

مولانا آزاد نیشنل اردو یونیورسٹی  
MAULANA AZAD NATIONAL URDU UNIVERSITY  
(A Central University established by an Act of Parliament in 1998)  
Gachibowli, Hyderabad – 500 032.  
(Accredited "A" Grade by NAAC)



**Department: Mathematics**

**School: School of Science**

**Ph.D. (Mathematics)**

<b>Ph.D in Mathematics Course Work Ist Semester</b>		
<b>Paper</b>	<b>Paper code</b>	<b>Paper title</b>
1	PHMM101CCT	Research Methodology
2	PHMM102CCT	Essential Mathematics
3	PHMM101DST	Specialization (Pure Mathematics)
4	PHCH102DST	Specialization (Applied Mathematics)
5	PHCC104CCT	Research and Publication Ethics

**Department of Mathematics, School of Sciences, MANUU**  
**Ph.D. (Mathematics)-Coursework-Syllabus**

**Course Title : RESEARCH METHODOLOGY**

**SEM-1**

**Course Code : PHMM101CCT**

**Paper -1**

**Scheme of Instruction**

Total Duration : 60 Hr  
Periods /Week : 4  
Credits : 4  
Instruction Mode : Lecture

**Scheme of Examination**

Maximum Score : 100  
Internal Evaluation : 30  
End Semester : 70  
Exam Duration : 3 Hrs

**Course Objectives:**

This course on Research Methodology is design in such a way that the scholars are motivated towards the Research Process and Problem Identification & Formulation. Further the scholars will develop the idea of Research Design and this course will develop rigorous understanding of Data Analysis in them. This course will also help the scholars in understanding different tools and techniques in documentation process and use of software for detection of Plagiarism.

**Course Outcomes:**

On completion of this course, the scholar should be able to get the concept of Research-Identification of problem, use of different softwares and can be able to prepare a document using LaTeX.

**UNIT 1**

**(15 Periods)**

**Introduction to Research Methodology:** A brief history of scientific thought and Philosophy of Science; Concept of theory- empiricism, deductive and inductive theory; Characteristics of scientific method; Evolutionary Epistemology, Hypotheses Generation and Evaluation, Code of Research Ethics, Definition, Objectives and motivation of Research, Various Steps in Scientific Research.

**Types of Research** Descriptive vs Analytical, Applied vs Fundamental, Quantitative vs Qualitative, Conceptual vs Empirical.

**UNIT 2**

**(15 Periods)**

**Formulation of Research Problem** Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Literature review – Primary and secondary sources – reviews,

treatise, monographs-patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis. **Research design and methods** – Research design – Basic Principles- Need of research design — Features of good design – Important concepts relating to research design – Observation and Facts, Laws and Theories, Prediction and Development of Models. Developing a research plan - Exploration, Description, Diagnosis, Experimentation. Determining experimental and sample designs.

### UNIT 3

(15 Periods)

**Data Collection and analysis:** Execution of the research - Observation and Collection of data - Methods of data collection – Sampling Methods- Data Processing and Analysis strategies - Data Analysis with Statistical Packages - Hypothesis-testing - Generalization and Interpretation. Scientific packages like Mathematica/Matlab/R.

### UNIT 4

(15 Periods)

**Reporting and thesis writing** – Structure and components of scientific reports - Types of report – Technical reports and thesis – Significance – Different steps in the preparation – Layout, structure and language of typical reports; Reproduction of published material – Plagiarism - Citation and acknowledgement – Illustrations and tables - Bibliography, referencing and footnotes - Oral presentation – Planning – Preparation – Practice – Making presentation – Use of visual aids - Importance of effective communication.

**Tools/techniques for creating report/thesis:** Methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism

### Reference Books:

1. . Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
2. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, ESS Publications. 2 volumes.
3. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
4. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
5. Day, R.A., 1992. How to Write and Publish a Scientific Paper, Cambridge University Press.
6. Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design, Prentice Hall.

**Course Title : ESSENTIAL MATHEMATICS**

**SEM-1**

**Course Code : PHMM102CCT**

**PAPER-2**

**Scheme of Instruction**

Total Duration : 60 Hr  
Periods /Week : 4  
Credits : 4  
Instruction Mode : Lecture

**Scheme of Examination**

Maximum Score : 100  
Internal Evaluation : 30  
End Semester : 70  
Exam Duration : 3 Hrs

**Course Objectives:**

This course of Essential Mathematics is design in such a way that the scholars can revise all the basic core concepts of Analysis, Algebra, Differential Equations(both Ordinary and Partial) needed for their research in their area of interest.

**Course Outcomes:**

On completion of this course, the scholar should be able to get the concepts of groups, rings fields with many examples and applications. The scholars will be able to understand and use many concepts of analysis and with the use of Differential Equations the scholar can change a physical problem to a mathematical model which can be solved and analyzed as per the need.

**UNIT-I: Abstract Algebra**

Normal subgroups - Direct products- Structure theorems of groups- Finitely generated abelian groups- Rings- Ideals- Principal ideals Domains-Euclidean domains- Polynomial rings.

**Unit-II: Analysis**

Metric spaces- compact sets- connected sets- sequences and series of functions- uniform convergence. Normed linear spaces- Banach spaces- Hilbert spaces- Topological spaces- compact spaces-Tychonoff's theorem- separation axioms- Tietze extension theorem- Urysohns lemma.

**Unit-III: Ordinary Differential Equations:**

Linear and Non-linear differential equations- some standard methods- differential equations with constant coefficients and variable coefficients- Cauchy-Euler Equations- power series solutions of ODE-Legendre's polynomial, Generating function of Legendre's polynomial-Bessel's functions.

#### **Unit-IV: Partial Differential Equations:**

Linear and Non-Linear Partial equations- Some standard methods- Lagrange's method- Charpit's method- Jacobi's method-Classifications of Partial Differential Equations- Reduction to Canonical or Normal form.

#### **Reference Books:**

1. An Introduction to Ordinary Differential Equations by Earl A Coddington
2. Ordinary and Partial Differential Equations by M.D.Raisinghania
3. Advanced Differential Equations By M.D.Raisinghania
4. Topics in Algebra by I N Herstein
5. Mathematical Analysis by Walter Rudin.
6. Introduction To Topology And Modern Analysis by G.F. Simmons

**Scheme of Instruction**

Total Duration : 60 Hr  
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Instruction Mode : Lecture

**Scheme of Examination**

Maximum Score : 100  
Internal Evaluation : 30  
End Semester : 70  
Exam Duration : 3 Hrs

**Course Objectives:**

This course of Specialization(Pure Mathematics) is design in such a way that the scholars can use the tools of fuzzy set theory and soft set theory in the core parts of Algebra-Group Actions-Functional Analysis etc in their chosen topic of research.

**Course Outcomes:**

On completion of this course, the scholar should be able to get the concepts of fuzzy sets , soft sets- Groups Actions-Fixed point theory and applications etc. The scholars can do research using fuzzy set theory , Soft set theory concepts in the areas of Algebra and Functional Analysis.

**Unit 1:**

General algebraic structures on sets: Group structure, Ring structure and special structures of fields with examples, Algebraic extension of fields. Linear and Module structures with examples. Multilinear algebra, Grade Linear algebra, Universal property, Graded Rings, grading and filtration.

**Unit 2:**

Groups actions on sets and effects- Group acting on themselves by left multiplication-Cayleys theorem-Group acting on themselves by conjugation- Matrix groups as examples of actions on linear spaces.

**Unit 3:**

Fixed point theorems and their applications. Banach Contraction Fixed point theorem and its generalization, Applications of Fixed Point theorems to Matrix equations, Differential equations, Integral equation.

**Unit 4:**

Fuzzy sets- Characteristic function and definition of fuzzy set-Fuzzy point  $\alpha$  -level set –Fuzzy subsets- Basic operations on fuzzy subsets-concept of uncertainty-t-norms , t-conorms and s-norms-Fuzzy relations and fuzzy graphs. Rough sets-Basic concepts of Roughsets- Soft set theory –Some new operations in soft set theory and related examples.

**Reference Books:**

1. Topics in Algebra by I.N. Herstein
2. Basic Abstract Algebra by P.B. Bhattacharya, S.K. Jain and Nagpaul
3. Abstract Algebra by David S. Dummit.
4. Fuzzy set and Fuzzy logic theory and applications by George J Klir, Bo Yuon.

**Scheme of Instruction**

Total Duration : 60 Hr  
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Credits : 4  
Instruction Mode : Lecture

**Scheme of Examination**

Maximum Score : 100  
Internal Evaluation : 30  
End Semester : 70  
Exam Duration : 3 Hrs

**Course Objectives:**

This course of Specialization(Applied Mathematics) is design in such away that the scholars can do research in the areas of Fluid Mechanics, Wavelet Analysis, Celestial Mechanics and many more Multi-Disciplinary areas.

**Course Outcomes:**

On completion of this course, the scholar should be able to get concepts of Fluid Dynamics-Fourier Series-Laplace Transforms –Mechanics etc which are of great use if the scholars pursue their research in areas of Celestial Mechanics, Wavelet Analysis and Fluid Dynamics.

**Unit I**

Kinematics of Fluids in Motion: Real Fluids and Ideal Fluids. Velocity of a Fluid at a point.Stream Lines and Path Lines. Steady and Unsteady Flows. The Equation of Continuity. Lagrange's and Euler's equations of motion.Viscous Flows: Stress Analysis in Fluid motion. Relation between stress and rate of strain.Newtonian and Non-Newtonian fluids-Boundary layer theory-Porous media-Definition and examples-Volumetric and Surface porosity.

**Unit II**

Fourier Series, Functions of any period  $p = 2L$ , Even and Odd Functions, Half-Range Expansions, Complex Fourier Series, Forced Oscillations, Approximation by Trigonometric Polynomials, Fourier Integral, Fourier Cosine and Sine Transforms, Fourier Transform, Discrete and Fast Fourier Transforms.

**Unit III**

Laplace Transforms and their basic properties, Convolution Theorem and properties of Convolution, Differentiation and Integration of Laplace Transforms, Inverse Laplace Transform and Examples, Applications of Laplace Transforms in solving Initial and Boundary Value Problems.

**Unit IV**

Generalised coordinates. D'Alembert's Principle.Lagrange's Equations. Cyclic or ignorable coordinates. Techniques of calculus of variation.Applications of the variational principle.Hamilton's principle.Hamilton's equations of motion.Canonical Transformations.Poisson brackets.The Hamilton-Jacobi equations.



**Reference Books:**

1. Advanced Engineering Mathematics by Erwin Kreyszig
2. Harmonic Analysis by Pereyra and Ward
3. Textbook of Fluid Dynamics by F. Charlton
4. Integral Transforms and Their Applications by L. Debnath, D. Bhatta,
5. Introduction to Classical Mechanics by R G Takwale and P S Puranik

**Course Title: Research and Publication Ethics****SEM-1**

Paper Code:	PHCC104CCT	Semester Exam:	50 Marks
Instruction:	2 h / week	Duration:	30 hours
Credits:	2	Internal Assessment:	15 Marks
		End Semester Exam:	35 Marks

**Learning Objectives:**

The objective of this paper is to-

- provide students with the fundamental knowledge of basics of philosophy of science and ethics, research integrity, publication ethics.
- Hands – on sessions are designed to identify research misconduct and predatory publications. Indexing and citation databases, open access publications, research metrics (citations, h- index, Impact factor etc.)
- Guide and mentor students in presenting plagiarism tools for a valid and ethical research report.

**Learning Outcomes:**

By the end of the course, students will be able to understand the importance of being ethical in carrying out research and publication activities. They will be able to differentiate the quality publication practices. More importantly, there will be an increased awareness about open access and contribution of research output to open access publishing platforms

Module	Topic
<b>THEORY</b>	
<b>RPE 01: Philosophy and Ethics (3hrs)</b>	
1.1	Introduction to philosophy: definition, nature and scope, concept, branches
1.2	Ethics: definition, moral philosophy, nature of moral judgements and reactions
<b>RPE 02: Scientific Conduct (5hrs.)</b>	
2.1	Ethics with respect to science and research
2.2	Intellectual honesty and research integrity
2.3	Scientific misconducts: Falsification. Fabrication. and Plagiarism (FFP)
2.4	Redundant publications: duplicate and overlapping publications, salami slicing
2.5	Selective reporting and misrepresentation of data
<b>RPE 03: Publication Ethics (7 hrs.)</b>	

3.1	Publication ethics: definition, introduction and importance
3.2	Best practices/standards setting initiatives and guidelines: COPE, WAME, etc.
3.3	Conflicts of interest
3.4	Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types
3.5	Violation of publication ethics, authorship and contributor ship
3.6	Identification of publication misconduct, complaints and appeals
3.7	Predatory publishers and journals
<b>PRACTICE</b>	
<b>RPE-04: Open Access Publishing (04 hrs)</b>	
4.1	Open Access Publications and initiatives
4.2	SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
4.3	Software tool to identify predatory publications developed by SPPU
4.4	Journal finder /journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggested, etc.
<b>RPE 05: Publication Misconduct:</b>	
<b>A. Group Discussions (2 hrs.)</b>	
5.1	Subject specific ethical issues, FFP, authorship
5.2	Conflicts of interest
5.3	Complaints and appeals: examples and fraud from India and abroad
<b>B. Software tools (2 hrs.)</b>	
5.4	Use of plagiarism software like Turnitin, Urkund and other open source software tools
<b>RPE 06: Databases And Research Metrics</b>	
<b>A. Databases (4 hrs.)</b>	
6.1	Indexing databases
6.2	Citation databases: Web of Science, Scopus, etc.
<b>B. Research Metrics (3 hrs.)</b>	
6.3	Impact Factor of journal as per Journal Citation Report, SNIP, SJR, PP, Cite Score
6.4	Metrics: h-index, g index, i10 index, Altmetrics
<b>Reference Books:</b>	
1	The Ethics of Teaching and Scientific Research by Miro Todorovich; Paul Kurtz; Sidney Hook.
2	Research Ethics: A Psychological Approach by Barbara H. Stanley; Joan E. Sieber; Gary B. Melton

3

Research Methods in Applied Settings; An Integrated Approach to Design and Analysis by Jeffrey A. Gliner; George A. Morgan Lawrence Erlbaum Associates, 2000