Estd. 1962
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With CGPA 3.52

Mechanism to ensure the proper implementation of Programme Project Reports (PPR)

Sr. No.	Component of PPR	Action Taken
1.	**A. Programme's objectives**	**In the Process of implementation**
2.	**B. Relevance of the program with CDOE's Mission and Goals** Vision, Mission, Goal, PO (Program Outcome), PSO (Program Specific Outcome)	**In the Process of implementation**
3.	**C. Nature of target group of learners**	**Reached to the Target Group**
4.	**D. Appropriateness of programme to be conducted in Open and Distance Learning and/or Online mode to acquire specific skills and competence**	**In the Process of implementation**
5.	**E. Instructional Design:** 1. Title of The Programme 2. Duration of the Programme 3. Medium of Instruction 4. Credit System Implementation 5. Programme Structure 6. Specification For Online Mode of Delivery of the Programme 7. Details Syllabus	**Completed**
6.	**F. Procedure for admissions, curriculum transaction and evaluation** 1. Eligibility 2. Intake 3. Academic Calendar 4. Required Document while taking Admission to Programme along with Payments of Fees. 5. Programme Fees. 6. Evaluation Pattern 7. Standard of Passing 8. Nature of Question Paper	**Completed**
7.	**G. Requirement of the laboratory support and Library Resources** a. Requirement of the laboratory support b. Requirement of the Library Resources	**Not Applicable**
8.	**H. Cost estimate of the programme and the provisions**	**Budgetary Provision is available**
9.	**I. Quality assurance mechanism and expected programme outcomes** a. Quality assurance mechanism: b. Expected programme outcomes:	**In the Process of implementation**

Quality assurance mechanism and expected programme outcomes:

1. Recognize the functioning of business opportunities involvement of business enterprises and exploring the entrepreneurial opportunities.

2. Develop incubation center and entrepreneurship development center for students who intent to take up start up or grow existing business.

3. Develop skills on analyzing the business data application of relevant analysis and problem solving.

4. Demonstrate a global outlook with the ability to identify aspects of the global business and cross-cultural understanding.

5. Identify the contemporary social problems, exploring the opportunities for social entrepreneurship, designing business solutions and demonstrate ethical standards in organizational decision making.

6. Develop effective and oral communication especially in business applications, with the use of appropriate technology.

7. Collaborate and lead teams across organizational boundaries and demonstrate leadership qualities, maximize the uses of diverse skill of team members in the related context.

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With CGPA 3.52

Shivaji University, Kolhapur

Centre for Distance and Online Education

Online MBA

Mechanism to ensure the proper implementation of Programme Project Report (PPR)

In accordance with the UGC's regulations (ODL Programmes and Online Programmes) Regulations, 2020, the following Key mechanisms are used to ensure the proper implementation of Programme Project Report (PPR)-

1. Admission, tuition fee and concession to various groups are approved by university authority and implemented time to time.
2. The developed e-content undergoes a structured process of assessment and review to ensure its overall quality, accuracy, and relevance to the prescribed course material. Each e-content is carefully examined to confirm its correctness, consistency, and alignment with the intended course outcomes. Based on the feedback and recommendations provided by the e- Content Review and Approval Committee (e-CRAC), necessary revisions are incorporated before finalization. Once approved, the validated e-content is uploaded on the Learning Management System (LMS). To further support accessibility and smooth functioning, the University has appointed dedicated technical assistants for managing and facilitating the use of e-content.
3. e-SLM is developed by subject experts and its editing process is implemented successfully before uploading on LMS with printable form.
4. Question paper setting and assessment workshop is conducted for proper implementation of evaluation structure approved by University authority.
5. Conduct of exam and declaration of results are scheduled as per university norms.
6. University has industry-interaction cell which conducts programme to enhance the employment and earnability of leaners.

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Shivaji University, Kolhapur

Centre for Distance and Online Education

Online M. Com.

Mechanism to ensure the proper implementation of

Programme Project Report (PPR)

In accordance with the UGC's regulations (ODL Programmes and Online Programmes) Regulations, 2020, the following Key mechanisms are used to ensure the proper implementation of Programme Project Report (PPR)-

1. Admission, tuition fee and concession to various groups are approved by university authority and implemented time to time.
2. The developed e-content undergoes a structured process of assessment and review to ensure its overall quality, accuracy, and relevance to the prescribed course material. Each e-content is carefully examined to confirm its correctness, consistency, and alignment with the intended course outcomes. Based on the feedback and recommendations provided by the e-Content Review and Approval Committee (e-CRAC), necessary revisions are incorporated before finalization. Once approved, the validated e-content is uploaded on the Learning Management System (LMS). To further support accessibility and smooth functioning, the University has appointed dedicated technical assistants for managing and facilitating the use of e-content.
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6. University has industry-interaction cell which conducts programme to enhance the employment and earn ability of leaners.

Mahajan

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Dean
Faculty of Commerce and Management
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Estd:1962
NAAC "A+ +" Grade with CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR
CENTRE FOR DISTANCE AND ONLINE EDUCATION (CDOE)

Programme Project Report (PPR)

of

M.Sc. Mathematics through Online Mode

A. Programme's mission and objectives:

1) To develop employable abilities of the learner where mathematics plays important role.
2) To motivate distance education M.Sc. (Mathematics) learner to take higher education.
3) To inspire learner to undertake research activity in Mathematics.
4) To make learners enough competent in basic functionalities.

B. Relevance of the program with CDOE's Mission and Goals:

CDOE's Mission and Goals:

Vision: Imparting Quality Higher Education across the Globe.

Mission: Serving the learners by offering digital learning without time and boundary restrictions.

Goals: Access to Higher Education to

- All segments of the Society across the globe.
- Offer high quality, innovative, career oriented programme to all aspirants.
- All professionals having aspiration of Career advancement are served irrespective of geographical boundaries.

With,

- Quality e-content developed by experts.
- Live Discussion Forums.
- 24 x 7 assistance through dedicated Learning Management System.
- Mentoring facilities provided to cater the needs of the learners.

By these Vision, Mission and Goals, CDOE on the global platforms; are providing the PG programmes to every aspirants of higher education.

C. Nature of prospective target group of learners:

In the post globalization period, there is a huge requirement of manpower having M.Sc. (Mathematics) degree to cater to the needs of manufacturing and service organizations. Further, the manpower which is already employed in manufacturing and service organizations, not having M.Sc. (Mathematics) degree are required to upgrade their qualification by possessing M.Sc. (Mathematics) degree without hampering their service/ working time.

Some graduates, primary teacher, high-school teacher already in service and they want to higher qualification than current qualification for success in their life and this is due only through Online Mode.

D. Appropriateness of programme to be conducted in online mode to acquire specific skills and competence:

Specific Skills and Competence to be achieved by every learner through this Online Mode programme are enlisted follows-

To prepare a young generation of Teachers, Bank staff, government officers who are:

1. Aware of the need of working systematically
2. Aware of the scientific and technological developments.
3. Capable of performing their work backed with theoretical and conceptual clarity.
4. Capable of solving problems and taking appropriate decisions.

E. Instructional Design:

Title of the course: M. Sc. (Mathematics) (Online Mode)

1) M.Sc.(Mathematics) Programme has semester pattern
2) Duration of the Program
    - The M.Sc. programme will be a full-time two years **online mode** i.e. 4 semesters. Pattern of examination will be Semester System.

Medium of Instruction

- The medium of Instruction will be English only**.**

Admission Procedure

Eligibility: 1. B.A / B. Sc graduate with Mathematics as specialization subject.
2. B.A. /B. Sc II with one subject Mathematics

3) Structure of the course

The following table gives the scheme of Examination at M.Sc. Mathematics (Part I) according to the New Syllabus and pattern of Examination.

Fees to be paid while registering for the first time for the First Year in accordance with NEP 2020 (Sem.- I & Sem.- II) in June / July :

Sr. No.	Details	Amount (in Rs.)
1.	Registration Fee	2000
2.	Exam Fee	1810
3.	Eligibility fee	As per circular of Qualification department
4.	Alumni associate fee	50
5.	Dhwaj Nidhi	10
6.	Cost of Application form	10
7.	Prospectus charges	20
8.	E-Facility Fee	50
9.	Student welfare fund	100
10.	Youth hostel fee	50
11.	Tuition / Course Fee	30000
12.	Student Accident / Medical Help Fund fee	20
	Total Amount	**34,120**

Fees to be paid while registering for the first time for the Second Year in accordance with NEP 2020 (Sem.- III & Sem.- IV) in June / July :

Sr. No.	Details	Amount (in Rs.)
1.	Registration Fee	2000
2.	Exam Fee	1810
3.	Eligibility fee	As per circular of Qualification department
4.	Alumni associate fee	50
5.	Dhwaj Nidhi	10
6.	Cost of Application form	10
7.	Prospectus charges	20
8.	E-Facility Fee	50
9.	Student welfare fund	100
10.	Youth hostel fee	50
11.	Tuition / Course Fee	30000
12.	Student Accident / Medical Help Fund fee	20
	Total Amount	**34,120**

M.Sc.(Mathematics) part I Semester - I

Course Code	Title of course	Number of Credits	Duration of Semester end Exam in hrs.	Marks-Term end Exam	Marks-(Internal) Mid Semester Exam	Total marks of Each Subject
MMT-101	**Mandatory Major 4 credits** Linear Algebra	4	3	60	40	100
MMT-102	Real Analysis	4	3	60	40	100
MMT-103	Ordinary Differential Equations	4	3	60	40	100
MMT-104	**Mandatory Major 2 Credits** Numerical Analysis-I	2	2	30	20	50
MET-105	**Mandatory Elective (any one) 4 credits** Combinatorics or Linear programming and its applications	4	3	60	40	100
RM-106	**Mandatory 4 credits** Research Methodology	4	3	60	40	100

M.Sc.(Mathematics) part I Semester - II

Course Code	Title of course	Number of Credits	Duration of Semester end Exam in hrs.	Marks- Term end Exam	Marks- (Internal) Mid Semester Exam	Total marks of Each Subject
MMT-201	**Mandatory Major 4 credits** Algebra	4	3	60	40	100
MMT-202	Topology	4	3	60	40	100
MMT-203	Advanced Calculus	4	3	60	40	100
MMT-204	**Mandatory Major 2 Credits** Numerical Analysis - II	2	2	30	20	50
MET-205	**Mandatory Elective (any one) 4 credits** Number Theory or Quantitative techniques in operations Research	4	3	60	40	100
OJT-206	**Mandatory 4 credits** On job Training / Field project	4	3	60	40	100

M.Sc.(Mathematics) part II Semester - III

Course Code	Title of course	Number of Credits	Duration of Semester end Exam in hrs.	Marks- Term end Exam	Marks- (Internal) Mid Semester Exam	Total marks of Each Subject
MMT-301	**Mandatory Major 4 credits** Functional Analysis	4	3	60	40	100
MMT-302	Complex Analysis	4	3	60	40	100
MMT-303	Classical Mechanics	4	3	60	40	100
MMT-304	**Mandatory Major 2 Credits** Advanced Discrete Mathematics	2	2	30	20	50
MET-305	**Mandatory Elective (any one) 4 credits** Fuzzy Set Theory or Fluid Dynamics	4	3	60	40	100
RP-306	**Mandatory 4 credits** Research Project	4	3	60	40	100

M.Sc.(Mathematics) part I Semester - II

Course Code	Title of course	Number of Credits	Duration of Semester end Exam in hrs.	Marks- Term end Exam	Marks- (Internal) Mid Semester Exam	Total marks of Each Subject
MMT-401	**Mandatory Major 4 credits** Integral Equations	4	3	60	40	100
MMT-402	Field Theory	4	3	60	40	100
MMT-403	Partial Differential Equations	4	3	60	40	100
MET-404	**Mandatory Elective (any one) 4 credits** Fuzzy Relation and Logic Or Computational Fluid Dynamics	4	3	60	40	100
RP-405	**Mandatory 6 credit** Research Project	6	3	100	50	150

M. Sc. Mathematics (Online Mode) (Part I) (Level-6.0) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2025-26)

Title of Course: Linear Algebra

Total Credits: 04

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. understand basic notions in Linear Algebra and use the results in developing advanced mathematics.
2. study the properties of Vector Spaces, Linear Transformations, Algebra of Linear Transformations and Inner product space in some details.
3. construct Canonical forms and Bilinear forms.
4. apply knowledge of Vector space, Linear Transformations, Canonical Forms and Bilinear Transformations.

Unit I: Elementary Basic concepts, Linear Independence and Bases, Dual Spaces, Annihilator of a subspace, Quotient Spaces. Inner product spaces, Linear Transformations. **15 Lectures**

Unit II: The Algebra of Linear transformations, Characteristic Roots, Matrices of linear transformations, Eigen values and eigenvectors of a linear transformation, Canonical Forms: Similarity of linear transformations. **15 Lectures**

Unit III: Triangular form, Nilpotent transformations, Jordan Form, Trace and transpose, Determinants. **15 Lectures**

Unit IV: Hermitian, Unitary and Normal linear transformations, Bilinear Forms, Symmetric Bilinear Forms, Skew Symmetric Bilinear Forms. **15 Lectures**

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Book(s):

1. Herstein I. N. : Topics in Algebra, 2nd Edition, Willey Eastern Limited.
2. Hoffman, Kenneth and Kunze R: Linear Algebra, Prentice Hill of India Private Limited., 1984.

Reference Books:

1. A. R. Rao and P. Bhimashankaran, Linear Algebra, Hidustan Book Agency.
2. Surjit Singh, Linear Algebra, Vikas publishing House (1997).
3. Gilbert Strang: Introduction to Linear Algebra, Wellesley-Cambridge Press

M. Sc. Mathematics (Online Mode) (Part I) (Level-6.0) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2025-26)

Title of Course: Real Analysis
Total Credits: 04

Course Outcomes: Upon successful completion of this course, the student will be able to:
1. generalize the concept of length of interval.
2. analyze the properties of Lebesgue measurable sets.
3. demonstrate the measurable functions and their properties.
4. understand the concept of Lebesgue integration of measurable functions.
5. characterize Riemann and Lebesgue integrability.
6. prove completeness of L^P Spaces.

UNIT I:
σ-algebra and Borel Sets of Real numbers, Lebesgue Outer Measure, The sigma algebra of Lebesgue measurable sets, Outer and Inner approximation of Lebesgue Measurable Sets, Countable Additivity, Continuity and Borel-Cantelli Lemma. **15 Lectures**

UNIT II:
Nonmeasurable Sets, Lebesgue Measurable Functions: Sums, Product and Composition of Measurable Functions, Sequential Pointwise Limits and Simple Approximation, Littlewood's Three Principles (Statement and importance of Egoroff's Theorem and Lusin's Theorem) **15 Lectures**

UNIT III:
Lebesgue Integral of a Bounded Measurable Function over a Set of Finite Measure, Lebesgue integral of a Measurable Non-negative Function, The General Lebesgue Integral, Characterizations of Riemann and Lebesgue Integrability. **15 Lectures**

UNIT IV:
Lebesgue's Theorem (Statement Only), Functions of Bounded Variations, Jordan's theorem, Absolutely Continuous Functions, Integrating Derivatives: Differentiating Indefinite Integrals, The L^P Spaces: Normed Linear Spaces, The Inequalities of Young, Hölder and Minkowski, The Riesz-Fischer Theorem.

15 Lectures

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Books:

1. H. L. Royden, P.M. Fitzpatrick, Real Analysis, Fourth Edition, PHI Learning Pvt. Ltd., New Delhi, 2010

Reference Books:

1. G. de Barra, Measure Theory and Integration, New Age International (P) Ltd., 1981.
2. I. K. Rana, An Introduction to Measure and Integration, Narosa Book Company, 1997.
3. S. K. Berberian, Measure and Integration, McMillan, New York, 1965.
4. P. K. Jain, V. P. Gupta, Lebesgue measure and Integration, Wiley Easter Limited, 1986.
5. W. Rudin, Principles of Mathematical Analysis, McGraw-Hill Book Co, 1964.
6. P. K. Halmos, Measure Theory, Van Nostrand, 1950.

M. Sc. Mathematics (Online Mode) (Part I) (Level-6.0) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2025-26)

Title of Course: Ordinary Differential Equations

Total Credits: 04

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. study basic notions in Differential Equations and use the results in developing advanced mathematics.
2. solve problems modeled by linear differential equations.
3. use power series methods to solve differential equations about ordinary points and regular singular points.
4. construct approximate solutions using method of successive approximation.
5. establish uniqueness of solutions.

Unit I : Linear differential equations with constant coefficients: The second order homogeneous equation, initial value problems for second order equations, linear dependence and independence, formula for the Wronskian, the non-homogeneous equations of order two.

15 Lectures

Unit II: The homogeneous equations of order n, initial value problems for the nth order equations, the non-homogeneous equation of nth order. Linear equations with variable coefficients: Initial value problems for the homogeneous equations. Solutions of the homogeneous equations, the Wronskian and linear independence. **15 Lectures**

Unit III: Reduction of the order of a homogeneous equation, the non-homogenous equations, homogeneous equations with analytic coefficients, the Legendre equations. Linear equations with regular singular points: The Euler equations, second order equations with regular singular points.

15 Lectures

Unit IV: The Bessel equation, regular singular points at infinity. Existence and uniqueness of solutions: The method of successive approximations, the Lipschitz condition, convergence of the successive approximation. **15 Lectures**

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended books:

1. E. A. Coddington: An introduction to ordinary differential equations. (2012) Prentice Hall of India Pvt.Ltd. New Delhi.

Reference books:

1. G. Birkoff and G.G.Rota, Ordinary differential equations, John Willey and Sons.
2. G.F. Simmons, Differential Equations with Applications and Historical note, McGraw-Hill, Inc. New York. (1972).
3. E.A. Coddington and Levinson, Theory of ordinary differential equations, McGraw-Hill, New York(1955).
4. E.D. Rainvills, Elementary differential equations, The Macmillan company, New York, (1964).

M. Sc. Mathematics (Online Mode) (Part I) (Level-6.0) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2025-26)

Title of Course: Numerical Analysis - I

Total Credits: 02

Course Outcomes: Upon successful completion of this course, the student will be able to:

1) apply the methods to solve linear and nonlinear equations.

2) find numerical integration and analyze error in computation.

3) solve differential equations using various numerical methods.

4) determine eigen values and eigen vectors of a square matrix.

5) construct LU decomposition of a square matrix.

Unit I: Transcendental & polynomial equations: Bisection method, Iteration methods based on First degree equation (Secant method, Regula-Falsi method and Newton-Raphson method). Rate of Convergence, Iterative methods (Birge-Vieta method and Bairstow method).

15 Lectures

Unit II: System of linear algebraic equations and eigen value problems: Matrix factorization methods (Doolittle's method, Crout's method), Iteration methods (Jacobi iteration method, Gauss-Seidel iteration method), convergence analysis of iterative methods, Eigen values and eigenvectors, Gerschgorin theorem, Brauer theorem, Jacobi method for symmetric matrices, Power method.

15 Lectures

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Books:

1. M. K. Jain, S. R. K. Iyengar, R. K. Jain, Numerical methods for scientific and Engineering Computation (Fifth Edition), New Age International Publishers 2007.

Reference Books:

1. S. S. Sastry, Introductory methods of Numerical Analysis (Fifth Edition), PHI learning Private Limited, New Delhi 2012.
2. D. Kincaid, W. Cheney, Numerical Analysis Mathematics of Scientific Computing (Third Edition), American Mathematical Society.
3. J.C. Butcher, Numerical methods for ordinary differential equations (Second Edition), John Wiley & Sons Ltd, 2008.
4. Kendall E. Atkinson, An Introduction to Numerical Analysis (Second Edition), John Wiley & Sons 1988.

M. Sc. Mathematics (Online Mode) (Part I) (Level-6.0) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2025-26)
Title of Course: Combinatorics
Total Credits: 04

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. describe Pigeonhole principle and use it to solve problems.
2. use definitions and theorems from memory to construct solutions to problems
3. use Burnside Frobenius Theorem in counting's.
4. use various counting techniques to solve various problems.
5. apply combinatorial ideas to practical problems.
6. improve mathematical verbal communication skills.

Unit I: The sum rule and product rule, permutations and combinations, the Pigeonhole principle, Ramsay numbers, Catalan numbers, sterling numbers. **15 Lectures**

Unit II: Further basic tools, generalized permutations and combinations sequences and selections, the inclusion and exclusion principle, systems of distinct representatives, solved problems derangements and other constrain derangements. **15 Lectures**

Unit III: Combinatorial number theory, the permanent of a matrix, Rook polynomials and Hit polynomials, SDR and coverings, (Sperners theorem and Symmetric chain decomposition, posets and Dilworth's theorem) statements. **15 Lectures**

Unit IV: Generating functions and recurrence relations, ordinary and exponential generating functions, partitions of a positive integer, recurrence relations, algebraic solutions of linear recurrence relations with constant coefficients and solutions of recurrence relations using generating functions. **15 Lectures**

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Books:

1. V. K. Balkrishnan: Combiactorics, Shaums Outlines Series, Mc Grow Hill Inc.

Reference Books:

1. Richard Brualdi – Introductory Combinatosics North Holland.
2. V. Krishnamurthy: Combinatorics, E. W. Press
3. A. Tucker: Combinatorics, John Wiley & Sons, Inc
4. C. Vasudev, Theory and Problems of Combinatorics, New Age International

M. Sc. Mathematics (Online Mode) (Part I) (Level-6.0) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2025-26)
Title of Course: Linear programming and its applications
Total Credits: 04

Course outcomes: Upon successful completion of this course, the student will be able to --
1. Recognize convex sets and convex functions.
2. Calculate maximum and minimum value of a function of several variables.
3. Solve LPP by simplex and dual simplex methods.

Unit – I: General formulation of linear programming problem, Slack and surplus variables, standard form of LPP, Solution of LPP, Feasible solution of LPP, Basic solution , Basic feasible solution, Optimum Basic feasible solution, unbounded solution, Lines and hyperplanes, Convex sets, polyhedron convex set, extreme points of a convex set, convex combination of vectors, convex hull , convex polyhedron, convex function, maxima and minima of functions of several variables. **15 lectures**

Unit -II : Introduction to linear programming problems ,fundamental theorem of linear programming, computational procedure of a simplex method, examples . Two phase method, Examples, big M method , disadvantages of big M method over two phase method , problem of degeneracy, Resolution of degeneracy, unbounded solutions, non-existing feasible solutions **15 lectures**

Unit -III : Duality in linear programming, rules for converting any primal into its dual, Duality theorems, fundamental duality theorem, The dual simplex method , Computational procedure of dual simplex method, examples. **15 lectures**

Unit – IV: Integer linear programming: Importance of integer Programming problems, Gomory's all IPP Method, Gomorian slack variable, Construction of Gomory's Constraints, Gomory's cutting plane Algorithm, Computational procedure for the solution of IPP by Gomorys Method, The Branch and Bound method, branch and bound algorithm, concept goal programming, single goal models,multiple goal models, multiple goals with equal priorities, multiple goal with priorities, multiple goals with priorities and weights, formulation of goal programming models, methodology of solution procedure, graphical solution. simplex method applied to GP problems. **15 lectures**

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Book: 1 S.D. Sharma: Operations Research, Kedar Nath Ram Noth and co. 15th edition reprint 2009

Reference Books: 1.J.K.Sharma : Operations research
2. Kanti Swarup ,P.K.Gupta and Manmohan : Operations research, S.Chand& Co.
3. Hamady Taha : Operations Research :Mac Millan Co.
4. R.K.Gupta : Operations Research Krishna Prakashan Mandir, Meeru
5. G.Hadley : Linear programming, Oxford and IBH Publishing Co.
6. S.I.Gass : Linear Programming, Mc Graw Hill Book Co

M. Sc. Mathematics (Online Mode) (Part I) (Level-6.0) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2025-26)
Title of Course: Research Methodology
Total Credits: 04

Course Outcomes: Upon successful completion of this course, the student will be able to:
1. understand skill of mathematical writing
2. Understand wetting research paper
3. revise the drafts, check the proofs
4. understand the copy copyright issues
5. Type in mathematics using latex

Unit I: Mathematical Writing: What Is a Theorem?, Proofs, The Role of Examples, Definitions, Notation, Words versus Symbols, Displaying Equations, Parallelism, Dos and Don'ts of Mathematical Writing. Writing a Paper: Audience, Organization and Structure, Title, Author List, Date, Abstract, Key Words and Subject Classifications. **15 Lectures**

Unit II: Writing a Paper (Continued...): The Introduction, Review of Literature, Computational Experiments, Tables, Citations, Conclusions, Acknowledgements, Appendix, Reference List, Specifics and Deprecated Practices. Revising a Draft: How to Revise, Examples of Prose, Examples Involving Equations, Examples from My Writing, A Revised Proof, A Draft Article for Improvement. **15 Lectures**

Unit III: Publishing a Paper: Choosing a Journal, Submitting a Manuscript, The Refereeing Process, How to Referee, The Role of the Copy Editor, Checking the Proofs, Copyright Issues, SIAM Journal Article: A case study. Writing and Defending a Thesis: The Purpose of a Thesis, Content, Presentation, The Thesis Defence. **15 Lectures**

Unit IV: Quality indices of research publication: impact factor, H- index, science citation index., Using web for literature review: Google Scholar, Scopus, MathSciNet. Latex –Basic Typesetting of Mathematics, Typesetting Theorems. **15 Lectures**

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Book:

1. Higham Nicholas J., Handbook of writing for the mathematical sciences, SIAM, 1961.
1. LATEX Tutorials A Primer, Indian TEX Users Group, Trivandrum, India, 2003 September.https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf

References:

1. Stegmann J., How to evaluate journal impact factors, Nature, 390(6660), (1997), 550-550.
2. Kaltenborn K. F. and Kuhn K, The journal impact factor as a parameter for the evaluation of researchers andresearch, Revista Espanola de Enfermedades Digestivas, 96(7), (2004), 460-476.
3. Hirsch J. E., An index to quantify an individual's scientific research output, https://arxiv.org/abs/physics/0508025
4. Garfield E., The evolution of the Science Citation Index, International Microbiology, 10, (2007), 65-69. DOI: 10.2436/20.1501.01.10
5. A Primer of Mathematical Writing, Steven G. Krantz, Universities Press Hyderabad 1998.https://arxiv.org/pdf/1612.04888.pdf 6McGraw- Hill's Concise Guide to Writing Research Papers, Carol Ellison, McGraw-Hill, New York, 2010.

M. Sc. Mathematics (Online Mode) (Part I) (Level-6.0) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2025-26)
Title of Course: Algebra
Total Credits: 04

Course Outcomes: Upon successful completion of this course, the student will be able to:
1. study group theory and ring theory in some details.
2. introduce and discuss module structure over a ring.
3. apply Sylow theorems.
4. use homomorphism and isomorphism theorems.
5. check irreducibility of polynomials over Q using Eisenstein criteria.

Unit I: Group of permutations, Examples, Alternating Groups, Simple groups, simplicity of An (n > 4), Applications, Subnormal and Normal Series, Jordan-Holder Theorem, The Center and the Ascending Central Series, Isomorphism Theorems. **15 Lectures**

Unit II: The Zassenhaus (Butterfly) Lemma, Schreier Theorem, Group action on a set, fixed sets and isotropy subgroups, Orbits, Applications of G-Sets to Counting, Burnside theorem, p-groups, The Sylow Theorems.

15 Lectures

Unit III: Applications of Sylow theorems to p-Groups and the Class equation, Further Applications, Polynomial in an Indeterminate, Polynomial rings, The evaluation Homomorphisms, Factorization of Polynomials over Fields**,** The Division Algorithm in F[x], Irreducible Polynomials, Eisenstein criteria, Ideal Structure in F[x], Uniqueness of Factorization in F[x].

15 Lectures

Unit IV: Principal Ideal Domain (PID), Uniqueness of Factorization Domain(UFD), Gauss lemma, Introduction and Definition of Euclidean Domain, Arithmetic in Euclidean Domains. Definitions and Examples of Modules, Direct Sums, Free Modules, sub-modules, Quotient Modules, Homomorphism, Simple Modules. **15 Lectures**

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Book(s):

1. John B. Fraleigh , A first course in Abstract Algebra (Third Edition), Narosa publishing house, New Delhi.
2. C. Musili, Introduction to Rings and Modules (Second Revised Edition), Narosa Publishing house, New Delhi.

Reference Books:

1. Joseph A. Gallian, Contemporary Abstract Algebra (Fourth Edition), Narosa Publishing house, New Delhi.
2. Bhattacharya, Jain and Nagpal, Basic Abstract Algebra, 2nd edition, Narosa Publishing House, New Delhi.
3. I. N. Herstein, Topics in Algebra, Vikas Publishing House.
4. N. Jacobson, Basic Algebra, Hind Publishing Corporation, 1984.

M. Sc. Mathematics (Online Mode) (Part I) (Level-6.0) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2025-26)
Title of Course: Topology
Total Credits: 04

Course Outcomes: Upon successful completion of this course, the student will be able to:
1. built foundations for future study in analysis, in geometry, and in algebraic topology.
2. introduce the fundamental concepts in topological spaces.
3. acquire demonstrable knowledge of topological spaces, product spaces, and continuous functions on topological spaces.
4. identify compact and connected sets in topological spaces.
5. use Separation and countability axioms, Urysohn lemma, Urysohn metrization.

Unit I: Topological Spaces, Basis and Subbasis for a Topology, The Order Topology, The Product Topology on $X \times Y$, The Subspace Topology. **15 Lectures**

Unit II: Closed Sets , Closure and Interior of a Set, Limit Points, Hausdorff Spaces, Continuity of Functions, Homeomorphisms, The Product Topology, The Metric Topology. **15 Lectures**

Unit III: Connected Spaces, Connected Subspaces of the Real Line, Components and Local Connectedness, Compact Spaces, Compact Subspaces of the Real Line. **15 Lectures**

Unit IV: The Countability Axioms, The Separation Axioms, Normal Spaces, The Urysohn Lemma, The Urysohn Metrization Theorem (Only statement and its importance), The Tietze Extension Theorem (Only statement and its importance). **15 Lectures**

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Book:

1. J. R. Munkers, Topology, Second Edition, Pearson Education (Singapore), 2000.

Reference Books:

1. W. J. Pervin, Foundations of General Topology, Academic Press, New York, 1964.
2. J. L. Kelley, General Topology, Springer-Verlag, New York, 1955.
3. S. Willard, General Topology, Addison-Wesley Publishing Company, 1970.
4. K. D. Joshi, Introduction to General Topology, New Age International, 1983.
   G. F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Company, New Delhi, 1963.

M. Sc. Mathematics (Online Mode) (Part I) (Level-6.0) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2025-26)
Title of Course: Advanced Calculus
Total Credits: 04

Course Outcomes: Upon successful completion of this course, the student will be able to:
(i) Analyze convergence of sequences and series, double sequences and double series
(ii) Analyze convergence of sequences and series of functions
(iii) check differentiability of functions of several variables
(iv) Apply inverse and implicit function theorems for functions of several variables

Unit I : Sequences and series of functions: Pointwise convergence of sequences of functions, Examples of sequences of real valued functions, Definition of uniform convergence, Uniform convergence and continuity, Cauchy condition for uniform convergence, Uniform convergence and Riemann integration, Uniform convergence and differentiation

15 Lectures

Unit II: Rearrangement of series, subseries, Double sequences, Double series, rearrangement of double series, sufficient condition for equality of iterated series, multiplication of series, Cesaro summability, sufficient conditions for uniform convergence of series, uniform convergence and double sequences, mean convergence, Taylor series generated by a function, Bernstein's theorem, binomial series.

15 Lectures

Unit III: Multivariable differential Calculus: The Directional derivatives, directional derivatives and continuity, total derivative, total derivatives expressed in terms of partial derivatives, The matrix of linear function, mean value theorem for differentiable functions, A sufficient condition for differentiability, sufficient condition for equality of mixed partial derivatives, Taylor's formula for functions from R^n to R^1

15 Lectures

Unit IV: Implicit functions: Functions of several variables, Linear transformations, Differentiation, Contraction principle, The inverse function theorem, The implicit function theorem and their applications.

15 Lectures

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended books:

1. Mathematical Analysis, Apostal, Second Edition, Narosa Publishing House.1974

Reference books:

1. Principles of mathematical Analysis, Walter Rudin, third Edition, McGraw Hill book company
2. Calculus Vol. I , Vol II, Tom M. Apostol, Second EditionWiley India Pvt. Ltd.
3. W.Fleming, Functions of several Variables,2nd Edition ,Springer Verlag, 1977.

M. Sc. Mathematics (Online Mode) (Part I) (Level-6.0) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2025-26)
Title of Course: Numerical Analysis - II
Total Credits: 02

Course Outcomes: Upon successful completion of this course, the student will be able to:

1) apply the methods to solve linear and nonlinear equations.
2) find numerical integration and analyze error in computation.
3) solve differential equations using various numerical methods.
4) determine eigen values and eigen vectors of a square matrix.
5) construct LU decomposition of a square matrix.

Unit I: Interpolation, differentiation and integration: Lagrange and Newton interpolations, Truncation error bounds, Newtons divided difference interpolation, finite difference operators, numerical differentiation, methods based on interpolation, numerical integration, methods based on interpolation, error analysis, Newton-Cotes methods, Error estimates for trapezoidal and Simpson's rule.

15 Lectures

Unit II: Numerical solution of differential equations: Euler method, analysis of Euler method, Backward Euler method, mid-point method, order of a method, Taylor series method, Explicit Runge-Kutta methods of order two and four, convergence and stability of numerical methods, Truncation error, error analysis.

15 Lectures

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Books:

1. M. K. Jain, S. R. K. Iyengar, R. K. Jain, Numerical methods for scientific and Engineering Computation (Fifth Edition), New Age International Publishers 2007.

Reference Books:

1. S. S. Sastry, Introductory methods of Numerical Analysis (Fifth Edition), PHI learning Private Limited, New Delhi 2012.
2. D. Kincaid, W. Cheney, Numerical Analysis Mathematics of Scientific Computing (Third Edition), American Mathematical Society.
3. J.C. Butcher, Numerical methods for ordinary differential equations (Second Edition), John Wiley & Sons Ltd, 2008.
4. Kendall E. Atkinson, An Introduction to Numerical Analysis (Second Edition), John Wiley & Sons 1988.

M. Sc. Mathematics (Online Mode) (Part I) (Level-6.0) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2025-26)
Title of Course: Number Theory
Total Credits: 04

Course Outcome-: Upon successful completion of this course, the student will be able to:-

1. learn more advanced properties of primes and pseudo primes.
2. apply Mobius Inversion formula to number theoretic functions.
3. explore basic idea of cryptography.
4. understand concept of primitive roots and index of an integer relative to a given primitive root.
5. derive Quadratic reciprocity law and its apply to solve quadratic congruences.

Unit I: Review of divisibility: The division algorithm, G.C.D., Euclidean algorithm, Diophantine equation ax + by = c. Primes and their distribution : Fundamental theorem of Arithmetic, The Goldbach Conjecture. **15 Lectures**

Unit II : Congruences : Properties of Congruences, Linear congruences, Special divisibility tests. Fermat's theorem : Fermat's factorization method, Little theorem, Wilsons theorem. Number theoretic functions : The functions τ and σ. The Mobius Inversion formula, The greatest integer function. **15 Lectures**

Unit III: Euler's Generalization of Fermat's theorem: Euler's phi function, Euler's theorem, properties of phi function, An application to Cryptography. Primitive roots : The order of an integer modulo n. **15 Lectures**

Unit IV: Primitive roots for primes, composite numbers having primitive roots, The theory of Indices. The Quadratic reciprocity law: Eulerian criteria, the Legendre symbol and its properties, quadratic reciprocity, quadratic reciprocity with composite moduli .

15 Lectures

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Books :

1. D.M.Burton : Elementary Number Theory, Seventh Ed.MacGraw Hill Education(India)Edition 2012, Chennai.

Reference Books :

1. S.B.Malik :Baisc Number theory, Vikas publishing House.
2. George E.Andrews : Number Theory, Hindusthan Pub. Corp.(1972).
3. Niven, Zuckerman : An Introduction to Theory of Numbers. John Wiley & Sons.
4. S. G. Telang , Number Theory, Tata Mc.Graw-Hill Publishing Co., New Delhi.
5. M.B. Nathanson, Methods in Number Theory, Springer(2009).

M. Sc. Mathematics (Online Mode) (Part I) (Level-6.0)
(Semester II) (NEP-2020)
(Introduced from Academic Year 2025-26)
Title of Course: Quantitative techniques in operations Research
Total Credits: 04

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Decide policy for replacement.
2. Calculate economic lot size.
3. Derive Poisson distribution theorem and compute attributes of distribution model.
4. Identify optimal path by using CPM and PERT.

Unit I: Replacement Problems: Introduction, Failure mechanism of items, Replacement policy for items whose maintenance cost increases with time and money values is constant, Money value, Present worth factor and discount rate, Replacement policy for items whose maintenance cost increases with time and money values changes with constant rate, Individual replacement policy: Mortality theorem ,Group replacement policy. **15 lectures**

Unit – II : Inventory – Introduction, Cost involved in inventory problems, variables in inventory problem, symbols in inventory , concept of Economic Ordering Quantity(EOQ), The EOQ models without shortage:Model I (a) The economic lot size system with uniform demand. Model I (b) Economic lot size with different rates of demand in different cycles. Model I (c) Economic lot size with finite Rate of Replenishment. (EOQ production model),EOQ model with shortages: Model II(a) The EOQ with constant rate of demand, scheduling time constant, ModelII (c) The production lot size model with shortages. Probabilistic inventory Models, Instantaneous demand, no set up cost model Model VI(a) Discrete case Model VI(b) continuous case ,Problems on above models. **15 lectures**

Unit – III : Queuing Theory - Queuing systems , Queuing Problems: transient and steady states,A list of symbols, traffic intensity, Probability distributions in Queuing systems: Distribution of arrivals 'The Poisson process', Properties of Poisson process of arrivals, Distribution of inter-arrival times(Exponential process).Distribution of Departures(Pure death model), Analogy of exponential service time with Poisson Arrivals Model I : (M/M/I) : (/FCFS):Birth and Death model ,Solution of model, Examples on model I, Problems. **15 lectures**

Unit – IV: PERT / CPM : Applications of PERT /CPM techniques, Network diagram representation. Rules for constructing the Network diagram, Time estimates and critical path in network analysis, Examples on optimum duration and minimum duration cost, Problems 15 lectures

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Books:

1. S.D.Sharma : Operations Research Kedarnath and co. 1999

Reference Books:

1. Hamdy Taha : Operations Research, Macmillan and Co.
2. J.K. Sharma : Operations Research, Macmillan India Ltd. 1999.
3. R.K.Gupta : Operations researcTime estimates h, Krishna Prakashan Mandir, 1999

M.Sc. Mathematics (Distance Mode) (Part I) (Level-6.5) (SemesterII) (NEP-2020)
(Introduced from Academic Year 2025-26)
Title of Course: On job Training / Field project
Total Credits: 04

M.Sc. Mathematics (Distance Mode) (Part II) (Level-6.5) (SemesterIII) (NEP-2020)
(Introduced from Academic Year 2026-27)
Title of Course: Functional Analysis
Total Credits: 04

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. understand the fundamental topics, principles and methods of functional analysis.
2. demonstrate the knowledge of normed spaces, Banach spaces, Hilbert space.
3. define continuous linear transformations between linear spaces, bounded linear functionals.
4. apply finite dimensional spectral theorem.
5. identify normal, self adjoint, unitary, normal operators.

UNIT– I : Normed linear spaces, Banach spaces, quotient spaces, continuous linear transformations, equivalent norms, finite dimensional normed spaces and properties, conjugate space and separability, The Hahn-Banach theorem and its consequences**.**

15 Lectures

UNIT –II: Second conjugate space, the natural embedding of the normed linear space in its second conjugate space, reflexivity of normed spaces, the open mapping theorem, projection on Banach space, the closed graph theorem, the conjugate of an operator, the uniform boundedness principle. **15 Lectures**

UNIT –III: Hilbert spaces: examples and elementary properties, orthogonal complements, the projection theorem, orthogonal sets, the Bessel's inequality, Fourier expansion and Perseval's equation, separable Hilbert spaces, the conjugate of Hilbert space, Riesz's theorem, the adjoint of an operator. **15 Lectures**

UNIT – IV: Self adjoint operators, normal and unitary operators, projections, eigen values and eigenvectors of an operator on a Hilbert space, the determinants and spectrum of an operator, the spectral theorem on a finite dimensional Hilbert space. **15 Lectures**

Recommended Book(s):

G. F. Simmons, Introduction to Topology and Modern Analysis, Tata McGraw Hill, 1963.

Reference Books:

1. Erwin Kreyszig, Introductory Functional Analysis with Applications, John Wiley and Sons, 1978.

2. A. E. Taylor, Introduction to Functional analysis, John Wiley and sons,1958.
3. J. B. Convey, A course in Functional Analysis, Springer-Verlag, 1985.
4. G. Bachman and L. Narici, Functional Analysis, Academic Press, 1972.
5. B. V. Limaye, Functioned Analysis, New age international, 1996.

M.Sc. Mathematics (Distance Mode) (Part II) (Level-6.5) (SemesterIII) (NEP-2020) (Introduced from Academic Year 2026-27)

Title of Course: COMPLEX ANALYSIS
Total Credits: 04

Course outcomes: to enable the student to

1. understand fundamental concepts of complex analysis.
2. identify analytic functions, Conformal maps.
3. construct Taylor and Laurent series.
4. classify singularity and apply Residue Theorem to evaluate real integrals.
5. enjoy the beauty of analytic functions and related concepts.

Unit 1: Power series, Radius of convergence, analytic functions, Cauchy-Riemann equations, Harmonic functions, Conformal mappings, Mobius Transformations, line integral. **15 Lectures**

Unit 2: Power series representation of analytic functions, zeros of an analytic function, Liouville's Theorem, Fundamental theorem of algebra, maximum modulus theorem, the index of a closed curve, Cauchy's theorem and integral formula, Morera's Theorem. **15 Lectures**

Unit 3: Counting zeros, open Mapping theorem, Goursat's Theorem, classification of singularities, Laurent series development, Casorati–Weierstrass theorem, residues, residue theorem, evaluation of real integrals. **15 Lectures**

Unit 4: The argument principle, Rouche's theorem, the maximum principle, Schwarz's lemma and its application to characterize conformal maps, Riemann mapping theorem. **15 Lectures**

Recommended Book :

1. J. B. Conway: Functions of One Complex Variable (3rd Edition) Narosa Publishing House.

References :

1. S.Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House.
2. Alfors L. V.: Complex Analysis, McGraw 1979.
3. Churchill and Brown, Complex Variables and applications, MacGrawHill(India). (8^{th} Edition, 2014)
4. Serge Lang, Complex Analysis, Springer
5. Steven G. Krantz, Complex Analysis, A Geometric view Point, The Carus Mathematical Monographs.
6. T. W. Gamelin, Complex Analysis, Springer.

M.Sc. Mathematics (Distance Mode) (Part II) (Level-6.5) (SemesterIII) (NEP-2020)
(Introduced from Academic Year 2026-27)

Title of Course: CLASSICAL MECHANICS
Total Credits: 04

Course outcomes: to enable the student to

1. discuss the motion of system of particles using Lagrangian and Hamiltonian approach.
2. solve extremization problems using variational calculus.
3. discuss the motion of rigid body.
4. construct Hamiltonian using Routh process.use infinitesimal and finite rotations to analyze motion of rigid body.

UNIT – I: Mechanics of a particle, Mechanics of a system of particles, conservation theorems, constraints, Generalized coordinates, D' Alembert's Principle, Lagrange's equations of motion, Simple applications of Lagrangian formulation, Cyclic co-ordinates and generalised momentum, conservation theorems. **15 Lectures**

UNIT – II: Functionals, basic lemma in calculus of variations, Euler- Lagrange's equations, first integrals of Euler- Lagrange's equations, Geodesics in a plane and space, the minimum surface of revolution, the case of several dependent variables . **15 Lectures** Undetermined end conditions, the problem of Brachistochrone, Isoperimetric problems, problem of maximum enclosed area.Hamilton's Principle, Derivation of Hamilton's principle from D'Alembert's principle, Lagrange's equations from Hamilton's principle. Lagrange's equations of motion for nonconservative systems (Method of Langrange's undetermined multipliers)

UNIT – III: Hamiltonian function, Hamilton's canonical equations of motion, cyclic co-ordinates and Routh's procedure, Derivation of Hamilton's equations from variational principle, Physical significance of Hamiltonian, The principle of least action.Orthogonal transformations, Properties of transformation matrix, infinitesimal rotations. **15 Lectures**

UNIT – IV: The Kinematics of rigid body motion: The independent co-ordinates of a rigid body, the Eulerian angles, Euler's theorem on motion of rigid body, Angular momentum and kinetic energy of a rigid body with one point fixed, the inertia tensor and moment of inertia, Euler's equations of motion, Cayley- Klein parameters, Matrix of transformation in Cayley- Klein parameters, Relations between Eulerian angles and Cayley- Klein parameters. **15 Lectures**

Recommended Books :

1) Goldstein, H. Classical Mechanics. (1980), Narosa Publishing House, New Delhi.
2) Weinstock: Calculus of Variations with Applications to Physics and Engineering (International Series in Pure and Applied Mathematics). (1952), Mc Graw Hill Book Company, New York. **Reference Books :-** 1) Whittaker, E. T. A Treatise on the Analytical Dynamics ofParticles and Rigid Bodies. (1965), Cambridge University Press.
3) Gupta, A. S. Calculus of Variations with Applications (1997), Prentice Hall of India.
4) Gelfand, I. M. and Fomin, S. V. Calculus of Variations (1963), Prentice Hall of India. Rana, N.C. and Joag, P. S. Classical Mechanics. (1991) Tata McGraw Hill, New Delhi

M.Sc. Mathematics (Distance Mode) (Part II) (Level-6.5) (SemesterIII) (NEP-2020)
(Introduced from Academic Year 2026-27)

Title of Course: Advanced Discrete Mathematics
Total Credits: 02

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. classify the graphs and apply to real world problems.
2. simplify the graphs using matrix.
3. simplify the Boolean identities and apply to switching circuits.
4. learn applications of discrete mathematics including lattices and Boolean Algebra.

UNIT– I : Graph: Definition, examples, isomorphism, simple graph, bipartite graph, complete bipartite graph, vertex degrees, regular graph, sub-graphs, complement of a graph, self complementary graph, paths and cycles in a graph, the matrix representation of a graph.Definition and simple properties of a tree, Bridges**. 15 Lectures**

UNIT –II: Posets: Definition, examples, Hasse diagrams of posets, supremum and infimum, isomorphic ordered sets, duality. Lattices: Definition, examples, sublattices. Ideals: Definition, examples, bounded lattices, distributive lattices, modular lattices, complemented lattices, Boolean algebra, basic definitions, basic theorems, Boolean algebras as lattices, CNF, DNF,applications of Boolean algebra to switching circuit**. 15 Lectures**

Recommended Book(s):

1. John Clark and Derek Holton, A first look at Graph Theory, Allied Publishers Ltd., 1991.
2. G. Gratzer, General Lattice Theory, Birkhauser, 2002.
3. J. Eldon Whitesitt, Boolean Algebra and Its Applications, Addison-Wesley Publishing Company, Inc.,1961**.**

Reference Books:

1. Seymon Lipschutz and Mark Lipson, Discrete Mathematics (second edition) Tata Mc Graw Hill Publishing Company Ltd. New Delhi.
2. Garrett Birkhoff: Lattice Theory, American mathematical society, 1940

M.Sc. Mathematics (Distance Mode) (Part II) (Level-6.5) (SemesterIII) (NEP-2020)
(Introduced from Academic Year 2026-27)

Title of Course: FUZZY SET THEORY

Total Credits: 04

Course outcomes: to enable the student to Course Outcomes-:-

1. acquire the knowledge of notion of crisp sets and fuzzy sets,
2. understand the basic concepts of crisp set and fuzzy set,
3. develop the skill of operation on fuzzy sets and fuzzy arithmetic,
4. demonstrate the techniques of fuzzy sets and fuzzy numbers.
5. apply the notion of fuzzy set, fuzzy number in various problems.

Unit I: Fuzzy sets and crisp sets, examples of fuzzy sets, types of fuzzy sets, standard operations, cardinality, degree of subset hood, level cuts and its properties, **r**epresentation of fuzzy sets, decomposition theorems, extension principle, properties of direct and inverse images of fuzzy sets. **15 Lectures**

Unit II: Operations on fuzzy sets, types of operations, fuzzy complement, equilibrium and dual point, Increasing and decreasing generators, fuzzy intersection: t-norms. **15 Lectures**

Unit III: Fuzzy union t-conorms, characterization theorem of t-conorm, combination of operators, aggregation operations, ordered weighted averaging operations. **15 Lectures**

Unit IV: Fuzzy numbers, characterization theorem, linguistic variables, arithmetic operations on intervals, arithmetic operations on fuzzy numbers, lattice of fuzzy numbers, fuzzy equations. **15 Lectures**

Unit V: Examples, seminars, group discussions on above four units. **15 Lectures**

Recommended Books:

1. George J. Klir, Bo Yuan, Fuzzy sets and Fuzzy Logic. Theory and Applications, PHI, Ltd.2000

Reference Books:-

1. M.Grabish, Sugeno, and Murofushi Fuzzy Measures and Integrals: Theory and Applications,PHI, 1999.
2. H.J.Zimmerermann, Fuzzy Set Theory and its Applications, Kluwer, 1984.
3. M. Hanss, Applied Fuzzy Arithmetic, An Introduction with EngineeringApplications, Springer- Verlag Berlin Heidelberg 2005.
4. M. Ganesh, Introduction to Fuzzy Sets & Fuzzy Logic; PHI Learning Private Limited, New Delhi 2011.

Bojadev and M. Bojadev, Fuzzy Logic and Application, World Scientific Publication Pvt.Ltd.
2007.

M.Sc. Mathematics (Distance Mode) (Part II) (Level-6.5) (SemesterIII) (NEP-2020)
(Introduced from Academic Year 2026-27)
Title of Course: FLUID DYNAMICS

Total Credits: 04

Course outcomes: to enable the student to Course Outcomes-:-

1) explain physical properties of fluids.
2) represent general motion of fluid element.
3) test possible fluid flows, classify rotational and irrotational fluid flows .
4) transform stress components from one co-ordinate system to another, establish relation between strain and stress tensor..
5) develop constitutive equations for Newtonian fluids, conservation laws and Navier-Stokes equation.
6) determine the complex potential and images of a two dimensional source, sink and doublet.

Unit I: Physical properties of fluids and kinematics of fluids: Concepts of fluids, continuum hypothesis, density, specific weight, specific volume, pressure, viscosity, surface tension, Eulerion & Lagrangian methods of description of fluids, Equivalence in Eulerian and Lagrangian methods, General motion of a fluid element, Integrability and compatibility conditions, general orthogonal curvilinear co-ordinate system, stream lines, path lines, streak lines, stream function, vortex lines, circulation, condition at rigid boundary. **15 Lectures**

Unit II: Stresses in fluids: Strain rate tensor, stress tensor, normal stress, shearing stress, symmetry of stress tensor, Transformation of stress components from one co-ordinate system to another, principle axes and principle values of stress tensor. Newtonian fluids, non Newtonian fluids, purely viscous fluids, Constitutive equations for Newtonian fluids. **15 Lectures**

Unit III. Conservation laws: Equation of conservation of mass, equation of conservation of momentum, Navier-Stokes equation, equation of moment of momentum, Equation of energy, Basic equations in different co-ordinate systems: Cartesian co-ordinate system, Cylindrical co-ordinate system, Spherical co-ordinate system, boundary conditions. **15 Lectures**

Unit IV. Rotational and irrotational flows: Theorems about rotational and irrotational flows: Kelvins minimum energy theorem, Kinetic energy of finite and an infinite fluid, uniqueness of irrotational flows, Bernoullis's equation, Bernoullis equation for irrotational flows, Two dimensional irrotational incompressible flows, Blasius theorem, circle theorem, Sources and sinks, sources, sinks and doublets in two dimensional flows, Methods of images. **15 Lectures**

Recommended Books:

a. R. K. Rathy, An introduction to Fluid Dynamics, Oxford & IBH publishing company.
b. F. Chorlton, Text book of Fluid Dynamics, CHS Publishers, Delhi, 1985.

Reference Books:

1. L. D. Landay and E. M. Lipschitz, Fluid Mechanics, Pergamon Press London 1985.
2. Kundu and Cohen, Fluid Mechanics, Elsevier pub. 2004.
3. L M Milne-Thomson, Theoretical Hydrodynamics, Macmillan Education Ltd, London 1986.

M.Sc. Mathematics (Distance Mode) (Part II) (Level-6.5) (SemesterIII) (NEP-2020)
(Introduced from Academic Year 2026-27)

Title of Course: Research Project

Total Credits: 04

M.Sc. Mathematics (Distance Mode) (Part II) (Level-6.5) (Semester IV) (NEP-2020)
(Introduced from Academic Year 2026-27)

Title of Course: INTEGRAL EQUATIONS

Total Credits: 04

Course outcomes: to enable the student to Course Outcomes-:-

1. classify the linear integral equations and demonstrate the techniques of converting the initial and boundary value problem to integral equations and vice versa.
2. develop the technique to solve the Fredholm integral equations with separable kernel.
3. develop and demonstrate the technique of solving integral equations by successive approximations, using Laplace and Fourier transforms
4. to analyze the properties of symmetric kernel.
5. toprove Hilbert Schmidt Theorem and solve the integral equation by applying it.

UNIT– I Classification of linear integral equations, conversion of initial value problem to Volterra integral equation, conversion of boundary value problem to Fredholm integral equation, separable kernel, Fredholm integral equation with separable kernel, Fredholm alternative. Homogeneous Fredholm equations and eigen functions.
15 Lectures

UNIT –II Solutions of Fredholm integral equations by: Successive approximations method, successive substitution method, Adomian decomposition method, modified decomposition method, resolvent kernel of Fredholm equations and its properties, solutions of Volterra integral equations, successive approximations method, Neumann series, successive substitution method. **15 Lectures**

UNIT –III Solution of Volterra integral equations by Adomian decomposition method and the modified decomposition method, resolvent kernel of Volterra equations and its properties, convolution type kernels, applications of Laplace and Fourier transforms to solutions of Volterra integral equations, symmetric kernels**,** fundamental properties of eigen values and eigen functions for symmetric kernels, expansion in eigen functions and bilinear form. **15 Lectures**

UNIT – IV Hilbert Schmidt Theorem and its consequences, solution of symmetric integral equations, operator method in the theory of integral equations, solution of Volterra and Fredholm integro-differential equations by Adomian decomposition method. Green's function: Definition, construction of Green's function and its use in solving boundary value problems. **15 Lectures**

Recommended Books:

1. R. P. Kanwal, Linear Integral Equation: Theory and Technique, Birkhauser 2012.
2. Abdul-Majid Wazwaz, Linear and Nonlinear Integral Equations-Methods and Applications, Springer, 2011

Reference Books:

1. L. G. Chambers, Integral Equations- A Short Course, International Text Book Company, 1976.
2. M. A, Krasnov, et.al. Problems and exercises in Integral equations, Mir Publishers, 1971.
3. J. A. Cochran, The Analysis of Linear Integral Equations, Mc Graw Hill Publications, 1972.
4. C. D. Green, Integral Equation Methods, Thomas Nelson and sons, 1969.

M.Sc. Mathematics (Distance Mode) (Part II) (Level-6.5) (Semester IV) (NEP-2020)
(Introduced from Academic Year 2026-27)

Title of Course: FIELD THEORY

Total Credits: 04

Course outcomes: to enable the student to

1) determine the basis and degree of a field over its subfield.
2) construct splitting field for the given polynomial over the given field.
3) find primitive n^{th} roots of unity and n^{th}cyclotomic polynomial.
4) make use of Fundamental Theorem of Galois Theory and Fundamental Theorem of Algebra to solve problems in Algebra.
5) apply Galois Theory to constructions with straight edge and compass.

UNIT-I: Algebraic Extensions of fields Adjunction of roots, Algebraic extensions, Algebraically closed fields. **15 Lectures**

UNIT-II: Normal and Seperable extensions Splitting fields, Normal extensions, Multiple roots, Finite fields, Separable extensions. **15 Lectures**

UNIT-III: Galois Theory Automorphism groups and fixed fields, Fundamental theorem of Galois theory, Fundamental theorem of algebra, Roots of unity and cyclotomic polynomials, Cyclic extensions. **15 Lectures**

UNIT-IV: Applications of Galois theory Polynomials solvable by radicals, Symmetric functions, Constructions by ruler and compass. **15 Lectures**

Recommended Book(s):

1. Bhattacharya, Jain and Nagpal, Basic Abstract Algebra, 2nd edition, Cambridge University Press, UK.(Asian edition) 2005.

Reference Books:

1.Nathan Jacobson, Basic Algebra I, second edition, W. H. Freeman and company, New York

2.I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd.

3.U. M. Swamy, A. V. S. N. Murthy, Algebra: Abstract and Modern, Pearson Education, 2012

4.John Fraleigh, A first course in Abstract Algebra (3rd edition) Narosa publishing house, New Delhi

5.I. T. Adamson, Introduction to Field Theory, second edition, Cambridge University Press,1982.

6.M. Artin, Algebra, PHI, 1996.Ian Stewart, Galois Theory, CRC Publication.

M.Sc. Mathematics (Distance Mode) (Part II) (Level-6.5) (Semester IV) (NEP-2020)
(Introduced from Academic Year 2026-27)

Title of Course: PARTIAL DIFFERENTIAL EQUATION

Total Credits: 04

Course outcomes: to enable the student to

1. classify partial differential equations and transform into canonical form
2. solve linear partial differential equations of both first and second order.
3. solve boundary value problems for Laplace's equation, the heat equation, the wave equation by separation of variables, in Cartesian, polar, spherical and cylindrical coordinates.
4. apply method of characteristics to find the integral surface of a quasi linear partial differential equations.
5. establish uniqueness of solutions of partial differential equations.

Unit I:

Curves and surfaces, First order Partial Differential Equations, classification of firstorder partial differential equations, classifications of Integrals, Linear equations of first order. Pfaffian differential equations, Criteria of Integrability of a Pfaffian differential equation.Compatible systems of first order partial differential equations. **15 Lectures**

Unit II:

Charpits method, Jacobi method of solving partial differential equations, Cauchy Problem, Integral surfaces through a given curve for a linear partial differential equations, for a non- linear partial differential equations. Method of characteristics to find the integral surface of a quasi linear partial differential equations. **15 Lectures**

Unit III:

Second order Partial Differential Equations. Origin of Partial differential equation,wave equations, Heat equation. Classification of second order partial differential equation, Vibration of an infinite string (both ends are not fixed), Physical Meaning of the solution of thewave equation. Vibration of an semi infinite string, Vibration of a string of finite length, Methodof separation of variables, Uniqueness of solution of wave equation. Heat conduction Problemswith finite rod and infinite rod.

15 Lectures

Unit IV:

Families to equipotential surfaces, Laplace equation, Solution of Laplace equation,Laplace equation in polar form, Laplace equation in spherical polar coordinates.Kelvin'sinversion theorem. Boundary Value Problems: Dirichlets problems and Neumann problems, Maximum and minimum principles, Stability theorem. Dirichlet Problems and Neumann problems for a circle, for a rectangle and for a upper half plane, Duhamel's Principle. **15 Lectures**

Recommended Book:

1. **T. Amarnath**: An Elementary Course in Partial Differential Equations, 2nd edition, Narosa publishing House(2012).

Reference Books:

1. Mark Pinsky: Partial Differential Equations and Boundary-value Problems with Ppplications, AMS,3rd edition(2011).
2. I. N. Sneddon: Elements of Partial Differential Equations, McGraw Hill Int.
3. Fritz John: Partial Differential Equations, Springer(1952).

M.Sc. Mathematics (Distance Mode) (Part II) (Level-6.5) (Semester IV) (NEP-2020)
(Introduced from Academic Year 2026-27)
Title of Course: FUZZY RELATIONS & LOGIC
Total Credits: 04

Course outcomes: to enable the student to Course Outcomes-:-

1. acquire the concept of fuzzy relations.
2. understand the basic concepts of fuzzy logic and fuzzy algebra.
3. develop the skills of solving fuzzy relation equations.
4. construct approximate solutions of fuzzy relation equations. 5.solve problems in Engineering and medicine.

Unit I

Projections and cylindrical extensions, binary fuzzy relations on single set, fuzzy equivalence relations, fuzzy compatibility relations, fuzzy ordering relations, fuzzy morphisms sup-i composition and inf-wi composition. **15 Lectures**

Unit II

Fuzzy relation equations, problem partitioning, solution methods, fuzzy relational equations based on sup-i and inf-wi compositions, approximate solutions. **15 Lectures**

Unit III

Fuzzy propositions, fuzzy quantifiers, linguistic hedges, inference from conditional fuzzy propositions, qualified and quantified propositions. **15 Lectures**

Unit IV

Fuzzy algebra, fuzzy groups and fuzzy rings and their basic properties . **15 Lectures**

Recommended Books:

1. George J Klir, Bo Yuan, Fuzzy Sets and Fuzzy Logic. Theory and applications,PHI.Ltd. (2000)
2. John Mordeson, Fuzzy Mathematics,Springer,2001

Reference Books:

1.M.Grabish, Sugeno, and Murofushi, Fuzzy Measures and Integrals: Theory and Applications PHI, 1999.
2. H.J.Zimmerermann, Fuzzy set :Theory and its Applications, Kluwer, 1984.
3. M. Ganesh, Introduction to Fuzzy sets & Fuzzy Logic; PHI Learning Private Limited, New Delhi. 2011.

.M.Sc. Mathematics (Distance Mode) (Part II) (Level-6.5) (Semester IV) (NEP-2020)
(Introduced from Academic Year 2026-27)
Title of Course: COMPUTATIONAL FLUID DYNAMICS
Total Credits: 04

1. **Course outcomes: to enable the student to Course Outcomes-:-**
2. classify partial differential equations (PDEs) mathematically and physically.
3. apply separation of variables method for solving initial boundary value problems.
4. construct forward, backward and centered difference formulae.
5. test stability, convergence & consistency of finite difference schemes.
6. solve problems in CFD using computer software.

Unit I

Comparison of experimental, theoretical and numerical approaches, governing equations, continuity equation, momentum equation (inviscid, viscous flows) energy equation, incompressible viscous flow, laminar boundary layer flow. Introduction of Scilab to solve problems in CFD. **15 Lectures**

Unit II Nature of a well posed problems, physical classification and mathematical classification of partial differential equations: hyperbolic, parabolic, elliptic partial differential equations (PDEs). Conversion of PDE to canonical form. Traditional solution method: separation of variables. Transformation relationships, evaluation of transformation parameters. Forward, backward, centered difference formulae, generalized co-ordinates structure of first and second order PDE. **15 Lectures**

UNIT –III:

Stability, convergence and consistency of finite difference scheme, Explicit, Implicit and Crank- Nicolson methods for heat equation, Von Neumann analysis, Euler's explicit method, upstream differencing method, Lax method, Euler implicit method for wave equation. Finite difference representation of Laplace equation, five point method. Problem solving by Scilab: codes of explicit methods for heat and wave equations and five point method for Laplace equation. **15 Lectures**

UNIT – IV:

Finite difference schemes for Burgers equation (inviscid): Lax method, implicit methods. Finite difference schemes for Burgers equation (viscous): FTCS method, Briley – Mc Donald method. Convergence and stability, grid generation, orthogonal gird generation, order of magnitude analysis, reduced Navier-Stokes equations, boundary layer flow. **15 Lectures**

Recommended Book(s):

1. Dale A Anderson, John Tannelhill, R. H. Fletcher, Computational Fluid Mechanics and Heat Transfer, Hemisphere publishing corporation, 1984.
2. G D Smith, Numerical Solution of Partial Differential Equations: Finite Difference Methods, Oxford Applied Mathematics and Computing Science Series, Oxford University Press, 1985.
3. C. A.J. Fletcher, Computational Techniques for Fluid Dynamics Vol. I & II, Springer Verlag Berlin Heidelberg, 1988.

Reference Books:

1. T J Chung, Computational Fluid Dynamics, Cambridge University Press, 2002.

M. Sc. Mathematics (Distance Mode) (Part II) (Level-6.5) (Semester IV) (NEP-2020)
(Introduced from Academic Year 2024-25)
Title of Course: Research Project
Total Credits: 06

F. Scheme of Teaching

1) Synchronous session as per the scheduled of Online education Shivaji University, Kolhapur.
2) e-Content videos.
3) Discussion Forum

G. Examination Pattern

Theory:

- **For 4 credit course:**
  University examinations shall be of 80 marks and internal examination of 20 marks
- **For 2 credit course:**
  University examinations shall be of 40 marks and internal examination of 10 marks

Practical:

Practical evaluation shall be through university appointed panel of one external and one internal examiner.

On Job Training/Field Project:

Assessment criteria of OJT/FP shall be based on final report, presentation and oral examination.

1. Student has to submit final report based on the work carried out during OJT/FP.
2. Student has to make a presentation of the work carried out during OJT/FP in front of examiner panel.
3. Student has to give midterm presentation of the work carried out during OJT/FP.

Research Project:

- **For 4 credit course:**

Assessment criteria of research project shall be based on final report/ dissertation, presentation and oral examinations. University examinations shall be of 80 marks and internal examination of 20 marks.

1. Project viva by university appointed external and internal examiners.
2. Internal evaluation will be carried out by internal guide.

- **For 6 credit course:**

Assessment criteria of research project shall be based on final report/ dissertation, presentation and oral examinations. University examinations shall be of 100 marks and internal examination of 50 marks.

1. Project viva by university appointed external and internal examiners.
2. Internal evaluation will be carried out by internal guide.

Research Methodology:

University examinations shall be of 80 marks and internal examination of 20 marks.

H. Nature of Question Paper and Scheme of Marking: Theory:

(I) Nature of the Theory Question Papers for courses of 4 credits:

1. There shall be 7questions each carrying 16 marks.
2. Question No.1 is compulsory. It consists of objective type questions.
3. Students have to attempt any four questions from Question No.2 to Question No.7.
4. Question No. 2 to Question No.7 shall consist of short/descriptive-answer type sub-questions.
5. Duration of university theory examination of 80 marks shall be of 3 hours.

(II) Nature of the Theory Question Papers for courses of 2 credits:

1. There shall be 4 questions.
2. Question No.1 is compulsory of objective type questions carrying 8 marks.
3. Students have to attempt any two questions from Question No.2 to Question No.4. Each question carries 16 marks.
4. Duration of university theory examination of 40 marks shall be of 2 hours.

Practical:

University examinations shall be of 80 marks and internal examination of 20 marks.

1) Duration of Practical Examination shall be of 3 hours.
2) There shall be three questions out of which any two questions to be attempted and each question carries 25 Marks.
3) The final practical examination shall be conducted by the university appointed examiners (External and internal). The pattern of final Practical Examination shall be as follows:

1	Coding and Execution of Program	50 Marks
2	Viva-voce	20 Marks
3	Journal	10 Marks
4	Total	80 Marks

The practical examination will be conducted semester wise in order to maintain the relevance of the respective theory course with laboratory course.

I. Procedure for Admissions, Curriculum Transaction and Evaluation:

Admissions:

Eligibility:

i) Any candidate who has successfully completed B. Sc. with a principal subject Mathematics or with a subsidiary subject Mathematics of this University or of any other statutory University recognized by UGC, New Delhi.

OR

ii) Any candidate who has successfully completed the Bachelor's degree with Mathematics courses at Second Year of Bachelor's degree of this University or of any other statutory University recognized by UGC, New Delhi.

OR

iii) Any candidate who has successfully completed level 5.5 with major or minor subject as Mathematics of this University or of any other statutory University recognized by UGC, New Delhi.

Eligibility for level 6.5:

i) Any candidate who has successfully completed Post Graduate Diploma (Level 6.0) in Mathematics of this University or of any other statutory University recognized by UGC, New Delhi.

OR

ii) Any candidate who has successfully completed Bachelor's Degree (Honours / Honours with Research) (Level 6.0) with principal / major subject Mathematics of this University or of any other statutory University recognized by UGC, New Delhi.

OR

iii) Completed all requirements of the relevant Post Graduate Diploma (Level 6.0) in Mathematics.

J. Intake: No limit

K. Documents Required for the Admission:

- Color scan copy of SSC, HSC and Graduation mark sheets.
- Caste Certificate (If applicable).
- Two identity card size photographs along with its scan copy of 09 KB and Scan signature of the student 09KB.
- TC/MC (whichever applicable). In case of TC/MC is not available at the time of admission student will get provisional admission. Grace period of 30 days will be given to submit the original TC/MC otherwise provisional admission gets cancelled no fee will be refunded.

L. Curriculum Transaction:

Web-based Tools:

- **e-Books**
- **PDFs**
- **Video Lectures (Synchronous and Asynchronous Type)**
- **OERs as per Need of Programme etc.**

M. Academic Calendar:

Part- I		
Sr. No.	**Programme Events**	**Months**
A.	Admission Process	15th June, 2025 to 30th June, 2025
B.	Induction Programme	1st July, 2025 to 15th July, 2025
C.	Dissemination of Course Contents and Internal Evaluation (Semester-I)	16th July, 2025 to 15th November, 2025
D.	Semester - I Examination	20th November, 2025 to 30th November, 2025
E.	Introductory Session (Semester-II)	10th December, 2025 to 15th December, 2025
F.	Dissemination of Course Contents and Internal Evaluation (Semester-II)	16th December, 2025 to 15th April, 2026
G.	Semester – II Examination	16th April,2026 to 30th April,2026

N. Programme Fees:

M.Sc. Mathematics through Online Mode Programme fees; learners have to pay through Internet Banking, Credit Card/ Debit Card (RuPay/Visa/MasterCard/Maestro), Internet Banking, IMPS, Cash Cards/ Mobile Wallets (additional service charges, as per rules, shall be applicable in addition to the application form processing fees). This fee is non-refundable and non-transferable under any circumstances.

₹ 30,000 /- (Excluding exam and other fees)
For 1 year

O. Requirement of the laboratory support and Library Resources:

a. Requirement of the Laboratory Support:

Nil

b. Requirement of Library Resources:

e-Books, e-journals, Online Subscriptions of Digital Books/ Library etc.

P. Cost estimate of the programme and the provisions:

Sr.	Particulars	Description	Amounts
1	e- Tutorial (Videos / Audios / Presentation, etc.) Required Videos = 864 Videos Required Minutes = 8640	For 10.00 Minutes Video Including Transcript and PPT approved rate is as Rs. 2,000/-	17,28,000/-
2	Development of Question Banks Total 48 Question bank sets * Rs. 500/-	Question paper set comprising of Case studies, Short/Long Answer, MCQs etc.	24,000/-
3	e-Content (SLMs/e-books/manual/Handbooks etc.)	For Unit Writing, Editing, DTP and allied activities	Nil
4	Discussion Forum/ Live Sessions	4 Live Sessions of each course	Nil
5	Employees Salary 1 Programme Co-Ordinator * 36,000/- 4 course Co-Ordinators * 36,000/- 1 mentor * 36,000/-	For Coordinating and Live Sessions	23,76,000/-
6	Digital Marketing	Rs. 3,00,000/- for 3 Months / 3 online courses	1,00,000/-
7	Advertising in Newspaper	Rs. 2,00,000/- / 3 online courses	67,000/-
8	Premiere Pro License	Rs. 80,000/- / 3 online courses	27,000/-
9	Learning Management System (LMS)	Rs. 25,00,000/- / 3 online courses	8,40,000/-
10	Personal Computers	Rs. 60,000/- * 06 Employees	3,60,000/-
	Miscellaneous Expenses		1,50,000/-
		Total Cost	**56,72,000/-**

Q. Quality assurance mechanism and expected programme outcomes:

After completion of M.Sc. (Mathematics) programme, distance learner can able to,

1) Solve any mathematical problem by properly applying mathematical principles.
2) Apply their knowledge in their current profession.
3) Make their careers in analysis of mathematical data in government and non-government organization.
4) Undertake research activity of new simplex methods in Mathematics.

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