(Revised Syllabus w.e.f. 2020-21)
H.N.B. Garhwal University Srinagar (Garhwal), Uttarakhand

Pre-Ph.D. Mathematics Course Structure

Core Course:

Paper I.   Research Methodology   SOS/MAT/PHD/C001 (4 Credits)

Paper II.   Research & Publication Ethics and MATLAB   SOS/MAT/PHD/C002 (3 Credits)

Elective Course:

Paper III.   Applied Functional Analysis   SOS/MAT/PHD/E001 (4 Credits)

Paper IV.   Partial Differential Equations   SOS/MAT/PHD/E002 (4 Credits)

Paper V.   Mathematical Analysis   SOS/MAT/PHD/E003 (4 Credits)

Paper VI.   Fluid Dynamics with Computational Technique SOS/MAT/PHD/E004 (4 Credits)

Paper VII. Differential Geometry   SOS/MAT/PHD/E005 (4 Credits)

Paper VIII. Algebraic Topology   SOS/MAT/PHD/E006 (4 Credits)

Note :

1. Papers I and II are compulsory.
2. Choose any two papers out of elective papers (III-VIII).
3. Each papers carries 100 marks which includes two sessional tests (each of 20 marks)

PAPER I: **RESEARCH   METHODOLOGY**   **(SOS/MAT/PHD/C001)**

 04 credits

I.   Perception of research, meaning of research, objective of research, different approaches to research, empirical and theoretical research, qualities of a research work, inductive and deductive logics.

II.   The scientific method, examples of scientific methods, different phases in scientific method, the use of computers in obtaining proofs of mathematical results, valid and invalid generalization.

III.   Problem posing, the soul of research methodology, chains of open ended problems, the art of solving problems, Polya's scheme for solving problems, model building in mathematics.

IV.   Basic idea of probability distribution, Elementary sampling theory (a brief introduction), test of significance T, F, Z   and Chi-square distribution (a brief introduction).

TEXT BOOKS

1. Research Methodology for Scientists and Engineers: J.N. Kapur, Mathematical Sciences Trust Society.
2. Fundamentals of Research Methodology and Statistics : Y.K. Singh, New Age International.
3. Thesis and Assignment Writing : Anderson and Jonathon. Wiley Eastern Bombay.
4. How to write Assignments, Research papers, Dissertation and Thesis : V.H. Bedkar, Karak publication New Delhi.

PAPER II: RESEARCH & PUBLICATION ETHICS and MATLAB   (SOS/MAT/PHD/C002)

Part (A): 02 credits.
 I. Research and Publication Ethics: Theory: - Philosophy and ethics, Scientific conduct, Publication ethics.
II. Research and Publication Ethics: Practice: - Open access publishing, Publication misconduct,   Databases and research metrics.
Part (B): 01 credit.
III. Introduction to programming in MATLAB, Applications of MATLAB, Numerical solution of algebraic and transcendental equations, System of linear equations and initial value problems.

TEXT BOOKS:

1. Ethics in Research Practice and Innovation, Antonio Sandu, Ana Frunza and Elena Unguru, IGI Global.

2. An Introduction to Programming and Numerical Methods in MATLAB: S.R. Otto and J.P. Denier, Springer.

3.Numerical Methods with MATLAB for Engineers and Scientists : S. Chapra, Mc-Graw-Hill.

Elective (Choose any two of the following papers III-VII, each of 04 credits)

PAPER III: APPLIED FUNCTIONAL ANALYSIS   (SOS/MAT/PHD/E001)

I.   Banach fixed point theorem and its applications.
II.   Approximation in normed spaces, Approximation in Hilbert spaces.
III.   Spectral theory of linear operators in normed spaces.
IV.   Spectral theory of bounded self-adjoint operators.

TEXT BOOKS

1. Introductory Functional Analysis with Applications :Kreyszig, John Wiley & Sons.
2. Functional Analysis : W. Rudin, McGraw-Hill.
3. Introduction to Hilbert spaces : S. Berberian, Oxford Univ. Press.
4. Introduction to Approximation Theory : E. W. Chency, McGraw-Hill.

PAPER IV: PARTIAL DIFFERENTIAL EQUATIONS WITH APPLICATIONS

(SOS/MAT/PHD/E002)

I. First order partial differential equations.
II. Principles for higher-order equations.
III. The wave equations.
IV. The heat equations.

TEXT BOOKS

1. Partial Differential Equations : Methods and Applications : R.C. Mcowen, Pearson Education.
2. Partial Differential Equations : L. Bers, F. John and M. Schechter, John Wiley and Sons.
3. Introduction to Partial Differential Equations : G. Folland, Princeton Univ. Press.
4. Partial Differential Equations : F. John, Springer-Verlag, New York.

PAPER V: MATHEMATICAL ANALYSIS   (SOS/MAT/PHD/E003)

I. Power series : Properties of functions expressible as power series, Abel's theorem,
II. Fourier series : Fourier coefficient, periodic functions, piecewise monotonic functions, Fourier series for even and odd functions, half range series.
III. Function of several variables: Explicit and implicit functions, function of two variables, repeated limits, continuity, partial derivatives, differentiability, Young's theorem, Schwarz theorem.
IV. Differentials of higher order, functions of functions, chain rule, change of variables, Taylor's theorem, functions of several variables, implicit function theorem.

TEXT BOOKS

1. Mathematical Analysis :Apostol, Narosa Publishing House.
2. Foundations of Modern Analysis : J. Dieudonne's Academic Press.
3. Principles of Mathematical Analysis : W. Rudin, McGraw-Hill.
4. A first Course in Real Analysis : S.K. Berberian, Springer-Verlag, New York.

PAPER VI: FLUID DYNAMICS WITH COMPUTATIONAL TECHNIQUES

(SOS/MAT/PHD/E004)

I. Laminar flow of viscous incompressible fluids.
II. Boundary layer theory.
III. Dimensional analysis.
IV. Fundamentals of finite element technique.

TEXT BOOKS

1. Foundation of Fluid Mechanics : S.W. Yuan, Prentice Hall Pvt. Ltd., 1960.
2. Text Book of Fluid Dynamics : F. Chorlton, CBS Pub. & Dist., 2004.
3. Fluid Dynamics : Hughes and Brighton, McGraw Higher Ed, 2007.
4. Finite Element Method : J.N. Reddy, McGraw-Hill, 2007.

PAPER VII: DIFFERENTIAL GEOMETRY   (SOS/MAT/PHD/E005)

I. Riemannian geometry.
II. Kaehlerian, Hermitian and Tachibana spaces.
III. Manifolds and submanifolds.
IV. Hypersurfaces

TEXT BOOKS

1. Differential Geometry :K. Yano& M. Kon, World Sci. Pub. Pvt. Ltd.
2. Differential Geometry :Weatherburn, Cambridge Univ. Press, 1930.
3. Differential Manifold :R.S. Mishra, Indian national Sci. Acad., 1978.

PAPER VIII: ALGEBRAIC TOPOLOGY (SOS/MAT/PHD/E006)

I. The fundamental group, homotopy, contractive spaces and homotopy type, the fundamental group of circle.
II. Finite simplical complexes, polyhedral and triangulations, simplical approximation.
III. Orientation of simplical complexes, simplical chain complex and homology, properties of integral homology groups.
IV. Induced homomorphism, degree of a map and its applications, invariance of homology groups, homotopy invariance, Lefschetz fixed point theorem.

TEXT BOOKS

1. Algebraic Topology :StyaDeo, Hindustan Book Agency, India, 2006.
2. Algebraic Topology : William Fulton, Springer, Verlag.
3. A Basic Course in Algebraic Topology : W.S. Massely, Springer, 2007.
4. Elements of Algebraic Topology : James Munkres, CRC Press.