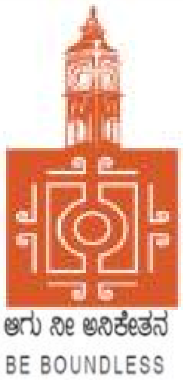

BENGALURU CITY UNIVERSITY

CHOICE BASED CREDIT SYSTEM

(Semester Scheme with Multiple Entry and Exit Options for Under Graduate Course- as per NEP 2020)

Syllabus for Mathematics
(III & IV Semester)

2022-23 onwards

PROCEEDINGS OF THE BOS MEETING IN MATHEMATICS (UG) CONDUCTED ON 28 SEPTEMBER 2022 IN THE DEPARTMENT OF MATHEMATICS, BENGALURU CITY UNIVERSITY, CENTRAL COLLEGE CAMPUS, BENGALURU

The following members attended the BOS meeting to finalize the syllabi of mathematics papers of BSc Third and Fourth semesters under NEP 2020 scheme:

1. Dr Ramesh B Kudenatti	Chairman	
2. Dr D Sujatha	Member	ABSENT
3. Prof T Ganghadharaiah	Member	
4. Dr D Radhakrishna	Member	
5. Dr M S Nagashree	Member	
6. Prof V S Ramesh Babu	Member	
7. Prof Vittal V Kulkarni	Member	
8. Dr S B Sathyanarayana	Member	
9. Dr S Bhagya	Member	
10. Prof Sanjaykumar Pattankar	Member	ABSENT

The esteem members discussed in deep the contents of the syllabi of mathematics and finalized syllabi of both semesters.

The Chairman thanked all the members for their cooperation.

Ramesh B Kudenatti
Chairman, BOS (UG)

Chairperson
Department of Mathematics
Bengaluru City University
Central College Campus
Bengaluru-560001.

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, Exact Differential equations, Necessary and sufficient condition for the equations to be exact. 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. 14 Hours

Unit II: Linear differential equations of the n^{th} 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, where V is a function of x. Cauchy–Euler equations, Method of variation of parameters. Simultaneous differential equations with two variables. Condition for integrability of total differential equations $Pdx + Qdy + Rdz = 0$. 14 Hours

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. Bolzano Weierstrass theorem for sequence (statement only), Cauchy's first and second theorem on limits of a sequence. Cauchy's general principle for convergence of a sequence.

14 Hours

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, Alternating series, Leibnitz's theorem. Absolute convergence and conditional convergence of a series. Summation of series: Binomial, exponential and logarithmic. 14 Hours

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 Prakash Nath & 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 hands-on experience of

- Free and Open Source software (FOSS) tools or computer programming.
- Solving exact differential equations
- Plotting 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. Verification of exactness of a differential equation
2. Solutions of differential equations that are solvable for x, y, p.
3. To find the singular solution by using Clairaut's form.
4. Finding the Complementary Function and Particular Integral of non-homogeneous linear differential equations with constant coefficients and plot the solutions.
5. Solutions to the Total and Simultaneous differential equations and plot the solutions.
6. Convergence of sequences.
7. Convergence of geometric series.
8. Convergence of p-series and D'Alembert's Test.
9. Examples on alternating series using Leibnitz's theorem.
10. Finding the convergence of series using Cauchy's criterion for partial sums.
11. Summation of exponential and logarithmic series.
12. Summation of binomial series.

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:

1. To understand the concept of differential equation and their classification.
2. To know the meaning of the solution of a differential equation.
3. To solve exact differential equations
4. To Solve Bernoulli differential equations.
5. 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. 14 Hours

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.
14 Hours

Unit III: Linear differential equations of the n^{th} 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(x) and xV(x) (with proofs).
14 Hours

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 Prakash Nath & Co. Meerut.
6. Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984.
7. Kreyzig, Advanced Engineering Mathematics, John Wiley, New Delhi.

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 & their applications in real life problems
- Understand and solve the problems based on age.
- Solve speed and distance related problems.

Unit-I: Number System

Numbers, Operations on numbers, Tests on Divisibility, HCF and LCM of numbers. Decimals, Fractions, Simplification, Square roots and Cube roots - Problems thereon. Surds and Indices. Illustrations thereon. 14 Hours

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 Hours

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 Hours

Reference Books:

1. R.S. Aggarwal, Quantitative Aptitude, S. Chand and Company Limited, NewDelhi.
2. A. Guha, Quantitative Aptitude, 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. Q. Zameerddin,V. K. Khanna, S K Bhambri, Business Mathematics-II Edition.
6. S. K. Sharma and G. Kaur, Business Mathematics, Sultan Chand & Sons.
7. H. 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:

- Formulate, classify and transform partial differential equations into canonical form.
- Solve the partial differential equations of the first order and second order
- 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.

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 Hours

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 Hours

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 their properties. Solutions of differential equations by using Laplace transforms and their properties. 14 Hours

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. Inverse Fourier transforms. 14 Hours

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, Laplace Transforms, Schaum's Series
9. Sudhir Kumar, Integral Transform Methods in Science & Engineering, CBS Engineering Series, 2017.
10. Murray R. Spiegal L, Fourier Transforms, Schaum' Series,
11. Earl David Rainville and Philip Edward Bedient–A short course in Differential Equations, Prentice Hall College Div; 6th Edition.
12. 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)

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 find the Fourier Transform of periodic functions
- To solve differential equations by using Integral transforms.

Programs using Scilab/Maxima/Python:

1 Solutions of linear partial differential equations of type 1 to type 3.
2 Solutions of Linear Partial differential equations of type 4 and Lagrange's method
3 Solutions of partial differential equation using Charpit's method.
4 Solutions of Second order non-homogenous partial differential equation with constant coefficients.
5 Solutions to the heat equation using separation of variables.
6 Solutions to the wave & Laplace equation using separation of variables method.
7 Finding the Laplace transforms of some standard and periodic functions.
8 Finding the inverse Laplace transform of simple functions.
9 Solution of ordinary linear differential 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 plotting them
12 To find cosine and 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

- Understand the concept of the partial differential equation.
- Classify the partial differential equations concerning their order and linearity.
- Understand the meaning of the solution of a partial differential equation.
- Solve a partial differential equation by Charpits method.
- 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 –Direct integration, Lagrange's linear equations of the form $Pp + Qq = R$. 14 Hours

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. 14 Hours

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 Hours

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 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: This course 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 Hours

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 Hours

Unit-III: Transportation Problem

Introduction, Formulation of Transportation problem, Initial basic feasible solution, Steps in solving a transportation problem, optimality check, special cases in Transportation problem. The traveling salesman problem (Routing Problem). 14 Hours

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 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)

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

- Understand the mathematical concept of sets and counting problems.
- Understand the concept of Probability 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, composite functions, higher order derivatives 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, Optimal 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, Wiley.
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.