T 8247

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2006.

Third Semester

Mechatronics Engineering

ME 1252 — KINEMATICS OF MACHINERY

(Regulation 2004)

Time : Three hours Maximum : 100 marks

Instructions :

1. Answer ALL questions.
2. Sketches should be drawn neatly.
3. Give brief procedure for graphical constructions.
4. Answers without units and with wrong units will carry less marks
5. Symbols used in the solutions should be explained atleast once for each answer.
6. Answers without substituting the data in the equations will carry zero marks.
7. A3 size drawing sheet will be supplied on request. Use both sides of the drawing sheet, if necessary.
8. Fold the drawing sheet to the size of the answer sheet and attach it.

PART A — (10 × 2 = 20 marks)

1. Differentiate between machine and mechanism.
2. Write down Kutzback criterion to find the mobility of a planar mechanism.
3. Define transmission angle and its significance.
4. How will you determine the magnitude and direction of coriolis component of acceleration?
5. List the classifications of cam followers based on shape.
6. What are the essential design features of high speed cams?
7. Define (a) Module (b) Diametral Pitch of gears.

8. What is under cutting of gears?

9. Distinguish between sliding and rolling friction.

10. State the condition for transmission of maximum power in belt drives.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Describe Whitworth's quick return mechanism. (6)

(ii) Distance between two parallel shafts connected by oldham's coupling is 25 mm. Determine maximum speed of sliding of tongue of intermediate piece in the slot in the flange if driving shaft is run at 250 rpm. (4)

(iii) Discuss the application of Grashof's law in identifying the input and output motions of four-bar mechanism. (6)

Or

(b) (i) Define and explain inversion of mechanisms. (4)

(ii) Sketch and explain Oldham's coupling. (6)

(iii) Design a four-bar crank rocker quick return mechanism to give a time ratio of 1.25 with rocker swing angle as 75° clockwise. Assume the output link (rocker) length as 50 mm and in the left extreme position it is vertical. (6)

12. (a) (i) A four bar mechanism DABC has the following dimensions :

DA = 300 mm; CB = AB = 360 mm; DC = 600 mm. Link DC is fixed and angle ADC is 60°. Driving link DA turns clockwise at 100 rpm. Constant driving torque is 50 N-m. Determine the following :

(1) Velocity of point B

(2) Angular velocity of driven link CB

(3) Mechanical advantage of mechanism in this position

(4) Resisting torque. (12)

(ii) Sketch a four-bar crank rocker mechanism in (1) Maximum transmission angle position and (2) toggle position where mechanical advantage is infinity. (4)

Or

(b) (i) Find the number of instantaneous centres for a six link mechanism. State the use of instantaneous centre method in kinematic analysis. (4)

(ii) Crank of a slider crank mechanism rotates clockwise at a constant speed of 300 rpm crank and connecting rod are of lengths 150 mm and 600 mm respectively. Determine the following; at a crank angle of 45° from inner dead centre position

(1) Linear velocity and acceleration of the midpoint of connecting rod

(2) Angular velocity and angular acceleration of the connecting rod. (12)

13. (a) (i) Explain the following terms :

(1) Prime circle

(2) Pressure Angle related to cams. (4)

(ii) Draw the profile of a disc cam to give uniform motion and uniform velocity during outstroke of 25 mm to a knife edge follower during first half revolution. Return of cam is also of similar uniform motion with uniform velocity during remaining half revolution. Minimum radius of the cam is 25 mm. Assume that the axis of knife edge follower passes through cam axis. (12)

Or

(b) (i) Briefly explain the features of mushroom followers. (4)

(ii) Draw the profile of a cam to give following motion to a flat faced reciprocating follower.

(1) Follower to have a stroke of 20 mm during 120° of cam rotation.

(2) Follower to dwell for 30° of cam rotation

(3) Follower to return to initial position during 120° of cam revolution.

(4) Follower to dwell for remaining 90° of cam rotation.

The base circle radius is 40 mm and the follower axis coincides with cam axis of rotation. (12)

14. (a) (i) Discuss the advantages of involute gear tooth profile. (4)

(ii) Describe the advantages and applications of helical, bevel and worm gears. (6)

(iii) In an epicyclic gear train, the sum gear A and the planet gear B are having 36 and 45 teeth respectively. If the arm rotates at 150 rpm counter clockwise about center of A which is fixed, determine speed of gear B. If the arm is locked and gear A rotates at 300 rpm what is the speed of gear B? (6)

Or

(b) (i) A pinion having 25 teeth drives a gear of 60 teeth. Tooth profile is involute with pressure angle of 20°, module of 8 mm and addendum of 1 module. Determine : (1) Length of path of contact (2) Length of arc of contact and (3) contact ratio. (6)

(ii) Design a compound gear train for an exact train ratio of 180 : 1.

Minimum teeth on any gear shall be 12 to avoid interference and Maximum gear ratio in any one stage is 10 : 1. Also sketch the arrangement. (6)

(iii) Discuss the necessity of differentials in automobiles. (4)

15. (a) (i) Discuss the advantages of V belts. (6)

(ii) A rope drive transmits 600 kW from a pulley of effective diameter 4 m, which runs at 90 rpm. Angle of lap is 160°; angle of groove is 45°; co-efficient of friction is 0.28; mass of rope is 1.5 kg/m and allowable tension per rope is 2400 N. Determine the number of ropes required. (6)

(iii) Describe the features of internal expanding brakes used in automobiles. (4)

Or

(b) (i) Following data are for a screw jack : Screw pitch is 12.5 mm; mean diameter of screw is 50 mm; co-efficient of friction is 0.13. Determine torques to raise and lower 20 kN load and efficiency of jack. (6)

(ii) Discuss the functions of clutches in automobiles. (4)

(iii) Derive the expression to determine the ratio of tensions in a flat belt drive. (6)
