MET 305: Mechanics of Machines

(Required)

Course Description: **MET 305: Mechanics of Machines LT: 2 LB: 3 CR:3**

This course introduces the student to the analysis of machines commonly used in mechanical engineering. The course deals with evaluation of velocity, acceleration, forces and torque associated with the performance of the machines, and stability, balancing and vibration analysis of different mechanical systems. Lab activities in various mechanisms and machines, reinforce theory.

Prerequisite: MET 301 – Applied Dynamics
MATH 301- Calculus III

Textbook: Kinematics and Dynamics of Machinery, by Charles E Wilson, Person Education International Inc, USA, 3rd Edition, 2007

References: Mechanisms of Machines, by John Hannah, Edward Arnold Publishers, London, 2nd Edition, 2006

Theory of Machines, R.S. Khurmi, J.K.Gupta, Eurasia Publishing House, New Delhi, 30th Edition, 2008

Objectives: To introduce the students to;

1. Analyze motion of elements in machines.
2. Recognize the function of flywheels
3. Understand the terminology and parameters of gears.
4. Understand various gear trains.
5. Analyze and draw cam profile.
6. Understand the balancing of rotating and reciprocating masses in machines
7. Understand the function of governors
8. Understand the concept of gyroscopic torque
9. Understand the fundamentals of vibrations

Course Outline:

[I] Modules:

Module	Topic	Duration
1.	Introduction to basic types of Mechanisms, joints etc.	1 Week
2.	Kinematic pairs and mobility of planar mechanisms, Types of joints, degrees of freedom, Grashof criterion, inversions of different kinematic chains.	1 weeks
3.	Velocity analysis in planar mechanisms: graphical and analytical methods	1 Week
4.	Acceleration analysis in planar mechanisms	2 weeks
5.	Types of toothed gearing and path and arc of contact. interference	1 weeks
6.	Analysis of gear trains	1 weeks
7.	Cam motions and dynamics: types of cam follower mechanisms, follower motion diagrams and design of cam profiles	1 Week
8.	Balancing rotating and reciprocating masses definition of balancing, causes of unbalance, static and dynamic balancing	2 weeks

9	Flywheels and gyroscopes	1 Week
10	Need for Governors. Types of governors, sensitivity, effort and power. Hunting of governors	1 Week
11	Introduction to mechanical vibrations. Forced damped vibrations, vibration isolation, transmissibility, whirling of shafts.	2 Week

[II] Laboratory Work/Projects:

Exercise	Topic	Duration
1.	Tutorial 1 Velocity Analysis of mechanisms Instantaneous method	1 Week
2.	Tutorial 2 Velocity Analysis of mechanisms Relative method	1 Week
3.	Tutorial 3- Acceleration Analysis in Mechanisms	1 Week
4.	Performance evaluation of gear trains	1 Week
5.	Performance evaluation of compound gear trains	1 Week
6.	Performance evaluation of cams,	1 Week
7.	Tutorial 4- Design of cam profiles	1 Week
8.	Tutorial 5- Balancing of rotating masses	1 Week
9.	Balancing Test – Balancing of Machines	1 Week
10.	Tutorial 6- Turning moment diagrams	1 Week
11.	Tutorial 7- Governors	1 Week
12.	Tutorial 8- Gyroscope	1 Week
13.	Tutorial 9_ Mechanical Vibrations	1 Week

Evaluation Methods:

1. Major exams and a final examination.
2. Homework and quizzes.
3. Lab work, mid and final lab exams.

Course Learning Outcome:

The expected outcome is that the students will be able to:

1. Gain clear knowledge about some of the basic mechanisms, such as four-bar and slider linkages.
2. Identify the joints of mechanisms and demonstrate ability to visualize their mobility.
3. Demonstrate ability to draw the kinematic diagrams of actual mechanisms and determine their mobility.
4. Demonstrate a clear understanding of the physical meaning of degree of freedom.
5. Determining the position parameters, velocities, and accelerations (rectilinear and angular) of various planar mechanisms using both complex number methods and graphical methods.
6. Construct various follower motion diagrams and understand the advantages and disadvantages of each type of motion.

7. Design cam profiles for any given follower displacement using graphical methods.
8. Demonstrate a basic understanding of the dynamics of flywheels and their motion, the cause of gyroscopic forces in rotating machinery and how to calculate them.
9. demonstrate a basic understanding of mechanical vibrations by been exposed to essential elements of vibration, such as natural frequency, resonance, damping, and motion of undammed and damped single degree freedom systems.

Prepared by:

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