UNIVERSITY OF RAJASTHAN
JAIPUR

SYLLABUS

M.A/M.Sc. Mathematics

Semester Scheme
I & II Semester  2016-2017
III & IV Semester  2017-2018
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-1</td>
<td>CCC</td>
<td>6</td>
<td>6</td>
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</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>
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<tr>
<td>3.</td>
<td>MAT 703</td>
<td>Differential Equations-1</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>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>MAT 705</td>
<td>Dynamics of Rigid Bodies</td>
<td>ECC</td>
<td>6</td>
<td>6</td>
<td>3</td>
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<tr>
<td>6.</td>
<td>MAT 706</td>
<td>Calculus of Variation and Special Function-1</td>
<td>ECC</td>
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<td></td>
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EoSE: End of Semester Examination
Second 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>
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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>
<tr>
<td>2.</td>
<td>MAT 802</td>
<td>Topology</td>
<td>CCC</td>
<td>6</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>
</tr>
<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>
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<td>3</td>
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<tr>
<td>6.</td>
<td>MAT 806</td>
<td>Special Functions-II</td>
<td>ECC</td>
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<tr>
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<td>Total Credits in the Semester</td>
<td></td>
<td></td>
<td>36</td>
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</table>

EoSE : End of Semester Examination
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>
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<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>
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<tr>
<td>MAT B01</td>
<td>BLT</td>
<td>Boundary Layer Theory-I</td>
<td>-</td>
<td>6</td>
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<tr>
<td>MAT B02</td>
<td>BLT</td>
<td>Boundary Layer Theory-II</td>
<td>MAT B01</td>
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<tr>
<td>MAT C01</td>
<td>MP</td>
<td>Mathematical Programming-I</td>
<td>-</td>
<td>6</td>
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<tr>
<td>MAT C02</td>
<td>MP</td>
<td>Mathematical Programming-II</td>
<td>MAT C01</td>
<td>6</td>
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<tr>
<td>MAT D01</td>
<td>CGT</td>
<td>Combinatorics and Graph Theory-I</td>
<td>-</td>
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<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>-</td>
<td>6</td>
</tr>
<tr>
<td>MAT I11</td>
<td>CA</td>
<td>Computer Applications-Practical</td>
<td>MAT I01</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>
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<tr>
<td>2.</td>
<td>MAT 902</td>
<td>Viscous Fluid Dynamics-I</td>
<td>CCC</td>
<td>6</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 and Advanced Calculus</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>
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<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
MA/M.Sc. (Previous) Mathematics Examination  
Scheme of Examination  
Semester System (I & II Semester) – 2016-2017  

Semester – I  

Note: 1. Papers MAT 701, MAT 702 are MAT 703 are compulsory (CCC) and Papers MAT 704, MAT 705 are MAT 706 are elective (ECC).  
2. 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.  

Compulsory Papers (CCC)  

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). Sylow’s theorems, Cauchy’s theorem for finite abelian groups.  

Unit - 2  
Isomorphism theorems – Diamond isomorphism theorem, Butterfly Lemma, Conjugate classes (Excluding p-groups). Commutators, Derived subgroups.  

Unit - 3  
Normal series and Solvable groups, Composition series, Refinement theorem and Jordan-Holder theorem for infinite groups. Polynomial rings and irreducibility criteria.  

Unit -4  
Field theory – Extension fields, Algebraic and Transcendental extensions, Separable and inseparable extensions, Normal extensions. Splitting fields.  

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.

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.
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

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 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 Forbenius) 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:
Elective Papers (ECC)

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, Inflectional tangents, Singular points, Indicatrix. Ruled surface, Developable surface, Tangent plane to a ruled surface. Necessary and sufficient condition that a surface ζ = f(ζ,η) 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:
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. Motion of a rigid body in two dimensions under finite and 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. Conservation of momentum (linear and angular).

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

Reference Books:
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).

Reference Books:
Semester - II

Note: 1. Papers MAT 801, MAT 802 and MAT 803 are compulsory (CCC) and Papers MAT 804, MAT 805 and MAT 806 are elective (ECC).
2. 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.

Compulsory Papers (CCC)

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
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.

Unit - 2
Linear transformation of vector spaces, Dual spaces, Dual basis and their properties, Dual maps, Annihilator. Matrices of a linear maps, Matrices of composition maps,

Unit - 3

Unit - 4
Real inner product space, Schwartzs inequality. 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.

Unit - 1
Topological spaces, Subspaces, Open sets, Closed sets, Neighbourhood system, Bases and subbases.

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

Unit - 3
Separation axioms (T0, T1, T2, T3, T4). Compact and locally compact spaces. Continuity and Compactness.

Unit - 4

Reference Books:
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
Classification of linear partial differential equation of second order, Canonical forms, Cauchy’s problem of first and second 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:
Elective Papers (ECC)

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 PaperMax. 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

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 the 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.

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:
M.A./M.Sc. (Final) Mathematics
Semester Scheme (Semester III and IV) – 2017-2018

Semester - III

Note: (i) Paper MAT 901, MAT 902 and MAT 903 are compulsory (CCC) in Semester III.
(ii) 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.
(iii) Continuous assessment (internal) will be done by teacher concerned on the basis of test papers, regularity in the class and performance of the candidate. A maximum mark in continuous assessment of each paper is 100.

Compulsory Papers (CCC)

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 – 2

Unit - 3

Unit – 4
Inner product spaces. Hilbert space and its properties. Orthogonality and Functionals in Hilbert Spaces. Phythagorean theorem, Projection theorem, Orthonormal sets, Bessel’s inequality,
Complete orthonormal sets, Parseval's identity, Structure of a Hilbert space, Riesz representation theorem, Reflexivity of Hilbert spaces.

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.

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 – 7 : 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
Fourier transform – Definition and properties of Fourier sine, cosine and complex transforms.
Convolution theorem. Inversion theorems. Fourier transform of derivatives.

Unit – 2
Mellin transform – Definition and elementary properties. Mellin transforms of derivatives and

Unit – 3
Laplace transform – Definition and its properties. Rules of manipulation. Laplace transform of

Unit – 4
Complex inversion formula. Infinite Hankel transform – Definition and elementary properties.

Reference Books:
1. Lokenath Debnath and Dambaru Bhatta, Integral Transforms and their Applications,
   Taylor and Francis Group, 2014.
2. Abdul J. Jerey, Introduction to Integral Equations with applications, Marcel Dekkar Inc.
   NY, 1999.
Optional (Elective) Papers: (ECC)

Paper - 3 : MAT A01 : Continuum Mechanics - 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:
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. e-8 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 dilatation.

Reference Books:
Paper – 4 : MAT B01 : Boundary Layer Theory- 1
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
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:
Paper-5: 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:
Paper – 6: 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


Unit - 2


Unit - 3


Unit - 4

Traveling salesman problem, operations on graphs. Trees– Trees, Rooted trees, Paths lengths in rooted trees, spanning trees, minimum spanning trees.

Reference Books:
1. N. Deo, Graph Theory with Applications to Computer Science, Prentice-Hall of India, 1979.
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

Reference Books:
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:
Paper – 10: MAT G01: Magnetohydrodynamics - 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
Maxwell electromagnetic field equations. Constitutive equations of fluid motion, Stokes

Unit - 2
Magnetofluiddynamic 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:
2. K.R. Cramer and S.I.Pai, Magnetofluidynamics for Engineers and Applied Physicists,
3. P.A. Davidson, An Introduction to Magnetohydrodynamics, Cambridge Univ. Press,
5. K.R. Cramer and S.I. Pai, Magnetofluid Dynamics for Engineers and Applied Physicists,
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

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-Doolitte’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:
Paper - 12: MAT 101: Computer Applications - Theory
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 - 3
Programming in C – Constants and variables. Arithmetic expressions, Input-output, Conditional statements, Implementing loops in programs.

Unit - 4
Defining and manipulating arrays, Processing character strings, functions. Files in C. Simple computer programming.

Reference Books:
Semester - IV

Note: (i) Paper MAT X01, MAT X02 and MAT X03 are compulsory in Semester IV.
   (ii) Candidates are required to opt the corresponding three elective core courses of same specialisation 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.
   (iii) Continuous assessment (internal) will be done by teacher concerned on the basis of test papers, regularity in the class and performance of the candidate. A maximum mark in continuous assessment of each paper is 100.

Compulsory Papers (CCC)

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.

Unit - 1

Unit - 2
Derivatives of a continuous map from an open subset of Banach space to a Banach space. Rules of derivation. Derivative of a composite, Directional derivative. Mean value theorem and its applications.

Unit - 3

Unit - 4
Inverse 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.

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 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:
Paper - 7: 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
Solution of Volterra integral equations of second kind with convolution type kernels by Laplace transform. Solution of singular integral equations by Fourier transform.
Classical Fredholm theory– Fredholm theorems. Solution of Fredholm integral equation of second kind by using Fredholm first theorem.

Reference Books:
Optional (Elective) Paper (ECC)

Paper – 3: 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
Momentum integral theorem and equation of motion.

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
Compatibility equations (Beltrami-Michell equations). Classification of types of problems in 
linear elasticity. Principle of superposition, Strain energy function, Uniqueness theorem, p-p 
relationship and work kinetic energy equation, Irrotational flow and Velocity potential.

Unit – 4
Kinetic equation of state and first law of Thermodynamics. Equation of continuity. Equations of 
motion. Vorticity-stream surfaces for inviscid flow, Bernoullis equations. Irrotational flow and 
velocity potential. Similarity parameters of fluid flow.

Reference Books:
Paper – 4: 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:
Paper – 5 : 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-Tueker 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 - 6: 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

Unit - 2

Unit - 3
Graph Colouring. Vertex colouring, Edge colouring and Map colouring. Chromatic number. Chromatic polynomials, The four and five colour theorems.

Unit - 4

Reference Books:

1. N. Deo, Graph Theory with Applications to Computer Science, Prentice-Hall of India, 1979.
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 \( GM = c^2 m \), 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:
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:
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
\[ y'' = f(x,y), \quad y''' = f(x,y,y') \] and \[ y^{(iv)} = f(x,y) \].

Reference Books:
Paper – 12: MAT I 11: Computer Applications- Practical
Teaching: 9 Hours per Week. (Six credits)
Examination 4 Hrs. duration  Practical Paper  Max.Marks 100

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

Exercises shall be assigned on the topics covered in units 1 to 4 of MAT J01.

Installation window XP. Simple C Programming of problems of numerical analysis, Solution of quadratic equations, Mean and standard deviation, Fitting of curves, Correlation coefficient, Applications into matrices, Sorting of numerical character string data etc.

Distribution of Marks:

Five Practicals – 15 Marks each = 75 Marks
Practical Record = 10 Marks
Viva-Voce = 15 Marks
Total Marks = 100 Marks

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.

[Signature]