B.A./B.Sc. I (SEMESTER-I) PAPER-I Differential Calculus & Integral Calculus

Programme: Certificate Class: B.A./B.Sc.	Year: First	Semester: First
Subject: Mathematics		
Course Code: B030101T	Course Title: Differential Calculus & Integral Calculus	

Course outcomes:

CO1: The Programme outcome is to give foundation knowledge for the students to understand basics of mathematics including applied aspect for developing enhanced quantitative skills and pursuing higher mathematics and research as well.

CO2: By the time students complete the course they will have wide ranging application of the subject and have the knowledge of real valued functions such as sequence and series. They will also be able to know about convergence of sequence and series. Also, they have knowledge about curvature, envelope and evolutes and trace curve in polar, Cartesian as well as parametric curves.

CO3: The main objective of the course is to equip the student with necessary analytic and technical skills. By applying the principles of integral he learns to solve a variety of practical problems in science and engineering.

CO4: The student is equipped with standard concepts and tools at an intermediate to advance level that will serve him well towards taking more advance level course in mathematics.

Credits: 4	Core Compulsory / Elective
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Part- A
Differential Calculus

Unit	Topics	No. of Lectures
I	Introduction to Indian ancient Mathematics and Mathematicians should be included under Continuous Internal Evaluation (CIE).(Appendix) Neighborhood of a point, bounded above sets, bounded below sets, Bounded Sets, Unbounded sets, open sets/intervals, closed sets/intervals, Limit points of a set, Isolated points, Limit, continuity and differentiability of function of single variable, Cauchy's definition, Uniform continuity, boundedness theorem, Intermediate value theorem, extreme value theorem, Darboux's intermediate value theorem for derivatives and Chain rule.	9
II	Rolle's theorem, Lagrange and Cauchy Mean value theorems, Taylor's theorem with various forms of remainders, Successive differentiation, Leibnitz theorem, Maclaurin's and Taylor's series. Partial differentiation, Euler's theorem on homogeneous function.	7
III	Tangent and Normal, Asymptotes, Curvature, Envelops and evolutes, Tests for concavity and convexity, Points of inflexion, Multiple points, Parametric representation of curves and tracing of parametric curves, Tracing of curves in Cartesian and Polar forms.	7
IV	Definition of a sequence, theorems on limits of sequences, bounded and monotonic sequences, Cauchy's convergence criterion, Cauchy sequence, limit superior and limit inferior of a sequence, subsequence, Series of non-negative terms, convergence and divergence, Comparison tests, Cauchy's integral test, Ratio tests, Root test, Raabe's logarithmic test, de Morgan and Bertrand's tests, alternating series, Leibnitz's theorem, absolute and conditional convergence.	7

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Part-B
Integral Calculus

Unit	Topics	No. of Lectures
V	Concept of partition of interval, Properties of Partitions, Riemann integral, Criterion of Riemann Integrability of a function, Integrability of continuous and monotonic functions, Fundamental theorem of integral calculus, Mean value theorems of integral calculus. Differentiation under the sign of Integration.	9
VI	Improper integrals, their classification and convergence, Comparison test, μ-test, Abel's test, Dirichlet's test, quotient test, Beta and Gamma functions.	7
VII	Rectification, Volumes and Surfaces of Solid of revolution, Pappus theorem, Multiple integrals, change of order of double integration, Dirichlet's theorem, Liouville's theorem for multiple integrals.	7
VIII	Vector Differentiation, Gradient, Divergence and Curl, Normal on a surface, Directional Derivative, Vector Integration., Statements of Theorems, of Gauss, Green & Stokes, only without proof, Applications of these theorems for evaluation of double and triple integrals.	7

Suggested Readings (Part- A Differential Calculus):
1. R.G. Bartle & D.R. Sherbert, **Introduction to Real Analysis**, John Wiley & Sons, 1999
2. T.M. Apostal, **Calculus Vol. I**, John Wiley & Sons Inc., 1974
3. Ajit Kumar and S. Kumaresan, **A Basic Course in Real Analysis**, CRC Press, 2019
4. S. Balachandra Rao & C. K. Shantha, **Differential Calculus**, New Age Publication. 1992
5. H. Anton, I. Birens and S. Davis, **Calculus**, John Wiley and Sons, Inc. 2007
6. G.B. Thomas and R.L. Finney, **Calculus**, Pearson Education, 2010
7. Wilson A Sutherland, **Introduction to Metric and Topological Spaces**, Oxford University Press, 2009
8. Suggestive digital platforms web links: NPTEL/SWAYAM/MOOCS

Suggested Readings (Part-B Integral Calculus):
1. T.M. Apostol, **Calculus Vol. II**, John Wiley Publication, 1974
2. Withold A.J. Kosmala, **A Friendly Introduction to Analysis, Single and Multivariable**, Pearson/Prentice Hall, 2003
3. Shanti Narayan & P.K. Mittal, **Integral Calculus**, S Chand, 2005
4. Erwin Kreyszig, **Advanced Engineering Mathematics**, John Wiley & Sons. 2011
5. Suggestive digital platforms web links: NPTEL/SWAYAM/MOOCS

This course can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), Chemistry/Biochemistry/Life Sciences (UG), Economics (UG/PG), Commerce (UG), BBA/BCA, B.Sc. (C.S.).

Suggested Continuous Evaluation Methods: Max. Marks: 25		
SN	Assessment Type	Max. Marks
1	Class Tests	10
2	Online Quizzes/ Objective Tests	5
3	Presentation	5
4	Assignment (Introduction to Indian ancient Mathematics and Mathematicians).	5

Course prerequisites: To study this course, a student must have subject Mathematics in class 12th

Suggested equivalent online courses:

Further Suggestions:

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B.A./B.Sc. I (SEMESTER-I) Paper-II Practical

Programme: Certificate Class: B.A./B.Sc.	Year: First	Semester: First	
		Subject: Mathematics	
Course Code: B030102P		Course Title: Practical	
Course outcomes:			

CO1: The main objective of the course is to equip the student to plot the different graph and solve the different types of equations by plotting the graph using different computer software such as Mathematica /MATLAB /Maple /Scilab/Maxima etc.

CO2. After completion of this course student would be able to know the convergence of sequences through plotting, verify Bolzano-Weierstrass theorem through plotting the sequence, Cauchy's root test by plotting n^{th} roots and Ratio test by plotting the ratio of nth and $(n + 1)^{th}$ term.

CO3. Student would be able to plot Complex numbers and their representations, Operations like addition, subtraction, Multiplication, Division, Modulus and Graphical representation of polar form.

CO4: Student would be able to perform following task of matrix as Addition, Multiplication, Inverse, Transpose, Determinant, Rank, Eigenvectors, Eigenvalues, Characteristic equation and verification of the Cayley-Hamilton theorem, Solving the systems of linear equations.

Credits: 2	Core Compulsory / Elective
Max. Marks: 25+75	Min. Passing Marks:
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4	

Unit	Topics	No. of Lectures
	Practical / Lab work to be performed in Computer Lab. List of the practical to be done using R/Python/Mathematica /MATLAB /Maple /Scilab/Maxima etc. **1.** Plotting the graphs of the following functions: i. a^x ii. $[x]$ (Greatest integer function) iii. $x^{2n}; n \in \mathbb{N}$ iv. $x^{2n-1}; n \in \mathbb{N}$ v. $\frac{1}{x^{2n-1}}; n \in \mathbb{N}$ vi. $\frac{1}{x^{2n}}; n \in \mathbb{N}$ vii. $\sqrt{ax + b}, |ax + b|, c \pm |ax + b|$ viii. $\frac{|x|}{x}, \sin\left(\frac{1}{x}\right), x\sin\left(\frac{1}{x}\right), e^x, e^{-x}$ for $x \neq 0$. ix. $e^{ax+b}, \log(ax+b), \frac{1}{ax+b}, \sin(ax+b), \cos(ax+b), |\sin(ax+b)|, |\cos(ax+b)|$. **2.** Observe and discuss the effect of changes in the real constants a and b on the graphs. i. By plotting the graph find the solution of the equations $x = e^x, x^2 + 1 = e^x, 1 - x^2 = e^x, x = \log10(x), \cos(x) = x, \sin(x) = x, \cos(y) = \cos(x), \sin(y) = \sin(x)$ etc. ii. Plotting the graphs of polynomial of degree 2,3, 4 and 5, and their first and second derivatives. iii. Sketching parametric curves, e.g., Trochoid, Cycloid, Epicycloid and Hypocycloid etc.	

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	iv. Graph of circular and hyperbolic functions. v. Obtaining surface of revolution of curves. vi. Complex numbers and their representations, Operations like addition, Multiplication, Division, Modulus. Graphical representation of polar form. vii. Find numbers between two real numbers and plotting of finite and infinite subset of R. viii. Matrix Operations: Addition, Multiplication, Inverse, Transpose, Determinant, ix. Study the convergence of sequences through plotting. x. Verify Bolzano-Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot. xi. Study the convergence/divergence of infinite series by plotting their sequences of partial sum. xii. Cauchy's root test by plotting n^{th} roots. xiii. Ratio test by plotting the ratio of nth and $(n + 1)^{th}$ term.	

Suggested Readings

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Further Suggestions:

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