M.A. / M. Sc. III Semester (Mathematics)
(Effective from session 2011-2012)

The M.A./M.Sc. Final (Mathematics) will consist of two semesters, called third and fourth semesters. Their examinations will be held in the months of December and April respectively. In each of these semester examinations there will be four compulsory papers and two optional papers—each one being selected from two separate groups of optional papers, marked Group 1 and Group 2. Each paper will be of three hours’ duration and of 50 maximum marks, except where stated otherwise. There will be a viva-voce and project work examination of 50 marks in the fourth semester.

Format of the Question Paper.

There will be one compulsory question consisting of 5 parts of short answer type questions based on the whole course, out of which all parts will have to be answered. Besides, there will be 8 questions, ordinarily consisting of two sections (a) and (b), out of which 4 questions (2 from each) will have to be answered. Thus in all 5 questions will have to be attempted and 9 questions will have to be set. All questions will carry equal marks, except where stated otherwise.

Third Semester

**Compulsory Papers**

<table>
<thead>
<tr>
<th>Paper</th>
<th>Subject</th>
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<tbody>
<tr>
<td>I</td>
<td>Advanced Real Analysis</td>
</tr>
<tr>
<td>II</td>
<td>Banach Spaces</td>
</tr>
<tr>
<td>III</td>
<td>Advanced Complex Analysis</td>
</tr>
<tr>
<td>IV</td>
<td>Dynamics of Rigid Bodies</td>
</tr>
</tbody>
</table>

**Optional Papers**

Group 1: Any one of the following will have to be opted.

<table>
<thead>
<tr>
<th>Paper</th>
<th>Subject</th>
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<tbody>
<tr>
<td>V (a)</td>
<td>Advanced Riemannian Geometry</td>
</tr>
<tr>
<td>V (b)</td>
<td>Theory of Summability</td>
</tr>
<tr>
<td>V (c)</td>
<td>Structures on a Differentiable Manifold-I</td>
</tr>
<tr>
<td>V (d)</td>
<td>Wavelet Theory-I</td>
</tr>
<tr>
<td>V (e)</td>
<td>Special Functions-I</td>
</tr>
</tbody>
</table>

Group 2: Any one of the following will have to be opted.

<table>
<thead>
<tr>
<th>Paper</th>
<th>Subject</th>
</tr>
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<tbody>
<tr>
<td>VI (a)</td>
<td>Mathematical Modelling</td>
</tr>
<tr>
<td>VI (b)</td>
<td>General Relativity</td>
</tr>
<tr>
<td>VI (c)</td>
<td>Magneto Fluid Dynamics-I</td>
</tr>
<tr>
<td>VI (d)</td>
<td>Theory of Elasticity</td>
</tr>
<tr>
<td>VI (e)</td>
<td>Application of Mathematics in Finance</td>
</tr>
</tbody>
</table>
**Viva –Voce and Project Work:** 50 marks

There will be a Viva-Voce and Project Work examination based on all the 12 papers of M.A./M.Sc. Final (Mathematics). Under the project, the candidate will present a dissertation in his/her own handwriting. The dissertation will consist of one theorem/article with proof or one problem with solution, relevant definitions with examples and/or counter-examples, wherever necessary, from each paper of Mathematics studied in third and fourth semesters. The dissertation will of 20 marks and the viva-voce will be of 30marks. For viva-voce examination and evaluation of project work there will be a board of examiners consisting of a coordinator, an external examiner and an internal examiner. The dissertation will be forwarded by the Head of Department at the university centre and by the Principal of the college at the college centre.

**M.A./ M. Sc. Third Semester**
**Mathematics**
**Paper – I**
**Advanced Real Analysis**


Functions of bounded variation and their properties. Absolutely continuous functions and their properties. Relation between absolute continuity and function of bounded variation.


Inadequacy of Riemann integration. Lebesgue’s outer measure λ and its properties. Length of an interval and Lebesgue outer measure. Lebesgue measurable sets in \( \mathbb{R} \) and \( \sigma \)-algebra of Lebesgue measurable sets \( M_\lambda \) in \( \mathbb{R} \) Lebesgue measurability of open sets, closed sets and Borel sets. Lebesgue measure on \( \mathbb{R} \). Example of a Non-Lebesgue measurable set. Cantor’s set and its Lebesgue measure.

General outer measure \( \mu \). Caratheodory’s definition of \( \mu \)-measurable sets. \( \sigma \)-algebra of \( \mu \)-measurable sets \( M_\mu \) Definition of a measure. Measurable space and a measure space. Extension of a measure on an algebra to an outer measure.

Convergence in Measure and its properties. F. Riesz theorem and Egorov theorem. Convergence almost everywhere, almost uniform convergence and their inter-relationships

Books recommended:

Reference books:

M.A./ M. Sc. Third Semester
Mathematics
Paper – II
Banach Spaces

Normed linear spaces, Banach spaces, their examples including \( \mathbb{R}^n, \mathbb{C}^n, l_p(n), 1 \leq p < \infty, c_0, c, l_p, 1 \leq p < \infty, P [a,b], C[a,b] \). Joint continuity of addition and scalar multiplication. Summable sequences and completeness. Subspaces, Quotient spaces of normed linear space and its completeness.

Continuous and bounded linear operators and their basic properties. Normed linear space of bounded linear operators and its completeness. Various forms of and operator norm.

Isometric isomorphism, Topological isomorphism. Equivalent norms. Finite dimensional normed spaces and compactness. Riesz Theorem, Bounded linear functionals Dual spaces. Form of dual spaces \((\mathbb{R}^n)^*, (\mathbb{C}^n)^*, c_0^*, l_1^*, l_p^*, 1 < p < \infty\).

(4 questions)

**Book recommended:**


**Reference books:**


M.A./ M. Sc. Third Semester

Mathematics

Paper – III

Advanced Complex Analysis


(3 questions)


(2 questions)
Conformal representation. Linear (bilinear) transformations involving circles and half-planes. Transformations \( w = z^2, w = (z + 1/z)/2, w = \log z, w = \tan^2 (z/2) \) Simple function and its properties. The “1/4 theorem”.

Radius of convergence of the power series. Analyticity of sum of power series. Position of the singularities.

(3 questions)

**Books recommended:**


**M.A./ M. Sc. Third Semester**

**Mathematics**

**Paper – IV**

**Dynamics of Rigid Bodies**


(4 questions)


(4 questions)
Books recommended:

M.A./ M. Sc. Third Semester
Mathematics
Paper – V (a)
Advanced Riemannian Geometry


(3 questions)


(1.5 question)

Lie derivative: Infinitesimal transformation. The notion of Lie derivative. Lie derivative of metric tensor and connection. Motion and affine motion in Riemannian spaces.

Books recommended:

M.A./M. Sc. Third Semester
Mathematics
Paper – V (b)
Theory of Summability


Simple theorems concerning Cesaro summability. Equivalence theorem. Cesero an Abel summability (theorems 63, 64, 65 and 66 from Hardy’s ‘Divergent series’).

Matrix summability: Ordinary summability of sequences by infinite matrices (Treatment of the above to follow from Maddox’s book).

Multiplication of series: Multiplication of (C,K) summable series.

Books recommended:
Structures on a Differentiable Manifold –I

Almost Complex Manifolds: Elementary notions, Nijenhuis tensor Eigen values of F, Integrability conditions, Contravariant and covariant analytic vectors, F-connection, Quaternion Structure (2.5 questions)

Almost Hermit Manifolds: Definition, Almost analytic vector fields. Curvature tensor. Linear connections. Almost quaternion metric structure. (1.5 question)


Nearly Kaehler Manifolds: Introduction, Curvature identities, Almost analytic vectors. (1.5 question)

Books recommended:

Wavelet Theory-I


Different Ways of Constructing Wavelets: Orthonormal bases generated by a single function. Balaon-Low theorem. Smooth projections on $L^2(R)$. Local sine and cosine bases and the construction of some wavelets. (4 questions)

Book recommended:

Reference books:

M.A./M. Sc. Third Semester
Mathematics
Paper – V (e)
Special Functions-I


(5 questions)

Legendre functions: Complete solution of Legendre’s differential equation. Integral representations and recurrence formulae for \( P_n(z), Q_n(z) \). Legendre polynomials of large degree. Neumann’s expansion theorem. Associated Legendre’s function.

(3 questions)

Book recommended :


M.A./ M. Sc. Third Semester
Mathematics
Paper – VI (a)
Mathematical Modelling


Mathematical Modelling Through Ordinary Differential Equations of First Order:

(3 questions)

Mathematical models in Medicine. Arm Race, Battles and International Trade in terms of system of ordinary differential equations, Mathematical modelling in Dynamics.

(2 questions )


(3 questions )

Book recommended:

M.A./ M. Sc. Third Semester
Mathematics
Paper – VI (b)
General Relativity


(3 questions )


(3 questions )

Gravitational red hift of spectral lines. Rader Echo delay, Schwarzschild internal solution, Energy momcrtum tensor of a perfect fluid. 

(2 questions )

Books recommended :

1. F.C. Lawdon : Relativity
5. P.G. Bergmann: Introduction to the Theory of Relativity

M.A./ M. Sc. Third Semester
Mathematics
Paper – VI (c)
Magneto Fluid Dynamics – I


(4 questions )


(4 questions )
Books recommended:

M.A./ M. Sc. Third Semester
Mathematics
Paper – VI (d)
Theory of Elasticity

Shear. Displacement. Strain and its varieties. Transformation of the components of strain. Relation connecting the dilatation, the rotation and the displacement. Resolution of any strain into dilatation and shearing strain.


(5 questions)


(3 questions)

Book recommended:

M.A./ M. Sc. Third Semester
Mathematics
Paper – VI (e)
Application of Mathematics in Finance


(2.5 questions)

Meaning of returns: Return as Internal Rate of Return (IRR). Numerical methods like Newton-Rapshon method to calculate IRR. Measurement of returns under uncertainty situations.


(3 questions)


(2.5 questions)

**Books recommended:**


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