Machine Mechanics

Academic Year: (2023 / 2024) **Review date: 12-02-2024**

Department assigned to the subject: Mechanical Engineering Department

Coordinating teacher: RUBIO HERRERO, PATRICIA

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

SKILLS AND 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.
CG1. Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
CG3. Ability to design a system, component or process in the field of Industrial Technologies to meet the required specifications
CG10. Ability to design and carry out experiments and to analyse and interpret the data obtained.
CG20. Knowledge of the principles of machine and mechanism theory.

RA1. Knowledge and understanding: Have basic knowledge and understanding of science, mathematics and engineering within the industrial field, as well as knowledge and understanding of Mechanics, Solid and Structural Mechanics, Thermal Engineering, Fluid Mechanics, Production Systems, Electronics and Automation, Industrial Organisation and Electrical Engineering.
RA2. Engineering Analysis: To be able to identify engineering problems within the industrial field, recognise specifications, establish different resolution methods and select the most appropriate one for their solution
RA4. Research and Innovation: To be able to use appropriate methods to carry out research and make innovative contributions in the field of Industrial Engineering.
RA5. Engineering Applications: To be able to apply their knowledge and understanding to solve problems and design devices or processes in the field of industrial engineering in accordance with criteria of cost, quality, safety, efficiency and respect for the environment.

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 5 points)
Exercise collected in class of the reduced group (EGR): Up to 1 point
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 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
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> 5 and EC2> 5), the final grade is calculated:
FINAL GRADE = 0,1xP+0,1xEGR+ 0,4xEC1+ 0,4xEC2
If the student passes one of the two continuous evaluations but fails the other, the final grade is calculated as follows:
If EC1> 5 and EC2 <5 then FINAL GRADE = = 0,1xP+0,1xEGR+ 0,4xEC1+ 0,15xEC2 + 0,25x EF2
If EC1 <5 and EC2 > 5 then FINAL GRADE = 0,1x P+ 0,1xEGR+0,4xEC2+ 0,15xEC1 + 0,25xEF1
If the student does not pass either of the two continuous evaluations (EC1 <5 and EC2 <5), the final grade is calculated as follows:
FINAL GRADE = 0,1x P+0,1xEGR+ 0,15xEC1+ 0,15xEC2 +0,25xEF1 + 0,25xEF2
To pass it is necessary to obtain a minimum of 4 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 50% of the grade for the extraordinary call. The continuous evaluation is considered in the same way as in the ordinary call.

% 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
- 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