Choice Based Credit System (CBCS)

UNIVERSITY OF DELHI

DEPARTMENT OF MATHEMATICS

UNDERGRADUATE PROGRAMME
(Courses effective from Academic Year 2015-16)

SYLLABUS OF COURSES TO BE OFFERED
Core Courses, Elective Courses & Ability Enhancement Courses

Disclaimer: The CBCS syllabus is uploaded as given by the faculty concerned to the Academic Council. The same has been approved as it is by the Academic Council on 13.7.2015 and Executive Council on 14.7.2015. Any query may kindly be addressed to the concerned faculty.

Undergraduate Programme Secretariat

Preamble

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters.

The UGC has formulated various regulations and guidelines from time to time to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions (HEIs) in India. The academic reforms recommended by the UGC in the recent past have led to overall improvement in the higher education system. However, due to lot of diversity in the system of higher education, there are multiple approaches followed by universities towards examination, evaluation and grading system. While the HEIs must have the flexibility and freedom in designing the examination and evaluation methods that best fits the curriculum, syllabi and teaching–learning methods, there is a need to devise a sensible system for awarding the grades based on the performance of students. Presently the performance of the students is reported using the conventional system of marks secured in the examinations or grades or both. The conversion from marks to letter grades and the letter grades used vary widely across the HEIs in the country. This creates difficulty for the academia and the employers to understand and infer the performance of the students graduating from different universities and colleges based on grades.

The grading system is considered to be better than the conventional marks system and hence it has been followed in the top institutions in India and abroad. So it is desirable to introduce uniform grading system. This will facilitate student mobility across institutions within and across countries and also enable potential employers to assess the performance of students. To bring in the desired uniformity, in grading system and method for computing the cumulative grade point average (CGPA) based on the performance of students in the examinations, the UGC has formulated these guidelines.

Sl. No.	CORE COURSE (12)	Ability Enhancement Compulsory Course	Skill Enhancement Course (SEC) (2)	GE
I				GE 1- Calculus
II				GE 2- Linear Algebra
III				GE 3- Differential Equations
IV				GE 4- Numerical Methods Or GE 4- Elements of Analysis
V				
VI				

Semester I

GE- I CALCULUS

Five Lectures per week + Tutorial as per University rules
Max. Marks 100 (including internal assessment)
Examination 3 hrs.

UNIT-I

ε-δ Definition of limit of a function, One sided limit, Limits at infinity, Horizontal asymptotes, Infinite limits, Vertical asymptotes, Linearization, Differential of a function, Concavity, Points of inflection, Curve sketching, Indeterminate forms,L'Hopital's rule, Volumes by slicing, Volumes of solids of revolution by the disk method.

UNIT-II

Volumes of solids of revolution by the washer method, Volume by cylindrical shells, Length of plane curves, Area of surface of revolution, Improper integration: Type I and II, Tests of convergence and divergence, Polar coordinates, Graphing in polar coordinates, Vector valued functions: Limit, Continuity, Derivatives, Integrals, Arc length, Unit tangent vector.

UNIT-III

Curvature, Unit normal vector, Torsion, Unit binormal vector, Functions of several Variables, Graph, Level curves, Limit, Continuity, Partial derivatives, Differentiability Chain Rule, Directional derivatives, Gradient, Tangent plane and normal line, Extreme values, Saddle points

REFERENCES:

[1] G. B. Thomas and R. L. Finney, Calculus, Pearson Education, 11/e (2012)
[2] H. Anton, I. Bivens and S. Davis, Calculus, John Wiley and Sons Inc., 7/e (2011)

Semester II

GE- 2 LINEAR ALGEBRA

Five Lectures per week + Tutorial as per University rules
Max. Marks 100 (including internal assessment)
Examination 3 hrs.

UNIT-I

Fundamental operation with vectors in Euclidean space $\mathbf{R}^n$, Linear combination of vectors, Dot product and their properties, Cauchy–Schwarz inequality, Triangle inequality, Projection vectors, Some elementary results on vector in $\mathbf{R}^n$, Matrices, Gauss–Jordan row reduction, Reduced row echelon form, Row equivalence, Rank, Linear combination of vectors, Row space, Eigenvalues, Eigenvectors, Eigenspace, Characteristic polynomials, Diagonalization of matrices, Definition and examples of vector space, Some elementary properties of vector spaces, Subspace.

UNIT-II

Span of a set, A spanning set for an eigenspace, Linear independence and linear dependence of vectors, Basis and dimension of a vector space, Maximal linearly independent sets, Minimal spanning sets, Application of rank, Homogenous and nonhomogenous systems of equations, Coordinates of a vector in ordered basis, Transition matrix, Linear transformations: Definition and examples, Elementary properties, The matrix of a linear transformation, Linear operator and Similarity.

UNIT-III

Application: Computer graphics- Fundamental movements in a plane, Homogenous coordinates, Composition of movements, Kernel and range of a linear transformation, Dimension theorem, One to one and onto linear transformations, Invertible linear transformations, Isomorphism: Isomorphic vector spaces (to $\mathbf{R}^n$), Orthogonal and orthonormal vectors, Orthogonal and orthonormal bases, Orthogonal complement, Projection theorem (Statement only), Orthogonal projection onto a subspace, Application: Least square solutions for inconsistent systems.

REFERENCES:

[1] S. Andrilli and D. Hecker, Elementary Linear Algebra, Academic Press, 4/e (2012)
[2] B. Kolman and D.R. Hill, Introductory Linear Algebra with Applications, Pearson Education, 7/e (2003)

Semester III

GE- 3 DIFFERENTIAL EQUATIONS

Five Lectures per week + Tutorial as per University rules
Max. Marks 100 (including internal assessment)
Examination 3 hrs.

UNIT-I

First order ordinary differential equations: Basic concepts and ideas, Exact differential equations, Integrating factors, Bernoulli equations, Orthogonal trajectories of curves, Existence and uniqueness of solutions, Second order differential equations: Homogenous linear equations of second order, Second order homogenous equations with constant coefficients, Differential operator, Euler-Cauchy equation.

UNIT-II

Existence and uniqueness theory, Wronskian, Nonhomogenous ordinary differential equations, Solution by undetermined coefficients, Solution by variation of parameters, Higher order homogenous equations with constant coefficients, System of differential equations, System of differential equations, Conversion of n^{th} order ODEs to a system, Basic concepts and ideas, Homogenous system with constant coefficients.

UNIT-III

Power series method: Theory of power series methods, Legendre's equation, Legendre polynomial, Partial differential equations: Basic Concepts and definitions, Mathematical problems, First order equations: Classification, Construction, Geometrical interpretation, Method of characteristics, General solutions of first order partial differential equations, Canonical forms and method of separation of variables for first order partial differential equations, Classification of second order partial differential equations, Reduction to canonical forms, Second order partial differential equationswith constant coefficients, General solutions.

REFERENCES:

[1] Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, Inc., 9/e, (2006)
[2] TynMyint–U and LokenathDebnath; Linear Partial Differential Equations for Scientists and Engineers, Springer, Indian Reprint (2009)

Semester IV

GE- 4 Numerical Methods
Or
GE- 4 Elements of Analysis

GE- 4 Numerical Methods
Five Lectures per week + Tutorial as per University rules
Max. Marks 100 (including internal assessment)
Examination 3 hrs.

Unit-I
Floating point representation and computer arithmetic, Significant digits, Errors: Roundoff error, Local truncation error, Global truncation error, Order of a method, Convergence and terminal conditions, Efficient computations Bisection method, Secant method, Regula Falsi method, Newton Raphson method, Newton's method for solving nonlinear systems

Unit-II

Gauss elimination method (with row pivoting) and Gauss–Jordan method, Gauss Thomas method for tridiagonal systems Iterative methods: Jacobi and Gauss-Seidel iterative methods Interpolation: Lagrange's form and Newton's form Finite difference operators, Gregory Newton forward and backward differences Interpolation.

Unit-III
Piecewise polynomial interpolation: Linear interpolation, Cubic spline interpolation (only method), Numerical differentiation: First derivatives and second order derivatives, Richardson extrapolation Numerical integration: Trapezoid rule, Simpson's rule (only method), Newton–Cotes open formulas
Extrapolation methods: Romberg integration, Gaussian quadrature, Ordinary differential equation: Euler's method Modified Euler's methods: Heun method and Mid-point method, Runge-Kutta second methods: Heun method without iteration, Mid-point method and Ralston's method Classical 4^{th} order Runge-Kutta method, Finite difference method for linear ODE

REFERNCES:
[1] Laurence V. Fausett, Applied Numerical Analysis, Using MATLAB, Pearson, 2/e (2012)
[2] M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and

Engineering Computation, New Age International Publisher, 6/e (2012)
[3] Steven C Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientists, Tata McGraw Hill, 2/e (2010)

OR

GE- 4 Elements of Analysis

Five Lectures per week + Tutorial as per University rules
Max. Marks 100 (including internal assessment)
Examination 3 hrs.

Unit I
Finite and infinite sets examples of countable and uncountable sets. Real line; absolute value bounded sets suprema and infima, statement of order Completeness property of R, Archimedean property of R, intervals. Real sequences, Convergence, sum and product of convergent sequences, proof of convergence of some simple sequences such as $(-1)^n/n$, $1/n^2$, $(1+1/n)^n$, x^n with $|x|<1, a_n /n$, where an is a bounded sequence. Concept of cluster points and statement of Bolzano Weierstrass' theorem. Statement and illustration of Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence.

Unit II

Definition and a necessary condition for convergence of an infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, limit comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test. Definition and examples of absolute and conditional convergemce.

Unit III
Definition of power series: radius of convergence, Cauchy-Hadamard theorem, statement and illustration of term-by-term differentiation and integration of power series. Power series expansions for exp(x), sin(x), cos(x), log(1+x) and their properties.

REFERNCES:
[1] R.G. Bartle and D.R. Sherbert: Introduction to Real Analysis, John Wiley and Sons (Asia)
Pte. Ltd., 2000.
[2] C. P. Simon and L. Blume: Mathematics for Economists, W W Norton and Company,1994.

[3] K. Sydsaeter and P.J. Hammod, Mathematics for Economics Analysis, Pearson
Education, 2002