NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF CIVIL ENGINEERING

CIVIL ENGINEERING PROGRAM

SYLLABUS - DYNAMICS

I. GENERAL INFORMATION

CODE	**:**	EC114
SEMESTER	**:**	4
CREDITS	**:**	4
HOURS PER WEEK	**:**	6 (Theory – Practice)
PREREQUISITES	**:**	FI204 Physics II, MA1333 Mathematics III
CONDITION	**:**	Compulsory
DEPARTMENT	**:**	Structures
INSTRUCTOR	**:**	Roque Sanchez, Fernando Lazares, Ricardo Proaño.
INSTRUCTOR E-MAIL	**:**	rsanchez@gmail.com

II. COURSE DESCRIPTION

This course provides students with the main principles of Mechanics and its applications. Its general objective is to understand and apply the concepts of particle kinematics, particle movement, relative motion, rigid body kinematics, dynamics of a particle and a system of particles, dynamics of a rigid body and vibration with one degree of freedom. Applications are related to several fields of engineering including structural engineering.

III. COURSE OUTCOMES

1. Interpret physic phenomena related to main principles of Mechanics.
2. Create models representing the dynamics of moving particles and bodies (longitudinal and rotational motion)
3. Physically and mathematically represent everyday problems, and problems related to engineering making their analysis and modeling.
4. Understand the importance of Mechanics for the study of practical situations related to problems of the career.

IV. LEARNING UNITS

1. PARTICLE KINEMATICS. RELATIVE MOTION

Framework of reference. Position. Trajectory parametrical equations. Velocity and acceleration. Velocity and acceleration in Cartesian coordinate system. Intrinsic components of acceleration. Applications. Particle movement in other coordinate systems. Coordinate systems that revolve with respect to a fixed coordinate system. General equation for the particle movement with respect to the moving coordinate system. Applications.

2. KINEMATICS OF A RIGID BODY / 7 HOURS

General equation for the movement of a rigid body. Translational motion. Rotation movement around a fixed axis. Main properties of the rigid body movement. Instantaneous axis of rotation and slipping. Movement in one plane of a rigid body. Instantaneous center of rotation. Rigid body movement with respect to a moving coordinate system. Rigid body movement with a fixed point. Euler angles. Euler velocities. General movement of a solid. Applications.

3. FLUID DYNAMICS / 70 HOURS
Differential equations for movement in various coordinate systems. Impulse and momentum. Conservation of momentum. Momentum and impulse theorem. Work and energy. Work-energy theorem and kinetic energy. Fields of conservative forces. Potential energy. Mechanical energy conservation. Center of mass movement. Total kinetic energy of a system of particles. Work and energy equation. Impulse and momentum. Angular momentum. Application.

4. RIGID BODY KINETICS AND VIBRATIONS
Angular momentum of a rigid body. Moments and products of solids inertia. Rotation of coordinate axes. Main axes. General equation of motion. Translation. Rotation around a fixed axis. Movement in one plane. Rotation around a fixed point. Work and energy equation for rigid bodies. Lagrange equation applied to solids movement. Vibration of a particle with a degree of freedom. Differential equation of shaking motion. D'Alembert's principle applied to the formulation of the differential equation for systems with a degree of freedom. Free vibrations without damping. Dynamic response. Free damped motion. Overdamped motion. Motion with critical damping. Free subdamped vibration. Logarithmic energy decrement. Energy dissipation. Forced damped vibrations. Dynamic amplification. Vibration-isolation. Duhamel's integral.

V. METHODOLOGY

The course is carried out in theory and practice sessions using active methods in the teaching-learning process and encouraging students' participation. The instructor exposes and gives examples to complement students' activity using the available audiovisual aids. Students should solve problems applied to diverse engineering fields.

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. **BEER, FERDINAND AND JOHNSTON, RUSSELL JR.**
   Newtonian Mechanics for Engineers. Dynamics
   Mc. Graw Hill Editorial, Mexico, 2005

2. **HIBBELER, R. C.**
   Mechanics And Dynamics
   Prentice Hall Hispano-American, Mexico, 2004

3. **SHAMES, IRVING**
   Mechanical Engineering
   Prentice Hall, Iberia, Madrid, 2005

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.	**K**
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.	**R**
Engineering Impact	Understand the impact of engineering solutions on people and society in local and global contexts.	**R**
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.	**R**
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.	