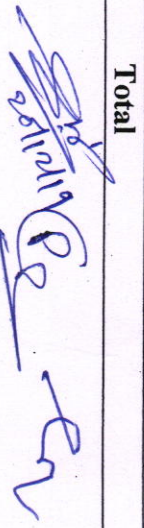
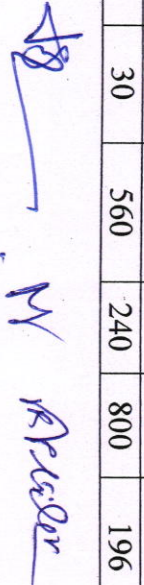


SCHOOL OF STUDIES IN MATHEMATICS, VIKRAM UNIVERSITY, UJJAIN
M.A./M.Sc. (MATHEMATICS)-SEMESTER IV-SESSION: 2019-20
SCHEME OF EXAMINATION FOR NEW CBCS

Paper code	Course Name (Theory/Practical)	Discipline	Credits	Examination Scheme				
				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)	ELECTIVE-I	4	60	40	100	21	14
	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								
MAT-E404 (A,B,C,D,E,F)	(to choose 1 out of 6)	ELECTIVE-II	4	60	40	100	21	14
	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								
MAT-E405 (A,B,C,D,E,F)	(to choose 1 out of 6)	ELECTIVE-III	4	60	40	100	21	14
	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								
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


 Controller of Examinations
 20/11/19

 Registrar
 20/11/19

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

Paper I (MAT-C401) Functional Analysis-II

Unit-1

Hahn-Banach theorem, Hahn-Banach theorem for complex vector space and normed spaces, Reflexive spaces, Category 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 coefficients, total orthonormal sets and sequences Parseval'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

Recommended Books:

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

Reference :

- [1] B. Choudhary and Sudarshan Nanda. Functional Analysis with applications, Wiley Eastern Ltd. .

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PR, [Signature], [Signature], My, RB, [Signature], [Signature] 20/12/19, [Signature] 20/12/19

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 IV

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 Dependency, Multivalued Functional Dependency, Database Design- Normalization up to BCNF.

Unit 5 -

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

Reference Books :

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

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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

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 - Alaouglu 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. Sami-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].

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.

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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

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

Unit-1

Generalized coordinates. 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 problems 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 Cartan Integral 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 separation of variables.

Attraction and Potential of rod, disc, Spherical shells and sphere.

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 Mechanics (2nd Edition), Narosa Publishing House, .

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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

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

Unit-1

Kahler manifolds. Affine connection

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, Particular affined connection K- Contact Rumanian manifolds.

Reference 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.
- 3- A. Bejaneu, Geometry of Cr- Submanifolds, D. Reidel Publishing Company, , 1986

Reference Books:

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

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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

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 analogues 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.

Recommended Books:

[1] S.R.Roy and Raj : Theory of Relativity Jaipur Publishing House, Jaipur, 1987.

[2] S. K. Shrivastva: General Relativity and Cosmology, PHI, .

[3] J.V. Narlikar, General Relativity and Cosmology: The Macmillan Company of Limited, 1978.

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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

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 $L_p(G)$, 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 $A(\Gamma)$ of all Fourier transforms invariance, of $A(\Gamma)$,

Unit-5

Fourier Stieltjes transform set $B(\Gamma)$ of all Fourier Stieltjes transform, invariance of $B(\Gamma)$, Duality Theorem.

Recommended Books.

- 1- George Bachman Elements of Abstract Harmonic Analysis Academic Press, New York. 1964
- 2- Taqdir Hussain Introduction to Topological Group W.D. Saudss Company 1966 to ok W.O.
- 3- Walter Rudin, Fourier Analysis On Group Interscience 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. Princeton.

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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

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 space. 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.

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 , 1966

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Max. Marks 100 (Credit 4)

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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

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

Unit-1

Extrapolation methods ordinary differential equations. multi step methods Predictor 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

Text book -

- (1) Numerical Mmethod 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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Max. Marks 100 (Credit 4)

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M.Sc. Mathematics

Under CBCS (Only for School of Studies in Mathematics)

SEMESTER IV

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.

Text Books:

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

Reference Books:-

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

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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

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, Dijkstra Algo-
rithm.

Text Book :-

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

Reference Book :-

- 1- Graph Theory by Harary.

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