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Question Paper Code : 30919

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2024

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 — ($10 \times 2 = 20$ marks)

1. Define kinematic chain. What conditions are required to be satisfied by a kinematic chain to give constrained motion?
2. Write examples for lower and higher pair mechanism.
3. Highlight the properties of instantaneous centre.
4. Define coriolis acceleration.
5. What is an offset follower? Why offset follower is used?
6. Write down the importance of pressure angle in cam design.
7. List the significance of contact ratio in gear drive.
8. What is a compound gear train? Why compound gear not used in gear box?
9. Define coefficient of friction.
10. Which type of friction is applied while applying brakes in motor cycle?

PART B — ($5 \times 13 = 65$ marks)

11. (a) Draw and explain any three inversions of simple slider crank chain.

Or

- (b) What is the condition for generating exact straight line motion? Draw and explain the same.

12. (a) For an inline slider-crank mechanism, the length of the crank and connecting rod are 3 m and 4 m respectively as shown in fig. 1. At the instant when the connecting rod is perpendicular to the crank, if the velocity of the slider is 1 m/s, Determine the magnitude of angular velocity of the crank.

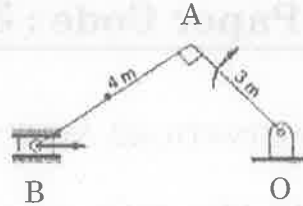


Fig. 1

Or

- (b) The crank of a slider crank mechanism rotates clockwise at a constant speed of 300 rpm as shown in fig. 2. The crank is 150 mm and connecting rod is 600 mm long. Determine (i) linear velocity and acceleration of the midpoint of the connecting rod and (ii) Angular velocity and angular acceleration of the connecting rod, at a crank angle of 45° from inner dead centre.

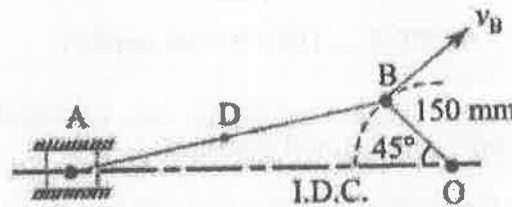


Fig. 2

13. (a) A knife edge follower has simple harmonic motion for both up and down motion and its 50 mm lift is completed in 60° cam rotation. The follower is offset in a direction opposite to the direction of rotation by 10 mm and radius of the base circle is 50 mm. Follower move to rise with 60° cam rotation; dwell for 45° cam rotation; return stroke with 90° cam rotation; dwell for the remaining period. Determine the maximum velocity and acceleration during forward and return stroke if the cam rotates at 1000 rpm in clockwise direction.

Or

- (b) A flat-faced valve tappet is operated by a symmetrical cam with circular arcs for flank and nose profiles; the straight line path of the tappet passes through the cam axis. The total angle of action is 150° , the lift is 6 mm, the base circle diameter is 30 mm and 10 period of acceleration is half that of deceleration during the lift. The cam rotates at 1250 rpm, determine, (i) nose and flank radii (ii) the maximum acceleration and deceleration while lifting.

14. (a) A pinion of 20° involute teeth and 120 mm pitch circle diameter drives a rack. The addendum of both pinion and rack is 6 mm. What is the least pressure angle which can be used to avoid interference? Also find the length of arc of contact and contact ratio.

Or

- (b) In an epicyclic gear train shown in fig 3, the gear A, fixed to the shaft S1, has 30 teeth and rotates at 500 rpm. Gear B, which meshes with gear A, is compounded with gear C. Gears B and C both are free to rotate on shaft S2. The gears B, C and D have 50, 70 and 90 teeth respectively. If the gear D rotates at 80 rpm in the direction opposite to that of the gear A, find the speed of the shaft S2.

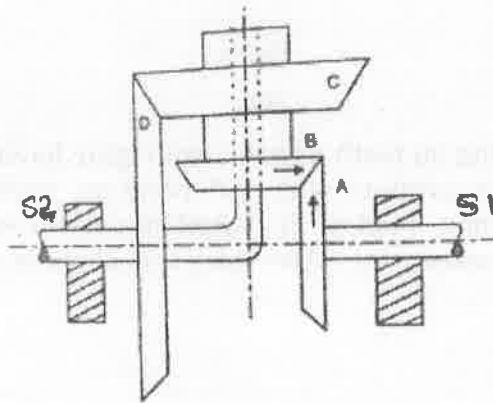


Fig. 3

15. (a) A screw jack with square threads having 60 mm pitch diameter is used to raise a load of 30 kN. The pitch of the thread is 16 mm and coefficient of friction between screw and nut is 0.2. Determine the ratio of torque required to lower the load to the torque required to raise the load and also determine the efficiency of the screw jack when the load is raised.

Or

- (b) A plate clutch has three discs on the driving shaft and two discs on the driven shaft. The outside diameter of the contact surfaces is 240 mm and inside diameter is 120 mm. Assuming uniform pressure and coefficient of friction 0.3, determine the total axial force on the springs to transmit 25 kW at 1500 rpm. If there are 6 springs each of stiffness 10 kN/m and each of contact surface has worn away by 0.5 mm, what is the maximum power that can be transmitted at the same speed with uniform wear?

PART C — (1 × 15 = 15 marks)

16. (a) A power transmission mechanism consists of a belt drive and a gear train as shown in the figure 4, Diameters of pulleys of belt drive and number of teeth (T) on the gears 2 to 7 are indicated in the figure. Analyse the mechanism and determine the speed and direction of rotation of gear 7.

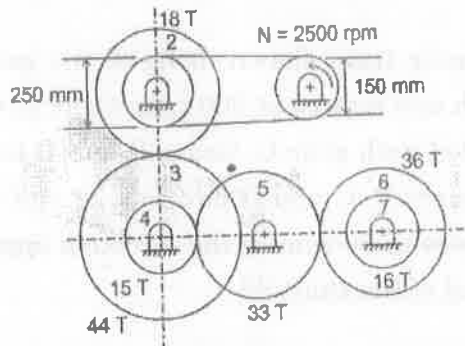


Fig. 4

Or

- (b) A pinion having 30 teeth drives a spur gear having 80 teeth. The profile of the gear is involute with 20° pressure angle 12 mm module and addendum 10mm. Find (i) the length of path of contact (ii) arc of contact and (iii) the contact ratio. Also show that there is no interference between the teeth.