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R 3456

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2007.

Fourth Semester

(Regulation 2004)

Mechanical Engineering

ME 1252 — KINEMATICS OF MACHINERY

(Common to B.E. (Part-Time) Third Semester Regulation 2005)

Time : Three hours   Maximum : 100 marks

Sketches to be drawn neatly.

Give brief procedure for graphical constructions.

A3 size drawing sheet will be issued, if required.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define Degree of Freedom and give the DOF for a shaft in a circular hole.

2. State Grashof's law for a four bar linkage.

3. What is Corioli's component of acceleration?

4. State the Freudenstein's equation for a four-bar mechanism.

5. What is a circular arc cam?

6. State the expressions for maximum velocity and acceleration of a follower moves with cycloidal motion.

7. Differentiate diametral pitch and circular pitch of a friction wheel.

8. What is reverted gear train?

9. Diagrammatically represent the forces acting on a body when it slides either up or down on an inclined plane with out considering the effect of friction.

10. List out any four desirable characteristics of brake lining material.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Define transmission angle of a four bar linkage. What is the effect of transmission angle on mechanical advantage? (4)

(ii) State and prove Kutchbach criterion for the following kinematic chains

Three bar chain

Four bar chain

Cam with knife edge follower (6)

(iii) Explain any two inversions of a four bar kinematic chain. (6)

Or

(b) Derive the displacement, velocity and acceleration equation of a slider crank mechanism.

12. (a) For the toggle mechanism as shown in fig. Q.12 (a), the slider D is constrained to move along horizontal direction. The crank rotates at 180 rpm. The dimensions of various links are as follows. OA = 180 mm ; CB = 240 mm ; AB = 360 mm ; BD = 540 mm. For the given configuration determine the

(i) velocity and acceleration of the slider

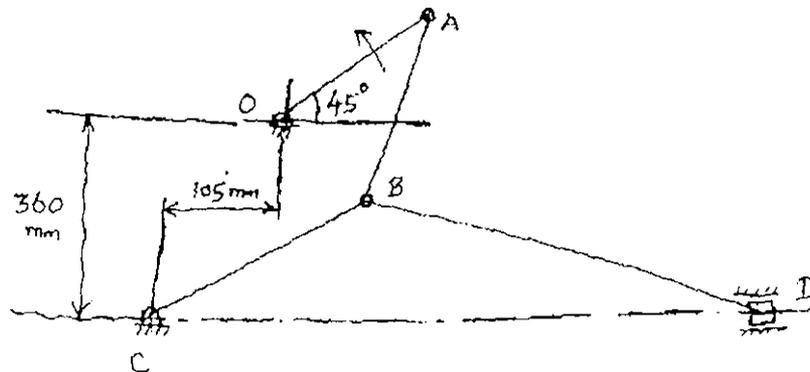(ii) angular velocity and angular acceleration of links AB, BC and BD.

Fig. Q. 12 (a)

Or

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(b) In a Whitworth quick return mechanism, as shown in fig. Q.12 (b), crank OA rotates at 30 rpm in clock wise direction. The dimensions of various links are OA = 150 mm, OC = 100 mm, CD = 125 mm and DR = 500 mm. Determine the acceleration of the sliding block R and the angular acceleration of the slotted lever BD.
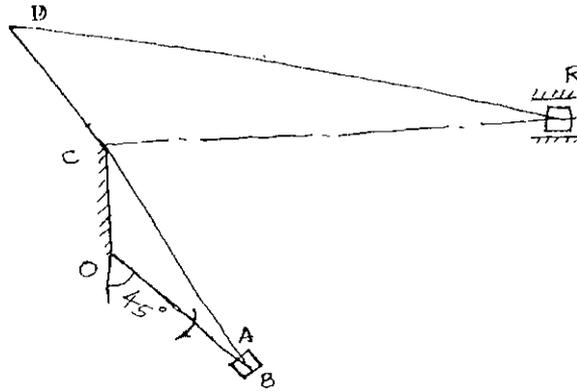

Fig. Q. 12 (b)

13. (a) A cam drives a flat reciprocating follower in the following manner :

   (i) Follower moves outwards through a distance of 20 mm with simple harmonic motion during the first 120° rotation of the cam.

   (ii) Follower dwells during next 30° of cam rotation.

   (iii) Follower moves inwards with simple harmonic motion for the next 120° of cam rotation.

   (iv) The follower dwells for the remaining period.

   Draw the profile of the cam, when the minimum radius of cam is 25 mm. Also calculate the maximum velocity and acceleration during outward and inward motion of the follower when the cam rotates with 200 rpm.

Or

   (b) Construct a tangent cam and mention the important terminologies on it. Also derive the expression for displacement, velocity, acceleration of a reciprocating roller follower when the roller has contact with the nose.

14. (a) (i) Two involute gears of 20° pressure angle are in mesh. The number of teeth on pinion is 20 and the gear ratio is 2. If the pitch expressed in module is 5 mm, and the pitch line speed is 1.2 m/s, determine the angle turned through by pinion, when one pair of teeth is in mesh. Also calculate the maximum velocity of sliding. Take addendum as one module. (8)

   (ii) Derive an expression for the minimum number of teeth required on the pinion in order to avoid interference in involute gear teeth. (8)

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(b) (i) What are the special advantages of an epicyclic gear train? (4)

(ii) An epicyclic gear train for an electric motor is shown in fig. Q.14 (b) (ii). The wheel S has 15 teeth and is fixed to the motor shaft running at 1450 rpm. The planet P has 45 teeth, gears with fixed annulus E and rotates on a spindle carried by an arm A which is fixed to the output shaft. If the motor transmits 1.5 KW, determine the torque required to fix the annulus E. (12)
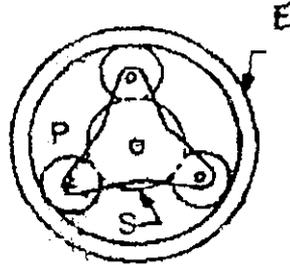

Fig. Q. 14 (b) (ii)

15. (a) (i) A square threaded bolt of root diameter 22.5 mm and pitch 5 mm is tightened by screwing a nut whose mean diameter of bearing surface is 50 mm. If the coefficient of friction between nut and bolt is 0.1 and nut and bearing surface is 0.16, determine the force required at the end of spanner 500 mm long when the load on the bolt is 10 kN. (8)

(ii) From the first principles, derive an expression for the frictional torque of a cone clutch under uniform wear consideration. (8)

Or

(b) (i) Determine the width of a 9.75 mm thick leather belt required to transmit 15 KW from a motor running at 900 rpm. The diameter of the driving pulley is 300 mm. The driven pulley runs at 300 rpm and the distance between the centers of two pulleys is 3 m. The density of the leather can be taken as 1000 kg/m^3. Take $\mu = 0.3$ and maximum allowable shear in the leather = 2.5 MPa and the drive is open type. (8)

(ii) A band brake acts on the 3/4th of circumference of a drum of 450 mm diameter which is keyed to the shaft. The band brake provides a braking torque of 225N-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 anticlockwise direction. (8)