UNIVERSITY OF RAJASTHAN
JAIPUR

SYLLABUS

M. Phil. Mathematics

Semester Scheme

Examinations 2016-2017
Course work for Ph.D. & M.Phil. students in Mathematics – 2017 and onwards

Scheme of Examination: One Semester
(July to October teaching and examination in November)

There shall be four papers in all. Two papers are compulsory and two papers are elective.

3 hrs. duration Each Theory paper and dissertation Max. Marks – 80
Internal assessment Max. Marks – 20
Total Marks – 100
(for each four papers)

(Internal Assessment will be done by Teacher concerned on the basis of test papers, regularity in the class and performance of the Candidate).

Semester – I is common for both Ph.D. and M.Phil. students.

Teaching Pattern:
Self study with guidance from a Faculty Member, who will act as Supervisor. To start with, each Supervisor will give one seminar lecture to all the students offering the paper so as to provide a model to the students.

For Semester – I, the papers are as follows:

Paper – I: Research Methodology
Paper – II: Analysis of Published Research Paper
(A short dissertation is to be submitted by each student under the supervision of a faculty member)

Each student has to opt two papers out of the following
Papers III to VI:

Paper – III: Advanced Numerical Analysis
Paper – IV: Generalized Hypergeometric Functions and Fractional Calculus
Paper – V: Operations Research
Paper – VI: Relativistic Cosmology and Differential Forms

Note:

1. There will be four hour teaching in a week per paper including dissertation.
2. For a pass in course work for Ph.D. and M.Phil. course a candidate shall be required to obtain (a) at least 40% marks in each paper separately in internal assessment and external assessment and (b) a minimum of 50% marks in aggregate of all the papers prescribed for the examination (internal and external assessment taken together).
Paper – I : Research Methodology

3 hrs. Duration       Theory Paper       Max. Marks - 80
Internal Assessment   Max. Marks - 20

(Internal Assessment will be done by Teacher concerned on the basis of test papers,
regularity in the class and performance of the Candidate).

Note: This paper is divided into Four Units. Two questions will be set from each Unit.
Candidates are required to attempt FOUR questions in all taking one question
from each Unit. All questions carry equal marks.

Unit – I : Perturbation Methods

Regular and singular perturbation: Examples of regular and singular perturbation
problems.
Method of Multiple Scales: Flow of fluid in a channel of slowly varying cross section,
Solution of Mathieu’s equation, Solution of the Vander Pal equation by the two-variable
method. Lindstedt-Poincare method.
Matched Asymptotic Expansions: Prandtl’s matching principle deduction of the boundary
layer equations for the flow of fluid past a flat plate, improving Stokes’ solution of flow
past a sphere at low Reynolds number, Whilehead’s paradox. Van Dyke’s matching
principle.

Unit – II : Mathematical Modelling:

Newtonian and non-Newtonian fluids. Constitutive equations, some important class of
non-Newtonian fluids. Fundamental equations of motion and continuity. Blood rheology,
Cardiovascular system. Hagen-Poiseuille flow. Steady laminar flow of blood in a circular
tube (Newtonian fluid and Casson fluid). Oscillatory flow of a viscous fluid through an
elastic tube. Oscillating flow through a circular tube (Newtonian fluid and two-phase
fluid). Oscillatory blood flow. Blood flow through artery with mild stenosis (Newtonian
fluid case). Peristaltic flows in a channel and a circular tube.

Unit – III : Integral Transforms

Construction of an integral transform to Strum-Liouville problems. Application of
integral transforms namely, Fourier exponential, sine and cosine transforms, Laplace
transform, Hankel transform, Mellin transform, Finite Fourier Cosine, Finite Fourier sine
and finite Hankel transforms in solving initial value problem and initial boundary value
problems for linear differential and integral equations.
Evaluation of integrals by change of order of integration and summation technique,
interchange of order of integrations method, and by the application of integral transforms.
Unit – IV : Advanced Tensor Analysis
Generalized Kronecker delta, Krutkov tensor, Ricci rotation coefficients and geometrical properties, Hypersurface, Gauss formulae, Curvature of a curve in a hypersurface, normal curvature of a hyper surface, Conformal invariance, classification of gravitational field, Space-matter tensor. Conharmonic curvature tensor, Conharmonically flat space, Symmetry, Maximally symmetric space, spherical, plane and cylindrical symmetries.

Paper – II : Analysis of Published Research Paper
(A short dissertation is to be submitted by each student under the supervision of a faculty member)

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<th>Dissertation Evaluation (External)</th>
<th>Max.Marks-80</th>
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<tr>
<td>Internal Assessment</td>
<td>Max.Marks-20</td>
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(Internal Assessment will be done by the supervisor concerned on the basis of the performance and aptitude towards research of the candidate)

Paper – III: Advanced Numerical Analysis
3 hrs. Duration

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<td>Max.Marks-20</td>
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(Internal Assessment will be done by Teacher concerned on the basis of test papers, regularity in the class and performance of the Candidate).

Note: This paper is divided into Two Units. Four questions will be set from each Unit. Candidates are required to attempt FOUR questions in all taking two questions from each Unit. All questions carry equal marks.


Paper – IV : Generalized Hypergeometric Functions and Fractional Calculus
3 hrs. Duration

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<td>Max.Marks-20</td>
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(Internal Assessment will be done by Teacher concerned on the basis of test papers, regularity in the class and performance of the Candidate).

Note: This paper is divided into Two Units. Four questions will be set from each Unit. Candidates are required to attempt FOUR questions in all taking two questions from each Unit. All questions carry equal marks.

Unit 1: Generalized hypergeometric function – Definition, Convergence of the series for \( \pFq \), Differential equation and its solution. Contiguous function relations. Saalschütz’s
theorem, Whipple’s theorem. Dixon’s theorem. Contour integral representation for $\,_{p}F_{q}$-Eulerian type integrals involving $\,_{p}F_{q}$. Integral representation for $\,_{p}F_{q}$.


Paper-V: Operation Research
3 hrs. Duration
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(Internal Assessment will be done by Teacher concerned on the basis of test papers, regularity in the class and performance of the Candidate).

Note: This paper is divided into Two Units. Four questions will be set from each Unit. Candidates are required to attempt FOUR questions in all taking two questions from each Unit. All questions carry equal marks.

Unit 1: Transportation Models – Mathematical formulation, Initial basic feasible solution, Optimality test, Transportation algorithm for minimization problem, Degeneracy in transportation problems, Unbalanced transportation problem.
Integer Linear Programming – Definition, Gomory’s cutting plane method. Branch and Bound method, Applications of Integer programming.


Paper- VI: Relativistic Cosmology and Differential Forms
3 hrs. Duration
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(Internal Assessment will be done by Teacher concerned on the basis of test papers, regularity in the class and performance of the Candidate).

Note: This paper is divided into Two Units. Four questions will be set from each Unit. Candidates are required to attempt FOUR questions in all taking two questions from each Unit. All questions carry equal marks.

Unit 1: Lie derivative of a Tensor field, Scalar function, Contravariant and covariant vectors. Covariant tensor of rank two, Symmetry and killing equations, Integrability of killing equation. Geodesic deviation, Conformal curvature tensor, its properties, Algebraic classification of conformal curvature tensor.

Unit 2: Basic equations of isotropic cosmology, singularity and Singularities in isotropic models, Red Shift in non-static form of de-Sitter universe, Einstein-space, Cosmological principles (perfect, ordinary and weak). Relativistic models not obeying cosmological principle. Godel universe and its properties.
M.Phil. Mathematics Examination 2018 and onwards

Scheme of Examination: Two Semesters
(July to October teaching and examination in November for Semester – I) and December to March teaching and examination in April for Semester – II)

For Semester – I teaching is common for both Ph.D. and M.Phil. students. (Papers, Syllabus and Scheme of Examination are also common)

For Semester - II

3 hrs. Duration Theory Paper Max.Marks-80
Internal Assessment Max.Marks-20

(Internal Assessment will be done by Teacher concerned on the basis of test papers, regularity in the class and performance of the Candidate).

Dissertation Max.Marks-100

Teaching Pattern:
Self study with guidance from a Faculty Member, who will act as supervisor. To start with, each Supervisor will give one seminar lecture to all the students offering the paper so as to provide a model to the students.

For Semester – II, the papers are as follows:

Note: Paper I and II are compulsionary and two papers out of the papers III to VI will remain the same which the candidate opted in Semester - I.

Paper 1: Non-Newtonian Fluid Dynamics (Compulsory for all candidates)

3 hrs. Duration Theory Paper Max.Marks-80
Internal Assessment Max.Marks-20

(Internal Assessment will be done by Teacher concerned on the basis of test papers, regularity in the class and performance of the Candidate).

Note: This paper is divided into Two Units. Four questions will be set from each Unit. Candidates are required to attempt FOUR questions in all taking two questions from each Unit. All questions carry equal marks.


Unit 2: Unidirectional shear flows. Form of the stress tensor. Steady shear flow material functions. Unidirectional unsteady shear flow material functions. Measurement of viscosity and normal stress coefficients in (i) Cone and plate instrument and (ii) Parallel disk instrument.
Paper – II: Dissertation: Each candidate has to submit a dissertation, based upon the papers opted by the candidate in M.Sc./M.Phil. Course, equal to a paper carrying 100 marks.

External Evaluation Max.Marks-100

Paper – III: Advanced Numerical Analysis
3 hrs. Duration Theory Paper Max.Marks-80
Internal Assessment Max.Marks-20

(Internal Assessment will be done by Teacher concerned on the basis of test papers, regularity in the class and performance of the Candidate).

Note: This paper is divided into Two Units. Four questions will be set from each Unit. Candidates are required to attempt FOUR questions in all taking two questions from each Unit. All questions carry equal marks.


Paper – IV: Generalized Hypergeometric Functions and Fractional Calculus
3 hrs. Duration Theory Paper Max.Marks-80
Internal Assessment Max.Marks-20

(Internal Assessment will be done by Teacher concerned on the basis of test papers, regularity in the class and performance of the Candidate).

Note: This paper is divided into Two Units. Four questions will be set from each Unit. Candidates are required to attempt FOUR questions in all taking two questions from each Unit. All questions carry equal marks.


Paper-V: Operation Research
3 hrs. Duration Theory Paper Max.Marks-80
Internal Assessment Max.Marks-20

(Internal Assessment will be done by Teacher concerned on the basis of test papers, regularity in the class and performance of the Candidate).
Note: This paper is divided into Two Units. Four questions will be set from each Unit. Candidates are required to attempt FOUR questions in all taking two questions from each Unit. All questions carry equal marks.

Unit 1: Inventory Models – Definition, elementary inventory models e.g. EOQ model without and with shortages and EOQ with constraints. Replacement and Reliability Models – Replacement of items that deteriorate, Replacement of items that fail completely and other replacement problems.

Unit 2: Queueing Theory – Definition, Queueing system. Arrival distribution theorem, Distribution of departures, Probabilistic queueing models – Models I to IX; Mixed queueing models – Model X; Deterministic queueing model – model XI.

Paper VI: Relativistic Cosmology and Differential Forms
3 hrs. Duration
Theory Paper Internal Assessment
Max. Marks 80 Max. Marks 20

(Note: This paper is divided into Two Units. Four questions will be set from each Unit. Candidates are required to attempt FOUR questions in all taking two questions from each Unit. All questions carry equal marks.

Unit 1: Non-static cosmological models, Robertson-Walker model and its derivation and Geometrical properties, Fredmann-Robertson-Walker model and its scale factor. Three different forms of scale factor, Doppler effect in Robertson-Walker model, Horizons (Event and Particle), Big Bang Theory; Steady state theory.


Note: 1. There will be Four hour teaching in a week per paper including dissertation.
2. For a pass, in M.Phil. course, a candidate shall be required to obtain (a) at least 40% marks in each paper separately in internal assessment and external assessment and (b) a minimum of 50% marks in aggregate of all the papers prescribed for the examination (internal and external assessment taken together).