PRINCIPAL SUBJECT AREA

MATHEMATICS

300 LEVEL COURSES

Courses MT 301 and MT 302 shall be compulsory for students offering Mathematics as a single subject.
Courses MT 301, MT 302, MT 310 and MT 312 shall be compulsory for students offering Mathematics as two subjects.
Courses MT 301, MT 302, MT 305, MT 306, MT 307, MT 309, MT 310 and MT 312 shall be compulsory for students following Special Degree Course in Mathematics.

MT 301 Linear Algebra (3 credits)
(Prerequisite: MT 201)

Vector Spaces*:** The abstract definition using the definition of vectors in $\Re^3$, $\Re^n$, $\mathbf{C}^n$. Subspaces, Dimension Theorem, Isomorphism Theorems. ***Linear Transformations and Matrices: Null Space and Range, Linear Operators, Rank-Nullity Theorem, Matrix Representation of a Linear Transformation, Composition of Linear Transformations, Change of Coordinate Matrix, Similar Matrices, Matrix of Change of Bases. ***Symmetric, Hermitian and Unitary Matrices*:** Properties of these Matrices, Shur's Theorem, The Reyleigh-Ritz Theorem. ***Elementary Matrices*:** Block Matrices, Elementary Matrix Operations and Elementary Matrices. ***Systems of Linear Equations*:** Augmented Matrix, Theoretical Treatment of Systems of Linear Equations. ***Determinants*:** Determinants of Order n, Properties of Determinants, Properties of the Adjoint. ***Diagonalisation of Matrices*:** Eigenvalues and Eigenvectors, Diagonalisability, Invariant Subspaces, Matrix Polynomials and Cayley-Hamiltion Theorem, Minimum Polynomial.
***Inner Product Spaces*:** Abstract Inner Products and Norms, Distance and angle between two vectors, Cauchy -Schwarz Theorem, The Gram-Schmidt orthogonalisation Process, Linear Operator in Inner Product Spaces, Positive definite linear operators.

Recommended Texts:
1. S. Lipschistz (1989), *Linear Algebra -Shaum Solved Problem Series*, McGraw-Hill
2. K. Hoffman and R. Kunze (1997), *Linear Algebra*, Prentice-Hall
3. G. L. Bradley (1975), *A Primer of Linear Algebra*, Prentice-Hall

MT 302 Real Analysis III (3 credits)
(Prerequisites: MT 202)
Jacobian, Inverse and Implicit Functions Theorem, Multiple integrals, change of variables (transformations) in multiple integrals, Function of Bounded Variation, Total variations, Rectifiable curves, Uniform convergence of infinite series, Infinite products, Special Functions (Gamma, Beta, Bessel, Legendre etc), Riemann Stieltjes Integral.

Recommended Texts:
W. Rudin (1976), *Principles of Mathematical Analysis*, McGraw-Hill
T. M. Apostol (1974), *Mathematical Analysis*, Addison-Wesley Longman

MT 303 Differential Geometry (2 credits)
Curves in space: Serret-Frenet formulae, Osculating plane, Osculating circle and osculating sphere, Involutes and evolutes, Helices.
Surfaces: Envelopes, Developable surfaces, Fundamental forms, Lines of curvature and Asymptotic curves, Ruled surfaces, Geodesics.

Recommended Texts:
1. T. J. Willmore (1959), *An Introduction to Differential Geometry*, Oxford University Press
2. CE. Weatherburn (1927), *Differential Geometry*, Cambridge University Press,

MT 304 Partial Differential Equations (2 credits)
(Prerequisite: MT 103)
***First order partial differential equations*:** Linear equations, Non-linear equations, Characteristics.
***Second order partial differential equations*:** Equations with constant coefficients, Equations with variable coefficients, Laplace equation, Wave equation, Diffusion equation, Boundary value problems,
Use of Fourier series.
Numerical methods of solving partial differential equations.

Recommended Texts:
1. R. V. Churchill & J.W. Brown (1987), *Fourier Series and Boundary Value Problems*, McGraw-Hill
2. E.T. Copson (1975) *Partial Differential Equations*, Cambridge University Press

MT 305 Group Theory (3 credits)
(Prerequisite: MT 201)
Classes of groups, Radicals and Residuals, Group Action on a set, Orbits and Stabiliser,
Sylow's Theorems, Simple groups, Applications of Sylow's Theorems, Subnormal and Normal Series, Jordan-Holders Theorem, p-groups, Soluble and Nilpotent groups, Non-solubility of S_n (n>4) and Simplicity of A_n (n>4), Action of groups on groups.

Recommended Texts:
1. J. B. Fraleigh (1999), *A First Course in Abstract Algebra*, Addison-Wesley Publishing Company
2. R. Scott (1964), *Group Theory*, Prentice-Hall
3. J. S. Rose (1978), *A Course in Group Theory*, Cambridge University Press

MT 306 Topology I (3 credits)
(Prerequisite: MT 105)
Metric spaces, open and closed sets, continuous and Bi-continuous functions, complete metric spaces and Banach's Fixed Point Theorem, Topology on $\Re^n$, General topological spaces, Neighborhood Axioms, Bases and Local Bases Homeomorphisms, Subspaces, Finite Products and Quotients, Separation Axioms, Convergence, Compactness, Connectedness, Homotopy of paths.

Recommended Texts:
1. E. T. Copson (1978), *Metric Spaces*, Cambridge University Press
2. J. R. Munkres (1975), *Topology: A First Course*, Prentice-Hall

MT 307 Complex Analysis I (2 credits)
(Prerequisite: MT 202)
The complex field, Riemann sphere, Topology of the complex plane, Analytic functions, Cauchy- Riemann equations, Elementary functions, Cauchy's Theorem (Proof based on Green's theorem), Cauchy's integral formulae, Taylor series, Laurent series, Classification of singularities, Residue Theorem, Evaluation of real-valued integrals by means of residues, Conformal mappings.

Recommended Texts:
1. R. V. Churchill & J. W. Brown (1984), *Complex Variables and Applications*, McGraw-Hill

MT 308 Combinatorics (2 credits)
(Prerequisite: MT 209)
***Recurrence relations and generating functions*:** Computing solutions to recurrence relations, The principle of Inclusion and Exclusion, Latin squares, System of distinct representatives, Extremal set theory.
***Steiner triple systems*:** Direct construction, Recurrence construction, Tournaments and Kirkman's school girls problem, Further Graph Theory, Networks, Matroids, Designs, Hadamard matrices.
***Error-Correcting codes* :** Linear Codes and Hadamard codes.

Recommended Texts:
1. P. J. Cameron (1994), *Combinatorics: Topics, Techniques, Algorithms*, Cambridge University Press

MT 309 Number Theory (3 credits)
(Prerequisite: MT 201)
Continued fractions, Linear congruences in two or more variables, System of congruences, Congruences of higher order, Euler ϕ-function and related theorems, Properties of the group $\phi(n)$, Euler's theorem, Wilson's theorem, Primitive roots, Quadratic residues, Gauss Quadratic Reciprocity law and its applications, Fermat numbers and Pepin's test.

Recommended Texts:
1. K. H. Rosen (1992), *Elementary Number Theory And Its Applications*, Addison-Wesley Publishing Company
2. I. Niven and H.S. Zuckerman (1980), *An Introduction to the Theory of Numbers*, John Wiely

MT 310 Fluid Mechanics I (3 credits)
(Prerequisites: MT 202, MT 204)
***Kinematics of Fluid Motion*:** Real and Perfect Fluids, Velocity of a fluid at a point, Streamlines and their differential equations, Steady and Unsteady motions, Vorticity and Circulation; Stokes's theorem, Irrotational flow and the velocity potential, Local, convectional and material rates of change of flow quantities, Acceleration as a material derivative, Equation of Continuity, Compressible and Incompressible fluids Conditions satisfied by a perfect fluid at a rigid boundary.
***Euler's Equation of Motion*:** Pressure at a point in a fluid (moving or at rest), Euler's Equation in vector form, Motion under conservative body force; Steady Rotation about a fixed vertical axis, Bernoulli's Equation in irrotational motion; Radial flow, Theorems on velocity potential,Kinetic Energy; Kelvin's theorems.
***Three-dimensional flow fields*:** Source, Sink and Doublet, Flow past a fixed sphere; Moving sphere in a fluid, Motion generated by impulses on boundaries of fluid, Concentric Spherical boundaries of fluid.
***Two-dimensional flow fields*:** Velocity and Vorticity in terms of the Stream Function in incompressible fluid, The Complex Potential and the Complex Velocity, in irrotational motion, Source, Sink, Doublet and Vortex, Image Systems for straight and circular boundaries Circle Theorem of Milne-Thomson, Flow past a fixed circular cylinder with singularities in the field outside.

Recommended Texts:
1. F. Chorlton (1990), Fluid Dynamics, Oxford University Press

MT 311 Linear Programming (3 credits)
***Convex Analysis*:** Convex combinations, Convex sets, Extreme points of a convex set, Convex polyhedron, Hyperplanes, Half-spaces and polytopes, Convex functions.
***Linear Programming (LP)*:** Mathematical formulation of the LP problem, LP in two-dimensional space, Graphical solution methods, General LP problem.
***The Simplex Method*:** Simplex algorithm, Two-phase simplex algorithm, Revised simplex algorithm, LP problems with unrestricted variables, LP problems with bounded variables.
***Duality in LP*:** Duality in LP problems, Duality theorems, Applications of duality, Dual simplex algorithm.
***Special Types of LP Problems*:** Transportation problem, Assignment problem.

Recommended Texts:
1. G. B. Dantzig & M. N. Thapa (1997), *Linear Programming*: *Introduction*, Springer-Verlag New York
2. K. Kapoor (1998), *Operations Research*, Sultan Chand & Sons

MT 312 Numerical Analysis II (3 credits)
(Prerequisite: MT 207)
***Initial-value Problems For Ordinary Differential Equations*:** Euler's method, Higher-order Taylor methods, Runge-Kutta method.
***Direct Methods for Solving Linear Systems*:** Linear systems of equations, Gaussian elimination and backward substitution.
***Numerical Solutions of Non-Linear Systems of Equations*:** Fixed points for functions of several variables, Newton's method, Quasi-Newton methods, Steepest descent techniques.
***Boundary-Value Problems for Ordinary Differential Equations*:** The linear shooting method, The shooting method for non-linear problems, Finite-difference methods for linear problems, Finite-difference methods for non-linear problems.

Recommended Texts:
1. K. E. Atkinson (1998), *An Introduction to Numerical Analysis*, John Wiley
2. P.A. Stark (1970), *Introduction to Numerical Analysis*, The Macmillan Company