Department of Mathematics
Faculty of Sciences, Jamia Millia Islamia

U. G. Minor Papers in Mathematics
(2024-25)
Course Structure and Syllabus

Semester	Code	Title of the Paper	Credit
I	24MATM101	Basic Calculus	4

Semester	Code	Title of the Paper	Credit
II	24MATM151	Ordinary Differential Equations	4

Semester	Code	Title of the Paper	Credit
III	24MATM201	Basic Linear Algebra	4

Semester	Code	Title of the Paper	Credit
IV	24MATM251	Mathematical Statistics	4

24MATM101	**Basic Calculus**
Unit-I	Function, limit of a function, algebra of limits. Continuity and Differentiability of a function, Successive differentiation, Leibnitz theorem, Rolle's Theorem, Mean value theorems (without proof).
Unit-II	Taylor's and McLaurin's series, Maxima and minima of a function of one variable, Indeterminate form, Curvature; Cartesian, polar and parametric formulae for radius of curvature.
Unit-III	Partial derivatives, applications of partial derivatives, Euler's theorem on homogeneous functions, Asymptotes, Test of concavity and convexity, Points of inflexion, multiple points. Tracing of curves in Cartesian and polar coordinates.
Unit-IV	Integral of irrational and trigonometric functions, properties of definite integrals, Reduction formulae, Quadrature, Rectification, Volumes and surfaces of solids of revolution.

Books Recommended

1. Howard Anton, Calculus, John Wiely & Sons, 2012.
2. George B. Thomas, Ross L. Finney, Calculus 11Ed., Pearson Education, 2008.
3. Gorakh Prasad: *Differential Calculus*, Pothishalas Pvt Ltd, Allahabad.
4. Shanti Narayan: *Differential Calculus*, S. Chand & Co.
5. Shanti Narayan: *Integral Calculus*, S. Chand & Co.
6. Khalil Ahmad: *Text Book of Calculus*, World Education Publishers, 2012.

24MATM151	**Ordinary Differential Equations**
Unit-I	Formulation of differential equations, Order and degree of a differential equation, Equations of first order and first degree, Method of separation of variables, Homogeneous equations, Linear equations, Bernoulli equations, Exact differential equations.
Unit-II	Equations of the first order and higher degree, Equations solvable for p, y and x, Clairaut's & Lagrange's equations, Orthogonal trajectories. Applications of first order differential equations to electric circuits and growth/decay models.
Unit-III	Linear differential equations of 2^{nd} order with constant coefficient, Method of auxiliary equation, Complementary function and particular integral. Operator method for finding particular integral for functions of the form e^x, $\sin ax$, $\cos ax$, x^m and $e^{\alpha x}V(x)$, Euler-Cauchy equations.
Unit-IV	Linear differential equations of second order, Complete solution in terms of a known integral belonging to the complementary function, Method of order reduction (Normal form), Solution using change of independent variable, Method of undetermined coefficients, Method of variation of parameters.

Books Recommended

1. Dennis G. Zill: *A First Course in Differential Equations with Modelling Applications,* Cengage Learning; 11th Edition, 2019.
2. G.F. Simmons: Differential Equations with Applications and Historical Notes, 3rd edition, CRC press, Taylor & Francis, 2017.
3. S. L. Ross: *Differential equations*, John Wiley and Sons, 2004.
4. Zafar Ahsan: *Textbook of Differential Equations and their Applications*, 2nd Edition, Prentice Hall of India, 2012.
5. Khalil Ahmad: *Textbook of Differential Equations*, World Education Publishers, 2012.

24MATM201	**Basic Linear Algebra**
Unit-I	Determinants, Properties of Determinates, Expansion of Determinants, Minors and Cofactors, Evaluation of Determinants, Classical adjoint, Cramer' rule, Solving Equations using Determinants, Area and Volume using Determinants
Unit-II	Matrices and their algebra, Types of matrices Identity, Singular and Non-singular matrices, Upper and Lower triangular Matrices, Diagonal Matrices, Transpose of a matrix, Adjoint and inverse of a matrix,
Unit-III	Hermitian and Skew Hermitian matrices, Row echelon and reduced row echelon form of a matrix, Rank of a matrix. Consistency of the system of homogeneous and non-homogeneous linear equations- with emphasis on problems. Gauss elimination method, Gauss Jordan Method.
Unit-IV	Eigenvalues and Eigenvectors of a matrix, Cayley Hamilton Theorem and its application to find out the inverse of a matrix. Similar matrices and diagonalization. Eigenvalues and eigenvectors of symmetric and Hermitian matrices

Books Recommended

1. David C. Lay: *Linear algebra and its applications (3rd Edition),* Pearson Education asia, Indian Reprint, 2007.
2. V. Krishnamurthy, V. P. Mainra and J. L. Arora, An Introduction to Linear Algebra, Affiliated East- West Press Pvt. Ltd., New Delhi.
3. Seymour Lipschutz and Marc Lars Lipson, Linear Algebra, Schaum's Outlines Series, McGraw-Hill.

24MATM251	**Mathematical Statistics**
Unit-I	Probability: Basic concepts and definitions, conditional probability, basic laws of total probability, Bayes' theorem, Discrete and continuous random variables, Probability mass/density functions, Cumulative distribution function, Mathematical expectation, Moments, Moment generating function, Characteristic function.
Unit-II	Discrete distributions: Uniform, Bernoulli, Binomial, Negative binomial, Geometric and Poisson; Continuous distributions: Uniform, Gamma, Exponential, Chi-square, Beta and normal; Normal approximation to the binomial distribution.
Unit-III	Two-dimensional random variables, Joint probability density function, joint distribution functions, marginal distributions, Expectation of function of two random variables, Joint moment generating function, Conditional distributions and expectations.
Unit-IV	Covariance, the Correlation coefficient, Linear regression for two variables, Method of least squares, least square method of fitting regression lines, Strong law of large numbers, Central limit theorem and weak law of large numbers.

Books Recommended

1. Irwin Miller and Marylees Miller**,** *John E. Freund's: Mathematical Statistics with Applications*, Pearson Education, 2012
2. Robert V. Hogg, Allen Craig Deceased and Joseph W. McKean: *Introduction to Mathematical Statistics*, Pearson Education, 2012.
3. Sheldon M. Ross: *Introduction to Probability and Statistics for Engineers and Scientists*, Elsevier Academic Press, 2009.

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Multidisciplinary Paper in Mathematics (2024-25) Course Structure and Syllabus

Semester	Code	Title of the Paper	Credits
I	24MATT101	Basic Statistics	3

Semester	Code	Title of the Paper	Credits
II	24MATT151	Elementary Calculus	3

Semester	Code	Title of the Paper	Credits
III	24MATT201	Matrices & Determinants	3

Note: Only for the students who do not have Mathematics papers as Major or Minor.

24MATT101	Basic Statistics
Unit-I	Introduction to Statistics, measure of Central tendency: mean, median and mode of grouped data, measures of dispersion: mean-deviation, variance, standard deviation, measure of kurtosis, measure of skewness
Unit-II	One dimensional random variable, discrete and continuous random variable, mathematical expectation, moments, properties of moment, moment generating function (MGF), properties of moment generating function, Binomial distribution, Poisson distribution.
Unit-III	Two-dimensional random variables, joint distribution functions, marginal distributions, covariance, linear regression and correlation, rank correlation, least square method of fitting regression lines.

Books Recommended

1. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons Publications, (2014).
2. K. M. Ramachandran and C. P. Tsokos, Mathematical Statistics with Applications, Academic Press (2009).
3. A. K. Sharma, Text book of Elementary Statistics: DPH Mathematical series, (2005).
4. Allan G. Bluman, Elementary Statistics: A Step-by-Step Approach; Mc Graw Hill (2009).

24MATT151	Elementary Calculus
Unit-I	Function, limit of a function, algebra of limits. Continuity and Differentiability of a function, Taylor's and McLaurin's series, Maxima and minima of a function of one variable,
Unit-II	Partial derivatives, applications of partial derivatives, Euler's theorem on homogeneous functions, Asymptotes, Test of concavity and convexity, Points of inflexion, multiple points.
Unit-III	Integral of irrational and trigonometric functions, properties of definite integrals, Reduction formulae, Quadrature, Rectification.

Books Recommended

1. Howard Anton, Calculus, John Wiely & Sons, 2012.
2. George B. Thomas, Ross L. Finney, Calculus 11Ed., Pearson Education, 2008.
3. Gorakh Prasad: *Differential Calculus*, Pothishalas Pvt Ltd, Allahabad.
4. Shanti Narayan: *Differential Calculus*, S. Chand & Co.
5. Shanti Narayan: *Integral Calculus*, S. Chand & Co.
6. Khalil Ahmad: *Text Book of Calculus*, World Education Publishers, 2012.

24MATT201	Matrices & Determinants
Unit-I	Concept, notation, order, equality, types of matrices, zero matrix, transpose of a matrix, symmetric and skew symmetric matrices. Addition, multiplication and scalar multiplication of matrices, simple properties of addition, multiplication and scalar multiplication. Non-commutativity of multiplication of matrices
Unit-II	Concept of elementary row and column operations. Invertible matrices and proof of the uniqueness of inverse, if it exists. Determinant of a square matrix (up to 3×3 matrices), properties of determinants, minors, cofactors and applications of determinants in finding the area of a triangle.
Unit-III	Adjoint and inverse of a square matrix. Consistency, inconsistency and number of solutions of system of linear equation by examples, solving system of linear equations in two or three variables using inverse of a matrix.

Books Recommended

1. V Krishnamurthy, V P Mainra and J L Arora, An introduction to Linear Algebra, Affiliated East- West Press Pvt. Ltd., New Delhi.
2. Seymour Lipschutz and Marc Lars Lipson, Linear Algebra, Schaum's outlines Series, McGraw-Hill.

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Skill Enhancement Course (SEC) in Mathematics (2024-25)
Course Structure and Syllabus

Semester	Code	Title of the Paper	Credits
I	24MATS101	Linear Programming	3

Semester	Code	Title of the Paper	Credits
II	24MATS151	Set Theory and Number Theory	3

Semester	Code	Title of the Paper	Credits
V	24MATS301	Integral Transforms and Applications	3

24MATS101 Linear Programming

Unit-I Linear Programming Problem: Mathematical formulation, Graphical method, Basic feasible solutions, Introduction to the simplex method: Optimality criterion. Integer programming: Branch and Bound method.

Unit-II Transportation Problem, Initial basic feasible solution using methods (North-West corner, Least Cost, Vogel's Approximation Method), Modified distribution method; Hungarian Method for Assignment Problems. Sequencing problem: m machines n jobs problem, Graphical method for sequence problem.

Unit-III Elementary inventory models: EOQ model with or without shortages; Replacement models: Individual replacement problem, Group replacement problem;

Books Recommended

1. A. H. Taha: *Operations Research – An Introduction*. Prentice Hall, 2010.
2. J. K. Sharma: *Operations Research – Theory and Application*, Macmillian Pub., 2007.
3. Thie, R. Paul, & G. E. Keough*: An Introduction to Linear Programming and Game Theory*. (3rd ed.). Wiley India Pvt. Ltd.,2014.
4. G. Hadley: *Linear Programming*, Narosa Publishing House, 2002.

24MATS151 Set Theory and Number Theory

Unit-I Cartesian products of sets, Equivalence relations, and partition, Fundamental Theorem of equivalence relation, Equivalent set, Countable and uncountable sets, Cantor's Theorem.

Unit-II Cardinal numbers, Power of continuum, Cardinal arithmetic, Inequalities in cardinals, Schroeder-Bernstein Theorem, Partially and totally ordered sets.

Unit-III Linear Diophantine equation, Prime counting function, Statement of prime number Theorem, Goldbach conjecture, Linear congruences, Complete set of residues, Properties of congruences, Chinese Remainder Theorem, Fermat's Little Theorem, Lagrange's Theorem, Wilson's Theorem.

Books Recommended

1. David M. Burton: Elementary Number Theory, 6th Ed., Tata McGraw - Hill, Indian reprint, 2007.

2. Neville Robinns: Beginning Number Theory, 2nd Ed., Narosa Publishing House Pvt. Ltd., Delhi, 2007.
3. Seymour Lipschutz: Set Theory and related topics. McGraw-Hill Education; 2nd edition, 1998.
4. J. Hunter: Number Theory, Oliver & Boyd, Edinburgh and London,1964.

24MATS301 Integral Transforms and Applications

Unit-I Definition of Laplace transform, Existence conditions for the Laplace transform. Laplace of some standard functions. Properties of Laplace transform. Derivatives and integrals of Laplace transform. Laplace transforms of special functions. Inverse Laplace transform and its properties. Heaviside unit step function and Dirac delta function. Convolution theorem. Initial and final value theorem. Laplace transforms of periodic functions. Solutions of ODEs, system of ODEs with constant and variable coefficients and PDEs using Laplace transform.

Unit-II Fourier integrals, Fourier sine and cosine integrals, Complex form of Fourier integral. Definition of Fourier transform and its properties. Fourier transform of derivatives and integrals. Fourier sine and cosine transforms and their properties. Convolution theorem and Parseval's inequality. Applications of Fourier transforms to boundary value problems.

Unit-III Infinite Mellin transform. Properties of Mellin transform. Mellin transforms of derivatives and integrals, Mellin inversion theorem. Convolution theorem and Parseval's theorem. Applications of Mellin transform in partial differential equations.

Books Recommended

1. E. Kreyszig: *Advanced Engineering Mathematics*, John Wiley & Sons, 2011.
2. R.K. Jain and S.R.K. Iyenger: *Advanced Engineering Mathematics*, Narosa Publishing House,2009.
3. F. B. Hildebrand: *Methods of Applied Mathematics*, Courier Dover Publications, 1992.
4. L. Debanth and D. Bhatt:, *Integral Transforms and Their Applications*, 2nd Ed., Taylor and Francis Group, 2007

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Value Added Courses (VAC) in Mathematics (2024-25)
Course Structure and Syllabus Under NEP

Semester	Code	Title of the Paper	Credits
I	24MATV101	Latex	2

Semester	Code	Title of the Paper	Credits
II	24MATV151	Word Processing and Spreadsheets	2

Semester	Code	Title of the Paper	Credits
III	24MATV201	Difference Equations and Z-transform	2

Semester	Code	Title of the Paper	Credits
IV	24MATV251	Mathematical Modelling	2

24MATV101 Latex

Unit-I Introduction to TeX and LaTeX: Typesetting a simple document, adding basic information to a document, Sectioning and displayed material, Document class. Mathematical typesetting, Mathematical Symbols, Arrays, Delimiters.

Unit-II Multiline formulas, Spacing and changing style in math mode, Graphics in LaTeX: Simple pictures using PSTricks, Pictures with nodes, Plotting of functions. Beamer presentation, Frames, Beamer document.

Books Recommended

1. D. Bindner & M. Erickson. *A Student's Guide to the Study, Practice, and Tools of Modern Mathematics*. CRC Press, Taylor & Francis Group, LLC, 2011.
2. L. Lamport, *LaTeX: A Document Preparation System, User's Guide and Reference Manual (2nd ed.).* Pearson Education. Indian Reprint, 1994.
3. M. R. C. van Dongen, *LaTeX and Friends*. Springer-Verlag, 2012.
4. J. N. Robbins, *Learning Web Design: A Beginner's Guide to HTML (5th ed.).* O'Reilly Media Inc, 2018.

24MATV151 Word Processing and Spreadsheets

Unit-I Introduction to word processing: working with text, formatting text, formatting pages; Inserting table, shapes, mathematical equations, header, footer, and page number; Bookmark, citation and cross referencing; Use of mail merge; Tracking changes to a document; Linking to another part of a document; Creating a new presentation; Formatting a presentation; Design, transition and animation in presentation; Setting up a Slide Show.

Unit-II Creating a spreadsheet, Formatting spreadsheet; Navigating within Spreadsheets; Working with columns and rows, Hiding and unhiding sheets; Conditional formatting in tables, sort and filter; Using Formulas and Functions; Importing data from text, CSV file, web and tables, Analyzing Data, Creating a Chart.

Books Recommended

1. Gerard Morgan, Séamus O'Neill, *Essential Computer Applications Data-bases, Spreadsheets, and Word-processing,* Gill and Macmillan Publishers, 1991.
2. Shelley Gaskin, Robert L. Ferrett, Alicia Vargas, Carolyn E. McLellan, *Go! with Microsoft Office 2010,* Pearson Education, Limited,

2010.
3. Dinesh Maidasani, *Learning Computer Fundamentals, MS Office and Internet & Web Tech*, Laxmi Publications, 2005.
4. Bonita Sebastian, *Microsoft Office 98: Step by Step Macintosh Edition: Word Processing with Word, Presentations with PowerPoint, Spreadsheets with Excel,* Computer Literacy Press, 1998.

24MATV201 Difference Equations and Z-transform

Unit-I Finite Difference Calculus: Finite Differences, Finite Difference Operators; Formation of Difference Equations; Linear Difference Equations with Constant Coefficients; Rules for Finding Complementary Functions and Particular Integrals; Simultaneous Difference Equations with Constant Coefficients; Solution of homogeneous and non-homogeneous difference equations.

Unit-II Z-Transform, Linearity Properties, Change of Scale Property or Damping Rule, Some Standard Z-Transforms Shifting u_n to the Right, Shifting u_n to the Left, Multiplication by n, Division by n, Initial Value Theorem, Final Value Theorem, Inverse Z-Transform, Convolution Theorem, Solution of Difference Equation by Z-Transform.

Books Recommended

1. N. Subramaniam, K. S. Ramaswami, *Transforms and Partial Differential Equations,* Pearson Education India, 2018.
2. Walter G. Kelley, Allan C. Peterson, *Difference Equations An Introduction with Applications,* Academic Press, 2001.
3. C. B. Gupta, A. K. Malik and V. Kumar, Advanced Mathematics, New Age International (P) Ltd., Publishers, 2009.

24MATV251 Mathematical Modelling

Unit-I Introduction- Definition & Simple situations for Mathematical Modelling, Technique of Mathematical Modelling, Classification of Mathematical Models, Some characteristic of Mathematical Models. Mathematical models based on Geometry, Algebra and Calculus. Limitations of Mathematical Modelling.

Unit-II Mathematical Models through ODE: Linear Growth and Decay Models, Non-linear Growth and Decay Models, Compartmental Models, M.M. in Population Growth, Epidemics through Systems, Compartment Models through system of ODE, Modelling in Economics through systems of ODE. MM for planetary motions, MM for Circular motion and motion of satellites.

Books Recommended

1. J. N. Kapur: *Mathematical Modelling*, 2nd Ed., New Age Publications, 2015
2. *UMAP-Module 322*: Published in cooperation with the Society for Industrial and Applied Mathematics
3. B. S. Grewal: *Higher Engineering Mathematics*, Khanna Publication, 2014.