Machine Mechanics

Academic Year: (2019 / 2020) **Review date: 26-11-2019**

Department assigned to the subject: Mechanical Engineering Department

Coordinating teacher: RUBIO HERRERO, PATRICIA

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 1

Branch of knowledge: Engineering and Architecture

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Physics I
Calculus I
Calculus II
Linear Algebra

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

11. 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
6.6. 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

LEARNING ACTIVITIES AND METHODOLOGY

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

ASSESSMENT SYSTEM

The subject will be evaluated according to the following criteria:
1- Continuous evaluation (up to 4 points)
¿ Continuous evaluation of the first part of the subject (EC1): Up to 1,5 points
¿ Continuous evaluation of the second part of the subject (EC2): Up to 1,5 points
¿ Laboratories (P): Up to 1 point

2- Ordinary final call
¿ Ordinary Final Exam, with two parts: Up to 6 points
O Final exam of the first part of the subject (EF1): Up to 3 points
O Final exam of the second part of the subject (EF2): Up to 3 points
Total: Up to 10 points

If the student passes any of the parts of the continuous evaluation, he (she) is released to attend the corresponding part of the final exam.
So that (All the grades are over 10):
- If the student passes the two continuous evaluations (EC1 greater than or equal to 5 and EC2 greater than or equal to 5), the final grade is calculated:
FINAL GRADE = 0.1 P + 0.45 EC1 + 0.45 EC2
- If the student passes one of the two continuous evaluations but fails the other, the final grade is calculated as follows:

If EC1 greater than or equal to 5 and EC2 less than 5 then FINAL GRADE = 0.1 P + 0.45 EC1 + 0.15 EC2 + 0.3 EF2
If EC1 less than 5 and EC2 greater than or equal to 5 then FINAL GRADE = 0.1 P + 0.45 EC2 + 0.15 EC1 + 0.3 EF1
¿ If the student does not pass either of the two continuous evaluations (EC1 less than 5 and EC2 less than 5), the final grade is calculated as follows:
FINAL GRADE = 0.1 P + 0.15 EC1 + 0.15 EC2 +0.3 EF1 + 0.3 EF2
To pass it is necessary to obtain a minimum of 3,5 points out of 10 in the total final exam

3- Extraordinary final call
The highest grade of the two cases will be computed.
- Case A: Extraordinary Final Exam, with two parts, computes the 100% of the grade for the extraordinary call
- Case B: Extraordinary Final Exam, with two parts computes the 60% of the grade for the extraordinary call. The continuous evaluation is taken into account in the same way as in the ordinary call.

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

BASIC BIBLIOGRAPHY

- Agulló Batlle Mecánica de la partícula y del sólido rígido, Publicaciones OK Punt, 1996
- Bedford y W. Fowler Mecánica para Ingeniería, Addison-Wesley, 1996
- Beer y Johnston Mecánica vectorial, Mc Graw Hill, 2010
- I.H. Shames Mecánica para ingenieros. Dinámica, Prentice Hall, 1999
- J.C. García-Prada, C. Castejón y H. Rubio Problemas resueltos de Teoría de Máquinas y Mecanismos, Thomson-Paraninfo, 2007
- M. Artés Mecánica, UNED, 2003
- M. Vázquez y E. López Mecánica para ingenieros, Noelas, 1998
- McGill y King Mecánica para ingeniería y sus aplicaciones, MC Graw Hill, 1990
- R. Calero Fundamentos de mecanismos y máquinas para ingenieros, E.T.S.I.I. Las Palmas de Gran Canaria, 1995
- Simón, Bataller,Guerra y Cabrero Fundamentos de Teoría de Máquinas, Ed. Técnicas y Científicas, 2000
- W.F. Riley y L.D. Sturges Estática y Dinámica, Reverté, 1996

ADDITIONAL BIBLIOGRAPHY

- A. Lamadrid y A. Corral Cinemática y dinámica de máquinas, E.T.S.I.I. UPM , 1969
- A.G. Erdman y G.N. Sandor Diseño de mecanismos. Análisis y síntesis, Prentice Hall, 1998
- C. F. González Fernández Mecánica del sólido rígido, Ariel, 2003
- D.J. Mc Gill Mecánica para ingeniería y sus aplicaciones (Dinámica), Grupo editorial iberoamericana, 1991
- J.E. Shigley Teoría de máquinas y mecanismos, McGraw Hill, 1988
- Spiegel y Murray Teoría y problemas de mecánica teórica, Mc Graw Hill, 1991