PRINCIPAL SUBJECT AREA

MATHEMATICS

200 LEVEL COURSES

Courses MT 201 and MT 202 shall be compulsory for students offering Mathematics as a single subject.
Courses MT 201, MT 202, MT 204, MT 206 and MT 207 shall be compulsory for students offering Mathematics as two subjects.

MT 201 Groups, Rings and Fields (3 credits)
(Prerequisite: MT 104)
Groups: Cosets, Normal Subgroups and Factor Groups, Direct Product and Semi-direct Products, omomorphisms, Isomorphisms, Isomorphism Theorems, Permutation Groups, Cayley's Theorem, Isomorphism between Dihedral and Symmetric Groups, Conjugacy and the Class Equation.
Rings: Commutative rings, Rings with unity, Integral Domains and Fields, Subrings, Ring Homomorphisms, Ideals and Factor Rings, Principal Ideal Domains, Euclidean Domains and Unique Factorisation Domains, Quotient Fields.
Polynomials: Polynomials with Integer Coefficients, Solution of Cubic and Quartic Polynomials, General Polynomial over a field, Roots of a Polynomial, Existence of Roots, Factorisation, Irreducible polynomials, Gauss's Lemma, Eisenstein's Irreducibility Criterion.
Fields: Properties of a Field, Properties of a multiplicative group of a Field, Field Extensions, Finite Fields.

Recommended Texts:
1. J. B. Fraleigh (1999), *A First Course in Abstract Algebra*, Addison-Wesley Publishing Company
2. M. Artin, *Algebra* (1994), Prentice-Hall
3. I.N. Herstein (1964), *Topics in Algebra*, Blaisdell

MT 202 Real Analysis II (3 credits)
(Prerequisite: MT 105)
Cauchy sequences, Convergence tests, Absolute and conditional convergence, Power series, Integration and differentiation of power series, Taylor series, Uniform continuity, Upper and lower Riemann integrals, Characterization of Riemann integrable functions, Functions of several variables, Limits and continuity, Partial derivatives, Differentials, Chain rule, Extrema of functions of several variables, Lagrange Multipliers.

Recommended Texts:
1. S. R. Lay (1986), *Analysis An Introduction to Proof*, Prentice-Hall
2. T. M. Apostol (1974), *Mathematical Analysis*, Addison-Wesley

MT 203 Ordinary Differential Equations (3 credits)
(Prerequisite: MT 103)
Series solutions, Picard iterates, Existence and uniqueness of solutions, eigenvector method for linear systems, Fundamental matrix solutions, Non-linear autonomous systems, Phase plane, Phase portraits of linear systems, stability, Liapunov functions, Periodic solutions, Poincare-Bendixson theorem, Introduction to bifurcation theory.

Recommended Texts:
1. M. Braun (1992), *Differential Equations and Their Applications*, Springer-Verlag

MT 204 Mathematical Methods (3 credits)

(Prerequisite: MT 101)

Differentiation of Vectors**:** Scalar and vector point functions and their partial derivatives with respect to coordinate variables, Gradient of a scalar point function; Directional derivative, Divergence and curl of a vector point function**.** ***Integration of Vectors*****:** Line integrals and their evaluation using parametric representation, Surface integrals, Green's theorem in the plane Stokes theorem, Circulation and flux of a vector point function, Volume integrals, Divergence theorem, Irrotational and Solenoidal vector fields, Orthogonal Curvilinear Coordinates, Grad, Div, Curl in OCC, Cylindrical polar and spherical coordinate systems, Use of these coordinate systems in evaluation of surface and volume integrals. ***Special Solution of Laplaces Equation*****:** Solutions in two-dimensions, Axi-symmetric solutions. ***Integral Transforms*****:**

Laplace transforms; Elementary Properties, Inverse Laplace transform and its properties, Convolution theorem and its use in evaluation of integrals, Uses of Special functions connected with Laplace transform, Evaluation of integrals using LT, Applications in ODE and integro-differential equations, Applications in PDE, Fourier Transforms; Infinite-Fourier sine/cosine transforms and their inverse formulae, Finite-Fourier sine/cosine transforms, Derivation of inverse formulae, Use of Fourier series, Boundary value problems-Use of Fourier transforms.

Recommended Texts:

1. M.R. Spiegel (1968), *Vector Analysis*, McGraw-Hill
2. M.D. Raisinghania (1997), *Vector Analysis*, S. Chand & Comp. Ltd.
3. M.D. Raisinghania (1995), *Integral Transforms*, S. Chand & Comp. Ltd.

MT 205 Classical Mechanics II (2 credits)

(Prerequisite: MT 106)

Statics

Catenary**:** Equation of catenary; Standard relations, Tension at a point, Examples on equilibrium of heavy strings, Tightly stretched catenary. ***Strings on plane curves*****:** Heavy string on smooth space, Heavy string on rough space.***Thin rigid beams*****:** Shear force and SF diagram, Bending Moment and BM diagram, Relationship between SF, BM and Loading (continuous/ concentrated). ***Deflection of beams*****:** Equilibrium of slightly elastic beams, Bending of slightly elastic beams, Equation of three moments.

Dynamics

Central Orbits**:** Particle motion under a central force, Use of polar and reciprocal polar coordinates, Use of pedal coordinates, Elliptic, Parabolic and Hyperbolic Orbits, Kepler's Laws of planetary motion, Distributed central orbits. *Small* ***Oscillations*****:** Expressions for Kinetic/Potential Energies, Equation of motion and their solutions, Normal modes of oscillation, Normal coordinates and their determination.

Recommended Texts:

1. S.L. Green (1962), *General Degree Applied Mathematics*, University Tutorial Press Ltd
2. F. Chorlton (1985), *Dynamics*, CBS publishers

MT 206 Mathematical Modelling (3 credits)

Dimensions and Units, Scaling, Approximation and reasonableness of answers, Linear and quadratic models, Polynomial and rational models, Traffic flow models, Exponential models, Catastrophe theory, usage of differential equations and Bifurcation

Economic Functions: supply; Demand; *TC*; *TR*; *AC*; *AR*; *MC* and *MR*. Elasticity, Cosumer's Surplus, Producer's Surplus, Income determination model, Cobweb model, Harod model, Equilibrium in Economic Resources, Economies, Attainable states, Private ownership, Fixed point theory,

Continuous-time systems, Controllability, Liner feed back, Discrete-time systems, Stability theory, Optimal controls.

Recommended Texts:

1. R. Haberman (1998), *Mathematical Models*, SIAM

MT 207 Numerical Analysis I (2 credits)

Difference equations, Solutions of equations in one variable: Bisection method, Fixed-point iteration, Newton-Raphson method, Error analysis for iterative methods.

Interpolation and Polynomial Approximation: Taylor polynomials, Interpolation and Lagrange polynomial, Iterated interpolation, Divided differences, Hermite interpolation, Cubic spline interpolation.

Numerical Differentiation and Integration: Numerical differentiation, Richardson's extrapolation, Elements of numerical integration.

Recommended Texts:

1. K. E. Atkinson (1998), *An Introduction to Numerical Analysis*, John Wiley

MT 208 Set Theory (1 credits)

Axiom schema of comprehension, Formulas, classes, ZFC-model; Algebra of sets, Principle of Duality, Indexing, Countability, Cardinal Arithmetic, Cantor's Theorem; Continuum Hypothesis, Partial ordering and Zone's Lemma, Ordinal numbers and Transfinite Induction, Well-ordering Principle.

Recommended Texts:

1. K.J. Delvin (1993), *The Joy of Sets : Fundamentals of Contemporary Set Theory* (*Undergraduate Texts in Mathematics*), Springer-Verlag

MT 209 Graph Theory (2 credits)

Isomorphism of Graphs, Paths, Circuits, Eulerian graphs, Hamiltonian graphs, Shortest path problem, Chinese postman problem, Directed graphs, Graph Colouring, Four colour problem, Proof of five colour theorem, Planar graphs, ***Trees and Searching*****:** Properties of trees, Travelling salesman problem, Tree Analysis of sorting algorithms, Hall's Theorem, Transversal theory, Applications to game theory.

Recommended Texts:

1. F. Harary (1988), *Graph Theory*, Narosa Publishing House
2. R. J. Wilson (1996), *Introduction to Graph Theory*, Addison-Wesley Longman