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# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech II Semester End Examinations (Regular) - May, 2018

Regulation: IARE – R16

## KINEMATICS OF MACHINERY

Time: 3 Hours

(ME)

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) State the difference between machine and a mechanism. [7M]
- (b) Explain different types of kinematic pairs with neat sketches. [7M]
2. With neat sketches explain four different inversions of single slider crank chain. [14M]

### UNIT – II

3. (a) Derive Kennedy theorem with a neat sketch. [7M]
- (b) For the mechanism shown in Figure 1. The crank OA rotate with 500 rpm. Determine the linear velocity of the slider D and the angular velocity of the link BD, when the crank is inclined at an angle of  $75^\circ$  to the vertical. The dimensions of various links are OA = 28 mm. AB = 44 mm BC= 49mm and BD = 46mm. The Centre distance between the Centre's of rotation O and C is 65 mm. The path of travel of the slider is 11 mm below the fixed point C. The slider moves along a horizontal path and OC is vertical. [7M]

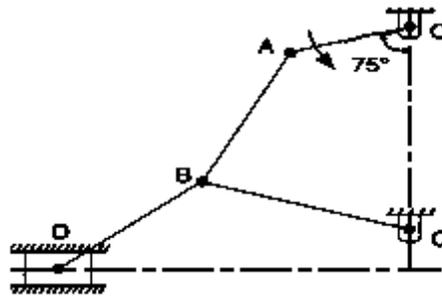


Figure 1

4. For the rotating cylinder engine mechanism as shown in Figure 2 determine the acceleration of the piston inside the cylinder, if the cylinder rotates uniformly at 200rpm. the crank OA is fixed. [14M]

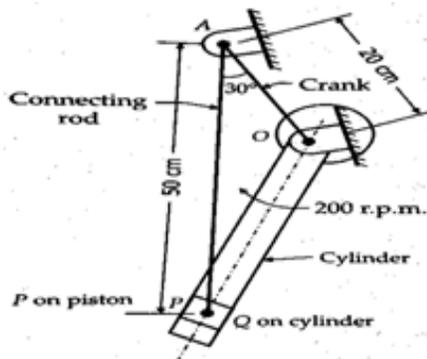


Figure 2

### UNIT – III

5. (a) The angle between the axes of two shafts connected by universal joint is  $30^\circ$ . The driving shaft rotates at uniform speed of 240rpm. The driven shaft carries a steady load of 9kW. Calculate the radius of gyration of the flywheel of the driven shaft having mass 50kg and the output torque of the driven shaft does not vary by more than 20% of the input shaft. [7M]
- (b) Describe the Watt's parallel mechanism for straight line motion and derive the condition under which the straight line is traced. [7M]
6. (a) Describe Hart's mechanism with a neat sketch and prove that the tracing point describes a straight line path. [7M]
- (b) A double universal joint is used to connect two shafts in the same plane. The intermediate shaft is inclined at an angle of  $20^\circ$  to the driving shaft as well as the driven shaft. Find the maximum and minimum speed of the intermediate shaft and the driven shaft if the driving shaft has a constant speed of 500 rpm. [7M]

### UNIT – IV

7. Draw the cam profile using the following data in which Knife-edge follower is raised with uniform acceleration and deceleration and is lowered with SHM. [14M]
  - Least radius of cam = 60 mm
  - Lift of follower = 40 mm
  - Angle of ascent =  $90^\circ$
  - Angle of dwell between ascent and descent =  $40^\circ$
  - Angle of descent =  $75^\circ$
 If cam rotates at 900 rpm, determine the maximum velocity and acceleration during ascent.
8. Draw the profile of a cam operating with a roller follower when the axis of the follower passes through the axis of cam shaft from the following data:
  - Roller diameter is 20mm.
  - Follower to move outwards through 40 mm during  $60^\circ$  of cam rotation.
  - Follower to dwell for the next  $45^\circ$ .
  - Follower to return to its original position during next  $90^\circ$  of cam rotation.
  - Follower to dwell for the rest of the cam rotation.

The displacement of the follower is to take place with simple harmonic motion during both the outward and the return strokes. The least radius of the cam is 50 mm. If the cam rotates at 300 rpm, determine the maximum velocity and acceleration of the follower during the outward stroke and return stroke.

[14M]

UNIT – V

9. (a) Derive an expression for minimum number of teeth required on the pinion in order to avoid interference in involute gear teeth. [7M]
- (b) A pair of 20° full depth involute spur gears having 30 and 50 teeth respectively of module 4mm are in mesh. Assuming addendum as standard and equal to one module, the smaller gear rotates at 1000rpm. Find
  - i. The contact ratio [7M]
  - ii. The maximum sliding velocity.
10. (a) Explain with a neat sketch reverted gear train and also state its applications. [7M]
- (b) In an epicyclic gear train, pinion A has 15 teeth and is rigidly fixed to the motor shaft. The wheel B has 20 teeth and gears with A and also with the annular fixed wheel E. Pinion C has 15 teeth and is integral with B (B, C being a compound gear wheel). Gear C meshes with annular wheel D, which is keyed to the machine shaft. The arm rotates about the same shaft on which A is fixed and carries the compound wheel B, C. If the motor runs at 1000 rpm. Find the speed of the machine shaft. [7M]

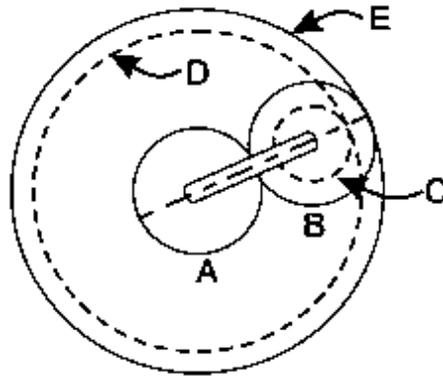


Figure 3

