KARNATAK UNIVERSITY, DHARWAD

DEPARTMENT OF MATHEMTAICS

M.PHIL. (MATHEMATICS)

SYLLABUS

(w.e.f. 2001-02)

Syllabus for M.Phil in Mathematics

M. Phil. Mathematics

Programme Outcomes (POs)

PO1. Identify the relevant research topic.
PO2. Carry out the survey of literature.
PO3. Analyze the Mathematical results.
PO4. Communicate effectively though presentations.
PO5. Enable for critical thinking to carry out scientific and systematic investigation for the study.
PO6. Apply reasoning to assess issues and the consequent responsibilities relevant to the professional practice.
PO7. Apply mathematics to understand the societal problems.

Course Structure and Scheme of Examination

Area of Specialization : **Complex Analysis**

Sl. No	Part	Paper Code No.	Name of the Course	Contact Hours per Week	Maximum Marks			Examination Hours
					Continuous Assessment (IA)	Course End-Examination	Total	
01	I	MP83T101A	Topics in Complex Analysis	04	20	80	100	03
02		MP83T102A	Nevanlinna Thoery / Geometric Function Theory	04	20	80	100	03
03	II	MP83T201	Dissertation work	04	--	--	150	--
04		--	Viva Voce	--	--	--	50	--
Total Marks							**400**	

Paper Code and Name: MP83T101A: Topics in Complex Analysis	Teaching Hours: 48
Course Outcomes (COs)	
After completing this paper, the students will be able to: CO1. Understand the Weirstrass factorization. CO2. Identify asymptotic curves. CO3. Understand entire function. CO4. Understand harmonic function.	

Poisson Integral formula, Poisson-Jenson Theorem. Infinite Product, Elementary properties, Weirstrass primary factors. Basic properties, Weirstrass factorization theorem. Hadamard's factorization theorem, Picard's and Borel's theorems. Some applications of Hadamard's factorization Theorem.

Asymptotic value and asymptotic curves. Connection between asymptotic values and various exceptional values.

Basic properties of Entire functions through M (r, f).

Elementary properties of Hormonic functions. Green functions, subhormonic functions. Solutions of the Drichlit's problems.

References:

1) A. I. Markushevich: Theory of functions of a Complex Variables, Vol. Ii Prentice – Hall (1965).
2) A. S. B. Holland: Introduction to Theory of Entire Functions, Academic Press, New York (1973).
3) C. L. Siegel: Nine Introductions in Complex Analysis, North Holland (1981).
4) W. K. Hayaman: Meromorphic Functions, Oxford University Press (1964).
5) Yang Lo: Value Distribution Theory, Springer Verlag, Scientific Press (1993).
6) I. Laine: Nevanlinna Theory and Complex Differential Equations, Walter de Gruyter, Berlin (1993).

Paper Code and Name: MP83T102A: Nevanlinna Thoery / Geometric Function Theory	Teaching Hours: 48
Course Outcomes (COs)	
After completing this paper, the students will be able to: CO1. Understand the entire function and relationships. CO2. Identify Connection between Asymptotic and various Exceptional Values. CO3. Understand Nevanlinna's Characteristic Function. CO4. Understand Fix-points of Integral Functions.	

Basic Properties of Entire Functions. Order and Type of an Entire Function. Relationship between the order of an Entire Function and its Derivative. Poisson Integral Formula. Poisson-Jensen Theorem. Jensen's Formula. Exponent of Convergence of Zeros of an Entire Function. Picard and Borel's Theorems for Entire Functions.

Asymptotic Values and Asymptotic Curves. Connection between Asymptotic and various Exceptional Values.

Meromorphic Functions. Nevanlinna's Characteristic Function. Cartan's Identity and Convexity Theorems. Nevanlinna's First and Second Fundamental Theorems. Order and Type of a Meromorphic Function. Order of a Meromorphic Function and its Derivatives. Relationship between T (r, f) and log M (r, f) for an Entire Functions. Basic Properties of T (r, f).

Deficient Values and Relation between the Various Exceptional Values. Fundamental Inequality of Deficient Values. Some Applications of Nevanlinna's Second Fundamental Theorem. Functions taking the same values at the same points. Fix-points of Integral Functions.

References:

1) A. I. Markushevich: Theory of functions of a Complex Variables, Vol. Ii Prentice – Hall (1965).
2) A. S. B. Holland: Introduction to Theory of Entire Functions, Academic Press, New York (1973).
3) C. L. Siegel: Nine Introductions in Complex Analysis, North Holland (1981).
4) W. K. Hayaman: Meromorphic Functions, Oxford University Press (1964).
5) Yang Lo: Value Distribution Theory, Springer Verlag, Scientific Press (1993).
6) I. Laine: Nevanlinna Theory and Complex Differential Equations, Walter de Gruyter, Berlin (1993).

Area of Specialization : **Algebra**

Sl. No	Part	Paper Code No.	Name of the Course	Contact Hours per Week	Maximum Marks			Examination Hours
					Continuous Assessment (IA)	Course End-Examination	Total	
01	I	MP83T101B	Rings and Modules	04	20	80	100	03
02		MP83T102B	Homological Algebra	04	20	80	100	03
03	II	MP83T201	Dissertation work	04	--	--	150	--
04		--	Viva Voce	--	--	--	50	--
Total Marks							**400**	

Paper Code and Name: MP83T101B: Rings and Modules	Teaching Hours: 48
Course Outcomes (COs)	
After completing this paper, the students will be able to: CO1. Understand the rings, fields. CO2. Identify quotient rings. CO3. Understand modules. CO4. Understand Nil radical and Jacobson radical	

Rings – Definition and examples. Commutative rings. Ideals, quotient rings, isomorphism theorems. Integral domain, field, quotient field. Regular elements in ring, total quotient ring of a ring. Quotient ring of a ring with respect to a multiplicatively closed set. Some basic properties.

Modules – Definition and examples. Submodule, factor module, isomorphism theorems. Direct sum of modules. Simple module. Noetherian module, Artinian module, module of finite length. Jordon-Holder theorem. Noetherian ring, Artinian ring. Nil radical and Jacobson radical of a commutative ring. Module of fractions with respect to a multiplicatively closed set.

References:

i) Introduction to Commutative Algebra, M. F. Atiyah and .G. Macdonald, Addison and Wesley Publishing Company, 1969.

ii) Modern Algebra – Subject Singh and Qazi Zameeruddin, Vikas Publishing House.

iii) Introduction to Rings and Modules – C. Musili, Narosa Publishing House, 2nd Edition, 1994.

iv) Commutative Algebra, O. Zariski and P. Samuel, Vol. I, Van Nostrand, 1958.

Paper Code and Name: MP83T102B: Homological Algebra	Teaching Hours: 48
Course Outcomes (COs)	
After completing this paper, the students will be able to: CO1. Understand Basic notions in modules. CO2. Identify Short exact sequence of modules. CO3. Understand Projective module. CO4. Understand Wedderburn – Artin theorem	

Basic notions in modules. Direct produt and direct sum of modules. Simple module, Schur's lemma. Semisimple modules. Free module. Short exact sequence of modules, split exact sequence of modules. Tensor product of modules over a commutative ring. Right exactness of tensor product. Module of homomorphisms of modules over a commutative ring. Left exactness of the Hom. Projective module, injective module. Wedderburn – Artin theorem for semisimple Artinian ring.

References:

i) Introduction to Homological Algebra – S. T. Hu, Holden – Day, 1968.

ii) Notes on Homological Algebra – J. J. Rotman.

iii) Introduction to Rings and Modules – C Musili, Narosa Publishing House, 2nd Edition, 1994.

iv) Rings and Homology, J. P. Jans, Holt, Rinehartand Winston, New York, 1964.

Area of Specialization : **Graph Theory**

Sl. No	Part	Paper Code No.	Name of the Course	Contact Hours per Week	Maximum Marks			Examination Hours
					Continuous Assessment (IA)	Course End-Examination	Total	
01	I	MP83T101C	Topics in Graph Theory	04	20	80	100	03
02		MP83T102C	Advanced Graph Theory	04	20	80	100	03
03	II	MP83T201	Dissertation work	04	--	--	150	--
04		--	Viva Voce	--	--	--	50	--
Total Marks							**400**	

Paper Code and Name: MP83T101C: Topics in Graph Theory	Teaching Hours: 48
Course Outcomes (COs)	
After completing this paper, the students will be able to: CO1. Understand Coloring of Graphs. CO2. Identify Planar graphs. CO3. Understand Connectivity. CO4. Understand Graph algorithms	

Coloring of Graphs, Brooks Theorem, Vizing's Theorem, The Four - Color Problem, Five Color Theorem, Chromatic Polynomials.

Planar graphs, Measurement of closeness to planarity, crossing numbers, Kuratowski's theorem, Heawood's Empire problems, Dual Graphs.

Connectivity, Menger's Theorem, Tutte Theorem, Traversability (Eulerian & Hamiltonian) Posa's Theorem, Ore and Dirac Theorem, The obrwolfach problem, Infinite Lattice graph, Graphs and Groups, Matrices, Graph Spectra and Graph angles. Covering of graphs, Grallai Theorem, Graph algorithms.

References:

1. G. Chartrand & L. Lesniak: Graphs & Digraphs (Third Edition) Chapman & Hall / CRC.
2. F. Buckley & F. Harary: Distance in Graphs, Addision – Wesley (1990)
3. R. Gould: Graph Theory, The Benjamin / Cummings, Publ. Co. inc. calif (1988)
4. J. A. Bondy & V. S. R. Murthy : Graph Theory with Applications, Macmillan and London.
5. F. Harary : Graph Theory, Addison Wwesiey, Reading mass (1969).
6. D. M. Cvetkovic, M. D. Horst sachs, Spectra of Graphs (Theory & Applications), Academic Press.
7. R. Balakrishnan and K. Ranganathan, A Textbook of Graph Theory, Springer, 1999.

Paper Code and Name: MP83T102C: Advanced Graph Theory	Teaching Hours: 48
Course Outcomes (COs)	
After completing this paper, the students will be able to: CO1. Understand the radius and diameter of a graph. CO2. Identify Long paths and Long cycles. CO3. Understand eccentric sequence. CO4. Understand Wiener number	

Basic concepts in distance in graphs. Eccentricity of a vertex, radius, diameter. The radius and diameter of a self-complementary graph. The existence of a graph with given radius and diameter.

The self-centered graph and the properties of self-centered graphs. The Median, Central paths and other Generalized centers.

Extremal distance problems, radius, small diameter, Long paths and Long cycles.

Metrics on graphs, Geodetic graphs and distance hereditary graphs.

The eccentric sequence, distance sequences, the distance distribution, path sequences and other sequences.

The wiener number, bounds on wiener number and the variations and generalizations of wiener number and some applications.

References:

1. Distance in Graphs, Fred Buckley, F. Harary.
2. Introduction to Graph Theory, Gary Chartrand, Ping Zhang.
3. Mathematical methods in Organic Chemistry, Gutman et. al.
4. Chemical Graph Theory, Vol. I and Vol. II, Nenad Trinajstic.

Area of Specialization : **Topology**

Sl. No	Part	Paper Code No.	Name of the Course	Contact Hours per Week	Maximum Marks			Examination Hours
					Continuous Assessment (IA)	Course End-Examination	Total	
01	I	MP83T101D	Advanced Topics in Topology	04	20	80	100	03
02		MP83T102D	Fuzzy Sets and Fuzzy Topology	04	20	80	100	03
03	II	MP83T201	Dissertation work	04	--	--	150	--
04		--	Viva Voce	--	--	--	50	--
Total Marks							**400**	

Paper Code and Name: MP83T101D: Advanced Topics in Topology	Teaching Hours: 48
Course Outcomes (COs)	
After completing this paper, the students will be able to: CO1. Understand the partition of unity. CO2. Identify normal spaces. CO3. Understand fully normal spaces. CO4. Understand Perfect mappings	

Paracompact spaces and partition of unity. Completely normal, totally normal and perfectly normal spaces. Hereditarily paracompact spaces, weakly paracompact spaces (meta compact spaces), strongly paracompact spaces and countably paracompact spaces.

Perfectly normal spaces fully normal spaces and collectionwise normal spaces. Screenable and strongly screenable spaces. Perfect mappings.

References:

1) James Dugundji, Topology, PHI / UBS pub. Co.
2) S. Willard, General Topology, Addison – Wesley pub co.
3) R. Engelking, General Topology, Polish scientific publishers.
4) A. Csaszar, General Topology, Adam Hilger Ltd pub co.
5) J. Nagata, Modern General Topology, North Holland pub co.
6) J.R. Munkres, Topology – A first course, PHI.

Paper Code and Name: MP83T102D: Fuzzy Sets and Fuzzy Topology	Teaching Hours: 48
Course Outcomes (COs)	
After completing this paper, the students will be able to: CO1. Understand the Fuzzy sets. CO2. Identify fuzzy relations. CO3. Understand Fuzzy Topology. CO4. Understand Fuzzy functions	

Fuzzy sets : Introduction, crisp sets, Fuzzy sets, operations on fuzzy sets, cuts and their properties, Representation of fuzzy sets, Extension principle for fuzzy sets, fuzzy complements, fuzzy intersections; t – norms, fuzzy unions; t-co norms, fuzzy relations.

Fuzzy Topology: Introduction, Chang's and Lowen's fuzzy topologies. Elementary concepts in fuzzy topological spaces. Continuous maps, open maps and closed maps on fuzzy topological spaces. Shading families. Various connectedness and compactness notions in fuzzy topological spaces. Fuzzy functions.

(Research papers by C.L. Chang, R. Lowen, R.H. Warren and C.K. Wong are to be covered)

References:

1) G.J. Klir and B. Yuan, Fuzzy sets and fuzzy logic: Theory and Applications, PHI (1999).
2) A. Kaufman, Introduction to the theory of fuzzy subsets, vol-I Academic press (1975)
3) Liu Ying – Ming and Luo Mao – Kang, Fuzzy topology, World Scientific pub co (1997)

Area of Specialization : **Graph Theory**

Sl. No	Part	Paper Code No.	Name of the Course	Contact Hours per Week	Maximum Marks			Examination Hours
					Continuous Assessment (IA)	Course End-Examination	Total	
01	I	MP83T101E	Topics in Graph Theory	04	20	80	100	03
02		MP83T102E	Graph Dynamics	04	20	80	100	03
03	II	MP83T201	Dissertation work	04	--	--	150	--
04		--	Viva Voce	--	--	--	50	--
Total Marks							400	

Paper Code and Name: MP83T101E: Topics in Graph Theory	Teaching Hours: 48
Course Outcomes (COs)	
After completing this paper, the students will be able to: CO1. Understand the Coloring of Graphs. CO2. Identify Planar graphs. CO3. Understand Traversability. CO4. Understand Graph algorithms	

Coloring of Graphs, Brooks Theorem, Vizing's Theorem, The Four - Color Problem, Five Color Theorem, Chromatic Polynomials.

Planar graphs, Measurement of closeness to planarity, crossing numbers, Kuratowski's theorem, Heawood's Empire problems, Dual Graphs.

Connectivity, Menger's Theorem, Tutte Theorem, Traversability (Eulerian & Hamiltonian) Posa's Theorem, Ore and Dirac Theorem, The obrwolfach problem, Infinite Lattice graph, Graphs and Groups, Matrices, Graph Spectra and Graph angles. Covering of graphs, Grallai Theorem, Graph algorithms.

References:

1. G. Chartrand & L. Lesniak: Graphs & Digraphs (Third Edition) Chapman & Hall / CRC.
2. F. Buckley & F. Harary: Distance in Graphs, Addision – Wesley (1990)
3. R. Gould: Graph Theory, The Benjamin / Cummings, Publ. Co. inc. calif (1988)
4. J. A. Bondy & V. S. R. Murthy : Graph Theory with Applications, Macmillan and London.
5. F. Harary : Graph Theory, Addison Wwesiey, Reading mass (1969).
6. D. M. Cvetkovic, M. D. Horst sachs, Spectra of Graphs (Theory & Applications), Academic Press.
7. R. Balakrishnan and K. Ranganathan, A Textbook of Graph Theory, Springer, 1999.

8.

Paper Code and Name: MP83T102E: Graph Dynamics	Teaching Hours: 48
Course Outcomes (COs)	
After completing this paper, the students will be able to: CO1. Understand the Graph operators. CO2. Identify Total graph, Middle graph. CO3. Understand planar graphs. CO4. Understand Connectivity and Covering	

Graph operators and composed operator – Block Point, Tree, Line graph, Total graph, Middle graph, n power graphs, Semi total – block graph, Total - Block graph etc.

Graph operators and planar graphs. Nonplanar graphs, Outerplanar graphs, traversability, k-trees.

Graph operators and Chromatic polynomials, Spectra of graphs, Connectivity. Covering and other graph-theoric parameters.

References:

1. M. Behzad, G. Chartrand & L. Lesniak Foster : graphs and Digraphs, Wadaworth, Belmont, Calif (1981).
2. G. Chartrand and P. Zhang, Introduction to Graph Theory, Tata McGraw – Hill Edition, 2006.
3. D. M. Cvetkovic, M. D. Horst sachs, Spectra of Graphs (Theory & Application) Academic Press.
4. Norman Biggs, Algebraic Graph Theory, Second Edition, Cambridge University Press (2001).
5. F. Harary, Graph Theory, Addison inesley, Reading mass (1969).
6. V. R. Kulli, Adances in graph theory Vishwa International Publications, Emerald Academic Press, Madras (1991).
7. V. R. Kulli, Recent studies in graph theory, Vishwa International Publications, Emerald Academic press, Madras (1989).

Area of Specialization : **Differential Geometry**

Sl. No	Part	Paper Code No.	Name of the Course	Contact Hours per Week	Maximum Marks			Examination Hours
					Continuous Assessment (IA)	Course End-Examination	Total	
01	I	MP83T101F	Advanced Topics in Complex Analysis	04	20	80	100	03
02		MP83T102F	Advanced Topics in Differential Geometry	04	20	80	100	03
03	II	MP83T201	Dissertation work	04	--	--	150	--
04		--	Viva Voce	--	--	--	50	--
Total Marks							**400**	

Paper Code and Name: MP83T101F: Advanced Topics in Complex Analysis	Teaching Hours: 48
Course Outcomes (COs)	
After completing this paper, the students will be able to: CO1. Understand the Complex Differentiability. CO2. Identify holomorphic functions. CO3. Understand Meromorphic functions. CO4. Understand Homotopy form	

Complex Differentiability and holomorphic functions, Fundamental properties of holomorphic functions, The theorems of Wierstrass and Montel, Meromorphic functions, The Looman – Menchoff Theorem, Covering Spaces and Lifting of Curves, Integration, The Monodromy Theorem and the Homotopy form of Cauchy's Theorem.

References:

1. L. V. Ahlfors, Complex Analysis Mc Graw Hill Publications
2. R. Narasimhan and Yves Nievergelt, Complex Analysis in One Variable, Birkhausar Publications.
3. A. R. Shastri, A First Course in Complex Analysis TMH Publications.
4. J. B. Conway, Functions of One Complex Variable, Narosa Publications.

Paper Code and Name: MP83T102F: Advanced Topics in Differential Geometry	Teaching Hours: 48
Course Outcomes (COs)	
After completing this paper, the students will be able to: CO1. Understand the Complex Manifolds. CO2. Identify Kahler manifolds. CO3. Understand Meromorphic functions. CO4. Understand Characterization of Holomorphic domains	

Complex Manifolds, Complex Structures on Manifolds, Almost Complex Structures, Kahler manifolds, Compact Riemann Surfaces, Meromorphic Functions on Compact Riemann Surfaces, Domains of Holomorphy, Characterization of Holomorphic domains.

References:

1. Matsushima, Complex Manifolds, Academic Press.
2. S. T. Hu, Differentiable Manifolds, Academic Press.
3. David R. Mumford, Complex Projective Varieties I Classics in Mathematics Springer Verlag.
4. George Springer, Introduction to Riemann Surfaces, Addisson Wessley Reading MA, 1957.

Paper Code and Name: MP83T201: Dissertation work	Teaching Hours: 48
Course Outcomes (COs)	
After completing this paper, the students will be able to: CO1. Survey literature. CO2. Understand real world problems through mathematical modeling. CO3. Formulate the problem and apply the suitable techniques for solution. CO4. Write the dissertation.	

Dissertation work