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Question Paper Code : 90858

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022

Third/Fourth Semester

Mechanical Engineering

ME 8492 – KINEMATICS OF MACHINERY

(Common to : Mechanical Engineering (Sandwich)/Mechatronics Engineering)

(Regulations 2017)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Find the mobility of the planar mechanism shown in Fig. 1

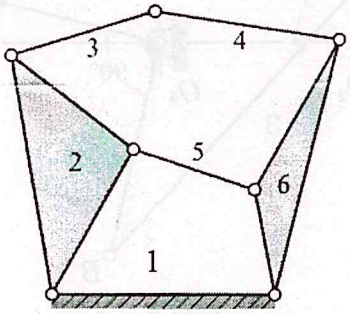

Fig. 1

2. Define the term 'mechanical advantage'.
3. Find the position difference from point P to point Q on the curve $y=x^2+x-16$, where $R_{xp}=2$ and $R_{xq}=4$.
4. What are the inputs required and outcome of acceleration analysis of simple mechanisms?
5. State the fundamental law of cam and list the types of follower motion.
6. Define the pressure angle and illustrate with simple sketch.
7. List any two characteristics of involute and cycloidal profiles in gears.
8. What are reverted gear trains? Illustrate with simple sketch.
9. Friction drives such as belt drives are fail safe drives-justify.
10. Differentiate the self lock and self energized brakes.

PART B — (5 × 13 = 65 marks)

11. (a) List the different inversions of a slider crank chain and brief about any one mechanism that is obtained by grounding the coupler with simple sketch.

Or

(b) State the Grashoff's criterion. Also, discuss about the different inversions of a four bar chain with kinematic diagram and specify any one application for each inversion.

12. (a) The four-bar linkage in the posture shown in Fig.2 is driven by crank 2 at $w_2 = 48 rad/s\ ccw$. Find the angular velocity of link 3 and the velocity of point C on link 4. The dimensions of different links are as follows: $AO_2 = 100\,mm, BA = 400\,mm, O_4O_2 = 200\,mm, BO_4 = 200\,mm$ and $CO_4 = 150mm$.

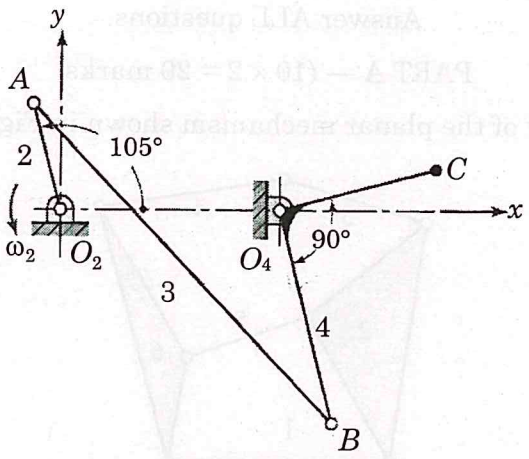

Fig. 2

Or

(b) In the slider-crank mechanism shown in Fig.3, the lengths of the various links are: $OA = AC = 200\,mm, AB = 600\,mm$. The crank rotates at a constant angular velocity of 10 rad/s CW. Determine the angular acceleration of the connecting rod AB, acceleration of slider B, and acceleration of a point C in AB.

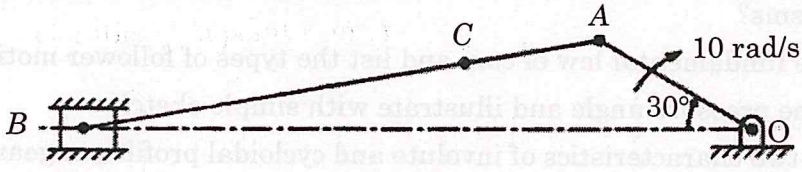

Fig. 3

13. (a) A cam with 30 mm as minimum diameter and 20 mm lift is rotating clockwise at a uniform speed of 1200 rpm and has to given the following motion to a roller follower 10 mm in diameter: Outward stroke during 120° with equal uniform acceleration and deceleration: Dwell for 60°; Return during 90° with uniform acceleration and retardation; Dwell during the remaining period. Draw the cam profile if the cam axis coincides with the follower axis. Also calculate the maximum velocity and acceleration during ascent.

Or

(b) A cam profile consists of two circular arcs of radii 30 mm and 15 mm joined by straight lines, giving the follower a lift of 15 mm. The follower is a roller of 25 mm radius and its line of action is a straight line passing through the cam shaft axis. When the cam shaft has a uniform speed of 600 rpm, find the maximum velocity and acceleration of the follower while in contact with the straight flank of the cam.

14. (a) Two involute have the diameters of 90 mm and 300 mm with a 6 mm module and the pressure angle is 20°. The addendum of both the gears is equal and larger as possible to avoid interference Find the addendum, contact ratio and the sliding velocity at the beginning of contact if the pinion is driving at 2500 rpm.

Or

(b) An epicyclic gear train shown in Fig. 4 is composed of a fixded annular wheel A having 150 teeth. $Z_B = 25$, $Z_D = 40$ and C is an idle gear. Gear D is concentric with gear A. Wheels B and C are carried on an arm E which revolves clockwise at 120 rpm about the axis of A. Find the number of teeth of gear C and its speed and sense of rotation.

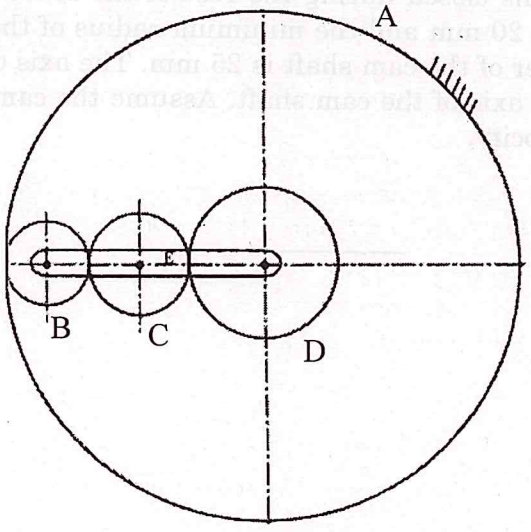

Fig. 4

15. (a) A screw jack raises a load of 16 kN through a distance of 150 mm. The mean diameter and the pitch of the screw are 56 mm and 10 mm respectively. Determine the work done and the efficiency of the screw if (i) The load rotates with the screw, (ii) Loose head on which the load rests does not rotate with the screw and the outside and the inside diameters of the bearing surface of the loose head are 50 mm and 10 mm respectively. Take the coefficient of friction for the screw and the bearing surface as 0.11.

Or

(b) A single plate clutch transmits 25 kW at 900 rpm. The maximum pressure intensity between the plates is 85 kN/m^2. The outside diameter of the plate is 360 mm. Both the sides of the plates are effective and the coefficient of friction is 0.25. Find (i) inner diameter of the plate, (ii) axial force to engage the clutch.

PART C — (1 × 15 = 15 marks)

16. (a) An open belt drive transmits power from a 300 mm diameter pulley running at 240 rpm to a pulley 450 mm diameter. Angle of lap on smaller pulley is 160°. The belt is on the point of slipping when 3 kW is being transmitted. The coefficient of friction between belt and pulley is 0.3. It is desired to increase the power transmitted. State which of the following methods suggested would be more effective?

(i) Initial tension in the belt is increased by 10%.

(ii) Suitable dressing is given to the belt surface to increase the coefficient of friction by 10%. Assume that initial tension is kept the same.

Or

(b) Draw the profile of a cam to raise a valve with harmonic motion through 50 mm in 1/3 of a revolution, keep it fully raised through 1/12 of a revolution, and to lower it with harmonic motion 1/6 of a revolution. The valve remains closed during the rest of the revolution. The diameter of the roller is 20 mm and the minimum radius of the cam is to be 25 mm. The diameter of the cam shaft is 25 mm. The axis of the valve rod passes through the axis of the cam shaft. Assume the camshaft to rotate with a uniform velocity.