Proposed Syllabus

B.Sc. MATHEMATICS for 1st and 2nd semester

Under

NEP-2020

CHOICE BASED CREDIT SYSTEM

With effect from academic year 2021-22

Department of Mathematics

Government College (Autonomous), Kalaburgi

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

SEMESTER – I

MATDSCT 1.1: Algebra - I and Calculus - I	
Teaching Hours : 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 56 Hours	**Max. Marks: 100 (S.A.-60 + I.A. – 40)**

Course Learning Outcomes: This course will enable the students to

- Learn to solve system of linear equations.
- Solve the system of homogeneous and non homogeneous linear of m equations in n variables by using concept of rank of matrix, finding eigen values and eigen vectors.
- Sketch curves in Cartesian, polar and pedal equations.
- Students will be familiar with the techniques of integration and differentiation of function with real variables.
- Identify and apply the intermediate value theorems and L'Hospital rule.

Unit-I: Matrix: Recapitulation of Symmetric and Skew Symmetric matrices, Cayley-Hamilton theorem, inverse of matrices by Cayley-Hamilton theorem (Without Proof). Algebra of Matrices; Row and column reduction to 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, **14 Hours**

Unit-II: Polar Co-ordinates: Polar coordinates, angle between the radius vector and tangent. Angle of intersection of two curves (polar forms), length of perpendicular from pole to the tangent, 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, asymptotes, evolutes and envelops. **14 Hours**

Unit-III: Differential Calculus-I: Limits, Continuity, Differentiability and properties. Properties of continuous functions. Intermediate value theorem, Rolle's Theorem , Lagrange's Mean Value theorem, Cauchy's Mean value theorem and examples. Taylor's theorem, Maclaurin's series, Indeterminate forms and evaluation of limits using L'Hospital rule. **14 Hours**

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. Tracing of curves (standard curves) **14 Hours**

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. Differential Calculus - Shanti Narayan, S. Chand & Company, New Delhi.
5. Applications of Calculus, Debasish Sengupta, Books and Allied (P) Ltd., 2019.
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.

MATDSCP 1.1: Practical's on Algebra - I and Calculus – I	
Practical Hours : 4 Hours/Week	**Credits: 2**
Total Practical Hours: 56 Hours	**Max. Marks: 50** **(S.A.-25 + I.A. – 25)**

Course Learning Outcomes: This course will enable the students to

- Learn *Free and Open Source Software (FOSS)* tools for computer programming
- Solve problem on algebra and calculus theory studied in **MATDSCT 1.1** by using FOSS software's.
- Acquire knowledge of applications of algebra and calculus through FOSS

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

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 non-homogeneous linear algebraic equations.
7. Finding the nth Derivative of e^{ax}, trigonometric and hyperbolic functions
8. Finding the nth Derivative of algebraic and logarithmic 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.
13. Tracing of standard curves

Open Elective Course

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

MATOET1.1(A) : Mathematics - I	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Totatl Teaching Hours: 42 Hours	**Max. Marks: 100 (S.A.-60 + I.A. – 40)**

Course Learning Outcomes: This course will enable the students to

- Learn to solve system of linear equations.
- Solve the system of homogeneous and non homogeneous m linear equations by using the concept of rank of matrix, finding eigen values and eigen vectors.
- Students will be familiar with the techniques of differentiation of function with real variables.
- Identify and apply the intermediate value theorems and L'Hospital rule.
- Learn to trace some standard curves.

Unit-I: Matrices: Recapitulation of Symmetric and Skew Symmetric matrices, Cayley-Hamilton theorem, inverse of matrices by Cayley-Hamilton theorem (Without Proof). 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, **14 Hours**

Unit-II: Differential Calculus: Limits, Continuity, Differentiability and properties. Intermediate value theorem, Rolle's Theorem , Lagrange's Mean Value theorem, Cauchy's Mean value theorem and examples. Taylor's theorem, Maclaurian's series, Indeterminate forms and examples. **14 Hours**

Unit-III: 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. Tracing of curves (standard curves) **14 Hours**

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. Applications of Calculus, Debasish Sengupta, Books and Allied (P) Ltd., 2019.
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.

Open Elective

(For Students of other than Science Stream)

MATOET1.1(B): Business Mathematics-I	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Totat Teaching Hours: 42 Hours	**Max. Marks: 100 (S.A.- 60 + I.A. – 40)**

Course Learning Outcomes: This course will enable the students to

- Translate the real word problems through appropriate mathematical modellling.
- Explain the concepts and use equations, formulae and mathematical expression and relationship in a variety of context.
- Finding the extreme values of functions.
- Analyze and demonstrate the mathematical skill require in mathematically intensive areas in economics and business.

Unit-I: Algebra – Set theory and simple applications of Venn Diagram, relations, functions, indices, logarithms, permutations and combinations. Examples on commercial mathematics.

14 Hours

Unit - II: Matrices: Definition of a matrix; types of matrices; algebra of matrices. Properties of determinants; calculations of values of determinants upto third order; Adjoint of a matrix, elementary row and column operations; solution of a system of linear equations having unique solution and involving not more than three variables. Examples on commercial mathematics.

14 Hours

Unit - III: Differential Calculus: Constant and variables, functions, Limits & continuity. Differentiability and Differentiation, partial differentiation, rates as a measure, maxima, minima, Partial Derivatives up to second order; Homogeneity of functions and Euler's Theorem; Total Differentials; Differentiation of implicit function with the help of total differentials, Maxima and Minima; cases of one variable involving second or higher order derivatives; Cases of two variables involving not more than one constraint.

14 Hours

Reference Books:

1. Basic Mathematics, Allel R.G.A, Macmillan, New Delhi.
2. Mathematics for Economics, Dowling, E.T., Schaum's Series, McGraw Hill, London.
3. Quantitative Techniques in Management, Vohra, N.D., Tata McGraw Hill, New Delhi.
4. Business Mathematics, Soni R.S., Pitamber Publishing House, Delhi

MATDSCT 2.1: Algebra - II and Calculus - II	
Teaching Hours : 4 Hours/Week	**Credits: 4**
Totat Teaching Hours: 56 Hours	**Max. Marks: 100 (S.A.-60 + I.A. – 40)**

Course Learning Outcomes: This course will enable the students to

- Recognize the mathematical objects called Groups.
- Link the fundamental concepts of groups and symmetries of geometrical objects.
- Explain the significance of the notions of Cosets, normal subgroups and factor groups.
- Understand the concept of differentiation and fundamental theorems in differentiation and various rules.
- Find the extreme values of functions of two variables.

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, Archimedean property of R. Intervals, neighborhood of a point, open sets, closed sets, limit points and Bolzano-Weierstrass theorem (Without proof) **14 hours**

Unit-II: Groups: Definition of a group with examples and properties, congruence, problems. Subgroups, center of groups, 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 Ø function. **14 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. **14 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 Leibnitzrule.

Reference Books:

1. Topics in Algebra, I N Herstein, Wiley Eastern Ltd., New Delhi.
2. Higher algebra, Bernard & Child, Arihant, ISBN: 9350943199/ 97893509431 99.
3. Modern Algebra, Sharma and Vasista, 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 B.Sc. Mathematics, G K Ranganath, S Chand & Company.

PRACTICAL

MATDSCP 2.1: On Algebra -II and Calculus - II	
Practical Hours : 4 Hours/Week	**Credits: 2**
Total Practical Hours: 56 Hours	**Max. Marks: 50 (S.A.-25 + I.A.-25)**

Course Learning Outcomes: This course will enable the students to

- Learn *Free and Open Source Software (FOSS)* tools for computer programming
- Solve problem on algebra and calculus by using FOSS software's.
- Acquire knowledge of applications of algebra and calculus through FOSS

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's 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 Ø 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.

Open Elective

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

MATHS 2.1(A): Mathematics – II

Teaching Hours : 3 Hours/Week	Credits: 3
Total Teaching Hours: 42 Hours	Max. Marks: 100 (S.A.- 60 + I.A. – 40)

Course Learning Outcomes: This course will enable the students to

- Recognize the mathematical objects called Groups.
- Link the fundamental concepts of groups and symmetries of geometrical objects.
- Explain the significance of the notions of Cosets, normal subgroups and factor groups.
- Understand the concept of differentiation and fundamental theorems in differentiation and various rules.
- Find the extreme values of functions of two variables.
- To understand the concepts of multiple integrals and their applications.

Unit-I: Groups: Definition of a group with examples and properties, congruence, problems. Subgroups, center of groups, 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 Ø function. **14 hours**

Unit-II: 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. **14 hours**

Unit-III: 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 Leibnitzrule. **14 hours**

Reference Books:

1. Topics in Algebra, I N Herstein, 2nd Edition, Wiley Eastern Ltd., New Delhi.
2. Higher algebra, Bernard & Child, Arihant Pub.
3. Modern Algebra, Sharma and Vasishta, Krishna Prakashan Mandir, Meerut, U.P.

4. A Course in Abstract Algebra, Vijay K Khanna and S K Bhambri, Vikas Publications.
5. Differential Calculus, Shanti Narayan, S. Chand & Company, New Delhi.
6. Integral Calculus, Shanti Narayan and P K Mittal, S. Chand and Co. Pvt. Ltd.,
7. Schaum's Outline Series, Frank Ayres and Elliott Mendelson, 5th ed. USA: McGraw Hill., 2008.
8. Mathematical Analysis, S C Malik, Wiley Eastern.
9. Text Book of B.Sc. Mathematics, G K Ranganath, S Chand & Company.

Open Elective

(For Students of other than science stream)

MATOET 2.1(B): Business Mathematics-II	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100 (S.A.- 60 + I.A.-40)**

Course Learning Outcomes: This course will enable the students to

- Integrate concept in international business concept with functioning of global trade.
- Evaluate the legal, social and economic environment of business.
- Apply decision-support tools to business decision making.
- Will be able to apply knowledge of business concepts and functions in an integrated manner.

Unit - I: Commercial Arithmetic: Interest: Concept of Present value and Future value, Simple interest, Compound interest, Nominal and Effective rate of interest, Examples and Problems Annuity: Ordinary Annuity, Sinking Fund, Annuity due, Present Value and Future Value of Annuity, Equated Monthly Installments (EMI) by Interest of Reducing Balance and Flat Interest methods, Examples and Problems.

14 Hours

Unit - II: Measures of central Tendency and Dispersion: Frequency distribution: Raw data, attributes and variables, Classification of data, frequency distribution, cumulative frequency distribution, Histogram and give curves. Requisites of ideal measures of central tendency, Arithmetic Mean, Median and Mode for ungrouped and grouped data. Combined mean, Merits and demerits of measures of central tendency, Geometric mean: definition, merits and demerits, Harmonic mean: definition, merits and demerits, Choice of A.M., G.M. and H.M. Concept of dispersion, Measures of dispersion: Range, Variance, Standard deviation (SD) for grouped and ungrouped data, combined SD, Measures of relative dispersion: Coefficient of range, coefficient of variation. Examples and problems.

14 Hours

Unit - III: Correlation and regression: Concept and types of correlation, Scatter diagram, Interpretation with respect to magnitude and direction of relationship. Karl Pearson's coefficient of correlation for ungrouped data. Spearman's rank correlation coefficient. (with tie and without tie) Concept of regression, Lines of regression for ungrouped data, predictions using lines of regression. Regression coefficients and their properties (without proof). Examples and problems.

14 Hours

Reference Books:

1. Practical Business Mathematics, S. A. Bari New Literature Publishing Company New Delhi
2. Mathematics for Commerce, K. Selvakumar Notion Press Chennai
3. Business Mathematics with Applications, Dinesh Khattar & S. R. Arora S. Chand Publishing New Delhi
4. Business Mathematics and Statistics, N.G. Das &Dr. J.K. Das McGraw Hill New Delhi
5. Fundamentals of Business Mathematics, M. K. Bhowal, Asian Books Pvt. Ltd New Delhi
6. Mathematics for Economics and Finance: Methods and Modelling, Martin Anthony and Norman, Biggs Cambridge University Press Cambridge
7. Financial Mathematics and its Applications, Ahmad Nazri Wahidudin Ventus Publishing APS Denmark
8. Fundamentals of Mathematical Statistics, Gupta S. C. and Kapoor V. K.:, Sultan Chand and Sons, New Delhi.
9. Statistical Methods, Gupta S. P.: Sultan Chand and Sons, New Delhi.
10. Applied Statistics, Mukhopadhya Parimal New Central Book Agency Pvt. Ltd. Calcutta.
11. Fundamentals of Statistics, Goon A. M., Gupta, M. K. and Dasgupta, B. World Press Calcutta.
12. Fundamentals of Applied Statistics, Gupta S. C. and Kapoor V. K.:, Sultan Chand and Sons, New Delhi.

Syllabus for B.A./B.Sc. with Mathematics as Major Subject
&
B.A./B.Sc. (Hons) Mathematics
(2022-23 onwards)

C.C

SEMESTER – III

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, Exact Differential equations, Necessary and sufficient condition for the equations to be exact, Reducible to the exact differential equations. 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. Bolzano Weierstrass theorem for sequence. Limit superior and limit inferior of sequences. Cauchy's first and second theorem on limits of a sequence. Cauchy's general principle for convergence of a sequence. Subsequence and their properties. **14hrs**

Unit IV: Infinite Series: Definition of convergent, divergent and oscillatory series. Series of non-negative terms, Cauchy's general principle of convergence. 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 (2nd 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)**

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. 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

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 2π and period 2L. Fourier series of even and odd functions. Half range Cosine and Sine series. Fourier Transforms - Finite Fourier Cosine and Sine transform. Transforms of derivates. Applications of Fourier Transforms.

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 2π 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,

Open Elective Course

(For students of other than Mathematics stream)

30 Hrs (1.5 hrs/week) : Mathematical Finance

Teaching Hours: 30 hrs (1.5 hrs/week)	Course: B
Total Teaching Hours: 30 hrs	Max Marks: 100
	(Exam Hrs)

Course Learning Outcomes: Students will able to be students to

- Understand how compute profit and loss, discount and Banker's discount.
- Understand the concept of Linear equation 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 involving 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. Murthi 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 1st 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.

Unit-II **14 Hours**

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

Unit-III **14 Hours**

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.

REFERENCE BOOKS **14 Hours**

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.

Syllabus for 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. **15 Hours**

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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 $w = \frac{1}{z}, w = sinz, w = e^z, w = \frac{1}{2}\left(z + \frac{1}{z}\right)$

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

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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.

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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: Straight Lines,Planes 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.

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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.

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MATDSINT 5.1: Internship/Project Work	
	Credits 2
	Max. Marks: 50 (I.A. – 50)

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)*

Continuous Assessment :	25 Marks
- Project Report :	15 Marks
- Viva-Voce :	10 Marks
Total :	50 Marks

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SEMESTER – V

[illegible]: 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 vector 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 Eigen vectors** – 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. **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.

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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.

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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 and Integration

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

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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.

HOD

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