

CORE -1
PAPER - I

CORE COURSE
SEMESTER-I

B. Sc. / B. A. Mathematics(Hons)

C-1.1: Calculus-I

100 Marks

Credit-6 (Theory 4 + Practical 2)

DISTRIBUTION OF MARKS

75 Marks (Mid Sem. 15 + End Sem. 60) + 25 Marks Practical End Sem.

All Units carry equal Marks

Duration of Examination = 3 Hours (End Sem. Theory)

Mid Sem. = 1 Hour and Practical = 6 Hours

Unit-I: Hyperbolic functions, higher order derivatives, Leibniz rule and its applications to problems of the type $e^{(ax+b)} \sin x$, $e^{(ax+b)} \cos x$, $(ax+b)^n \sin x$, $(ax+b)^n \cos x$, concavity and inflection points, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves.

Unit-II: LHospitals rule. Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin nx dx$, $\int \cos nx dx$, $\int \tan nx dx$, $\int \sec nx dx$, $\int (\log x)^n dx$, $\int \sin^n x \cos^n x dx$ etc.

Unit-III: Volumes by slicing, disks and washers methods, Volumes by cylindrical shells, parametric equations, parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution.

Unit-IV: Techniques of sketching conics, reflection properties of conics, rotation of axes and second degree equations, classification into conics using the discriminant, polar equations of conics. Sphere, Cone, Cylinder, Central Conicoids

Unit-V: ~~Vector~~ Triple product, introduction to vector functions, operations with vector-Valued functions, limits and continuity of vector functions, differentiation and integration of vector functions, tangent and normal components of acceleration.

**CORE -1
PAPER - II**

Part-II (Practical, Marks: 25)

List of Practicals (Using any software) Practical / Lab work to be performed on a Computer.

1. Plotting the graphs of the functions $e^{(ax+b)}$, $\log(ax+b)$, $1/(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$, $|ax+b|$ and to illustrate the effect of a and b on the graph.
2. Plotting the graphs of the polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.
3. Sketching parametric curves (Eg. Trochoid, cycloid, epicycloids, hypocycloid).
4. Obtaining surface of revolution of curves.
5. Tracing of conics in cartesian coordinates/polar coordinates.
6. Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic, paraboloid, hyperbolic paraboloid using cartesian coordinates.
7. Matrix operation (addition, multiplication, inverse, transpose).

Books Recommended:

1. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007. Chapters:4(4.3,4.4,4.5 & 4.7), 9(9.4), 10(10.1-10.4).
2. H. Anton, I. Bivens and S. Davis, Calculus, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002. Chapters: 6, (6.2-6.5),7(7.8), 8(8.2-8.3, Pages:532-538), 11(11.1), 13(13.5)
3. Analytical Geometry of Quadratic Surfaces, B.P. Acharya and D.C. Sahu, Kalyani Publishers, New Delhi, Ludhiana. Chapters: 2, 3, 4

Books for Reference:

1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
2. R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer-Verlag, New York, Inc., 1989.
3. Text Book of Calculus, Part-II- Shantinayakan, S. Chand & Co.,
4. Text Book of Calculus, Part-III-Shantinayakan, S. Chand & Co.,
5. Shanti Narayan and P.K. Mittal-Analytical Solid Geometry, S. Chand & Company Pvt. Ltd., New Delhi.

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CORE - 2
PAPER - I

CORE COURSE
SEMESTER-I
B. Sc. / B. A. Mathematics(Hons)

100 Marks

C-1.2: Algebra-I

Credit-6 (Theory 5 + Tutorial 1)

DISTRIBUTION OF MARKS

80 Marks (End Sem.) + 20 Marks Mid Sem.

All Units carry equal Marks

Duration of Examination = 3 Hours (End Sem. Theory)

Mid Sem. = 1 Hour

- Unit-I:** Polar representation of complex numbers, n-th roots of unity, De Moivre's theorem for rational indices and its applications.
- Unit-II:** Equivalence relations, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set.
- Unit-III:** Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.
- Unit-IV:** Systems of linear equations, row reduction and echelon forms, the matrix equation $Ax = b$, solution sets of linear systems, linear independence.
- Unit-V:** Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Subspaces of R^n , dimension of subspaces of R^n and rank of a matrix, Eigen values, Eigen Vectors and Characteristic Equation of a matrix.

Books Recommended:

1. L.V. Ahlfors, Complex Analysis, McGraw-Hill(International Student Edn.)
2. Titu Andreescu and Dorin Andrica, Complex Numbers from A to Z, Birkhauser, 2006. Chapter:2
3. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005. Chapters:2(2.4), 3,4(4.1-4.1.6, 4.2-4.2.11, 4.4(4.1-4.4.8),4.3-4.3.9, 5(5.1-5.1.4).
4. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007. Chapters:1(1.1-1.9), 2(2.1-2.3, 2.8, 2.9), 5(5.1,5.2)

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CORE - 3
PAPER - I

CORE COURSE

C3.I

SEMESTER-II

B. Sc. / B. A. Mathematics(Hons)

C-2.1: Real Analysis(Analysis-I)

100 Marks

Credit-6 (Theory 5 + Tutorial 1)

(100)

DISTRIBUTION OF MARKS

80 Marks (End Sem.) + 20 Marks Mid Sem.

All Units carry equal Marks

Duration of Examination = 3 Hours (End Sem. Theory)

Mid Sem. = 1 Hour

- Unit-I:** Review of Algebraic and Order Properties of R , Neighborhood of a point in R , Idea of countable sets, uncountable sets and uncountability of R . Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Suprema and Infima.
- Unit-II:** The Completeness Property of R , The Archimedean Property, Density of Rational (and Irrational) numbers in R , Intervals. Limit points of a set, Isolated points, Illustrations of Bolzano-Weierstrass theorem for sets.
- Unit-III:** Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy's Convergence Criterion.
- Unit-IV:** Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy's n -th root test, Integral test.
- Unit-V:** Alternating series, Leibniz test, Absolute and Conditional convergence.

Book Recommended:

1. G. Das and S. Pattanayak, Fundamentals of Mathematics Analysis, TMH Publishing Co. ,Chapters: 2(2.1 to 2.4, 2.5 to 2.7), 3(3.1-3.5), 4(4.1 to 4.7, 4.10, 4.11,4.12, 4.13).

Books for References:

1. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
2. Gerald G. Bilodeau , Paul R. Thie, G.E. Keough, An Introduction to Analysis, 2nd Ed., Jones & Bartlett, 2010.
3. Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner, Elementary Real Analysis, Prentice Hall, 2001.
4. S.K. Berberian, A First Course in Real Analysis, Springer Verlag, New York, 1994.
5. S.C. Mallik and S. Arora-Mathematical Analysis, New Age International Publications.
6. D. Smasundaram and B. Choudhury-A First Course in Mathematical Analysis, Narosa Publishing House.
7. S.L. Gupta and Nisha Rani-Real Analysis, Vikas Publishing House Pvt. Ltd., New Delhi.

CORE - 4
PAPER - I

C4.I

CORE COURSE

SEMESTER-II

B. Sc. / B. A. Mathematics(Hons)

C-2.2: Differential Equations

100 Marks

Credit-6 (Theory 4 + Practical 2)

(75 + 25)

DISTRIBUTION OF MARKS

75 Marks (Mid Sem. 15 + End Sem. 60) + 25 Marks Practical End Sem.

All Units carry equal Marks

Duration of Examination = 3 Hours (End Sem. Theory)

Mid Sem. = 1 Hour and Practical = 6 Hours

- Unit-I:** Differential equations and mathematical models. First order and first degree ODE (variables separable, homogeneous, exact, and linear). Equations of first order but of higher degree. Applications of first order differential equations (Growth, Decay and Chemical Reactions, Heat flow, Oxygen debt, Economics).
- Unit-II:** Second order linear equations (homogeneous and non-homogeneous) with constant coefficients, variation of parameters, method of undetermined coefficients.
- Unit-III:** Equations reducible to linear equations with constant coefficients, Euler's equation, Applications of second order differential equations. Second order linear equations with variable coefficients.
- Unit-IV:** Power series solutions of second order differential equations.
- Unit-V:** Laplace transforms and its applications to solutions of differential equations.

**CORE - 4
PAPER - II**

Part-II (Practical: Marks:25)

List of Practicals (Using any Software) Practical/Lab work to be performed on a Computer.

1. Plotting of second order solution of family of differential equations.
2. Plotting of third order solution of family of differential equations.
3. Growth model (exponential case only).
4. Decay model (exponential case only).
5. Oxygen debt model.
6. Economic model.
7. Vibration problems.

Book Recommended:

1. J. Sinha Roy and S. Padhy, A Course of Ordinary and Partial Differential Equations, Kalyani Publishers, New Delhi. Chapters: 1, 2(2.1 to 2.7), 3, 4(4.1 to 4.7, 4.8, 4.9), 5, 7(7.1-7.4), 9(9.1, 9.2, 9.3, 9.4, 9.5, 9.10, 9.11, 9.13).

Books for References:

1. Martin Braun, Differential Equations and their Applications, Springer International.
2. M.D. Raisinghania-Advanced Differential Equations, S. Chand & Company Ltd., New Delhi.
3. G. Dennis Zill-A First Course in Differential Equations with Modelling Applications, Cengage Learning India Pvt. Ltd.
4. S.L. Ross, Differential Equations, John Wiley & Sons, India, 2004.

GENERIC ELECTIVE

~~CORE COURSE~~

SEMESTER-I / II

Generic Electives- Mathematics

GE-1: Calculus and Ordinary Differential Equations

100 Marks

Credit-6 (Theory 5 + Tutorial 1)

DISTRIBUTION OF MARKS

80 Marks (End Sem.) + 20 Marks Mid Sem.

All Units carry equal Marks

Duration of Examination = 3 Hours (End Sem. Theory)

Mid Sem. = 1 Hour

- Unit-I:** Curvature, Asymptotes, Tracing of Curves (Cartenary, Cycloid, Folium of Descartes, Astroid, Limacon, Cissoid & loops), Rectification, Quadrature, Volume and Surface area of solids of revolution.
- Unit-II:** Sphere, Cones and Cylinders, Conicoid.
- Unit-III:** Explicit and Implicit functions, Limit and Continuity of functions of several variables, Partial derivatives, Partial derivatives of higher orders, Homogeneous functions, Change of variables, Mean value theorem, Taylor's theorem and Maclaurin's theorem for functions of two variables. Maxima and Minima of functions of two and three variables, Implicit functions.
- Unit-IV:** Ordinary Differential Equations of 1st order and 1st degree (Variables separable, homogeneous, exact and linear). Equations of 1st order but higher degree.
- Unit-V:** Second order linear equations with constant coefficients, homogeneous forms, Second order equations with variable coefficients, Variation of parameters. Laplace transforms and its applications to solutions of differential equations.

Books Recommended:

1. Shantinakaran-Text Book of Calculus, Part-II, S. Chand and Co., Chapter-8 (Art. 24, 25, 26)
2. Shantinakaran-Text Book of Calculus, Part-III, S. Chand and Co., Chapter-1 (Art 1,2), 3, 4(Art. 10 to 12 ommitting Simpsons Rule), 5(Art-13) and 6(Art-15).
3. B.P. Acharya and D.C. Sahu-Analytical Geometry of Quadratic Surfaces, Kalyani Publishers, New Delhi, Ludhiana.
4. Santosh K. Sengar-Advanced Calculus, Chapters: 2, 4, 5, 6, 7, 11, 12, 13.
5. J. Sinharoy and S. Padhy-A Course of Ordinary and Partial Differential Equations, Kalyani Pub- lishers. Chapters: 2(2.1 to 2.7), 3, 4(4.1 to 4.7), 5, 9(9.1, 9.2, 9.3, 9.4, 9.5, 9.10, 9.11, 9.13).

Books for References:

1. Shanti Narayan and P.K. Mittal-Analytical Solid Geometry, S. Chand & Company Pvt. Ltd., New Delhi.
2. David V. Weider-Advanced Calculus, Dover Publications.
3. Martin Braun-Differential Equations and their Applications-Martin Braun, Springer International.
4. M.D. Raisinghanian-Advanced Differential Equations, S. Chand & Company Ltd., New Delhi.