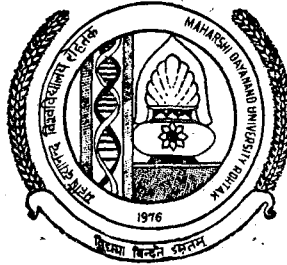


Maharshi Dayanand University Rohtak



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

Session—1999-2000

Available from :

Deputy Registrar (Publication)
Maharshi Dayanand University
Rohtak-124 001 (Haryana)

Price :

At the Counter : Rs. 50/-
By Regd. Parcel : Rs. 75/-
By Ordinary Post : Rs. 60/-

ORDINANCE : MASTER OF ARTS EXAMINATION

1. The Master of Arts 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/May, on such dates as may be fixed by the Vice-Chancellor.

A supplementary examination in Part-II of M.A. will be held in December or on such dates as may be fixed by the Vice-Chancellor for those candidates who have passed all the Papers of Part-I exam, but have got 're-appear' 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 form and fee without late fee as fixed by the Vice-Chancellor, shall be notified to the Heads of the University Teaching Departments, P.G. Regional Centre Rewari and the colleges concerned.
4. A candidate's admission form and fee may be accepted after the last date on Payment of late fee of Rs.105/- upto the date notified by the University.

Note: 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. A person who has passed one of the following Examinations, shall be eligible to join the first year (Part-I) class of Master of Arts course: (except Master of Physical Education).
 - (i) B.A./B.Sc./B.Com. (Hons.) Examination in the subject of Postgraduate Course.
 - (ii) B.A./B.Sc./B.Com. (Hons.) in a subject other than the subject of Post-graduate Course with atleast 50% marks in the aggregate.
 - (iii) Ist Bachelor's degree with atleast 50% marks in aggregate or 45% marks in the subject of P.G. Course in which the candidate wishes to seek admission.
 - (iv) Shastri Examination (New scheme) of this University in the manner prescribed in (i) and (ii) above.
 - (v) Master's degree examination in another subject.
 - (vi) The B.A. degree obtained through English only etc. shall be considered for admission to M.A. in various subjects at par with B.A. degree.

- (vii) An examination of any other University recognised by this University as equivalent to (i) or (ii) or (iii) or (iv) or (v) or (vi) above.

Provided that:

- a) A candidate who has passed B.Com. Examination with atleast 45% marks in the subject(s)/paper(s) related to Economics including Statistics shall also be eligible to take up M.A. Economics course.
- b) A candidate who has passed B.Sc. (Agri.) with Agriculture Economics as one of the paper/subjects shall also be eligible to join M.A. Economics course.
- c) A candidates who has passed B.A. examination with atleast 45% marks in *Public Administration or Sociology* shall be eligible to thake up M>A. Political Science.
- d) A candidate getting atleast 55% marks in Hindi (Compulsory) subject may also be considered eligible for admission to M.A. Hindi.
- e) A candidate who has passed B.A. (Hons.) in Sanskrit with atleast 45% marks or B.A. Examination with atleast 45% in Sanskrit (Elective) may also be considered eligible to tade up M.A. (Hindi), if the cdandidates who have passed B.A. (Hons.) Hindi or B.A. with Hindi (Elective) obtaining 45% marks are not available
- f) A candidate who has passed Bachelors Degree Examination in Music (B.Mus. from any Indian University shall be eligible for admission to M.A. course without any condidion of minimum percentage of but no one who dida not take up Music as one of his subject for the B.A. Examination shall be eligible to take up M.A. Music provided he is working as a teacher of Music in a college admitted to the Privileges of this University or in a recognised Higher Secondary School within the jurisdiction of the University or in addition to passing B.A./B.Sc. he has passed one of the following examination:

Sangeet Visharad: Form Bhatkhande Sangeet Vidyapeeth Lucknow or from Gandharva Mahavidyalaya, Bombay.

Sangeet Prabhakar: From Prayag Sangeet Smiti, Allahabad or from Rafasthan Sangeet Sansthan, Jaipur.

Sangeet Visharad: From Prachin Kala Kender Chandigarh.

- g) A candidate who has passed B.A. Examination with Sociology or an allied subject such as Psychology, Political Science, Economics, History and Geography as one of the subjects with 45% marks in aggregate and 45% marks in Sociology or allied subject mentioned above shall be eligible to take up M.A. Sociology.
- h) A candidate who has passed B.A. Examination with History or in any other subject listed in the Faculty of Social Sciences (i.e. Political Science, Sociology, Public Administration, Geography, Psychology etc.) obtaining at least 45% marks in the subject shall be eligible to take up M.A. History.
- i) A candidate who has not passed B.A./B.Sc. (Pass or Hons.) with Mathematics as one of the subjects shall not be eligible to join M.A. Mathematics Course.
- j) A candidate who has studied the subject of Sanskrit at B.A. level, whether elective or compulsory, for a full span of three years shall be eligible to seek admission to M.A. Sanskrit Course. The minimum percentage of marks for those who have studied Sanskrit compulsory should be 55% in the subject.
- k) For admission to M.A. (Rural Development) a candidate must have passed Sc. (Agriculture) with Agricultural Economics as one of the papers/subjects obtaining 50% marks in aggregate or B.A. with 45% marks in any subject of Social Sciences.

FOR M.A. PHYSICAL EDUCATION

Eligibility condition for admission to M.A. Physical Education:-

Note: A person who has passed one of the following examinations shall be eligible to join the 1st year (Part-I) of the Master of Arts (Physical Education) course:-

- A i) A Bachelors's Degree examination in Humanities of the M.D. University, Rohtak or an examination recognised as equivalent thereto with at least 45% marks in the aggregate with English as one of the subjects at the under-graduate level or B.Com./B.Sc./B.Sc. (Home Science) B.Sc. (Agri.) with 45% marks.
- ii) B.P. Ed./D.P. Ed. one year course after graduation with at least 50% marks.
- iii) B.A./B.Sc. with Health and Physical Education as one of the subjects in three years degree course with at least 50% marks.
- iv) Bachelor of Physical Education (B.P.F.) three year degree course with at least 50% marks.

v) B.S.H. and P.E. five years course with atleast 50% marks.

AND

B The candidate has taken part in the Inter-University or Inter state or National Tournament in the games and sports recognised by the Inter-University Sports Board Provided that the candidate qualified in the standard efficiency test at the time of Examination to the first year course.

IMPORTANT NOTE

A person who has passed Post-graduate examination shall not ordinarily be allowed to seek admission to P.G. Course in another subject as a regular student.

6. A candidate who is placed under compartment in the qualifying exam shall not be allowed to join M.A. Course.
7. A candidate who has failed in one or more paper(s) or fails to appear in M.A. Examination shall be allowed two additional subsequent chances only to pass the M.A. examination. This is however, subjects to the provision in Clause-8 below.
8. A candidate who fails to pass the M.A. Examination within a period of four years of his admission to the course shall be deemed to be unfit for Post-graduate Studies in the subject concerned.
9. A person who has passed the following Examinations shall be eligible to join the M.A. Part-II:-
 - a) M.A. Part-I Examination from M.D. University, in the subject concerned. This is however, subject to Clause-7. However, the candidates 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 exam. of the University will be promoted to Part-II class, provisionally

OR

- b) M.A. Part-I Examination of the subject offered from the Kurukshetra University or Panjab University or Punjabi University, or Guru Nanak Dev University or Himachal Pradesh University, provided that the Head of the University Departments/Principal of the college concerned is satisfied that the contents of papers already passed by him are almost the same as in the M.A. Part-I Examination this University; in this case the marks obtained in M.A. Part-I of the course at any of these Universities shall be counted towards division of

successful candidates by increasing or reducing the marks obtained in accordance with maximum marks prescribed for M.A. Part-I Examination of this University.

10. The M.A. Examination in Part-I/Part-II shall be open to a student who:-

- a) has passed the requisite qualifying Exam. or is covered under Clause-5 and 8 and
- b) has his name submitted to the Controller of Examinations by the Head of the University Dept./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 Department/College during the year preceding the Examination and of having attended not less than 65% of the full course of lectures and tutorials separately and 75% of practicals (the courses to be counted upto the last day when the classes break up for the preparatory holidays).

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

12. The amount of Examination fee to be paid by a candidate for each year shall be as follows :

| Regular | Ex-Student |
|---|------------|
| Rs. 100/- (Plus Rs. 20/- per practical Rs. 110/- Subject) | |

13. A candidate who re-appears in one more paper(s) Practical(s) for the purpose of passing/improvement of score of marks/result shall pay fee as for the whole Examination.

- i) The medium of instructions shall be:-
 - a) Hindi in case of Hindi and English in case of English
 - b) English or Hindi or Sanskrit in case of Sanskrit and
 - c) English/Hindi in case of other subjects.
- ii) The question papers will be set :-
 - a) in Hindi in case of Hindi, Sanskrit and Music and
 - b) in English and Hindi in case of other subjects.

iii) The candidate shall write their answer as under :-

- a) in Hindi in case of Hindi;
- b) in English or Hindi or Sanskrit in case of Sanskrit
- c) in English in case of English and Mathematics and
- d) in English/Hindi in case of other subjects.

15.1. The minimum number of marks required to pass the Examination shall be as under :

A) In all subjects except Physical Education

- i) 33% in each paper (written and practical separately);
- ii) 40% in each practical in the case of Music;
- iii) 40% in Dissertation/Viva-Voce, where prescribed;
- iv) 40% in aggregate

B) In Physical Education

- i) 35% in each theory paper;
- ii) 40% in practical; and
- iii) 40% in aggregate

15.2. A candidate who has completed the prescribed course of instructions in College/University Teaching Department for previous/final examination but has not appeared in it or having 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 year in the examination paper(s) as the case may be without attending a fresh course of Instruction. While reappearing in the examinations the candidate shall be exempted from reappearing in paper(s) and/or practical(s) in which he has obtained atleast 40% marks.

16.1. A candidate who has passed M.A. Part-I Examination obtaining at least 55% marks in aggregate may offer dissertation wherever prescribed in the Scheme of Examination for the course. The subject of the dissertation shall be approved by the Head of the Department concerned. A candidate shall submit to the Head of the Department an

application for the approval of the topic for the dissertation along with a synopsis within one month of his admission to M.A. Part-II.

- 16.2 Every candidate who offers dissertation shall be required to submit three copies of his dissertation along with a brief abstract of the same giving an account of the investigation/research conducted and its main findings (which will not exceed 500 words). The dissertation shall be examined by one external Examiner only.
- 16.3 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, 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 his dissertation even during the extended period he will be considered to have absented in the dissertation paper and his result shall be declared accordingly.
- 16.4 A candidate who has submitted a dissertation as a part of the Examination may withdraw the same before it has been examined but once it is examined and 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 in to account when he appears in any future examination for the purpose of passing therein or for improving the score of marks/result.
17. As soon as possible, after the termination of the examination the Registrar/Controller of Examinations shall publish the result of candidates and issue Detailed Marks Card.
18. The result of candidates who have passed the M.A. examination shall be classified into division as under, the division obtained by the candidate will be stated in his degree :-
- | | |
|---|-----------------|
| a) Those who obtain 60 percent or more marks | First Division |
| b) Those who obtain 50 percent or more but less than 60 percent marks | Second Division |
| c) All below 50 percent | Third Division |

19. A candidate who has already passed the Master of Arts Examination from this University, in a subject in which different optional papers are permitted, may appear in one or more other optional papers of that subject, at any subsequent examination when held, without attending a regular course of study on payment of fee as prescribed for the whole exam. Provided that if there is any corresponding Practical work involved he must attend the prescribed number of practicals etc. in the Department. Such a candidate shall, in order to pass, be required to obtain at least 40 percent marks in each paper.
20. A candidate who has passed Part-I of M.A. Examination of this University, will be allowed to appear for improvement of his result as an ex-student in one or more theory papers of M.A. Part-I Examination once within a period of three years of his passing the Part-I Examination. A candidate who has passed Part-II of M.A. Examination of this University will be allowed to appear for improvement of his result as an ex-student in one more theory paper(s) of the M.A. Part-II. Examination once within a period of two years of his passing the Part-II Examination.

The candidates may however, appear for improvement of Part-I Examination simultaneously with Part-II Examination while appearing in Part-II Examination for passing or for Improvement.

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 reappeared and the marks obtained by him earlier in the remaining paper(s) etc. The fact that the candidate has improved shall be mentioned in the Detailed-Marks Card.

Provided further that the candidate will take the Examination according to syllabus in force for the regular student for that examination.

21. 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 hold good only for the examination 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.

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. (Previous) Mathematics and M.A. / M.Sc.(Final) Mathematics is as given below:-

M.A./M.Sc. (Mathematics) Previous

| | | Max. Marks | Time |
|-----------|--|------------|---------|
| Paper-I | Real Analysis | 100 | 3 hours |
| Paper-II | Algebra | 100 | 3 hours |
| Paper-III | Mechanics and Calculus of Variations | 100 | 3 hours |
| Paper-IV | Differential and Integral Equations | 100 | 3 hours |
| Paper-V | Complex Analysis and Differential Geometry | 100 | 3 hours |

M.A./M.Sc. (Mathematics) (Final)

| | | | |
|------------|--|----------------------------|------------------|
| Paper-VI | General Topology | 100 | 3 hours |
| Paper-VII | General Measure Theory and Functional Analysis. | 100 | 3 hours |
| Paper-VIII | Statistical and Numerical Methods and Computer Programming | Theory 70 Practicals 30 | 3 Hrs. 4 Hrs. |

(Computer Programming based on Statistical and Numerical Methods)

Paper-IX & X Two papers to be offered out of either of the following groups:

Applied Group

- A_1 Fluid Dynamics
- A_2 Theory of Elasticity
- A_3 Electro Magnetic Theory
- A_4 Magnetohydrodynamics
- A_5 Mathematical Statistics
- A_6 Theory of Relativity
- A_7 Mathematical Methods
- A_8 Theoretical Seismology
- A_9 Continuum Mechanics

Pure Group

- P₁ Theory of Numbers
- P₂ Theory of Groups and Fields
- P₃ Operator Theory
- P₄ Applied Algebra
- P₅ Computer Mathematics
- P₆ Probability Theory
- P₇ Differential Manifolds
- P₈ Calculus on Banach Spaces
- P₉ Approximation Theory
- P₁₀ Fourier Analysis
- P₁₁ Algebraic Topology and Category Theory

M.A./M.Sc. Mathematics (Previous)

Paper-I Real Analysis

Max. Marks : 100

Time : 3 Hours

Section-I (Two Questions)

Functions on \mathbb{R}^n , Differentiation on functions on \mathbb{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, Lefschetz's multipliers methods. Jacobians and its properties.

Section-II(Three Questions)

Set functions. Intuitive idea of measure. Elementary properties of measure. Counting measure. Measurable sets and their fundamental properties. Lebesgue measure of sets of real numbers. σ algebra of measurable sets. Borel sets. Equivalent formulations of measurable sets in terms of open, closed, G_δ and F_σ sets. Non-measurable sets. 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. Eiesz theorem for convergence in measure.

Section-III(Three Questions)

Riemann Integral and its shortcomings. Lebesgue Integral of a bounded function over a set of finite measure and its properties. Lebesgue Integral as generalization of Riemann Integral, Bounded convergence theorem. Lebesgue theorem regarding points of discontinuities of Riemann integrable functions. Integral of non-negative function, Fatou's lemma. Monotone convergence theorem. General Lebesgue integral, Lebesgue convergence theorem and its generalizations. Vitali's 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.

Sections IV (Two questions)

Trigonometric series, Fourier series associated to a Lebesgue Integral periodic function. Fourier coefficients. Convergence problem of Fourier series. Dirichlet's Integral, Riemann Lebesgue theorem. Dini's Jordan's and de la Valee-Pousson's test of convergence. Convergence through out the interval. Fejer's Theorem of summability of Fourier series by arithmetic means, Fejer-Lebesgue theorem, Continuous function with a divergent Fourier series. Integration of Fourier series. Parseval's theorem. Functions of class L^2 : Bessel's inequality Riesz-Fischer theorem.

Books Suggested

- | | |
|---------------------|-----------------------------------|
| 1. Phillips .E.G. | A Course of Mathematical Analysis |
| 2. Royden, H.L. | Real Analysis |
| 3. Halmos, P.R. | Measure Theory |
| 4. Titchmarsh, E.C. | The Theory of Functions. |

NOTE: The questions paper will consist of ten questions as indicated. The candidate will be required to attempt five questions selecting at least one question from each section.

Paper-II

ALGEBRA

Max. Marks : 100

Time : 3 Hours

Section-I (Three Questions)

Groups, subgroups, cosets, Lagrange's theorem, normal subgroups, quotient groups, homomorphisms, Isomorphism theorems, cyclic groups, Cauchy's theorem for abelian groups. Permutations, Cayley's Theorem, Permutation group, simplicity of A_n for $n \geq 5$

(Sections 2.1-2.10, of Chapter-2 of Topics in Algebra by I.N. Herstein)

Section-II (Two Questions)

Rings, subrings, ideals, skew fields, fields, integral domains and their fields of quotients, characteristic of a field and prime fields Euclidean rings, polynomial rings, Eisenstein's irreducibility criterion, unique factorization domains.

(Sections 3.1-3.7, 3.9-3.11 of Chapter-3 of Topics in Algebra by I.N. Herstein).

Section-III (Two Questions)

Vector spaces, Linear independence and Bases, Dual spaces, Modules, submodules, quotient modules, Hom (M:N).

(Sections 4.1-4.3, 4.5 of Chapter-4 of Topics in Algebra by I.N. Herstein)

Section-IV (Three Questions)

Finite dimensional real and complex inner-product spaces. Cauchy-Schwartz inequality, Orthonormal basis, self adjoint, unitary and normal transformations. Real quadratic forms and complex Hermitian forms. Signature of real quadratic forms. Positive definite, semi-definite and negative definite quadratic forms. Sylvester's law of inertia, Triangular, Jordan and Rational canonical-forms for a matrix.

(Section 4.4 of Chapter-4 and 6.1-6.4, 6.6,6.7,6.10,6.11 of Chapter-6 of Topics in Algebra by I.N. Herstein)

Books Suggested

1. P.B. Bhattacharya and S.K. Jain : First Course in rings, Field and Vector spaces (Wilay Eastern)
2. P.M. Cohn : Algebra, Vol. I & II (John Wilay)
3. I.N. Herstein : Topics in Algebra (Vikas)
4. B.W. Jones : Linear Algebra (Olden Day)
5. Hoffman & Kunze : Linear Algebra (Prentice-Hall Inc.)
6. S.Lange : Linear Algebra (Addison-Wilay).
7. Surjeet Singh & Quazi Zameeruddin : Modern Algebra (Vikas)
8. I.S. Luthar & I.B.S. Passi : Algebra Vol. I (Narosa)
9. Krishnamurthy, Mainra and Arora : An introduction to Linear Algebra (Affiliated East-West Press).

Note : The question paper will consist of Ten questions as indicated. The candidates will be required to attempt five questions selecting atleast one question from each section.

Paper-III Mechanics and Calculus of Variations **Max. Marks : 100**
Time : 3 Hrs.

Section I (Three Questions)

Statics. Virtual work. Forces in three dimension. Conditions of equilibrium. Constrained bodies. Principle of Virtual work. Work function.

Poinsot's central axis. Wrench. Reciprocal Screws. Null lines and null planes. (Sections 100-106, 162-194, 203-209 of Loney's book).

Section II (Two Questions)

Curvilinear co-ordinates. Orthogonal curvilinear coordinates. Gradient, Divergence, Curl and Laplacian operator in term of Curvilinear, Cylindrical and spherical polar coordinates.

Calculus of Variations. Lagrange's multipliers, Euler-equation. Stationary function. Natural boundary and transition conditions. Variational notation. Functionals. Variable end points. Sturm-Liouville problem. Hamilton's principles (Sections 2.1-2.10 of Hildebrand's book).

Section III (Two questions)

Dynamics of particle. Velocity and acceleration of a particle along a curve. Radial and transverse components. Relative velocity and acceleration. Angular velocity. Composition of angular velocities. Moving axes. Instantaneous axis and centre of rotation.

Motion of a particle under a central force. Differential equations for a central orbit in polar and pedal coordinates. Kepler's laws. Newton's law of gravitation, Disturbed orbits.

Linear and angular momentum of a system of particles. Impulsive forces (Section 2.1.2.10, 5.1-5.5, 6.1-6.5 of Charlton's book.)

Section IV (Three questions)

Dynamics of rigid body. Moments and Products of inertia. Theorems of parallel and perpendicular axes. Principal axes, Momental ellipsoid. Coplanar distributions.

Euler's dynamical equations. Rigid body motion under no forces.

Generalized co-ordinates. Generalized velocities. Virtual work and generalized forces. Lagrange's equations of a holonomic system for conservative forces and for impulsive forces. Kinetic energy as a quadratic function of velocities. Small oscillations of conservative holonomic dynamical systems. (Sections 7.1-7.8, 9.1-9.3, 10.1-10.12 of Charlton's book).

The Hamilton-Jacobi equations (Section 10.2 of Synge and Griffith's book)

Books Suggested

- | | |
|----------------------------------|---------------------------------|
| 1. Loney, S.L. | Elementary Treatise in Statics |
| 2. Narayan, S. | A Text Book of Vector Calculus. |
| 3. Hildebrand, F.S. | Methods of Applied Mathematics |
| 4. Charlton, F. | Test book of dynamics |
| 5. Synge, J.L. and Griffith, B.A | Principles of Mechanics |

NOTE: The question paper will consist of ten questions as indicated. The candidate will be required to attempt five questions, selecting atleast one question from each section.

Paper-IV Differential and Integral Equations.

Max. Marks : 100

Time : 3 Hrs.

Section I (Three Questions)

Linear differential equations, methods of undetermined coefficients and variation of parameters, reduction of order of a linear differential equations, general properties of solutions of linear differential equations of order n , Wronskian, linear dependence and independence of solutions.

System of simultaneous equations of the type $dx/P=dy/Q=dz/R$, total differential equations.

Adjoint and self-adjoint equations, Lagrange's identity, Green's function, Sturm-Liouville's boundary value problems, eigen functions and eigenvalues, expansion in eigenfunctions, Sturm's comparison and separation theorems.

Section II (Two Questions)

Integration in series: Power series solution of linear differential equations about an ordinary point, regular singular point and the point at infinity.

Hypergeometric functions: Hypergeometric differential equation and its solution in series, Hypergeometric function and its simple properties.

Bessel functions: Bessel equation and its solution in series, Bessel functions, generating function, recurrence relations, integral representations of $J_n(x)$, addition formula for $J_n(x)$, orthogonality of Bessel functions, expansion of a function in a series of Bessel functions, Behaviour of $J_n(x)$ for large values of x .

Legendre functions: Legendre equation, Legendre polynomials and Legendre functions, Rodrigue's formula generating functions, recurrence relations, orthogonality of Legendre polynomials, definite integral representation of $P_n(x)$, expansion of a function in a series of Legendre polynomials, behaviour of $P_n(x)$ for large values of n .

Section III (Three Questions)

Formation of partial differential equations, classification of integrals of first order equations, Lagrange's linear equations, determination of surfaces orthogonal to a given system of surfaces, compatible systems of first order equations, Charpit's method special types of first order equations, solutions satisfying given conditions, Jacobi's method.

Second order linear equations with constant coefficients, equations with variable coefficients, classification of second order equations with two independent variables and reduction to canonical forms, Monge's method for the solution of nonlinear equations.

Solutions of Laplace, wave and heat equations (Cartesian coordinates only) by the method of separation of variables with reference to boundary value problems.

(Section 2.1, 2.2, 2.4-2.7, 2.9-2.13, 3.1, 3.4, 3.5, 3.9-3.11, 4.5, 5.4 and 6.4 of Sneddon's Book)

Section IV (Two Questions)

Linear integral equations: Volterra and Fredholm integral equations of different kinds, initial and boundary value problems reduced to integral equations, methods of successive substitution and approximations for the solution of integral equations of second kind, Laplace transform method, solution of Volterra equation of the first kind, Neumann series, homogeneous and nonhomogeneous Fredholm equations with separable kernels, approximation of a kernel by a separable kernel, methods of resolvent and iterated kernels for Fredholm equations of second kind.

Books Suggested

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|---------------------|---|
| 1. Jari, A.J. | Introduction to Integral Equations with Applications. |
| 2. Hildebrand, F.B. | Methods of Applied Mathematics |
| 3. Ross, S.L. | Differential equations. |
| 4. Sen, B. | Treatise on special functions for scientists and engineers. |
| 5. Sneddon, I.N. | Elements of partial Differential Equations |
| 6. Sneddon, I.N. | Special functions of mathematical physics and Chemistry. |

Note: The question paper will consist of ten questions as indicated. The candidate will be required to attempt five questions, selecting at least one question from each section.

Paper-V Complex Analysis and Differential Geometry

Max. Marks : 100

Time : 3 Hrs.

Section I (Three Questions)

Analytic functions, Cauchy Riemann Equations in cartesian and Polar Coordinates. Circle and Radius of Convergence of Power Series, term by term differentiation of a Power series within its circle of convergence. Complex integration, integration along a regular arc, absolute value of complex integral. Cauchy's Theorem, Cauchy's Integral Formula, derivative of an analytic functions, Morera's Theorem, Cauchy's Inequality, Liouville's Theorem, Taylor's and Laurents Theorem isolated singularities of an analytic functions, limit points of zeros and poles, Weierstrass-Theorem about the

behaviour of an analytic function near an isolated essential singularity. Cauchy's Residue Theorem and its application to the evaluation of definite integrals.

Section II (Two Questions)

Poles and zeros of a meromorphic functions, Argument Principle, Rouchy's Theorem, Fundamental Theorem of Algebra, Hurwitz's Theorem, level curves and zeros of $f(z)$, Poisson's Integral Formula, Expansion of Meromorphic functions by Mittag-Leffler's Theorem and its application to trigonometric functions. Maximum Modulus Principle and Minimum Modulus Principle, Schwarz's Lemma, Hadamard's Three Circle Theorem and its convexity form.

Section III (Two Questions)

Integral function, Factorization of Integral function, Weierstress's Theorem concerning the construction of integral function. Definition and uniqueness of analytic continuation. Power Series Method for analytic continuation, Natural Boundaries, Branch Points and Branch Lines, Riemann surfaces. Isogonal and Conformal Mappings, Critical Points, Bilinear Transformation. Transformation of a circle, conformal representation of a half plane on a circle.

Section IV (Three Questions)

Laplace Transform, Existence Theorem and properties, Laplace transform of various functions, Inverse Laplace Transform and its properties, convolution Theorem, Inversion theorem, Solution of ordinary differential equations using Laplace Transforms, Fourier Integral Theorem, Fourier Transforms and its Properties, Fourier transforms of simple functions, convolution Theorem, Application of Fourier transforms to solve ordinary differential equations.

Differential Geometry of curves in space, Serret-Frenet Formula. Spherical curvature and locus of its centre. Envelopes, Edge of regression, curvi-linear coordinates, First and Second order Magnitudes (Sections-1-6,13-16 and 22-27 of Weatherburn's Book).

Books Suggested

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|----------------------|---|
| 1. Copson, E.T. | An Introduction to the Theory of functions of a complex Variable. |
| 2. Sneddon, I.N. | Use of Integral Transforms |
| 3. Titchmarsh, E.C. | The Theory of Functions. |
| 4. Weatherburn, C.E. | Differential Geometry of Three Dimension. |
| 5. Williams, J., | Laplace Transforms. |

NOTE: The question paper will consist of ten questions as indicated. The candidate will be required to attempt five questions, selecting at least one question from each section.