Programme	B.Sc. (Engg.) Energy Engineering	Course Code	NS 215	Credit Hours	3 + 0 = 3
Course Title	**Applied Differential Equations**				

Course Introduction

Differential Equations (NS 215) is a crucial course in the third semester that delves into the theory and applications of differential equations, a fundamental tool in engineering and the sciences. The course provides students with a comprehensive understanding of how to formulate and solve various types of differential equations. Emphasis is placed on the application of these equations in modeling and solving real-world engineering problems. By the end of the course, students will be adept at using differential equations to analyze and predict system behaviors, equipping them with the skills needed for advanced technical challenges.

Mapped SDGs	SDG-4: Quality Education

Learning Outcomes

1. **Identify** the differential equation (C1)
2. **Illustrate** the use of differential equations in engineering applications. (C3)
3. **Solve** differential equations. (C3)

Course Content		Assignments/Readings
Week 1	**Unit-I Ordinary Differential Equations** 1.1. Basic concepts of ordinary differential equation 1.2. General and particular solution	The teacher may assign home assignments/problem-based learning/reading materials/learning activity etc.
Week 2	**Unit-I Ordinary Differential Equations** 1.3. Initial and boundary condition 1.4. Linear and nonlinear differential equations 1.5. Solution of first order differential equation 1.5.1. homogeneous 1.5.2. non-homogeneous	
Week 3	**Unit-I Ordinary Differential Equations** 1.5.1 exact and non-exact (integrating factor)	
Week 4	**Unit-I Ordinary Differential Equations** 1.5.2 linear and non-linear Bernoulli.	
Week 5	**Unit-I Ordinary Differential Equations** 1.5.3. Equations of Ricatti and Clairaut.	
Week 6	**Unit-I Ordinary Differential Equations** 1.1 Applications of Linear and Non-Linear First Order ODEs.	

Week 7	**Unit-II Second Order Differential Equations** 2.1. Linear Differential Equations of Higher Order: Preliminary Theory, Initial and Boundary Value Problems, Linear Dependence and Linear Independence.	
Week 8	**Unit-II Second Order Differential Equations** 2.2. Solution of second order differential equations	
Week 9	**Unit-II Second Order Differential Equations** 2.3. Homogeneous Linear Equations with constant coefficients.	
Week 10	**Unit-II Second Order Differential Equations** 2.4 Non-Homogeneous Linear Equations with Variable Coefficients: Cauchy-Euler Equation.	
Week 11	**Unit-III Partial Differential Equations** 3.1. Basic Concepts linear and non-linear P.D equations 3.2. Quasi linear and Quasi non-linear P.D equations	
Week 12	**Unit-III Partial Differential Equations** 3.3. homogenous and non-homogenous P.D equations 3.4. Solutions of P.D equations 3.5. Boundary and initial conditions	
Week 13	**Unit-III Partial Differential Equations** 3.6. Analytic Solution by separation of Variables of the Steady State, two-dimensional heat equation/Laplace equation.	
Week 14	**Unit-III Partial Differential Equations** 3.7. Un-steady one-dimensional heat equation/Diffusion equation with homogenous and non-homogenous boundary conditions.	
Week 15	**Unit-IV Laplace Transform** 4.1. Laplace Transform: Laplace Transform and Inverse Transform. 4.2. Unit step function, Dirac delta function	
Week 16	**Unit-IV Laplace Transform** 4.3. Solution of 1st and higher order initial value problem using Laplace Transform	
Textbooks and Reading Material		
1. Textbooks. 1.1 Ochieng, F. O. (2022). Calculus For Scientists and Engineers. (n.p.): Amazon Digital		

Services LLC - Kdp.
1.2 Nonlinear Functional Analysis and Its Applications. (2021). Switzerland: MDPI AG.
1.3 Zill, D. G. (2016). Differential equations with boundary-value problems. Nelson Education.
1.4 Greenberg, M. D. (2013). Foundations of applied mathematics. Courier Corporation.
1.5 Stroud, K. A., & Booth, D. J. (2013). Engineering mathematics. Macmillan International Higher Education

2. Suggested Readings

2.1 Zill, D. G. (2012). A first course in differential equations with modeling applications. Cengage Learning.

Teaching Learning Strategies

1 Multimodal **Instruction**: Utilize lectures with multimedia and white/blackboard to deliver content and facilitate understanding.

2 **Interactive and Collaborative Learning**: Engage students through group discussions, project-based learning, and presentations to develop critical thinking and communication skills.

3 **Assignments and Assessments**: Assign individual and group tasks, reading and writing assignments to assess comprehension and encourage independent study.

4 **Practical Application**: Integrate real-world projects and case studies to bridge theory and practice, enhancing problem-solving and practical skills.

Assignments: Types and Number with Calendar

Week	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Activity	-	-	-	Quiz 1	Assignment 1	-	-	

Week	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Activity	-	-	-	Assignment 2	Quiz 3	-	-	-

The abovementioned schedule of assignments/quizzes/presentations is tentative. The schedule will be provided to the students at the start of semester.

Assessment

Sr. No.	**Elements**	**Weightage**	**Details**
1.	Midterm Assessment	35%	Written assessment at the mid-point of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work, report writing, and viva-voce examination, etc.
2.	Sessional Assessment	25%	This assessment may include classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.

3.	Final Assessment	40%	Written assessment at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work, report writing, and viva-voce examination, etc.