UNIVERSITY OF KOTA

SCHEME OF EXAMINATION

AND

COURSES OF STUDY

Mathematics
Faculty of Science

M.Sc. (Mathematics)

Third Semester Examination,
December 2024

Fourth Semester
Examination, June 2025

UNIVERSITY OF KOTA
MBS Marg, Near Kabir Circle, KOTA
(Rajasthan)-324 005
INDIA

Edition: 2024

M.A./ M.Sc. MATHEMATICS EXAMINATION - 2024-25

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.

CONTENTS

Program Objectives

The Program Objectives are the knowledge skills and attributes which the students will have at the time of post-graduation. At the end of the program the student will be able to:

1. To provide comprehensive curriculum to groom the students into qualitative scientific manpower
2. Enable students to enhance mathematical skills and understand the fundamental concepts of pure and applied mathematics.
3. To provide qualitative education through effective teaching learning processes by introducing projects, participative learning, and latest software tools.
4. To inculcate innovative skills, teamwork, ethical practices among students to meet societal expectations.
5. To encourage collaborative learning and application of mathematics to real life situations.
6. To inculcate the curiosity for mathematics in students and to prepare them for future research.

Program Outcome

1. Various courses of Mathematics are selected for the M.Sc. in Mathematics with the aim to achieve higher standard in mathematical reasoning, sophistication in thinking.
2. To acquire acquaintance with enough number of subjects including application-oriented ones to suit the present needs of various allied branches in Engineering and Science as well as provision of opportunities to pursue research in higher mathematics.
3. To prepare for pursuing careers in industry with the understanding of mathematical sciences and allied fields.
4. To inculcate the skills to analyze problems, formulate hypothesis, valuate and validateresults, and draw reasonable conclusions thereof.
5. To inculcate critical thinking to carry out scientific investigation objectively without being biased with preconceived notions.
6. Imbibe effective scientific and technical communication in both oral and writing.

Program Specific Outcome

1. Understanding of the fundamental axioms in mathematics and capability of developing ideas based on them.
2. Prepare and motivate students for research studies in mathematics and related fields.

3. Provide knowledge of a wide range of mathematical techniques and application of mathematical methods/tools in other scientific and engineering domains.
4. Provide advanced knowledge on topics in pure mathematics, empowering the students to pursue higher degrees at reputed academic institutions.
5. Inculcate mathematical reasoning.
6. Strong foundation on algebraic topology and representation theory which have strong links and application in theoretical physics, in particular string theory.
7. Good understanding of number theory which can be used in modern online cryptographic technologies.
8. Nurture problem solving skills, thinking, creativity through assignments, project work.
9. Assist students in preparing (personal guidance, books) for competitive exams e.g. NET, GATE, etc
10. To nurture the understanding the scope and willingness to use the latest computing technology with the self-learning of various computing software.
11. Encourage the use of open-source programs and to contribute for further enhancement of those programs.

Duration of the Course

There shall be four semesters in two consecutive academic years and two semesters in each academic year (or as per the Rajasthan Government Directions wherever applicable)

Admission Criteria

Fresh Admissions – Semester – I

A candidate who has passed any one of the following examinations with Mathematics as a major subject from any University recognized by the UGC shall be permitted to take admission:

a. B.Sc. or B.A. with Mathematics as a main subject of study.
b. Three / Four-year B.Sc. (Hons.) with Mathematics
c. Bachelor of Science and Education (B.Sc.-B.Ed.) with Mathematics as a main subject.

Minimum qualifying marks to apply for the admission in M.Sc. Mathematics

A. Qualifying examination passed from any recognised University which is situated in Rajasthan State:

General Category = 55%.

SC / ST / OBC / SBC or MBC = Min. Pass Marks

B. Qualifying examination passed from any recognized University which is situated at outsidethe Rajasthan State:

All Categories = 60%.

Promotion – Semester – III

1. A candidate may be promoted in the next academic session (odd semester i.e. III semester) if he/she has cleared separately at least 50% of the papers of each semester (semester I & II) of previous academic session with 36% of the aggregate marks.
2. The candidate who does not fulfil the above condition will remain as an ex-student and will reappear in the previous semesters (semester I & II) examinations.
3. A candidate who has passed B.Ed. examination as a regular course of study after completing first and second semester examinations from this University shall also be eligible to take admission in third semester succeeding to B.ed. examination session.

Program Structure

The M.Sc. (Mathematics) programme with a credit weightage of 100 credit points, consists of:

1. Core and applied courses of theory papers which are compulsory for all students, which consist of 24 credit points for each semester I and II.
2. In semester III and IV one paper in each semester is compulsory while the candidate may opt for 3 papers from a group of available optional papers.
3. In IV semester the Prior requirement to opt 4O1, 4O2, 4O3, 4O4 and 4O5 are 3O1, 3O2, 3O3, 3O4 and 3O5respectively.
4. In IV semester an optional Dissertation/Project Work will be taken under the guidance of the teaching faculty available in the department/ affiliated college. This consist of 6 credit point of the required 24 credit points for IV semester.
5. Any of the optional courses/activities from following list[#] will be opted and accordingly completed by the candidate to get remaining 4 credit point to complete the full 100 credit points required to get the degree M.Sc. in Mathematics.

List of Interdisciplinary Courses/ Activities (4 Credits)

To get 4 credit points the candidate needs to engage with the following activities for at least 50 hours. The Course completion certificate, report with geo-tagged photographs, certificate from the organisations the candidate worked with will be submitted to the department/college and will be dully evaluated, only after successful evaluation the credit points would be awarded to the candidate.

1. Courses from UGC-SWAYM (Course Completion Certificate)
2. Courses from MOOC (Course Completion Certificate)
3. Courses from in.coursera.org (Course Completion Certificate)
4. Any other course from the sites like Linkedin* etc. which provide a certificate with clear mention of the course hours.
5. Any relevant theory course from interdisciplinary department available with the institution.
6. Extension Activities# – Community Services** (50 Hours) (Report with geo-tag photographs along with the Certificate by the organisation)
7. Significant contribution toward any research project (Data Collection, Data Analysis, Programming for computation) (Certificate from Principal Investigator/ Mentor/ Student Project with a clear mention of working hours)

#The extension activities do not include activities as NSS, Scout or NCC volunteer.

*The candidate is free to choose the course and site whether paid or free, however a completion certificate with a clear mention of hours attendance will be mandatory.

**Community Services would include – working for cleanliness drives, education specially to deprived children or adolescents, working for skill enhancement of deprived groups specially women, adolescents and children, conservation of natural flora and fauna, conservation of any endangered art or craft or any other activity allotted to the candidate by the organisation he/ she would be working with. This list is suggestive only and not to be considered as complete and final.

Note: All of the above activities must commence and complete within the period of the study of degree i.e. time period between the admission in Semester I to commencement of the examination for Semester IV, which should not ; in any condition be more then 2 years.

Course Code and Nomenclature

Paper Code will stand as MATH for mathematics, 1/2/3/4 for semester number, C or O forcompulsory/ optional and (1/2/3…) for paper number.

Semester III			
1	MATH 3C1	ANALYSIS – III	6
2	MATH 3O1	OPERATIONS RESEARCH - I	6
3	MATH 3O2	FLUID DYNAMICS I	6
4	MATH 3O3	MATHEMATICAL STATISTICS I	6
5	MATH 3O4	MATHEMATICAL MODELLING I	6
6	MATH 3O5	PROGRAMMING IN C WITH ANSI FEATURES I	6
7	MATH 3O6	DIFFERENTIAL GEOMETRY & TENSOR	6
8	MATH 3O7	H-FUNCTION OF ONE VARIABLE AND FRACTIONAL CALCULUS	6
Semester IV			
1	MATH 4C1	TOPOLOGY	6
2	MATH 4O1	OPERATIONS RESEARCH – II	6
3	MATH 4O2	FLUID DYNAMICS – II	6
4	MATH 4O3	MATHEMATICAL STATISTICS II	6
5	MATH 4O4	MATHEMATICAL MODELLING II	6
6	MATH 4O5	PROGRAMMING IN C WITH ANSI FEATURES II	6
7	MATH 4O6	RELATIVITY	6
8	MATH 4O7	DISSERTATION	6

University of Kota, Kota
M.Sc. Mathematics: Semester-wise Scheme of Examinations

Year / Semester	Nomenclature of Paper		Duration of Exam	Teaching Hours / Week	Credit Points	Distribution of Marks				Total Marks	
						Internal Assessment		Final Assessment		Total Marks	
	Paper Code/ ID	Nomenclature of Paper				Max Marks	Passing Marks	Max Marks	Passing Marks	Max Marks	Passing Marks
	MATH 3C1	ANALYSIS – III	3	6	6	50	20	100	40	150	60
	MATH 3O1	OPERATIONS RESEARCH - I	3	6	6	50	20	100	40	150	60
	MATH 3O2	FLUID DYNAMICS I	3	6	6	50	20	100	40	150	60

	MATH 3O3	MATHEMATICAL STATISTICS I	3	6	6	50	20	100	40	150	60
Semester III	MATH 3O4	MATHEMATICAL MODELLING I	3	6	6	50	20	100	40	150	60
	MATH 3O5	PROGRAMMING IN C WITH ANSI FEATURES I	3	6	6	50	20	100	40	150	60
	MATH 3O6	DIFFERENTIAL GEOMETRY & TENSOR	3	6	6	50	20	100	40	150	60
	MATH 3O7	H-FUNCTION OF ONE VARIABLE AND FRACTIONAL CALCULUS	3	6	6	50	20	100	40	150	60
TOTAL OF III SEMESTER				**24**	**24**	**200**	**-**	**400**		**600**	
	MATH 4C1	TOPOLOGY	3	6	6	50	20	100	40	150	60
	MATH 4O1	OPERATIONS RESEARCH - II	3	6	6	50	20	100	40	150	60
	MATH 4O2	FLUID DYNAMICS - II	3	6	6	50	20	100	40	150	60
	MATH 4O3	MATHEMATICAL STATISTICS II	3	6	6	50	20	100	40	150	60
Semester IV	MATH 4O4	MATHEMATICAL MODELLING II	3	6	6	50	20	100	40	150	60
	MATH 4O5	PROGRAMMING IN C WITH ANSI FEATURES II	3	6	6	50	20	100	40	150	60
	MATH 4O6	RELATIVITY	3	6	6	50	20	100	40	150	60
	MATH 4O7	DISSERTATION	Viva	6	6	50	25	100	50	150	75
TOTAL OF IV SEMESTER				**24**	**24**	**200**	**-**	**400**		**600**	

Teaching Methodology

The classroom teaching would be through conventional lectures or power point presentations (PPT).The lecture would be such that the student should participate actively in the discussion.

Student seminars would be conducted, and group discussions would be arranged to improve their communicative skills.

The teaching methods would encourage use of technology as computing with some basic programming languages and software like C, C++, R Statistics, Python, MS Excel etc. the list is notconcluding.

Assessment Scheme

There shall be 4 Papers in each of the four semesters. Each paper has Max. 150 marks, 50 marks for Internal assessment and 100 marks for Main semester Examination of 3 hours duration. The Internal assessment consist of CIE (Term Test, Seminar, Assignments etc.) Minimum Pass Marks for Internal Assessment shall be 20 and for Semester Examination 40 for each paper.

A student who remains absent (defaulter) or fails or wants to improve the marks in the internal assessment may be permitted to appear in the desired paper(s) (only one time) in the same semester with the permission of the concerned Head of the Department. A defaulter / improvement fee of Rupees 250/- per paper shall be charged from such candidates. Duly forwarded application of such candidates by the teacher concerned shall be submitted to HOD who may permit the candidate to appear in the internal assessment after depositing the defaulter/ improvement fee. A record of such candidates shall be kept in the Department.

Question Paper Pattern

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

Section-A : One compulsory question with 10 parts, having 2 questions from each unit. Each question will carry equal marks.

Total marks: 20

Section-B: This section has 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit. Each question will carry equal marks.

Total marks: 80

Dissertation

One optional Dissertation work for 6 credit point is there to allow students to present their findings in response to a proposition chosen by themselves. The aim of the dissertation is to test the independent research skill, students have acquired during their studies with the assessment used to help to determine their final grade. The dissertation would be largely independent however the available teaching faculty would help deciding the topic as well as provide their guidance throughout the work.

Format of the Cover Page and Title Page

TITLE OF THE DISSERTATION / PROJECT REPORT

A Dissertation / Project Report Submitted in partial fulfilment of the requirement for the award of

the

Degree of Master of Science in

Mathematics

Logo of University

Submitted by

(Name of Student)

(Enrolment Number)

Submitted to

Department of Mathematics,

(Name of College, if any)

University of Kota, Kota

(Month, Year)

(Name of Supervisor / Mentor)

(Designation)

M.A./M.Sc. MATHEMATICS SEMESTER – III (2023-24)

MATH 3C1 – ANALYSIS – III

Duration: - 3 Hrs. Max. Marks: – 150

Distribution of marks:

Internal assessment 50 Theory paper 100

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

Section-A: One compulsory question with 10 parts, having 2 questions from each unit. Each question will carry equal marks.

Total marks: 20

Section-B: This section has 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit. Each question will carry equal marks.

Total marks: 80

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. Subspaces, product spaces, dense and non-dense sets, separable spaces. Sequences in a metric space, Cauchy's sequences, complete metric space, cantor's intersection theorem, Baire's category theorem, continuity in metric spaces, fixed point theorem.

Unit II

Normed Linear space, Banach Spaces and their examples, subspaces and quotient spaces in Banach space. Hann Banach Theorem and its applications

Unit –III

Continuous Linear Transformations, Inner Product Space, Hilbert Space and their examples, Cauchy Schwartz inequality, Parallelogram Law.

Unit IV

Orthogonal compliments, Orthonormal sets, Projection theorem, Pythogorian Theorem, Bessel's inequality, Grahm Schmidt orthogonalisation process.

Unit – V

Conjugate Space, Riesz Representation Theorem, Adjoint of an operator, Self Adjoint, Normal and Unitary Operators, Perpendicular Projections, Orthogonal Projections, invariance and Reducibility.

References:-

1. G.F. Simmons Introduction to Topology and Modern Analysis, Mc Graw Hill
2. Ervin Kreyszig Functional Analysis
3. J. N. Sharma. Functional Analysis (Krishna Prakashan)
4. James R.Munkres Topology, A First Cource (Prentice Hall of India)
5. George F.Simmons Introduction to Topology and Modern Analysis (McGraw Hill)
6. K.D. Joshi Introduction to General Topology (Wiley Eastern Ltd)

MATH 3O1 - OPERATIONS RESEARCH I

Duration: - 3 Hrs. Max. Marks: – 150

Distribution of marks:

Internal assessment 50 Theory paper 100

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

Section-A: One compulsory question with 10 parts, having 2 questions from each unit. Each question will carry equal marks.

Total marks: 20

Section-B: This section has 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit. Each question will carry equal marks.

Total marks: 80

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. 4. B.S. Goyal and S. K. Mittal Operations Research Pragati Prakashan

MATH 3O2 - FLUID DYNAMICS I

Duration: - 3 Hrs. Max. Marks: – 150

Distribution of marks:

Internal assessment 50 Theory paper 100

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

Section-A: One compulsory question with 10 parts, having 2 questions from each unit. Each question will carry equal marks.

Total marks: 20

Section-B: This section have 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit. Each question will carry equal marks.

Total marks: 80

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, Bernoulli'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. 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 MathemeticalIntrodution 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 KrishnaPrakashan

MATH 3O3 - MATHEMATICAL STATISTICS I

Duration: - 3 Hrs. Max. Marks: – 150

Distribution of marks:

Internal assessment 50 Theory paper 100

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

Section-A: One compulsory question with 10 parts, having 2 questions from each unit. Each question will carry equal marks.

Total marks: 20

Section-B: This section has 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit. Each question will carry equal marks.

Total marks: 80

Unit - I

Probability inequalities (Chebyshev, 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, 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, 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

MATH 3O4 - MATHEMATICAL MODELLING I

Duration:- 3 Hrs. Max. Marks: – 150

Distribution of marks:

Internal assessment 50 Theory paper 100

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

Section-A: One compulsory question with 10 parts, having 2 questions from each unit. Each question will carry equal marks.

Total marks: 20

Section-B: This section has 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit. Each question will carry equal marks.

Total marks: 80

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.

References:

1. Mathematical Modelling : J. N. Kapur New Age Int. Pub.
2. Mathematical Modelling : Dr. Maurya Navkar pub. Ajmer

MATH 3O5 - PROGRAMMING IN C WITH ANSI FEATURES I

Duration :- 3 Hrs. Max. Marks: – 150

Distribution of marks:

Internal assessment 50 Theory paper 100

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

Section-A: One compulsory question with 10 parts, having 2 questions from each unit. Each question will carry equal marks.

Total marks: 20

Section-B: This section has 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit. Each question will carry equal marks.

Total marks: 80

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 pre-processor.

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 go to 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.

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

MATH 3O6 – DIFFERENTIAL GEOMETRY & TENSOR

Duration :- 3 Hrs. Max. Marks: – 150

Distribution of marks:

Internal assessment 50 Theory paper 100

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

Section-A: One compulsory question with 10 parts, having 2 questions from each unit. Each question will carry equal marks.

Total marks: 20

Section-B: This section has 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit. Each question will carry equal marks.

Total marks: 80

Unit - I

Space curves, Tangent, contact of curve and surface, Osculating plane, Principal normal and Binormal, Curvature, Torsion, Serret-Frenet's formulae, Osculating circle and Osculating sphere, Existence and Uniqueness theorems, Bertrand curves. Involute. Evolutes.

Unit - II

Conoids, Inflexional tangents, Singular points, Indicatrix. Ruled surface, Developable surface, Tangent plane to a ruled surface. Necessary and sufficient condition that a surface = f(n) should represent a developable surface. Metric of a surface, First, second and third fundamental forms, Fundamental magnitudes of some important surfaces, Orthogonal trajectories.

Unit - III

Normal curvature, Principal directions and Principal curvatures, First curvature, Mean curvature, Gaussian curvature. Radius of curvature of any normal section at an umbilic on z – f(x,y). Lines of curvature, Principal radial, Relation between fundamental forms. Asymptotic lines, Differential equation of un asymptotic line, Curvature and Torsion of an asymptotic line. Gauss's formulae, Gauss's characteristic equation.

Unit - IV

Tensor Analysis - Kronecker delta Contra variant and Covariant tensors, Symmetric tensors, Quotient law of tensors, Relative tensor. Riemannian space. Metric tensor, Indicator, Permutation symbols and Permutation tensors. Christoffel symbols and their properties, Covariant differentiation of tensors. Ricci's theorem.

Unit - V

Intrinsic derivative, Geodesics, Differential equation of geodesics, Geodesic coordinates. Field of parallel vectors, Reumann-Christoffel tensor and its properties. Covariant curvature tensor, Einstein space. Bianchi's identity. Einstein tensor, Flate space, Isotropic point, Schur's theorem.

References :

Serge Lang: Fundamentals of differential geometry, Springer

D.C.Agrawal: Tensor Calculus and Riemannian Geometry, Krishna Prakashan Mandir, Meerut.

Devid C. Kay: Schaum’s Outline Series – Tensor Calculus, McGraw Hill

S.S. Gupta J.K. Goyal, K.P. Gupta, G.S. Gupta: Tensor Calculus and Riemannian Geometry, Pragati Prakashan Mandir, Meerut.

MATH 3O7 – H-FUNCTION OF ONE VARIABLE AND FRACTIONAL CALCULUS

Duration :- 3 Hrs. Max. Marks: – 150

Distribution of marks:

Internal assessment 50 Theory paper 100

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

Section-A: One compulsory question with 10 parts, having 2 questions from each unit. Each question will carry equal marks.

Total marks: 20

Section-B: This section has 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit. Each question will carry equal marks.

Total marks: 80

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.

M.A./M.Sc. MATHEMATICS SEMESTER – IV (2023-24)

MATH 4C1 – TOPOLOGY

Duration: - 3 Hrs. Max. Marks: – 150

Distribution of marks:

Internal assessment 50 Theory paper 100

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

Section-A: One compulsory question with 10 parts, having 2 questions from each unit. Each question will carry equal marks.

Total marks: 20

Section-B: This section has 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit. Each question will carry equal marks.

Total marks: 80

Unit – I

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

Unit II

Local Bases, Bases and Continuous function: Local Bases, Bases and Sub bases, Subspaces and relative topology, First and Second Countable spaces, Continuous function, continuity, sequentially continuous, open and closed mapping, bicontinuous mapping, homeomorphism, topological property, topology induced by mapping

Unit –III

Separation axiom: T0, T1, T2, spaces, normal space, Hausdorff spaces, regular spaces, T3, T4, spaces, completely regular spaces, Tyconoff space, completely normal

Unit IV

Compactness: compact sets, basic property of compactness, compactness and finite intersection property, Sequentially and accountably, compact sets, local compactness, Heine-Borel theorem, Compactness in metric space, Countable and sequential compactness in metric space

Unit – V

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

Product Space: Product topology, Projection map, theorem related to product related, topology for Cartesian product of arbitrary collection, Tyconoff space

References:

1. G.F. SimmonsIntroduction to Topology and Modern Analysis, Mc Graw Hill
2. Ervin Kreyszig Functional Analysis
3. J. N. Sharma. Functional Analysis (Krishna Prakashan)
4. James R.Munkres Topology, A First Course (Prentice Hall of India)
5. George F.Simmons Introduction to Topology and Modern Analysis (McGraw Hill)
6. K.D. Joshi Introduction to General Topology (Wiley Eastern Ltd)

MATH 4O1 - OPERATIONS RESEARCH - II

Duration :- 3 Hrs. Max. Marks: – 150

Distribution of marks:

Internal assessment 50 Theory paper 100

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

Section-A: One compulsory question with 10 parts, having 2 questions from each unit. Each question will carry equal marks.

Total marks: 20

Section-B: This section has 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit. Each question will carry equal marks.

Total marks: 80

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.

MATH 4O2 - FLUID DYNAMICS - II

Duration :- 3 Hrs. Max. Marks: – 150

Distribution of marks:

Internal assessment 50 Theory paper 100

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

Section-A: One compulsory question with 10 parts, having 2 questions from each unit. Each question will carry equal marks.

Total marks: 20

Section-B: This section has 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit. Each question will carry equal marks.

Total marks: 80

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 fluids, Stress components in real fluids, Relations between components of stress. Analysis of stresses and rate of strain. Navier-stoke equations of motion: Cartesian, Polar, Cylindrical, Spherical Polar system of coordinates.

Unit III

Dynamical Similarity, Buckingum π theorem and its applications, Non dimensional parameters and their physical importance: Reynolds number, Froude number, Mach number, Prandtle number, Eckert number, Grashoff number, Brinkman number, Lift and drag coefficients, Skin Friction coefficient, Nusselt number.

Unit - IV

Exact Solutions of Navier-Stoke's Equations: Plane Couette, plane Poiseuille and Hagen-Poiseuille flows. Flow through tubes of uniform cross sections.

Unit V

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 MathemeticalIntrodution 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 4O3 - MATHEMATICAL STATISTICS II

Duration :- 3 Hrs. Max. Marks: – 150

Distribution of marks:

Internal assessment 50 Theory paper 100

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

Section-A: One compulsory question with 10 parts, having 2 questions from each unit. Each question will carry equal marks.

Total marks: 20

Section-B: This section has 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit. Each question will carry equal marks.

Total marks: 80

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

MATH 4O4 -MATHEMATICAL MODELLING II

Duration :- 3 Hrs. Max. Marks: – 150

Distribution of marks:

Internal assessment 50 Theory paper 100

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

Section-A: One compulsory question with 10 parts, having 2 questions from each unit. Each question will carry equal marks.

Total marks: 20

Section-B: This section has 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit. Each question will carry equal marks.

Total marks: 80

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.

MATH 4O5 - PROGRAMMING IN C WITH ANSI FEATURES II

Duration :- 3 Hrs. Max. Marks: – 150

Distribution of marks:

Internal assessment 50 Theory paper 100

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

Section-A: One compulsory question with 10 parts, having 2 questions from each unit. Each question will carry equal marks.

Total marks: 20

Section-B: This section has 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit. Each question will carry equal marks.

Total marks: 80

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 FuctionArguments, 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

MATH 4O6 – RELATIVITY

Duration :- 3 Hrs. Max. Marks: – 150

Distribution of marks:

Internal assessment 50 Theory paper 100

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

Section-A: One compulsory question with 10 parts, having 2 questions from each unit. Each question will carry equal marks.

Total marks: 20

Section-B: This section has 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit. Each question will carry equal marks.

Total marks: 80

Unit - I

Concepts of relativity, Michelson- Morley experiment, Equation of geodesics for the given metric, Riemann Christoffel tensors.Postualtes of special theory of Relativity, Lorentz-Fitzgerald contraction hypothesis,Lorentz transformation.

Unit - II

Mass-Energy formula, Minkowski's 4 dimensional continuum, Space like and time like intervals.Hamiltonian principle, Energy - Momentum tensor and its expression for perfect fluid, principle of Covariance, Principle of equivalence.

Unit - III

Condition for flat space time, Einstein's law of gravitation for empty space and material world. Schwartz child exterior and interior solution for gravitational field.

Unit - IV

Planetary orbit, three crucial tests, Advances of perihelion, Gravitational deflection of light, Shift in spectral lines. Wayl hypothesis, Displacement of the Fraunhoffer lines.

Unit - V

Einstein and De-sitter models, their comparison with the actual universe, 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.
4. Tolman R.C.: Relativity, Thermodynamics and Cosmology, Oxford University Press.
5. Synge J.L.: Relativity the Special and General North Holland Publishing Company, Amsterdam.
6. Eddention A.S.: The Mathematical Theory of Relativity, Cambridge.