Machine Mechanics

Academic Year: (2023 / 2024) **Review date: 18/07/2023 13:58:58**

Department assigned to the subject: Mechanical Engineering Department

Coordinating teacher: MENESES ALONSO, JESUS

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Physics I
Calculus I
Calculus II
Linear algebra

LEARNING OUTCOMES

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study.
CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
COCIN1. Ability to draft, sign and develop projects in the area of industrial engineering for construction, renovation, repair, preservation, demolition, manufacture, installation, assembly or operation of: structures, mechanical equipment, energy installations, electrical and electronic installations, industrial plants and installations and automation and manufacturing processes.
COCIN3. Knowledge of basic and technological subject areas that will capacitate them to acquire new methods and theories and endow them with the versatility to adapt to new situations.
COCIN4. Ability to resolve problems with initiative, decision-making, creativity, and critical reasoning skills and to communicate and transmit knowledge, skills and abilities in the Industrial Engineering field.
COCIN5. Knowledge to perform measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar jobs.
CEP3. Ability to design and carry out experiments to analyze and interpret data obtained.
CER7. Knowledge of the fundamentals of mechanism and machine theory.

By the end of this content area, students will be able to have:
RA1.1. Knowledge and understanding of machine theory and mechanisms fundamentals.
RA1.2. A systematic understanding of the key aspects and concepts of mechanical engineering.
RA1.4. Awareness of the wider multidisciplinary context of engineering.
RA2.2. the ability to apply their knowledge and understanding to identify, formulate and solve problems of machine theory and mechanisms using established methods.
RA4.2. The ability to design and conduct appropriate experiments, interpret the data and draw conclusions;
RA4.3. Workshop and laboratory skills.
RA5.1. The ability to select and use appropriate equipment, tools and methods.
RA5.2. The ability to combine theory and practice to solve problems of machine theory and mechanism.
RA5.3. An understanding of applicable techniques and methods in mechanical engineering and of their limitations.

OBJECTIVES

By the end of this subject, students will be able to have:
1. The knowledge and understanding of the fundamentals of kinematic and dynamic of the rigid body and machines theory and mechanisms.

2. The ability to apply their knowledge and understanding to identify, formulate and solve problems of kinematics and dynamics of the rigid solid and mechanisms and simple machines using established methods.
3. The ability to design and perform experiments on machine theory and mechanisms, analyse the data and draw conclusions.
4. The technical and laboratory skills in machine theory and mechanisms.
5. The ability to select and use appropriate equipment, tools and methods to solve problems of kinematics and dynamics of rhe rigid body, mechanisms and simple machines.
6. The ability to combine theory and practice to solve problems of kinematics and dynamics of rigid body, mechanisms and simple machines
7. The understanding of methods and techniques applicable in machine theory and mechanisms and their limitations.

DESCRIPTION OF CONTENTS: PROGRAMME

0. Introduction to Mechanics. Static. Kinematics of the point. Systems of Units
  0.1. Mechanics
  0.2. Basics
  0.3. The particle and rigid body
  0.4. Static
  0.5. Point Kinematics
  0.6. Speed Concept
  0.7. Acceleration Concept
  0.8. System Units

1. Kinematics of rigid bodies
  1.1. Orthonormal basis of a scalar dependent
  1.2. Movement of the Rigid Solid
  1.3. Instantaneous axis of rotation
  1.4. Intrinsic component of acceleration
  1.5. Acceleration of Rigid Solid
  1.6. Euler Angles

2. Reference Systems in relative motion
  2.1. "Absolute", relative and drag velocity
  2.2. "Absolute", relative and drag Acceleration
  2.3. No Inertial Reference Systems. Inertia Forces

3. Dynamics of rigid bodies
  3.1. Newton's Laws
  3.2. Momentum
  3.3. Angular momentum
  3.4. Theorem of angular momentum
  3.5. Motion of a rigid body with a fixed point
  3.6. Gyroscopic motion
  3.7. Motion of a rigid body with a fixed axis. Equation of Motion
  3.8. Calculation of reactions
  3.9. Balancing of shafts

4. Planar Mechanisms
  4.1. Introduction
  4.2. Component parts of a mechanism
  4.3. Mobility mechanisms
  4.4. Four-bar linkage
  4.5. Determining the relative CIR

5. Kinematics of planar Mechanisms
  5.1. Determination of rates members of a mechanism
  5.2. Determination of members of an acceleration mechanism
  5.3. Value of accelerations and velocities of points of kinematic pairs
  5.4. Cinema speed
  5.5. Cinema accelerations.

6. Forces in planar Mechanisms
6.1. Introduction
6.2. Kinetic analysis of mechanisms-static flat
6.3. Static Analysis
6.4. Analysis Efforts Inertia
6.5. Full Dynamic Analysis

7. Energy and Power in machines
7.1. Work and power
7.2. Kinetic energy. Theorem of the prime movers
7.3. Potential energy
7.4. Energy Conservation Principle
7.5. Dissipative Forces. Generalization of the energy conservation principle
7.6. Mechanical Performance

LEARNING ACTIVITIES AND METHODOLOGY

Master class, classroom exercises and / or laboratories and work.

ASSESSMENT SYSTEM

% end-of-term-examination/test:	50
% of continuous assessment (assigments, laboratory, practicals…):	50

The qualification is made up of CONTINUOUS ASSESMENT and FINAL EXAM. The percentages of each section on the final qualification are indicated:

CONTINUOUS ASSESSMENT
Pr: Practices. 10%
Ex: Exercises delivered in small group class. 10%
P1: Partial exam part 1. 15%, if not passed. 40% if passed (F1 exempt in Ordinary Call)
P2: Partial exam part 2. 15%, if not passed. 40% if passed (exempt F2 in Ordinary Call)

FINAL EXAM
F1: Final exam part 1. 25%. Exempt (in the Ordinary Call) if P1 is passed
F2: Final exam part 2. 25%. Exempt (in the Ordinary Call) If P2 is passed
To pass, a minimum of 35% in each part must be obtained.

In the Extraordinary call, no part is exempt and the partials count 15% each.
To pass a minimum of 40% of the final exam must be obtained.

PERCENTAGES CONTINUOUS ASSESSMENT-FINAL EXAM:
If none of the partial exams are passed: continuous evaluation 50% - final exam 50%
If one of the partial exams is passed: continuous evaluation 75% - final exam 25%
If both partial exams are passed: continuous evaluation 100%

BASIC BIBLIOGRAPHY

- Erdman, A., Mechanism design . Vol I : Analysis and synthesis, Prentice Hall, New Jersey, 2001

- Hibbeler, R.C., Engineering Mechanics. Dynamics, Prentice Hall, Singapore, 2010

- J.C. García-Prada, C. Castejón, H. Rubio, J. Meneses Problemas resueltos de Teoría de Máquinas y Mecanismos 2ed, Thomson-Paraninfo, , 2014

- M. Artés Mecánica, Universidad Nacional de Educación a Distancia, 2003

- Norton, R.L, Design of machinery, McGraw-Hill, New York, 2012

- Uicker, J., Theory of machines and mechanisms, Oxford University Press, New York, 2010

ADDITIONAL BIBLIOGRAPHY

- Spiegel, Murray R. Teoría y problemas de mecánica teórica: con una introducción a las ecuaciones de Lagrange y a la teoría Hamiltoniana, : McGraw-Hill, 1991.

- A. Lamadrid, A. Corral Cinemática y dinámica de máquinas, E.T.S.I.I. Madrid, 1969.

- A.G. Erdman, G.N. Sandor Diseño de mecanismos, análisis y síntesis, Prentice Hall, 1998.

- J.E. Shigley Teoría de máquinas y Mecanismos, McGraw-Hill, 1988.

- MacGill, David J. Mecánica para ingeniería y sus aplicaciones [dinámica], Grupo Editorial Iberoamericana, 1991.