NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF CIVIL ENGINEERING

CIVIL ENGINEERING PROGRAM

SYLLABUS   -   MATHEMATICS IV

I. GENERAL INFORMATION

CODE   : MA143
SEMESTER   : 4
CREDITS   : 4
HOURS PER WEEK   : 4 (Theory – Workshop)
PREREQUISITES   : MA133 Mathematics III
CONDITION   : Compulsory
DEPARTMENT   : Basic Sciences
INSTRUCTOR   : Leonardo Flores, Armando Velasquez
INSTRUCTOR E-MAIL : avromero2002@gmail.com

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 civil 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 derivates 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, derivates 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

VIII. COURSE CONTRIBUTIONS TO STUDENT OUTCOMES ATTAINMENT

Course contributions to Student Outcomes are shown in the following table:

K = Key   **R** = Related   **Empty box** = Does not apply

	Outcome	Contribution
Engineering Design	Design civil works satisfying requirements and needs as well as given constraints and limitations.	
Problem solving	Identify, formulate and solve engineering problems properly using the methods, techniques and tools of civil engineering.	**K**
Sciences Application	Apply the knowledge and skills of mathematics, sciences and engineering to solve civil engineering problems.	**K**
Experimentation	Conceive and conduct experiments, analyze data and interpret results	
Modern Engineering	Use and apply techniques, methods and tools of modern engineering necessary for the practice of civil engineering.	
Engineering Impact	Understand the impact of engineering solutions on people and society in local and global contexts.	
Project Management	Plan and manage civil engineering projects taking into account efficiency and productivity criteria.	
Environmental Appraisal	Takes into account the importance of preserving and improving the environment in the development of their personal and professional activities.	
Lifelong Learning	Recognize the need to keep their knowledge and skills up to date according to advances of civil engineering and engage in lifelong learning.	
Contemporary Issues	Know and analyze relevant contemporary issues in local, national and global contexts.	
Ethics and Professional Responsibility	Evaluate their decisions and actions from a moral perspective and assume responsibility for the executed projects.	
Communication	Communicate clearly and effectively in oral, written and graphical formats, interacting with different types of audiences.	
Teamworking	Appraise the importance of teamworking and participate actively and effectively in multidisciplinary teams.	