Syllabus for B.Sc. (Honors) Mathematics w.e.f. 2021-22
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 (S.A.-60 + I.A. – 40)

Course Objectives: This course will enable the students to
- ⍰ Learn to identify various differential equations.
- ⍰ Learn to identify suitable methods to solve various differential equations .
- ⍰ Learn to identify nature of sequence and series.

Course Learning Outcomes: This course will enable the students to
- ⍰ Understand the concept of differential equation.
- ⍰ Classifies the differential equations with respect to their order and linearity.
- ⍰ Demonstrate skills in constructing rigorous mathematical arguments.
- ⍰ Demonstrate skills in communicating mathematics.
- ⍰ Understand and be able to apply basic definitions and concepts of convergence.
- ⍰ To prove simple statements involving convergent arguments.
- ⍰ Learn to solve differential equation using Scilab/Maxima

III SEMESTER
Ordinary Differential Equations and Real Analysis-I
(4 lecture hours/ week: 14 x 4 = 56 HOURS)

Ordinary Diffrential Equation

UNIT – I: Differential Equations– I   (14   Hours)
Definition, examples of differential equations (Recapitulation). Differential equations of first order- separation of variables (Recapitulation) reducible to variable separable, homogeneous differential equations (Recapitulation) reducible to homogeneous differential equations. Exact Differential Equations (Recapitulation), Equation reducible to exact form, 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   Hours)
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)

Real Analysis-I

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; 6thedition.
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 and Savita Arora, Mathematical Analysis, 2nd ed. New Delhi, India: New Age international (P) Ltd.,1992
7. Richard R Goldberg, Methods of Real Analysis, Indian ed.
8. Asha Rani Singhal and M .K Singhal, A first course in Real Analysis
9. Robert G Bartle and Donald R Sherbert, Introduction to Real Analysis, John Wiley and Sons Inc., Fourth Ed.
10. S S Bali – Real analysis.
11. B. S. Grewal – Higher EngineeringMathematics
12. E Kreyszig- Advanced Engineering Mathematics, Wiley India Pvt.Ltd.

Mathematics Lab-III
Ordinary Differential Equations and Real Analysis-I
(4 hours/ week per batch of not more than 15 students)

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)**

Mathematics practical with Free and open Source Software (FOSS)
tools for computer programs
Programs using Scilab/maxima/Python:

1. Solution of differential equation and plotting the graph of the solution by variable separable method.

2. Solution of differential equation and plotting the graph of the solution for homogeneous differential equation.

3. Scilab/maxima programs to solve exact differential equation.

4. Scilab/maxima programs to solve a Linear differential equation.

5. Scilab/maxima programs to solve Bernoulli's differential equation.

6. Solution of Differential equation using Scilab/Maxima and plotting the graph to solution.

7. Scilab/maxima programs to solve Cauchy-Euler's differential equation.

8. Scilab/maxima programs to solve differential equations and find particular solution.

9. Illustration of convergent, divergent and oscillatory sequences using Scilab/Maxima.

10. Illustration of convergent, divergent and oscillatory series using Scilab/Maxima.

11. Scilab/Maxima programs to find the sum of the series and its radius of convergence.

12. Using Cauchy's criterion determine convergence of a sequence.

13. Using Cauchy's criterion on the sequence of partial sums of the series determine convergence of a series.

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

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

Course Objectives: This course will enable the students to
- ⍰ Learn to identify various differential equations.
- ⍰ Learn to identify suitable methods to solve various differential equations .

Course Learning Outcomes: This course will enable the students to
- ⍰ Understand the concept of differential equation.
- ⍰ Classifies the differential equations with respect to their order and linearity.
- ⍰ Demonstrate skills in constructing rigorous mathematical arguments.
- ⍰ Demonstrate skills in communicating mathematics.

Ordinary Differential Equations–I

UNIT – I: **(14 Hours)**

Definition, examples of differential equations (Recapitulation). Differential equations of first order- separation of variables (Recapitulation) reducible to variable separable, homogeneous differential equations (Recapitulation) reducible to homogeneous differential equations. Exact Differential Equations (Recapitulation).

UNIT – II: **(14Hours)**

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– III: **(14 Hours)**

Ordinary Linear differential equations with constant coefficients – Complementary function – particular integral – Inverse differential operators. Cauchy – Euler differential equations.

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. B. S. Grewal – Higher Engineering Mathematics
7. E Kreyszig- Advanced Engineering Mathematics, Wiley India Pvt.Ltd.

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

Course Objectives: This course will enable the students
- To learn Simple Interest.
- To learn Speed and Distance.
- To understand the Age based problems.

Course Learning Outcomes: This course will enable the students to
- Apply Simple Interest in day today applications.
- Solve Speed and Distance related problems.
- Solve Present & Past age calculations.

Quantitative Mathematics

Unit-I: Problems on Simple Interest   **(14Hours)**

Calculate Interest, Calculate Profit / Loss, Interest Appreciation / Depreciation.

Unit-II: Problems on Speed & Distance   **(14Hours)**

Calculate Speed & Velocity, Calculate Speed & Distance Proportion

Unit-III: Problems on Age   **(14Hours)**

Age Calculations, Problems on conditional age calculations, Present & Past age calculations.

Books for References:
1. Business Mathematics by Dr. S.K. Sharma and Dr. Gurmeet Kaur
   (Published by Sultan Chand & Sons).
2. A Text book of Business mathematics for B.Com and BBA Course by Hazarika
    Padmalochan, Chand Publication.
3. Business Mathematics by J K Thukrol published by abcibook:2020 first edition.
4. Business Mathematics and Statics by N G Das and J K Das
   publisher Mc Graw Hill Education, 2017.

Syllabus for B.Sc. (Honors) Mathematics w.e.f. 2021-22

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 (S.A.-60 + I.A. – 40)

Course Objectives: This course will enable the students to
- Learn to identify various Partial differential equations.
- Understand basic properties of standard partial differential equations.
- Demonstrate capacity to model physical phenomena using PED's (In particular using heat and wave equations) .
- Learn to understand Integral Transforms and its applications

Course Learning Outcomes: This course will enable the students to
- Understand the concept of Partial differential equation.
- Classifies the Partial differential equations with respect to their order and linearity.
- Understand and be able to apply various methods to solve Partial Differential Equations.
- Learn to solve Integral Equations and differential equations using Laplace Transforms.

IV- SEMESTER
Partial Differential Equations and Integral Transforms
(4 lecture hours/ week: 14 x 4 = 56 HOURS)
Partial Differential Equations

UNIT–I: First Order Partial Differential Equations   (14 Hours)
Basic concepts–Formation of a partial differentia lequations 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.

UNIT–II: Second Order Partial Differential Equations   (14Hours)
Second Order Partial Differential Equations - Introduction, origin of second order equations. Linear partial differential equations with constants coefficients and equations having operator of the form $(\alpha_r D + \beta_r D' + \gamma_r)^n$. Solution of one dimensional heat, wave and Laplace equation using separation of variable methods.

Integral Transforms

UNIT –III: Laplace Transform   (14 Hours)
Definition and basic   properties–laplace transforms of e^{kt} , coskt, sinkt, a^t, t^n, coshkt and sinhkt – Laplace transform of $e^{at} F(t)$, $t^n F(t)$, $F(t)/t$ – problems – Laplace transform of derivatives of functions–Laplace transforms of integrals of functions–Laplace transforms of periodic functions.

UNIT – IV: Inverse Laplace transforms   (14 Hours)
Inverse Laplace transforms – problems. Convolution theorem with proof – Simple initial value problems – Solution of first and second order differential equations with constant coefficients by Laplace transforms method and solutions of integral equations.

Books for References

1. Daniel A Murray – Introductory Course to Differentialequations.
2. EarlDavidRainvilleandPhilipEdwardBedient–AshortcourseinDifferentialequations, Prentice Hall College Div; 6thedition.
3. G. Stephonson – An introduction to Partial DifferentialEquations.
4. B. S. Grewal – Higher EngineeringMathematics
5. M D Raisinghania, Advanced Differential Equations, S Chand and Co. Pvt. Ltd.,2013.
6. S Narayanan and T K Manicavachogam Pillay, Differential Equations .: S V Publishers Private Ltd., 1981.

Mathematics Lab-IV
Partial Differential Equations and Integral Transforms
(4 hours/ week per batch of not more than 15 students)

MATDSCP 4.1: Theory Based 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

Programs using Scilab/Maxima/Python:

1. Solutions to the Partial differential equations of type1to type4.
2. 2Solutions to the Partial differential equation of Lagrange's form (quasi linear).
3. Solutions to the Non-linear first order Partial differential equation using Charpit's Method.
4. Solutions to Second order homogenous Partial differential equation with constant coefficients.
5. Solutions to Second order non-homogenous Partial differential equation with constant coefficients.
6. Solutions to the Partial differential equations using separation of variables method (Heat/ Wave/Laplace).
7. Finding the Laplace transforms of some standard functions.
8. To evaluate some definite integrals using Laplace transform.
9. To find the Laplace transform of periodic functions.
10. Finding the inverse Laplace transform of simple functions.
11. Verification of Convolution Theorem.
12. To solve ordinary linear differential equation using Laplace transform.
13. To solve Integral equation using Laplace transform.

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

MATOET 4.1: Partial Differential Equations	
Teaching Hours : 3 Hours/Week	Credits: 3
Total Teaching Hours: 42 Hours	Max. Marks: 100 (S.A.-60 + I.A. – 40)

Course Objectives: This course will enable the students to
- Learn to identify various Partial differential equations.
- Understand basic properties of standard partial differential equations.
- Demonstrate capacity to model physical phenomena using PED's (In particular using heat and wave equations) .

Course Learning Outcomes: This course will enable the students to
- Understand the concept of Partial differential equation.
- Classifies the Partial differential equations with respect to their order and linearity.
- Understand and be able to apply various methods to solve Partial Differential Equations.

Partial Differential Equations

UNIT–I: (14 Hours)
Basicconcepts–Formationofapartialdifferentialequationsbyeliminationofarbitraryconstants   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 differentialequations.

UNIT – II: (14 Hours)

Solution of ordinary second order linear differential equations with variable coefficient by various methods such as: (i) By finding part of a complementary function, (ii) Changing the independent variable,   (iii) Changing the dependent variable, (iv) By method of variation of parameters, (v) Exact equations.

UNIT– III:
Total differential equations - Necessary and sufficient condition for the equation Pdx + Qdy + Rdz = 0 to be exact(Problems only) – Simultaneous equations of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$.

                                                                (14 Hours)

Books for References
1. Daniel A Murray – Introductory Course to Differentialequations.
2. EarlDavidRainvilleandPhilipEdwardBedient–AshortcourseinDifferentialequations, Prentice Hall College Div; 6thedition.
3. Murray R Speigel – LaplaceTransforms
4. E Kreyszig- Advanced Engineering Mathematics, Wiley India Pvt.Ltd.
5. B. S. Grewal – Higher EngineeringMathematics
6. E Kreyszig- Advanced Engineering Mathematics, Wiley India Pvt.Ltd.
8. G. Stephonson – An introduction to Partial DifferentialEquations.
9. B. S. Grewal – Higher EngineeringMathematics
10. M D Raisinghania, Advanced Differential Equations, S Chand and Co. Pvt. Ltd.,2013.
11. S Narayanan and T K Manicavachogam Pillay, Differential Equations .: S V Publishers Private Ltd., 1981.

Open Elective
(For Students of other than Science Stream)

MATOET 4.1: Mathematical Finance	
Teaching Hours : 3 Hours/Week	Credits: 3
Total Teaching Hours: 42 Hours	Max. Marks: 100 (60 S.A. + 40 IA)

Course Objectives: This course will enable the students
- ⮚ To learn to calculate Percentage.
- ⮚ To learn find True Discount.
- ⮚ To understand the Profit and Loss.

Course Learning Outcomes: This course will enable the students to
- ⮚ Find solution to the problems related percentage, true discount and profit and loss.

Mathematical Finance

Unit-I Problems on Percentage   14Hours

Calculate Percentage of Profit & Loss, Percentage Calculation on Buying & Selling, Percentage & Proportion.

Unit-II: Problems on True Discount   14Hours

Buying & Selling Prices Calculations, Discounts in transaction calculations, Profit ratio calculations

Unit-III: Problems on Profit And Loss   14Hours

Finding Selling Price, Finding Cost Price, Profit And Loss

Books for References:
1. Business Mathematics by Dr. S.K. Sharma and Dr. Gurmeet Kaur
   (Published by Sultan Chand & Sons).
2. A Text book of Business mathematics for B.Com and BBA Course by Hazarika
    Padmalochan, Chand Publication.
3. Business Mathematics by J K Thukrol published by abcibook:2020 first edition.
4. Business Mathematics and Statics by N G Das and J K Das
   publisher Mc Graw Hill Education, 2017.