

**DEPARTMENT OF MATHEMATICS
ASSAM UNIVERSITY: SILCHAR**

Syllabus for IPP Course Work (effective from 2020 Session)

Course Structure

Course Number	Course Name	Nature	Max Credit	Max Marks
Paper-501	Research Methodology	School Level	2	50
Paper-502	Research Methodology	School Level	4	100
Paper-503	Mathematics	Department Level	4	100
Paper-504	Term Paper	Department Level	6	150
Total		16	16	400

Paper 501 (2 credit)
Research and Publication Ethics (RPE)

UNIT-1 RPE 01: PHILOSOPHY AND ETHICS

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

UNIT-II RPE 02: SCIENTIFIC CONDUCT

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

UNIT-III RPE 03: PUBLICATION ETHICS

1. Publication ethics: definition, introduction and importance
2. Best practices/standards setting initiatives and guide line: 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:

UNIT-IV RPE 04: OPEN ACCESS PUBLISHING

1. Open access publications and initiatives
2. SHEPRA/ROMEO online resource to check publisher copyright and 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.

UNIT-V RPE 05: PUBLICATION MISCONDUCT

- A. Group Discussions
 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
Use of plagiarism software like Turnitin, Urkund and other open source software tools

UNIT-VI RPE 06: DATA BASES AND RESEARCH METRICS

A. Databases

1. Indexing databases
2. Citation databases: Web of Science, Scopus, etc.

B. Research Metrics

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 Academic Press

Resnik, D.B. (2011), What is ethics in research and why is it important, National Institute of Environmental health Sciences, 1-10, Retrieved from <http://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:978-81-939482-1-1. http://www.insaindia.res.in/pdf/Ethics_Book.pdf

Paper 502 (4 credit)

UNIT – I:

Research: Meaning, objectives, types, approaches. Criteria of good research, research problems, research design. Review of literature: Meaning, objectives, principles and procedure. Report writing: Meaning, significance, types, techniques, essentials of writing scientific article.

UNIT – II:

Quantitative methods of research: Methods of data collection – experimental data, field data, data from secondary sources. Relation between variables: correlation (both continuous & binary data), regression (both linear & non-linear) for two variables. Test of significance including one-way-ANOVA. Errors and analysis of errors.

UNIT – III:

Computer application in research: Data analysis – use of software like Excel/Matlab/Mathematica/SPSS/R package etc., Word processing – use of software like MS Word/LATEX/End Note etc., Data bases – use of software like MS Access/My SQL etc. Introduction to Computer Network: Network Protocol and topology. Computer simulations: Introduction to mathematical and simulation models, deterministic and stochastic simulation models, continuous and discrete simulation.

UNIT – IV:

Intellectual Property Rights (IPR) – concept and definition, types - patents, trademarks, copyrights and trade secrets. Salient aspects of :National Science, Technology and Innovation Policy 2013 (STI 2013), National Education policy 2020 (NEP 2020) : introduction (p.1-6), Part-II-Higher Education (p. 33-49), Role of different national level GoI Funding Agency (CSIR, DST, DBT, DAE, DRDO, DOS etc.) for promotion of scientific research.

Suggested readings:

1. Research Methodology-Methods and Techniques, New Age International, C. R. Kothari, 2nd Ed. (New Delhi), 2008.
2. Research Methodology: A step-by-step guide for beginners, SAGE Publications, Ranjit Kumar, 2005.
3. Mastering MATLAB by Duane C. Hanselman and Bruce L. Littlefield, 2011.
4. Queuing system-vol.2-D, Kleinrock, John Wiley & Sons Inc New York, 1976.
5. Computer Network by A. Tanenbaum. Prentice Hall Ind. Englewood cliffs N.J., 1981.
6. Data and computer communications by W. Stallings, Mc Millan Pub. Co. New York, 1976.
7. Document (pdf) on NEP 2020 :
https://www.mhrd.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf
8. Writing and Presenting Scientific Papers (2nd edition), B. Malmfors, P. Garnsworthy and M. Grossman, Publications from USDA-ARS / UNL Faculty, 2005

Department of Mathematics

Assam University, Silchar

Paper-503: Mathematics

Credit: 2+2=4

Group A (Compulsory)

Department Level Methodology

Unit-I

Theory of existence and uniqueness of Initial Value Problems, Picard's Theorems, Continuous dependence, Maximal interval of existence, Autonomous Systems and Phase Space Analysis, Interpolation, Finite difference methods for ODE, Series solution of differential equations.

Unit -II

Knowledge of Matrix theory, Eigen values and Eigen vectors, Characteristic and Minimal polynomial, Diagonalization of matrices and their characterization, Jordan and Rational Canonical forms, Convex and Concave functions with their properties, Probabilities and its distribution.

Recommended texts

1. Simmons G. F, Krantz S.G: Differential Equations: Theory, Technique, and Practice, McGraw Hill, 2000.
2. M.K Jain, Numerical Solution of Differential Equation-finite difference and finite element methods, New Age International Publishers,2018
3. Hoffman K, Kunze R: Linear Algebra, Prentice Hall of India

Part: B (Optional)

Research Area Specific

A: Advanced Optimization and Operations Research

Unit –III

Unconstrained optimization, constrained optimization with equality and inequality constraints –methods and applications, Fractional Programming (Linear and non-linear)-Methods and applications. Basics of inventory control, Inventory models with price breaks, probabilistic inventory model, fuzzy inventory model

Unit –IV

Introduction to interval analysis with applications in decision making problems, fuzzy set theory and applications in optimization (Formulation and applications)

Recommended texts

- A.K Bhunia, L.Sahoo,A.A Shaikh, Advanced Optimization and Operations Research, Springer,2019
- I.M Stancu-Minasian, Fractional Programming-Theory Methods and Applications, Kluwer Academic Publisher, 1992.
- R.E .Moore, R.B.Kearfott, M.J.Cloud, Introduction to Interval Analysis, Siam, 2009.(forUnit-IV)

H.J. Zimmermann, Fuzzy Set Theory and its Applications, Kluwer Academic Publisher, 1992.(Unit-IV)

B. Advanced Discrete Mathematics

Unit III: Elliptic curves

Definition of Elliptic Curves in projective setting, Group structure of elliptic curves, Elliptic Curves over Rationals and Number fields, Nagell-Luth theorem, Mordell-Weil theorem, Modular Forms and their relation with Elliptic Curves.

Unit IV: Graph Theory

Definition of graph and examples of graphs, Paths, cycles, Trails, Matrix of a graph, Directed graphs, Connectivity and Paths, Trees and distance, Hamiltonian and Eulerian graphs, Colouring of graphs, planar graphs, Application of graph theory in various fields.

Recommended Texts:

1. Washington L: Elliptic Curves, CRC Press, 2003.
2. West D. B: An introduction to Graph Theory, Pearson, Second edition, 2002.

C. Advanced Functional Analysis

Unit-III

Weak and weak* topologies, Banach-Alaoglu theorem, separability and metrizability, the Krein-Milman theorem, structure of Banach spaces, projections and complementability.

Unit-IV

Adjoint of a bounded linear operator, schauder bases, block basic sequences, Pitt's theorem, unconditional bases.

Recommended Texts:

- 1.M. Fabian, P. Habala, P. Hajek, V. Montesions, S. J. Pelant, V. Zizler, Functional analysis and infinite dimensional geometry, CMS books in Mathematics, 2000.
- 2.R.E. Megginson, An introduction to Banach space theory, Springer, 1998.

D. Advanced Fluid Dynamics

Unit-III

Basic concepts and Navier - Stokes equations: Continuum hypothesis, viscosity and viscous fluid; Newton's law of viscosity, Newtonian and non-Newtonian fluid behaviours, classifications of non-Newtonian fluids and the constitutive equations; Navier-Stokes equations in various co-ordinate systems; some steady and unsteady exact

flow cases for axisymmetric flow, parallel flow past a sphere.

Unit-IV

Velocity and Thermal boundary layer theories: Boundary layer concepts; flow separation and reversed flow; approximations and derivations of laminar (velocity) boundary layer equations; approximations and derivation of laminar (thermal) boundary layer equations for temperature field; thermal boundary layer over a flat plate, Prandtl number and its influence to temperature field.

Recommended Text Books:

1. Textbook of fluid dynamics- F. Chorlton, Van Nostrand
2. Boundary Layer Theory- H. Schlichting & K.Gersten, Springer.
3. Rheology and Non-Newtonian Fluids- Fridtjov Irgens, Springer.

E. Numerical Linear Algebra

Unit-III

Eigenvalues and eigenvectors, Schur's theorem - real and complex versions, Spectral theorems for normal and Hermitian matrices - real and complex versions. Gerschgorin discs with associated perturbation theorems and inclusion results. Jordan canonical forms with application (in detail), minimal polynomials, companion matrices. Functions of matrices via spectral decompositions.

Unit-IV

Iterative methods for linear systems : Classical iterative methods (Jacobi, Gauss-Seidel and successive overrelaxation (SOR) methods), Krylov subspace methods; GMRES, Conjugate-gradient, biconjugate- gradient (BiCG), BiCGStab methods, preconditioning techniques, parallel implementations.

Recommended Texts:

1. D.S. Watkins, Fundamentals of Matrix Computations, second Edition, Wiley-interscience, New York, 2002.
2. C. Johnson, Numerical Solution of Partial Differential Equations by the Finite Element Method, Cambridge University Press, 1987.
3. R. A. Horn and C. R. Johnson, Matrix Analysis, CUP, 1985.

Paper-504
Term Paper

Max. Marks: 150

Credit: 6

A prospective Ph. D scholar shall prepare a term paper (not exceeding 10-15 pages) which will involve both a report as well as a presentation on the subject area of his/her Ph.D topic including objectives /literature review, etc. This term paper shall be guided by the supervisor.