma, Pólya's enumeration theorem

Unit - 4
Graph and Algorithms: Applications
Shortest path algorithms, Dijkstra's algorithm, Algorithm for minimal spanning tree, Kruskal's algorithm, Prim's algorithm, The labeling algorithm

Reference Books:

2. C. Vasudev, Graph theory and it application, New Age International Pvt., 2006.
5. N. Deo, Graph Theory, Prentice Hall of India, New Delhi, 2004.

[Signature]
Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Paper – 8 : MAT E02 : General Relativity & Cosmology
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit - 1
Mach’s principle, 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, Removal of clock paradox in General Relativity.

Unit - 2
Schwarzschild exterior metric, its isotropic form, Singularity and singularities in Schwarzschild exterior metric, Derivation of the formula GM = c²m, Mass of sun in gravitational unit, Relativistic differential equation for the orbit of the planet.

Unit - 3
Three crucial tests in General Relativity and their detailed descriptions, Analogues of Kepler’s laws in General Relativity, Trace of Einstein tensor, Energy-momentum tensor and its expression for perfect fluid, Schwarzschild interior metric and boundary condition.

Unit - 4
Lorentz invariance of Maxwell’s equations in empty space, Lorentz force on charged particle, Energy-momentum tensor for electro-magnetic field. Einstein’s field equation with cosmological term, Static cosmological models (Einstein & de-Sitter models) with physical and geometrical properties, Non-static form of de-Sitter line-element and Red shift in this metric, Einstein space, Hubble’s law, Weyl’s postulate.

Reference Books:

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Paper – 9 : MAT F02 : Industrial Mathematics – II
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit - 1
Inventory Models. EOQ models with and without shortages.

Unit - 2
EOQ models with constraints.

Unit – 3
Replacement and Reliability models. Replacement of items that deteriorate, Replacement of items that fail completely.

Unit - 4
Reliability Theory – Coherent structure, Reliability of systems of independent components, Bounds on system reliability, Shapes of the system reliability function, Motion of aging, Parametric families of life distribute with Monotone failure rate.

Reference Books:

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit - 1
MHD flow near a stagnation point. MHD Reyleigh’s flow. MHD Stoke’s flow past a sphere, MHD Oseen’s flow past a sphere.

Unit - 2
MHD boundary layer flow past a flat plate in an aligned magnetic flow. Wilson’s numerical solution technique. MHD boundary layer flow past a flat plate in a transverse magnetic field. modified Rossow’s method of solution.

Unit - 3
MHD plane free jet flow. Wave and theory of characteristics, Equation of the characteristics, Characteristic surfaces, MHD characteristic equations. MHD waves.

Unit - 4

Reference Books:
Paper-11 : MAT H02 : Numerical Analysis – II
Teaching 6 hours per week. (6 credits)

Examination 3 hrs. duration Theory Paper Max.Marks-100

Note: There shall be five questions in all. Candidates are required to attempt all five questions. This paper is divided into four units. There shall be two parts in question paper. Part ‘A’ of the question paper shall contain first question with 10 subparts consisting of very short answer type questions based on knowledge, understanding and applications of the topics covering the syllabus (all four units). Each question of the subpart will carry 2 marks. Part ‘B’ of the paper shall contain four questions. One question will be set from each unit. Each question will have three parts. Candidates are required to attempt all four units by taking any two parts from each question of the unit. All questions carry equal marks.

Unit – 1
Curve Fitting and Function Approximations – Least square error criterion. Linear regression. Polynomial fitting and other curve fittings, Approximation of functions by Taylor series and Chebyshev polynomials.

Unit – 2

Unit – 3
Stability analysis – Single and Multistep methods. BVP’s of ordinary differential Equations – Boundary value problems (BVP’s), Shooting methods.

Unit - 4
Finite difference methods. Difference schemes for linear boundary value problems of the type $y'' = f(x,y), y''' = f(x,y,y')$ and $y^{iv} = f(x,y)$.

Reference Books:

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur
Paper – 12: MAT II1: Computer Applications- Practical Teaching: 9 Hours per Week. (Six credits)

Examination 3 Hrs.duration Practical Paper Max.Marks 100

Note: There shall be five practicals with internal choice and candidates are required to attempt all give practicals.


Distribution of Marks:

<table>
<thead>
<tr>
<th>Component</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Five Practicals – 15 Marks each</td>
<td>75</td>
</tr>
<tr>
<td>Practical Record</td>
<td>10</td>
</tr>
<tr>
<td>Viva-Voce</td>
<td>15</td>
</tr>
<tr>
<td>Total Marks</td>
<td>100</td>
</tr>
</tbody>
</table>

Note:
1. Each candidate is required to appear in the Practical examination to be conducted by internal and external examiners. External examiner will be appointed by the University through BOS and internal examiner will be appointed by the Head of the Department/Principal of the College.
2. Each candidate has to prepare his/her practical record.

Dy. Registrar (Academic-I)
University of Rajasthan
Jaipur