Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 70897

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023.

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. What is meant by inversion of a kinematic chain and name the different inversions of a four-bar chain?

2. How many numbers of sliding and turning pairs are possible in a single slider crank mechanism?

3. Define instantaneous center of a link in a mechanism.

4. Name any two mechanisms in which Coriolis component of acceleration is possible.

5. List the different types of follower motions that are possible in a cam follower mechanism.

6. State the different methods, that may be used to reduce the pressure angle in a cam follower mechanism.

7. Mention the advantages of a gear drive over other methods of power transmission like belts, ropes, chain etc.,.

8. What is called compound gear train? Draw the same with a simple line diagram.

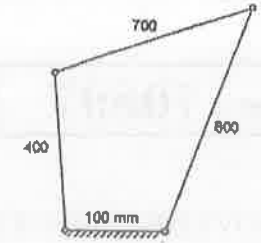
9. Write mathematical expression for apparent coefficient of friction for V-belt.

10. Differentiate between dry and wet clutches.

PART B — (5 × 13 = 65 marks)

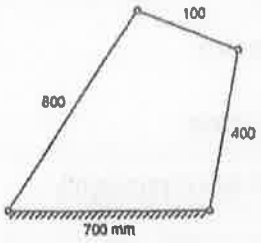
11. (a) Identify the nature of the mechanism shown in Fig. 11 (a) (i) to (iv).

(i)



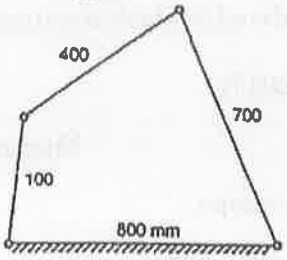
(4)

(ii)



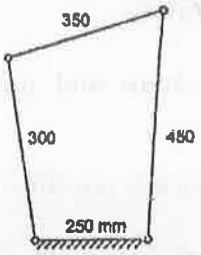
(3)

(iii)



(3)

(iv)



(3)

Fig. 11 (a) Four-bar mechanism All dimensions are in 'mm'

Or

(b) In a crank and slotted lever mechanism shown in Fig. 11 (b) the length of crank is 560 mm and the ratio of time of working stroke to return stroke is 2.8. Determine

(i) Distance between the fixed centers, and (7)

(ii) The length of the slotted lever, if length of stroke is 250 mm (6)

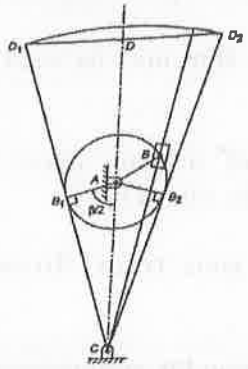


Fig. 11 (b) Crank and slotted lever mechanism

12. (a) Locate the instantaneous centers of the slider crank mechanism shown in Fig. 12 (a). Find the velocity of the slider. OA = 160 mm, AB = 470 mm, and OB = 600 mm, $\omega_2 = 12$ rad/s clockwise.

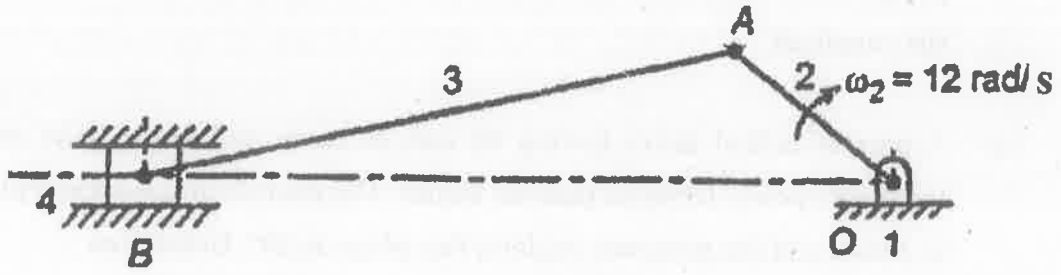


Fig. 12 (a) Slider-crank mechanism

Or

(b) In the slider-crank shown in Fig. 12 (b) the lengths of the various links are OA = AC = 200 mm, AB = 600 mm. The crank rotates at 10 rad/s. Determine

(i) The acceleration of the connecting rod AB (5)

(ii) The acceleration of slider B and (4)

(iii) Acceleration of a point C in AB (4)

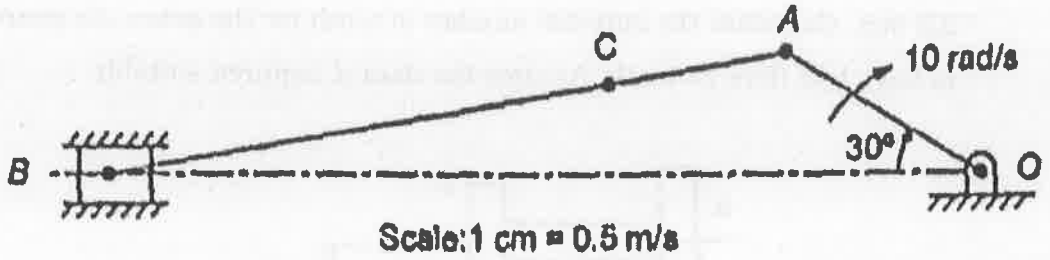


Fig. 12 (b)

13. (a) Discuss in detail about displacement, velocity and acceleration diagrams of the following follower motions

(i) Uniform velocity (6)

(ii) Simple harmonic motion (7)

Or

(b) A disc cam is to give simple harmonic motion to a knife edge follower during out stroke of 50 mm. The angle of ascent is 120°, dwell 60°, and angle of descent 90°. The minimum radius of cam is 50 mm. Draw the profile of the cam when the axis of the follower passes through the axis of the camshaft.

14. (a) A pair of helical gears having 30 and 48 teeth and a 23° helix angle transmits power between parallel shafts. The module in the normal plane is 3 mm, and the pressure angle in this plane is 20°. Determine

(i) the module in the plane of rotation, (2)

(ii) pitch diameters, (2)

(iii) center distance, (3)

(iv) circular pitch in the normal plane, and (3)

(v) circular pitch in the plane of rotation. (3)

Or

(b) The speed ratio of the reverted gear train shown in Fig. 14(b) is to be 12. The module of gears A and B is 3.125 mm and of gears C and D is 2.5 mm. Calculate the suitable number of teeth for the gears. No gears is to have less than 24 teeth. Assume the data if required suitably.

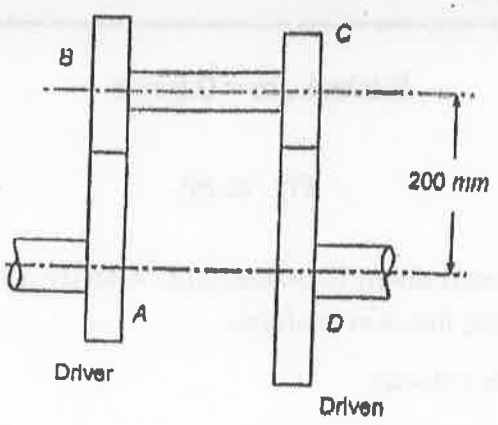


Fig. 14 (b) Reverted gear train

15. (a) Determine the width of a 9.75 mm thick leather belt required to transmit 15 kW from a motor running at 900 rpm. Diameter of the driving pulley of the motor is 300 mm. The driven pulley runs at 300 rpm and the distance between the center of the two pulleys is 3 m. The weight of the leather is 0.1×10^{-3} N/mm^2. Maximum allowable stress in the leather is 2.5 MPa. Coefficient of friction between leather and pulley is 0.3. Assume open belt drive and neglect the sag and slip of the belt.

Or

(b) A single-plate clutch, with both sides effective, has inner and outer diameters of friction surface 250 mm and 350 mm, respectively. The maximum intensity of pressure is not to exceed 0.15 MPa. The coefficient of friction is 0.3. Determine the power transmitted by the clutch at a speed of 2400 rpm for (i) uniform wear and (ii) uniform pressure.

PART C — ($1 \times 15 = 15$ marks)

16. (a) The pitch circle diameter of the annular gear in the epicyclic gear train shown in Fig. 16(a) is 425 mm and the module is 5 mm. When the annular gear 3 is stationary, the spindle A makes one revolution in the same sense as the sun gear 1 for every 6 revolutions of the driving spindle carrying the sun gear. All the planet gears are of the same size. Determine the number of teeth on all the gears.

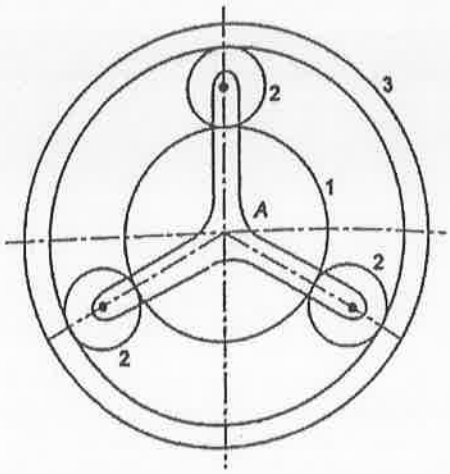


Fig. 16(a) Epicyclic gear train

Or

(b) A simple band brake, as shown in Fig. 16(b), is used on a shaft carrying a flywheel of mass 450 kg. The radius of gyration of the flywheel is 500 mm and runs at 320 rpm. The coefficient of friction is 0.2 and the brake drum diameter is 250 mm. Find (i) torque applied due to a hand load of 150 N, (ii) the number of turns of the wheel before it is brought to rest, and (iii) the time required to bring it to rest from the moment of application of the brake. (5+5+5)

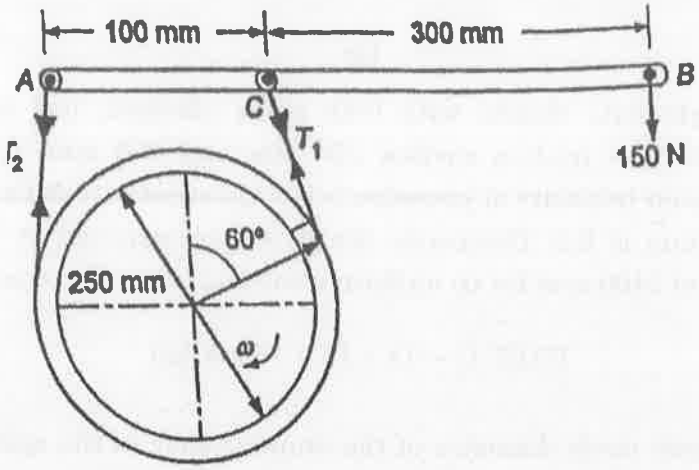


Fig. 16(b) Simple band brake mechanism