Machine Mechanics

Academic Year: (2020 / 2021) **Review date: 10-07-2020**

Department assigned to the subject: Mechanical Engineering Department

Coordinating teacher: GOMEZ GARCIA, MARIA 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

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

1. Introduction to Mechanics (student self-study)
1.1. Mechanics
1.2. Basic concepts
1.3. Particles and rigid bodies
1.4. System of Units
1.5. Kinematics of a Point
1.6. Definition of Velocity
1.7. Definition of Acceleration

2. Kinematics of Rigid Solids
2.1. Time-dependent orthoganol basis
2.2. Movement of a Rigid Solid
2.3. Instantaneous axis of rotation
2.4. Specific cases of general movement
2.5. Instrinsic frame of reference
2.6. Acceleration of a Rigid Solid
2.7. Relative movement
2.8. Euler angles
2.9. Recommended reading

3. Dynamics of Rigid Solids
3.1. Introduction. Dynamics of a particle
3.2. Newton¿s Laws
3.3. Principle of Angular momentum
3.4. Dynamics in non-inertial reference systems

3.5. Dynamics of a system of particles
3.6. Movement of a rigid solid about a fixed point
3.7. Gyroscopic movement
3.8. Movement of a rigid solid with no externally applied moments
3.9. Movement of a rigid solid on a fixed axis
3.10. Equation of movement
3.11. Calculation of reactions
3.12. Balancing of shafts

4. Introduction to kinematics for planar systems
4.1. Introduction
4.2. Constituent part of a mechanism
4.3. Mobility of a mechanism
4.4. Four-bar linkage (parellelogram)
4.5. Instantaneous centre of rotationKinematics of planar mechanisms

5. Kinematics of planar mechanisms
5.1. Introduction to planar mechanisms
5.2. Determination of the velocity
5.3. Velocity image (or polygon)
5.4. Determination of accelerations
5.5. Calculation of accelerations for isolated links
5.6. Relations between point accelerations in kinematic pairs
5.7. Acceleration image (or polygon)

6. Dynamics of planar mechanisms
6.1. Introduction
6.2. Static analysis
6.3. Dynamic analysis

7. Work and Energy. Friction forces. Performance
7.1. Work
7.2. Power
7.3. Kinetic Energy ¿ Work-energy Theorem
7.4. Conservative forces - Potential Energy
7.5. Conservation of energy
7.6. Conservation of energy of rigid solids

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:

- 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
- In-class exercises: up to 1 point
- Laboratories (P): up to 1 point. Compulsory to pass the course.
-Ordinary final call
-Ordinary Final Exam, with two parts: Up to 5 points
  - Final exam of the first part of the subject (EF1): Up to 2.5 points
  - Final exam of the second part of the subject (EF2): Up to 2.5 points

Total: up to 10 points

To pass it is necessary to obtain a minimum of 4 points out of 10 in the total final exam

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

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

- Erdman, A Mechanism design . Vol I : Analysis and synthesis, Prentice Hall, 2001
- Hibbeler, R.C. Engineering Mechanics. Dynamics, Prentice Hall, 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
- Norton, R.L Design of machinery, McGraw-Hill, 2012
- 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
- Uicker, J. Theory of machines and mechanisms, Oxford University Press, 2010
- 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