Scheme & Syllabi for Pre-Ph.D. (Mathematics)
w.e.f. 2020-2021

Paper No.	Nomenclature	Credits
PPD-101	Research Methodology	04 Credits
PPD-102	Review of Literature, Research Ethics and Seminar	04 Credits
PPD-103	Departmental Elective Course Option - I : Continuum Mechanics Option - II : Advances in Real Analysis and Algebraic Structure	04 Credits
PPD-104	Research and Publication Ethics (RPE)	02 Credits

Course Work

i) The duration of the Ph.D. course work will be of one semester. It will be offered in the first semester. It will consist of 04 papers.

ii) Each paper of the course work except PPD-104 will be of 4 credits. PPD-104 is of 02 credits. Each paper will of 100 marks.

iii) The scheme for Ph.D. course work is as under:

PPD-101: Research Methodology

PPD-102: Review of Literature, Research Ethics and Seminar - It includes discussions on research ethics, presenting a seminar on review of published research or on own published review/survey paper or training or field work done in the relevant area of research etc.

PPD-103: Departmental Elective Course

It includes an elective course related to the relevant field of research and it will be offered by the respective department/school.

PPD-104: Research and Publication Ethics (RPE)

This course is for awareness about the publication ethics and publication misconducts. It includes basics of philosophy of Science and ethics, research integrity, publication ethics.

Paper- 1
Research Methodology
(Science Discipline)
PPD 101

M. Marks: 100
CREDITS: 4
Time: 3 Hours

Paper setter is required to set nine questions in all. Question no. 1 is Compulsory and is based on the entire syllabus consisting of five short answer type questions each of 2 marks.

The remaining eight questions is to be set uniformly having two questions from each unit. The student is required to attempt five questions in all selecting one question from each unit and Question no. 1 is Compulsory.

Course Objective	Course Outcome
The course on the Research Methodology deals with the research problem, writing of thesis, computer application in research and presentation.	The student will be able to understand how to frame the objectives of research problem using various tools and finally the presentation.

Unit -I

Introduction to Research Methodology: Meaning, Objectives, Types and Significance of research, Creativity and Innovation, Hypothesis formulation and development of Research plan.
Research Problem: Definition, necessity and techniques of defining the research problem.
Library: Classification system, e-library, Reference management, Web based literature search engines.
Use of modern aids: Making technical presentation, Research and academic integrity: Avoiding Plagiarism using software. Copy right issues, ethics in research, Intellectual Property Rights (IPRs) & patent Law.

Unit -II

Scientific Communications: Role and importance of communications, Effective oral and Written Communication, Scientific and Research paper writing, Technical report writing. Making Research & Development (R&D) proposals.
Publishing Research paper: Selection of journal, formulation of problem, discussion and references, Submission and handling of reviewers comments.
Writing of thesis: Format of thesis, Review of literature, Formulation: Writing methods result, preparation of tables, figures; writing discussion: writing conclusion; Writing summary and synopsis; Reference citing and listing/ Bibliography.
Laboratory safety issues: Related to various labs, Workshop, electrical, health and fire safety, safe disposal of hazardous materials.

Unit-III

Statistical analysis and errors: Mean, Mode, Median, Relative and absolute errors, Hypothesis testing for mean, proportion and variance, Chi-square tests, Correlation and regression analysis, Factor analysis.
Linear and non-linear least squares fitting methods, Interpolation methods including cubic splines, Fourier Series Analysis, Fast Fourier Transform, Convolution and Correlation.

Unit-IV

Computational tools and Programming: Resume of Practical approach of learning operating systems (DOS, Windows, UNIX), Graphical packages, Calculations using Spreadsheet programming. Technical research paper writing in Latex. Introduction to HTML, XML & programming languages, an overview of Modeling and simulation software's,

Online Resources: Introduction to Massive Open Online Courses (MOOCs) and Study Webs of Active –Learning for Young Aspiring Minds (SWAYAM), Indexing and abstracting services, Citation index and impact factor, Research quality parameters and indicators

References:

1. Gurumani, N. (2010), Scientific thesis writing and Paper presentation, MJP publishers.
2. Gerald, C.F. and Wheatley, P.O. (2002) Applied numerical analysis, 6th Ed, Addison Wesley.
3. Smith G.D., (1982) Numerical solution of partial differential equation, Oxford University Press.
4. Schwartz H.R., Rutishauser H. Stiefel E. et al (1976)Numerical analysis of symmetric matrices, Prentic Hall
5. C.R. Kothari & Gaurav Garg (2014), Research Methodology, Third Edition, New Age International Publishers.
6. Web resources: www.sciencedirect,com for journal references, www.aip.org and www.aps.org for references styles.
7. Web Resources: www.nature .com, www.science marg.org, www.springer.com,www.pnas.org, www.tandf.co.uk,www.opticsinfobase.org for research updates.

PPD– 102   Review of Literature, Research Ethics and Seminar

Total Marks: 100

Note: The candidates shall review 20 to 30 research papers and shall submit the report (a copy of Review of Literature) as well as present seminar on the relevant research topic. The performance will be evaluated on the basis of submitted literature and the presentation given by the candidates before the evaluation committee.

PPD-103 (Option-I)   Continuum Mechanics
(w.e.f. 2020-2021)

Marks for Major Test (External): 70   **4 Credits (4-0-0)**
Internal Assessment: 30   **Time: 3 Hours**
Total Marks: 100

Note: The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.

General solution of the equilibrium equations: Papkovitch-Neuber solution, Lame's strain potential, Galerkin Vector, Love's strain function, Applications to the solution of the Kelvin problem for an unbounded medium and the Boussinesq problem for a semi-infinite medium. Generalized Hooks's law including the effect of thermal expansion, Naviers' equation, thermal stresses in a long circular cylinder

Seismic Waves: Field equations of linear elastodynamics, Plane waves in unbounded media, P, SV and SH waves of seismology, wave propagation in two dimensions, Surface waves-Love & Rayleigh waves, Reflection of P, SV, SH waves at a free boundary, Reflection and transmission of SH-waves at a solid-solid interface.

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

Fluid Dynamics: Vector & tensor analysis in fluid dynamics, The idea and viscous fluid, Newtonian, generalized Newtonian and non- Newtonian fluids, Rheology of fluid, Constitutive laws, Conservation laws, Navier-Stokes, Couette flow, flow over a Flat Plate, Wedge flows, Hangen-Poiseuille flow. Boundary layer flow, similarity solution. Flow through porous media: Darcy, Brinkman and Forchheimer models. Heat transfer: Free convection through Vertical plate, horizontal plate, cylinders.

Books suggested:
1.   Bath, M. :   Mathematical Aspects of Seismology, Elsevier
2.   Bullen, K.E. and A. Bolt: An Introduction to the Theory of Seismology, Cambridge University Press
3.   Fung, Y.C. : Foundations of Solid Mechanics, Prentice Hall
4.   Peter M. Shearer: Introduction to Seismology, Cambridge University Press
5.   W. Flugge, Viscoelasticity, Springer Verlag.
6.   Kundu, P.K. and Cohen I.M., Fluid Mechanics, 3rd Ed., academic Press, (2004).
7.   Nield, A.D. and Bejan, A., Convection in Porous Media, Springer, Berlin, 1999
8.   Schlichting H., Boundary-layer theory, McGraw Hill International, (1979)
9.   Sherman F.S., Viscous Flow, McGraw Hill International, (1990)
10.   White F.M., Viscous Fluid Flow, McGraw Hill International, (1991)

PPD-103 (Option-II) Advances in Real Analysis and Algebraic Structure
(w.e.f. 2020-2021)

Marks for Major Test (External): 70　　　　　　**4 Credits (4-0-0)**
Internal Assessment: 30　　　　　　　　　　　　**Time: 3 Hours**
Total Marks: 100

Note: **The question paper will contain eight questions in all. The candidates are required to attempt any five questions. All questions carry equal marks.**

Metric Space

Fixed point (definition and examples), Brouwer, Schauder, Monch and Banach Contraction principle (BCP). Application of BCP in solving differential equation, integral equation, initial and boundary value problems, root finding problems, dynamic programming. Banach contraction mapping, Continuity of Banach contraction mapping, Kannan contraction mapping and theorem, Continuity of mapping in Kannan contraction.

Fuzzy Sets and Theory

Concept of Fuzzy sets, Relation between Fuzzy sets, Operation on Fuzzy sets, Certain numbers associated with Fuzzy sets, Fuzzy relations and functions, Neighborhood structure of Fuzzy sets, Fuzzy continuity, Definition and examples of continuous t-norms, Fuzzy Metric spaces and examples, Sequences in fuzzy Metric spaces and their convergence, Fuzzy version of Banach Contraction Principle, Topology of Fuzzy sets, Integration and differentiation of Fuzzy functions. Application of fuzzy fixed point theory.

Group Theory

Introduction to p-groups, Cauchy's theorem, Sylow's theorems and its applications. Frattini subgroups, Frattini argument, direct products of groups. Subnormal series, normal series, central series, lower central series and upper central series. Nilpotent groups.

Coding Theory

The Communication channel. The Coding Problem. Types of Codes. Block Codes. Error Detecting and Error-Correcting Codes. Linear Codes. The Hamming Metric. Description of Linear Block Codes by Matrices. Dual Codes. Standard Array. Syndrome. Error-Correction Capabilities of Linear Codes.

Suggested Texts:

1. *R. P. Agarwal, Donal O'Regan and D. R. Sahu*, Fixed Point Theory of Lipschitizian-type mapping with Applications, Springer-Verlag, New York, 2009, pp. 300.
2. *Dhananjay Gopal, Poom Kumom, and Mujahid Abbas,* Background and Recent Developments of Metric Fixed Point Theory, Tayler and Francis Group,2018, pp.218
3. *F.J. MacWilliams and N.J.A. Sloane,* Theory of Error Correcting Codes, North Holland Publishing Company 1977.
4. *J. J. Rotmann,* An Introduction to the theory of Groups, 4th Ed. Springer-Verlag, New York, Inc. 1995.

5. *H. E. Rose,* A Course on Finite Groups, 1st Ed. Springer-Verlag London Limited 2009.
6. *L. R. Vermani,* Elements of Algebraic Coding Theory, CRC Press, 1996
7. *M. Ganesh,* Introduction to Fuzzy sets and Fuzzy Logic, P. Hall of India.
8. *George J. Klirt &Tina A. Folger, Fuzzy sets ,* Uncertainty and information , Prentice Hall of India.

PPD-104: Research and Publication Ethics (RPE)

Course structure

- The course comprises of six modules listed in table below. Each module has 4-5 units.

Modules	Unit title	Teaching hours
Theory		
RPE 01	Philosophy and Ethics	4
RPE 02	Scientific Conduct	4
RPE 03	Publication Ethics	7
Practice		
RPE 04	Open Access Publishing	4
RPE 05	Publication Misconduct	4
RPE 06	Databases and Research Metrics	7
	Total	**30**

<u>Syllabus in detail</u>

THEORY

- **RPE 01: PHILOSOPHY AND ETHICS (3 hrs.)**

    1. Introduction to philosophy: definition, nature and scope, concept, branches
    2. Ethics: definition, moral philosophy, nature of moral judgements and reactions

- **RPE 02: SCIENTIFICCONDUCT (5hrs.)**

    1. Ethics with respect to science and research
    2. Intellectual honesty and research integrity
    3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
    4. Redundant publications: duplicate and overlapping publications, salami slicing
    5. Selective reporting and misrepresentation of data

- **RPE 03: PUBLICATION ETHICS (7 hrs.)**

    1. Publication ethics: definition, introduction and importance
    2. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.
    3. Conflicts of interest
    4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
    5. Violation of publication ethics, authorship and contributorship
    6. Identification of publication misconduct, complaints and appeals
    7. Predatory publishers and journals

PRACTICE

- **RPE 04: OPEN ACCESS PUBLISHING(4 hrs.)**

1. Open access publications and initiatives
2. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

- **RPE 05: PUBLICATION MISCONDUCT (4hrs.)**

  A. Group Discussions (2 hrs.)

  1. Subject specific ethical issues, FFP, authorship
  2. Conflicts of interest
  3. Complaints and appeals: examples and fraud from India and abroad

  B. Software tools (2 hrs.)

  Use of plagiarism software like Turnitin, Urkund and other open source software tools

- **RPE 06: DATABASES AND RESEARCH METRICS (7hrs.)**

  A. Databases (4 hrs.)
  1. Indexing databases
  2. Citation databases: Web of Science, Scopus, etc.

  B. Research Metrics (3 hrs.)
  1. Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
  2. Metrics: h-index, g index, i10 index, altmetrics

References

Bird, A. (2006). *Philosophy of Science*. Routledge.

MacIntyre, Alasdair (1967) *A Short History of Ethics*. London.

P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978-9387480865

National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). *On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition*. National Academies Press.

Resnik, D. B. (2011). What is ethics in research & why is it important. *National Institute of Environmental Health Sciences*, 1–10. Retrieved from https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm

Beall, J. (2012). Predatory publishers are corrupting open access. Nature, 489(7415), 179–179. https://doi.org/10.1038/489179a

Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance(2019), ISBN:978-81-939482-1-7. http://www.insaindia.res.in/pdf/Ethics_Book.pdf