DEPARTMENT OF MATHEMATICS & STATISTICS
University College of Science, Maharana Bhupal Campus
Mohanlal Sukhadia University, Udaipur

M.A. /M.Sc. MATHEMATICS (CBCS) 2016-17

Semester- IV

Cou-rse no.	Course Code PSSSCCXX	Title of the Course	L-T-P	No. of Credits	Max. Marks		Total
					University Exam.	Internal Assessment	
	1	2		3	4	5	6
I	M4 MAT 01-CT 13	Core Course- 13 Functional Analysis	3-1-0	4	80	20	100
II	M4 MAT 02-CT 14	Core Course- 14 Relativity and Cosmology-II	4-1-0	5	80	20	100
III	M4 MAT 0 X –DSE 0X	DSE - 0 X		5	80	20	100
IV	M4 MAT 0 X –DSE 0X	DSE - 0 X		5	80	20	100
V	M4 MAT 0 X –DSE 0X	DSE - 0 X		5	80	20	100
VI	M4 MAT -SC 02	Skill Course- 02	2-0-0	2	80	20	100

Discipline Specific Elective Course (DSE) for Semester IV

Note: Students are to opt any three DSE courses among the following with the permission of the Head of the Department.

Cou-rse no.	Course Code PSSSCCXX	Title of the Course	L-T-P	No. of Credits	Max. Marks		Total
					University Exam.	Internal Assessment	
	1	2		3	4	5	6
I	M4 MAT01 –DSE 01	DSE- 01 Numerical Analysis-II	4-1-0	5	80	20	100
II	M4 MAT02 –DSEP 02	DSE – 02 * Computer Programming of Numerical Methods	2-0-3	5	80	20	100
III	M4 MAT03 –DSE 03	DSE - 03 Discrete Mathematics-II	4-1-0	5	80	20	100
IV	M4 MAT04 –DSE 04	DSE - 04 Optimization Techniques-II	4-1-0	5	80	20	100

V	M4 MAT05 –DSE 05	DSE - 05 Mathematical Theory of Statistics-II	4-1-0	5	80	20	100
VI	M4 MAT06 –DSE 06	DSE - 06 Viscous Fluid Dynamics-II	4-1-0	5	80	20	100
VII	M4 MAT07 –DSE 07	DSE - 07 Integral Transforms	4-1-0	5	80	20	100
VIII	M4 MAT08 –DSE 08	DSE - 08 Astronomy-II	4-1-0	5	80	20	100
IX	M4 MAT09 –DSE 09	DSE - 09 Number Theory-II	4-1-0	5	80	20	100

* This paper can be opted by maximum of 25 students on the basis of merit of previous semesters.

Prerequisites to opt the DSE courses for semester IV are as follows:

For	M4 MAT01 –DSE 01	is	M3 MAT01–DSE 01
For	M4 MAT02 –DSE 02	is	M3 MAT02–DSE 02
For	M4 MAT03 –DSE 03	is	M3 MAT03–DSE 03
For	M4 MAT04 –DSE 04	is	M3 MAT04–DSE 04
For	M4 MAT05 –DSE 05	is	M3 MAT05–DSE 05
For	M4 MAT06 –DSE 06	is	M3 MAT06–DSE 06
For	M4 MAT07 –DSE 07	is	M3 MAT07–DSE 07
For	M4 MAT08 –DSE 08	is	M3 MAT08–DSE 08
For	M4 MAT09 –DSE 09	is	M3 MAT09–DSE 09

Skill Course (SC) for Semester IV

Note: Students can opt one SC courses with the permission of the Head of the Department.

Course no.	Course Code PSSSCCXX	Title of the Course	L-T-P	No. of Credits	Max. Marks		Total
					University Exam.	Internal Assessment	
	1	2		3	4	5	6
I	M4 MAT -SC 01	Skill Course Elective 01 Basic Statistical Techniques	2-0-0	2	80	20	100
II	M4 MAT -SC 02	Skill Course Elective - 02 Official Statistics-II	2-0-0	2	80	20	100

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

SEMESTER IV   M. Sc. MATHEMATICS   2016-17

Note- There will be five papers in all.

M4 MAT 01-CT 13

FUNCTIONAL ANALYSIS

L-T-P	3-1-0

TIME: 3 hours   External Assessment 80
Internal Assessment 20

UNIT I
Normed linear spaces; Banach spaces, Riesz Lemma, Quotient space of normed liner space and its completeness and examples Continuous linear transformations.

UNIT II
Hahn-Banach theorem; the natural embedding of a normed linear space into its second conjugate, the open mapping theorem; the closed graph theorem, the uniform boundedness theorem.

UNIT III
Inner product spaces, Hillbert spaces; Schwartz's inequality: Bessel's inequality, orthogonality, Parallelogram law, Polarization identity with examples, Pythagoras theorem, orthonormal sets.

UNIT IV
Orthonormal basis and Parseval's identity, Complete Orthonormal sets, Gram Schmidt Orthogonalization process with examples, conjugate space.

UNIT V
Riesz representation theorem, Adjoint of an operator, self adjoint operator, Normal operator, unitary operator, Matrix representation of a linear operator.

Books recommended:

1. George F. Simmons   :   Introduction to Topology and modern analysis, McGraw Hill Book Co.

2. S.I.Hu   :   Elements of Real Analysis.

3. H.L. Royden   :   Real analysis.

4. W.J. Thron   :   Topological structure.

5. J. Kelley   :   General Topology.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
SEMESTER IV   M. Sc. MATHEMATICS   2016-17
M4 MAT 02-CT 14
RELATIVITY AND COSMOLOGY

L-T-P	4-1-0

TIME: 3 hours   External Assessment 80
                                             Internal Assessment 20

UNIT I

Principle of covariance, principle of equivalence, Mach- Principle, geodesic postulates, Newton's Potential, Newtonian approximation of relativistic equation of motion. Einstein field equations with derivation and its Newtonian approximation.

UNIT II

Clock paradox, Schwarzchild exterior solution for empty space, singularities and related problems, isotopic form of Schwazchild line element, energy momentum tensor and its expression for perfect fluid.

UNIT III

Planetary orbit, Three crucial tests, Advance of Perihelion of planets, Gravitational Deflection of light ray, Shift in the spectral lines. Radar echo delay. Analogous to Kepler's law, Schwarzchild interior solution.

UNIT IV

Principals of Cosmology, Static cosmological models. Einstein and De-Sitter Universes, their derivations, properties and comparison with the actual universe and some related problems.

UNIT V

Non static cosmological models. Hubble's law, Weyl's postulate. Derivation of Robertson-Walker Metric, Geometrical features of R-W metric. Surface brightness, source counts, Red shift. Particle and event Horizons, Expressions for FRW model upto non zero pressure. .

Books Recommended:

1. P.G. Bergman   : Introduction to Theory of Relativity.
2. J.L. Synge   : Relativity, the General Theory.
3. J.V. Narlikar   : Lecture on general Relativity.
4. Roy & Bali   : Theory of Relativity.
5. B.F. Shutz   : A first course in General Relativity.

Discipline Specific Elective (DSE) Courses

Any three of the following papers with the permission of the Head of the Department of Mathematics & Statistics.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

SEMESTER IV   M. Sc. MATHEMATICS   2016-17

M4 MAT 01–DSE 01

NUMERICAL ANALYSIS-II

| L-T-P | 4-1-0 |

TIME: 3 hours   **External Assessment 80**
                                                     Internal Assessment 20

UNIT I

Curve fitting and Function Approximations: Least square principle, fitting a straight line, exponential functions, parabola and polynomial of nth degree, Approximation of functions by Chebyshev Polynomials.

UNIT II

Numerical Solutions of ordinary differential equations using Taylor series method, Picard's method, Euler's method, modified Euler's method.

UNIT III

Solutions by Runge-Kutta method up to fourth order, solutions by multi step method: Milne's method, Adams Moulton's method, Stability Analysis of Single and Multi step methods.

UNIT IV

Difference method for solving linear boundary value problem of ODE's: Finite difference method and shooting method, Numerical integration by Trapezoidal, Simpson's and Gauss Quadrature rule.

UNIT V

Finite Difference scheme for non-linear boundary value problems of the type $y^{'} = f(x,y)$, $y^{''} = (x,y,y^{'})$ and $y^{iii} = f(x,y,y',y'')$, $y^{iv} = f(x,y,y',y''y''')$

Books Recommended:

1. Jain, Iyenger and Jain   : Numerical Analysis.
2. Jain, M. K.   : Numerical solutions of differential equation.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
SEMESTER IV   M. Sc. MATHEMATICS   2016-17

M4 MAT 02–DSEP 02
COMPUTER PROGRAMMING OF NUMERICAL METHODS
(Practical Oriented)

| L-T-P | 2-0-3 |

TIME: 3 hours

External Assessment 80
Internal Assessment 20

UNIT I

Algorithm, Flowchart and Computer Programming in C on: Arithmetic operations with normalized floating point numbers, Number system conversions

UNIT II

Algorithm, Flowchart and Computer Programming in C for numerical solution of algebraic and transcendental equations: bisection, false position, Newton-Raphson, secant method

UNIT III

Algorithm, Flowchart and Computer Programming in C for numerical solution of simultaneous linear equation: Gauss Elimination method, Gauss-Seidel method

UNIT IV

Algorithm, Flowchart and Computer Programming in C for Differentiation & Integration: Simpson's rule, Trapezoidal rule, Gaussian Quadrature formula.

UNIT V

Algorithm, Flowchart and Computer Programming in C for Numerical Solutions of differential equations: Eulers method, Taylor's series 4th order method, Runge Kutta 4th order method, Predictor-corrector method

Books Recommended:

1. The C-Programming Language: B.W. Kernyharn & D.M. Ritche - PHI Ltd.

2. Computer Programming in C   : Y Kanetkar-B.P.B. Publication, New Delhi.

3. Programming in ANSI C: E Balagurusamy.

4. Computer oriented Numerical Methods: V. Rajaraman PHI Ltd.

Note: Two theory lectures per week are required for this paper and at least two programs from each unit must be practiced in computer laboratory

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

SEMESTER IV   M. Sc. MATHEMATICS   2016-17

M4 MAT 03–DSE 03

DISCRETE MATHEMATICS-II

| L-T-P | 4-1-0 |

TIME: 3 hours   **External Assessment 80**
Internal Assessment 20

UNIT I

Graph theory: Definition of (Undirected) graphs, Paths, Circuits, Cycles and Sub graphs. Induced Subgrapha..., Degree of vertex. Connectivity. Planer graphs and their properties.

UNIT II

Trees. Euler's formula for connected planar graphs Complete and Complete Bipartite graphs. Non Planar graph, Kuratowsk's theorem (Statement only). Spanning trees. Cut sets, Fundamental cut–sets, and Cycles. Minimal spanning trees and Kruskal's Algorithm.

UNIT III

Euler's theorem on the existence of eulerian paths and circuits. Directed graphs. In degree and out degree of a vertex. Weighted undirected graphs, Dijkstra's Algorithm. Strong connectivity . Directed trees. Search trees. Tree traversals.

UNIT IV

Introductory computability Theory – Finite state machines and their Transition Table Diagrams. Equivalence of finite state machines. Reduced machines. Homomorphism. Finite Automata. Acceptors. Non- deterministic Finite Automata.

UNIT V

Phrase structure Grammar. Rewriting Rules. Derivations, Sentential forms. Language generated by a Grammar. Regular context – free, and context sensitive Grammars and Languages. Regular sets, Regular expressions and pumping Lemna, Kleene's Theorem stamens.

Books recommended:

1. J.P. Tremblay & R. Manohar   : Discrete Mathematical structure with applications to computer science.

2. J.L. Gerstling   : Mathematical Structures for Computer Science, (3rd edition).

3. N. Arsing Deo   : Graph theory with applications to Engineering and Computer Science.

4. K.D. Joshi   : Foundation of Discrete Mathematics

5. S. Wiitala   : Discrete mathematics – A Unified Approach

6. C. L. Liu   : Elements of Discrete Mathematics.

7. Gokhroo & Gokhroo   : Advanced Discrete Mathematics(Navkar Publications)

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

SEMESTER IV   M. Sc. MATHEMATICS   2016-17

M4 MAT 04–DSE 04

OPTIMIZATION TECHNIQUES-II

| L-T-P | 4-1-0 |

TIME: 3 hours   External Assessment 80
                                                     Internal Assessment 20

UNIT I

Classical Optimization Techniques: Unconstrained problems of Maxima-Minima global maximum, Local maxima mothod of Lagrange's Multipliers for constrained with equality constraints.

UNIT II

Constraints in the form of inequalities: Kuhn Tuker Theorem Kuhn-Tuker necessary and sufficient conditions, saddle point.

UNIT III

Quadratic programming problem: Wolfe's algorithms and Beale's algorithm, Fractonal Programming problem.

UNIT IV

Dynamic Programming Problem: Bellman's principle of optimality, multiple stage decision problems, characteristics of DPP. Solution of finite number of stages problems by DPP.

UNIT V

Network flow problems: Maximal flow, minimal flow, shortest route problem.

Books Recommended:

1. Kanti swaroop, Mak-Mohan, : Operation Research.
   P.K. Gupta.

2. Hamdy A Taha   : Operation Research.

3. S.D. Sharrna   : Operation Research.

4. S.I. Gass   : Linear-Programming.

5. K.V. Mittal   : Optimization Methods in Operations
                               Research and systems analysis.

6. J.K. Sharma   : Operation Research

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
SEMESTER IV   M. Sc. MATHEMATICS   2016-17

M4 MAT 05–DSE 05

MATHEMATICAL THEORY OF STATISTICS-II

| L-T-P | 4-1-0 |

TIME: 3 hours   **External Assessment 80**
                                                     Internal Assessment 20

UNIT I
Chi-square and t sampling distribution with derivations, properties and applications.

UNIT II
F sampling distribution with derivations, properties and applications. Large sample theory and applications. Determination of sample size.

UNIT III
Elements of theory of estimation: Point estimation, criterion of good estimators for one parameter; Consistency, Efficiency, sufficiency and unbiasedness.

UNIT IV
Method of maximum likelihood estimation properties of maximum likelihood estimators (without proof). M.L.E. for Binomial, Poisson and Normal populations. Interval estimation for mean and variance in case of Normal population.

UNIT V

Elements of testing of hypothesis: Two kinds of error in testing of hypothesis. Critical region, Neyman-Pearson Lemma and determination of BCR in Neyman sense for testing simple v/s simple hypothesis in uniform and normal populations.

Note: Candidates who have offered Mathematical Statistics / Statistics / Applied Statistics as an optional subject in their B.A. /B.Sc. examination will not be permitted to offer this course.

Books recommended:

1. Gupta and Kapoor   : Fundamentals of Mathematical Statistics.
2. Kapur and Saxena   : Mathematical Statistics.
3. Goon and Others   : Outline of Statistical Theory, Vol. I, II.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
SEMESTER IV   M. Sc. MATHEMATICS   2016-17
M4 MAT 06–DSE 06
VISCOUS FLUID DYNAMICS-II

| L-T-P | 4-1-0 |

TIME: 3 hours   **External Assessment 80**
                                                   Internal Assessment 20

UNIT I

Boundary layer Theory: Boundary layer equations for two dimensional flows over a plane wall. Boundary layer on a flat plate (Blasius, Topper solution). Characteristic boundary layer parameters. Similar solutions of the boundary layer equations. Exact solutions of the steady state boundary layer equation in two dimensional motion, Boundary layer along a flat plate.

UNIT II

Flow past a wedge, Flow past a convergent channel. Boundary layer separation. Blasius series solution, Gortler, new series method. Prandtl-mises transformation, Axial symmetrical and three dimensional boundary layer: - Boundary layer on a Yawed cylinder.

UNIT I

Approximate methods for the solution of the boundary layer equations Karman momentum integral equation, Karman-Pohlhousen method. Energy integral equations. Walz-Thwaites method based on energy integral equation.

UNIT IV

Thermal Boundary Layer in Two Dimension Flow. Thermal boundary layer equation for a plane wall. Forced convection in a laminar boundary layer on a flat plate (i) Crocco's first integral (ii) Reynolds's analogy (iii) Crocco's second integral for Pr =1.

UNIT V

Free convection from a heated vertical plate: Thermal energy integral equation. Approximate solution of the Pohlhousen's problem of free convection from a heated vertical plate.

Book& Recommended:

1. G. Schfichting   : Boundary Layer Theory.
2. S.I. Pai   : Viscous Flow Theory, Vol.I, Laminar flow.
3. J.L. Bansal   : Viscous Fluid Dynamics.
4. M. D. Raisinghania : Fluid Dynamics.
5. Shanti Swarup   : Fluid Dynamics.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
SEMESTER IV   M. Sc. MATHEMATICS   2016-17
M4 MAT 07–DSE 07
INTEGRAL TRANSFORMS

| L-T-P | 4-1-0 |

TIME: 3 hours   **External Assessment 80**
                                     Internal Assessment 20

UNIT I

Laplace transform: Definition and its properties. Rules of manipulations, Laplace theorems of derivatives and integrals, Properties of inverse laplace transtorms, Convolution theorem, Complex inversion formulas.

UNIT II

Applications of Laplace transform to the solutions of ordinary differential equations with constant and variable coefficients and simple boundary value problems.

UNIT III

Fourier Transform: Definition and properties of fourier sine and cosine and complex transforms, Convolution theorem, Inversion theorems and Fouries transform of derivations.

UNIT IV

Applications of Fourier transforms to the solutions of partial differential equations. Mellin Transform: Definition and elementary properties, Mellin transforms of derivations and integrals Inversion theorem and convolution theorem.

UNIT V

Infinite Hankel transform: Definition and Elementary Properties, Hankel transform of derivations, Inversion theorem and parseval theorem. Application to the Solution of simple boundary value problems.

Books Recommended:

1. Ranville, E.D.   : Laplace and Fourier Transforms.
2. Sneddon, I.N.   : The use of Integral Transforms.
3. Ze manian, A.H.   : Generalized Integral transforms.
4. Lowit   : Linear Integral equations.
5. Goyal,. S.P. & Goyal, A. K.   : Integral Transforms.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
SEMESTER IV   M. Sc. MATHEMATICS   2016-17

M4 MAT 08–DSE 08
ASTRONOMY-II

| L-T-P | 4-1-0 |

TIME: 3 hours   **External Assessment 80**
                                                          Internal Assessment 20

UNIT I

Parallax: shape of each, geocentric parallax, distance of Moon, Parallax in declination and Hour angle and geocentric parallax in zenith dist. azimuth, right ascension and declination annual parallax in longitude, and latitude, Parallactic angle and stellar parallax in right ascension and declination.

UNIT II

The meridian circle: the three errors, Besell's formula, correction for level and collimation error, total correction to the observed time of transit.

UNIT III

Kepler's Laws and planetary motion: Various definitions and laws, relation in elliptic motion, anomaly V in terms of eccentric anomaly, true anomaly V in terms of mean anomaly M, Euler's theorem.

UNIT IV

Planetary phenomena: Sydereal period and synodic period and their relation, elongation phases of moon, brightness, maximum brightness. Eclipses: Eclipses of moon angular radius of earth's shadow, duration of eclipses, the ecliptic limits, eclipses of sun and their Limits, frequency of eclipse, the metonic cycle.

UNIT V

Proper motions of stars and their relation, tangential velocity and parallax, radial velocity at different epochs, the solar motion and parallactic motion, determination of solar apex form proper motions.

Books Recommended:

1. Gorakh Prasad   : Astronomy
2. Smart   : Astronomy

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
SEMESTER IV   M. Sc. MATHEMATICS   2016-17
M4 MAT 09–DSE 09
NUMBER THEORY-II

| L-T-P | 4-1-0 |

TIME: 3 hours   **External Assessment 80**
                                                              Internal Assessment 20

UNIT I

Continued Fractions: Finite and infinite continued fraction convergent of a given continued fraction and their properties.

UNIT II

Uniqueness of a continued fraction Periodic continued fraction, Pell's equation in general, characterization of solutions of x-dy = 1 in terms of its smallest positive solution.

UNIT III

Algebraic number fields and their rings of integers, Calculations for quadratic and cubic cases. Localization , Glois extension.

UNIT IV

Dedikind rings, discrete valuation rings completion, unramified and ramified extensions.

UNIT V

Different discriminates, cyclotomie fields, roots of unity.

Books Recommended:

1.   Donald M. Burton   :   Elementary Number Theory, Allyn and Bacon Inc.
2.   Niven & H.S. Zuckerman   :   An Introduction to the Theory of Numbers,
                                   Willey eastern India Ltd.
3.   Lang, S.   :   Algebraic Number theory, GTM Vol. 110,
                                   Springer-Verlag 194.

SKILL COURSE

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
SEMESTER IV   M. Sc. MATHEMATICS   2016-17

M4 MAT   -SC 01
Skill Course Elective 01 for IV Semester
BASIC STATISTICAL TECHNIQUES

L-T-P	2-0-0

(For M.Sc. Students not having Statistics as a subject in UG Course)

UNIT I

An introduction to Statistics: Data collection and data presentation, frequency distribution, graphical representation, measures of central tendency, dispersion, skewness and kurtosis.

UNIT II

Concept of probability, Probability distributions: Binomial, Poisson and Normal distribution (Simple applications only).

UNIT III

Introduction to bivariate frequency data and its measurement: covariance, correlation, scatter diagram, Regression analysis: Linear regression, regression coefficient, fitting of regression equation by least square method.

UNIT IV

Population, sample, Statistica, standard error, estimation, confidence interval and confidence level, confidence interval estimate of proportion and mean. Hypothesis and its types, errors, level of significance. Test statistics (only Practicals Problems): Student's Chi-square, F and Z-Statistics and their applications in testing of hypothesis.

UNIT V

An introduction to Analysis of Variance (ANOVA), its definition, assumptions and uses, One way classification and statistical analysis of the model involved in it (Only Practicals Problems).

Text Books:
(1) Hogg, R. V. & Tanis, E. A. (2002): Probability and Statistical Inference Pearson Education, Asia.
(2) Mood, A.M., Graybill, F. A. and Boes D. C. (1999): Introduction to the theory of Statistics, MCGraw Hill, New York.
(3) Arora, P.N. and Malhan, P.K. (2001): Biostatistics, Himalaya Publishing House, New Delhi.
(4) Goon, A.M., Gupta, M.K. and Das Gupta, B. (2006): Basic Statistics, World Publication, Kolkata.
(5) Gupta, S.C.: Fundamental of Statistics.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

SEMESTER IV   M. Sc. MATHEMATICS   2016-17

M4 MAT   -SC 01
Skill Course Elective 02

OFFICIAL STATISTICS-II

L-T-P	2-0-0

UNIT I
System of collection of Agricultural statistics.

UNIT II
Crop forecasting and estimation, productivity.

UNIT III
Fragmentation of holdings, support prices, buffer stocks, impact of irrigation projects.

UNIT IV
Statistics related to industries, foreign trade.

UNIT V
Balance of payment, cost of living, inflation, educational and other social statistics.

References:

Basic statistics Relating to the Indian Economy (CSO) 1990.

Guide to Official Statistics (CSO), 1999.

Statistical System in India (CSO) 1995).

Principles and Accommodation of National Population Censuses, UNESCO.

Panse, V. G., Estimation of Crop Yields (FAO)

Family Welfare Yearbook. Annual Publication of D/0 Family Welfare.

Monthly Statistics of Foreign Trade in India, DGCIS, Calcutta and other Govt. Publications.