Machine Mechanics

Academic Year: (2023 / 2024) **Review date: 30-03-2023**

Department assigned to the subject: Mechanical Engineering Department

Coordinating teacher: CALVO RAMOS, JOSE ANTONIO

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Particle kinematics.
Relative movement.
Particle dynamics.
Conservative and nonconservative forces. Work and energy.
Dynamics of a system of particles.
Kinematics of rigid bodies.
Dynamics of rigid bodies.

OBJECTIVES

1. To have the Knowledge and understanding of the fundamentals of the kinematic and dynamic behavior of rigid body, the machines theory and mechanisms.
2. To have 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. To have the ability to design and perform experiments on machine theory and mechanisms, interpret the data and draw conclusions.
4. To have the Technical and laboratory skills in machine theory and mechanisms.
5. To have the ability to select and use appropriate equipment, tools and methods to solve problems of kinematics and dynamics of rigid body, mechanisms and simple machines.
6. To have the ability to combine theory and practice to solve problems of kinematics and dynamics of rigid body, mechanisms and simple machines
7. To have the understanding of methods and techniques applicable in machine theory and mechanisms and their limitations.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction to Mechanics. Static. Kinematics of the point. Systems of Units
   1.1. Mechanics
   1.2. Basics
   1.3. The particle and rigid body
   1.4. Static
   1.5. Point Kinematics
   1.6. Speed Concept
   1.7. Acceleration Concept
   1.8. System Units

2. Kinematics of rigid bodies
   2.1. Orthonormal basis of a scalar dependent
   2.2. Movement of the Rigid Solid
   2.3. Instantaneous axis of rotation
   2.4. Intrinsic component of acceleration
   2.5. Acceleration of Rigid Solid
   2.6. Movement Absolute, Relative and Drag
   2.7. Speed relative motion
   2.8. Acceleration in relative motion
   2.9. Euler Angles

3. Dynamics of rigid
   3.1. Newton's Laws
   3.2. No Inertial Reference Systems

3.3. Inertia Forces
3.4. Momentum
3.5. Angular momentum
3.6. Theorem of angular momentum
3.7. Motion of a rigid body with a fixed point
3.8. Gyroscopic motion
3.9. Motion of a rigid body with a fixed axis
3.10. Equation of Motion
3.11. Calculation of reactions
3.12. Balancing of shafts

4. Mechanisms Plans
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. Polar diagram of velocities
5.5. Polar diagram of accelerations

6. Dynamics of Planar Mechanisms
6.1. Introduction
6.2. Kineto-static analysis of planar mechanisms
6.3. Static Analysis
6.4 Theorem of virtual works
6.5. Analysis of Inertia Forces 7.5. Full Dynamic Analysis

7. Energy and Power
7.1. Work and power
7.2. Kinetic energy. Theorem of the prime movers
7.3. Potential energy
7.4. Energy Conservation
7.5. Friction Forces
7.6. Mechanical Performance
7.7. Energy and Power of planar mechanisms

LEARNING ACTIVITIES AND METHODOLOGY

Master class
Classroom exercises
Laboratories exercices
Personal work.
Team Work

ASSESSMENT SYSTEM

The subject will be evaluated according to the following criteria:
- Continuous assessment of the first part of the course (EC1): Up to 1,5 points
- Continuous assessment of the second part of the course (EC2): Up to 1,5 points
- Class exercises of the first part of the subject (EGR1): up to 0.5 points
- Class exercises of the second part of the subject (EGR2): up to 0.5 points
- Practices (P): Up to 1 point
- Final Exam, consisting of two parts:
    - Final exam of the first part of the course (EF1): Up to 2,5 points
    - Final exam of the second part of the course (EF2): Up to 2,5 points

Total: Up to 10 points

If any of the parts of the continuous assessment is exceeded, attendance at the approved part of the subject is released. So that (All the notes are about 10):

- If the student exceeds the two continuous assessments (EC1 > 5 and EC2 > 5), the final grade is calculated:
  FINAL NOTE = 0.1 x P + 0,05 x EGR1+ 0.40 x EC1 +0,05x EGR2+ 0.4 x EC2

- If the student passes one of the two continuous assessments and suspends the other, the final grade is calculated:

If EC1 > 5 and EC2 <5 then FINAL NOTE = 0.1 x P +0,05 x EGR1+ 0.4 x EC1 + 0,05 x EGR2 +0.15 x EC2 + 0.25 x EF2

If EC1 <5 and EC2 > 5 then FINAL NOTE = 0.1 x P + 0,05 x EGR2+ 0.4 x EC2 + 0,05 x EGR1 +0.15 x EC1 + 0.25 x EF1

- If the student does not pass either of the two continuous assessments (EC1 <5 and EC2 <5), the final grade is calculated:

FINAL NOTE = 0.1 x P + 0,05 x EGR1 +0.15 x EC1 + 0,05 x EGR2 +0.15 x EC2 +0.25 x EF1 + 0.25 x EF2

To pass it is necessary to obtain a minimum of 4 points out of 10 in each part of the final exam: (EF1 >4 y EF2 >4)

The extraordinary subjet involve the entire subject regardless of whether a part has been approved by partials, so that: Extraordinary FINAL NOTE: = 0,1 x P + 0,05 x EGR1 +0,15 x EC1+ 0,05 x EGR2+0,15 x EC2 +0,25 x EF1 + 0,25 x EF2

To pass in extraordinary call it is necessary to obtain a minimum of 4 points out of 10 in each part of the final exam: (EF1 >4 y EF2 >4)

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

BASIC BIBLIOGRAPHY

- J. Agulló Batlle Mecánica de la partícula y del sólido rígido, Publicaciones OK Punt, 1996..
- J.C. García-Prada, C. Castejón, H. Rubio Problemas resueltos de Teoría de Máquinas y Mecanismos, Thomson-Paraninfo, 2007.
- M. Artés Mecánica, Universidad Nacional de Educación a Distancia, 2003.
- McGill-King Mecánica para ingeniería y sus aplicaciones, McGraw-Hill, 1990..
- P. Pintado Mecánica Vectorial en Ejemplos, Paraninfo, 2017
- R. Calero Fundamentos de mecanismos y máquinas para ingenieros, E.T.S.I.I. Las Palmas de Gran Canaris, 1995..
- W.F. Riley y L.D. Sturges Estática"y Dinámica, Reverté, 1996..

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.
- González Fernández, Carlos F. Mecánica del sólido rígido, Ariel, 2003.
- 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.