Machine Mechanics

Academic Year: (2023 / 2024) **Review date: 13/07/2023 12:36:52**

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

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.
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.
CB4. Students should be able to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.
CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.
CG10. Being able to work in a multi-lingual and multidisciplinary environment
CE2 Módulo FB. Understanding and command of the fundamental concepts of the general laws of mechanics, thermodynamics, fields and waves, electromagnetism and their application for solving engineering problems.
CE19 Módulo CRI. Knowledge of the fundamentals of mechanism and machine theory.
CT1. Ability to communicate knowledge orally as well as in writing to a specialized and non-specialized public.
CT2. Ability to establish good interpersonal communication and to work in multidisciplinary and international teams.
CT3. Ability to organize and plan work, making appropriate decisions based on available information, gathering and interpreting relevant data to make sound judgement within the study area.
CT4. Motivation and ability to commit to lifelong autonomous learning to enable graduates to adapt to any new situation.

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

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

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

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 each part of the final exam

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