ANNA UNIVERSITY OF TECHNOLOGY, COIMBATORE

B.E. / B.TECH. DEGREE EXAMINATIONS : NOV / DEC 2011

REGULATIONS : 2008

THIRD SEMESTER : MECHANICAL ENGINEERING

080120010 - KINEMATICS OF MACHINERY

(A3 sheets may be provided if necessary)

Time: 3 Hours **Max. Marks : 100**

PART - A

(10 x 2 = 20 Marks)

ANSWER ALL QUESTIONS

1. How are kinematic pairs classified?
2. What do you mean by degrees of freedom?
3. Name the types of instantaneous centres?
4. What is meant by Coriolis component of acceleration?
5. How are cam followers classified?
6. Define cam profile and cam angle.
7. Define module and addendum.
8. What are the types of gear trains?
9. What are the factors upon which selection of a belt drive depends?
10. State the laws of dry friction.

PART - B

(5 x 16 = 80 Marks)

ANSWER ALL QUESTIONS

11. a)(i) Sketch and explain any two inversions of a double slider crank chain. (8)

(ii) What is the significance of degrees of freedom of a kinematic chain when it functions as a mechanism? Give examples. (8)

OR

11. b) (i) Explain with sketches any two inversions of a single slider crank chain. (8)

(ii) Explain Kutzbach criterion for the movability of mechanism having plane motion with suitable examples. (8)

12. a)(i) For a single cylinder reciprocating engine mechanism, locate all the instantaneous centres. (6)

(ii) The crank and connecting rod of a horizontal steam engine are 0.5 m and 2m long respectively. The crank makes 180 rpm in the clockwise direction. When it has turned 45° from the inner dead centre position, determine (1) velocity of piston, (2) angular velocity of connecting rod (3) velocity of point E on connecting rod 1.5 m from the gudgeon pin and (4) rubbing velocity at the pins of the crank shaft, crank and cross-head when the diameters of their pins are 5 cm, 3 cm and 6 cm respectively. (10)

OR

b) The lengths of the crank and connecting rod of a horizontal reciprocating engine are 100 mm and 500 mm respectively. The crank is rotating at 400 rpm. Using Klein's construction, find (1) velocity of piston, (2) acceleration of piston (3) angular velocity of connecting rod and (4) angular acceleration of connecting rod when the crank has turned 30° from IDC after crossing IDC while rotating clockwise.

13. a) Draw the profile of cam operating a knife-edge follower from the following data:

(i) follower to move outward through a distance of 20 mm during 120° of cam rotation

(ii) follower to dwell for the next 60° of cam rotation

(iii) follower to return to its initial position during 90° of cam rotation

(iv) follower to dwell for the remaining 90° of cam rotation.

Contd...Q.No.13(a)

The cam is rotating clockwise at a uniform speed of 500 rpm. The minimum radius of the cam is 40 mm and the line of stroke of the follower is offset 15 mm from the axis of the cam and the displacement of the follower is to take place with uniform and equal acceleration and retardation on both the outward and the return strokes. Determine (1) the maximum velocity of the follower during outward and return strokes and (2) the maximum acceleration during outward and return strokes

OR

13. b) Draw the profile of cam operating a roller follower with the roller radius of 10mm. (when the axis of the follower passes through the axis of the cam shaft) from the following data:

(i) follower to move outward through a distance of 30 mm with simple harmonic motion during 120° of cam rotation

(ii) follower to dwell for the next 60° of cam rotation

(iii) follower to return to its original position with uniform velocity during 90° of cam rotation

(iv) follower to dwell for the rest of cam rotation.

The least radius of the cam is 40 mm and the cam rotates at 240 rpm. Determine (1) maximum velocity and maximum acceleration of the follower during outstroke and (2) maximum velocity and maximum acceleration of the follower during return stroke.

14.a) (i) How are gears classified? (6)

(ii) Two gear wheels mesh externally and are to give a velocity ratio of 3 to 1. The teeth are of involute form; module = 6 mm, addendum = one module, pressure angle = 20°. The pinion rotates at 90 rpm. Find (1) number of teeth on pinion to avoid interference on it and the corresponding number on the wheel, (2) length of path and arc of contact, (3) number of pairs of teeth in contact. (10)

OR

14. b) (i) Derive the expression for velocity ratio of a simple gear train with intermediate shaft. (5)

(ii) In a reverted epicycle train, the arm F carries two wheels A and D and a compound wheel B – C. The wheel A meshes with wheel B and the wheel D meshes with wheel C. The number of teeth on wheel A, D and C is 80, 48 and 72 respectively. Find the speed and direction of wheel D when wheel A is fixed and arm F makes 200 rpm clockwise. (11)

15. a) (i) A shaft running at 200 rpm is to drive a parallel shaft at 300 rpm. The pulley on the driving shaft is 600 mm diameter. Calculate the diameter of the pulley on the driven shaft; (1) neglecting belt thickness (2) taking belt thickness into account, which is 5 mm thick (3) assuming in the latter case a total slip of 4%. (6)

(ii) Power is transmitted using a V-belt drive. The included angle of V-grooves is 30°. The belt is 2 cm deep and maximum width is 2 cm. If the mass of the belt is 3.5 gm per cm length and maximum allowable stress is 140 N/cm^2, determine the maximum power transmitted when angle of lap is 140° and $\mu = 0.15$. (10)

OR

b) (i) The external and internal radii of a friction plate of a single clutch are 120 mm and 60 respectively. The total axial thrust with which the friction surfaces are held together is 1500 N. For uniform wear, find the maximum, minimum and average pressure on the contact surfaces. (8)

(ii)A band brake acts on the $3/4^{th}$ circumference of a drum of 450 mm diameter which is keyed to the shaft. The band brake provides a braking torque of 225 N.m. One end of the band is attached to a fulcrum pin of the lever and the other end to a pin 100 mm from the fulcrum. If the operating force is applied at 500 mm from the fulcrum and the coefficient of friction is 0.25, find the operating force when the drum rotates in the (1) anticlockwise direction and (2) clockwise direction. (8)

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