Syllabus B.Sc. Mathematics (Theory and Practicles)

I SEMESTER Paper - MATDSCT 1.1: Algebra - I and Calculus - I

Total: 64 Hrs Credits :4

Teaching Hours : 4 hours/week Marks: Theory 70 + IA 30

Unit-I: Matrices: Recapitulation of Symmetric and Skew Symmetric matrices. Algebra of Matrices; Row and column reduction, Echelon form. Rank of a matrix; Inverse of a matrix by elementary operations; Solution of system of linear equations; Criteria for existence of non-trivial solutions of homogeneous system of linear equations. Solution of non-homogeneous system of linear equations. Eigen values and Eigen vectors of square matrices, real symmetric matrices and their properties, reduction of such matrices to diagonal form, Cayley-Hamilton theorem, inverse of matrices by Cayley-Hamilton theorem (Without Proof). **16hrs**

Unit-II: Polar Co-ordinates: Polar coordinates, angle between the radius vector and tangent. Angle of Intersection of curves (polar forms), pedal equations. Derivative of an arc in Cartesian, parametric and polar forms, curvature of plane curve-radius of curvature formula in Cartesian, parametric and polar and pedal forms- center of curvature, Evolutes and envelops. **16hrs**

Unit-III: Differential Calculus-I: Limits, Continuity, Differentiability (Only Definitions) Intermediate value theorem, Rolle's Theorem (without proof), Lagrange's Mean Value theorem, Cauchy's Mean value theorem and examples. Taylor's theorem (without proof), Taylor's series, Maclaurin's expansions, Indeterminate forms and examples. **16hrs**

Unit-IV: Successive Differentiation: nth Derivatives of Standard functions $e^{ax+b}, (ax+b)^n, \log(ax+b), \sin(ax+b), \cos(ax+b), e^{ax}\sin(bx+c), e^{ax}\cos(bx+c)$, Leibnitz theorem and its applications. **16hrs**

Reference Books:

1. University Algebra - N.S. Gopala Krishnan, New Age International (P) Limited
2. Theory of Matrices - B S Vatsa, New Age International Publishers.
3. Matrices - A R Vasista, Krishna Prakashana Mandir.
4. Elements of Real Analysis - Shanti Narayan, S. Chand & Company, New Delhi.
5. Differential Calculus - Shanti Narayan, S. Chand & Company, New Delhi.
6. Calculus – Lipman Bers, Holt, Rinehart & Winston.
7. Calculus - S Narayanan & T. K. Manicavachogam Pillay, S. Viswanathan Pvt. Ltd., vol. I & II.
8. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed. USA: Mc. Graw.

PRACTICAL: MATDSCP 1.1: On Algebra - I and Calculus - I

Total: 64 Hrs Credits : 2

Practicle Hours : 4 hours/week Marks: Practical 35 + IA 15

Practical/Lab Work to be performed in Computer Lab

Suggested Software's: Maxima/Scilab/Maple/MatLab/Mathematica/Phython/R.

- Introduction to the software and commands related to the topic.

1. Computation of addition and subtraction of matrices,
2. Computation of Multiplication of matrices.
3. Computation of Trace and Transpose of Matrix
4. Computation of Rank of matrix and Row reduced Echelon form.
5. Computation of Inverse of a Matrix using Cayley-Hamilton theorem.
6. Solving the system of homogeneous and nonhomogeneous linear algebraic equations.
7. Finding the nth Derivative of e^{ax}, trigonometric and hyperbolic functions
8. Finding the nth Derivative of algebraic and logorithmic functions.
9. Finding the nth Derivative of $e^{ax}\sin(bx+c)$, $e^{ax}\cos(bx+c)$.
10. Finding the Taylor's and Maclaurin's expansions of the given functions.
11. Finding the angle between the radius vector and tangent.
12. Finding the curvatures of the given curves.

Open Elective: MATOE 1.1a: Basic Mathematical Modelling-I:

Unit.1: Number bases, conversion of a base, Binary fractions and Binary Arthemic

Unit.2: Linear, quadratic, exponential and logarithmic functions with examples.; Break-Even point

Unit.3: Arithmetic and Geometric progressions including series and illustrative with examples.

Unit.4: Permutations and Combinations, matrices.

Open Elective: MATOE 1.1b: Business Mathematics-I:

II SEMESTER Paper - MATDSCT 2.1: Algebra - II and Calculus - II

Total: 64 Hrs Credits :4

Teaching Hours : 4 hours/week Marks: Theory 70 + IA 30

Unit-I: Real Number System: Recapitulation of number system. Countable and uncountable sets-standard theorems. Real line, bounded sets, suprimum and infimum of a set, completeness properties of R, Archimidean property of R. Intervals, neighbourhood of a point, open sets, closed sets, limit points and Bolzano-Weierstrass theorem (Without proof) **16 hours**

Unit-II: Groups: Definition of a group with examples and properties, Problems there on, Subgroups, center of groups, definition of order of an element of a group and its related theorems, cyclic groups, Coset decomposition, Factor groups, Lagrange's theorem and its consequences. Fermat's theorem and Euler's ϕ function. **16 hours**

Unit-III: Partial Derivatives: Functions of two or more variables-explicit and implicit functions, partial derivatives. Homogeneous functions- Euler's theorem, total derivatives, differentiation of implicit and composite functions, Jacobians and standard properties and illustrative examples. Taylor's and Maclaurin's series for functions of two variables, Maxima-Minima of functions of two variables. **16 hours**

Unit-IV: Integral Calculus: Recapitulation of definite integrals and its properties. *Line integral*: Definition of line integral and basic properties, examples on evaluation of line integrals. *Double integral*: Definition of Double integrals and its conversion to iterated integrals. Evaluation of double integrals by changing the order of integration and change of variables. Computation of plane surface areas, volume underneath a surface of revolution using double integral. *Triple integral*: Definition of triple integrals and evaluation-change of variables, volume as triple integral. Differentiation under the integral sign by Leibnitz rule. Applications of Integration-Finding the arc lengrth, surface area, volume of solid revolution (Cartesian, parametric and Polar forms) **16 hours**

Reference Books:

1. Topics in Algebra- I N Herstain, Wiley Eastern Ltd., New Delhi.
2. Higher algebra - Bernard & Child, Arihant, ISBN: 9350943199/ 9789350943199.
3. Modern Algebra - Sharma and Vasishta, Krishna Prakashan Mandir, Meerut, U.P.
4. Differential Calculus - Shanti Narayan, S. Chand & Company, New Delhi.
5. Integral Calculus - Shanti Narayan and P K Mittal, S. Chand and Co. Pvt. Ltd.,
6. Schaum's Outline Series - Frank Ayres and Elliott Mendelson, 5th ed. USA: Mc. Graw Hill., 2008.
7. Mathematical Analysis- S C Malik, Wiley Eastern.
8. A Course in Abstract Algebra- Vijay K Khanna and S K Bhambri, Vikas Publications.
9. Text Book of BSc Mathematics-G K Ranganath, S Chand Publications.

PRACTICAL: MATDSCP 2.1: On Algebra -II and Calculus - II

Total: 64 Hrs Credits : 2

Practicle Hours : 4 hours/week Marks: Practical 35 + IA 15

Practical/Lab Work to be performed in Computer Lab

Suggested Software's: Maxima/Scilab/Maple/MatLab/Mathematica/Phython/R.

1. Program for verification of binary operations.
2. Program to construct Cayley table and test abelian for given finite set.
3. Program to find all possible cosets of the given finite group.
4. Program to find generators and corresponding possible subgroups of a cyclic group.
5. Programs to verification of Lagrange's theorem with suitable examples.
6. Program to verify the Euler's ϕ function for a given finite group.
7. Program to
8. Program to verify the Euler's theorem and its extension.
9. Programs to construct series using Maclaurin's expansion for functions of two variables.
10. Program to evaluate the line integrals with constant and variable limits.
11. Program to evaluate the Double integrals with constant and variable limits.
12. Program to evaluate the Triple integrals with constant and variable limits.
13. Programs to compute arc length, surface area and volume.

Open Elective: MATOE 2.1a: Basic Mathematical Modelling-II:

Open Elective: MATOE 2.1b: Business Mathematics-II (other than science stream students)

Unit.1: Graph of linear inequality in two variables, linear inequalities in two variables, graphs of linear inequalities-solution sets,

Unit.2: Elements of trigonometry, measurement of angles, relation between sexagesimal and centesimal systems, illustrative examples, Trignometrical ratios

Unit.3: Trignometrical ratios of some standard angles and associated angles and illustrative examples.

Unit.4: Compound angles, trigonometric ratios of multiple and sub multiple angles, trigonometric identities, inverse trigonometric circular functions

III SEMESTER Paper - MATDSCT 3.1: Ordinary Differential Equations and Real Analysis-I

Total: 64 Hrs Credits :4

Teaching Hours : 4 hours/week Marks: Theory 70 + IA 30

Unit-I: Ordinary Differential Equations: Recapitulation of definition of an ordinary differential equation, order and degree, solution of first degree and first order equations. Solution of exact differential equations and reducible to exact form with standard integrating factor. Equations of first order and higher degree- Solvable for p, x, y and Clairaut's form (general and singular solutions). Orthogonal trajectories. **16 hours**

Unit-II: Higher Order Linear Differential Equations: Second and higher order linear differential equations with constant co-efficients, complementary functions, Particular integral, standard types and particular solution by method of undetermined coefficients. Cauchy-Euler differential equations. Simultaneous differential equations with constant co-efficients (two variables). **16 hours**

Unit-III: Sequence of Real Numbers: Definition of a sequence, limits of a sequence, algebra of limit of a Sequence- Bounded and unbounded sequence; Convergent, Divergent and Oscillatory sequence and problems there on. Every convergent sequence is bounded-converse is not true, Monotonic Sequence and their properties, Cauchy's sequence. **16 hours**

Unit-IV: Infinite Series: Convergence and divergence of infinite series of positive real numbers, necessary condition for convergence, Cauchy's criterion for convergence; test for convergence of positive term series- geometric, p-series. Geometric series; Cauchy's criterion (statement only). Tests of convergence of series - comparison tests-Cauchy's nth root test - D'Alemberts Ratio test - Raabe's test. Summation of series; exponential, logarithmic and binomial series and related examples. **16 hours**

Reference Books:

1. Introductory course in Differential Equations - Daniel Murray, Orient longman.
2. Advanced Engineering Mathematics- Erwin Kreyszig, Wiley 10th Edition.
3. Textbook of BSc Mathematics - Chakravarthy L.N, Vol 2, ISBN:1234567176245, Chethana. Book House.
4. Ordinary and Partial Differential Equations - M D Raisinghania, S. Chand and Co. Pvt. Ltd.
5. Schaum's outline of theory and problems of Differential Equations - Frank Ayres, McGrawHill Publishing Co.
6. Differential Equations and Its Applications - S Narayanan and T K Manicavachagom Pillay, S V Publishers Private Ltd.
7. Differential equations with Applications and Historical Notes - G F Simmons, 2nded. McGraw-Hill Publishing Company.
8. Elimentary Analysis- K A Ross, 2nd Edition, Springer.
9. An Introduction to Analysis- Gerald G.Bilodeau, Paul R.Thie and G.E.Keough, 2nd Edition, Jones and Bartlett.
10. Mathematical Analysis- S C Malik and Savith Arora, Wiley Eastern.
11. Elements of Real Analysis (Revised Edition) – S Narayan and M D Raisinghania, S Chand.

PRACTICAL: MATDSCP 3.1: **Ordinary Differential Equations and Real Analysis-I**

Total: 64 Hrs Credits : 2

Practicle Hours : 4 hours/week Marks: Practical 35 + IA 15

Practical/Lab Work to be performed in Computer Lab

Suggested Software's: Maxima/Scilab/Maple/MatLab/Mathematica/Phython/R.

1. Program to find the solution of given differential equation (1st order 1st degree non-linear)
2. Program to find the solution of given differential equation and plotting the solution (1st order 1st degree linear)
3. Program to find complementary function and particular integral of given higher order differential equation with constant coefficients.
4. Program to find solution of given simultaneous differential equations with constant coefficients and plot the curve.
5. Program to find the solutions of differential equations for x, y, p.
6. Program to find singular solution by using Clairat's form.
7. Program to find the solutions of differential equations using orthogonal trajectories.
8. Program to find the Particular solution of differential equations using Method of Undetermined coefficients.
9. Program to illustrate convergence, divergence or oscillatory sequences.
10. Program for Cauchy's criterion to determine convergence of a given sequence.
11. Program to illustrate the convergence of series of positive terms.
12. Program to illustrate Cauchy;s root test, Rabie's and ratio tests.
13. Program for verification of exponential, logarithmic and Binomial series.

Open Elective: MATOE 3.1a: Quantitative Mathematics

Open Elective: MATOE 3.1b: Bio Mathematics

IV SEMESTER Paper - MATDSCT 4.1: Partial Differential Equations and Integral Transforms (Laplace , Fourier series and Transform)

Total: 64 Hrs Credits :4

Teaching Hours : 4 hours/week Marks: Theory 70 + IA 30

Open Elective: MATOE 4.1a: Mathematical Finance

Open Elective: MATOE 4.1b: Linear Programming and Game theory

V SEMESTER Paper - MATDSCT 5.1: Complex Analysis

Total: 48 Hrs Credits : 3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

V SEMESTER Paper - MATDSCT 5.2: Advanced Algebra

Total: 48 Hrs Credits : 3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

V SEMESTER Paper - MATDSCP 5.1: practical's on Complex Analysis

Total: 48 Hrs Credits : 2

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

V SEMESTER Paper - MATDSCP 5.2: practical's on Advanced Algebra

Total: 48 Hrs Credits : 2

V SEMESTER Paper - MATDSE 5.1a: Riemann Integration and Improper Integrals

Total: 48 Hrs Credits : 3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

V SEMESTER Paper - MATDSE 5.1b: Vector Calculus

Total: 48 Hrs Credits : 3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

V SEMESTER Paper - MATDSE 5.1c: Mechanics

Total: 48 Hrs Credits : 3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

V SEMESTER Paper - MATDSE 5.1d: Mathematical Logic

Total: 48 Hrs Credits : 3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

VI SEMESTER Paper - MATDSCT 6.1: Linear Algebra

Total: 48 Hrs Credits :3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

VI SEMESTER Paper - MATDSCT 6.2: Numerical Analysis

Total: 48 Hrs Credits :3

Teaching Hours : 4 hours/week Marks: Theory 70 + IA 30

VI SEMESTER Paper - MATDSCP 6.1: Practical's on Linear Algebra

Total: 48 Hrs Credits :2

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

VI SEMESTER Paper - MATDSCP 6.2: Practical's on Numerical Analysis

Total: 48 Hrs Credits :2

Teaching Hours : 4 hours/week Marks: Theory 70 + IA 30

VI SEMESTER Paper - MATDSE 6.1a: Analytical Geometry in 3D

Total: 48 Hrs Credits :3

VI SEMESTER Paper - MATDSE 6.1b: Number Theory

Total: 48 Hrs Credits :3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

VI SEMESTER Paper - MATDSET6.1c: Special Functions

Total: 48 Hrs Credits :3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

VI SEMESTER Paper - MATDSET 6.1d: Linear Programming Problmes

Total: 48 Hrs Credits :3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

VII SEMESTER Paper - MATDSCT 7.1: Discrete Mathematics

Total: 48 Hrs Credits :3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

VII SEMESTER Paper - MATDSCT 7.2: Advanced Ordinary Differential Equations

Total: 48 Hrs Credits :3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

VII SEMESTER Paper - MATDSCP 7.1: Practical's on Discrete Mathematics

Total: 48 Hrs Credits :3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

VII SEMESTER Paper - MATDSCP 7.2: Practical's on Advanced Ordinary Differential Equations

Total: 48 Hrs Credits :3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

VII SEMESTER Paper - MATDSCT 7.3: Advanced Analysis

Total: 64 Hrs Credits :4

Teaching Hours : 4 hours/week Marks: Theory 70 + IA 30

VII SEMESTER Paper - MATDSCE 7.1a: Graph Theory

Total: 48 Hrs Credits :3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

VII SEMESTER Paper - MATDSCE 7.1b: Differential Geometry

Total: 48 Hrs Credits :3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

VII SEMESTER Paper - MATDSCE 7.1c: Fuzzy sets and Fuzzy Systems

Total: 48 Hrs Credits :3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

VII SEMESTER Paper - MATDSCE 7.2: Research Methodology in Mathematics

Total: 48 Hrs Credits :3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

VIII SEMESTER Paper - MATDSCT 8.1: Advanced Complex Analysis

Total: 64 Hrs Credits :4

Teaching Hours : 4 hours/week Marks: Theory 70 + IA 30

VIII SEMESTER Paper - MATDSCT 8.2: Advanced Partial Differential Equations

Total: 64 Hrs Credits :4

Teaching Hours : 4 hours/week Marks: Theory 70 + IA 30

VIII SEMESTER Paper - MATDSCT 8.3: General Topology

Total: 48 Hrs Credits :3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

VIII SEMESTER Paper - MATDSCE 8.1a: Operations Research

Total: 48 Hrs Credits :3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

VIII SEMESTER Paper - MATDSCE 8.1b: Fuzzy Logic and Applications

Total: 48 Hrs Credits :3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

VIII SEMESTER Paper - MATDSCE 8.1c: Mathematical Modelling

Total: 48 Hrs Credits :3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

VIII SEMESTER Paper - MATDSCE 8.2: Research Project work/Any TWO of the following electives

MATDSCE 8.2a: Finite Element Methods

MATDSCE 8.2b: Graph Theory and Networking

MATDSCE 8.2c: Cryptography

MATDSCE 8.2d: Information Theory and Coding

MATDSCE 8.2d: C++ Programming for Mathematics

MATDSE 8.2F: Latice theory and Boolean Algebra

Total: 48 Hrs Credits :3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

For Minor Mathematics

V SEMESTER Paper – MATDSC B5: Vector Differential Calculus

Total: 48 Hrs Credits : 3

Teaching Hours : 3 hours/week Marks: Theory 70 + IA 30

Syllabus for B.A./B.Sc. with Mathematics as Major Subject
&
B.A./B.Sc. (Hons) Mathematics

SEMESTER – III
(2022-23 onwards)

MATDSCT 3.1: Ordinary Differential Equations and Real Analysis – I	
Teaching Hours: 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 56 Hours	**Max. Marks: 100** **(SEE- 60 + I.A. - 40)**

Course Learning Outcomes: This course will enable the students to:

- Solve first-order non-linear differential equations and linear differential equations.
- To model problems in nature using Ordinary Differential Equations.
- Formulate differential equations for various mathematical models
- Apply these techniques to solve and analyze various mathematical models.
- Understand the fundamental properties of the real numbers that lead to define sequence and series, the formal development of real analysis.
- Learn the concept of Convergence and Divergence of a sequence.
- Able to handle and understand limits and their use in sequences, series, differentiation, and integration.
- Apply the ratio, root, alternating series, and limit comparison tests for convergence and absolute convergence of an infinite series.

Ordinary Differential Equations:

Unit I: Recapitulation of Differential Equations of first order and first degree, Differential equations of the first order and higher degree: Equations solvable for p, x, y. Clairaut's equation and singular solution. Orthogonal trajectories of Cartesian and polar curves. **14hrs**

Unit II: Linear differential equations of the nth order with constant coefficients. Particular Integrals when the RHS is of the form e^{ax}, sin(ax+b), cos(ax+b), x^n, e^{ax} V and x V (with proofs), where V is a function of x. Cauchy – Euler equations, Legendre differential equations, Method of variation of parameters. Simultaneous differential equations with two and more than two variables. Condition for integrability of total differential equations P dx +Q dy+ R dz = 0.

14 hrs

Real Analysis – I :

Unit III: Sequences: Sequences of real numbers, Bounded sequences. Limit of a sequence. convergent, divergent, and oscillatory sequences. Monotonic sequences. Algebra of convergent sequences. Limit points of a sequence. Limit superiorand limit inferior of sequences.

14hrs

Unit IV: Infinite Series: Definition of convergent, divergent and oscillatory series. Series of non-negative terms, Geometric series, P-series (Harmonic series). Comparison tests for positive term series. D'Alembert's ratio test, Raabe's test. Cauchy's Root test and Cauchy's integral test. Alternating series. Leibnitz's theorem. Absolute convergence and conditional convergence of a series. Summation of series: Binomial, exponential and logarithmic. **14 hrs**

Reference Books:

1. M.D.Raisinghania, Ordinary Differential Equations & Partial Differential Equations, S. Chand & Company, New Delhi.
2. J. Sinha Roy and S Padhy: A course of Ordinary and Partial Differential Equation, Kalyani Publishers, New Delhi.
3. D. Murray, Introductory Course in Differential Equations, Orient Longman (India)
4. W. T. Reid, Ordinary Differential Equations, John Wiley, New Delhi.
5. M. L. Khanna, Differential Equations, Jai PrakashNath& Co. Meerut.
6. S. L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984.
7. R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2015.
8. Gerald G. Bilodeau, Paul R. Thie, G.E. Keough, An Introduction to Analysis, 2nd Ed., Jones & Bartlett, 2010.
9. K. A. Ross, Elementary Analysis: The Theory of Calculus (2^{nd} edition), Springer, 2013
10. S. K. Berberian, A First Course in Real Analysis, Springer Verlag, New York, 1994.
11. T. Apostol, Mathematical Analysis, Narosa Publishing House
12. M.L Khanna and L.S. Varhiney, Real Analysis by, Jai Prakash Nath & Co. Meerut.
13. Kreyzig, Advanced Engineering Mathematics, John Wiley, New Delhi.

PRACTICAL

MATDSCP 3.1: Practicals on Ordinary Differential Equations and Real Analysis – I	
Teaching Hours: 4 Hours/Week	**Credits: 2**
Total Teaching Hours: 56 Hours	**Max. Marks: 50** **(SEE - 25 + I.A. – 25)**

Course Learning Outcomes: This course will enable the students to gain handson experience of

- Free and Open Source software (FOSS) tools or computer programming.
- Solving exact differential equations
- Ploting orthogonal trajectories
- Finding complementary function and particular integral of linear and homogeneous differential equations.
- Acquire knowledge of applications of real analysis and differential equations.
- Verification of convergence/divergence of different types of series

Practicals/Lab Work to be performed in Computer Lab

Use open-source software to executive the practical problems. (Maxima/ Scilab/MatLab /Mathematica/Python

1. Fundamentals of Ordinary differential equations and Real analysis using FOSS
2. Verification of exactness of a differential equation
3. Plot orthogonal trajectories for Cartesian and polar curves
4. Solutions of differential equations that are solvable for x, y, p.
5. To find the singular solution by using Clairaut's form.
6. Finding the Complementary Function and Particular Integral of linear and homogeneous differential equations with constant coefficients and plot the solutions.
7. Finding the Particular Integral of differential equations up to second order and plot the solutions.
8. Solutions to the Total and Simultaneous differential equations and plot the solutions.
9. Test the convergence of sequences
10. Verification of exponential, logarithm and binomial series.
11. Verification of geometric series, p-series, Cauchy's Integral test, root test, and D Alembert's Test
12. Examples on a series of positive terms.
13. Examples on alternating series using Leibnitz's theorem.
14. Finding the convergence of series using Cauchy's criterion for partial sums.

Open Elective Course

(For students of Science stream who have not chosen Mathematics as one of the Core Course)

MATOET3.1(A) Ordinary Differential Equations	
Teaching Hours: 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100** **(SEE - 60 + I.A. – 40)**

Course Learning Outcomes: This course will enable the students to:

- Understand the concept of the differential equation and their classification
- Know the meaning of the solution of a differential equation.
- To solve first-order ordinary differential equations.
- To Solve exact differential equations and Converts to separable and homogenous equations to exact differential equations by integrating factors.
- To Solve Bernoulli differential equations.
- To find the solution to higher-order linear differential equations.

Unit I: Recapitulation of Differential Equations of first order and first degree, Exact Differential equations, Necessary and sufficient condition for the equations to be exact, Reducible to the exact differential equations. **14hrs**

Unit II: Differential equations of the first order and higher degree: Equations solvable for p, x, y. Clairaut's equation and singular solution. Orthogonal trajectories of Cartesian and polar curves. **14hrs**

Unit III: Linear differential equations of the nth order with constant coefficients. Particular Integrals when the RHS is of the form e^{ax}, sin(ax+b), cos(ax+b), x^n, e^{ax} V and x V (with proofs), where V is a function of x. **14 hrs**

Reference Books:

1. M.D.Raisinghania, Ordinary Differential Equations & Partial Differential Equations, S. Chand & Company, New Delhi.
2. J. Sinha Roy and S Padhy: A Course of Ordinary and Partial Differential Equation Kalyani Publishers, New Delhi.
3. D Murray, Introductory Course in Differential Equations, Orient Longman (India)
4. W T Reid, Ordinary Differential Equations, John Wiley, New Delhi
5. M. L. Khanna, Differential Equations, Jai PrakashNath& Co. Meerut.
6. Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984.

Open Elective Course

(For students of other than Science stream)

MATOET 3.1(B): Quantitative Mathematics	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100** **(SEE - 60 + IA - 40)**

Course Outcomes: This course will enable the students to:

- Understand number system and fundamental operations
- Understand the concept of linear quadratic and simultaneous equations and their applications in real life problems
- Understand and solve the problems based on Age.
- Solve Speed and Distance related problems.

Unit-I:NumberSystem

Numbers, Operations on Numbers,Tests on Divisibility, HCF and LCM of numbers. Decimal Fractions, Simplification, Square roots and Cube roots - Problems thereon. Surds and Indices. Illustrations thereon.

14 Hrs

Unit-II:Theory of equations

Linear equations, quadratic equations, simultaneous equations in two variables, simple application problems - Problems on Ages, Problems on conditional Age calculations, Present & Past age calculations. 14 Hrs

Unit-III:Quantitative Aptitude

Percentage, Average, Average Speed-problems.Time and distance, problems based on trains, problems on-work and time,work and wages, clock and calendar.

14 Hrs

Reference Books:

1. R.S. Aggarwal, *Quantitative Aptitude*, S. Chand and Company Limited, NewDelhi-110 055 .
2. Abhijit Guha, *QuantitativeAptitude*,5th Edition,Mc.Grawhillpublications.2014.
3. R V Praveen,*QuantitativeAptitudeand Reasoning*,PHI publishers.
4. R S Aggarwal, Objective Arithmetic, S. Chand & Company Ltd.
5. Qazi Zameerddin,Vijay K Khanna, S K Bhambri, *BusinessMathematics-II Edition.*
6. S. K. Sharma and Gurmeet Kaur, Business Mathematics , Sultan Chand & Sons.
7. Hazarika Padmalochan, A Text Book of Business mathematics for B.Com and BBA Course, Chand Publication.
8. J K Thukrol, Business Mathematics, abci book:2020 First Edition.
9. N. G. Das and J. K. Das, Business Mathematics and Statics, Mc Graw Hill Education, 2017.

Open Elective Course

(For Students of other than Science Stream)

MATOET 3.1(C): Vedic Mathematics	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100(S.A.- 60 + I.A. – 40)**

Course Outcomes: This course will enable the students to:

- Understand the vedic methods of arithmetic
- Understand the vedic methods of division with two/three digit divisor
- Understand the vedic methods of power and root power of two digit numbers

Unit-I: Multiplication:

1. Ekadhikenpurven method (multiplication of two numbers of two digits).
2. Eknunenpurven method (multiplication of two numbers of three digits).
3. Urdhvatiragbhyam method (multiplication of two numbers of three digits).
4. Nikhilam Navtashchramam Dashtaha (multiplication of two numbers of three digits).
5. Combined Operations. **14 Hours**

Unit-II: Division and Divisibility

Part A: Division

1. NikhilamNavtashchramamDashtaha (two digits divisor)
2. ParavartyaYojyet method (three digits divisor)

Part B:Divisibility

1. Ekadhikenpurven method (two digits divisor)
2. Eknunenpurven method (two digits divisor) **14 Hours**

Unit-III:

Power and Root Power:

1. Square (two digit numbers)
2. Cube (two digit numbers).

Root:

1. Square root (four digit number)
2. Cube root (six digit numbers).
3. Solution of linear simultaneous equations. **14 Hours**

Reference Books:

1. Vedic Mathematics, Motilal Banarsi Das, New Delhi.
2. Vedic Ganita: Vihangama Drishti-1, SikshaSanskritiUthana Nyasa, New Delhi.
3. Vedic GanitaPraneta, Siksha Sanskriti Uthana Nyasa, New Delhi.
4. Vedic Mathematics: Past, Present and Future, Siksha Sanskriti Uthana Nyasa, New Delhi.
5. Leelavati, ChokhambbaVidya Bhavan, Varanasi.
6. Bharatiya Mathematicians, Sharda Sanskrit Sansthan, Varanasi.

SEMESTER – IV

MATDSCT 4.1: Partial Differential Equations and Integral Transforms	
Teaching Hours: 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 56 Hours	**Max. Marks: 100 (SEE - 60 + I.A. – 40)**

Course Learning Outcomes: This course will enable the students to

- Solve the Partial Differential Equations of the first order and second order
- Formulate, classify and transform partial differential equations into canonical form.
- Solve linear and non-linear partial differential equations using various methods; and apply these methods to solving some physical problems.
- Able to take more courses on wave equation, heat equation, and Laplace equation.
- Solve PDE by Laplace Transforms and Fourier Transforms

Partial Differential Equations:

Unit I: Basic concepts–Formation of a partial differential equations by elimination of arbitrary constants and functions, Solution of partial differential equations – Solution by Direct integration, Lagrange's linear equations of the form Pp + Qq = R , Standard types of first order non-linear partial differential equations, The integrals of the non-linear equation by Charpit's method. **14 Hrs**

Unit II: Homogeneous linear partial differential equations with constant coefficients. Partial differential equations of the second order. Classification of second-order partial differential equations, canonical forms. **14 Hrs**

Integral Transforms:

Unit III: Laplace Transforms: Definition**,** Basic Properties. Laplace transforms of some standard functions. Laplace transform of Periodic functions. Laplace transform of derivative and integral of a function. Heaviside function. Dirac-delta function. Convolution theorem. Inverse Laplace transforms and its properties. Solution of differential equations by using Laplace transforms. **14 Hrs**

Unit IV: Fourier Series and Transforms: Periodic functions. Fourier Coefficients. Fourier series of functions with period 2 and period 2L. Fourier series of even and odd functions. Half range Cosine and Sine series. **14 Hrs**

Reference Books:

1. D. A. Murray, Introductory Course in Differential Equations, Orient and Longman
2. H. T. H.Piaggio, Elementary Treatise on Differential Equations and their Applications, CBS Publisher & Distributors, Delhi,1985.
3. G. F. Simmons, Differential Equations, Tata McGraw Hill.

4. S. L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.
5. M. D. Raisinghania, Ordinary Differential Equations & Partial Differential Equations, S. Chand & Company, New Delhi.
6. K.Sankara Rao, Introduction to Partial Differential Equations: PHI, Third Edition, 2015.
7. I. N. Sneddean, Elements of Partial differential equations, McGraw-Hill International Editions, 1986.
8. R. Murray and L. Spiegal (Schaum's Series), Laplace Transforms
9. Goel and Gupta, Laplace Transform.
10. Sudhir Kumar, Integral Transform Methods in Science & Engineering, CBS Engineering Series, 2017.
11. Murray R. Spiegal L, Fourier Transforms, Schaum' Series,
12. Earl David Rainville and Philip Edward Bedient–A short course in Differential Equations, Prentice Hall College Div; 6th Edition.
13. Sathya Prakash, Mathematical Physics, S Chand and Sons, New Delhi.

PRACTICALS

MATDSCP 4.1: Practical's on Partial Differential Equations and Integral Transforms	
Practical Hours : 4 Hours/Week	**Credits: 2**
Total Teaching Hours: 56 Hours	**Max. Marks: 50 (S.A.-25 + I.A. – 25)**

Mathematics practical with Free and open Source Software (FOSS) tools for computer programs

Course Learning Outcomes: This course will enable the students to

- Learn Free and Open Source software (FOSS) tools or computer programming.
- Solve problems on Partial Differential Equations and Integral Forms
- To find Laplace transform of various functions
- To finf the Fourier Transform of periodic functions
- To solve differential equations by using Integral transforms.

Programs using Scilab/Maxima/Python:

Elements of Partial differential equations and Integral transforms using FOSS

1. Solutions of Linear Partial differential equations of type1 to type4 and Lagrange's method
2. Solutions of partial differential equation using Charpit's method.
3. Solutions of Second order homogenous partial differential equation with constant coefficients.
4. Solutions to the partial differential equations using separation of variables method (Heat/ Wave/Laplace).
5. Finding the Laplace transforms of some standard and periodic functions.
6. Finding the inverse Laplace transform of simple functions
7. Verification of Convolution Theorem.
8. To solve ordinary linear differential equation using Laplace transform.
9. To solve Integral equation using Laplace transform.
10. To find full range Fourier series of some simple functions with period 2 and 2L
11. To find Half range sine and cosine series of some simple functions and ploting them.
12. To find Cosine Fourier transforms.
13. To find Sine Fourier transforms.

Open Elective Course

(For students of Science stream who have not chosen Mathematics as one of the Core Course)

MATOET4.1(A): Partial Differential Equations	
Teaching Hours: 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100 (SEE-60 + I.A. – 40)**

Course Learning Outcomes: This course will enable the students to

- explain the concept of the differential equation.
- Classifies the differential equations concerning their order and linearity.
- Explains the meaning of the solution of a differential equation.
- solve first-order ordinary differential equations.
- Solves exact differential equations and Converts separable and homogenous equations to exact differential equations by integrating factors.
- Solves Bernoulli differential equations.
- Will be able to find the solution to higher-order linear differential equations.

Unit I: Basic concepts–Formation of a Partial differential equations by elimination of arbitrary constants and functions – Solution of partial differential equations – Solution by Direct integration, Lagrange's linear equations of the form Pp + Qq = R . **14 Hrs**

Unit II : Standard types of first order non-linear partial differential equations, The integrals of the non-linear equation by Charpit's method.Homogeneous Linear partial differential equations with constant coefficients. Partial differential equations of the second order. Classification of second-order partial differential equations, canonical forms.

14 Hrs

Unit III: Classification of second order linear equations as hyperbolic, parabolic, and elliptic. Solutions of the Heat equation, Laplace equation and Wave equation (using separation of variables). **14 Hrs**

Reference Books:

1. D.A. Murray, Introductory course in Differential Equations, Orient and Longman
2. H.T. H.Piaggio, Elementary Treatise on Differential Equations and their applications, C.B.S Publisher & Distributors, Delhi,1985.
3. G.F.Simmons, Differential Equations, Tata McGraw Hill 14
4. S.L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.
5. M.R. Speigel, Schaum's outline of Laplace Transform
6. M. D. Raisinghania, Ordinary Differential equations & Partial differential equations, S. Chand & Company, New Delhi.
7. K.Sankara Rao, Introduction to Partial Differential Equations: PHI, Third Edition, 2015.
8. I. N. Snedden, Elements of Partial differential equations,

OpenElective Course

(For students of other than science stream)

MATOET4.1(B) : Mathematical Finance	
Teaching Hours: 3Hours/week	**Credits: 3**
Total Teaching Hours:42Hours	**Max.Marks:100 (S.A-60+I.A.-40)**

Course Learning Outcomes: Thiscourse will enable the students to

- Understand how compute profit and loss, discount and Banker's discount.
- Understand the concept of Linear equations and inequalities and their use in the solving the Linear Programming Problems.
- Formulation of Transportation Problem and its application in routing problem.

Unit-I:Commercial Arithmetic

Bill of exchange, Bill of discounting procedure. Basic formula related to profit, loss, discount and brokerage, Successive discount, True discount, Banker's discount.

14 Hrs

Unit-II:Linear Programming

Linear equations and inequalities- Rectangular coordinates, straight line, parallel and intersecting lines and linear inequalities, Introduction to linear programming, Mathematical formulation of LPP, Solution of a LPP by graphical method, special cases in graphical method

14 Hrs

Unit-III:Transportation problem

Introduction, Formulation of Transportation problem, Initial basic feasible solution, Steps insolving a transportation problem, optimality check, special cases in Transportation problem. The Traveling salesman Problem (Routing Problem). **14 Hrs**

Reference Books:

1. R S Aggarwal, Objective Arithmetic, S. Chand & Company Ltd.
2. Mizrahi and Sullivan, Mathematics for Business and Social Sciences an Application approach.
3. Qazi Zameeruddin, Vijay K Khanna, S K Bhambri, Business Mathematics- II Edition, Vikas Publishing House.
4. S. Kalavathy, Operation Research, Fourth edition, Vikas publication house Pvt. Ltd.
5. Sreenivasa Reddy M, Operations Research 2nd edition, Sanguine Technical publishers, Bangalore.
6. S. D. Sharma, Operation Research,

Open Elective Course

(For students otherthan science stream)

MATOET 4.1 (C): Mathematics for Social Sciences	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100 (S.A.- 60 + I.A. – 40)**

Course Learning Outcomes: Thiscourse will enable the students to

- Understand the mathematical concept of sets and counting problems.
- Understand the concept of Probalitity and its applications in social sciences.
- Understand the concept of limits and continuity of functions and its applications in business and social sciences.

Unit-I

Sets, counting, permutations, combinations, counting problems, binomial theorem and problems thereon. Probability – Introduction, sample space and assignment of probabilities, properties of the probability of an event, probability of equally likely events, conditional probability, Baye's formula and examples thereon.

14 Hours

Unit-II

Limit and continuity, Derivative- interpretation, derivative formulas, general derivatives for differentiation, composit functions, higher order derivaties and problems thereon.

14 Hours

Unit-III

Applications of the derivative – Relative maxima and Relative minima, Absolute maximum and Absolute minimum, Applied problems, Concavity, Asymptotes, Marginal analysis, Models- Maximizing tax revenue, Otimal trade-in time, and minimizing inventory cost.

14 Hours

REFERENCE BOOKS

1. Abe Mizrahi and Michael Sullivan, Mathematics for Business and Social Sciences and Applied Approach – Third Edition, Wieley.
2. Carl P. Simon and Lawrence Blume, Mathematics for Economists, Viva Books Private Limited, New Delhi, 2015.
3. L. Peccati, M. D'Amico and M. Cigola , Maths for Social Sciences, , Springer.

CURRICULUM CONTENTS FOR

B.A./B.Sc. V SEMESTER & VI SEMESTER

with

MATHEMATICS as Major

W.e.f. the Academic Year
2023 – 2024 and Onwards

DEPARTMENT OF MATHEMATICS
GULBARGA UNIVERSITY
JNANAGANGA CAMPUS, KALABURAGI – 585 106
Phone: 08472 263296

SEPTEMBER, 2023

Name of the Degree Program : B.A./B.Sc.
Discipline Course : Mathematics
Starting Year of Implementation : 2023-24 (V & VI Semesters)

Programme Outcomes (PO): By the end of the program the students will be able to :

PO 1	**Disciplinary Knowledge** : Bachelor degree in Mathematics is the culmination of in-depth knowledge of Algebra, Calculus, Geometry, differential equations and several other branches of pure and applied mathematics. This also leads to study the related areas such as computer science and other allied subjects
PO 2	**Communication Skills**: Ability to communicate various mathematical concepts effectively using examples and their geometrical visualization. The skills and knowledge gained in this program will lead to the proficiency in analytical reasoning which can be used for modeling and solving of real life problems.
PO 3	**Critical thinking and analytical reasoning:** The students undergoing this programme acquire ability of critical thinking and logical reasoning and capability of recognizing and distinguishing the various aspects of real life problems.
PO 4	**Problem Solving** : The Mathematical knowledge gained by the students through this programme develop an ability to analyze the problems, identify and define appropriate computing requirements for its solutions. This programme enhances students overall development and also equip them with mathematical modelling ability, problem solving skills.
PO 5	**Research related skills:** The completing this programme develop the capability of inquiring about appropriate questions relating to the Mathematical concepts in different areas of Mathematics.
PO 6	**Information/digital Literacy**: The completion of this programme will enable the learner to use appropriate software's to solve system of algebraic equation and differential equations.
PO 7	**Self – directed learning**: The student completing this program will develop an ability of working independently and to make an in-depth study of various notions of Mathematics.
PO 8	**Moral and ethical awareness/reasoning:** : The student completing this program will develop an ability to identify unethical behavior such as fabrication, falsification or misinterpretation of data and adopting objectives, unbiased and truthful actions in all aspects of life in general and Mathematical studies in particular.
PO 9	**Lifelong learning**: This programme provides self directed learning and lifelong learning skills. This programme helps the learner to think independently and develop algorithms and computational skills for solving real word problems.
PO 10	Ability to peruse advanced studies and research in pure and applied Mathematical sciences.

Assessment

Weightage for the Assessments (in percentage)

Type of Course	Formative Assessment/ I.A.	Summative Assessment (S.A.)
Theory	40%	60 %
Practical	50%	50 %
Projects	40 %	60 %
Experiential Learning (Internship etc.)	50 %	50 %

Courses for B.A./B.Sc. with Mathematics as Major Subject for V & VI Semester

Semester	Course No.	Theory / Practic	Credit	Paper Title	Marks in percentage	
					S.A.	I.A.
V	MATDSCT5.1	Theory	4	Real Analysis-II and Complex Analysis	60	40
	MATDSCP5.1	Practical	2	Theory based Practical's on Real Analysis-II and Complex Analysis	25	25
	MATDSCT5.2	Theory	4	Vector calculus and Analytical geometry	60	40
	MATDSCP5.2	Practical	2	Theory based Practical's on Vector calculus and Analytical geometry	25	25
	MATSECT-5.1	Theory	2	Programming with Python	30	20
	MATSECP-5.1	Practical	1	Practical's on Python Programming	--	25
VI	MATDSCT6.1	Theory	4	Linear Algebra	60	40
	MATDSCP6.1	Practical	2	Theory based Practical's on Linear Algebra	25	25
	MATDSCT6.2	Theory	4	Numerical Analysis	60	40
	MATDSCP6.2	Practical	2	Theory based Practical's on Numerical Analysis	25	25
	Internship /Project Work	Project	2	Internship Report/Project Report	25	25

Syllabus for B.A./B.Sc. with Mathematics as Major Subject

SEMESTER – V

MATDSCT 5.1: Real Analysis-II and Complex Analysis	
Teaching Hours : 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 60 Hours	**Max. Marks: 100 (S.A.-60 + I.A. – 40)**

Course Learning Outcomes:

The overall expectation from this course is that the student builds a basic understanding on Riemann integration and elementary complex analysis. The broader course outcomes are listed as follow. At the end of this course, the student will be able to:

1. Carry out certain computations such as computing upper and lower Riemann sums as well integrals
2. Describe various criteria for Integrability of functions.
3. Exhibit certain properties of mathematical objects such as integrable functions, analytic functions, harmonic functions and so on.
4. Prove some statements related to Riemann integration as well as in complex analysis
5. Carry out the existing algorithms to construct mathematical structures such as analytic functions
6. Applies the gained knowledge to solve various other problems.

Real Analysis-II

Unit – I: Riemann Integration-I

Definition & examples for partition of an interval, refinement of a partition and common refinement. **Riemann Darboux Sums** - Upper and lower (Darboux) sums –definition, properties & problems.

Riemann Integral – Upper and Lower integrals (definition & problems), Darboux's theorem and Criterion for Integrability, Integrability of sum, difference, product, quotient and modulus of integrable functions. **Integral as a limit of sum (Riemann sum)** – Problems. **Some integrable functions** – Integrability of continuous functions, monotonic functions, bounded function with finite number of discontinuity. **15 Hour**

Unit –II: Riemann-Stieltjes Integral and Improper Integral

Fundamental theorem of Calculus–related problems, change of variables, integration by parts, first and second mean value theorems of integral calculus. Riemann-Stieltjes Integral–Definition & examples. Riemann Integral as a special case. Improper Integral-Improper integrals of the first, second and third kind with examples. Improper integral has the limit of the proper integral. Comparison test, Abel's test and Dirichlet's test for the convergence of the integral of a product of two functions. **15 Hours**

Complex Analysis

Unit – III: Complex numbers and functions of complex variables:

Complex numbers-Cartesian and polar form-geometrical representation-complex-Plane-Euler's formula- $e^{i\theta} = \cos\theta + i\sin\theta$. Functions of a complex variable-limit, continuity and differentiability of a complex function. Analytic function, Cauchy-Riemann equations in Cartesian and Polar forms-Sufficiency conditions for analyticity(Cartesian form only)-Harmonic function-standard properties of analytic functions-construction of analytic function when real or imaginary part is given-Milne Thomson method. **15 Hours**

Unit –IV: Transformations and Complex integration:

Transformations: Definition- Jacobian of a transformation- Identity transformation-Reflection- Translation- Rotation- Stretching- Inversion- Linear transformation- Definitions-Bilinear transformations- Cross-ratio of four points- Cross-ratio preserving property-Preservation of the family of straight lines and circles- Conformal mappings- Discussion of the transformations $w = z^2$, $w = \sin z$, $w = e^z$, $w = \frac{1}{2}\left(z + \frac{1}{z}\right)$.

Complex integration– definition, Line integral, properties and problems. Cauchy's Integral theorem-proof using Green's theorem-direct consequences. Cauchy's Integral formula with proof-Cauchy's generalized formula for the derivatives with proof and applications for evaluation of simple line integrals. **15 Hours**

Reference Books:

1. S.C Malik, *Real Analysis,* New Age International (India) Pvt. Ltd.
2. S.C.Malik and Savita Arora, *Mathematical Analysis*, 2nd ed. New Delhi, India: New Age international (P) Ltd.
3. Richard R Goldberg, *Methods of Real Analysis*, Oxford and IBH Publishing
4. Ajit Kumr and S. Kumaresan - *A Basic Course in Real Analysis*, Taylor and Francis Group.
5. L. V. Ahlfors, *Complex Analysis*, 3rd Edition, McGraw Hill Education
6. Bruce P. Palka *, Introduction to the Theory of Function of a Complex Variable*, Springer
7. Serge Lang, *Complex Analysis*, Springer
8. Shanthinarayan, *Theory of Functions of a Complex Variable,* S. Chand Publishers.
9. S. Ponnuswamy, *Foundations of Complex Analysis*, 2nd Edition, Alpha Science International Limited.
10. R.V. Churchil & J.W. Brown, *Complex Variables and Applications*, 5th ed, McGraw Hill Companies

MATDSCP 5.1: Practical's on Real Analysis-II and Complex Analysis	
Practical Hours : 4 Hours/Week	**Credits: 2**
Total Practical Hours: 60 Hours	**Max. Marks: 50 (S.A.-25 + I.A. – 25)**

Course Learning Outcomes: This course will enable the students to

1. Learn *Free and Open Source Software (FOSS)* tools for computer programming
2. Solve problem on Real Analysis and Complex Analysis studied in **MATDSCT 5.1 by** using FOSS software's.
3. Acquire knowledge of applications of Real Analysis and Complex Analysis through FOSS.

Practical/Lab Work to be performed in Computer Lab (FOSS) Suggested Software's: Maxima/Scilab /Python/R.

Suggested Programs:

1. Program to check whether a given set of real numbers attains supremum or infimum.
2. Program to find upper and lower Riemann sums with respect to given partition
3. Program to test Riemann Integrability.
4. Program to evaluate Riemann integral as a limit of sum.
5. Program on verification of Cauchy – Riemann equations (Cartesian form) or test for analyticity.
6. Program on verification of Cauchy – Riemann equations (Polar form) or test for analyticity.
7. Program to check whether a function is harmonic or not.
8. Program to construct analytic functions (through Milne–Thompson method)
9. Program to find Cross ratio of points and related aspects.
10. Program to find fixed points of bilinear transformations.
11. Program to verify De Moivre's theorem.

MATDSCT5.2: Vector Calculus and Analytical Geometry	
Teaching Hours : 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 60 Hours	**Max. Marks: 100 (S.A.-60 + I.A. – 40)**

Course Learning Outcomes: This course will enable the students to

1. Get introduced to the fundamentals of vector differential and integral calculus.
2. Get familiar with the various differential operators and their properties.
3. Get acquainted with the various techniques of vector integration.
4. Learn the applications of vector calculus.
5. Recollect the fundamentals of Analytical Geometry in 3D.
6. Interpret the geometrical aspects of planes and lines in 3D.

Vector Calculus

Unit – I: Vector Algebra

Vector Algebra –Multiple product – scalar triple product, vector triple product, geometrical interpretation, related problems; vector function of a scalar variable – interpretation as a space curve, derivative, tangent, normal and binormal vectors to a space curve; Curvature and Torsion of a space curve- definitions, derivation and problems, Serret-Frenet formulae.

Scalar field - Gradient of a scalar field, geometrical meaning, directional derivative, unit normal using surfaces - tangent plane and normal to the surface; Vector field - divergence and curl of a vector field, geometrical meaning, solenoidal and irrotational fields; Laplacian of a scalar field; Vector identities. **15 Hours**

Unit – II: Vector Integration

Vector Integration – Definition and basic properties, vector line integral, surface integral and volume integral; **Green's theorem in the plane** – Proof and related problems, Direct consequences of the theorem; **Gauss' Divergence theorem** – Proof and related problems, Direct consequences of the theorem; **Stokes' theorem** – Proof and related problems, Direct consequences of the theorem. . **15 Hours**

Analytical Geometry

Unit-III: Planes, Straight Lines and Spheres Planes: Distance of a point from a plane, Angle between two planes, pair of planes, Bisectors of angles between two planes; Straight lines: Equations of straight lines, Distance of a point from a straight line, Distance between two straight lines, Distance between a straight line and a plane; Spheres: Different forms, Intersection of two spheres, Orthogonal intersection, Tangents and normal, Radical plane, Radical line, Coaxial system of spheres, Pole, Polar and Conjugacy. **15 Hours**

Unit-IV: Locus, Surfaces, Curves and Conicoids Space curves, Algebraic curves, Ruled surfaces, Some standard surfaces, Classification of quadric surfaces, Cone, Cylinder, Central conicoids, Tangent plane, Normal, Polar planes, and Polar lines. **15 Hours**

References:

1. Robert J. T. Bell (1994). An Elementary Treatise on Coordinate Geometry of Three Dimensions. Macmillan India Ltd.
2. D. Chatterjee (2009). Analytical Geometry: Two and Three Dimensions. Narosa Publishing House.
3. Shanthi Narayan and P. K. Mittal, *Analytical Solid Geometry*, S. Chand Publications.

4. A. N. Das, *Analytical Geometry of Two and Three Dimensions*, New Central Book Agency Pvt. Ltd.
5. M. D. Raisinghania, *Vector Calculus*, S Chand Co. Pvt. Ltd., 2013.
6. M. Spiegel, *Vector Analysis*, 2nd Edition, Schaum's Outline Series, Mc-Graw Hill, Education, 2017.
7. C. E. Weatherburn, *Elementary Vector Analysis*, Alpha edition, 2019.
8. P. N. Wartikar and J. N. Wartikar, *A Textbook of Applied Mathematics*, Vol. II, Pune Vidyarthi Griha Prakashan, Pune, 2009.
9. C. E. Weatherburn, *Differential Geometry of Three Dimension*, Khosla Publishing House, 2020.
10. B. S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers.
11. G. B. Thomas and R. L. Finney, *Introduction to Calculus and Analytical Geometry*, Narosa Publishing House, 2010.

MATDSCP5.2: Practical's on Analytical Geometry and Vector Calculus	
Teaching Hours : 4 Hours/Week	**Credits: 2**
Total Teaching Hours: 60 Hours	**Max. Marks: 50** **(S.A.-25 + I.A. – 25)**

Course Learning Outcomes: This course will enable the students to

1. Learn *Free and Open Source Software (FOSS)* tools for computer programming
2. Solve problems related to Analytical Geometry and Vector Calculus using FOSS software.

Practical/Lab Work to be performed in Computer Lab (FOSS) Suggested Software: Maxima/SciLab /Python/R.

Suggested Programs:

1. Program on multiple product of vectors – Scalar and Cross product.
2. Program on vector differentiation and finding unit tangent.
3. Program to find curvature and torsion of a space curve.
4. Program to find the gradient and Laplacian of a scalar function, divergence and curl of a vector function.
5. Program to demonstrate the physical interpretation of gradient, divergence and curl.
6. Program to evaluate a vector line integral.
7. Program to evaluate a surface integral.
8. Program to evaluate a volume integral.
9. Program to verify Green's theorem.
10. Program to find equation and plot sphere, cone and cylinder
11. Program to find distance between a straight line and a plane.
12. Program to construct and plot some standard surfaces.

Skill Enhancement Course

MATDSECT 5.1: Programming with Python	
Teaching Hours : 2 Hours/Week	**Credits: Theory : 2**
Total Teaching Hours: Theory : 30 Hours	**Max. Marks: 50 (S.A.-30 + I.A. – 20)**

Course Learning Outcomes: On the completion of this course the students will be able to

1. Learn the syntax and semantics of Python programming language.
2. Write Python functions to facilitate code reuse and manipulate strings.
3. Understand the use of built-in functions to navigate the file system
4. Apply the concepts of file handling.

Unit-1: Introduction, Basics and Program flow **(15 Hours)**

Python character set, Tokens, Variables and assignments, print statement, comments, Python data structure and data types, string operation in Python, Simple input and output (including simple output-formatting, operators in Python, expressions, standard library modules, Debugging, indentation, Flow of control (if, if-else, if-elif, nested if), range function, iteration/looping statements, String and list manipulation, Tuples, dictionaries, sorting techniques

Unit-2: Functions, Libraries and File handling **(15 Hours)**

Understanding and creating your own functions, Function parameters, Flow of execution in a function call, passing parameters, Returning values from functions, Scope of a function, Importing modules in a Python, Using standard library functions and Modules, Creating a Python library, Data files, Operating and closing files, working with text files, Standard, input, output and error streams, Working with binary and CSV files.

References

1. Automate the Boring Stuff with Python -, Al Sweigart, Willam Pollock, 2015
2. Python Cook Book-, David Beazely and Brain K. Jones 2022.
3. Basic Python Programming for Beginners- Varada Rajkumar, Marapalli Krishna, Jaya Prakash, Blue Rose Publishers, 2022.
4. Python- John Shovic and Alan Simpson, Paperback, 2020.
5. Learning Python- Mark Lutz, O'Reilly Media, Paperback, 2nd edition, 2020.
6. Programming and Problem Solving Through Python- Satish Jain and Shashi Singh, BPB Publications, 2020

MATDSECT 5.1: Practical's on Python Programming	
Practical Hours : 2 Hours/Week	**Credits: Theory : 1**
Total Practical Hours: 30 Hours	**Max. Marks: 25 (S.A.- 15 + I.A. – 10)**

Practical Implementation of Python **(30 Hours)**

1. Write python programs using the concepts of control structures.
2. Implement Python programs using functions and strings.
3. Implement methods to create and manipulate lists, tuples and dictionaries.
4. Apply the concepts of file handing and regExusing packages.
5. Illustrate the working of scraping websites with CSV.

SEMESTER – VI

MATDSCT 6.1: Linear Algebra	
Teaching Hours : 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 60 Hours	**Max. Marks: 100 (S.A.-60 + I.A. – 40)**

Course Learning Outcomes

The overall expectation from this course is that the student will build a basic understanding in few areas of linear algebra such as vector spaces, linear transformations and inner product spaces. Some broader course outcomes are listed as follows. At the end of this course, the student will be able to

1. Understand the concepts of Vector spaces, subspaces, bases dimension and their properties.
2. Become familiar with the concepts Eigen values and eigen vectors, minimal polynomials, linear transformations etc.
3. Learn properties of inner product spaces and determine orthogonality in inner product spaces.
4. Prove various statements in the context of vectors spaces.
5. Realise importance of adjoint of a linear transformation and its canonical form.

Unit – I: Vector spaces

Vector spaces - Definition, examples and properties; **Subspaces** - Examples, criterion for a sub- set to be a subspace and some properties; **Linear Combination** - Linear span, Linear dependence and Linear independence, basic properties of linear dependence and independence, techniques of determining linear dependence and independence in various vector spaces and related problems; **Basis and dimension** - Co-ordinates, ordered basis, some basic properties of basis and dimension and subspace spanned by given set of vectors; **Quotient space.** Dimension of quotient space (derivation in finite case); **Sum and Direct sum of subspaces** - Dimensions of sum and direct sum spaces (Derivation in finite case).

15 Hours

Unit – II: Linear Transformations

Linear transformation - Definition, examples, equivalent criteria, some basic properties and matrix representation and change of basis and effect on associated matrix, similar matrices; **Rank - Nullity theorem** - Null space, Range space, proof of rank nullity theorem and related problems. **15 Hours**

Unit – III: Isomorphism, Eigenvalues and Diagonalization

Homomorphism, Isomorphism and automorphism - Examples, order of automorphism and Fundamental theorem of homomorphism; **Eigenvalues and Eigenvectors** - Computation of Eigenvalues, algebraic multiplicity, some basic properties of eigenvalues, determination of eigenvectors and eigenspace and geometric multiplicity. **Diagonalizability of linear transformation** - Meaning, condition based on algebraic and geometric multiplicity (mentioning) and related problems (Only verification of diagonalizability). **15 Hours**

Unit – IV: Invertible Transformation and Inner product spaces

Invertible transformation - some basic properties of Invertible, singular and non-singular trans- formations and conditions for existence of inverses; Minimal polynomial of a transformation**.** Relation between characteristic and minimal polynomials and related problems.

Inner product and normed linear spaces - Definitions, examples, Cauchy-Schwartz inequality (with proof) and related problems; Gram-Schmidt orthogonalization - Orthogonal vectors, orthonormal basis, Gram-Schmidt orthogonalization process: both proof and problems; Orthogonal projection - Orthogonal projection of a vector and a subspace on another subspace, problems related to the same. **15 Hours**

Reference Books:

1. I. N. Herstein, *Topics in Algebra*, 2nd Edition, Wiley.
2. Stephen H. Friedberg, Arnold J. Insel & Lawrence E. Spence (2003), Linear Algebra (4^{th} Edition), Printice-Hall of India Pvt. Ltd.
3. F. M. Stewart, *Introduction to Linear Algebra*, Dover Publications.
4. S. Kumaresan, *Linear Algebra*, Prentice Hall India Learning Private Limited.
5. Kenneth Hoffman & Ray Kunze (2015), Linear Algebra, (2^{nd} Edition), Prentice Hall India Leaning Private Limited.
6. Gilbert. Strang (2015), Linear Algebra and its applications, (2^{nd} Edition), Elsevier.
7. Vivek Sahai & Vikas Bist (2013), Linear Algebra (2^{nd} Edition) Narosa Publishing.
8. Serge Lang (2005), Introduction to Linear Algebra (2^{nd} Edition), Springer India.
9. T. K. Manicavasagam Pillai and K S Narayanan, Modern Algebra Volume 2.

MATDSCP 6.1: Practical's on Linear Algebra	
Practical Hours : 4 Hours/Week	**Credits: 2**
Total Practical Hours: 60 Hours	**Max. Marks: 50 (S.A.-25 + I.A. – 25)**

Course Learning Outcomes: This course will enable the students to

4. Learn *Free and Open Source Software (FOSS)* tools for computer programming
5. Solve problem on Linear Algebra studied in **MATDSCT 6.1 by** using FOSS software's.
6. Acquire knowledge of applications of Linear Algebra through FOSS.

Practical/Lab Work to be performed in Computer Lab (FOSS)

Suggested Software's: Maxima/Scilab /Python/R.

Suggested Programs:

1. Program on linear combination of vectors.
2. Program to verify linear dependence and independence.
3. Program to find basis and dimension of the subspaces.
4. Program to verify if a function is linear transformation or not.
5. Program to find the matrix of linear transformation.
6. Program to find the Eigenvalues and Eigenvectors of a given linear transformation.
7. Program on Rank – nullity theorem.
8. Program to verify if the given linear transformation is singular/non-singular.
9. Program to find the minimal polynomial of given transformation.
10. Program to find the algebraic multiplicity of the Eigenvalues of the given linear transformation.
11. Program on diagonalization
12. Program on diagonalization.

MATDSCT 6.2: Numerical Analysis	
Teaching Hours : 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 60 Hours	**Max. Marks: 100 (S.A.-60 + I.A. – 40)**

Course Learning Outcomes:

The overall expectation from this course is that the student will get equipped with certain numerical techniques for various computations such as finding roots, finding the integrals and derivatives, and finding solutions to differential equations. Some broader course outcomes are listed as follows. At the end of this course, the student will be able to

1. Describe various operators arising in numerical analysis such as difference operators, shift operators and so on.
2. Articulate the rationale behind various techniques of numerical analysis such as in finding roots, integrals and derivatives.
3. Reproduce the existing algorithms for various tasks as mentioned previously in numerical analysis.
4. Apply the rules of calculus and other areas of mathematics in justifying the techniques of numerical analysis.
5. Solve problems using suitable numerical technique
6. Appreciate the profound applicability of techniques of numerical analysis in solving real life problems and also appreciate the way the techniques are modified to improve the accuracy.

Unit – I: Algebraic and Transcendental Equations

Errors - Significant digits, absolute, relative, percentage errors, rounding off and truncation errors (meanings and related problems), general error formula (derivation of formula and problems based on it), error in series approximation: Taylor series approximations (problems only), Solutions to algebraic and transcendental equations - Bisection method, Regula-Falsi method, iterative method Newton-Raphson method and secant method (Plain discussion of the rationale behind techniques and problems on their applications). **15 Hours**

Unit – II: System of Linear Algebraic Equations

Direct Methods – Gauss elimination method, Gauss-Jordan elimination method and Tringularization method; Iterative methods – Jacobi method, Gauss-Jacobi method, Gauss-Seidal method, Successive-Over Relaxation method (SOR) method**.** **15 Hours**

Unit – III: Polynomial Interpolations

Finite differences**.** Forward, backward and central differences and shift operators: definitions, properties and problems; Polynomial interpolation - Newton-Gregory forward and backward interpolation formulas, Gauss's Forward and backward interpolation formulas, Lagrange interpolation polynomial, Newton's divided differences and Newton's general interpolation formula (Discussion on setting up the polynomials, differences between them and problems on their applications). **15 Hours**

Unit-IV: Numerical Differentiation an Integration

Formula for derivatives (till second order) based on Newton-Gregory forward and backward interpolations (Derivations and problems based on them). Numerical

Integration - General quadrature formula, Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule and Weddell's rule (derivations for only general quadrature formula, trapezoidal rule and Simpson's $1/3^{rd}$ rule and problems on the applications of all formulas). **15 Hours**

Reference Books :

1. E. Isaacson and H. B. Keller, *Analysis of Numerical methods*, Dover Publications.
2. S. S. Sastry, *Introductory methods of Numerical Analysis*, 5th Edition, PHI Learning Private Limited.
3. E Kreyszig, *Advanced Engineering Mathematics*, Wiley India Pvt. Limited
4. B. S. Grewal, *Numerical Methods for Scientists and Engineers*, Khanna Publishers.
5. M. K. Jain, S. R. K. Iyengar and R. K. Jain, *Numerical Methods for Scientific and Engineering computation*, 4th Edition, New Age International
6. H. C. Saxena, *Finite Difference and Numerical Analysis,* S. Chand Publishers
7. B. D. Gupta, *Numerical Analysis*, Konark Publishers Pvt. Ltd.

MATDSCP 6.2: Practical's on Numerical Analysis	
Practical Hours : 4 Hours/Week	**Credits: 2**
Total Practical Hours: 60 Hours	**Max. Marks: 50 (S.A.-25 + I.A. – 25)**

Course Learning Outcomes: This course will enable the students to

1. Learn *Free and Open Source Software (FOSS)* tools for computer programming
2. Solve problem on numerical Analysis studied in **MATDSCT 6.2 by** using FOSS software's.
3. Acquire knowledge of applications of Numerical Analysis through FOSS.

Practical/Lab Work to be performed in Computer Lab (FOSS)

Suggested Software's: Maxima/Scilab /Python/R.

Suggested Programs:

1. Program to find root of an equation using bisection and Regula-Falsi methods.
2. Program to find root of an equation using Newton-Raphson and Secant methods.
3. Program to solve system of algebraic equations using Gauss-elimination method.
4. Program to solve system of algebraic equations using Gauss-Jordan method.
5. Program to solve system of algebraic equation using Gauss-Jacobi method.
6. Program to solve system of algebraic equation using Gauss-Seidel method.
7. Program to solve the system of algebraic equations using SOR method
8. Program to evaluate integral using Simpson's 1/3 and 3/8 rules.
9. Program to evaluate integral using Trapezoidal and Weddle rules
10. Program to find the sums of powers of successive natural numbers using Newton – Gregory technique.
11. Program to find differentiation at specified point using Newton-Gregory interpolation method.
12. Program to find the missing value of table using Lagrange method.

MATDSINT 6.1: Internship/Project Work	
	Credits : 2
	Max. Marks: 50 (S.A.-25 + I.A. – 25)

Course Learning Outcomes:

On the completion of this course, students will be able

1. Apply the acquired Mathematical knowledge to study, interpret and solve some of the real life problems.
2. Analyze the outcomes of the study both qualitatively and quantitatively.
3. Apply the programming skills to solve the problems.
4. Write the Reports in the structured format.
5. Make presentations by using PPT's.

Internship:

Students may be encouraged to go for internship at the relevant industries / Business firms to study the system, analyze and apply the relevant skill to solve problems in industries.

OR

In case any student faces hardship to get Internship, such students may be assigned projects of real life problems under the supervision of staff member in the College. At the end, student shall prepare a project report and submit to the Principal for assessment.

Assessment Criteria: *(for both Internship and Project)*

A. Continuous Assessment	:	25 Marks
B. Semester End Examination: - Project Report	:	15 Marks
- Viva-Voce	:	10 Marks
Total	:	50 Marks