RAJIV GANDHI UNIVERSITY

(A Central University)

RONO HILLS :: DOIMUKH

DEPARTMENT OF MATHEMATICS

Semester wise Course Structure

M. Phil. (Two Years)

Mathematics & Computing

w.e.f. 2017-18

STRUCTURE OF THE SYLLABUS FOR M. Phil. PROGRAMME

M. Phil. Programme			
Semester	*Paper Code*	*Title*	*Marks Distribution*
I-Semester (Two Papers)	*MATH -601*	*Research Methodology*	*Th-60, Int- 20, P-20*
	MATH -602	*Computer Applications*	*Th-50, P-30, Int- 20*
II-Semester (Optional Papers - One paper is to be selected)	*MATH -603*	*Advanced Analyses*	*Th-80, In- 20*
	MATH -604	*Functional Analyses*	*Th-80, Int- 20*
	MATH -605	*Approximation Theory*	*Th-80, Int- 20*
	MATH -606	*Fluid Dynamics*	*Th-80, Int- 20*
	MATH -607	*Algebra*	*Th-80, Int- 20*
	MATH -608	*Number theory and special functions*	*Th-80, Int- 20*
	MATH -609	*Distribution theory*	*Th-80, Int- 20*
III-Semester	*MATH -610*	*Review of Research paper (Concerned Research field)*	*Review-70, Presentation- 30*
IV-Semester	*Dissertation for concerned Research topic and Viva-Voce*		

HEAD
Department of Mathematics
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M. Phil. Syllabus

MATH: 601: RESEARCH METHODOLOGY

Course Outcome: *The paper equips students with the basics of the research. It equips students with concept of Formulating research aim and objectives in an appropriate manner are one of the most important aspects and give the overall direction of the research.*

Full Marks: 100
Term end: 60
Practical: 20
Internal: 20

Unit-I: ***An overview of Research Methodology:*** *Research concept, characteristics of Research, the choice and statement of research problem, justification and hypothesis. Literature collection-textual and digital.*
Elementary Scientific Method: *Authority in science, observation and descriptions, analysis and synthesis, Hypothesis, Deduction, Models and Mathematics, Testing of Hypothesis, Preparation of research synopsis, Significance of Research Work.* ***Marks: 15***

UNIT- II: *Mathematical Writing, Writing a Paper, Revising a Draft, Publishing a Paper, Writing and Defending a Thesis, Writing a Talk, Giving a Talk, Preparing a poster.* ***Marks: 30***

UNIT-*III:* ***Numerical Analysis:*** *Interpolations, Differentiations and Integrations. Solving differential equations by Euler and Euler modified methods, Finite Difference Methods, Curve Fitting, Predictor-Corrector method for accuracy and stability.* ***Marks: 15***

UNIT-*IV:* *Research Project Proposal and Resource Generation:*
1. *Write a Research Project Proposal;*
2. *Getting funds from different funding agencies.* ***Marks-20***

Internal Assessment: Seminar Presentation. ***Marks: 20***

Text and Reference Books

1. *Nicholas J. Higham: Handbook of Writing for te Mathematical Sciences, Second Edition, SIAM Publisher (1998).*
2. *Robert K, Yin: Case Study Research: Design and Methods, Sage Publications Ltd., London (2008).*
3. *Leslie C.Prerelman: The Mayfield Technical Scientific Writing, Tata James parade & McGraw Hills (2001).*
4. *H. C. Saxena: Finite Difference and Numerical Analysis, S. Chand & Co. (2005).*

MATH: 602: COMPUTER APPLICATIONS:

Course Outcome: *The students are expected to be well equipped with fundamentals knowledge of computer programming and mathematical software's for their computational aspects of their research.*

Full Marks: 100
Term end: 50
Practical: 30
Internal: 20

UNIT-I: *Fundamental of computing, Windows and UNIX (Linux) operating systems, MS- Office, Problem solving techniques, networking.* ***Marks: 20***

UNIT –II: *Programming in C, MATLAB and MATHEMATICA Complete idea on LaTeX and LyX.* ***Mark: 30***

UNIT-III: *Practical Materials covered in Unit-I and Unit-II* ***Marks: 30***

Internal Assessment: Seminar Presentation ***Marks: 20***

Text and Reference Books

1. *V.Rajarman* : *Fundamentals of Computing, PHI.*
2. *Jon Sticklen & M Taner Eskil* : *An Introduction to Technical Problem Solving with MATAB v.7, 2e, 2006, Great lakes press.*
3. *Michel Trott* : *The Mathematical Guide Book for Programming, 2004, Spinger-Verlag.*
4. *P .Dey and M. Ghosh* : *Computer Fundamentals and Programming in C, 2007, Oxford University Press*
5. *Shubhi Lall* : *Computer Fundamentals and Introduction to IBM. PC, 2005, University Book House*
6. *E.Balagurusamy* : *Programming in ANSIC, Tata McGraw Hill, 2001.*
7. *Laslie Lamport* : *LaTeX: a document preparation system, User's guide and reference Manual, 2nd Edition, Addison Wesley, 1994.*
8. F. *Mittelbach* : *The LaTeX Companion, 2nd Edition, AddisonWesley, 2004.*

M. Phil. –II Semester
Optional Paper
MATH -603 AVANCED ANALYSES

Course Outcome: *The students are expected to apply these concepts to study the topological properties of different spaces in their research work.*

UNIT-I: *Nets and filters, their convergence, and interrelation. Hausdorffness and compactness in terms of net/filter convergence.* ***Marks -20***

UNIT – II: *Tychonoffs theorem on the topological product of compact spaces. Local finiteness. Paracompactness- Normality of a paracompact space.* ***Marks -30***

UNIT-III: *The L^p - space. Convex functions. Jensen's inequality. Holder and Murkowski inequalities. Completeness of L^p . Convergence in measure, almost uniform convergence.* ***Marks -30***

Internal Examination: ***Marks -20***

Text Book: *James Munkers-Topology*
H.L Rodyn –Real Analysis
Apostol T.M., Mathematical Analysis

M. Phil. –II Semester
Optional Paper
MATH -604: FUNCTIONAL ANALYSIS

Course Outcome: *Knowing this module, if someone wants to do research works on functional analysis, especially in- sequence space, operator theory, fixed point theory etc., then this module will certainly guides the students.*

UNIT-I: *Convergence of Cauchy nets in a Banach spaces, computation of conjugate spaces of continuous linear functional on certain Banach spaces, Weak and Weak* topologies on Banach spaces, the conjugate space of C([0,1]).* ***Marks -20***

UNIT – II*: The Lebesgue space:* L^1 *and* L^∞ *; The Dardy spaces:* H^1 *and* H^∞ *.* ***Marks -20***

UNIT-III: *The Banach algebra of continuous functions, Abstract Banach algebras, Abstract index in a Banach algebra, Gelfand- Mazur Theorem, Sectral radius formula, Stone Weierstrass theorem, The Disk algebra, Algebra of functions with absolutely convergent Fourier series.* ***Marks -20***

UNIT-IV: *Weak and strong operator topology, W* algebras, Isomorphism of* L^∞ *spaces, Maximal abelian W* algebras, Homomorphism of C* algebras, Extended functional calculus, Fuglede Theorem.* ***Marks -20***

Internal Examination: ***Marks -20***

Text Book: R.G.Dougals, Banach Algebra Techniques in Operator Theory, Academic Press, 1971.

1. *R.Larsen, Banach algebras, Marcel Dekker Inc., New York, 1973.*
2. *B.V, Limaye, Functional Analysis, Wiley Eastern Limited, New delhi, 1996.*
3. *Ervin Kreyszig: Introductory Functional Analysis with Applications John Wiley and Sons.*

M. Phil. –II Semester
Optional Paper
MATH -605: APPROXIMATION THEORY

Course Outcome: *The students are expected to understand and master theoretical issues that arise in approximation of functions by polynomials which will encourage research in the areas of approximation theory.*

UNIT –I *: Linear operators, Examples – Bernstein Polynomials, Fourier series, Approximation theorem-Bohman and Korvokin's theorems, and its applications.* ***Marks – 20***

UNIT-II *: Exostejce pf polynomials of best approximation, characteristics of polynomial of best Approxination, Applications of convexity, Chebyshev system.* ***Marks – 20***

UNIT-III : Apolication of some complex functions, Uniqueness of polynomials of Best Approximation, Chebyshev theorem, Chebyshev polynomial Interpolation, Algebraic polynomials, Trigonometric Polynomials. ***Marks – 20***

UNIT-IV ***:*** *Least square approximation, Approxmation on an interval, Jacobi polymomials, Approcimation on a finite set of uniform approximation on a finite set of points.* ***Marks – 20***

Internal Examination: ***Marks -20***

Tex Books:

1. *G.G. Lorentz, Approximation of Functions; Holt, Tinehart and Wiston, Inc. 1966.*
2. *T.J. Rivlin; An introduction to the Approximation of Functions, Dover publications, 1981.*

Reference Books:

1. *Hrushikesh N, M haskar and D.V.Pai, Fundamental of Approximation theory, Narosa Publishing House, 2000.*
2. *Timan A.F., Theory of Functions Real Variable, New York, Macmillan, 1963.*
3. *G.Meinnardus, Approximation of Functions Theory and Nunerical Methods, Springer Verlag, Vol-13, 1967.*

M. Phil. –II Semester
Optional Paper
MATH -606: FLUID DYNAMICS

Course Outcome: *It is intended to provide a treatment of advanced topics in fluid mechanics where the students will be able to apply the techniques used in deriving arrange of important results and in research problems.*

Unit –I: *Navier Stokes equations of motion of a viscous fluid, Energy equation, Diffusion of Vorticity, Equations of* vorticity *and circulation, Dissipation of energy***.** ***Marks-25***

Unit-II: *Dimesional analysis, dimensional homogeneity, Technique of dimensional analysis, Stokes flow, Oseen's approximation, Lubrication Theory .* ***Marks-25***

Unit- III*:* *Idea of boundary layer theory, Idea of thermal boundary layer, free and forced convection, thermal boundary equation in two dimensional flows, Newton's law of cooling, exact solutions for the problem of temperature distribution in a viscous flow (Coutts flow, Poiseuille flow through channel with flat walls and Poiseuille flow through circular pipe), forced convection in laminar boundary layer on a flat plate (Reynolds analog, Cracco's first and second integral solution of the cooling problem of plate thermometer and thermal boundary layer equation for an isothermal plate, Introduction to MHD.* ***Marks-30***

Internal Assessment: ***Marks-20***

Text Books:

1. *H.Schlichting : Boundary Layer theory, Mc. Graw- Hill pub Co.*
2. *M.D. Raisinghania : Fluid Dynamics, S. Chand and Company Ltd., New Delhi.*
3. *J. A. Shercliff : A Text Book of Magnetohydrodynamics, Pergamen Press.*

Reference Books*:*

1. *L.Rosenhead : Laminar boundary layers.*
2. *F.Chorlton : A Text Book of Fluid Dynamics by, CBS.*
3. *Schaum's Series : Fluid Dynamics, 3rd Edition.*
4. *V.C. A. Ferraro & C.Plumpton : Magnetohydrodynamics, Oxford University Press.*
5. *Von Dyake : Fluid Dynamics*

M. Phil. –II Semester
Optional Paper
MATH -607: ALGEBRA

Course Outcome: *Knowing this module, if someone wants to do research works on algebra, especially in- commutative and non-commutative algebra, category theory, Goldie dimension, algebraic geometry, lie groups, algebraic graphs theory, theoretical computer science etc., then this module will certainly guides the students.*

Unit-I: *Rings and Ideals; Maximal ideals: Algebra of Ideals; Quotient Ring; Local Ring; Modules; Basic properties of Modules; Simple Modules.* ***Marks-20***

Unit-II*:** *Chain conditions; ascending chain conditions on modules; maximal condition; Noetherian modules; descending chain conditions; minimal condition, Artinian modules; their properties; Noetherian rings; Hilbert basis theorem; Artinian rings; structure theorem for Artinian rings, Uniform Modules; Goldie Rings.* ***Marks-30

Unit-III: *Tensor Product of modules; Existence and uniqueness of tensor product of two modules; Tensor product of scakars; exactness properties of the tensor products; Algebras; Tensor product of algebras, Essential Extensions; Injective Hulls: Semi simple Modules; The Singular Submodules.* ***Marks-30***

Internal Assessment: Seminar Presentation ***Marks-20***

Text Books:

1. *M. F. Atiyah and I.G. Macdonald: Introduction to Commulative Algebra, AdditionWesley, 2000.*
2. *S. Lang : Algebra, Addition –Wesley Publication Company, London, 2000.*
3. *C. Musili: Introduction to Rings and Modules, Narosa Publishing House, New Delhi,1999.*

Reference Books*:*

1. *K.R. Gooderal : Rings Theory Nonsingular Rings and Modules, Marcel Dekker Inc, New York, 1976*
2. *M.Reid : Undergraduate Commutative Algebra; London, Math. Soc. 1995*
3. *H.Matsumara : Commutative Algebra; Benjamin/ Cummings Pub. Company, 1980.*
4. *A.W.Chatters and C.R.Hajarnavis :An Introduction Course in Commutative Algebra; Oxford University Press, 1960.*
5. *David Eisenbud : Commutative Algebra; Springer 1960.*

M. Phil. –II Semester
Optional Paper
MATH -608: Number Theory and Special Functions

Course Outcome: *The course provides a foundation to number theory, q-series and their applications in the field of partition theory, continued fractions and other related areas. The paper encourages research in the areas of mathematics inspired by Ramanujan.*

Unit-I: *Liner and Polynomial congruence, Diophantine equation, representations of number as of two squares and three squares, Fermat's last theorem.* ***Marks-25***

Unit-II: *Partition of a number, graphical representation of portion, conjugates partition.* ***Marks-25***

Unit-III: *Q-Series and infinite products, Ramanujan's general theta-function and its special cases. Simple relations of theta-functions. Jacobi's triple product identity, Rogers-Ramanujan functions, their identities and partition theoretic interpretations.* ***Marks-30***

Internal: –Seminar Presentation ***Marks-20***

M. Phil. –II Semester
Optional Paper
MATH -609: Distribution Theory

Course Outcome: *The course provides a foundation to distribution, transformation, Sobolev Spaces and their applications in the distribution theory. The paper encourages research in the areas of different transformations.*

Unit-I: *Test functions and Distributions, Convergence of distribution, Differentiation of Distributions.* ***Marks-30***

Unit-II: *Fourier transforms and Tempered Distributions: Tempered distributions, Fourier Transformation in S, Fourier transformation in S', Properties of Fourier transformation in S', Convolution theorem in S', Fourier transformation in E', Applications.*

Unit-III: *Sobolev Spaces: Soboleve space $W\{m, p\}$, Sovboleve space $H^{s,}$* ***Marks-20***

Internal Assessment: Seminar ***Marks-20***

Reference Books*:*

1. *M.A. Al-Gwaiz, Theory of Distribution, Marcel Dekker, Inc, New York, 1992.*
2. *R.S.Pathak, a Course in Distribution Theory and Applications, Narosa Publishing House, 2001.*

M. Phil. –II Semester
Optional Paper
MATH -610: Wavelet Analysis

Course Outcome: *Wavelets is a wonderful course in collaboration with applied sciences and it is familiarize the knowledge on applications of Fourier transforms. Introduction of applied structure through wavelets.*

Unit-I ***:*** *Signals and systems. The short – time Fourier transform (STFT), Elementary properties of STFT.* ***Marks-20***

Unit-II *: Difination and examples of wavelets, continous and discrete wavelet transforms, and Basic properties of wavelet transform. Frames and frame operators, Orthonormal wavelets, the Frankline wavelet, The Battle –Lemarie wavelet.* ***Marks-30***

Unit- III *: The Haar scaling function, Basic properties of Haar scaling functions, Construction of wavelets from a Multiresolution Analysis, Cardinal B-splines and Spline wavelets, the Frankline wavelets, The Battle – Lemarie wavelets.* ***Marks-30***

Internal Assessment: ***Marks-20***

Reference Books*:*

1. *C.K. Chui: An Introduction to Wavelets, Academic Press.*
2. *Lokenath Debnath: Wavelet Transforms and Their Applications, Birkhauser.*
3. *A. Boggess, and F.J. Narcowich: A First Course in Wavelets with Fourier analysis, Wiley; 2 Edition (September8, 2009).*
4. *David F. Walnut: An Introduction to Wavelet Analysis, Birkhauser.*
5. *Eugenia Hernandez, Guido L. Weiss: A first Course on Wavelets, CRC Press.*
6. *P. WojtasZczyk: A Mathematical Introduction to Wavelet, CRC Press.*