**SHRI GOVIND GURU UNIVERSITY**

**Syllabus for B. Sc. Semester I (Mathematics)**

**BS23MD1MT1 Multidisciplinary: Differential Equations (Theory)**

**Hours: 2 /week** **Credits: 2**

**Prerequisite**: Introduction to Ordinary Differential Equation.

**Course Objectives:** The specific objective of the course is to develop crystal clear understanding of fundamental concepts of differential equations, Explore various techniques for solving differential equations, Apply these methods to solve real-world problems, Establish a strong foundation for advanced mathematics courses, Understand the ethical implications of mathematical modeling and problem-solving.

**Course Learning Outcomes:** The learning outcomes reflect the breadth and depth of understanding that students are expected to achieve in this course. Upon completing the course, students should be able to:

1. Classify differential equations based on degree and order of the equation.
2. Solve various types ordinary differential equations and recognize their applications in modeling dynamic systems.
3. Demonstrate understanding of techniques applied to solve a differential equation..
4. Establish a strong foundation for advanced courses that build upon Differential Equations, such as Real Analysis, Mechanics, Theoretical Physics and Engineering Mathematics.

**Unit I:** Definition of differential equation, order and degree of differential equation, types of first-order and first-degree differential equations: separable variable, homogeneous differential equation, non-homogeneous differential equation, exact differential equation, necessary and sufficient condition of exact differential equation,linear differential equation and Bernoulli's differential equation.

**Unit II:** Linear differential equation first order and higher degree with application, Method of solving differential equations of first order and higher degree: solvable for $y$, solvable for $x$, solvable for $p$ (where $p = \frac{dy}{dx}$ ), Clairaut's differential equation and Lagrange's Differential Equation.

**Unit III:** Linear differential equations of higher order and degree one with constant and variable coefficients: Complementary Function and Particular Integrals, Inverse operator, and methods of finding particular integral (Integral corresponds to terms of the form $e^{ax}, x^m, \sin ax, \cos ax, e^{ax}V$ and $xV$).

**Reference Books:**


1. Differential equations and their applications, - Zafar Ahsan, Prentice Hall of India, 2004.
2. Elementary Differential equations-Kella, Mcgraw-Hill.
3. Advanced Engineering Mathematics, Erwin Kreyszig, 10th edition, John Wiley and Sons .
4. Introductory course in Differential equations - Murray, Ulan Press.

**Teaching Plan:** The teaching plan may be followed as:
**Weeks 1 and 2:** order and degree of differential equation, and Types of linear differential equations.
**Weeks 3 and 4:** Linear differential equations, Bernoulli's differential equation and solving examples.
**Weeks 5, 6 and 7:** Linear differential equation first order and higher degree with application, and method of solving differential equation first order and higher degree.
**Weeks 8 and 9:** Clairaut's differential equation and Lagrange's Differential Equation.
**Weeks 10, 11 and 12:** Linear differential equations of higher order and degree one with constant and variable coefficients.
**Weeks 13 and 14:** Inverse operator and Methods of finding particular integral (Integral corresponds to terms of the form $e^{ax}, x^m, \sin ax, \cos ax, e^{ax}V$ and $xV$).
**Week 15:** Discussion about learning outcomes of the course.

**Multidisciplinary: Differential Equations (Practical)**

**Hours: 4 /week** **Credits: 2**

**Number of Practicals: 12**

**List of Practicals:**

1. Problems on finding the order and degree of the differential equations.
2. Problems on Exact differential equations and Integrating factors.
3. Problems on Linear differential equations.
4. Problems on Bernoulli's differential equations.
5. Problems on Method of solving differential equations of first order and higher degree: solvable for $y$.
6. Problems on Method of solving differential equations of first order and higher degree: solvable for $x$.
7. Problems on Method of solving differential equations of first order and higher degree: solvable for $p$ (where $p = \frac{dy}{dx}$ ).
8. Problems on Clairaut's and Lagrange's differential equations.
9. Examples on finding the Particular integral terms of the form $e^{ax}, x^m$.
10. Examples on finding the Particular integral terms of the form $\sin ax, \cos ax$.
11. Examples on finding the Particular integral terms of the form $e^{ax}V$, $xV$.
12. Problems on Differential equation of higher order with variable coefficients.

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