



**NATIONAL UNIVERSITY OF ENGINEERING**  
**COLLEGE OF MECHANICAL ENGINEERING**  
**MECHANICAL ENGINEERING PROGRAM**

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**MB155 – DIFFERENTIAL EQUATIONS**

**I. GENERAL INFORMATION**

<b>CODE</b>	: MB155 Differential Equations
<b>SEMESTER</b>	: 4
<b>CREDITS</b>	: 5
<b>HOURS PER WEEK</b>	: 6 (Theory – Practice)
<b>PREREQUISITES</b>	: MB148 Vector Calculus
<b>CONDITION</b>	: Compulsory

**II. COURSE DESCRIPTION**

This course is theoretical and practical and provides students with advanced mathematics knowledge and tools to be applied to solve engineering problems. Its main objective is to make students learn to apply all the knowledge acquired in the prerequisite courses to deal with new subjects and, above all, demonstrate the multiple application of mathematics to mechanical engineering.

**III. COURSE OUTCOMES**

1. Identify the scientific nature of mathematics and assess the rigor and the objectivity of the discipline contributing to the proper professional training of students.
2. Analyze, interpret, assess and adapt with strategies the fundamental theorems of the course adequately applying them in the solution to specific problems inherent to the career with the necessary thoroughness.
3. Correctly operate with complex numbers, successions, series of powers, ordinary differential equations and creatively find Laplace's transform of real functions.
4. Understand concepts of series of power and apply it to calculate derivatives and integrals and the convergence analysis and assess its importance in engineering problems solving.
5. Define first-order differential equations and classify in separate-homogeneous-exact variables and integrating factor and apply solution methods in every case.
6. Define differential equations with and without damping, and apply it in beams deflection (mathematical models).
7. Define Laplace's transform and inverse Laplace's transform, properties, derivatives and integrals of real functions, real variables with creativity, ability of analysis and constructive vision.

**IV. LEARNING UNITS**

**1. SUCCESSIONS, SERIES AND POWER SERIES / 8 HOURS**

Successions of real numbers. Converge criteria and applications. Series of real numbers. Convergence criteria and applications.

**2. ORDINARY DIFFERENTIAL EQUATIONS / 8 HOURS**

Ordinary differential equations. Order and grade. Differential equations with separable variables. Homogeneous differential equations. Exact differential equations. Some integration factors. Differential, linear and Bernoulli's equations.

### **3. SECOND-ORDER HOMOGENEOUS AND NON HOMOGENEOUS DIFFERENTIAL EQUATIONS / 12 HOURS**

Second-order homogeneous and non homogeneous differential equations. Solution to non homogeneous equations. Methods of undetermined coefficients and differential operators. Solution to ordinary differential equations with variable coefficients. Euler's and Legendre's equation.

### **4. APPLICATION PROBLEMS. BEAMS, DAMPING; LEGENDRE'S, BESSEL'S EQUATIONS; GAMMA AND BETA / 12 HOURS**

Application problems: beams and damping. Special functions: Gamma and Beta. Solution to differential equation using power series. Frobenius' theorem. Legendre's equation, Legendre's polynomial.

### **5. CONTINUOUS FUNTIONS, LAPACE'S TRANSFORM / 16 HOURS**

Continuous function in segments and of exponential order. Laplace's transform, properties, theorem, calculation methods and application of Laplace's transform. Inverse Laplace transform, calculation methods. Application of the inverse Laplace's transform. Application of the inverse Laplace's transform to differential equations with constant and variable coefficients, other applications. Systems of 2x2 linear differential equations. Matrix solution for Laplace's transform.

## **V. METHODOLOGY**

The course is carried out in theory and practice sessions. In theory sessions, the instructor introduces concepts, theorems and applications. In practice sessions, several types of problems are solved, and their solutions are analyzed. In all sessions student's active participation is encouraged.

## **VI. EVALUATION FORMULA**

The average grade PF is calculated as follows:

$$PF = ( EP + EF + PP ) / 3$$

EP: Mid-Term Exam

EF: Final Exam

PP: Average of six quizzes

## **VII. BIBLIOGRAPHY**

1. **DENNIS G. ZILL**  
Differential Equations  
Iberoamerican Editorial, 2009
2. **O. NEIL B.**  
Advanced Mathematics for Engineering  
Continental Editorial, 2009