Maharshi Dayanand University
Rohtak

Ordinances, Syllabus and Courses of Reading for M.Sc. (Prev.) Mathematics Examination

Session—2002-2003

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ORDINANCE - 'MASTER OF SCIENCE EXAMINATION'

1. The Master of Science Examination shall be held in two parts. Part-I examination shall be held at the end of the first year and Part-II Examination at the end of the second year.

2. The Examination in Part-I and Part-II shall be held once a year ordinarily in the month of April on such dates as may be fixed by the Vice-Chancellor.
   A supplementary examination in Part-II of M.Sc. will be held in December for those candidates who have passed all the papers of part-I examination but have got 'reappear' or have failed or want to improve their score in paper(s) of part-II examination. However, total number of chances will not exceed as given in the Ordinance.

3. The last date for the receipt of admission from and fee without late fee as fixed by the Vice-Chancellor shall be notified to the Heads of the University Teaching Deaprtments and the Colleges concerned.

4. A candidate's admission form and fee may be accepted after the last date on payment of late fee as prescribed from time to time up to the date notified by the University.
   No late fee shall be charged if the admission form and fee are received within three working days of grace after the last date for the receipt of the same without late fee.

5. No one shall be eligible to join the first year (Part-I) class of M.Sc. Course unless he has passed one of the following examination:-
   a) B.Sc. (Hons.) examination of this University with atleast 45% marks in the aggregate in the subject offered for the M.Sc. Course.
   b) B.Sc. (Pass) examination with alteast 50% marks in the aggregate.
   c) An examination of any other university recognised by the University as equivalent to (a) or (b) above.

   Provided that :
   i) to be eligible to join M.Sc. Course in Physics, a candidate must have passed B.Sc. Examination with Physics and Mathematics as two of the main subjects:

ii) to be eligible to join M.Sc. Chemistry, a candidates must have passed B.Sc. Examination with Chemistry as one of the main subject.

Note : A Minimum of 25% of the total seats shall be filled in by the students who have passed the B.Sc. Examination with Chemistry, Physics and Mathematics. Any seat remaining unfilled out of this quota may be offered to other eligible candidates

iii) The eligibility condition for admission to M.Sc. courses shall be as follows :

Bio-Chemistry and Bio-Technology:

B.Sc. (Hons.) exam. of this university in the subject offered for the M.Sc. course or an examination of another University recognised as equivalent thereto with atleast 45% marks in the aggregate.

OR

B.Sc. (Pass) examination of this University or an examination of another University recognised as equivalent thereto with atleast 50% marks in the aggregate provided that a cnadidate must have passed B.Sc. examination with any three of the subjects Botany, Zoology, Chemistry, Microbiology, Genetics, Environmental Science, Medical Bio-Chemistry, Bio-Technology, Bio-Chemistry, Bio-Chemical Engineering, Fermentation Technology, Food Processing, Medical Laboratory Technology, Industrial Chemistry, Applied Haemotology and Industrial Microbiology.

Note :

Out of the three subjects atleast one should be related to Biology.

OR

Bachelor degree with 50% marks in Pharmacy/Home Science/Agriculture/Veternary Science from a recognised University.

M.Sc. (Previous) in Botany, Environmental Sciences, Genetics and Zoology.

a) B.Sc. (Hons.) examination of this university in the subject offered for the M.Sc. course or an examination of another University recognised as equivalent thereto with atleast 45% marks in the aggregate.

OR

b) B.Sc. (Pass) examination of this University or an examination of another University recognised as equivalent thereto with atleast 50% marks in the aggregate provided that :

i) to be eligible to join M.Sc. Botany, a candidate must have passed B.Sc. examination with Botany and any two of the subjects viz. Zoology, Chemistry, Microbiology, Environmental Science, Bio-Chemistry, Bio-Technology, Anthropology, Fisheries and Genetics.

ii) to be eligible to join M.Sc. Environmental Science a candidate must have passed B.Sc. examination with any three of the subjects viz. Botany, Zoology, Chemistry, Microbiology, Environmental Science, Bio-Chemistry, Bio-Technology, Anthropology, Fisheries and Genetics.

iii) to be eligible to join M.Sc. Genetics a candidate must have passed B.Sc. examination with any three of the subjects viz. Botony, Zoology, Chemistry, Microbiology, Environmental Science, Bio-Chemistry, Bio-Technology, Anthropology, Fisheries, Geology and Genetics.

iv) to be eligible to join M.Sc. Zoology, a candidate must have passed B.Sc. examination with Zoology and any two of the subjects viz. Botany, Chemistry, Microbiology, Environmental Science, Bio-Chemistry, Bio-Technology, Anthropology, Fisheries and Genetics.

iv) conditions for admission to M.Sc. Course in Mathematics shall be same as prescribed for admission viz. M.A. Course in this subject.

v) To be eligible to join M.Sc. Course in Geology, a candidate must have passed B.Sc. Examination wtih atleast 50% marks in the aggregate with Geology and any of two of the subjects viz. Physics, Mathematics, Chemistry, Botany, Zoology, Bio-Science and Geography;

vi) to be eligible to join M.Sc. Course in

Mathematical Statistics and Operations Research a candidate must have passed B.A./B.Sc. (Pass) Examination with atleast 50% marks in the aggregate with Mathematics or Statistics as one of the subjects or have passed B.A./B.Sc. (Hons.) Examination in Mathematics or Statistics with atleast 45% marks in Mathematics/Statistics.

There shall be a Project Report in M.Sc. Mathematical Statistics (Final) and that the project report shall be evaluated by the external examiner on five point grading. The last date for submission of Project Report will be two months after the theory papers which can be extended further by two months with the permission of the Vice-Chancellor.

Note : A candidate who is placed under compartment in the qualifying Examination shall not be allowed to join M.Sc. Course. He/She will be eligible only after clearing the qualifying Examination.

6.1 A candidate who has failed in one or more papers or fails to appear in the examination shall be allowed two additional subsequent chances only to pass the examination.

6.2 A candidate who fails to pass the M.Sc. examination within a period of four years of his admission to the course shall be deemed to be unfit for postgraduate studies in the subject concerned.

6.3 A person who has passed the M.Sc. (Previous) examination in the subject concerned from this University shall be eligible to join the M.Sc. final class. This is subject to Clause-6.2 above. However, the candidate who have passed atleast two theory papers out of four or five theory papers or atleast three theory papers out of six or seven theory papers of part-I examination of this University will be promoted to Part-II Class provisionally.

7. M.Sc. Examination in Part-I/Part-II shall be open to a student who :-

a) has passed the requisite qualifying Examination or is covered under Clause-6 and

b) has his name submitted to the Controller of Examinations by the Head of the University Department/Principal of the College. He has

most recently attended and produces the following certificates signed by him:-

i) of possessing good character.

ii) of having remained on the rolls of the Department/College, during the year preceding the Examination.

iii) of having attended not less than 65% of full course of lectures and tutorial separately and 75% of practicals in each part (the course to be counted upto the last day when the classes break up for the preparatory holidays).

8. A candidate whether a regular student or an ex-student shall submit his admission application to the Registrar/Controller of Examination duly signed by the Principal of the College/Head of the University Department he has last attended.

9. Every candidate shall be examined according to the Scheme of examination and syllabus as approved by the Academic Council from time to time.

10. The amount of Examination fee to be paid by a candidate for each part shall be as prescribed from time to time.

Note : A candidate who re-appears in one or more theory or practical papers for the purpose of passing the examination or a candidate who appears in one or more theory papers for the purpose of improvement of score of marks/result shall pay fee as for the whole examination.

11. The medium of instructions and examination shall be English.

12.1 The minimum number of marks required to pass the examination shall be as under:-

i) 33% in each paper (written and practical) separately;

ii) 40% in dissertation/viva-voce where prescribed;

ii) 40% in aggregate.

12.2 A candidate who has completed the prescribed course of instructions in a college/University Teaching Department for Previous/Final examination but has not appeared in it or have appeared fails may be allowed on the recommendation of the Principal of the College/ Head of University Teaching Department concerned to appear in the subsequent years in the

examination paper(s) as the cases may be without attending a fresh course of instructions while re-appearing in the examination, the candidates shall be exempted from re-appearing in the paper(s) and/or practical(s) in which he has obtained atleast 40% marks.

13. As soon as possible, after the termination of the examination the Registrar/Controller of Examinations shall publish the result of the Candidates and issue Detailed Marks Card.

14. The result of candidates who have passed M.Sc. examination shall be classified into divisions, as under and the division ontained by the candidate will be stated in this degree.

a) Those who obtain 60% or more marks — First Division

b) Those who obtain 50% or more but less than 60% marks — Second Division

c) All below 50% — Third Division.

15.1 A candidate who has passed M.Sc. Previous examination with atleast 55% marks may offer dissertation wherever prescribed in the Scheme of Examination for the course. The subject of dissertation shall to approved by the Head of Department concerned. A candidate sahll submit to the Head of the University Department an application for the approval of the topic for the dissertation alongwith a synopsis within one month of his admission to M.Sc. (Final) examination.
Provided in the case of M.Sc, (Geology) exam. there shall be a dissertation based on days field work (surface maping) in the M.Sc. Previous. The work of dissertation will be done in the M.Sc. previous and viva-voce examination of dissertation will be held at the end of M.Sc. previous alongwith practical examination. Provided further that the condition of obtaining 55% marks in M.Sc. previous examination, for offering dissertation in M.Sc. final shall not be applicable in the case of students of M.Sc. (Geology) course.

15.2 Every candidate who offers dissertation shall be required to submit three copies of his dissertation alongwith a brief abstract of the same giving an

account of the Investigation research conducted and its main finding (which will not exceed 500 words). The dissertation shall be examined by one external examiner only.

15.3 The last date for receipt of the dissertation in the office of the Controller of Examinations shall be one month before the commencement of the theory examination : Provided that in exceptional cases; the Vice-Chancellor shall have the power to extend, on the recommendation of the Head of the Department the last date for receipt of the dissertation upto three months. If a candidate fails to submit the dissertation even during the extended period he will be considered to have absented in the dissertation paper and his result shall be declared accordingly.

15.4 A candidate who has submitted a dissertation as part of his examination may withdraw the same before it has been examined but once it is examined and the candidate obtains the minimum pass marks he shall not be permitted to withdraw it or submit another dissertation in lieu thereof. The marks obtained by him for the dissertation shall be taken into account when he appears in any future examination for the purpose of passing therin or for improving score of marks/result.

16. A candidate who has already passed the Master of Science examination from this University, in a subject in which different optional papers are permitted, may appear in one or more optional paper(s) of that subject at an subsequent examination when held as a regular student only. The examination fee shall be as prescribed from time to time.

Such a candidate shall in order to pass, be required to obtain atleast 40% marks in each paper in theroy and practical spearately.

17.1 A person who has passed the M.Sc. previous examinations of this University will be allowed to appear as an ex-student in the M.Sc. previous examinations for improvement alongwith M.Sc. final examinations respectively, only once, in one or more theory paper(s) within a period of 3 years of passing M.Sc. previous examination.

A person who has passed the M.Sc. examination of this University, and desirous of improving his score of marks will be allowed to appear as an ex-student in the M.Sc. final examinations, for improvement only once in one or more theory paper(s) within a period of two years of his passing the M.Sc. examination. In all a candidate will be allowed to avail one chance within the period specified above. Improvement in practical paper is not permissible.

The result of such a candidate shall be declared only if he improves his score of marks, by taking into account the marks obtained by him in the paper(s) in which he re-appeared and the marks obtained by him earlier in the remaining paper(s). The fact that the candidate has improved the division shall be mentioned in the Detail Marks Cards. If a candidate opts to appear in both previous and final examinations for the purpose of improvement but finds that he has improved the score of marks obtained by him in the previous examination, he may not appear in the final examination as the case may be and inform the Controller of Examinations for the declaration of his result.

Provided further that the candidate will take the examination according to the syllabus in force for the regular students for that examination. Provided that the syllabus for the candidates for the special examination to be held in September/October shall be the same as was in force for the regular student in the last annual examination.

18. Notwithstanding the integrated nature of this course which is spread over more than one academic year, the Ordinance in force at the time a student joins the course shall held good only for the exmination held during or at the end of the academic year and nothing in this ordinance shall be deemed to debar the University from amending the Ordinance and the amended Ordinance, if any, shall apply to all students whether old or new.

19. candidate admitted to M.Sc. Course in 1990-91 or earlier shall be governed by the old rules. The new rules shall be applicable w.e.f. the admission of academic Session 1991-92.

Scheme of Examination
for
M.A./M.Sc. (Mathematics)

The duration of the course of instructions for M.A./M.Sc. (Mathematics) degree shall be two years. There will be five papers in each year course. The detailed Scheme of Examination for M.A./ M.Sc. (P revious) Mathematics and M.A./M.Sc. (Final) Mathematics is as give below :

M.A.M.Sc. Mathematics (Previous)
W.E.F. 2002-2003

		Max. Marks	Time
MM 401	Advanced Abstract Algegra	100	3 hrs
MM 402	Real Analysis	100	3 hrs
MM 403	Topology	100	3 hrs
MM 404	Complex Analysis	100	3 hrs
MM 405	Differential Equations	100	3 hrs

M.A./M.Sc. Mathematics (Final)
W.E.F. 2003-2004

Duration of the Course		**One year**	
MM 501	Integration Theory and Functional Analysis	100	3 hrs
MM 502	Partial Differential Equations and Mechanics	100	3 hrs
MM 503	Programming in C (Theory)	70	3 hrs
	Practicals : Programming in C based on the Syllabus MM 503 (Out of four questions given in practical examination, the students will be required to attempt 2 question.)	30	3 hrs
MM 504 & MM 505	Two papers to be offered out of either of the following groups :	100	3 hrs

Pure Group

P_1 Advanced Functional analysis

P_2 Theory of Linear Operators

P_3 Advanced Discrete Mathematics

P_4 Algebraic Coding Theory

P_5 Analytical Number Theory

P_6 Non Commutative Rings

Applied Group

A_1 Mechanics of Solids

A_2 Fluids Dynamics

A_3 Integral Equations and Boundary Value Problems

A_4 Theory of Ordinary Differential Equations

A_5 Biomechanics

A_6 Difference Equations

A_7 Commputational Fluid Dynamics

Note : Question paper will consist of three sections. Section I consisting of one question with ten parts of 2 marks each covering whole of the syllabus shall be compulsory. From Section-II, 10 questions to be set selecting two questions from each unit. The candidate will be required to attempt any seven questions each of five marks. In Section-III, five questions to be set, one from each unit. The candidate will be required to attempt any three questions each of 15 marks.

MM 401 : Advanced Abstract Algebra

Max. Marks : 100

Time : 3 hours

Unit-I

Groups, subgroups, Lagrange's theorem, normal subgroups, quotient groups, homomorphisms, Isomorphism Theorems, cyclic groups, Permutations, Cayley's Theorem, simplicity of A_n for $n \geq 5$.

Unit-II

Normal and Subnormal series. Composition Series, Jordan-Holder theorem. Solvable groups. Nilpotent groups.

Unit-III

Modules, submodules, cyclic modules, simple modules, Schure's Lemma. Free modules, Fundamental structure theorem for finitely generated modules over a principal ideal domain and its application to finitely generated abelian groups. Similarity of linear transformations. Invariant subspaces, reduction to triangular forms. Primary decomposition theorem and Jordan forms. Rational canonical form.

Unit-IV

Rings, subrings ideals, skew fields, integral domains and their fields of quotients, Euclidean rings, polynomial rings, Eisenstein's irreducibility criterian. Prime field, field extensions, Algebraic and transcendental extensions, Splitting field of a polynomial and its uniqueness. Separable and inseparable extensions.

Unit-V

Normal extensions, Perfect fields, finite fields, algebraically closed fields, Automorphisms of extensions, Galois extensions, Fundamental theorem of Galois therory. Solution of polynomial equations by radicals. Insolvability of the general equation of degree 5 by radicals.

Note : Question paper will consist of three sections. Section I consisting of one question with ten parts of 2 marks each covering whole ofthe syllabus shall be compulsory. From Section II, 10 questions to be set selecting two questions from each unit. The candidate will be required to attempt any seven questions each of five marks. In Section III, five questions to be set, one from each unit. The candidate will be required to attempt any three questions each of 15 marks.

Books Recommended

1. I.N.Herstein. Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2. P.B. Bhattacharys, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra (2nd Edition), Cambridge University Press, Indian Edition, 1997.
3. M. Artin, Algebra, Prentice-Hall of India, 1991.
4. P.M. Cohn Algebra, Vols. I, II & III, John Wiley & Sons, 1982, 1989, 1991.

5. N. Jacobson, Basic Algebra, Vol. I & II W.H. Freeman, 1980 (Also published by Hindustan Publishing Company).

6. S. Lang, Algebra, 3rd edition. Addison-Wesley. 1993.

7. I.S. Luther and I.B.S.Passi, Algebra, Vol. I-Groups, Vol. II-Rings, Narosa Publishing House (Vol. I-1996, Vol. II-1990).

8. D.S. Malik, J.N. Mordenson, and M.K. Sen, Fundamentals of Abstract Algebra, McGraw Hill,International Edition, 1997.

9. K.B. Datta, Matrix and Linear Algebra, Prentice Hall of India Pvt., New Delhi, 2000.

MM 402 Real Analysis

Max. Marks : 100

Time : 3 hours

Unit-I

Sequence and series of functions, pointwise and uniform convergence, Cauchy criterion for uniform convergence, Weierstress's M test, Abel's and Dirichlet's tests for uniform convergence, uniform convergence and continuity, uniform convergence and Riemann-Stieltjes, Integration, uniform convergence and differentiation, Weiertrass Approximation theorem, Power Series, uniqueness theorem for power series, Abel's and Tauber's theorems.

Unit-II

Functions of several variables, linear transformations, derivatives in an open subset of R^n, Partial derivatives, Higher order differentials, Taylor's theorem. Explicit and implicit functions. Implicit function theorem and inverse function theorem. Change of variables. Extreme values of explicit and stationary values of implicit functions. Lagrange's multipliers method. jacobian and its properties.

Unit-III

Definition and existence of Riemann-Stieltjes intergral, Properties of the integral, Intergration and differentiation, The fundamental theorem of calculus, Integration of vectorvalued functions, Rectifiable curves.

Set functions, intuitive idea of measure, Elementary properties of measure, Measurable sets and their fundamental properties. Lebesgue measure of sets of real numbers, Algebra of measurable sets, Borel

sets, Equivalent formulation of measurable sets in terms of open Closed, F_σ and G_δ sets Non measurable sets.

Unit-IV

Measurable functions and their equivalent formulations. Properties of measurable functions. Approximation of measurable functions by sequences of simple functions, Measurable functions as nearly continuous functions, Egoroff's theorem, Lusin's theorem, Convergence in measure and F. Riesz theorem for convergence in measure. Almost uniform convergence.

Shortcomings of Riemann Integral, Lebesgue Intergral of a bounded function over a set of finite measure and its properties. Lebesgue Intergral as a generalization of Riemann integral, Bounded convergence theorem, Lebesgue theorem regarding points of descontinuities of Riemann intergrable functions, Integral of non-negative functions, Fatou's Lemma, Monotone convergence Theorem, General Lebesgue Intergral, Lebesgue convergence theorem.

Unit-V

Vitali's covering Lemma, Differentiation of monotonic functions, Functions of bounded variation and its representation as difference of monotonic functions, Differentiation of Indefinite Integral, Fundamental Theorem of Calculus, Absolutely continuous functions and their properties.

L^p spaces, convex functions, Jensen's inequalities. Measure space, Generalized Fatous" Lemma, Measure and outer measures, Extension of a measure, caratheodory Extension Theorem.

Note : Question paper will consist of three sections. Section I consisting of one question with ten parts of 2 marks each covering whole of the syllabus shall be compulsory. From Section II, 10 questions to be set selecting two questions from each unit. The candidate will be required to attempt any seven questions each of five marks. In Section-III, five questions will be set, one from each unit. The candidate will be required to attempt any three questions each of 15 marks.

Books Rcommended

1. Walter Rudin, Principles of Mathematical Analysis (3rd edition) McGraw-Hill, Kogakusha, 1976, International Student Edition.
2. T.M. Apostol, Mathematical Analysis, Narosa Publishing House,

New Delhi, 1985.
3. A.J. White, Real Analysis; an introduction, Addison-Wesley Publishing Co., Inc., 1968.
4. G.deBarra, Measure Theory and Integration, Wiley Eastern Limited, 1981.
5. E.Hewitt and K.Stromberg. Real Abstract Analysis, Berlin, Springer, 1969.
6. P.K. Jain and V.P. Gupta, Lebesgu Measure and Integration, New Age International (P) Limited New Delhi, 1986 (Reprint 2000).
7. I.P. Natanson, Theory of Functions of a Real Variable, Vol. I, Frederick Ungar Publishing Co., 1961.
8. H.L. Royden, Real Analysis, Macmillan Pub. Co., Inc. 4th Edition, New York, 1993.
9. Carothers, Real Analysis, Cambridge University Press.
10. P.R. Halmos, Measure Theory, Van Nostrand, Princeton, 1950.
11. Walter Rudin, Real and Complex Analysis, Tata McGraw Hill Publishing Co. Ltd. New Delhi, 1966.

MM 403 : Topology

Max. Marks : 100
Time : 3 hours

Unit-I

Definition and examples of topological spaces, closed sets and closure, dense subsets. Neighbourhoods interior. Exterior and boundary operations, Accumulation points and Derived sets. Bases and subbase. Subspaces and relative topology. Alternative method of defining a topology in terms of Kuratowski closure operator and neighbourhood systems. Continuous functions and homoemorphisms.

Connected spaces. Connectedness on the real line. Components. Locally connected spaces.

Unit-II

Compactness, continuous functions and compact sets. Basic properties of compactness and finite intersection property. Sequentially and countably compact sets, Local compactness and one point compacitification.

Separation axioms, T_0, T_1 and T_2 spaces, Their characterization and basic properties, Convergence on T_0-space. First and second countable spaces, Lindelof's Theorems, Separable spaces and spearability.

Unit-III

Regular and normal spaces, Urysohn's Lemma and Tietze Extension Theorem, T_3 and T_4 spaces, Complete regularity and complete normality, T_3 and T_5 spaces.

Embedding and Metrization. Embedding Lemma and Tychonoff emedding, Urysohn's Metrization Theorem.

Unit-IV

Product topological spaces, Projection mappings, Tychonoff product topology in terms of standard subbases and its characterizations, Separation axioms and product spaces, Connectedness, locally connectedness and Compactness of product spaces. Product space as first axiom space.

Nets and filters. Topology and convergence of nets. Hausrffness and nets. Compactness and nets. Filters and their convergence. Canonical way of converting nets to filters and vice-versa. Ultra filters and compactness. Stone-Cech compactification.

Unit-V

Covering of a space, local finiteness, paracompact spaces, Michaell theorem on characterization of paracompactness in regular space, Paracompactness as normal, Nagata-Smirnov Metrization theorem

Homotopy of paths, Fundamental group, Covering spaces, The fundamental group of the circle and fundamental theorem of algebra.

Note : Question paper will consist of three sections. Section I consisting of one question with ten parts of 2 marks each covering whole of the syllabus shall be compulsory. From Section-II, 10 questions to be set selecting two questions from each unit. The candidate will be required to attempt any seven questions each of five marks. In Section-III, five questions to be set, one from each unit. The candidate will be required to attempt any 15 questions each of fifteen marks.

Books Recommended

1. James R. Munkres, Topology, A First Course, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.
2. J. Dugundij, Topology, Allyn and Bacon, 1966 (Reprinted in India by Prentice Hall of India Pvt. Ltd.).

3. George F. Simmons, Introduction to topology and Modern Analysis, McGraw-Hill Book Company, 1963.
4. K.D. Joshi, Introduction to General Topology, Wiley Eastern Ltd., 1983.
5. J.L. Kelley, General Topology, Van Nostrand, Reinhold Co., New York, 1966.
6. N. Bourbaki, General Topology Part-I (Trans.), Addison Wesley, Reading, 1996.
7. R. Engelking, General Topology, Polish Scientific Publishers, Warszawa, 1977.
8. W.J. Pervin, Foundations of General Topology, Academic Press Inc. New York, 1964.
9. E.H. Spanier, Algebraic Topology, McGraw-Hill, New York, 1966.
10. S. Willard, General Topology, Addison-Wesley, Reading, 1970.
11. Sze-Tsen Hu, Elements of General Topology, Holden-Day, Inc. 1965.
12. C. Berg, Topological Spaces, Macmillan Company, New York, 1963.

MM 404 Complex Analysis

Max. Marks : 100
Time : 3 hours

Unit-I

Analytic functions, Cauchy-Riemann equation in cartesian and polar coordinates.

Complex integration. Cauchy-Goursat Theorem. Cauchy's integral formula. Higher order derivatives. Morera's Theorem. Cauchy'inequality and Liouville's theorem. The fundamental theorem of algebra. Taylor's theorem.

Unit-II

Isolated singularities. Meromorphic functions. Maximum modulus principle. Schwarz lemma. Laurent's series. The argument principle. Rouche's theorem. Inverse function theorem.

Residues. Cauchy's residue theorem. Evaluation of integrals. Branches of many valued functions with special reference to arg z, log z and z^a.

Unit-III

Biliner transformations, their properties and classifications. Definitions and examples of Conformal mappings.

Space of anylytic functions. Hurwitz's theorem. Montel's theorem. Riemann maping theorem.

Weierstrass' factorisation theorem. Gamma function and its properties. Riemann Zeta function. Riemann's functional equation. Runge's theorem. Mittag-Leffler's theorem.

Unit-IV

Analytic Continuation. Uniqueness of direct analytic continuation. Uniqueness of analytic continuation along a curve. Power series method of analytic continuation. Schwarz Relfection prinicple. Monodromy theorem and its consequences. Harmonic functions on a disk. Harnack's inequality and theorem. Dirichlet problem. Green's function.

Canonical products. Jensen's formula. Poisson-Jensen formula. Hadamard's three circles theorem.

Unit-V

Order of an entire function. Exponent of Convergence. Borel's theorem. Hadamard's factorization theorem.

The range of an analytic function. Bloch's theorem. The Little Picard theorem. Schottky's theorem. Montel Caratheodory and the Great picard theorem.

Univalent functions. Bieberbach's conjecture (Statement only) and the " ¼ theorem.

Note : Question paper will consist of three sections. Section I consisting of one question with ten parts of 2 marks each covering whole of the syllabus shall be compulsory. From Section II, 10 questions to be set selecting two questions from each unit. The candidate will be required to attempt any seven questions each of five marks.Section III, five questions to be set, one from each unit. The candidate wil be required to attempt any three questions each of 15 marks.

Books Recommended

1. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford, 1990.

2. J.B. Conway, Functions of one Complex variable, Springer-Verlag, International student-Edition, Narosa Publishing House, 1980.
3. L.V. Ahlfors, Complex Analysis, McGraw Hill, 1979.
4. S. Lang, Complex Analysis, Addison Wesley, 1977.
5. D. Sarason, Complex Function Theory, Hindustan Book Agency, Delhi, 1994.
6. Mark J. Ablowitz and A.S. Fokas, Complex Variables: Introduction and Applications, Cambridge University Press, South Asian Edition, 1998.
7. C. Caratheodory, Theory of Functions (2 Vols.), Chelsea Publishing Company, 1964.
8. M. Heins, Complex Function Theory, Academic Press, 1968.
9. Walter Rudin, Real and Complex Analysis, McGraw-Hill Book Co., 1966.
10. E.C. Tichmarsh, The Theory of Functions, Oxford University Press, London.
11. W.A. Veech, A Second Course in Complex Analysis, W.A. Benjamin, 1967.
12. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.

MM 405 Differential Equations

Max. Marks :100
Time : 3 Hours

Unit-I

Preliminaries : Initial value problem and the equivalent integral equation, mth order equation in d-dimensions as a first order system, concepts of local existence, existence in the large and uniquness of solutions with examples.

Basic Theorems : Ascoli-Arzela Theorem. A theorem on convergence of solutions of a family of initial problems.

Picard-Lindelof theorem-Peano's existence theorem and corollary. Maximal intervals of existence. Extension theorem and corollaries. Kamke's convergence theorem. Kneser' theorem (statement only).

Unit-II

Dependence on initial conditions and parameters : Preliminaries.Continuity. Differentiability. Higher Order Differentiability.

Differential Inequalities and Uniqueness : Gronwall's inequality. Maximal and Minimal solutions. Differential inequalities. A theorem of Wintner. Uniqueness Theorems. Nagumo's and Osgood's criteria.

Egres points and Lyapunov functions. Successive approximations.

Unit-III

Linear Differential Equations : Linear Systems, Variation of constants, reduction to smaller systems. Basic inequalities, constant coefficients. Floquet theory. Adjoint systems, Higher order equations.

Unit-IV

Poincare-Bendixson Theory : Autonomous systems. Umlanfsatz. Index of a stationary point. Poincare-Bendixson theorem. Stability of periodic solutions, rotation points, foci, nodes and saddle points.

Use of Implicit function and fixed point theorems : Period solutions. Linear equations. Nonlinear problems.

Second order Boundary value problems-Linear Problems. Nonlinear problems. Aprori bounds.

Unit-V

Linear second order equations : Preliminaries. Basic facts. Theorems of Sturm. Sturm-Liouville Boundary value Problems. Number of zeros. Nonoscillatory equations and principal solutions Nonoscillation theorems.

Note : Question paper will consist of three sections. Section I consisting of one question with ten parts of 2 marks each covering whole of the syllabus shall be compulsory. From Section II, 10 questions to be set selecting two questions from each unit. The candidate will be required to attempt any seven questions each of five marks.Section III, five questions to be set, one from each unit. The candidate will be required to attempt any three questions each to fifteen marks.

Recommended Texts

1. P. Hartman, Ordinary Differential Equations, John Wiley (1964).
2. W.T. Reid, Ordinary Differential Equations, John Wiley and Sons, NY (1971).
2. E.A. Coddington and N.Levinson, Theory of Ordinary Differential Equations, McGraw-Hill, NY (1955).