M.Sc. – MATHEMATICS
SEMESTER SCHEME

UNIVERSITY OF KOTA
MBS Marg, Swami Vivekanand Nagar,
Kota - 324 005, Rajasthan, India
Website: uok.ac.in

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 - 2020-21
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	Sn.	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
OPTIONAL PAPERS					
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(vii)	ORTHOGONAL POLYNOMIALS	7	MATH4 O(vii)	H-FUNCTION OF ONE VARIABLE AND FRACTIONAL CALCULUS

M.A./M.Sc. MATHEMATICS 2020-21

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.
                    Total marks : 35

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 $w = z2 , z = \square\square w, \ z = c \sin w,$

Unit-II

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

Unit -III

Morera's Theorem. Lioville'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 , zn   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

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

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. 2020-21
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

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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.
                                                                                              Total marks : 35

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 cartesion 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 Singhania :   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

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

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 Kummar's theorems.

Unit – II

The generalised   hypergeometric function ${}_pF_q$ $(a_1, ..., a_p , b_1 ....bq ;z)$, 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, Kummar's formulas.

Unit - V

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

References:
1.Special functions by E.D. Rainville, Chelsea publishing company, Bronex, 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

NOTE : Non programmable Scientific Calculator is allowed.

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
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 -2020-21

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 PAPRES 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

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

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

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
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 countablly, compact sets, local compactness, Heine-Borel theorem

References :
1. James R.Munkres, Topology, A First Cource,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

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 clyinders in an infinite mass of liquid, Kinetic energy of liquid, Theorem of Blasius,

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.Chortion, Textbook of fluid Dynamics, C.B.S, Publishers, Delhi 1985.
4. A.J.Chorin and A.Marsden, A Mathemetical Introdution to Fuild Dynamics, Springer-Vertag, New Yark 1993.
5. L.D.Landau and E.M. Lipschitz, Fluid mechanics, Pergamon Press, Londan, 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, Jenson), 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, Hypergeometic, 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, σ 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 Phillp 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
Postualtes 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. Eddention A.S.   :   The Mathematical Theory of Relativity, Cambridge.

Opt. Paper – MATH 3 O(vii) - ORTHOGONAL 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
Orthogonal polynomials : condition for orthogonality, zeros and expansion of polynomials, recurrence relation, the christoffel - Darboux formula, Bessel's inequality.

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

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

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

Unit - V
Jacobi polynomials : definitions, Bateman's generating function, orthogonality, pure, differential and mixed recurrence relations, Brafman's generating function, expansion in series of polynomials
Ultraspherical and Gegebauer polynomials : definition, generating function and related properties.

Suggested Books :
        1.Special functions by E.D. Rainville, Chelsea publishing company, Bronex, 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

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 , Hann 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 , pythogoren 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, invarience and reducibality , 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, Connnectedness 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, baseof 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.

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 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

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: Cartiasian , Polar Cylendrical , Polar Spherical system of coordinates

Unit - IV

Plane Poiseuille and Couette flows between two paralled 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.Chortion, Textbook of fluid Dynamics, C.B.S, Publishers, Delhi 1985.
4. A.J.Chorin and A.Marsden, A Mathemetical Introdution to Fuild Dynamics, Springer-Vertag, New Yark 1993.
5. L.D.Landau and E.M. Lipschitz, Fluid mechanics, Pergamon Press, Londan, 1985.
6. Shanti Swaroop : Fluid Dynamics Krishna Prakashan

MATH 4 O(iii) -MATHEMATICAL STATISTICS 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

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 liklihood 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 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
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 Encreption and Decryption. Pointer Arithmetic. Passing pointers as Fuction Arguments, Accessing Array. Elements through Pointers. Passing Arrays a Function Arguments. Sorting Algorithms.

Unit III
Strings. Multimensional Arrays. Arrays of Pointers. Pointers to Pointers. Storage Classes-Fixed vs. Automatic Duration. Scope. Global variables. The register Specific. ANSI rules for the syntex 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 Phillp 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 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
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 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
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
 Wayl 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(vii) – H-FUNCTION OF ONE VARIABLE AND FRACTIONAL CALCULUS

 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
Definition of H-function. Asymptotic expansion of H-function. Simple transformation formulae and elementary properties of H-function. Mellin transform and Laplace transform of H-function. Special cases of H-function.

Unit- II
Differentiation formulae for H-function. Contiguous relations and simple expansion formulae for H-function. Summation formulae for the H-function.

Unit -III
Integral formulae involving product of two H-function. Finite integrals involving H-function. Expansions of the H-function in series of orthogonal polynomials. Expansions of the H-function in series of product of generalized hypergeometric function and the H-function.

Unit – IV
The Riemann-Liouville fractional integral: Introduction, Definitions, Fractional integrals of elementary functions, Derivative of fractional integral and fractional integral of derivative. Laplace transform of fractional integral.

Unit -V

The Riemann-Liouville Fractional Calculus: Introduction, Fractional derivative, Leibnitz's formulae for fractional derivatives. Fractional derivatives of elementary functions, Integral representations, Laplace transform of fractional derivatives.

Suggested Books :

1. The H-function with application in Statistics and other disciplines by A.M. Mathai and R.K. Saxena, Willey Eastern Ltd, New Delhi
2. The H-functions of one and two variables with applications by H.M. Srivastava, K.C. Gupta and S.P. Goyal, South Asian Publishers, New Delhi, Madras.
3. The Fractional Calculus: Theory and Applications of Differentiation and Integration to arbitrary order by K.B. Oldham and J. Spanier, Academic Press New York, London.
4. An introduction to the Fractional Calculus and Fractional Differential Equations by K.S. Miller and B. Ross, John Wiley and Sons Inc., New York, Chichester.
5. Fractional Integrals and Derivatives: Theory and Applications by S.G. Samko, A.A. Kilbas and O.I. Marichev, Gordon and Breach Science Publishers, Switzerland and USA
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