SCHOOL OF STUDIES IN MATHEMATICS

VIKRAM UNIVERSITY, UJJAIN

Syllabus

For

M.A./M.Sc. Mathematics

(Choice Based Credit System) CBCS

Session 2021-2022

SCHOOL OF STUDIES IN MATHEMATICS

VIKRAM UNIVERSITY,UJJAIN

Program: M.Sc. Mathematics

Duration: 4 semesters

Number of seats: 60 (40 Free seat +20 Payment seat) (reservation as per state govt. Rules)

Aims:

1. Strengthening the logical reasoning which is the main ingredient to understand Mathematical concepts.
2. Create more interest in the subject and motivate students for self learning.
3. Developing the Mathematical skills among the students and preparing them to take up a career in research.

Objectives:

1. To make students understand the techniques of proofs in Mathematics and apply suitable techniques to tackle problems.
2. To inculcate the habit of making observations and experimentation and arrive at the final result.
3. Make student acquire the communication skill to present technical Mathematics so as to take up a career in Teaching Mathematics at various levels including schools, colleges, universities, etc.
4. To develop inter-disciplinary approach of learning between Mathematics and other disciplines.
5. To use technology as significant aid in mathematics learning.
6. To revisit the fundamental concepts principles of the discipline and strengthen them.
7. To encourage collaborative learning through group activities, hands-on learning and concretizing mathematical concepts.
8. To provide motivation and support in research and development.

Program outcome:

The Program Outcomes of the Department of Mathematics are as follows:

1. Understanding Ability Enhancement: To enable students to read and demonstrate an understanding of mathematical and/or statistical research literature.
2. Problem Solving Ability Enhancement: Students will be able to identify mathematical and computational methods in order to solve comprehensive problems.
3. Deductive Thinking: Students will be able to read and write logical arguments in order to prove advanced mathematical results.
4. Effective Communication: Students will be able to effectively communicate mathematical concepts, problems and their solutions in written and oral form.
5. Social Service: To learn to apply Mathematics in real life situations aiming at service to the society.
6. Working knowledge in courses taught. Ability to apply to real life problems and industrial problems. Tackle applications to other branches of Mathematics and science. Ability to face competitive exams like NET, GATE, SET etc.

Program specific outcome:

- To become good teachers and researchers.
- To develop problem-solving skills and apply them independently to problems in pure and applied mathematics.
- To assimilate complex mathematical ideas and arguments.
- To improve your own learning and performance.
- To develop abstract mathematical thinking.

SCHOOL OF STUDIES IN MATHEMATICS, VIKRAM UNIVERSITY, UJJAIN

M.A./M.Sc. (MATHEMATICS)

SEMESTER-I

SESSION: 2021-22

SCHEME OF EXAMINATION FOR NEW CBCS

Paper Code	Course Name (Theory/ Practical)	Examination Scheme						
		Discipline	Credits	Maximum Marks		Total Marks	Minimum Marks	
				End-Semester Exam	CCE		End-Semester Exam	Internal (CCE)
MAT-C101	Advanced Abstract Algebra I	Core	5	60	40	100	21	14
MAT-C102	Real Analysis I	Core	5	60	40	100	21	14
MAT-C103	Topology I	Core	4	60	40	100	21	14
MAT-E104 (A,B,C,D)	**A.** Complex Analysis I **B.** Differential Equation I **C.** Advanced Discrete Mathematics I **D.** Differential Geometry of Manifolds I	Any one from the list of discipline centric elective courses **(Elective –I)**	4	60	40	100	21	14
MAT-E105	Programming in C-I (Theory)	Elective-generic or course at SWAYAM **(Elective-II)**	3	40	40	100	14	14
	Programming in C-I (Practical)		1	20	-		07	-
MAT-E106	Entrepreneurship Development	**Elective-III**	4	60	40	100	21	14
MAT-C107	Comprehensive Viva-Voce	-	4	100	-	100	35	-
Total			30	460	240	700	161	84

Ajit Srivastav

8/9/21

Max. Marks 100 (Credit 5)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester I

Objectives:

- To inculcate the basic features of Advanced Abstract algebra.
- To teach solvable and nilpotent groups.
- To acquainted with field extension and finite field theory.
- To introduce Galois Theory.
- To teach solvability of polynomial equation using the theory.

Paper I (MAT-C101) Advanced Abstract Algebra - I

Unit 1 -Automorphisms, Normal and subnormal series of groups, composition series, Jordan-Holder Theorem.

Unit 2 -Commutator subgroup, Solvable series and Solvable groups, Cenral series and Nilpotent groups.

Unit 3- Extension fields, Roots of polynomials, Algebraic and transcendental extensions, Splitting fields, Separable and inseparable extensions.

Unit 4 - Perfect fields, Finite fields, Algebraically closed fields.

Unit 5 - Automorphism of extensions, Galois extensions, Fundamental theorem of Galois theory, Solution of polynomial equations by radicals, Insolvability of the general equation of degree 5 by radicals.

Learning Outcomes: After completion of this course the students will be able to understand the composition series, Jordan-Holder theorem, solvable groups, nilpotent groups. Further, they will understand field extension and Galois Theory and solvability of polynomial equation using the Galois theory

Recommended Books :

1) I. N. Herstein. Topics in algebra, Wiley Eastern Ltd. New Delhi, 1975.
2) Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999.
3) P.B. Bhattacharya, S.K. Jain and S. R.. Nagpaul, Basic Abstract Algebra (2nd Edition), Cambridge University Press, Indian Edition, 1997.

Reference Books :

1) N. Jacobson, Basic Algebra, Vols. i & ii, W. H. freedman, 1980 (also published by Hindustan Publishing Company).
2) S. Lang, Algebra, Addison-Wesley.
3) I.S. Luther and I.B.S. Passi, Algebra, Vol. I - Groups, Vol. II - Rings, Narosa Publishing House (Vol. I -1996, Vol. II - 1999).

Max. Marks 100 (Credit 5)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester I

Objectives:

- To teach fundamentals of Riemann & Riemann-Stieltjesintegration.
- To introduce the Rearrangement of series, Riemann's,Dirichlet's theorem.
- To explain sequence, series sequence of functions, uniform convergence.
- To teach Inverse function, Implicit functiontheorem.
- To explain the concept of extremum in several variable.

Paper II (MAT-C102) Real Analysis - I

Unit 1 - Definition and existence of Riemann-Stieltjes integral, Properties of integral, integration and differentiation, the fundamental theorem of Calculus.

Unit 2 - Integration of vector valued functions, Rectifiable curves. Rearrangement of terms of a series, Riemann's theorem. Sequences and series of functions, pointwise and uniform convergence.

Unit 3 -Cauchy criterian for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's test for uniform convergence, uniform convergence and continuity, uniform convergence and Riemann -Stieltjes integration, uniform convergence and differentiation, Weierstrass approximation theorem,

Unit 4 -Power series, Uniqueness theorem for power series, Abel's theorem, Functions of several variables, linear transformations, Derivatives in an open subset of R^n, chain rule, partial derivatives, interchange of the order of differentiation, derivatives of higher orders. Taylor's theorem,

Unit 5 - Inverse function theorem, Implicit function theorem, Jacobians, Lagrange's multiplier method, Differentiation of integrals, partitions of unity, Differential forms, Stoke's theorem.

Learning Outcomes: After completion of this course, students will able to know the concept of integration, convergence of series and sequence of functions, point wise and uniform convergence. The students will able to know how to read and write the proofs in analysis. Another outcome includes that student able to the proof of several important theorems. They will know a variety of examples and counter examples in Real analysis.

Recommended Books :

1) Walter Rudin, Principles of Mathematical Analysis (3rd edition), McGraw-Hill, Kogakusha, 1976, International Student edition.

Reference Books :

1) T.M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi,1985.

2) H.L. Royden, Real Analysis, Macmillan Publishing Co. Inc., 4th Edition, New York, 1993.

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester I

Objectives:

- To teach fundamental of set theory.
- To introduce Topology.
- To explain the topological properties of topological spaces.
- To teach Urysohn lemma& Tietz Extension Theorem.
- To explain the characteristics of topological space

Paper III (MAT-C103) Topology- I

Unit 1 -Countable and Uncountable sets. Infinite sets and the Axiom of Choice. Cardinal numbers and its arithmetic. Schroeder-Bernstein theorem. Cantor's theorem and the continuum hypothesis. Zorn's lemma. Well - ordering theorem.

Unit 2 -Defintion and examples of topological spaces. Closed sets, Closure. Dense subsets. Neighbourhoods. Interior, exterior and boundary. Accumulation points and derived sets.

Unit 3 -Bases and sub bases. Subspaces and relative topology, Product Topology, Metric Topology, Continuous functions and homomorphism.

Unit 4 - First and Second Countable spaces. Covering and Lindelof's spaces, Separable spaces, second countability and Separability.

Unit 5- Connected spaces, connectedness on real line, components, Path connectedness, locally connected spaces.

Learning Outcomes: After completion of this course, students will able to know the concept of integration, know the definitions of standard terms in topology. The students will able to know how to read and write the proofs in topology. They will know a variety of examples and counterexamples in topology.

Reference Books :

1) K.D. Joshi, Introduction to General Topology,Willey Eastern Limited, 1983.
2) George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.
3) J. Dugundji, Topology, Allyn and Bacon, 1966 (Reprinted in India by Prentice-Hall of India Pvt. Ltd.)1111444555566
4) N. Bourbaki, General Topology part-I (Transl.) Addison Wesley Reading 1966.
5) B. Mendelson, Introduction to Topology, Allyn & Becon, Inc., Boston, 1962.
6) E.H. Spanier, Algebraic Topology, McGraw-Hill, New York, 1966.
7) J.L. Kelley, General Topology, Van Nostrand, Reinhold Co., New York, 1995.
8) M.J. Mansfield, Introduction to Topology, D.Van Nostrand Co. Inc., Princeton, N.J. 1963.

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester I

Objectives:

- Importance of analytic functions in the complex integration.
- Series expansion of complex valued functions of a complex variable.
- To understand Singularities and learn to use Argument principle.
- Applications of complex integration for the evaluation of real integrals.
- To visualize the multi-valued complex functions.

Paper IV (MAT-E104-A)(Elective-I) Complex Analysis- I

Unit 1 - Complex integration. Cauchy-Gorsat Theorem. Cauchy's integral Formula. Higher Order derivatives.

Unit 2- Morera's Theorem. Cauchy's inequality and Liouville's theorem. The fundamental theorem of Algebra. Taylor's theorem.

Unit 3 - Maximum modulus principle. Schwarz lemma. Laurent's series. Isolated singularities. Meromorphic functions. The argument principle. Rouche's theorem inverse function theorem.

Unit 4 - Mobius Transformations. Fixed Points, Cross Ratio, Bilinear transformations, their properties and classifications. Definitions and Examples of Conformal mappings.

Unit 5 - Residues. Cauchy's residue theorem. Evaluation of integrals. Branches of many valued functions with special reference to arg z, log z and z^a.

Learning Outcomes: In the end of the course, students will learn the fundamental concepts of complex integration, Contour integration to evaluate complicated real integrals using residue calculus and also know how to construct conformal mappings in which Hilbert space ideas are used.

Recommended Books :

1) J.B. Conway, Functions of one Complex variable, Springer-Verlag, International Student Edition, Narosa Publishing House, 1980.
2) Brijendra Singh, Varsha Karanjgaokar and R. S. Chandel, Complex Analysis, Gaura Pustak Sadan, Agra - 7.

Reference Books :

1) S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.
2) L.V. Ahlfors, Complex Analysis, McGraw-Hill, 1979.

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester I

Objectives:

- Importance of differential equation in the Mathematics.
- Series expansion of complex valued functions of a complex variable.
- To understand Differential inequalities and their Uniqueness.
- Applications of differential equation for the evaluation of different problems.
- To visualize the multi-purpose use of differential equation.

Paper IV (MAT-E104-B) (Elective-I) Differential Equations - I

Unit 1 - Initial value Problem and the equivalent integral equation, mth order equation in d - dimension as a first order system, concepts of local existence, existence in the large and uniqueness of solutions with examples.

Unit 2 - Basic Theorems- Ascoli- Arzela Theorem. A theorem on convergence of solutions of a family of initial value problems.

Unit 3 - Picard-Lindelof theorem-Peano's existence theorem and corollary. Maximal intervals of existence. Extension theorem and corollaries. Kamke's convergence theorem. Kneser's theorem (Statement only)

Unit 4 - Differential inequalities and Uniqueness - Gronwall's inequality. Maximal and Minimal Solutions. Differential inequalities. A theorem of Winter. Uniqueness Theorems. Nagumo's and Osgoods's criteria.

Unit 5 - Egres points and Lyapunov functions. Successive approximations. Linear Differential Equations - Linear systems, Variation of Constants, reduction to smaller systems. Basic inequalities, Constant coefficients. Floquet theory. Adjoint systems, Higher Order equations.

Learning Outcomes: In the end of the course, students will learn the fundamental concepts of differential equation, Initial value Problem and the equivalent integral equation and also know how to solve real problems and their uniqueness of solutions with examples.

Recommended Books :

1) P. Hartman, Ordinary Differential Equations, John Wiley (1964).

Reference Books :

1) W.T. Reid, Ordinary Differential Equations, John Wiley & Sons, NY (1971).
2) E.A. Coddington and N. Levinson, Theory of Ordinary Differential Equaions, Mc Graw Hill, NY (1955).

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester I

Objectives:

- To train the students to get expertise in the mathematical concepts involved in the field Discrete Mathematics which has applications in diverse areas including Computer science and Electrical Engineering.
- To learn the basic concepts in combinatorics and the idea of tackling problems using generating functions and recurrence relation.
- Also, in this course, the rudiments of Graph theory viz., Paths and connectedness of Graphs, Matching, Planarity, Vertex colourings, Edge colourings, are introduced.

Paper IV (MAT-E104-C)(Elective-I) Advanced Discrete Mathematics - I

Unit 1 - Semigroups & Monoids - Definitions and examples of Semigroups and Monoids (including those pertaining to concatenation operation). Homomorphism of semigroups and Monoids. Congruence relation andQuotient Semigroups. Subsemigroup and submonoids. Direct products. Basic Homomorphism Theorem.

Unit 2 - Lattices - Lattices as partially ordered sets. Their properties. Lattices as Algebraic systems. Sublattices, Direct products,and Homomorphisms. Some Special Lattices e.g.., Complete, Complemented and Distributive Lattices.

Unit 3 - Boolean Algebras-Boolean Algebras as Lattices. Various Boolean Identities. The Switching Algebra example. Subalgebras, Direct products and Homomorphisms. join- irreducible elements, Atoms and Minterms. booleean forms and Teir Equivalence. Minterm Boolean forms, Sum of products Canonical forms. Minimization of Boolean Fuctions. Applications of boolean Alegebra to Switching Theory- (using AND, OR & NOT gates). the Karnaugh Map method.

Unit 4 - Graph Theory- Definiition of (undirected) Graphs, Paths, Circuits Cycles & Subgraphs. Induced Subgraphs. Degree of a vertex. Connectivity. Planar Graphs and their properties. Trees.

Unit 5 - Eulers Formula for connected Planar Graphs. Complete & Complete Bipartite Graphs. Kuratowskis Theorem (statement only) and its use . Spanning trees, cut-sets. Fundamental Cut- Sets, and Cycles. minimal Spanning trees and Kruskals Algorithm. Matrix Representations of Graphs.

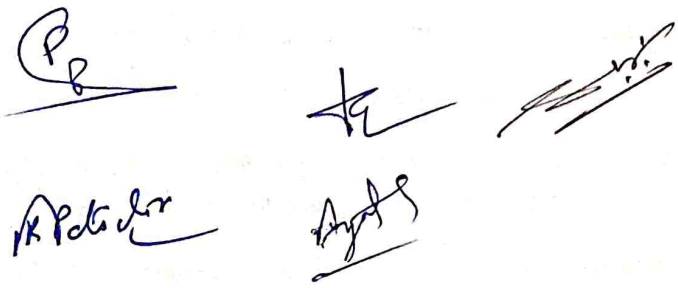
Learning Outcomes: After completing this course, the student will be able to review and explain the techniques required in addressing problems on permutations and combinations with the help of generating functions and recurrence functions. Understand and work on the elementary concepts of graphs namely, subgraph, cut vertex, blocks, connectivity of a given graph.

Recommended Books :

1) J.P.Trembly & R.Manohar, Discrete mathematical Structures with Applications to Computer Science, McGraw Hill Book Co. 1997.
2) N. Deo, Graph Theory with applications to Engineering and Computer Sciences, Prentice Hall of India.

Reference Books :

1) J.L.Gersting, Mathematical Structures for Computer Science, (3rd edittion), Computer Science Press, New york.
2) Seymour Lepschutz, Finite Mathematics (International edition 1983) McGraw- Hill Book Company, Newyork.
3) S.Wiitala,Discrete Mathematics - A Unified Approach, MC graw- Hill Book Co.
4) J.E.Hopcroft and J,D. Ullman, Introduction to Automata Theory Languages & Compulation Narosa Publishing House.
5) B. Singh, R.S.Chandel and Akhilesh Jain, Advanced Discrete Mathematics,Golden Valley Publications.



M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester I

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives:

This paper is introduced for the study of Tensor Algebra, Differentiable manifold, Differentiable functions, Differentiable curves, Tangent space, Vector fields, Lie bracket, Covariant differentiation, Torsion, Curvature, Lie derivative, Riemannian Manifold , Exterior algebra and Submanifolds & Hypersurfaces. The main objective of Differential Geometry of Manifolds is that to prepare the students for further research in analysis of differential geometry.

Paper IV (MAT-E104-D)(Elective-I) Differential Geometry of Manifolds - I

Unit I - Definition and examples of differentiable manifolds. Tangent spaces. Jacobian map. One parameter goup of transformations.

Unit II - Lie derivatives. Immersions and Embeddings. Distributions. Exterior algebra. Exterior derivative.

Unit III - Topological Groups. Lie groups and lie algebras. Product of two Liegroups.

Unit IV - One parameter subgroup and exponential maps. Examples of Liegroups.

Unit V - Homomorphism and Isomorphism. Lie transformation groups. General Linear groups. Principal fibre bundle. Linear frame bundle.

Learning Outcomes: In mathematics Differential Geometry of Manifolds is the branch of differential geometry. Students will be able to demonstrate an intuitive and computational understanding of Tensor Algebra, Differentiable manifold, Riemannian Manifold, Exterior algebra and Submanifolds & Hypersurfaces. Differential Geometry of Manifolds covers a wide area of research in differential geometry. It is also used in physical sciences and Cosmology.

Recommended Books :

1) B.B. Sinha, An Introduction to Modern differential Geometry, Kalyani Publishers, New Delhi, 1982.
2) K. Yano and M. Kon, Structure of Manifolds, World Scientific Publishing Co. Pvt. Ltd., 1984.

References Books :

1) R.S. Mishra, A Course in tensors with applications to Riemannian Geometry, Pothishala (Pvt.) Ltd., 1965.
2) R.S. Mishra, Structures on a differentiable manifold and their applications, Chandrama Prakashan, Allahabad, 1984.

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester I

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 40 (Min. 14) (Credit 3)
C.C.E. Marks: 40 (Min. 14)
Practical Marks: 20 (Min. 7) (Credit 1)

Objectives:

The course aims to provide exposure to problem-solving through programming. It aims to train the student to the basic concepts of the C-programming language. This course involves a lab component which is designed to give the student hands-on experience with the concepts.

Paper V (MAT-E105) (Elective-II) Programming in C-I (Theory and Practical)

Unit-1 An overview of programming languages

Unit-2 Classification. C Essentials - Programs development, Functions

Unit-3 Anatomy of a Function. Variables and Constants Expressions. Assignment Statements. Formatting Source files Continuation Character. the Preprocessor.

Unit-4 Scalar Data types - Declarations, Different Types of integers. Different kinds of Integer Constants Floating - point type Initialization

Unit-5 Mixing types Explicit conversions - casts. Enumeration Types. The void data type , Typedefs. Pointers.

Learning Outcomes: After the course the students are expected to be able to:

- Identify situations where computational methods and computers would be useful.
- Given a computational problem, identify and abstract the programming task involved.
- Approach the programming tasks using techniques learned and write pseudo-code.
- Choose the right data representation formats based on the requirements of the problem.

Reference Books:

1) Samuel P. Harkison and Gly L Steele Jr. C; A Reference manual , 2an Edition Prentice hall, 1984.
2) Brain W Kernigham & Dennis M Ritchie the C Programmed Language 2nd Edition (ANSI Features), Prentice Hall 1989.

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester I

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives:

To prepare the budding entrepreneurs and to provide the students seedbeds of entrepreneurship at the entry level and enhance their entrepreneurial skills.

Paper VI (MAT-E106) (Elective-III) ENTREPRENEURSHIP DEVELOPMENT- I

Unit I: Introduction - Entrepreneurship - meaning, nature, importance, specific traits of Entrepreneurs, role of entrepreneurs in Indian Economy.

Unit II: Analysis of Entrepreneur opportunities - Defining, objectives, identification, process of sensing, accessing the impact of opportunities and threats.

Unit III: Search of business idea - Preparing for business plan, legal requirements for establishing of a new unit-procedure for registering business, starting of new venture, product designing / branding, research and development, selection of forms of business organization.

Unit IV: Role of Supportive Organizations - D.I.C and various government policies for the development of entrepreneurship Government schemes and business assistance, subsidies, role of banks.

Unit V: Market assessment - Meaning of market assessment, components and dimensions of market assessment, Questionnaire preparations, survey of local market, visit to industrial unit, business houses, service sector etc. Submission of survey based report on one successful and unsuccessful entrepreneur.

Learning Outcomes: After learning the course the students should be able to develop idea generation, creative and innovative skills, Aware of different opportunities and successful growth stories, learn how to start an enterprise and design business plans those are suitable for funding by considering all dimensions of business. Understand entrepreneurial process by way of studying different case studies and find exceptions to the process model of entrepreneurship. Run a small enterprise with small capital for a short period and experience the science and art of doing business.

Suggested Readings:

1) Entrepreneurship Development by Dr. C. B. Gupta.
2) Dynamics of Entrepreneurial Development and Management by Vasant Desai.
3) Innovation and Entrepreneurship by Peter F. Drucker.
4) Entrepreneurship Development by G. A. Kaulgud.
5) Entrepreneurship-Need of the Hour by Dr.Vidya Hattangadi.
6) Entrepreneurship Development by Dipesh D. Uike.

M.Sc. II Semester

SCHOOL OF STUDIES IN MATHEMATICS, VIKRAM UNIVERSITY, UJJAIN

M.A./M.Sc. (MATHEMATICS)

SEMESTER-II

SESSION: 2021-22

SCHEME OF EXAMINATION FOR NEW CBCS

Paper Code	Course Name (Theory/ Practical)	Examination Scheme						
		Discipline	Credits	Maximum Marks		Total Marks	Minimum Marks	
				End-Semester Exam	CCE		End-Semester Exam	Internal (CCE)
MAT-C201	Advanced Abstract Algebra II	Core	5	60	40	100	21	14
MAT-C202	Lebesgue Measure and Integration	Core	5	60	40	100	21	14
MAT-C203	Topology II	Core	4	60	40	100	21	14
MAT-E204 (A,B,C,D)	**A.** Complex Analysis II **B.** Differential Equation II **C.** Advanced Discrete Mathematics II **D.** Differential Geometry of Manifolds II	Any one from the list of discipline centric elective courses **(Elective –I)**	4	60	40	100	21	14
MAT-E205	Programming in C-II (Theory)	Elective-generic or course at SWAYAM **(Elective-II)**	3	40	40	100	14	14
	Programming in C-II (Practical)		1	20	-		07	-
MAT-E206	Communication Skills	**Elective-III**	4	60	40	100	21	14
MAT-C207	Comprehensive Viva-Voce	-	4	100	-	100	35	-
Total			30	460	240	700	161	84

Max. Marks 100 (Credit 5)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester II

Objectives:

- To inculcate the basic features of Advanced Abstract algebra.
- To teach canonical forms and primary decomposition theorem.
- To acquainted with Module theory.
- To introduce Noetherian and Artinian modules.
- To teach finitely generated modules over a PID.

Paper I (MAT-C201) Advanced Abstract Algebra - II

Unit 1 - Introduction to Modules, Examples, Sub-modules and direct sums, Examples of sub-modules, Quotient Modules, R-Homomorphism and Examples of R-Homomorphism ,

Unit 2 -Finitely generated modules. Cyclic modules, Simple modules, Schur's Lemma, Free modules .

Unit 3 - Noetherian and Artinian modules and rings, Hilbert basis theorem.

Unit 4 - Uniform modules, primary modules and Noether-Lasker theorem.

Unit5- Algebra of linear transformations, Characteristic roots, Similarity of linear transformations, Invariant subspaces, Reduction to triangular forms, Nilpotent transformations, Index of nilpotency, Invariants of a nilpotent transformation, The primary decomposition theorem.

Learning Outcomes: After completion of this course the students will be able to understand thecanonical forms and primary decomposition theorem, Module theory, Noetherian and Artinian modules,finitely generated modules over a PID and rational canonical forms.

Recommended Books :

1) I. N. Herstein. Topics in algebra, Wiley Eastern Ltd. New Delhi, 1975.
2) Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999.

Reference Books :

1) P.B. Bhattacharya, S.K. Jain and S. R.. Nagpaul, Basic Abstract Algebra (2nd Edition), Cambridge University Press, Indian Edition, 1997.
2) S. Kumaresan, Linear Algebra - A geometric approach, Prentice Hall of India, Ltd.

Max. Marks 100 (Credit 5)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester II

Objectives:

- To inculcate the basic features of Lebesgue measures.
- To teach Lebesgue integration Theory.
- To acquainted withLebesgue differentiation.
- To introduce The Lp-space and some inequalities.
- To teach Completeness of Lp-space and convergence in measure.

Paper II (MAT-C202) Lebesgue Measure and Integration

Unit 1 - Lebesgue outer measure. Measurable sets. Regularity. Measurable functions. Borel and Lebesgue measurability. Non-measurable sets.

Unit 2 - Integration of Non-negative functions. The General integral. Integration of Series. Reimann and Lebesgue integrals.

Unit 3- The Four derivatives. Functions of bounded variation. Lebesgue Differentiation Theorem. Differentiation and Integration.

Unit 4- The L^p spaces, Convex functions, Jensen's inequality, Hölder and Minkowski inequalities, Completeness of L^p.

Unit 5 - Dual of space, Convergence in Measure, Uniform convergence and Almost uniform Convergence.

Learning Outcomes: After completion of this course the students will be able to understand the basic concept of measure and integration, Lebesgue integration Theory, Lebesgue differentiation, Lp-space and some inequalities. Further, they will learn Completeness of Lp-space and convergence in measure and almost uniform convergence

Recommended Books :

1) G.de Barra, Measure Theory and Integration, Wiley Eastern Limited, 1981.

Reference Books :

1) Walter Rudin, Principles of Mathematical Analysis (3rd edition), McGraw-Hill, Kogakusha, 1976, International Student edition.
2) H.L. Royden, Real Analysis, Macmillan Publishing Co. Inc., 4th Edition, New York, 1993.
3) Inder K. Rana, An Introduction to Measure and Integration, Narosa Publishing House, 1997.
4) P.R. Halmos, Measure Theory, Van Nostrand, Princeton, 1950.
5) P.K. Jain and V.P. Gupta, Lebesgue Measure and Integration, New Age International (P) Limited Published New Delhi, 1986 (Reprint 2000).

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester II

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives:

- To teach the concept of compactness and connectedness.
- To introduce product space.
- To explain the nets & filters and their convergence.
- To teach Urysohn metrization Theorem & Tychonoff Embedding Theorem.
- To explain the concept of the fundamental group

Paper III (MAT-C203) Topology- II

Unit 1 - Separation axioms T0, T1, T2, T31/2 , T4 their characterization and basic properties. Urysohn's lemma. Tietze extension theorem.

Unit 2 - Compactness. Continuous functions and compact sets. Basic properties of compactness. Compactness and finite intersection property. Sequentially and countably compact sets. Local Compactness and one point compactification. Stone-Cech compactification.

Unit 3-Tychonoff product, Projection maps. Separation axioms and product spaces. Connectedness and product spaces. Compactness and product spaces (Tychonoff Theorem). Embedding lemma and Tychonoff embedding.

Unit 4- Nets and Filters. Topology and Convergence of nets. Hausdorffness and nets. Compactness and nets. Filters and their convergence. Canonical way of converting nets to filters and vice versa. Ultrafilters and compactness.

Unit 5- The fundamental group and covering spaces-Homotopy of paths. The fundamental group. Covering spaces. The fundamental group of the circle and the fundamental theorem of algebra.

Learning Outcomes: After completion of this course, students will know the definitions of standard terms in topology. The students will able to know how to read and write the proofs in topology. They will know a variety of examples and counterexamples in topology.

Recommended Books :

1) James R. Munkres, Topology : A First Course, Prentice Hall of India Pvt. Ltd. New Delhi, 2000.
2) K.D. Joshi, Introduction to General Topology,Willey Eastern Limited, 1983.

Reference Books :

1) George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.
2) J. Dugundji, Topology, Allyn and Bacon, 1966 (Reprinted in India by Prentice-Hall of India Pvt. Ltd.)1111444555566
3) N. Bourbaki, General Topology part-I (Transl.) Addison Wesley Reading 1966.
4) B. Mendelson, Introduction to Topology, Allyn & Becon, Inc., Boston, 1962.
5) E.H. Spanier, Algebraic Topology, McGraw-Hill, New York, 1966.
6) J.L. Kelley, General Topology, Van Nostrand, Reinhold Co., New York, 1995.
7) M.J. Mansfield, Introduction to Topology, D.Van Nostrand Co. Inc., Princeton, N.J. 1963.

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester II

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives:

- Introduce infinite product of complex numbers.
- Importance of infinite product for defining Gamma and Zeta functions.
- To understand the principal of analytic continuation and its applications.
- Factorization theorems of entire functions having infinite zeros.
- Idea related to univalent functions and conjecture for complex valued functions.

Paper IV (MAT-E204-A)(Elective-I) Complex Analysis- II

Unit 1 - Weierstrass' factorisation theorem. Gamma function and its properties. Riemann Zeta function. Riemann's functional equation.

Unit 2 - Runge's theorem. Mittag-Leffler's theorem. Analytic Continuation. Uniqueness of direct analytic continuation. Uniqueness of analytic continuation along a curve. Power series method of analytic continuation.

Unit 3 - Schwarz Reflection principle. Monodromy theorem and its consequences. Harmonic functions on a disk.

Unit 4- Harnack's inequality and theorem. Dirichlet problem. Green's function. Canonical products. Jensen's formula. Poisson - Jensen formula. Hadamard's three circles theorem. Order of an entire function. Exponent of Convergence. Borel's theorem. Hadamard's factorization theorem.

Unit 5 - The range of an analytic function. Bloch's theorem. The little Picard theorem. Schottky's theorem. Montel Caratheodary and great Picard theorem. Univalent function. Bieberbach conjecture and the 1/4 theorem.

Learning Outcomes: In the end of the course, students will be able to express entire function in the form of canonical products. Also, they knowing about theory related to convergence of infinite product and expression of some well known functions in the form of Infinite products.

Recommended Books :

1) J.B. Conway, Functions of one Complex variable, Springer-Verlag, International Student Edition, Narosa Publishing House, 1980.

Reference Books :

1) S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.
2) H.A. Priestly, Introduction to complex analysis, Clarendon Press, Oxford, 1990.
3) D, Sarason, Complex Function Theory, Hindustan Book Agency, Delhi, 1994.
4) E.C. Titchmarsh, The Theory of Functions, Oxford University Press, London.
5) L.V. Ahlfors, Complex Analysis, McGraw-Hill, 1979.
6) Walter Rudin, Real and Complex Analysis, McGraw-Hill Book Co., 1966.
7) S. Saks and Zygmund, Analytic Functions, Monografie matematyczne, 1952.
8) B. Singh, Varsha Karanjgoakar and R.S.Chandel, Complex analysis,Golden Valley Publications.

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester II

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives: The students will learn the governing mathematical formulations and their solutions of various physical problems.

Paper IV (MAT-E204-B) (Elective-I) Differential Equations - II

Unit 1 - Dependence on initial conditions and parameters, preliminaries. Continuity. Differentiability. Higher Order Differentiability.

Unit 2 - Poincare-Bendixson Theory - Autonomous Systems. Umlanfsatz. Index of a stationary point. Poincare-Bendixson Theorem. Stability of periodic solutions, rotation points, foci, nodes and saddle points.

Unit 3 - Linear second order equations-preliminaries. Basic facts. Theorems of Sturm. Sturm-Liouvelle Boundary Value Problems. Number of Zeros. Nonoscillatory equations and principal solutions. Nonoscillation theorems.

Unit 4 - Use of Implicit function and fixed point theorems- periodic solutions. Linear equations. Nonlinear problems.

Unit 5 - Second Order Boundary Value Problems- Linear Problems. Nonlinear problems. Aprori bounds.

Learning Outcomes: After going through this course the students will be able to:

(i) Formulate the governing Mathematical equations of Physical Problems.
(ii) Solve Differential Equations using various Mathematical tools.

Recommended Books :

1) P. Hartman, Ordinary Differential Equations, John Wiley (1964).

Reference Books :

1) W.T. Reid, Ordinary Differential Equations, John Wiley & Sons, NY (1971).
2) E.A. Coddington and N. Levinson, Theory of Ordinary Differential Equaions, Mc Graw Hill, NY (1955).

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester II

Objectives:

- To train the students to get expertise in the mathematical concepts involved in the field Discrete Mathematics which has applications in diverse areas including Computer science and Electrical Engineering.
- To learn the basic concepts in combinatorics and the idea of tackling problems using generating functions and recurrence relation.
- Also, in this course, the rudiments of Graph theory viz., Paths and connectedness of Graphs, Matching, Planarity, Vertex colourings, Edge colourings, are introduced.

Paper IV (MAT-E204-C)(Elective-I) Advanced Discrete Mathematics - II

Unit 1 - Directed Graphs. Indegree and Outdegree of a Vetex. Weighted Undirected Graphs, Dijkstra's Algorithms. Strong connectivity and Warshall's Algorithms. Directed Tress. Search Trees. Tree Traversals.

Unit 2 - Introductry Computability Theory- Finite State Machines and their Transition Table Diagrams. Equivalence of Fintie State Machines. Reduced Machines. Homomorphism. Finite Automata. Acceptors.

Unit 3 - Non- deterministic finite Automata and equivalence of its power to that of Deterministics Finte Automata Moore and Mealy Machines.

Unit 4 - Turing Machine and Partial Recursive Functions. Grammars and Languages - Phrase-Structure Grammars. Rewriting Rules. Derivations.

Unit 5 - Sentential forms. Language generated by a Grammar . Regular , Context -Free , and Context Sensitive Grammers and Languages Regular Sets, Regular Expressions and the Pumping Lemma Kleenes Theorem. Notions of Syntax Analysis. Polish Notations Conversion of Infix Experessions to Polish Natations. The Reverse Polish Notation.

Learning Outcomes: After completing this course, the student will be able to review and explain the techniques required in addressing problems on Graphs and Machine with the help of generating functions and recurrence functions.

Recommended Books :

1) J.P.Trembly & R.Manohar, Discrete mathematical Structures with Applications to Computer Science, McGraw Hill Book Co. 1997.
2) N. Deo, Graph Theory with applications to Engineering and Computer Sciences, Prentice Hall of India.

Reference Books :

1) J.L.Gersting, Mathematical Structures for Computer Science, (3rd edittion), Computer Science Press, New york.
2) Seymour Lepschutz, Finite Mathematics (International edition 1983) McGraw- Hill Book Company, Newyork.
3) S.Wiitala,Discrete Mathematics - A Unified Approach, MC graw- Hill Book Co.
4) J.E.Hopcroft and J,D. Ullman, Introduction to Automata Theory Languages & Compulation Narosa Publishing House.
5) B. Singh, R.S.Chandel and Akhilesh Jain, Advanced Discrete Mathematics,Golden Valley Publications.

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester II

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives:

This paper is introduced for the study of Tensor Algebra, Differentiable manifold, Differentiable functions, Differentiable curves, Tangent space, Vector fields, Lie bracket, Covariant differentiation, Torsion, Curvature, Lie derivative, Riemannian Manifold , Exterior algebra and Submanifolds & Hypersurfaces. The main objective of Differential Geometry of Manifolds is that to prepare the students for further research in analysis of differential geometry.

Paper IV (MAT-E204-D)(Elective-I) Differential Geometry of Manifolds - II

Unit I - Associated fibre bundle. Vector bundle. Induced undle. Bundle homomorphisms.

Unit II - Riemannian manifolds. Riemannian connection. Curvature tensors. Sectional Curvature. Schur's theorem.

Unit III - Geodesics in a Riemannian manifold. Projective curvature tensor. Conformal curvature tensor.

Unit IV - Submanifolds & Hypersurfaces. Normals. Gauss' formulae. Weingarten equations. Lines of Curvature. Generalised Gauss and Mainardi-Codazzi equations.

Unit V - Almost Complex manifolds. Nijenhuis tensor. Contravariant and covariant almost analytic vector fields. F-connection.

Learning Outcomes: In mathematics Differential Geometry of Manifolds is the branch of differential geometry. Students will be able to demonstrate an intuitive and computational understanding of Tensor Algebra, Differentiable manifold, Riemannian Manifold, Exterior algebra and Submanifolds & Hypersurfaces. Differential Geometry of Manifolds covers a wide area of research in differential geometry. It is also used in physical sciences and Cosmology.

Recommended Books :

1) B.B. Sinha, An Introduction to Modern differential Geometry, Kalyani Publishers, New Delhi, 1982.
2) K. Yano and M. Kon, Structure of Manifolds, World Scientific Publishing Co. Pvt. Ltd., 1984.

References Books :

1) R.S. Mishra, A Course in tensors with applications to Riemannian Geometry, Pothishala (Pvt.) Ltd., 1965.
2) R.S. Mishra, Structures on a differentiable manifold and their applications, Chandrama Prakashan, Allahabad, 1984.

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 40 (Min. 14) (Credit 3)
C.C.E. Marks: 40 (Min. 14)
Practical Marks: 20 (Min. 7) (Credit 1)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester II

Objectives:

The course aims to provide exposure to problem-solving through programming. It aims to train the student to the basic concepts of the C-programming language. This course involves a lab component which is designed to give the student hands-on experience with the concepts.

Paper V (MAT-E205) (Elective-II) Programming in C-II (Theory and Practical)

Unit-1 Control Flow - Conditional Branching, the Switch Statement. looping. nested loops

Unit-2 The Break and Continue statement . the goto statement infinite loops.

Unit-3 Operators and Expressions - Precedence and associatively. Unary plus and Minus operators. Binary Arithmetic operators arithmetic assignment operators. Increment and decrement operators. Comma Operator Relational operators logical operators bit-Manipulation operators Bitwise assignment operators. Cast operators size of Operators , Conditional Operators, memory operator.

Unit-4 Arrays and multidimensional Arrays. Storage Classes - fixed vs. Automatic Duration Scope, global variable

Unit-5 The Register Specifier Structures and Unions.

Learning Outcomes: After the course the students are expected to be able to:

- Use the comparisons and limitations of the various programming constructs and choose the right one for the task in hand.
- Write the program on a computer, edit, compile, debug, correct, recompile and run it.
- Identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.

Recommended Books :

1) Peter A Darnell and Philip E. Margolis, C; A Software Engineering Approched, Narosa Publishing House (Springer International Student Edition) 1993.

Reference Books:

1) Samuel P. Harkison and Gly L Steele Jr. C; A Reference manual , 2an Edition Prentice hall, 1984.
2) Brain W Kernigham & Dennis M Ritchie the C Programmed Language 2nd Edition (ANSI Features), Prentice Hall 1989.

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester II

Objectives:

The objective of this paper is to make students aware of the practical significance of good communication skills and help them in acquiring competence in reporting ,drafting and development of negotiations skills.

Paper VI (MAT-E206) (Elective-III) Communication Skills

Unit I: Introduction:- Definition, nature, objects, elements and importance of communication, principles and practices, models of communication, types of communication,.

Unit II: Communication skills and soft skills - Interviewing and group discussion, resume preparation , etiquette and manners, self management, body and sign language, presentation skills, feedback & questioning technique: objectiveness in argument (Both one on one and in groups).

Unit III: Concept to effective communication - Dimensions and directions of communication, means of communication, 7C's for effective communication.

Unit IV: Listening skills - Importance of listening skills, good & bad listening , communication channels, types of communication medium- audio, video, digital, barriers of communication.

Unit V: Public speaking and reporting - effective public speaking and its principles, interpretation and techniques of report writing, letter writing, negotiation skills.

Learning Outcomes: After learning the course the students should be able to Students will be able to understand and evaluate key theoretical approaches used in the interdisciplinary field of communication. Students will develop knowledge, skills, and judgment around human communication that facilitate their ability to work collaboratively with others.

Suggested Reading:

1. Business Communication- Royan and V.lesikar, John D. Pettit, JR.Richard D.Irwin, INC
2. Business communication- K.K. Sinha
3. Business Etiquettes - David Robinson
4. Business communication - Dr. Nageshwar Rao and Dr. R.P. Das
5. Effective business communication- Morphy Richards

M.Sc. III Semester

SCHOOL OF STUDIES IN MATHEMATICS, VIKRAM UNIVERSITY, UJJAIN

M.A./M.Sc. (MATHEMATICS) -SEMESTER-III - SESSION: 2021-22

SCHEME OF EXAMINATION FOR NEW CBCS

Paper Code	Course Name (Theory/ Practical)	Examination Scheme						
		Discipline	Credits	Maximum Marks		Total Marks	Minimum Marks	
				End-Semester Exam	CCE		End-Semester Exam	Internal (CCE)
MAT-C301	**Integration Theory and Functional Analysis-I**	CORE	5	60	40	100	21	14
MAT-C302	**Fundamentals of Computer Science (Theory)-I**	CORE	3	40	40	100	14	14
	Fundamentals of Computer Science(Pract.)-I		1	20	-		7	-
MAT-E303 (A,B,C,D,E,F)	**(to choose 1 out of 5)** A. Advanced Functional Analysis-I **B. Partial Differential Equations** C. Differentiable Structures on manifolds-I D. General Theory of Relativity & Cosmology-I E. Abstract Harmonic Analysis-I F. Mathematics of Finance & Insurancel	ELECTIVE-I	4	60	40	100	21	14
MAT-E304 (A,B,C,D,E,F)	**(to choose 1 out of 5)** **A. Theory of Linear Operator I** B. Advanced Numerical Analysis –I C. Fuzzy Sets and their Applications-I D. Advanced Graph Theory-I E. Advanced Special Function-I F. Spherical Trigonometry and Astronomy-I	ELECTIVE-II	4	60	40	100	21	14
MAT-E305 (A,B,C,D,E,F)	**(to choose 1 out of 5)** **A. Operations Research -I** B. Computational Biology –I C. Fluid Mechanics –I D. Bio- Mechanics -I E. Analytic Number Theory-I F. Integral Transform-I	Elective-III	5	60	40	100	21	14
MAT-E306	**Personality Development (Elective Generic)**	ELECTIVE IV	4	60	40	100	21	14
MAT-V307	**Comprehensive Viva-Voce**		4	100	-	100	35	-
Total			30	460	240	700	161	84

Max. Marks 100 (Credit 5)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester III

Objectives:

- To inculcate the basic features of normed spaces.
- To teach basic properties of finite dimensional spaces.
- To acquainted with four pillars of Functional Analysis.
- To introduce Measure Theory for Signed measure, product measures.
- To teach Fubini's theorem and decomposition theorem.

Paper I (MAT-C301) Integration Theory and Functional Analysis-I

Unit-1 Signed measure. Hahn decomposition theorem, mutually singular measures. Radon Nikodim theorem. Lebesgue decomposition. Riesz representation theorem.

Unit-2 Outer measure, Extension theorem Caratheodory theorem, Lebesgue -Stieltjes integral, product measures, Fubini's theorem.

Unit-3 Normed linear spaces. Banach spaces, Further properties of Normed Spaces, Finite dimensional Normed Spaces and Subspaces and Quotient normed linear space.

Unit-4 Compactness and finite dimension, Linear Operators, Bounded and Continuous Linear Operators.

Unit-5 Linear Functionals, Linear Operators and functional on finite dimensional Spaces, Normed Spaces of Operators and Dual Space.

Learning Outcomes: At the end of the course, the students will be able to explain the fundamental concepts of functional analysis and their role in modern mathematics. Utilize the concepts of functional analysis, for example continuous and bounded operators, normed spaces, Hilbert spaces and to study the behavior of different mathematical expressions arising in science and engineering.

Recommended Books :

1) H.L. Royden, Real Analysis, Prentic Hall of India Publishing Co. Inc.
2) E. Kreyszig, Introductory Functional Analysis with applications, John Wiley & Sons New York.
3) G.F. Simmons, Introduction to Topology & Modern Analysis Mc Graw Hill, New York.

Reference Books:

1) B. Choudhary and Sudarshan Nanda. Functional Analysis with applications, Wiley Eastem Ltd.

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester III

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 40 (Min. 14) (Credit 3)
C.C.E. Marks: 40 (Min. 14)
Practical Marks: 20 (Min. 7) (Credit 1)

Objectives:

The subject aims to provide the student with an understanding of basic concepts of computer science and engineering. An introduction to the fundamentals of software and programming. An introduction to OOP.

Paper II (MAT-C302) Fundamentals of Computer Science-I

Unit 1 - Object Oriented Programming Paradigm, Basic Concepts, Benefits and Applications of Object Oriented Programming.

Unit 2 - C++ - Introduction, Tokens, Keywords, Identifiers and Constants, Basic Data Types, User-Defined Data Types, Derived Data Types, Variables, Operators in C++, Expressions, Implicit Conversions.

Unit 3 - Operator Overloading, Operator Precedence, Control Structure - The if Statement, The switch Statement, The do...while Statement, The while Statement, The for statement.

Unit 4 - Functions in C++, The main Function, Function Prototyping, Call by Reference, Inline Function, Function Overloading, Friend and Virtual Functions.

Unit 5 - Classes and Objects : Specifying a Class, Defining Member Function, Nesting of Member Function, Private Member Functions, Arrays within a Class, Static Data Members, Static Member Functions, Pointers to Members.

Learning Outcomes: At the end of the course, the students will be able to demonstrate the use of mathematical programming and solve simple mathematical problems. Demonstrate the use of Operating system commands and shell script.

Reference Books :

1) E. Balagurusamy, Object Oriented Programming with C++, III Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
2) B. Stroustrup, The C++ programming Language, Addition Wesley.

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester III

Objectives:

The course is designed to review fundamental topics in functional analysis. It is necessary to study the Banach contraction principle and its various generalizations. The power of abstraction in mathematics can be realize from the concept of metric spaces in functional analysis.

Paper III (MAT-E303-A)(ELECTIVE-I) Advanced Functional Analysis-I

Unit-1 Definition and examples of topological vector Spaces Convex, Balanced and absorbing sets and their properties.

Unit-2 Minkowski's functionals, Subspace product space and quotient space of a topological Vector space. Chapter 1 of R. Larsen.

Unit-3 Locally convex topological Vector Spaces. Normable and metrizable topological vector spaces .

Unit-4 Complete topological vector spaces and Frechet space.Chapter 2 and 3 of R. Larsen.

Unit-5 Linear transformations and linear functionals and their continuity. Chapter 2 and 3 of R. Larsen.

Learning Outcomes: After completing this course, students will be able to

- define and state some of the main concepts and theorems of Functional Analysis
- apply their knowledge of the subject in the investigation of examples
- prove basic propositions concerning functional analysis

Recommended Books :

1) R.Larsen, Functional Analysis, Marcel Dekker, Inc. New york, 1973.
2) Walter Rudin, Functional Analysis, TMH Edition,1974.
3) L.V.Kantorovich and G.P. Akilov, Functional Analysis, Pergamon Press 1982.

Reference Books :

1) Laurent Schwartz, Functional Analysis Courant Institute of Mathematical Sciences, New York University, 1964.

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester III

Objectives: The problem arising in physical phenomena widely involve partial differential equations (PDEs). The main objective is to equip students to classify partial differential equations and solve linear Partial Differential equations using different methods. To give a detailed study of Heat equation, Wave equation and Laplace equation.

Paper III(MAT-E303-B) (ELECTIVE-I) Partial Differential Equations

Unit-1 Transport Equation-Intial value Problem Non-homogeneous Equation.Laplace's Equations - Fundamental Solution, Mean Value Formula, Properties of Harmonic functions, Green's Functions, Energy Methods.

Unit-2 Heat Equation - Fundamental Solution, Mean Value Formula, Properties of Solutions, Energy Methods. Wave Equation- Solution by Spherical Means, Non-homogeneous Equations, Energy Methods.

Unit-3 Nonlinear First Order PDE. Complete integrals , Envelopes, Characteristics, Hamilton-Jacobi Equations (Calculus of Variations, Hamiltons ODE, Legendre Transform, Hopf-Lax formulae)

Unit-4 Conservation Laws (Shocks, Entropy Condition Lax-Oleinic formula, Riemanns Problem, Long Time behaviour). Represenation of Solutions- Separation of Variables , Similarity Solutions (Plane and Travelling Waves, Soluitions, Similarity under Scalling)

Unit-5 Fourier and Laplace Transform, Hopf- Cole Transform, Hodographand, legendre Transforms, Potential Functions, Power Series (non - charcateristic surface, Real analytic Functions, Cauchy - Kovalevskaya Theorem).

Learning Outcomes: At the end of the course, the students will be able to: Understand partial differential equations of first order(linear and nonlinear), second and higher order. Apply various analytic methods for computing solutions of various PDEs. Understand the formation and solution of some significant PDEs like wave equation, heat equation and diffusion equation. Apply the knowledge of PDEs and their solutions in order to understand physical phenomena.

Recommended Books :

1) L.C. Evans, Partial Differential Equations, 1998.

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester III

Objectives: Differentiable manifolds are a certain class of topological spaces which, in a way we will make precise, locally resemble R^n. We introduce the key concepts of this subject, such as vector fields, differential forms, integration of differential forms etc.

Paper III (MAT-E303-C)(ELECTIVE-I) Differentiable Structures on manifolds-I

Unit-1 Submanifolds & Hyper surfaces. Normals. Gauss's formulae, Weingarten equations.

Unit-2 Lines of Curvature. Generalized Gauss and Mainrdi - Codazzi equations .

Unit-3 Almost complex manifolds, Njenhuis tensors. Contravariant and covariant almost analytic vector fields.

Unit-4 F-connection, almost Hermit manifolds.

Unit-5 Almost analytic vector fields. cUrvature tensor, Linera connection.

Learning Outcomes: By the end of the paper, the student must be able to:

- Define and understand the key concepts (differentiable structure, (co)tangent bundle etc.)
- Use these concepts to solve problems.
- Prove the main theorems.

Recommended Books :

1) B.B. Sinha, An Introduction to modern Differential Geometry, Kalyani Publishers, new Delhi, 1982.
2) K. Yano and M. Kon structure of Manifolds. world scientific Publishing C. Pvt. Ltd. 1984
3) A. Behaneu, Geomatry of CR- sub manifolds, D. Reidel Publishing company, Dordrecht, 1986 .

Reference Books:

1) R.S. Mishra, A course in tensor with application to Riemannian geometry.

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester III

Objectives: The more difficult topic of deriving Riemann curvature tensor is presented here. In this way Einstein field equation is justified with the proper mathematics. The cosmology module can be thought as composed of two parts, the basic cosmology, and cosmology with the addition of cosmological constants

Paper III (MAT-E303-D)(ELECTIVE-I) General Theory of Relativity and Cosmology-I

Unit-1 Transformation of coordinates. Tensors. Algebra of Tensors. Symmetric and skew symmetric Tensors.

Unit-2 Contraction of tensors and quotient law. Riemannian metric. Christoffel Symbols

Unit-3 Covariant derivatives. Gradient, Divergence and Curl.

Unit-4 Intrinsic derivatives and geodesics, Riemann Christoffel curvature tensor and its symmetry properties.

Unit-5 Intrinsic derivatives and geodesics, Riemann Christoffel curvature tensor and its symmetry properties.

Learning Outcomes: Graduate students are expected to learn some of the basic features of differential geometry (covariant differentiation and parallel transport, etc.) for a proper formulation of general relativity. One can then derive Riemann curvature tensor by parallel transport a vector around a closed path, or through the equation of geodesic deviation. Cosmology understanding why general relativity is th e natural framework for the study of our universe as a physical system

Recommended Books:

1) S.R.Roy and Raj Bali: Theory of Relativity Jaipur Publishing House,Jaipur, 1987.
2) S. K. Shrivastva: General Relativity and Cosmology, PHI, New Delhi.
3) J.V. Narlikar, General Relativity and Cosmology: The Macmillan Company of India Limited, 1978.

References Books:

1) C.E. Weatherburn, An Introduction to Riemannian Geometry and the tensor Calculus, Cambridge University, Press 1950.
2) H. Stephani, General Relativity: An Introduction to the theory of the gravitational field, Cambridge University Press 1982.
3) A.S. Eddington, The Mathematical Theory of Relativity. Cambridge University Press, 1965.
4) R. Adler, M. Bazin, M. Schiffer, Introduction to general relativity, McGraw Hill Inc.,1975.

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester III

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives:

- To teach the concept of Topological Groups.
- To introduce product groups.
- To explain the Structure theory for compact and locally compact Abelian groups.
- To teach Open mapping, Hausdorff quotient group compact quotient group.
- To explain the concept of Symmetric neighbourhood.

Paper III (MAT-E303-E) (ELECTIVE-I) Abstract Harmonic Analysis I

Unit-1 Topological groups, Examples of topological groups and its basic Properties. Subgroups and quotient groups.

Unit-2 Product groups and projective limits. (See G. Bachman[1]) Continuity, homeomorphism. left translate, right translate, inversion mapping, inner automorphism,

Unit-3 Homogenous topological group . Properties of topological groups involving connectedness. Invariant pseudo-metrics and separation axioms. .

Unit-4 Symmetric neighbourhood of identity, compact sets, Structure theory for compact and locally compact Abelian groups. (See Hewitt and Ross [3]), Locally compact topological groups

Unit-5 Compact support subgroups and quotient groups of topological groups, topology for quotient group, open sets, Open mapping, Hausdorff quotient group compact quotient group.

Learning Outcomes: Graduate students are expected to learn some of the basic features of topological groups and certains of its properties.

Recommended Books.

1) George Bachman Elements of Abstract Harmonic Analysis Acadmic Press, New Your. 1964.
2) Taqdir Hussain Introduction to Topological Group W.D. Saudss Company 1966 to ok W.O.
3) Walter Rudin, Fourier Analysis On Group Intersceince publisher , John wiley, New York,1967.

Reference Books.

1) Edwin Hewit and Kenneth A. Ross. Abstract Harmonic Analysis -1, Springer - Verlag, Berlin, 1963.
2) lynn H. Loomis : An Introduction to Abstract Harmonic Analysis, D, Van Nostrand Co. Princet.
3) R. Adler, M. Bazin, M. Schiffer, Introduction to general relativity, McGraw Hill Inc.,1975.

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester III

Objectives:

- To teach the concept of Elements of Theory of Interest.
- To introduce Flow Valuation Annuities.
- To explain Amortization and Sinking Funds.
- To teach Survival Distributions and Valuing Contingent Payment Life insurance..
- To explain the Net Premiums Insurance Models including Expenses.

Paper III (MAT-E303-F) (ELECTIVE-I) Mathematics of Finance and Insurance- I

Unit-1 Elements of Theory of Interest

Unit-2 Flow Valuation Annuities

Unit-3 Amortization and Sinking Funds, brief review of probability theory.

Unit-4 Survival Distributions , Life Tables, Valuing Contingent Payment Life insurance,

Unit-5 life annuities, Net Premiums Insurance Models including Expenses .

Learning Outcomes: Understand general theoretical principles of mathematical methods, apply analytical and optimization methods to solving practical problems, solve problems in banking and insurance and interpret results in practice. Implement methods on computer and work with data sets.

Text Books:

1) Options, Futures and other Drivatives by Jhon C. Hull Prentice -Hall of India Pvt. Ltd.
2) An introduction to Mathematic Finance by Cheldon M. Ross, Cambridge University Press.

Reference Books:

1) An Introduction to Mathematics of Financial Derivatives by Salih N.Neftci, Academic Press, Inc.
2) Mathematics of Financial markets by Ribert J. Elliot & P.E. Kopp Springer Verlag, New Yorlk Inc.

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester III

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives: The idea behind the second course on functional analysis is to emphasize very basic results which are left out in the first course and are important for analysts who apply these tools.To study compact operators, spectral theory of Banach space operators and Hilbert space operators, Banach algebras.

Paper IV (MAT-E304-A)(ELECTIVE-II) Theory of Linear Operators I

Unit-1 Spectral theory in normed linear spaces, resolvent set and spectrum, Spectral properties of bounded linear operators. Properites of resolvent and spectrum, Spectral maping theorem for polynomials.

Unit-2 Spectral radius of a bounded linear operator on a complex Banach space. Elementary theory of Banach alegbras. General properties of compact linear operators. Spectral properties of compact linear operators on normed spaces. Chapter 7,8 (E. Kreyszig).

Unit-3 Behaviours of Compact linear operators with respect to solvability of operators equations. Fredholm type theorems. Fredholm alternative theorem. Fredholm alternative for integral equations

Unit-4 Spectral properties of bounded self -adjoint linear operators on a complex Hilbert space. Positive operators. Monotone sequence theorem for bounded self -adjoint operators on a complex Hilbert space.

Unit-5 Square roots of a positive operator. projection operators. Spectral family of a bounded self -adjoint linear operator and its properties.

Learning Outcomes: At the end of the course, the students will be able to have understanding of main topics of Banach Algebras and Spectral Theory. Terminology, notation and the basic results and concepts of Banach and Hilbert spaces. Understand the concept of spectrum and resolvent, adjoint operators, compact operators, self-adjoint and normal operators, Positive Operator.

Recommended Books:

1) E. Kreyszig Introductory functional analysis with applications, Jhon wiley & Sons, Nwe York, 1978.

Referance Books:

1) P. R. Halmos Introduction to Hilbert space and the theory of Spectral Multiplicity, Second edition, Chelsea publishing co. N.Y. 1957.
2) N. Dundford and J.T. Schwartz, linear operator -3 part, Interscience / Wiley, New York 1958-71.
3) G.Bachman and L. Narci, Functuional analysis, Academic press New York, 1966.

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester III

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives:

- To teach the techniques of solution of algebraic and transcendental equations.
- To introduce Least squares approximation .
- To explain the Bivariate interpolation Approximation.
- To explain the Uniform approximation Rational approximation.
- To explain the concept of interpolation, and different types of interpolation.

Paper IV (MAT-E304-B)(ELECTIVE-II) Advanced Numerical Analysis I

Unit-1 Piece wise and spline interpolation

Unit-2 Bivariate interpolation Approximation,

Unit-3 Least squares approximation

Unit-4 Uniform approximation Rational approximation, choice of method

Unit-5 Numerical differentiation optimum choice of step length

Learning Outcomes: After completion of this course, students will learn the numerical techniques for the numerical solution of the Piece wise and spline interpolation.The students can also learn the Uniform approximation Rational approximation, choice of method. They will know a variety of numerical examples and derivation of several numerical methods.

Text book -

1) Numerical Methods for scientific and Engineering computation by M.K. Jain, S.R.K. Iyenger, R.K. Jain south Edition (2003) New Age.

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester III

Objectives: This course introduces students to the basic concepts of modeling in systems usingfuzzy sets.The concepts of fuzzy sets are introduced and their role in applications of semantic interpreters,control systems and reasoning systems.

Paper IV (MAT-E304-C)(ELECTIVE-II) Fuzzy Sets and Their Applications I

Unit-1 Fuzzy Sets-Basic definitions, A-level sets, convex fuzzy sets,

Unit-2 Basic operations on fuzzy sets Types of fuzzy sets, Cartesian, Product, Algebraic products,

Unit-3 Bounded sum and difference, t-norms and T - co norms.

Unit-4 The Extension Principle - The Zadeh's extension principle,

Unit-5 Image and inverse image of fuzzy sets, fuzzy numbers, Elements of fuzzy arithmetic.

Learning Outcomes: By the end of the course, student will be able to:

- Understand basic knowledge of the fuzzy sets, operations and their properties.
- Understand the fundamental concepts of Fuzzy functions and Fuzzy logic
- Apply the concepts of Fuzzy sets in image processing, Pattern reorganization and Decision making.

Text Books:

1) Fuzzy set theory and its Applications by H.J. Zimmermann, Allied Publishers Ltd., New Delhi, 1991.
2) Fuzzy sets and Fuzzy logic by G.J. Klir and B. Yuan Prentice - Hall of India, New Delhi,1995

Reference Books:-

1) Fuzzy sets and Uncertainty and Information by G.J. Kalia Tina A. Foljer - Prentice - Hall of India.

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester III

Objectives: The main objective of this course is to introduce students with the fundamental concepts in graph Theory, with a sense of some its modern applications and it helps students to solve live problems that can be modelled by graphs.

Paper IV (MAT-E304-D)(ELECTIVE-II) Advanced Graph Theory- I

Unit-1 Revision of graph theoretic preliminaries, Operations on graphs. Graph Isomorphism. Disconnected graph and their Components. Traveling salesman problem, round table problem,

Unit-2 Eulerian and Hamiltonian Paths and circuits.

Unit-3 Properties of trees, Distance centre, radius, diameter eccentricity and related theorems, Graph as Metric space Rooted and binary trees,

Unit-4 Labelled graph and trees spanning tree, weighted spanning tree, Shortest path,

Unit-5 Fundamental cutsets. Rank and nullity, cutsets and cut vertices, fundamental cutsets,

Learning Outcomes: After completing this course, the student will be able to: Understand the basic concepts of graphs , directed graphs, weighted graphs, trees, minimal spanning trees for a given graphs, Eulerian graphs, Hamiltonian graphs and apply the shortest path algorithm to solve some real life problems.

Text Book :-

1) Graph Theory with Application to Engineering and Computer Science by Narsingh Deo.

Reference Book :-

1) Graph Theory by Harary.

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester III

Objectives: The main objective of this course is to introduce Gamma and Beta Functions, Factorial Function, Legendre's duplication formula, Gauss multiplication theorem, Hypergoemetric and Generalized Hypergeometric functions.

Paper IV (MAT-E304-E)(ELECTIVE-II) Advanced Special Function I

Unit-1 Gamma and Beta Functions : The Euler or Mascheroni Constant ? , Gamma Function, A series for ' (z) / (z) , Difference equation ?(z+1) = z?(z),

Unit-2 Beta function, value of ?(z) ?(1-z), Factorial Function, Legendre's duplication formula, Gauss multiplication theorem.

Unit-3 Hypergoemetric and Generalized Hypergeometric functions: Function 2F1 (a,b;c;z) A simple integral form evaluation of 2F1 (a,b;c;z)

Unit-4 Contiguous function relations, Hyper geometrical differential equation and its solutions, F (a,b;c;z) as function of its parameters,

Unit-5 Elementary series manipulations, Simple transformation, Relations between functions of z and 1 -z.

Learning Outcomes: After studying this course the student will be able to: Find the Gamma Function, a series for r'(z)/r(z), Difference equation r(z+1)= zr(z), value of rz/r(1-z). Learn and Apply Hypergeometric funtion and function 2f1(a,b;c;z). A simple integral form valuation of 2F1(a,b;c;z).To Explain confluent hyper geometric function and its properties. Learn Elementary series manipulations, Simple transformation, Relations between function of z and 1-z.

Books Recommended:

1) Rainville, E.D, ; Special Functions, The Macmillan co., New york 1971.
2) Srivastava, H.M. Gupta, K.C. and Goyal, S.P.; The H-functions of One and Two Variables with applications, South Asian Publication, New Delhi.
3) Saran, N., Sharma S.D. and Trivedi, - Special Functions with application, Pragati prakashan,1986.

Reference Books.

1) Lebdev, N.N, Special Functions and Their Applications, Prentice Hall, Englewood Cliffs, New jersey, USA 1995.
2) Whittaker, E.T. and Watson, G.N., A Course of Modern Anal.

M.Sc. Mathematics
Under CBCS (Only for School of Studies in Mathematics)
Semester III

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives: The course aims at introducing the concepts of Fundamental of Spherical Trigonometry, solution and properties of right angled triangle, Spherical triangle & Examples.

Paper IV (MAT-E304-F)(ELECTIVE-II) Spherical Trigonometry an Astronomy- I

Unit-1 Fundamental of Spherical Trigonometry

Unit-2 solution of right angled triangle

Unit-3 Properties of Right angle triangle

Unit-4 Relation between Sides & angles of a Spherical triangle

Unit-5 Application of Spherical triangle & Examples.

Learning Outcomes: After studying this course the student will be able: To Explain and learn Fundamental of Spherical Trigonometry. To Explain Properties of Right angle triangle and solution. To Explain Relation between Sides & angles of a Spherical triangle. To Explain Application of Spherical triangle & Examples.

Text Books:-

1) A text book of spherical trigonometry : Gorakh Prasad.
2) A text book of spherical Astronomy : Gorakh Prasad.

Reference Book.

1) Spherical Astronomy - Smarat
2) Spherical Astronomy - Bell

Max. Marks 100 (Credit 5)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester III

Objectives:

- To introduce the scope of operations research and formulation of LPP.
- To obtain the solution of LPP by Simplex method.
- To find the initial basic feasible solution of a transportation problem.
- Identify and develop operations research model describing a real life problem.
- Understand the mathematical tools that are needed to solve various optimization problems.

Paper V (MAT-E305-A)(ELECTIVE-III) Operations Research - I

Unit-1. Operations Research and its scope ,Nature and Meaning of OR, Origin and Development of OR, Necessity of OR in Industry, Case studies of OR. Model in OR , Main Face of OR ,Uses and limitation of OR, Scope of OR, and role of OR in decision making.

Unit-2 . Linear Programming Problem, Mathematical Formulation, Graphical Solution Method. Graphical Solution in some exceptional cases. Geometrical properties of L.P.P, General Formulation of L.P.P, Slack and Surplus Variables, Standard form of L.P.P. Assumptions in L.P.P, Limitation of L.P.P.

Unit-3. Linear Programming Problem -Simplex Method with exceptional cases, Computational procedure of simplex method, artificial variable techniques; Big M method, two phase Method, Problem of degeneracy.

Unit-4. Duality: Fundamental properties of Duality and Theorem of Duality.

Unit-5. Transportation Problems, Initial Feasible Solution to T.P., North- West corner rule, Row minima, Colum Minima, Matrix Minima, VAM , Optimality test for the initial Feasible solution, Degeneracy in T.P., Assignment Problems ,Hungarian Method for assignment Problem and unbalanced assignment Problem.

Learning Outcomes: After completion of this paper students will able to formulate and find solution of Linear Programming Problem, Transportation problem and project evaluations. Also, they may able to find the shortest path of any network related problem in their daily-life.

Recommended Books:-

1) Kanti Swarup, P.K. Gupta and Manmohan, Operations Research, Sultan Chand & Sons, New Delhi.

Reference Books:-

1) S.D, Sharma, Operation Research.
2) F.S, Hiller and G.J. Lieberman, Industrial Engineering Series, 1995 (This book comes with a CD containing software).
3) G. Hadley , Linear Programming, Narosa Publishing House. 1995.
4) G. Hadley, Linear and Dynamic programming, Addison - Wesley Reading Mass.
5) H.A. Taha, Operations Research - An introduction, Macmillan Publishing co. Inc. New york.
6) Prem Kumar Gupta and D.S. Hira, Operation Reasearch, an Introdution, S. Chand & Company Ltd. New Delhi.
7) N.S. Kambo, Mathematical Programming Techniques, Affilated East - West Pvt. Ltd.

Max. Marks 100 (Credit 5)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

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Semester III

Objectives: The objective of the course is to introduce students to the rapidly evolving field of bioinformatics. we will aim to cover in the lectures the most fundamental topics, such as sequence alignment and pattern finding, and then explore some of the frontier areas.

Paper V (MAT-E305-B)(ELECTIVE-III) Computational Biology- I

Unit-1 Basic concepts of Molecular biology

Unit-2 DNA and Proteins, The Central Dogma, Gene and Genome Sequences.

Unit-3 Restriction Maps - Graphs, Interval graphs. Measuring Fragment sizes,

Unit-4 Algorithms for double digest problem (DDP) - Algorithms and complexity,

Unit-5 Approaches to DDP.

Learning Outcomes: After completing this course, the students will gain an understanding of the computational challenges (and their solutions) in the analysis of large biological data sets; they will understand how some of the commonly used bioinformatics tools work, how to use these tools effectively, and how to read and evaluate research articles in the field.

Text Books:-

1) Introduction to Computational Biology by M.S, Waterman Chapman & Hall, 1995.
2) Bio informatics - A practical Guide to the analysis of Genes and Proteins by A. Baxevanis and B. Ouelette, WileyInterscience (1998).

Reference Books:-

1) Introduction to Bio informatics by Attwood.
2) Bioinformatics-Sequence and Genome analysis by David W.Mount.

M.Sc. Mathematics

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Semester III

Max. Marks 100 (Credit 5)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives: The objective of this course is to introduce:

- Fundamental aspects of fluid flow behaviours.
- Dynamics of viscous fluid flows and governing equations of motion.
- To acquire the knowledge of solving problems using partial differential equations.

Paper V (MAT-E305-C)(ELECTIVE-III) Fluid Mechanics- I

Unit-1 Lagrangian and Eulerian Methods

Unit-2 Equation of continuity, types of flow lines, velocity potential,

Unit-3 Stream function irrigational and rotational motions, vortex lines.

Unit-4 Lagrange's and Euler's equation of motion, burnoulli's theorem,

Unit-5 Irrotational motion in two dimensions,

Learning Outcomes: After completing this course, the students will be able to: Understand the basic ideas of fluid velocity, streamlines and rotational and irrotational flows, Understand the meanings of fundamental terms like pressure and body force, Develop special mathematical methods involving images and complex variables for incompressible fluids.

Text Books.

1) A text book of Fluid Mechanics in SI units by R.K, Rajput.
2) An introduction to Fluid Dynamics by R.K. Rathy, Oxford and IBH Published Co.

Reference Books:

1) Fluid Mechanics (Springer) By Joseph H. Spurk.
2) Fluid Mechanics by Irfan A Khan (H.R.W.)
3) An Introduction to Fluid Mechanics by G.K. Batchelor, Foundation Books, New Delhi, 1994.

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester III

Max. Marks 100 (Credit 5)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives:

- To introduce students to the application of mathematical modelling in the analysis of biological systems.
- To show how mathematics and computing can be used in an integrated way to analyse biological systems.

Paper V (MAT-E305-D)(ELECTIVE-III) Bio-Mechanics- I

Unit-1 Bio-physics of Human Cardio - vascular system: Types of Blood Vessels, Properties of Blood

Unit-2 Flow in Tubes, Poiseuibles law, Erythrocyte Sedimentation Rate , Stroke's law , Palatial flow in elastic vessels.

Unit-3 Bio - physics of Human Thermo- Regulation Head Flow in Human Dermal and Subdermal parts

Unit-4 Derivation of Governing partial differential equations Incorporating

Unit-5 Microcirculation and perspiration.

Learning Outcomes: At the end of the course, students will be able to:

- have an enhanced knowledge and understanding of mathematical modelling and statistical methods in the analysis of biological systems,
- have sound knowledge of developing mathematical models in the areas of Bio sciences and bio fluid dynamics and their analysis.
- develop skills in algebraic manipulation, the calculus of linear and non-linear differential equations.

Text books:

1) Introduction to Mathematical Biology by S.I. Rubinow, J. Wiley & Sons.
2) Biomechanics by Y.C, Fung, Springer - Verlag.
3) Introduction to Biomathematics by V.P. Saxena, Vishwa Prakashan (Wiley eastern)

Reference Book :-

1) Biofluid Dynamics by Mazumdar.

RPatiker

Max. Marks 100 (Credit 5)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

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Semester III

Objectives:

- To explain the cocept of primes and Fermat numbers.
- To introduce various arithmetic functions, The Character Group, Dirichlet characters.
- To explain the Dirichlet Theorem on primes.
- To explain the arithmetic in Zn, The group Un
- To explain the Dirichlet series and Euler products.

Paper V (MAT-E305-E)(ELECTIVE-III) Analytic Number Theory- I

Unit-1 Characters of finite abelian groups

Unit-2 The Character Group, Dirichlet characters

Unit-3 Sums involving Dirichilet characters.

Unit-4 Dirichlet Theorem on primes in arithmetic progressions.

Unit-5 Dirichlet series and Euler products,

Learning Outcomes: After completion of this course, students will learn tools of prime number theory. They will know the definitions of several arithmetic functions and also learn how to solve number theory problems through the use of arithmetic functions. They can also learn to solve the Dirichlet series and Euler products.

Book Rocommneded :

1) T.M. Apostol, Introduction to Analytic Number Theory, Narosa Pub, House, 1989.

Max. Marks 100 (Credit 5)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester III

Objectives:

The course aims at introducing the concepts of Laplace Transforms, Laplace equations, Laplace wave equation 'ft, Heat conduction equation.

Paper V (MAT-E305-F)(ELECTIVE-III) Integral Transform I

Unit-1 Application of Laplace Transforms

Unit-2 Laplace's equations,

Unit-3 Laplace's wave equation

Unit-4 Application of Laplace Transforms

Unit-5 Heat conduction equation.

Learning Outcomes: After studying this course the student will be able to:

1) To Explain and Apply Laplace Transforms,
2) To Explain and Verify Laplace's wave equation,
3) To Explain Laplace's equations, and Application of Laplace Transforms,
4) To Explain Heat conduction equation.

Books recommended :-

1) Integral Transforms by Goyal & Gupta.
2) Integral Transforms by Sneddon

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester III

Objectives:

To prepare student with the aim of developing personality for leadership & awareness to develop an ideal citizenship values. This course makes the students groom their personality and prove themselves as good Samaritans of the Society.

Paper VI (MAT-E306)(ELECTIVE-IV) Personality Development

Unit I: Introduction

Personality development- concept, types, role and impact, developing self awareness, projecting a winning personality.

Unit II: Personality assessment

Personality assessment and testing- resume writing- types, contents, formats, interviewing skill , group discussion, JAM sessions, persuasive communication .

Unit III: Communication skill

Practice on oral/spoken communication skill and testing-voice and accent, feedback and questioning techniques, objectives in an argument.

Unit IV: Presentation skills

Skills and techniques, etiquette, project/assignment presentation, role play and body language, impression management.

Unit V: Personality development activities

Leadership activities, motivation activities, team building activities, stress and time management techniques, creativity and ideation.

Learning Outcomes: Polishing manners to behave appropriately in social and professional circles. Enhancing the ability to handle casual and formal situations in terms of **personal** grooming, dining and entertaining etiquette. **Developing** and maintaining a positive attitude and being assertive.

Suggested Readings:

1) Business Communication- Royan and V.lesikar, John D. Pettit, JR.Richard D.Irwin, INC.
2) Personality Development and soft skills- Barun K. Mitra, Oxford Publisher.
3) Personality Development -Rajiv K.Mishra, Rupa Publisher.

M.Sc. IV Semester

SCHOOL OF STUDIES IN MATHEMATICS, VIKRAM UNIVERSITY, UJJAIN
M.A./M.Sc. (MATHEMATICS)-*SEMESTER IV*-SESSION: 2021-22
SCHEME OF EXAMINATION FOR NEW CBCS

Paper code	Course Name (Theory/Practical)	Examination Scheme						
		Discipline	Credits	Maximum Marks		Total Marks	Minimum Marks	
				End Semester Exam	CCE		End Semester Exam	Internal (CCE)
MAT-C401	**Functional Analysis-II**	CORE	4	60	40	100	21	14
MAT-C402	**Fundamental of Computer Science (Theory)-II**	CORE	3	40	40	100	14	14
	Fundamental of Computer Science (Practical)-II		1	20	-		7	-
MAT-E403 (A,B,C,D,E,F)	**(to choose 1 out of 6)** A. Advanced Functional Analysis-II **B. Mechanics** C. Differentiable Structures on manifolds-II D. General Theory of Relativity and Cosmology-II E. Abstract Harmonic Analysis-II F. Mathematics of Finance & Insurance -II	ELECTIVE-I	4	60	40	100	21	14
MAT-E404 (A,B,C,D,E,F)	**(to choose 1 out of 6)** **A. Theory of Linear Operator II** B. Advanced Numerical Analysis –II C. Fuzzy Sets and their Applications-II D. Advanced Graph Theory-II E. Advanced Special Function-II F. Spherical Trigonometry and Astronomy-II	ELECTIVE-II	4	60	40	100	21	14
MAT-E405 (A,B,C,D,E,F)	**(to choose 1 out of 6)** **A. Operations Research -II** B. Computational Biology –II C. Fluid Mechanics –II D. Bio- Mechanics -II E. Analytic Number Theory-II F. Integral Transform-II	ELECTIVE-III	4	60	40	100	21	14
MAT-E406	**Tourism Management**	ELECTIVE-IV	4	60	40	100	21	14
MAT-P407	**Project Work**	-	3	100	-	100	35	-
MAT-V408	**Comprehensive Viva-Voce**	-	3	100	-	100	35	-
Total			30	560	240	800	196	84

M.Sc. Mathematics

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Semester IV

Max. Marks 100 (Credit 5)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives: To familiarize with the basic tools of Functional Analysis involving normed spaces, Hahn-Banach spaces and Hilbert spaces, their properties dependent on the dimension and Riesz representation theorem. Uniform boundedness theorem.

Paper I (MAT-C401) Functional Analysis-II

Unit-1 Hahn-Banach theorem, Hahn-Banach theorem for complex vector space and normed spaces, Reflexive spaces, Catigory Theorem and Uniform boundedness theorem.

Unit-2 Strong and Weak convergence, Open Mapping Theorem, Closed Linear Operators and closed Graph Theorem., Closed Range Theorem.

Unit-3 Inner product spaces, Hilbert spaces, further properties of inner product spaces, Orthogonal complements and Direct Sums (Projection Operator)

Unit-4 Complete Orthonormal sets and Bessel's Inequality, Convergence Theorems and fourier coeifficients ,total orthonormal sets and sequences Parsval's Relation Riesz representation theorem.

Unit-5 Representation of Functionals on Hilbert space (Riesz theorem, Riesz representation). Hilbert adjoint operator, Self-adjoint operators, Unitary operators and Normal operators

Learning Outcomes: After studying this course the student will be able to:

1) Distinguish between Hahn- Banach spaces and Hilbert spaces, decompose a Hilbert space in terms of Orthonormal Sets
2) Classify operators into self-adjoint , Normal and Unitary operators.
3) Find Projection Mapping , Projection theorem structure of Hilbert spaces
4) To Explain Bessel's inequality. Complete orthonormal sets and Parseval's Identity,

Recommended Books :

1) E. Kreyszig, Introductory Functional Analysis with applications, John Wiley & Sons New York.
2) G.F. Simmons, Introduction to Topology & Modern Analysis Mc Graw Hill, New York.

Reference Books:

1) B. Choudhary and Sudarshan Nanda. Functional Analysis with applications, Wiley Eastem Ltd.

M.Sc. Mathematics

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Semester IV

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 40 (Min. 14) (Credit 3)
C.C.E. Marks: 40 (Min. 14)
Practical Marks: 20 (Min. 7) (Credit 1)

Objectives:

To introduce programming style that is associated with the concept of class, objects and other concepts revolving around these two, like inheritance and polymorphism.To realize object-oriented programming is a vast improvement over procedural programs.

Paper II (MAT-C402) Fundamentals of Computer Science-II (Theory and Practical)

Unit 1 Inheritance, Single Inheritance, Multilevel Inheritance, Multiple Inheritance, Hierarchical Inheritance, Hybrid Inheritance, Templates including Class Templates.

Unit 2 C++ Streams, C++ Stream Classes, put() and get() Functions, getline() and write() Functions.

Unit 3 Database Systems - Role of Database Systems, Database Systems Architecture.

Unit 4 SQL -Basic Features including views, Integrity Constraints, Key, Functional Depedency, Multivalued Functional Dependency, Database Design- Normalization up to BCNF.

Unit 5 Operating Systems - User Interface, Processor Mangement, Memory management , Network and Distributed Systems.

Learning Outcomes: Students will be able to: Understand that object oriented programs are organized around objects, which contain both data and functions that act on that data and a class is a template for a number of objects. Study how Inheritance allows a class to be derived from an existing class without modifying it. Learn programming basics, viz., simple functions, call by value and reference, returning values of different type, function overloading, and recursive functions. Appreciate with examples structures and classes, static data, static function and array of objects. Explain the concepts of operator overloading, type casting pointers and work on templates.Identify class hierarchies and types of inheritance. Master the concept in files and streams and error handling during file operations Have a working knowledge of Disk I/O operations with member functions.

Reference Books :

1) E. Balagurusamy, Object Oriented Programming with C++, III Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
2) S.B.Lipman , J Lajoi; C++ Primer Addison Wesley.
3) C.J. Date ; Introduction to Database systems, Addition Wesley.
4) C. Ritchie; Operating Systems, Incorporating UNIX and Windows, BPB Publications.

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester IV

Objectives:

The course is designed to review fundamental topics in advanced functional analysis. It is necessary to study the Linear transformations and linear functionals. The power of abstraction in mathematics can be realize from the concept of topological vector spaces in functional analysis.

Paper III (MAT-E403-A)(ELECTIVE-I) Advanced Functional Analysis-II

Unit-1 Finite - dimensional topological vector spaces. Linear Varieties and Hyperplanes. Geometric form of Hahn -Banch theorem. . Chapter 2(2.2), 5(5.1, 5.2) 6(6.2), 7 and 9 (9.4) of R. Larsen.

Unit-2 Uniform - Boundedness principle. Open Mapping theorem and closed graph theorem for Frehet spaces, Banach - Alaooglu theorem. Chapter 6(6.2), 7 and 9 (9.4) of R. Larsen.

Unit-3 Extreme points and Extremal sets. Krein- Milman's theorem. Duality polar. Bipolar theorem. Baralled and Bornological spaces.

Unit-4 Macekey Spaces. Semi-reflexive and Reflexive topological vector spaces. Montel Spaces and Schwarz spaces. Quasi-completeness. Chapter 11(11.1, 11.2) of R. Larsen

Unit-5 Inverse Limit and inductive limit of locally convex spaces. Distributions. [Walter Rudin and L.V. Kantorovich and G.P. Akilov].

Learning Outcomes: After completing this course, students will be able to

- define and state some of the main concepts and theorems of Functional Analysis
- apply their knowledge of the subject in the investigation of examples
- prove basic propositions concerning functional analysis

Recommended Books :

1) R.Larsen, Functional Analysis. Marcel Dekker, Inc. New york. 1973.
2) Walter Rudin, Functional Analysis, TMH Edition,1974.
3) L.V.Kantorovich and G.P. Akilov, Functional Analysis, Pergamon Press 1982.

Reference Books :

1) Laurent Schwartz, Functional Analysis Courant Institute of Mathematical Sciences, New York University, 1964.

R Patil

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester IV

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives: This course is aim to be a second course to the existing undergraduate courses. They will introduce Lagrangian and Hamiltonian mechanics.

Paper III (MAT-E403-B) (ELECTIVE-I) Mechanics

Unit-1 Generalized cordinates. Holonomic and Non-holonomic systems. Scleronomic and Rheonomic System Generalized Potential. Lagrange's equations of first kind. Lagrange's equations of second Kind. Uniqueness of solution. Energy equation for conservative fields.

Unit-2 Hamilton's variables, Hamilton's canonical equations, Donkin's theorem, Matovating probelms of calculus of variations, Shortest distance. Minimum surface of revolution. Brachistochrone problem. Fundamental lemma of calculus of variations. Euler's equation for one dependent function and its generalization to (i) n dependent functions. (ii) higher order derivatives.

Unit-3 Hamilton's Principle. Principle of least action, Hamilton-Jacobi equation (time-dependent and time-independent), Whittaker's equations, Statement of Lee HWA Chung's theorem, Poincare Carten Integal invariant.

Unit-4 Poisson's Bracket. Poisson's Identity. Jacobi-Poisson theorem, Lagrange Brackets. Condition of canonical character of a transformation in terms of Lagrange brackets and Poisson brackets, Invariance of Lagrange brackets and Poisson brackets under canonical transformations.

Unit-5 Hamilton-Jacobi Theory: Solution of Hamilton-Jacobi equation, Jacobi theorem. Method of saperation of variables. Attraction and Potential of rod, disc, Spherical shells and sphere.

Learning Outcomes: This course can be followed by courses in Integrable models, foundation of Mechanics, Celestial Mechanics etc. This prepares an adequate mathematical background for understanding any research papers in Mechanics.

Reference Books:

1) Narayanan Chandra Rana & Pramod Sharad Chandra Joag, Classical Mechanics, Tata Mcgraw Hill 1991.
2) F. Gantmacher, Lectures in Analytic Mechanics MIR Publishers.
3) M. Ray, Attraction and Potential, Student's Friends and Company, Agra.
4) H. Goldstein Classical Machanics (2nd Edition), Narosa Publishing House , .

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

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Under CBCS (Only for School of Studies in Mathematics)

Semester IV

Objectives: Differentiable manifolds are a certain class of topological spaces which, in a way we will make precise, Kahler manifolds. Affine conncetion. We introduce the key concepts of this subject, such as Holomorphic sectional curvature. Curvature tensor, Almost analytic vector fields etc.

Paper III (MAT-E403-C)(ELECTIVE-I) Differentiable Structures on manifolds-II

Unit-1 Kahler manifolds. Affine conncetion

Unit-2 Holomorphic sectional curvature. Curvature tensor. Almost analytic vector fields.

Unit-3 Nearly Kahler manifolds, Curvature identities. Constant Holomorphic sectional curvature

Unit-4 Almost analytic vector fields Almost Kahler Manifold Anilities vector fields, Almost Contact manifolds : Lie derivative normal contact structure

Unit-5 Affinely almost almost cosymplectic manifold, Almost Grayn manifolds: D-conformal transformation, Perticular affined connection K- Contact Rumanian manifolds.

Learning Outcomes: By the end of the paper, the student must be able to:

- Define and understand the key concepts (Holomorphic sectional curvature. Curvature tensor. Almost analytic vector fields etc.)
- Use these concepts to solve problems.
- Prove the main theorems.

Recommended Books :

1) B.B. Sinha, An Introduction to modern Differential Geometry, Kalyani Publishers, new Delhi, 1982.
2) K. Yano and M. Kon structure of Manifolds. world scientific Publishing C. Pvt. Ltd. 1984
3) A. Behaneu, Geomatry of CR- submanifolds, D. Reidel Publishing company, Dordrecht, 1986 .

Reference Books:

1) R.S. Mishra, A course in tensor with application to Riemannian geometry pothishala Pvt. Ltd. 1965.
2) R.S. Mishra, Structures on Differentiable manifold and theire applications, Chandrema Prakashan , 1984.

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Semester IV

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives:

- To explain the cocept of special theory of relativity and geodesic principle.
- To introduce Newtonian approximation of relativistic equations of motion.
- To explain the Planetary orbits and anologues of Kepler's Laws in general relativity.
- To explain Energy-momentum tensor of a perfect fluid.
- To explain the Schwarzschild internal solution.

Paper III (MAT-E403-D)(ELECTIVE-I) General Theory of Relativity and Cosmology-II

Unit-1 Review of the special theory of relativity and the Newtonian Theory of gravitation. Principle of equivalence and general covariance, geodesic principle.

Unit-2 Newtonian approximation of relativistic equations of motion. Einstein's field equations and its Newtonian approximation.

Unit-3 Schwarzschild external solution and its isotropic form. Planetary orbits and anologues of Kepler's Laws in general relativity. Advance of perihelion of a planet

Unit-4 Bending of light rays in a gravitational field. Gravitational redshift of spectral lines. Radar echo delay.

Unit-5 Energy-momentum tensor of a perfect fluid. Schwarzschild internal solution. Boundary conditions.

Learning Outcomes: By the end of the paper, the student must be able to: learn special theory of relativity and the Newtonian Theory of gravitation. One can then derive Principle of equivalence and general covariance, geodesic principle. Cosmology understanding why general relativity is the natural framework for the study of our universe as a physical system.

Recommended Books:

1) S.R.Roy and Raj Bali: Theory of Relativity Jaipur Publishing House,Jaipur, 1987.
2) S. K. Shrivastva: General Relativity and Cosmology, PHI, New Delhi.
3) J.V. Narlikar, General Relativity and Cosmology: The Macmillan Company of India Limited, 1978.

M.Sc. Mathematics
Under CBCS (Only for School of Studies in Mathematics)
Semester IV

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives:

- To teach the concept of Haar covering function.
- To introduce translation character, Characters, Characters group.
- To explain the Structure theory for compact and locally compact Abelian groups.
- To teach The Fourier transform.
- To explain the concept of Fourier Stieltjes transform.

Paper III (MAT-E403-E) (ELECTIVE-I) Abstract Harmonic Analysis II

Unit-1 The Haar covering function Existence and properties of Haar covering function Definition and properties of the function Ig (f) . Existence and Uniqueness of the Haar integral ,

Unit-2 Translation in Lp(G), uniform continuity of translation character, Characters, Characters group, properties of characters

Unit-3 Character group or dual group Locally compact abelian group non - trivial complex homomorphism.

Unit-4 The Fourier transform, Convolution, convolution of function set A( ) of all Fourier transforms invariance, of A ( ) ,

Unit-5 Fourier Stieltjes transform set B( ) of all Fourier Stieltjes transform, invariance of B ( ), Duality Theorem.

Learning Outcomes: Students would be able to:

1) Understand the concept of Fourier series and Fourier transformation using various theorems.
2) Learn about Character group or dual group Locally compact abelian group non - trivial complex homomorphism.
3) Study the boundary behaviour of Fourier Stieltjes transform.
4) Operate with The Fourier transform, Convolution, convolution of function set A( ).

Recommended Books.

1) George Bachman Elements of Abstract Harmonic Analysis Acadmic Press, New Your. 1964.
2) Taqdir Hussain Introduction to Topological Group W.D. Saudss Company 1966 to ok W.O.
3) Walter Rudin, Fourier Analysis On Group Intersceince publisher , John wiley, New York,1967.

Reference Books.

1) Edwin Hewit and Kenneth A. Ross. Abstract Harmonic Analysis -1, Springer - Verlag, Berlin, 1963.
2) lynn H. Loomis : An Introduction to Abstract Harmonic Analysis, D, Van Nostrand Co. Princet.

R.R. Pakhale

M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

Semester IV

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives:

- To teach introduction to financial Markets.
- To introduce basics of Securities, Stocks Bonds and financial derivatives.
- To explain Futures, Options and Swaps.
- To teach stochastic process, geometric Brownian motion.
- To explain the Pricing models- Binamial Models and Black Scholes.

Paper III (MAT-E403-F) (ELECTIVE-I) Mathematics of Finance and Insurance- II

Unit-1 A Brief introduction to financial Markets,

Unit-2 Basics of Securities, Stocks Bonds and financial derivatives,

Unit-3 Viz forwards, Futures, Options and Swaps.

Unit-4 An Introduction to stochastic Calculus stochastic process, geometric Brownian motion stochastic integration andI ito's lemma

Unit-5 Option Pricing models- Binamial Models and Black Scholes Option Pricing Model for European Options, Black Scholes formula and computation of greeks.

Learning Outcomes: Understand general theoretical principles of financial Markets. Apply analytical and optimization methods to solving practical problems. Implement methods on computer and work with data sets.

Text Books:

1) Options, Futures and other Drivatives by Jhon C. Hull Prentice -Hall of India Pvt. Ltd.
2) An introduction to Mathematic Finance by Cheldon M. Ross, Cambridge University Press.

Reference Books:

1) An Introduction to Mathematics of Financial Derivatives by Salih N.Neftci, Academic Press, Inc.
2) Mathematics of Financial markets by Ribert J. Elliot & P.E. Kopp Springer Verlag, New Yorlk Inc.

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Semester IV

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives: The course aims at introducing the concepts of Fredhoml alternative forintegral equation. compact linear operators on normed spaces. Positive operatorsMonotone sequence theorem . Square roots of a positive operator.

Paper IV (MAT-E404-A)(ELECTIVE-II) Theory of Linear Operators II

Unit-1 Spectral representation of bounded self- adjoint linear operators. Spectral theorem. Spectral measures. Spectral Integral.

Unit-2 Regular Spectral Measure. Real and Complex Spectral Measure. Complex Spectral Integral Description of the Spectral Subspaces. Characterization of the Spectral Subspaces.

Unit-3 The Spectral theorem for bounded Normal Operators. Unbounded linear operators in Hilbert spece. Hellinger- Toeplitz theorem. Hilbert adjoint operators.

Unit-4 Symmetric and self -adjoint linear operators. Closed linear operators and closures. Spectrum of an unbounded self-adjoint linear operators.

Unit-5 Spectral theorem for unitary and self- adjoint linear operators. Multiplication operator and Differentiation Operator. Chapter 10, E. Kreyszig.

Learning Outcomes: After studying this course the student will be able to:To Explain Regular Spectral Measure. Real and Complex Spectral Measure, Hellinger- Toeplitz theorem. Hilbert adjoint operators. To explain Spectral theorem for unitary and self- adjoint linear operators. Multiplication operator and Differentiation Operator.

Recommended Books:

1) E. Kreyszig Introductory functional analysis with applications, Jhon wiley & Sons, Nwe York, 1978.

Referance Books:

1) P. R. Halmos Introduction to Hilbert space and the theory of Spectral Multiplicity, Second edition, Chelsea publishing co. N.Y. 1957.
2) N. Dundford and J.T. Schwartz, linear operator -3 part, Interscience / Wiley, New York 1958-71.
3) G.Bachman and L. Narci, Functuional analysis, Academic press New York, 1966.

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Semester IV

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives:

- To teach the techniques of solution of numerical integration.
- To introduce Stability analysis of multistep methods.
- To explain the Boundary value problems, shooting method.
- To explain Finte difference methods and Finte element methods.

Paper IV (MAT-E404-B)(ELECTIVE-II) Advanced Numerical Analysis II

Unit-1 Extrapolation methods ordinary differential equations. multi step methods Predicator and corrector method

Unit-2 Stability analysis of multistep methods. Ordinary differential equation

Unit-3 Boundary value problems shooting method.

Unit-4 Finte difference methods

Unit-5 Finite element method

Learning Outcomes: After completion of this course, students will learn the numerical techniques for the numerical solution of the numerical integration. The students can also learn the Stability analysis with ODE. They will know a variety of numerical examples and derivation of several numerical methods.

Text book -

1) Numerical Methods for scientific and Engineering computation by M.K. Jain, S.R.K. Iyenger, R.K. Jain south Edition (2003) New Age.

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Semester IV

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives: This course introduces students to the basic concepts of modeling in systems using fuzzy Relation and fuzzy graphs. The concepts of fuzzy Relation and fuzzy graphs are introduced and their role in applications of semantic interpreters, control systems and reasoning systems.

Paper IV (MAT-E404-C)(ELECTIVE-II) Fuzzy Sets and Their Applications II

Unit-1 Fuzzy Relation and fuzzy graphs - Fuzzy relation on Fuzzy sets, Composition of Fuzzy relation,

Unit-2 Min-Max composition and its properties, Fuzzy equivalence relation Fuzzy compatibility relation Fuzzy relation equation Fuzzy graphs, Similarity relation.

Unit-3 Possibility Theory-Fuzzy measures, Evidence theory, Necessity Measure, possibility measure,

Unit-4 Possibility distribution, possibility theory and fuzzy sets possibility theory versus probability theory.

Unit-5 Fuzzy Logic-An overview of classical logic, multivalued logics, Fuzzy proposition Fuzzy quantifiers Linguistic variables and hedges, Inference from conditional fuzzy proposition, the compositional rule of inference.

Learning Outcomes: By the end of the course, student will be able to:

- Understand basic knowledge of the fuzzy Relation and fuzzy graphs, operations and their properties.
- Understand the fundamental concepts of Min-Max composition and its properties.
- Apply the concepts of Fuzzy Relation and fuzzy graphs in image processing, Pattern reorganization and Decision making.

Text Books:

1) Fuzzy set theory and its Applications by H.J. Zimmermann, Allied Publishers Ltd., New Delhi, 1991.
2) Fuzzy sets and Fuzzy logic by G.J. Klir and B. Yuan Prentice - Hall of India, New Delhi,1995

Reference Books:-

1) Fuzzy sets and Uncertainty and Information by G.J. Kalia Tina A. Foljer - Prentice - Hall of India.

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Semester IV

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives: The main objective of this course is to introduce students with the fundamental concepts in graph Theory, with a sense of some its modern applications and it helps students to solve live problems that can be modelled by graphs.

Paper IV (MAT-E404-D)(ELECTIVE-II) Advanced Graph Theory- II

Unit-1 Connectivity and separability in graphs Abstract graphs geometric graphs planar graphs Kurtowski two graphs embedding and regions of a planar graphs Detection of planarity

Unit-2 Geometric dual and combinationa dual.

Unit-3 Coloring and covering of graphs, Chromatic, Polynomial chromatic partitioning Dimmer problem Domination sets independent sets, Four colour conjecture.

Unit-4 Digraph and types of digraphs, Digraph and binary relation Equivalence relation in a graph Directed path walk circuit and connectedness Eulerian digraph, arborscence matrices A, B and C of digraphs.

Unit-5 Adjacency metric of a digraph, Alogorithms, Kruskal algorithm, Prism algorithm, Dijkastra Algorithm.

Learning Outcomes: After completing this course, the student will be able to: Understand the basic concepts of Connectivity and separability in graphs , Geometric dual and combinationa dual, Coloring and covering of graphs and apply the different algorithm to solve some real life problems.

Text Book :-

1) Graph Theory with Application to Engineering and Computer Science by Narsingh Deo.

Reference Book :-

1) Graph Theory by Harary.

M.Sc. Mathematics

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Semester IV

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives: The main objective of this course is to introduce Bessel function, Laguerre Polynomials and Legendre polynomials and Generating function for that and its properties.

Paper IV (MAT-E404-E)(ELECTIVE-II) Advanced Special Function II

Unit-1 Bessel function and Legendre polynomials : Definition of Jn (z), Bessel's differential equation, Generating function, Bessel's integral with index half and an odd integer,

Unit-2 Generating function for Legendre polynomials Rodrigues formula, Bateman's generating function, Additional generating funtions, Hypergeometric forms of Pn (X) , Special properties of PnX), Some more generating functions, Laplace's first integral form, Othergonality.

Unit-3 Special properties of Pn(X), Some more generating functions, Laplace's first integral form, Othergonality.

Unit-4 Definition of Hermite polynomials Hn(x), Pure recurrence relations, Differential recurrence relations, Rodrigue's formula, Other generating functions, Othogonality, Expansion of polynomials, more generating functions.

Unit-5 Laguerre Polynomials : The Laguerre Polynomials Ln(X), Generating functions, Pure recurrence relations, Differential recurrence relation, Rodrigo's formula, Orthogonal, Expansion of polynomials, Special properties, Other generating functions.

Learning Outcomes: After studying this course the student will be able to: Find the solution of Bessel function, Laguerre Polynomials and Legendre polynomials and use it for solving different equation, integral equation.

Books Recommended:

1) Rainville, E.D, ; Special Functions, The Macmillan co., New york 1971.
2) Srivastava, H.M. Gupta, K.C. and Goyal, S.P.; The H-functions of One and Two Variables with applications, South Asian Publication, New Delhi.
3) Saran, N., Sharma S.D. and Trivedi, - Special Functions with application, Pragati prakashan,1986.

Reference Books.

1) Lebdev, N.N, Special Functions and Their Applications, Prentice Hall, Englewood Cliffs, New jersey, USA 1995.
2) Whittaker, E.T. and Watson, G.N., A Course of Modern Anal.

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Semester IV

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives: The course aims at introducing the concepts of Fundamental of Spherical Astronomy, solution and properties, Atmospheric Retraction and Time planetary phenomena.

Paper IV (MAT-E404-F)(ELECTIVE-II) Spherical Trigonometry an Astronomy- II

Unit-1 Spherical Astronomy - Various system of references and related topics.

Unit-2 Celestial sphere.

Unit-3 Transit instrument. Atmospheric Retraction. Time planetary phenomena.

Unit-4 Atmospheric Retraction.

Unit-5 Time planetary phenomena.

Learning Outcomes: After studying this course the student will be able: To Explain and learn Fundamental of Spherical Astronomy. To Explain Properties of Atmospheric Retraction, Time planetary phenomena.

Text Books:-

1) A text book of spherical trigonometry : Gorakh Prasad.
2) A text book of spherical Astronomy : Gorakh Prasad.

Reference Book.

1) Spherical Astronomy - Smarat
2) Spherical Astronomy – Bell

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Semester IV

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives: Operations research is included in M.Sc. classes due to its wide application in our daily life. Operations research is an important course in applied mathematics because it is very useful in Industry, banking, Defense sector, Multinational companies etc to optimize their performance.

Paper V (MAT-E405-A)(ELECTIVE-III) Operations Research - II

Unit-1 Network analysis, constraints in Network, Construction of network, Critical Path Method (CPM) PERT, PERT Calculation, Resource Levelling by Network Techniques and advances of network (PERT/CPM).

Unit-2 Dynamic Programming - recursive equation approach, Characteristic of Dynamic Programming, Computational procedure, Integer programming Gomory's all I.P.P. method, Branch and Bound Technique.

Unit-3 Game theory - Two person Zero-sum games, Maximix-Minimax principle, games without saddle points - Mixed strategies, Graphical solution of 2Xn and Mx2 Games, Solution by Linear Programming.

Unit-4 Non-linear programming: Mathematical Formulation, General Non-linear Programming Problems, Problems of Constrained Maxima and Minima (Kuhn-Tucker Condition), Non-negative Constraints.

Unit-5 Quadratic programming: Wolfe's Modified Simplex method, Beale's Method, Separable programming, Convex programming, Separable programming algorithms.

Learning Outcomes: Due to its applicability in different sectors Operations research becomes very useful course in research field. After studying this course students may do their research work in different topics like Game theory, Job sequencing, Network analysis, dynamical programming etc. Most of the companies hire OR technician to get maximum output of company.

Recommended Books:-

1) Kanti Swarup, P.K. Gupta and Manmohan, Operations Research, Sultan Chand & Sons, New Delhi.

Reference Books:-

1) S.D, Sharma, Operation Research.
2) F.S, Hiller and G.J. Lieberman, Industrial Engineering Series, 1995 (This book comes with a CD containing software).
3) G. Hadley , Linear Programming, Narosa Publishing House. 1995.
4) G. Hadley, Linear and Dynamic programming, Addison - Wesley Reading Mass.
5) H.A. Taha, Operations Research - An introduction, Macmillan Publishing co. Inc. New york.
6) Prem Kumar Gupta and D.S. Hira, Operation Reasearch, an Introdution, S. Chand & Company Ltd. New Delhi.

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Semester IV

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives: The objective of the course is to introduce students to the rapidly evolving field of bioinformatics. we will aim to cover in the lectures the most fundamental topics, such as Integer programming, Partition Problems, Traveling Salesman Problem (TSP) simulated annealing Sequence, and then explore some of the frontier areas.

Paper V (MAT-E405-B)(ELECTIVE-III) Computational Biology- II

Unit-1 Integer programming, Partition Problems, Traveling Salesman Problem (TSP) simulated annealing Sequence.

Unit-2 Assembly - Sequencing strategies,

Unit-3 Traveling Salesman Problem (TSP) simulated annealing Sequence.

Unit-4 Fragment alignment, Sequence accuracy,

Unit-5 Sequence comparisons Methods - Local and global alignment, Dynamic programming method.

Learning Outcomes: After completing this course, the students will gain an understanding of the computational challenges in the analysis of large biological data sets; they will understand how some of the commonly used bioinformatics tools work, how to use these tools effectively, and how to read and evaluate research articles in the field.

Text Books:-

1) Introduction to Computational Biology by M.S, Waterman Chapman & Hall, 1995.
2) Bio informatics - A practical Guide to the analysis of Genes and Proteins by A. Baxevanis and B. Ouelette, WileyInterscience (1998).

Reference Books:-

1) Introduction to Bio informatics by Attwood.
2) Bioinformatics-Sequence and Genome analysis by David W.Mount.

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Semester IV

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives: The objective of this course is to introduce:

- Fundamental aspects of fluid flow behaviours.
- Dynamics of viscous fluid flows and governing equations of motion.
- To acquire the knowledge of solving problems using partial differential equations.

Paper V (MAT-E405-C)(ELECTIVE-III) Fluid Mechanics- II

Unit-1 Motion of a sphere through a gapsquid at rest as infinity. equation of motion of a sphere, stress components in a real fluid.

Unit-2 Relations between rectangular components of stress convection between streses and gradients of velocity,

Unit-3 Plane Poiseuille and coquette flows between two parallel plate, flow through tubes of uniform, cross - section in the former of circle, annulus under constant pressure gradient.

Unit-4 Dynamical similarity, Reynolds number, Prandt's boundary layer, boundary layer equations in two dimension, blasius solution

Unit-5 Boundary layer thickness, displacement thickness, Karman itegral conditions, separation of boundary layer flow.

Learning Outcomes: After completing this course, the students will be able to: Understand the basic ideas of fluid velocity, streamlines and rotational and irrotational flows, Understand the meanings of fundamental terms like pressure and body force, Develop special mathematical methods involving images and complex variables for incompressible fluids.

Text Books.

1) A text book of Fluid Mechanics in SI units by R.K, Rajput.
2) An introduction to Fluid Dynamics by R.K. Rathy, Oxford and IBH Published Co.

Reference Books:

1) Fluid Mechanics (Springer) By Joseph H. Spurk.
2) Fluid Mechanics by Irfan A Khan (H.R.W.)
3) An Introduction to Fluid Mechanics by G.K. Batchelor, Foundation Books, New Delhi, 1994.

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Semester IV

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives:

- To introduce students to the application of mathematical modelling in the analysis of Bio-Mechanics.
- To show how mathematics and computing can be used in an integrated way to analyse Bio-Mechanics.

Paper V (MAT-E405-D)(ELECTIVE-III) Bio-Mechanics- II

Unit-1 Solution of steady state and Unsteady - state flow problems in one dimesion, application of finite element method and exact solutions.

Unit-2 Diffusion processes in biology ; diffusion in Tissue Fick's principle,

Unit-3 One, two and three Dimensional diffusion problems and their solution, Water Transport, Diffusion through membranes.

Unit-4 Respiratory Gas Flows, flow in Airways, Interaction Between convection and diffusion Exchange between Alvoelar Gas and Erythrocytes,

Unit-5 Pulmonary function Test, Dynamics of Ventilation system.

Learning Outcomes: At the end of the course, students will be able to:

- have an enhanced knowledge and understanding of mathematical modelling and analysis of biological systems,
- have sound knowledge of developing mathematical models in the areas of Bio sciences and bio fluid dynamics and their analysis.
- develop skills in algebraic manipulation, the calculus of linear and non-linear differential equations.

Text books:

1) Introduction to Mathematical Biology by S.I. Rubinow, J. Wiley & Sons.
2) Biomechanics by Y.C, Fung, Springer - Verlag.
3) Introduction to Biomathematics by V.P. Saxena, Vishwa Prakashan (Wiley eastern)

Reference Book :-

1) Biofluid Dynamics by Mazumdar.

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Semester IV

Max. Marks 100 (Credit 4)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

Objectives:

- To explain the cocept of Dirichlet series and Euler products.
- To introduce the function defined by Dirichlet series.
- To explain the Analytic properties of Dirichilet series.
- To explain the Properties of the gamma function

Paper V (MAT-E405-E)(ELECTIVE-III) Analytic Number Theory- II

Unit-1 Dirichlet series and Euler products,

Unit-2 The function defined by Dirichlet series, the halfplane of convergence of a Dirichlet series.

Unit-3 Integral formula for the coefficients of Dirichlet series

Unit-4 Analytic properties of Dirichilet series, Mean value formula for Dirichilet series.

Unit-5 Properties of the gamma function, Integral representations of Hurwitz zeta functions, Analytic continuation of Hurwitz zeta function.

Learning Outcomes: After completion of this course, students will learn tools of Analytic Number theory. They will know the definitions of several arithmetic functions and also learn how to solve number theory problems through the use of arithmetic functions. They can also learn to solve the Dirichlet series and Euler products.

Book Rocommneded :

1) T.M. Apostol, Introduction to Analytic Number Theory, Narosa Pub, House, 1989.

Max. Marks 100 (Credit 5)
Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks: 40 (Min. 14)

M.Sc. Mathematics

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Semester IV

Objectives: The course aims at introducing the concepts of Laplace Transforms, Electric Circuits. Application to Beams, Properties of Fourier Transoforms, Convolution & Parseval's identity, Fourier Transform of the derivatives, Finite Fourier Sine & Cosine Transform.

Paper V (MAT-E405-F)(ELECTIVE-III) Integral Transform II

Unit-1 Application of Laplace Transform to Boundary Value Problems.

Unit-2 Electric Circuits. Application to Beams.

Unit-3 The complex Fourier Transform, Inversion Formula, Fourier cosine and sine transform,

Unit-4 Properties of Fourier Transoforms, Convolution & Parseval's identity

Unit-5 Fourier Transform of the derivatives, Finite Fourier Sine & Cosine Transform, Inversion Operational and combined properties Fourier transform.

Learning Outcomes: After studying this course the student will be able to:

1) To Explain and Apply Laplace Transforms,
5) To Explain and and Apply Fourier Transforms,
6) To Explain Properties of Fourier Transoforms, Convolution & Parseval's identity.

Books recommended :-

1) Integral Transforms by Goyal & Gupta.
2) Integral Transforms by Sneddon

RB Patil

Anjali S

Max. Marks 100 (Credit 4)

Regular
Theory Marks : 60 (Min. 21)
C.C.E. Marks : 40 (Min. 14)

M.Sc. Mathematics

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SEMESTER IV

Paper VI (MAT-E406) (ELECTIVE-IV) Tourism Management

UNIT I: Introduction

Concept of tourism & importance in economy, types of tourism, tourism in Madhya Pradesh history and development ,Geography, Climate, Forest , River and Mountain.

UNIT II: Overall Scenario

Present scenario, planning, development and opportunities. Social and Economical impact of tourism, role of public and private sector in the promotion of tourism.

UNIT III: Tourism Resources

Physical and Biographical ,Tourist satisfaction and service quality-Transport accommodation, other facilities and amenities available in Madhya Pradesh. Role of tourist service provider, heritage site in M.P.

UNIT IV: Financial aspects of Tourism

Requirements of capital investment, sources of finance, Madhya Pradesh State Tourism Development Corporation Limited - funds, finance, policies, packages and its role for the development of tourism in Madhya Pradesh.

UNIT V: Practical training

Case studies of popular tourist places and tourist statistics in Madhya Pradesh, Analytical studies of tourist arrivals trends.

Books recommended :-

1. Ancient Geography of M.P-Bhattacharya D.K
2. All district Gazettes of M.P
3. Tourism planning -Gunn. Clare A