Hall Ticket No | | | | | | | | | | | Question Paper Code: AAE523

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER - II

B. Tech V Semester End Examinations (Regular), December – 2018

Regulations: R16

MECHANISM AND MACHINE DESIGN

(**AERONAUTICAL ENGINEERING**)

Time: 3 hours **Max. Marks: 70**

Answer ONE Question from each Unit

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

UNIT – I

1. a) How are the whitworth quick return mechanism and crank and slotted – lever mechanism different from each other **[7M]**

   b) In a crank and slotted lever quick return mechanism, the distance between the fixed centers is 240mm and the length of the driving crank is 120 mm. Determine the inclination of the slotted bar with the vertical in the extreme position and the time ratio of cutting stroke to return stroke. **[7M]**

2. a) Explain any two inversion of double slider crank chain. **[7M]**

   b) Prove that a point on one of links of a hart mechanism traces a straight line on the movement of its links. **[7M]**

UNIT – II

3. a) Explain the method of determining the Coriolis component of acceleration in crank and slotted lever quick return mechanism. **[7M]**

   b) In a slider crank mechanism, the crank OA makes 400 rpm in the counter clockwise direction which is 600 from IDC. The lengths of the links are OA= 60 mm, OB= 220 mm and BA= 280 mm. Determine the velocity and acceleration of the slider B. **[7M]**

4. a) Describe the procedure to locate the Instantaneous center in a mechanism. **[7M]**

   b) In Slider crank mechanism the lengths of the crank and the connecting rod are 200mm and 800 mm respectively. Locate all the I-centers of the mechanism for the position of the crank when it has turned 30^0 from the inner dead center. Also, find the velocity of the slider and the angular velocity of the connecting rod if the crank rotates at 40 rad/s **[7M]**

5. a) What do you mean by fixed centrode and moving centrode? Explain. **[7M]**

   b) Derive the condition for generating a straight line in Grasshopper's mechanism **[7M]**

6. a) Derive an expression for the ratio of shaft velocities in a Hooke's joint. **[7M]**

   b) A hooks joint connects two shafts whose axes intersect at 25^0. What will be the angle turned by the driven shaft when the velocity ratio is maximum, minimum and unity. **[7M]**

UNIT – IV

7. a) What are cams? Explain types of cams with a neat sketch. **[7M]**

   b) A cam has straight working faces which are tangential to a base circle of diameter 90 mm. The follower is a roller of diameter 40 mm and the centre of roller moves along a straight line passing through the centre line of the cam shaft. The angle between the tangential faces of the cam is 90^0 and the faces are joined by a nose circle of 10 mm radius. The speed of rotation of the cam is 120 revolutions per min. Find the acceleration of the roller centre. **[7M]**

8. a) Explain in detail about equivalent mechanism for a cam and follower. **[7M]**

   b) It is required to set out the profile of a cam to give the following motion to the reciprocating follower with a flat mushroom contact face: (i) Follower to have a stroke of 20 mm during 120^0 of cam rotation; (ii) Follower to dwell for 30^0 of cam rotation; (iii) Follower to return to its initial position during 120^0 of cam rotation; and (iv) Follower to dwell for remaining 90^0 of cam rotation. The minimum radius of the cam is 25 mm. The out stroke of the follower is performed with simple harmonic motion and the return stroke with equal uniform acceleration and retardation. **[7M]**

UNIT – V

9. a) Deduce expression for the maximum efficiency of helical gears. **[7M]**

   b) The center distance between two meshing spiral gears is 260mm and the angle between the shafts is 65^0. The normal circular pitch is 14mm and the gear ratio is 2.5. The driven gear has a helix angle of 35^0. Find the i) number of teeth on each wheel ii) exact center distance iii) efficiency assuming the friction angle to be 5.5^0. **[7M]**

10. a) Explain the terms module, pressure angle and addendum in gears. Explain the method of eliminating interference in gears **[7M]**

    b) A pair 20^0 full depth involute spur gear having 30 and 50 teeth respectively module 4 mm arc in mesh, the smaller gear rotates at 1000 rpm. Determine (i) Sliding velocities at engagement and disengagement of a pair of teeth and (ii) Contact ratio **[7M]**

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COURSE OBJECTIVES:

The course should enable the students to:

I	Understand the basic principles of kinematics and the related terminology of machines.
II	Discriminate mobility; enumerate links and joints in the mechanisms.
III	Formulate the concept of analysis of different mechanisms.
IV	Understand the working of various straight line mechanisms, gears, gear trains, steering gear mechanisms, cams and a Hooke's joint.
V	Analyze a mechanism for displacement, velocity and acceleration of links in a machine.

COURSE OUTCOMES (COs):

CO 1	Describe the concept of mechanisms and machines in which all the links and their mechanism studied.
CO 2	Determine the velocity and acceleration diagrams for different mechanisms using graphical methods.
CO 3	Understand the concept of plane motion of body and gyroscopic motion precession in which gyroscopic mechanism is studied.
CO 4	Explore the concept of cams and followers, steering gear mechanism to understand real time applications of mechanisms.
CO 5	Introduction to gears and gear mechanism where different tooth profiles of gear is designed.

COURSE LEARNING OUTCOMES (CLOs):

AAE523.01	Classifications of the kinematic links, kinematic pairs and formation of the kinematic chain.
AAE523.02	Distinguish between mechanism and machine
AAE523.03	Design and develop inversions of quadratic cycle chain, slider crank mechanism, and double slider crank mechanism and cross slider mechanism.
AAE523.04	Demonstrate type synthesis, number synthesis and dimensional synthesis.
AAE523.05	Construct Graphical methods of velocity polygon and acceleration polygons for a given configuration diagram.
AAE523.06	Understand other methods of acceleration diagrams like Klien's construction.
AAE523.07	Develop secondary acceleration component i.e Correli's component involving quick return mechanisms
AAE523.08	Alternative approach for determining velocity by using I centres and centriods methods.
AAE523.09	Significance of exact and approximate straight line mechanisms.
AAE523.10	Application of straight line mechanism in steam engine indicators.
AAE523.11	Applications of Ackerman's and Davi's steering mechanisms in automobiles.
AAE523.12	Develop the condition for exact steering.
AAE523.13	Develop the polar velocity diagram for a single hook joint and double hook joint and develop condition for unity for higher and lower speeds.
AAE523.14	Study different displacement profiles applicable in I.C engines cam shafts.
AAE523.15	Plot the displacement, velocity and acceleration profiles with respect to time.
AAE523.16	Understand the geometry of gears and deduce the expression for arc of contact.
AAE523.17	Derive the expression for minimum number of teeth to avoid interference in case of pinion and gear as well as rack and pinion.
AAE523.18	Application of different gear trains including epicyclic and deduce the train value using tabular and relative velocity method.
AAE523.19	Significance of differential gear box in an automobile while taking turn on the road.
AAE523.20	Enable the students to understand the importance of theory of machines for lifelong learning, Higher Education and competitive exams.

Mapping of Semester End Examinations to Course Learning Outcomes:

SEE Question No.		Course Learning Outcomes		Course Outcomes	Blooms Taxonomy Level
1	a	AAE523.02	Distinguish between mechanism and machine	CO 1	Understand
	b	AAE523.01	Design and develop inversions of quadratic cycle chain, slider crank mechanism, and double slider crank mechanism and cross slider mechanism.	CO 1	Understand
2	a	AAE523.01	Classifications of the kinematic links, kinematic pairs and formation of the kinematic chain.	CO 1	Understand
	b	AAE523.03	Design and develop inversions of quadratic cycle chain, slider crank mechanism, and double slider crank mechanism and cross slider mechanism.	CO 1	Understand
3	a	AAE523.08	Alternative approach for determining velocity by using I centers and centroid methods.	CO 2	Understand
	b	AAE523.08	Alternative approach for determining velocity by using I centers and centroid methods.	CO 2	Remember
4	a	AAE523.08	Alternative approach for determining velocity by using I centers and centroid methods.	CO 2	Remember
	b	AAE523.05	Construct Graphical methods of velocity polygon and acceleration polygons for a given configuration diagram.	CO 2	Remember
5	a	AAE523.09	Significance of exact and approximate straight line mechanisms.	CO 3	Understand
	b	AAE523.09	Significance of exact and approximate straight line mechanisms.	CO 3	Understand
6	a	AAE523.13	Develop the polar velocity diagram for a single hook joint and double hook joint and develop condition for unity for higher and lower speeds.	CO 3	Understand
	b	AAE523.11	Applications of Ackerman’s and Davi’s steering mechanisms in automobiles.	CO 3	Understand
7	a	AAE523.15	Plot the displacement, velocity and acceleration profiles with respect to time.	CO 4	Understand
	b	AAE523.14	Study different displacement profiles applicable in I.C engines cam shafts.	CO 4	Remember
8	a	AAE523.15	Plot the displacement, velocity and acceleration profiles with respect to time.	CO 4	Remember
	b	AAE523.14	Study different displacement profiles applicable in I.C engines cam shafts.	CO 4	Remember
9	a	AAE523.16	Understand the geometry of gears and deduce the expression for arc of contact.	CO 5	Remember
	b	AAE523.17	Derive the expression for minimum number of teeth to avoid interference in case of pinion and gear as well as rack and pinion.	CO 5	Understand
10	a	AAE523.15	Plot the displacement, velocity and acceleration profiles with respect to time.	CO 5	Remember
	b	AAE523.15	Plot the displacement, velocity and acceleration profiles with respect to time.	CO 5	Remember

Signature of Course Coordinator **HOD, AE**