

Reg. No. :

**Question Paper Code : 80232**

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Third/Fourth Semester

Mechanical Engineering

ME 8492 — KINEMATICS OF MACHINERY

(Common to Mechanical Engineering (Sandwich) and Mechatronics Engineering)

(Regulation 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define rigid link and give examples.
2. List the inversions of a double slider crank chain.
3. What is meant by normal component of acceleration?
4. Define centrode.
5. Differentiate between radial cam and cylindrical cam.
6. Draw the displacement diagram for a follower when it moves with uniform acceleration and retardation.
7. Define module of gears and its relation to circular pitch.
8. Write the advantages of cycloidal gears.
9. What is the effect of centrifugal tension in belt drives?
10. What are the advantages of hydraulic brake over other brakes?

PART B — (5 × 13 = 65 marks)

11. (a) Explain with neat sketch, kinematic inversions of four bar chain.

Or

- (b) With neat sketch, explain the crank and slotted lever quick return mechanism

12. (a) (i) State and prove the Kennedy's theorem of three instantaneous centres. (5)  
 (ii) Give the types of instantaneous centres with examples. (4)  
 (iii) Give the procedure to be followed for locating instantaneous centres for four bar mechanism. (4)

Or

- (b) The crank of a slider crank mechanism rotates clockwise at a constant speed of 300 rpm. The crank is 150 mm and the connecting rod is 600 mm long. Determine:  
 (i) Linear velocity and acceleration of the midpoint of the connecting rod, and (6)  
 (ii) Angular velocity and angular acceleration of the connecting rod, at a crank angle of  $45^\circ$  from inner dead centre position. (7)
13. (a) It is required to set out the profile of a cam to give the following motion to the reciprocating follower with a flat mushroom contact face:  
 (i) Follower to have a stroke of 20 mm during  $120^\circ$  of cam rotation. (3)  
 (ii) Follower to dwell for  $30^\circ$  of cam rotation (3)  
 (iii) Follower to return to its initial position during  $120^\circ$  of cam rotation; and (3)  
 (iv) Follower to dwell for remaining  $90^\circ$  of cam rotation. The minimum radius of the cam is 25 mm. The motion of the follower is to take place with simple harmonic motion during out stroke and return stroke. (4)

Or

- (b) A flat ended valve tappet is operated by a symmetrical cam with circular arc for flank and nose. The straight line path of the tappet passes through the cam axis. Total angle of action  $150^\circ$ , lift 6mm, base circle diameter 30mm, period of acceleration is the half the period of retardation during the lift. The cam rotates at 1250 rpm. Find (i) Flank and nose radii (ii) Maximum acceleration and retardation during the lift.
14. (a) A pair of  $20^\circ$  full depth involute spur gears having 30 and 50 teeth respectively of module 4 mm are in mesh. The smaller gear rotates at 1000 r.p.m. Determine:  
 (i) Sliding velocities at engagement and at disengagement of pair of a teeth, and  
 (ii) Contact ratio.

Or

- (b) In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 r.p.m. in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 300 r.p.m. in the clockwise direction, what will be the speed of gear B?

15. (a) An open belt running over two pulleys 240 mm and 600 mm diameter connects two parallel shafts 3 metres apart and transmits 4 kW from the smaller pulley that rotates at 300 r.p.m. Coefficient of friction between the belt and the pulley is 0.3 and the safe working tension is 10 N per mm width. Determine  
 (i) Minimum width of the belt.  
 (ii) Initial belt tension, and  
 (iii) Length of the belt required.

Or

- (b) A dry single plate clutch is to be designed for an automotive vehicle whose engine is rated to give 100 kW at 2400 r.p.m. and maximum torque 500 N-m. The outer radius of friction plate is 25% more than the inner radius. The intensity of pressure between the plate is not to exceed  $0.07 \text{ N/mm}^2$ . The coefficient of friction may be assumed equal to 0.3. The helical springs required by this clutch to provide axial force necessary to engage the clutch are eight. If each spring has stiffness equal to 40 N/mm, determine the initial compression in the springs and dimensions of the friction plate.

PART C — (1 × 15 = 15 marks)

16. (a) A double start square threaded screw with 50 mm major diameter has 8 mm pitch. The coefficient of friction between screw and nut is 0.1. If the nut is held fixed, determine the torque required on the screw to raise and to lower a load of 40 kN assuming the load to rotate with the screw. State giving reasons whether the screw is self locking or over hauling.

Or

- (b) A tangent cam with straight working faces tangential to a base circle of 120 mm diameter has a roller follower of 48mm diameter. The line of stroke of the roller follower passes through the axis of the cam. The nose circle radius of the cam is 12 mm and the angle between the tangential faces of the cam  $90^\circ$ . If the speed of the cam is 180 rpm, determine the acceleration of the follower, when  
 (i) during the lift, the roller just leaves the straight flank  
 (ii) the roller is at the outer end of its lift, i.e. at the top of the nose.