**Differential Equations**

**Programme(s) in which it is offered: B.Sc.B.Ed Mathematics**

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| --- | --- |
| **Course Category**: Core | **Schedule of Offering**: Even |
| **Course Credit Structure:** 4 | **Course Code:** MTH2111 |
| **Total Number of Hours: 4** | **Contact Hours Per Week: 4** |
| **Lecture:** 3 | **Tutorial:** 1 |
| **Practical:** 0 | **Medium of Instruction:** English |
| **Date of Revision:** | **Skill Focus:** Employability |
| **Short Name of the Course:** Differential Equations | **Course Stream *(Only for Minor Courses)*:** |
| **Grading Method:** Regular | **Repeatable:** Credit |
| **Course Level:** Beginner |  |

**Course Description**

This course is offered as a Core Course for B.Sc. B.Ed. Mathematics students. The goal of this course is to provide the student with an understanding of the solutions and applications of ordinary differential equations.

**Course Introduction**

This course provides an introduction to the theory, solutions, and applications of ordinary differential equations. Topics discussed in the course include methods of solving first-order differential equations, higher-order linear equations, Cauchy-Euler differential equation, Simultaneous equations of the form dx/P = dy / Q = dz / R. The goal of this course is to provide the student with an understanding of the solutions and applications of ordinary differential equations.

**Course Objective**

The objectives of the course are to

1. Introduce learners to various methods of solving differential equations
2. Enable learners to model some real-world problems using differential equations.
3. Discuss solutions to first and second order linear homogeneous and non-homogeneous differential equations.
4. Discuss solutions to second order equations, especially using power series methods.
5. Explore the applications of differential equations to problems in engineering, physics, biology and economics.

**Course Outcome**

At the end of the course student will be able to

1. Solve first order differential equations by applying appropriate methods.
2. Understand the rules for solving Cauchy-Euler differential equation, Legendre’s differential equations and simultaneous differential equations.
3. Solve simultaneous equations of the form dx/P = dy / Q = dz / R.
4. Apply the method of separation of variables to solve Differential Equations.
5. Appreciate the applications of differential equations and their solutions to various fields like science, engineering and economics.

**PO-CO Mapping**

**PO-CO Mapping Matrix**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| CO/PO Mapping | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
| CO1 |  |  |  |  |  |  |
| CO2 |  |  |  |  |  |  |
| CO3 |  |  |  |  |  |  |
| CO4 |  |  |  |  |  |  |
| CO5 |  |  |  |  |  |  |

**Prerequisites and other constraints**

The course requires basic knowledge in Calculus. It is offered to all the students of B.Sc. B.Ed. Mathematics programme.

**Pedagogy**

The course will be taught in theory-based mode through lectures. The students will be engaged in regular problem-solving sessions and will make presentations. Problem posing/solving approach and guided discovery approach will be the key strategies to be employed.

**Suggested Reading:**

1. Grewal (1965). Higher Engineering Mathematics. Khanna Publishers.
2. Kreyszig (2015). Advanced Engineering Mathematics. Wiley Eastern Ltd.
3. Murray (2012). Introductory Course in Differential Equations. Orient Blackswan Pvt. Ltd. New Delhi.
4. Simmons (2017). Differential Equations. Tata McGraw Hill.
5. Ayres (1992). Differential Equations, Schaum’s Outline Series. Tata McGraw Hill.
6. Raisinghania (2020). Ordinary and Partial Differential Equations. S. Chand and Co.
7. Vasishta and Sharma (2020). Differential Equations. Krishna Prakashan Mandir.
8. Mittal (2007). A Textbook of Differential Equations. Har Anand Publications.

**Evaluation Pattern**

**Evaluation Matrix**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Continuous**  **Internal**  **Assessment (CIA) Components** | **Component Type** | **Weightage Percentage** | **Total**  **Marks** | **Tentative Dates** | **Course Outcome Mapping** |
| Mid-term Exam | 50 % of CIA | 15 | 10th week | 1,2,3 |
| Quizzes/ Problem Solving | 17% of CIA | 5 | Weekly | 1,2 |
| Presentation | 8% of CIA | 2.5 | At the end of two modules | 1,2,3,4,5 |
| Assignments | 25 % of CIA | 7.5 | At the end of each module | 1,2,3,4,5 |
| CIA Marks | 30 % (To be converted to 60%) | 30 |  |  |
|  | **ESE** | **70%** | **70** | End of the Semester | 1,2,3,4,5 |

**Module Sessions**

**Module 1: (15 Hours)**

Definition, Formation of a differential equation, Solution of a differential equation, Equations of the first order and first degree, Variables separable, Integrating factors, Homogeneous form– Reducible to homogeneous form, Linear equations, Bernoulli’s equation, Exact equations, Equations reducible to exact equations.

**Reading:**

* 1. Raisinghania
  2. Grewal
  3. Rainville and Bedient

**Activities:**

1. Quiz
2. Assignment

**Module 2: (20 Hours)**

Equations of the first order and higher degree, Clairaut’s equation solvable for x and y and p, Orthogonal trajectories in polar and Cartesian form, Operator D, Rules for finding the particular integral, Cauchy-Euler differential equation, Legendre’s differential equations, Simultaneous differential equations**.**

**Reading:**

* + 1. Raisinghania
    2. Kreyszig
    3. Murray

**Activities:**

1. Quiz
2. Assignment
3. Presentation

**Module 3: (20 Hours)**

Equations which do not contain x, Equation whose one solution is known, Equations which can be solved by changing the independent variable and dependent variable, Variation of parameters, Total differential equation: Pdx + Qdy + Rdz = 0, Simultaneous equations of the form dx/P = dy / Q = dz / R.

**Reading:**

* + - 1. Raisinghania
      2. Ayres
      3. Mittal

**Activities:**

1. Quiz
2. Assignment

**Module 4: (20 Hours)**

Formation by elimination of arbitrary constants, Formation by elimination of arbitrary functions, Solution by direct integration, Lagrange’s linear equations Pp + Qq = R, Standard types of first order non-linear partial differential equations, Charpit’s method, Homogeneous linear equations with constant coefficients, Rules for finding the complementary functions, Rules for finding the particular integral, Separation of variables.

**Reading:**

* + - 1. Raisinghania
      2. Ayres
      3. Vasishta and Sharma
      4. Mittal

**Activities:**

1. Quiz
2. Assignment
3. Presentation