Scheme of Examination

Ph. D. Course Work in Mathematics
(w.e.f. session 2020-21)

<table>
<thead>
<tr>
<th>Paper no.</th>
<th>Paper Code</th>
<th>Nomenclature of the Paper</th>
<th>Hrs per week</th>
<th>Credits</th>
<th>Marks (Theory)</th>
<th>Marks (Internal Assessment)</th>
<th>Total Marks</th>
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</thead>
<tbody>
<tr>
<td>Paper-I</td>
<td>DMRM-01</td>
<td>Research Methodology</td>
<td>04</td>
<td>04</td>
<td>70</td>
<td>30</td>
<td>100</td>
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<tr>
<td>Paper-II</td>
<td>DMDC-02</td>
<td>Advanced Mathematical Methods</td>
<td>04</td>
<td>04</td>
<td>70</td>
<td>30</td>
<td>100</td>
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<tr>
<td>Paper-III</td>
<td>DMDE-03; Any one of the following papers:</td>
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<td></td>
<td>Option-i</td>
<td>Mechanics of Continuous Media</td>
<td>04</td>
<td>04</td>
<td>70</td>
<td>30</td>
<td>100</td>
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<td></td>
<td>Option-ii</td>
<td>Advanced Solid Mechanics</td>
<td>04</td>
<td>04</td>
<td>70</td>
<td>30</td>
<td>100</td>
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<tr>
<td>Paper-IV</td>
<td>RPE-04</td>
<td>Research and Publication Ethics</td>
<td>02</td>
<td>02</td>
<td>30</td>
<td>20</td>
<td>50</td>
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Paper-I
DMRM - 01: Research Methodology

Marks (Theory): 70  Marks (Internal Assessment): 30  Marks (Total): 100
Credits: 04  Time: 03 Hours

Note: The question paper will consist of nine questions carrying equal marks.
Question no. I will be compulsory consisting of seven short answer questions (2-marks each) covering the whole syllabus.
In addition, eight more questions will be set unit-wise comprising two questions from each of the four units.
The students shall be required to attempt five questions in all, selecting on question from each unit and the compulsory question.

Unit: I
Introduction and definition: Meaning of research, objectives of research, types of research, research approaches, significance of research, research methods versus methodology, research and scientific method, research process, criteria of good research, problems encountered by researchers in India; Definition, necessity and techniques of defining research problem; Meaning and need for research design, features of a good design.
(Relevant chapters/portion from the Book by C. R. Kothari)

Unit: II
(Relevant chapters/portion from the Book by S. Saxena)

Unit: III
Basic Computer Applications - II: Excel Basics, Data Sort, Power Point Basics.
(Relevant chapters/portion from the Book by S. Saxena)

Unit: IV
Scientific Thesis writing and Communications: Writing – introduction; Review of literature; Abstract, Summary and synopsis; Discussion; Reference citing and listing; Preparing manuscript for publication.
(Relevant chapters/portion from the Book by N. Gurumani)

Books Recommended:
Paper-II
DMDC - 02: Advanced Mathematical Methods

Marks (Theory): 70  Marks (Internal Assessment): 30  Marks (Total): 100
Credits: 04  Time: 03 Hours

Note: The question paper will consist of nine questions carrying equal marks.

Question no. I will be compulsory consisting of seven short answer questions (2-marks each) covering the whole syllabus.

In addition, eight more questions will be set unit-wise comprising two questions from each of the four units.

The students shall be required to attempt five questions in all, selecting one question from each unit and the compulsory question.

Unit-I
Bessel’s equation and its solution, Bessel functions of the first and second kind, Hankel functions, Recurrence relations for Hankel functions, Equations reducible to Bessel’s equation, Modified Bessel functions, Recurrence relations and integral representations for the modified Bessel functions, Kelvin’s functions, Spherical Bessel functions.

Unit-II
Fourier series: Euler’s formulae, Fourier series of a function, even and odd functions, cosine and sine series, half range series, Parseval’s formula, complex Fourier series, practical harmonic analysis, Fourier integral, Fourier cosine and sine integrals, Complex Fourier integral and the Fourier transform, Application of Fourier transform to boundary value problem.

Unit-III
Dirac delta function δ(x), Heaviside’s unit step function and relation between them, Integral representation of delta function, Properties of Dirac delta function. Fourier series solutions of the Wave Equation: Vibrating string with zero initial velocity, Vibrating string with given initial velocity and zero initial displacement, Vibrating string with initial displacement and velocity.

Unit-IV
Hankel transforms, Definition, Elementary properties, Basic operational properties, Inversion theorem, Hankel transform of derivatives and some elementary functions, Relation between Fourier and Hankel transforms, Application of Hankel transform to Boundary Value Problem.

Books Recommended:
1. W.W. Bell; Special functions for Scientist and Engineers, D. VAN Nostrand Company Ltd.
2. Lokenath Debnath; Integral Transforms and their Applications, CRC Press.
Paper-III
DMDE - 03 (Option-i): Mechanics of Continuous Media

Marks (Theory): 70  Marks (Internal Assessment): 30  Marks (Total): 100
Credits: 04  Time: 03 Hours

Note: The question paper will consist of nine questions carrying equal marks.
Question no. I will be compulsory consisting of seven short answer questions (2-marks each) covering the whole syllabus.
In addition, eight more questions will be set unit-wise comprising two questions from each of the four units.
The students shall be required to attempt five questions in all, selecting on question from each unit and the compulsory question.

Unit: I

Unit: II
Viscoelasticity: Spring & Dashpot, Maxwell & Kelvin Models, Three parameter solid, Analysis of stress and strain, Viscoelastic law, Correspondence principle & its application to the Deformation of a viscoelastic Thick-walled tube in Plane strain.

Unit: III
Introduction to Seismology: Earthquakes, Location of earthquakes, Causes of Earthquakes, Observation of Earthquakes, Aftershocks and Foreshocks, Earthquakes magnitude, Interior structure of the Earth. Reduction of equation of motion to wave equations, P and S waves and their characteristics, Polarization of plane P and S waves.

Unit: IV

Books Recommended:
Paper-III
DMDE - 03 (Option-ii): Advanced Solid Mechanics

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Question no. I will be compulsory consisting of seven short answer questions (2-marks each) covering the whole syllabus.

In addition, eight more questions will be set unit-wise comprising two questions from each of the four units.

The students shall be required to attempt five questions in all, selecting one question from each unit and the compulsory question.

**Unit: I**
Thick Cylinder and Spheres: Hollow Cylinder with Internal and External Pressures with Free and Fixed ends, Hollow Spheres subjected to Internal and External Pressures.
Thermal Stresses in Long Cylinders: The Cylinder is not free to deform longitudinally in case of Solid and hollow Cylinder, Thermal Stresses for a Solid and Hollow Sphere.

**Unit: II**

**Unit: III**

**Unit: IV**

**Books Recommended:**
3. A. Sommerfield; Mechanics of Deformable Bodies, Vol.-1, Academic Press, Relevant portions of Chapter-V.