III SEMESTER

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)

UNIT – I: Differential Equations – I   **(14 Hours)**
Recapitulation of Definition, examples of differential equations. Differential equations of first order- separation of variables, homogeneous differential equations. Exact Differential Equations, The general solution of a linear equation – Integrating factors found by inspection. The determination of integrating factors, Linear differential equations, Bernoulli's equation. Illustrative Examples.

UNIT – II: Linear Differential Equations - I   **(14 Hourss)**
Ordinary Linear differential equations with constant coefficients – Complementary function – particular integral – Inverse differential operators. Cauchy – Euler differential equations – Simultaneous differential equations (two variables with constant coefficients)

<center>Real Analysis-I</center>

UNIT – III: Sequences   **(14 Hours)**

Sequence of real numbers – Bounded and unbounded sequences – Infimum and supremum of a sequence – Limit of a sequence – Sum, product and quotient of limits – Standard theorems on limits – Convergent , divergent and oscillatory sequences – Standard properties – Monotonic sequences and their properties.

UNIT – IV :Infinite Series   **(14 Hours)**
Infinite series of real numbers – Convergence and Divergence - Oscillation of series – Properties of convergence – Series of positive terms – Geometric series – p – series – Comparison tests – D'Alembert's ratio test – Raabe's test – Cauchy's root test.

Books for References
1. Daniel A Murray – Introductory Course to Differential equations.
2. Earl David Rainville and Philip Edward Bedient – A short course in Differential equations, Prentice Hall College Div; 6th edition.
3. F Ayres, Schaum's outline of theory and problems of Differential Equations, 1st ed. USA McGraw-Hill, 2010.
4. S Narayanan and T K Manicavachogam Pillay, Differential Equations .: S V Publishers Private Ltd., 1981.
5. M D Raisinghania, Advanced Differential Equations, S Chand and Co. Pvt. Ltd., 2013.
6. S.C Malik –Real Analysis
7. S.C.Malik and Savita Arora, Mathematical Analysis, 2nd ed. New Delhi, India: New Age international (P) Ltd., 1992
8. Richard R Goldberg, Methods of Real Analysis, Indian ed.
9. Asha Rani Singhal and M .K Singhal, A first course in Real Analysis
10. Robert G Bartle and Donald R Sherbert, Introduction to Real Analysis, John Wiley and Sons Inc., Fourth Ed.
11. S S Bali – Real analysis.
12. B. S. Grewal – Higher Engineering Mathematics
13. E Kreyszig- Advanced Engineering Mathematics, Wiley India Pvt. Ltd.

PRACTICALS
Mathematics Lab-III

MATDSCP 3.1: Theory Based Practical's on Ordinary Differential Equations and Real Analysis-I	
Practical Hours : 4 Hours/Week	Credits: 2
Total Teaching Hours: 56 Hours	Max. Marks: 50 (S.A.-25 + I.A. – 25)

Use open-source software to executive the practical problems. (FOSS)

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 curve.
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 Core Course)

MATOET 3.1(A): Ordinary Differential Equations	
Teaching Hours : 3 Hours/Week	Credits: 3
Total Teaching Hours: 42 Hours	Max. Marks: 100 (S.A.-60 + I.A. – 40)

UNIT – I: (14 Hours)

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.

UNIT – II: (14 Hours)

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.

UNIT– III: (14 Hours)

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.

Books for References

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.

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

Unit-I Number System   (14 Hours)

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.

Unit-II: Theory of equations   (14 Hours)

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

Unit-III: Quantitative Aptitude   (14 Hours)

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

Books for References:

1. 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, *Quantitative Aptitude and Reasoning*, PHI publishers.
4. R S Aggarwal, Objective Arithmetic, S. Chand & Company Ltd.
5. Qazi Zameerddin, Vijay K Khanna, S K Bhambri, *Business Mathematics-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: (14 Hours)
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.

Unit-II: Division and Divisibility: (14 Hours)
 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)

Unit-III: (14 Hours)
 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.

Books for References:

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.

IV SEMESTER

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)

Partial Differential Equations:

UNIT–I: (14 Hours)

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.

UNIT–II: (14 Hours)

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).

Integral Transforms

UNIT –III: **Laplace Transform** (14 Hours)

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.

UNIT – IV: **Fourier Series and Transforms** (14 Hours)

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.

Books for References

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
Mathematics Lab-IV

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)

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 Core subjects)

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)

UNIT–I: (14 Hours)

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 $Pp + Qq = R$.

UNIT – II: (14 Hours)

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.

UNIT– III: (14 Hours)

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).

Books for References

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 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)

Unit-I: Commercial Arithmetic (14 Hours)

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

Unit-II: Linear Programming (14 Hours)

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

Unit-III: Transportation problem (14 Hours)

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).

Books for References:

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. Business Mathematics by Dr. S.K. Sharma and Dr. Gurmeet Kaur.

Open Elective Course
(For students other than 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)

Unit-I   14 Hours

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

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.

I Semester B.Sc. Examination

MATHEMATICS
BSM 1T: ALGEBRA - I AND CALCULUS – I (Theory)

Time: 3 Hours   **Max. Marks: 60**

Note: All the sections are compulsory.

SECTION – A

1. Answer **any FIVE questions** of the following: **(5x2 = 10)**
a)
b)
c)
d)
e)
f)
g)
h)

SECTION – B

Answer **any FIVE questions** of the following: **(5x4 = 20)**
2.
3.
4.
5.
6.
7.
8.
9.

SECTION – C

                                                                     (3x10 = 30)

Answer **any THREE full questions** of the following:

10.   a)
      b)
11.   a)
      b)
12.   a)
      b)
13.   a)
      b)
14.   a)
      b)
15.   a)
      b)

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Question Paper pattern for Practical

MATHEMATICS

Time: 3 Hours   **Max. Marks: 25**

1. Answer **any two** questions: (10x2 =20)
    a. Program- 1 writing & Execution

    b. Program – II writing & Execution

    c. Program – III writing & Execution

    (Note: Writing a Program & Execution carries 05 & 05 marks, respectively.)

2. Viva-Voce & Project Record   (5)

Note: 1) Credit means the unit by which the course work is measured. One hour session of Lecture per week for 16 weeks amounts to 1 credit. Two hours session of Tutorial/Practical per week for 16 weeks amounts to 1 credit.

2) Internal Assessment (IA) marks of Theory (for 40 marks) & practical (for 25 marks) should be conducted by the course teacher.

Sl. No.	IA Component	Marks to be Awarded
	IA Pattern (Theory)	
1	Assignment	05
2	Attendance for Theory >75%	05
3	1st IA test for 30 marks of 90 minutes duration after 8 weeks & 2nd IA Test for 30 marks of 90 minutes duration after 15 weeks. Average of two IA tests should be considered.	30
	IA Pattern (Practical)	
1	Journal/Practical record	05
2	Attendance for Practical Labs >75%	05
3	1st IA test for 15 marks of 90 minutes duration after 8 weeks & 2nd IA Test for 15 marks of 90 minutes duration after 15 weeks. Average of two IA tests should be considered.	15

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