

## **M.A./ M.Sc. MATHEMATICS EXAM.- 2019-20**

1. The Ordinances Governing the examination in the Faculties of Arts, Fine Arts, Social Sciences, Science, Commerce, Management, Engineering, Education and Law are contained in separate booklet. The students are advised to refer to the same.
2. Changes in Statutes/ Ordinances/ Rules/ Regulations/ Syllabus and Books may, from time to time, be made by amendment or remaking , and a candidate shall, except in so far as the University determines otherwise comply with any change that applies to years he has not completed at the time of change.

**Note :** The decision taken by the Academic Council shall be final.

**SCHEME OF EXAMINATION - 2019-20**  
**M.A./ M.Sc. MATHEMATICS**

**Scheme – Semester**

**Duration of course**

**There shall be four semesters in Two consecutive academic years and two semesters in an academic year**

Teaching hours :- 6 hours/week for each paper

**Paper Code will stand as MATH for mathematics, 1/2/3/4 for semester number, C or O for compulsory/ optional and ( i/ii/iii/iv/v/...) for paper number.**

There shall be 5 Papers in each of the four semesters. Each paper has Max. 100 marks (30 marks for Internal assessment, Exam. Time duration 1 hour. and 70 marks for Main semester Exam, Duration 3 hours.) Min. Pass Marks for Internal Assessment shall be 12 and for Semester Exam. 28 for each paper .

**Pattern of Question paper (Semester Exam.)**

The syllabus for each theory paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

**Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10

**Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25

**Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

**Code and nomenclature of papers**

Semester I			Semester II		
Sn	Code	Name Of Paper	Sn.	Code	Name Of Paper
1	MATH 1 C(i)	ADVANCED ALGEBRA I	6	MATH 2 C(i)	ADVANCED ALGEBRA
2	MATH 1 C(ii)	COMPLEX-ANALYSIS	7	MATH 2 C(ii)	REAL ANALYSIS
3	MATH 1 C(iii)	MECHANICS	8	MATH 2 C(iii)	PARTIAL DIFFERENTIAL EQUATIONS
4	MATH 1 C(vi)	INTEGRAL EQUATIONS	9	MATH 2 C(vi)	SPECIAL FUNCTION
5	MATH 1 C(v)	NUMERICAL ANALYSIS	10	MATH 2 C(v)	DISCRETE MATHEMATICS

*N.B. CANDIDATE HAS TO OPT OPTIONAL PAPER IN FOUTTH SEMESTER KEEPING THE SAME PAPER NUMBER OF THIRD SEMESTER.*

Semester III			Semester IV		
Sn.	Code	Name Of Paper	S n.	Code	Name Of Paper
6	MATH 3 C(vi)	FUNCTIONAL ANALYSIS I	6	MATH 4 C(vi)	FUNCTIONAL ANALYSIS II
7	MATH 3 C(vii)	TOPOLOGY I	7	MATH 4 C(vii)	TOPOLOGY II
<b>OPTIONAL PAPERS</b>					
1	MATH 3 O(i)	OPERATIONS RESEARCH I	1	MATH 4 O(i)	OPERATIONS RESEARCH II
2	MATH 3 O(ii)	FLUID DYNAMICS I	2	MATH 4 O(ii)	FLUID DYNAMICS II
3	MATH 3 O(iii)	MATHEMATICAL STATISTICS I	3	MATH 4 C(iii)	MATHEMATICAL STATISTICS II
4	MATH 3 O(iv)	PROGRAMMING IN C WITH ANSI FEATURES I	4	MATH 4 O(iv)	PROGRAMMING IN C WITH ANSI FEATURES II
5	MATH 3 O(v)	MATHEMATICAL MODELING I	5	MATH 4 O(v)	MATHEMATICAL MODELING II
6	MATH 3 O(vi)	RELATIVITY I	6	MATH 4 O(vi)	RELATIVITY II
7	MATH 3 O(vi)	HYPERGEOMETRIC FUNCTIONS & POLYNOMIALS I	7	MATH4 O(vii)	HYPERGEOMETRIC FUNCTIONS & POLYNOMIALS II

## M.A./M.Sc. MATHEMATICS 2019-20

### Semester I

#### MATH 1 C(i) :- LINEAR ALGEBRA I

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The syllabus for each theory paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

**Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10

**Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25

**Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

### Unit - I

Linear transformations, Range, Kernel, Rank-nullity theorem, Singular and nonsingular transformations, Vector space of linear transformations. Linear functional, Dual and bidual of a Vector space, Annihilators, Invariance, Projections, Adjoint of a linear transformations.

### Unit-II

Matrix representation of a linear transformation, Change of Basis. Transition matrix, Similarity, Eigen values and Eigen vectors for a linear transformation, Cayley-Hamilton Theorem,

### Unit - III

Minimal polynomial and minimal equation, Canonical forms, Diagonalization, Reduction to triangular form, Nilpotent transformations. Index of nilpotency. Jordan Canonical form.

### Unit-IV

Bilinear form, its matrix representation and rank, Symmetric and skew symmetric bilinear forms, Quadratic form associated with a bilinear form, Symmetric matrix associated with a quadratic form. Diagonalization of a quadratic form, Hermitian form and its matrix representation, Positive definite Hermitian form.

### Unit V

Inner product spaces, Cauchy-Schwartz inequality, orthogonal vectors. Orthogonal complements, orthonormal sets and bases, Bessel's inequality for a finite orthonormal set. Gram Schmidt orthogonalisation process.

#### References :

- |                           |   |
|---------------------------|---|
| 1. I.N.Herstien           | Topics in Linear Algebra ( Wiley Eastern) |
| 2. Sharma & Vashistha     | Linear Algebra ( Krishna Publication)     |
| 3. KHoffemn & R.Kunje     | Linear Algebra (Prentice- Hall India Ltd) |
| 8. S. Lang                | Linear Algebra                            |
| 9 V V Vovevodin           | Linear Algebra ( MIR Publications)        |
| 10.D.S.Chauhan &K.N.Singh | Studies in Algebra ( JPH, Jaipur)         |

### MATH 1 C(ii) :- COMPLEX-ANALYSIS I

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The syllabus for each theory paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

**Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10

**Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks.

Total marks : 25

**Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words.

**Unit-I**

Analytic functions, Sterographic projection of complex numbers, Holomorphic complex valued functions and their inverse, Cauchy-Reimann equations, Power series. conformal mapping. Bilinear transformations their properties and classification, Special transforms  $w = z^2$ ,  $z = \sqrt{w}$ ,  $z = c \sin w$ ,

**Unit-II**

complex integration, Cauchy Theorem and integral formula, Poisson's integral formula, Taylor's and Laurents series

**Unit -III**

Morera's Theorem. Liouville's Theorem, Maximum modulus principle, Minimal modulus principle, Schwarz's Lemma.

**Unit-IV**

Classification of Singularities. Branch Points, Reimann Theorem on removable Singularity, open mapping theorem Casoratti-Weirstrass theorem.

**Unit - V**

meromorphic functions, The argument principle. Roche's Theorem, Residues, Cauchy's residue theorem; evaluation of integrals, branches of many valued function with reference to  $\arg z$ ,  $\log z$ ,  $z^n$  Analytic continuation .

**References :**

- |                     |   |
|---------------------|---|
| 1. Malik- Arora     | Mathematical Analysis (New Age International Limited) |
| 2. Schaum Series    | Complex Variable ( TataMcgraw Hill)                   |
| 3.Churchill & Brown | Complex Analysis ( TataMcgraw Hill)                   |
| 4. Walter Rudin     | Real and Complex Analysis ( TataMcgraw Hill)          |

**MATH 1 C(iii) MECHANICS I**

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The syllabus for each theory paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

**Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10

**Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25

**Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

The syllabus for each theory paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

**Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10

**Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25

**Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

### Unit-I

Moment and product of Inertia- principal axes and Momental Ellipsoid, D'Alembert's principle,

### Unit II

Motion about a fixed axis, (General equation of motion).

### Unit-III

Generalized Coordinates, Holonomic and Non-holonomic systems, Scleronomic and Rheonomic systems, Generalized potential. Lagrange's equations

### Unit-IV

Hamilton's variables, Hamilton canonical equations, Euler's dynamical equations for the motion of a rigid about an axis .

### Unit-V

Hamilton's Principle, Principle of least action. Poisson's Bracket, poisson's identity, Jacobi-Poisson Theorem, Hamilton Jacobi equations

#### Books Suggested

1. Gold Stein : Classical Mechanics (Narosa Publication)
2. P.P. Gupta : Rigid Dynamics (Krishna Prakashan, Meerut.)
3. M. Ray : Dynamics of Rigid Body (Student's and Friend's, Agra)

## MATH 1 C(iv) INTEGRAL EQUATIONS I

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The syllabus for each theory paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

**Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10

**Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks.

Total marks : 25

**Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words.

Total marks : 35

### Unit-I

Fredholm and Volterra types Linear Integral Equations, Integral Equations of the first and second kinds Solution of Fredholm Integral Equations with separable Kernels.

### Unit II

Fredholm types Linear Integral Equations:- Solution by successive substitutions and successive approximations.

### Unit-III

Volterra types Linear Integral Equations:- Solution by successive substitutions and successive approximations.

### Unit IV

Laplace Transform :- Definition, properties, Laplace transform of derivatives. Laplace Transforms for Integrals, Inverse Laplace Transforms, convolution theorem

### Unit-V

Laplace Transform :- Application to Ordinary Differential Equations and Integral Equations.

#### References:

- |                     |   |
|---------------------|---|
| 1. Erwin Kreyszig   | Engineering Mathematics(New Age Intern. Limited)                          |
| 2. M.D.Raisinghania | Integral Transform ( S. Chand Pub.)                                       |
| 3. Shanti Swaroop   | Integral Equations ( Krishna Publication Meerut)                          |
| 4. Pundir & Pundir  | Integral Equations and Boundary value Problems (Pragati Prakashan Meerut) |
| 5. Gupta and Goyal  | Integral Transform ( Krishna Prakashan Meerut)                            |
| 6. I N Snedan       | Uses of Integral Transform  |

## MATH 1 C(v) NUMERICAL ANALYSIS I

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The syllabus for each theory paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

**Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10

**Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25

**Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35.

### **Unit I**

Solutions of Equations : Solutions and Rate of Convergence of Bisection, Secant method, Regula-falsi, N-R Methods, Chebshev method. N-R Method for non linear equation. Roots of polynomial equations -Bairstaw and Birge-Veta method, Graeffe's root square method .

### **Unit II**

Solution of System of linear equations : Direct methods, Gauss, Gauss-Jordan, Cholesky, Partition, Triangularisation method. **Iterative methods: Jacobi, Gauss-Seidal and Relaxation Methods**

### **Unit III**

Curve Fitting and Approximation : Least square principle, Chebshev Approximation. Matrix inversion and eigen value problem- Power methods, Jacobi method, complex eigen values.

### **Unit-IV**

Numerical Solution of Ordinary Differential Equations : Iterative methods –improved Euler methods. Runge-Kutta methods. Predictor Corrector methods.

### **Unit V**

Stability analysis, Difference methods for Boundary Value Problems (BVP).

### **References :**

1. Jain-Iyenger-Jain Numerical Analysis (New Age International Limited)
2. Chauhan, Vyas & Soni Studies in Numerical Analysis (Jaipur Publishing House)
3. Vedamurthy, S.N. Iyanger Numerical Methods (Vikas Publication House)
- 4 Goyel, Mittal Numerical Analysis (Pragati Prakashan)
5. Gupta Malik Calculus of Finite Difference & Numerical Analysis

## **M.A/M.Sc. 2019-20**

### **Semester II**

#### **MATH 2 C(i) :- ADVANCED ALGEBRA**

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The syllabus for each theory paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

**Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10

**Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks.

Total marks : 25

**Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks 35

### **Unit-I**

Homomorphism theorems on groups, conjugate elements, classes and class equation of a finite group, Sylows Theorem. Cauchy's theorem for finite Abelian group.

### **Unit-II**

Normal and Subnormal series, Composition series, Jordan-Holder Theorem, Solvable groups.

### **Unit - III**

Ideals, Principal Ideal rings, Division and Euclidean algorithm for polynomials over a field, Euclidean rings and domains,

### **Unit IV**

Unique factorization theorems, unique factorization domains. Finite field extension

### **Unit -V**

Algebraic and Transcendental extensions, Separable and Inseparable extensions, Normal extensions, Perfect field.

### **References :**

- |                                |  |
|--------------------------------|--|
| 1. A.R.Vashistha               | Algebra (Krishna Publications- Meerut)                 |
| 2. Shanti Naravan              | A Text book of Modern Abstract algebra (Wiley Eastern) |
| 3. Surjeet Singh & Zameeruddin | Modern Algebra( Vikas Pub. House)                      |
| 4. S. Maclane and G. Birkhoff  | Algebra 2nd ed. (Macniillen Co.)                       |
| 5. D.S.Chauhan &K.N.Singh      | Studies in Algebra ( JPH, Jaipur)                      |

## **MATH 2 C(ii) Real Analysis II**

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The syllabus for each theory paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

**Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10

**Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks.

Total marks : 25

**Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words.

Total marks : 35

### Unit-I

Riemann- Stieltjes integral, properties of Integral and Differentiation,

### Unit II

Point wise and uniform convergence of sequence & series of functions, Cauchy criterion, Weirstrass M-test, Abel and Dirchlet test for Uniform Convergence, Uniform Convergence and continuity.

### Unit-III

Measurable sets , Lebesgue outer measure and measurability.

### Unit IV

Measurable functions. Borel and Lebesgue measurability. Non measurable sets.

### Unit-V

Convergence of sequence of measurable functions. Lebesgue integral of a bounded function.

### References :

- |                 |   |
|-----------------|---|
| 1. Malik- Arora | Mathematical Analysis (New Age International Limited) |
| 2-.H.L.Royden   | Real Analysis ( Macmillen Pub. Co.)                   |
| 3. Walter Rudin | Real and Complex Analysis ( TataMcgraw Hill)          |
| 4. G N.Purohit  | Lebesgue measure & Integration (JPH. Jaipur)          |

## MATH 2 C(iii) :- PARTIAL DIFFERENTIAL EQUATIONS

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The syllabus for each theory paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

**Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10

**Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks.

Total marks : 25

**Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words.

**Unit-I**

Existence and uniqueness of solution of  $(dy/dx) = f(x,y)$ . Examples of PDE. Classification. Canonical forms, Nonlinear First Order PDE-Complete Integrals, Envelopes,

**Unit -II**

Method of solving Second order PDE - separation of variable and Cauchy's problem.

**Unit-III**

Laplace's Equation, Heat Equation and Wave Equation upto three dimension in cartesian coordinates.

**Unit - IV**

Laplace's Equation, Heat Equation and Wave Equation:- upto two dimension in polar coordinates, their fundamental solutions by variable separation.

**Unit V**

Calculus of variations, Shortest distance, Minimum surface of revolution, Brachistochrone problem, Isoperimetric problem, Geodesic.

References :

- |                        |   |                                |                             |
|------------------------|---|--------------------------------|-----------------------------|
| 1. Erwin Creyszig      | : | Engineering Mathematics        | New Age India Ltd.          |
| 2. M.D. Rai Singhanian | : | Advanced Differential Equation | S.Chand Publication         |
| 3. Gold Stein          | : | Classical Mechanics            | Narosa Publication          |
| 4. P.P. Gupta          | : | Rigid Dynamics                 | Krishna Prakashan Meerut.   |
| 5. M. Ray              | : | Dynamics of Rigid Body         | Student's and Friend's Agra |

**MATH 2 C(iv) SPECIAL FUNCTION**

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

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**Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10

**Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25

**Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

**Unit-I**

The hypergeometric functions : The Gauss' hypergeometric function  $F(a, c; z)$  its integral form, continuous function relations, the hypergeometric differential equation, elementary properties, simple and quadratic transformations, Gauss' and Kummer's theorems.

#### Unit – II

**The generalised hypergeometric function  $F(a_1, \dots, a_p, b_1, \dots, b_q; z)$** , its differential equations, continuous function relations, integral forms, Saalschut's, Whipple's, Dixon's theorems, contour integral representation.

#### Unit- III

Bessel function : its differential equation, pure and differential recurrence relations, generating function, modified Bessel function and its properties.

#### Unit IV

**Confluent hypergeometric function  ${}_1F_1(a, b; z)$**  : definitions, properties, recurrence relations, Kummer's formulas.

#### Unit - V

**Generating functions:** generating functions of the form  $G(2xt - t^2)$ , sets generated by  $e^{t^2}$  and  $A(t) \exp[-xt / (1-t)]$  and the related theorems.

References:

- 1.Special functions by E.D. Rainville, Chelsea publishing company, Bronx, New York
- 2.Special functions by Y.L.Luke, Academic press, New York, London
- 3.Special functions by M.A. Pathan, P.K. Benarji, V.B.L. Chourasia and MC. Goyal, Ramesh Book Depot, Jaipur
4. Special functions by R.K. Saxena and D.C. Gokharoo, Jaipur Publishing House, m

## MATH 2 C(v) DISCRETE MATHEMATICS II

**NOTE : Non programmable Scientific Calculator is allowed.**

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

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**Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10

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**Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

### **Unit-I**

Sets and Proposition: Cardinality. Mathematical Induction, Principle of inclusion and exclusion, Pigeon hole principle.

### **Unit II**

Logic , Predicate , Validity of Statements , Quantification , Proof of Implications /Identities, Method of Proofs.

### **Unit III**

Boolean Algebra : Boolean functions and expression, propositional calculus.  
Design and Implementation of digital networks, Application to switching and Logic circuits.

### **Unit IV**

Graph Theory : Graphs. planer graph. Eulerian and Hamiltonian Graph. Directed Graphs  
Trees : Binary Tree, Binary Search Tree.

### **Unit-V**

Lattices : Lattice and algebraic structure, duality, distributed and complemented lattice, partially ordered sets.

References

- |                    |   |
|--------------------|---|
| 1. Schuam Series   | Discrete Mathematics ( Tata Mcgraw Hill)            |
| 2. C.L.Liu         | Elements of Discrete Mathematics (Tata McGraw Hill) |
| 3. Kenneth H Rosen | Discrete Mathematics ( Tata Mcgraw Hill)            |
| 4. M.k. Gupta      | Discrete Mathematics (Krishna Prakashan Meerut)     |

## **M.A. / M.Sc. Semester III Examination -2019-20**

### **IMPORTANT NOTICE**

**CANDIDATE HAS TO OPT OPTIONAL PAPER IN FOURTH SEMESTER KEEPING THE SAME PAPER NUMBER OF THIRD SEMESTER.**

**IMPORTANT INFORMATION : - NEW OPTIONAL PAPER WILL BE STARTED IF ASPIRANTS ARE AT LEAST 10**

**SCHEME OF STUDY: THERE SHELL BE 5 PAPERS INCLUDING TWO COMPULSORY AND THREE OPTIOAL PAPPRES FOR EACH SEMESTER.**

### **PATTERN OF QUESTION PAPER (SEMESTER EXAM.)**

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The syllabus for each theory paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

**Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10

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**Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

### SEMESTER III

#### compulsory Paper –MATH 3 C(i)- FUNCTIONAL ANALYSIS I

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

**Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10

**Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25

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#### Unit - I

Metric spaces and their examples, Bounded and unbounded metric spaces , open sphere , closed ball, limit point, closure , interior , exterior and boundary of a set .

#### Unit II

Subspaces , product spaces , dense and non dense sets , separable spaces

#### Unit -III

Sequences and subsequences in a metric space , Cauchy's sequences , complete metric space , cantor's intersection theorem ,

#### Unit IV

Bair's category theorem , continuity in metric spaces , contracting mapping , fixed point theorem .

#### Unit - V

Normed linear spaces, Banach Spaces and their examples, subspaces and quotient spaces in Banach space

**Book Recommended:**

1. G.F. Simmons. Introduction to Topology and Modern Analysis, Mc Graw Hill Book Company Chapters 2, 9 and 10 (1963).
2. Ervin Kreyszig. Functional Analysis
3. J. N. Sharma. Functional Analysis (Krishna Prakashan)

**Compulsory Paper –MATH 3 C(ii) -TOPOLOGY I**

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

**Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10

**Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks.

Total marks : 25

**Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

The paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

**Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10

**Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks.

Total marks : 25

**Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words.

**Total marks : 35**

**Unit-I**

Definition and examples of topological spaces, closed sets, closure, dense sets, Neighbourhoods, interior, exterior, Boundary and accumulation points, derived sets

**Unit-II**

Local Bases, Bases and Sub bases, Subspaces and relative topology, First and Second Countable spaces, Lindelof's theorem

### Unit-III

Continuous function, continuity, sequentially continuous, open and closed mapping, bicontinuous mapping, homeomorphism, topological property, topology induced by mapping

### Unit-IV

Separation axiom,  $T_0$ ,  $T_1$ ,  $T_2$ , spaces, normal space, hausdorff spaces, regular spaces,  $T_3$ ,  $T_4$ , spaces, completely regular spaces, Tyconoff space, completely normal

### Unit-V

Compactness, compact sets, basic property of compactness, compactness and finite intersection property, Sequentially and countably, compact sets, local compactness, Heine-Borel theorem

### References :

1. James R.Munkres, Topology, A First Course, Prentice Hall of India Pvt. Ltd. New Delhi, 2000.
2. George F.Simmons, Introduction to Topology and Modern Analysis McGraw Hill Book Company, 1983.
3. K.D. Joshi, Introduction to General Topology, Wiley Eastern Ltd.

### M.A. / M.Sc. Semester III- Optional Papers

Candidate has to opt three papers which are running in the University / College

#### Opt. Paper –MATH3 O(i) - OPERATIONS RESEARCH I

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

**Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10

**Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25

**Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

### **Unit - I**

Linear Programming : Two Phase Simplex method, Bounded variable problems.

### **Unit II**

Duality, Dual Simplex methods. Sensitivity analysis.

### **Unit - III**

Game Theory : Two person Zero sum game, Games with mixed Strategies, Solution of game theory by Linear programming.

### **Unit IV**

Integer Programming. Revised simplex method.

### **Unit - V**

Network Analysis : Shortest Path Problem, PERT and CPM

### **References :-**

- 1.Kanti Swaroop: Operations Research, S.Chand Publications
- 2.S.D.Sharma: Operations Research
3. V. K. Kapoor : Operations Research Sultan Chand and Sons
4. B.S. Goyal and S. K. Mittal: Operations Research Pragati Prakashan
5. Prem Kumar Gupta, D.S. Hira S. Chand and Co.

## **PAPER MATH 3 O(ii) FLUID DYNAMICS I**

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

- Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10
- Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25
- Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

### **Unit - I**

Kinematics-Lagrangian methods. Equation of Continuity. Boundary surfaces. Stream lines, Path lines and streak lines, Velocity potential, Irrotational and rotational motion. Vortex Lines.

### **Unit II**

Equations of Motion-Lagrange's and Euler's equations of motion, Bernouli's theorem, Equation of motion by flux method.

### **Unit - III**

Equations referred to moving axes. Impulse reactions. Stream function, Irrotational motion in two-dimensions.

### **Unit IV**

Complex velocity potential. Sources, Sinks, Doublets and their images. Conformal mapping. Milne-Thomson circle theorem.

### Unit - V

Two-dimensional Irrotational motion, motion of circular, co-axial and elliptic cylinders in an infinite mass of liquid, Kinetic energy of liquid, Theorem of Blasius,

### References :

1. W.H.Besaint and A.S.Ramsey. Treatise on Hydromechanics, Part II, CBS Publishers, Delhi 1988.
2. G.K. Batchelor and Introduction to Fluid Mechanics, Foundation, Books, New Delhi 1991.
3. F.Chorton, Textbook of fluid Dynamics, C.B.S, Publishers, Delhi 1985.
4. A.J.Chorin and A.Marsden, A Mathematical Introduction to Fluid Dynamics, Springer-Verlag, New York 1993.
5. L.D.Landau and E.M. Lipschitz, Fluid mechanics, Pergamon Press, London, 1985.
6. M Ray : Hydrodynamics
7. M Ray : Fluid Dynamics
8. Shanti Swaroop Fluid Dynamics Krishna Prakashan

### MATH 3 O(iii) -MATHEMATICAL STATISTICS I

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

- Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10
- Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25
- Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

### Unit - I

Probability inequalities (Tchebyshef, Markov, Jensen), Convergence in distribution, weak law of large numbers and central limit theorem for independent, identically distributed( i.i.d.) random variable with finite variance.

### Unit II

Marginal and conditional distribution in multivariate case, Covariance matrix and Correlation Coefficient (Product moment- Partial and multiple), Regression.

### Unit - III

Probability Distributions:- poisson, Multinomial, Hypergeometric, Geometric.

### Unit IV

Probability Distributions : Uniform, Exponential, Cauchy, Gamma, Beta and Normal distribution.

### Unit V

Statistical Quality Control : control chart for process control ,setting control limits using  $\bar{x}$  chart,  $R$  chart,  $\sigma$  chart and their interpretation . Control chart for attributes control chart for fraction defectives ( $p$  chart),control chart for number of defects( $c$  chart)

**References :**

1. Fundamentals of Statistics: Gupta, Kapoor, S.Chand Publications
2. Mathematical Statistics: Kapoor, Saxena, S.Chand Publications
3. Basic Statistics : B. L. Agrawal , New age International Publishers

**Opt. Paper MATH 3 O(iv) -PROGRAMMING IN C WITH ANSI FEATURES I**

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

- Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10
- Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25
- Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

**Unit - I**

An overview of programming. Programming language, Classification. C Essentials-Program Development, Functions, Anatomy of a Function, Variables and Constants, Expressions.

**Unit II**

Assignment Statements. Formatting Source Files. Continuation Character. The preprocessor.

**Unit - III**

Scalar Data Types-Declarations, Different Types of Integers. Different kinds of Integer Constants. Floating-Point Types. Initialization. Mixing Types. Explicit Conversions-Casts. Enumeration Type. The Void Data Type. Typedefs. Finding the Address of an object.

**Unit IV**

Pointers. Control Flow-Conditional Branching. The Switch Statement. Looping. Nested Loops. The break and continue Statements. The goto statement. Infinite Loop.

**Unit - V**

Operators and Expressions-Precedence and Associativity, Unary Plus and Minus operators. Binary Arithmetic Operators. Arithmetic Assignment Operators. Increment and Decrement Operators. Comma Operators.

**References :**

1. Peter A.Darnell and Phillip E.Margolis. C: A. Software Engineering Approach, Aarosa Publishing House (Singapur International Student Edition ) 1993.
2. Samiel P. Harkison and Gly L. Steele Jr. C: A Reference manuai 2nd Edition Prentice house 1984
3. Brain n. Kernighan & Dennis M. Ritchie. The C Programme Language, 2nd Edition ANSI 1989

### **Opt. Paper – MATH 3 O(v) -MATHEMATICAL MODELLING I**

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

**Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10

**Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25

**Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

#### **Unit - I**

Techniques, classification and simple illustrations. Mathematical Modelling through ordinary differential equation of first order.

#### **Unit II**

Mathematical Modelling through system of linear inequalities

#### **Unit III**

Mathematical models of Investment and annuity

#### **Unit - IV**

Mathematical Modelling through systems of ordinary differential equation of first order.

#### **Unit V**

Mathematical Modelling through ordinary differential equation of second order.

### **Opt. Paper MATH 3 -O(vi) – RELATIVITY I**

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

**Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10

**Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25

**Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

### **Unit - I**

Concepts of relativity, Michelson- Morley experiment, Equation of geodesics for the given metric, Riemann Christoffel tensors .

### **Unit II**

Postulates of special theory of Relativity, Lorentz-Fitzgerald contraction hypothesis, Lorentz transformation.

### **Unit - III**

Mass-Energy formula, Minkowski's 4 dimensional continuum, Space like and time like intervals.

### **Unit IV**

Hamiltonian principle, Energy - Momentum tensor and its expression for perfect fluid, principle of Covariance, Principle of equivalence.

### **Unit - V**

Condition for flat space time, Einstein's law of gravitation for empty space and material world

### **References :**

1. Tolman R.C. : Relativity, Thermodynamics and Cosmology, Oxford University Press.
2. Synge J.L. : Relativity the Special and General North Holland Publishing Company, Amsterdam.
3. Eddington A.S. : The Mathematical Theory of Relativity, Cambridge.

### **Opt. Paper – MATH 3 O(vi) - HYPERGEOMETRIC FUNCTIONS & POLYNOMIALS I**

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

**Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10

**Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25

**Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

### **Unit - I**

The hypergeometric functions : The Gauss' hypergeometric function  $F(a, c; z)$  its integral form, continuous function relations, the hypergeometric differential equation, elementary properties, simple and quadratic transformations, Gauss' and Kummer's theorems.

#### Unit II

**The generalised hypergeometric function  $F(a_1, \dots, a_p, b_1, \dots, b_q; z)$** , its differential equations, continuous function relations, integral forms, Saalschut's, Whipple's, Dixon's theorems, contour integral representation.

#### Unit- III

Bessel function : its differential equation, pure and differential recurrence relations, generating function, modified Bessel function and its properties.

#### Unit IV

**Confluent hypergeometric function  ${}_1F_1(a, b; z)$**  : definitions, properties, recurrence relations, Kummer's formulas. **Generating functions:** generating functions of the form  $G(2xt - t^2)$ , sets generated by  $e^{xt}$  and  $A(t) \exp[-xt / (1-t)]$  and the related theorems.

#### Unit- V

**Orthogonal polynomials** : condition for orthogonality, zeros and expansion of polynomials, recurrence relation, the Christoffel - Darboux formula, Bessel's inequality.

**M.Sc. MATHEMATICS SEMESTER IV**  
**Compulsory papers**  
**Paper –MATH 4 C(vi)- FUNCTIONAL ANALYSIS II**

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

- Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10
- Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25
- Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

**Unit - I**

Continuous linear transformations, Riesz lemma , Hahn Banach theorem and its applications  
Natural imbedding of  $N$  into  $N^{**}$ .

**Unit II**

The open mapping theorem , projections , the closed graph theorem the uniform boundedness theorem .

**Unit III**

Inner product spaces, Hilbert spaces and their examples , Cauchy Schwartz inequality, parallelogram law.

**Unit IV**

orthogonal complements , Orthonormal sets, Projection theorem , Pythagorean theorem , Bessel's inequality , Gram Schmidt orthogonalization process Conjugate space  $H^*$  , Riesz representation theorem ,

**Unit V**

The adjoint of an operator , self adjoint , normal and unitary operators , perpendicular projections, invariance and reducibility , Orthogonal projections.

**Book Recommended:**

4. G.F. Simmons. Introduction to Topology and Modern Analysis, Mc Graw Hill Book Company Chapters 2, 9 and 10 (1963).
5. Ervin Kreyszig. Functional Analysis
6. J. N. Sharma. Functional Analysis (Krishna Prakashan)

**Paper –MATH 4 C(vii) -TOPOLOGY II**

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

- Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10
- Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25
- Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

#### Unit-I

Compactness in metric space, Equivalence of compactness, Countable and sequential compactness in metric space

#### Unit-II

Connected space, connectedness on the real line, locally connected space, separated space, continuity and connectedness, components

#### Unit-III

Product Topology, projection map, product invariant properties, general product space, Tychonoff topology, Separation axioms and product spaces, Connectedness and product space, compactness and product space, Tychonoff theorem

#### Unit-IV

Binary relation, directed sets, residual subsets, cofinal subset, net sequence, convergence of a net, cluster point, subnet, isotone map, ultranet , Hausdorffness and nets, compactness and nets

#### Unit-V

Filters, standard filters, neighbourhood filters, comparison of filters, intersection of filters, filters generated by collection of sets, filters generated by family of sets, filter base, base of filters , ultra filter, convergence of filters

#### References :

1. James R.Munkres, Topology, A First Course, Prentice Hall of India Pvt. Ltd. New Delhi, 2000.
2. George F.Simmons, Introduction to Topology and Modern Analysis McGraw Hill Book Company,1983.
3. K.D. Joshi, Introduction to General Topology, Wiley Eastern Ltd.

## M.A. / M.Sc. Semester IV- Optional Papers

### Opt. Paper –MATH 4 O(i) - OPERATIONS RESEARCH II

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

- Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10
- Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25
- Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

#### Unit I

Dynamic Programming : Deterministic models, probabilistic models

#### Unit - II

Inventory problems and their analytical structures. Simple deterministic problems.

#### Unit III

Nonlinear Programming : One and multivariable unconstrained Optimization, K.T. Conditions for Constrained Optimization. Sequencing

#### Unit - IV

Quadratic programming, Separable programming

#### Unit V

Queuing System : Steady state solution of queuing model : M/M/1, M/M/1 with limited waiting space, M /M/C, M/M/C with limited waiting space.

#### References :-

- 1.Kanti Swaroop: Operations Research, S.Chand Publications
- 2.S.D.Sharma: Operations Research
3. V. K. Kapoor : Operations Research Sultan Chand and Sons
4. B.S. Goyal and S. K. Mittal: Operations Research Pragati Prakashan
5. Prem Kumar Gupta, D.S. Hira S. Chand and Co.

### Paper - MATH 4 O(ii) FLUID DYNAMICS

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

- Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10
- Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25
- Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

#### Unit I

Motion of a sphere through a liquid at rest at infinity. Liquid streaming past a fixed sphere. Equation of motion of a sphere, Stoke's stream function.

Vortex motion and its elementary properties, Kelvin's proof of permanence, Motions due to circular and rectilinear vortices.

#### Unit - II

Fluid Properties : General properties of Newtonian and Non-newtonian and plastic fluids Stress components in real fluid, Relations between rectangle components of stress. Relation between stresses and gradients of velocity,

#### Unit III

Navier-stoke equations of motion: Cartesian , Polar Cylindrical , Polar Spherical system of coordinates

#### Unit - IV

Plane Poiseuille and Couette flows between two parallel plates. Theory of Lubrication. Flow through tubes of uniform cross section in form of circle, annulus and equilateral triangle under constant pressure gradient, Unsteady flow over a flat plate.

#### Unit V

Reynolds number, Prandit's boundary layer. Boundary layer equations in two dimensions. Blasius solution, Boundary layer thickness. Displacement thickness. Karman Integral Conditions. Separation of boundary layer flow.

#### References :

1. W.H.Besaint and A.S.Ramsey. Freatiseon Hydromechanics, Part II, CBS Publishers, Delhi 1988.
2. G.K. Batchelor and Introduction to Fluid Mechanics, Foundation, Books, New Delhi 1991.
3. F.Chorton, Textbook of fluid Dynamics, C.B.S, Publishers, Delhi 1985.
- 4.A.J.Chorin and A.Marsden, A Mathematical Introdtion to Fuild Dynamics, Springer-Vertag, New Yark 1993.
5. L.D.Landau and E.M. Lipschitz, Fluid mechanics, Pergamon Press, London, 1985.
6. Shanti Swaroop : Fluid Dynamics Krishna Prakashan

### MATH 4 O(iii) -MATHEMATICAL STATISTICS

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

- Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10
- Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25
- Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

### Unit - I

Sampling Distribution:- t, F, Chi-Square distribution as sampling distribution, Standard errors and large Sampling distribution. Distribution of order statistics.

### Unit II

Theory of Statistics:- Methods of estimation, maximum likelihood method, method of moments, minimum chi square method, least square method.

### Unit - III

Unbiasedness, efficiency, Consistency, Cramer Rao inequality. Statistical Method : Test of mean and variance in normal distribution, one Population and two Population cases, related confidence intervals, Tests of Product Moment.

### Unit IV

Partial and multiple Correlation Coefficients of Karl Pearson. Regression and Regression analysis.

### Unit - V

Analysis of discrete data : Chi-square test of goodness of fit, Contingency table Analysis of variance:- one way and two way classification, large sample tests through normal approximation, Non-Parametric tests, Sign test, Median test, rank correlation and test of independence.

### References :

1. Fundamentals of Statistics: Gupta, Kapoor, S.Chand Publications
2. Mathematical Statistics: Kapoor, Saxena, S.Chand Publications
3. Basic Statistics : B. L. Agrawal , New age International Publishers

## Opt. Paper – MATH 4 O(iv)-PROGRAMMING IN C WITH ANSI FEATURES

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

- Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10
- Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25
- Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one

question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

#### Unit I

Relational Operators. Logical Operators. Bit - Manipulation Operators. Bitwise Assignment Operators. Cast Operator. Size of Operators. Conditional Operator. Memory Operator.

#### Unit - II

Arrays and Pointers-Declaring an Array. Arrays and Memory Initializing Arrays Encryption and Decryption. Pointer Arithmetic. Passing pointers as Function Arguments, Accessing Array. Elements through Pointers. Passing Arrays a Function Arguments. Sorting Algorithms.

#### Unit III

Strings. Multidimensional Arrays. Arrays of Pointers. Pointers to Pointers. Storage Classes-Fixed vs. Automatic Duration. Scope. Global variables. The register Specific. ANSI rules for the syntax and Semantics of the storage-class keywords. Dynamic Memory Allocation

#### Unit - IV

Structure and Union-Structures. Linked Lists, Union.Declarations. Functions-Passing Arguments. Declarations and Calis, Pointers to Functions. Recursion. The Main Function. Complex Declarations

#### Unit V

The C Preprocessor-Macro Substitution. Compilation. Include Facility line Control. Input and Output-Streams, Buffering. The <stdio.h> Header file. Error Handling. Opening and Closing a file. Reading and writing Data. Selecting an I/O Method, Unbuffered. I/O Random Access. The standard library for Input / Output.

#### References :

1. Peter A.Darnell and Phillip E.Margolis. C: A. Software Engineering Approach, Aarosa Publishing House (Singapur International Student Edition ) 1993.
2. Samiel P. Harkison and Gly L. Steele Jr. C: A Reference manuai 2nd Edition Prentice house 1984
3. Brain n. Kernighan & Dennis M. Ritchie. The C Programme Language, 2nd Edition ANSI 1989

#### Opt. Paper – MATH 4 O(v) -MATHEMATICAL MODELLING

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

- Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10
- Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25
- Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

### Unit - I

Mathematical Modelling through difference equation. Mathematical Modelling through partial differential equations.

### Unit - II

Mathematical Modelling through graphs. Mathematical Modelling through functional Integral, Delay-differential.

### Unit - III

Mathematical Modelling through calculus of variations and dynamic programming.

### Unit IV

Mathematical Modelling of statistical quality control.

### Unit V

Mathematical Modelling through mathematical programming, maximum principle and maximum entropy principle.

### References

1. Mathematical Modelling : J. N. Kapur New Age Int. Pub.
2. Mathematical Modelling : Dr. Maurya Navkar pub. Ajmer
3. Basic statistics :B. L. Agrawal , NEW AGE International Publisher
4. Operations Research P. K.Gupta , D.S. Hira , S. Chand and Co. Ltd.

### Paper - MATH 4 - O(vi) – RELATIVITY

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

- Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10
- Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25
- Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

### Unit I

Schwartz child exterior and interior solution for gravitational field.

### Unit - II

Planetary orbit, three crucial tests, Advances of perihelion, Gravitational deflection of light, Shift in spectral lines

### Unit III

Wavl hypothesis, Displacement of the Fraunhoffer lines.

### Unit - IV

Einstein and De-sitter models, their comparison with the actual universe,

### Unit V

Red shift in the spectral line on distant galaxies, Hubble constant, Birkhoits theorem.

**References :**

1. Tolman R.C. : Relativity, Thermodynamics and Cosmology, Oxford University Press.
2. Synge J.L. : Relativity the Special and General North Holland Publishing Company, Amsterdam.
3. Eddention A.S. : The Mathematical Theory of Relativity, Cambridge.

**Opt. Paper – MATH 4 O(vi) - HYPERGEOMETRIC FUNCTIONS & POLYNOMIALS**

duration :- 3 Hrs.

Max. Marks: – 100

distribution of marks :- Internal assessment 30

Theory paper 70

The paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

- Section-A :** One compulsory question with 10 parts, having 2 questions from each unit,. Answer limit 20 words for each question. Each question will carry equal marks. Total marks : 10
- Section-B :** this section will 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer limit 250 words for each question. Each question will carry equal marks. Total marks : 25
- Section-C :** this section will carry 05 questions. Question Number 12 will be compulsory and irrespective of units and carry 15 marks. Remaining 4 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, 2 questions to be attempted. Each question will carry 10 marks. answer limit 500 words. Total marks : 35

**Unit I**

**Legendre polynomials :** generating functions, differential equations, Rodrigues formula, more generating functions, orthogonality, expansions of  $x^n$ , and analytical functions.

**Unit- II**

**Hermite polynomials :** definition, recurrence relations, Rodrigues formula, integral representation, orthogonality, expansion of polynomials, more generating functions.

**Unit III**

**Laguerre polynomials :** definitions, recurrence relations, Rodrigues formula, orthogonality, expansion of polynomials and special properties, other generating functions.

**Unit - IV**

**Jacobi polynomials :** definitions, Bateman's generating function, orthogonality, pure, differential and mixed recurrence relations, Brafman's generating function, expansion in series of polynomials

**Unit V**

**Ultraspherical and Gegebauer polynomials :** definition, generating function and related properties.

**Suggested Books :**

- 1.Special functions by E.D. Rainville, Chelsea publishing company, Bronx, New York
- 2.Special functions by Y.L.Luke, Academic press, New York, London
- 3.Special functions by M.A. Pathan, P.K. Benarji, V.B.L. Chourasia and MC. Goyal, Ramesh Book Depot, Jaipur
4. Special functions by R.K. Saxena and D.C. Gokharoo, Jaipur Publishing House, m Jaipur