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A.C. :

Item No. :

Annexure No.

# PROPOSED SYLLABUS

## B.A. (Prog.) Mathematical Courses SEMESTER SCHEME

DEPARTMENT OF MATHEMATICS  
UNIVERSITY OF DELHI  
DELHI-110007

BS

## B.A. (PROGRAMME) MATHEMATICS COURSES

Each of six courses will be having 100 Marks weightage and will be taught in five lectures and one tutorial per week.

### SEMESTER I

#### Calculus

##### Section - I

Limit and continuity, Types of discontinuities. Differentiability of functions, Successive differentiation, Leibnitz's theorem, Partial differentiation, Euler's theorem on homogeneous functions.

##### Section - II

Tangents and normals, Curvature, Asymptotes, Singular points, Tracing of curves.

##### Section - III

Rolle's theorem, Mean value theorems, Taylor's theorem with Lagranges and Cauchy's forms of remainder. Taylor's series, Maclaurin's series of  $\sin x$ ,  $\cos x$ ,  $e^x$ ,  $\log(1+x)$ ,  $(1+x)^n$ , Applications of mean value theorems to monotonic functions and inequalities. Maxima and minima, Indeterminate forms.

##### REFERENCES:

1. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons, Inc., 2002.
2. G.B. Thomas and R. L. Finney, *Calculus*, Pearson Education, 2007.

## SEMESTER II

### Algebra

#### Section - I

Definition and examples of a vector space, Subspace and its properties, Linear independence and dependence of vectors, basis and dimension of a vector space, Types of matrices, Rank of a matrix, Invariance of rank under elementary transformations, Reduction to normal form, Solutions of linear homogeneous and non-homogeneous equations with number of equations and unknowns upto four, Cayley-Hamilton theorem, Characteristic roots and vectors.

#### Section - II

De Moivre's theorem (both integral and rational index), Solutions of equations using trigonometry, Expansion for  $\cos nx$  and  $\sin nx$  in terms of powers of  $\sin x$  and  $\cos x$ , Expansion of  $\cos^n x$  and  $\sin^n x$  in terms of cosine and sine of multiples of  $x$ , Summation of series, Relation between roots and coefficients of  $n^{\text{th}}$  degree equation, Solutions of cubic and biquadratic equations, when some conditions on roots of the equation are given, Symmetric functions of the roots for cubic and biquadratic equations.

#### Section - III

Integers modulo  $n$ , Permutations, Groups, Subgroups, Lagrange's Theorem, Euler's Theorem, Symmetry groups of a segment of a line and regular  $n$ -gons for  $n = 3, 4, 5$  and  $6$ , Rings and subrings in the context of  $C[0,1]$  and  $Z_n$ .

#### REFERENCES:

1. John A. Beachy and William D. Blair, *Abstract Algebra with a Concrete Introduction*, Prentice Hall, 1990.
2. W. J. Gilbert, *Modern Abstract Algebra with Applications*, John Wiley & Sons 1976.

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## SEMESTER III

### Integration and Differential Equation

#### Section - I : Integration

Reduction formulae, Integration of irrational and trigonometric functions, Properties of definite integrals, Quadrature, Rectification of curves, Volumes and areas of surfaces of revolution.

#### Section - II : Ordinary Differential Equations

First order exact differential equations including rules for finding integrating factors, First order higher degree equations solvable for  $x$ ,  $y$ ,  $p$ , Wronskian and its properties, Linear homogeneous equations with constant coefficients, Linear non-homogeneous equations. Method of variation of parameters, Euler's equations, Simultaneous differential equations, Total differential equations, Applications of ordinary differential equations to Mixture Problems, Growth and decay, Population dynamics and orthogonal trajectories.

#### Section - III : Partial Differential Equations

Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, formation of first order partial differential equations, Linear partial differential equations of first order, Lagrange's method, Charpit's method, Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only, Applications to Traffic Flow.

#### REFERENCES:

1. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons, Inc. 2002.
2. S. L. Ross, *Differential Equations*, John Wiley and Sons, Third Edition, 1984.
3. I. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill International Editions, 1967.

## SEMESTER IV

### Analytic Geometry and Applied Algebra

#### Section-I : Geometry

Techniques for sketching parabola, ellipse and hyperbola, Reflection properties of parabola, ellipse and hyperbola and their applications to signals, Classification of quadratic equation representing lines, parabola, ellipse and hyperbola.

#### Section-II : 3-Dimensional Geometry and Vectors

Rectangular coordinates in 3-space; spheres, cylindrical surfaces cones, Vectors viewed geometrically, Vectors in coordinate system, vectors determine by length and angle, Dot product, cross product and their geometrical properties, Parametric equations of lines in plane, planes in 3-space.

#### SECTION - III : Applied Algebra

Latin Squares, Table for a finite group as a Latin square, Latin squares as in design of experiments, Mathematical models for matching jobs, Spelling checker, Network reliability Street surveillance, Scheduling meetings.

#### REFERENCES:

1. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons, Inc. 2002.
2. A. Tucker, *Applied Combinatorics*, John Wiley and Sons, 2003.



## SEMESTER V

### Analysis

#### Section-I

Order completeness of real numbers, Open and closed sets, Limit point of sets, Bolzano Weierstrass theorem, Properties of continuous functions, Uniform continuity.

#### Section-II

Sequences, Convergent and Cauchy sequences, Subsequences, Limit superior and limit inferior of a sequence, Monotonically increasing and decreasing sequences, Infinite series and their convergences, Positive term series, comparison tests, Cauchy's  $n^{\text{th}}$  root test, D'Alembert's ratio test, Raabe's test, alternating series, Leibnitz's test, absolute and conditional convergence.

#### Section -III

Riemann integral, Integrability of continuous and monotonic functions, Improper integrals and their convergences, Comparison tests, Beta and gamma functions and their properties, Pointwise and uniform convergence of sequences and series of functions, Weierstrass M-test, Uniform convergence and continuity, Statement of the results about uniform convergence and integrability or differentiability of functions, Power series and radius of convergence, Fourier series.

#### REFERENCES:

1. R. G. Bartle and D. R. Sherbert, *Introduction to Real Analysis*, John Wiley and Sons, (Asia) Pvt. Ltd., 2000.
2. Richard Courant and Fritz John A. Tucker, *Introduction to Calculus and Analysis I*, Springer Verlag, 1999.
3. S. K. Berbarian, *Real Analysis*, Springer -Verlag, 2000.

## SEMESTER VI

### Numerical Analysis and Statistics

#### 1. Numerical Analysis

Solution of linear equations: Gaussian elimination including pivoting, Iterative methods: Gauss Jacobi and Gauss Seidel methods, Roots of Non-linear equations, Bisection method, Newton's method, Interpolation: Lagrangian interpolating polynomials, Newton interpolating polynomials, Divided difference, Error analysis.

#### REFERENCES:

1. **C. F. Gerald and P. O. Wheatlay**, *Applied Numerical Analysis*, Sixth edition, Addison - Wesley, New York, 1999.
2. **M. K. Jain, S. R. K. Iyengar and R. K. Jain**, *Numerical Methods for Scientific and Engineering Computation*, New Age International Publisher, 4<sup>th</sup> Edition, New Delhi, 2003.

#### 2. Mathematics Statistics

Measures of skewness and kurtosis bivariate data, Scatter diagram, Principles of least squares and its application in fitting of curves, Correlation, Rank correlation and linear regression, Random variable, Concept of mathematical expectations and its simple properties, Moments and moment generating functions, Discrete and continuous distributions: Binomial, Poisson, geometric, uniform and normal distributions and their simple properties.

#### REFERENCES:

1. **V. K. Rohtagi**, *An Introduction to Probability Theory and Mathematical Statistics*, John Wiley and Sons, 1976.
2. **R. V. Hogg and A. T. Craig**, *Introduction to Mathematical Statistics*, Amerind Publishers Co. Pvt. Ltd., 1970.
3. **A. M. Mood and F. A. Graybill and D. C. Boes**, *Introduction to the Theory of Statistics*, McGraw Hill Book Company, 1963.