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
II	24MATM151	Ordinary Differential Equations	4
III	24MATM201	Basic Linear Algebra	4
IV	24MATM251	Mathematical Statistics	4
V	24MATM301	Groups, Rings and Vector Spaces	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 2nd 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.

24MATM301	**Groups, Rings and Vector Spaces**
Unit-I	Sets, Cartesian product of sets, Relation, Types of relations, Equivalence relation, and Equivalence classes, Definition of group and its' properties, Subgroups and their characterizations, cosets, Lagrange's Theorem and its applications.
Unit-II	Normal subgroups and their properties, Quotient groups, Homomorphism, Kernel of a homomorphism, Isomorphism, Permutation group, Even and odd permutations, Cycles, Alternating group.
Unit-III	Definition and examples of rings, Properties of rings, Subrings, Ideals, Quotient rings, Ring homomorphism, Isomorphism, Kernel of a homomorphism, Isomorphism Theorems.
Unit-IV	Definition and examples of Vector Spaces, Properties of Vector Spaces, Subspaces and their Characterizations, Linear dependence and Independence, Basis and Dimension, Linear transformation, Range and Kernel, Rank and Nullity of linear transformations, Rank Nullity Theorem of a linear transformation.

Books Recommended

1. N. Herrnstein: Topics in Algebra, Wiley Eastern Ltd., New Delhi.
2. David C. Lay: Linear algebra and its applications (3rd Edition), Pearson Education Asia, Indian Reprint.
3. Surjeet Singh & Qazi Zameeruddin: Modern algebra, Vikas Publishing House Pvt. Ltd., New Delhi
4. N. Jacobson: Basic Algebra, Volume I and II. W. H. Freeman and Co.