

# CBCS SCHEME

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18MR42

## Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024 Theory of Machines

Time: 3 hrs.

Max. Marks: 100

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

### Module-1

- 1 a. Define the following:
- (i) Link
  - (ii) Kinematic chain
  - (iii) Degree of freedom
  - (iv) Inversion
- b. Explain with a neat sketch Whitworth quick return mechanism. (06 Marks)
- c. Explain Grubler's criterion for plane mechanisms. (08 Marks)
- (06 Marks)

OR

- 2 a. Derive the expression for the condition of correct steering. (05 Marks)
- b. Explain with sketch Pantograph Mechanism and Geneva Wheel Mechanism. (10 Marks)
- c. With a neat sketch, explain Peaucellier straight line mechanism. (05 Marks)

### Module-2

- 3 a. Explain D' Alembert's principle. (10 Marks)
- b. When the crank is  $45^\circ$  from the inner dead centre on the down stroke, the effective steam pressure on the piston of a vertical steam engine is 2.5 bar. The diameter of the cylinder = 0.75 m, stroke of the piston = 0.50 m and length of connecting rod = 1m. Determine the torque on the crank shaft, if the engine runs at 350 rpm and the mass of reciprocating parts is 200 kg. (10 Marks)

OR

- 4 a. Derive an expression for the ratio of belt tensions. (10 Marks)
- b. Two pulleys of diameters 450 mm and 200 mm are mounted on two parallel shafts 2m apart and are connect by a cross belt drive. Find the length of the belt required and the angle of contact between the belt and each pulley. Also find the power which can be transmitted by the belt when the larger pulley rotates at 200 rpm. The maximum permissible tension in the belt is 1000 N and the coefficient of friction between the belt and the pulley is 0.25. (10 Marks)

### Module-3

- 5 a. Explain balancing of several masses rotating in the same plane. (10 Marks)
- b. A rotating shaft carries four masses 1, 2, 3 and 4 which are radially attached to it. The mass centres are 30 mm, 38 mm, 40 mm and 35 mm respectively from the axis of rotation. The masses 1, 3 and 4 are 7.5, 5 and 4 kg respectively. The axial distance between the planes 1 and 2 is 400 mm and, 2 and 3 is 500 mm. The masses 1 and 3 are at right angles to each other. Find for complete balance,
- (i) Angle between 1, 2 and 1, 4
  - (ii) Axial distance between 3 and 4
  - (iii) Magnitude of mass 2
- (10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and/or equations written eg,  $42+8=50$ , will be treated as malpractice.

OR

- 6 A 5 cylinder inline engine running at 500 rpm has successive cranks at  $144^\circ$  apart. The distance between the cylinder centre line is 300 mm. Piston stroke = 240 mm, length of CR = 480 mm. Examine the engine for balance of primary and secondary forces and couples. Find the maximum value of these and position of central crank at which these maximum values occur. The reciprocating mass for each cylinder is 150 N. (20 Marks)

Module-4

- 7 a. Define: (i) Controlling force (ii) Governor (iii) Sensitiveness (iv) Stability (08 Marks)  
 b. A porter governor has all four arms 300 mm long, the upper arms are pivoted on the axis of rotation and lower arms are attached to the sleeve at a distance 35 mm from axis. The mass of each ball is 7 kg and the load on the sleeve is 540 N. Determine the equilibrium speed for the two extreme radii of 200 mm and 260 mm of rotation of governor balls. (12 Marks)

OR

- 8 a. Derive an expression for gyroscopic couple. (08 Marks)  
 b. The motor of a marine having a mass of 1000 kg and radius of gyration 300 mm rotates at 1550 rpm clockwise when looking from the bow. Determine the gyroscopic couple and its effect on the ship in the following cases:  
 (i) When the ship pitches with an angular velocity of 1 rad/sec when the bow (i) Rising (2) Falling  
 (ii) When the ship is speeding at 40 km/hr and takes a right turn in a circular path of 200 m radius.  
 (iii) When the ship rolls at certain instant, it has an angular velocity of 0.5 rad/sec when viewed from the stern. (12 Marks)

Module-5

- 9 a. Write a note on types of followers used in cams. (06 Marks)  
 b. Derive an expression for displacement, velocity and acceleration of follower when the roller is in contact with straight flank. (14 Marks)

OR

- 10 A cam with 3 cm as minimum radius is rotating clockwise at a uniform speed of 1200 rpm and has to give the motion to the knife edge follower as defined below:  
 (i) Follower to move outward through 3 cm during  $120^\circ$  of cam rotation with SWM.  
 (ii) Dwell for the next  $60^\circ$   
 (iii) Follower to return to its starting position during the next  $90^\circ$  with UARM.  
 (iv) Dwell for the remaining period  
 Draw the cam profile:  
 a. Follower axis passes through cam axis  
 b. Follower axis is offset to the right by 1 cm.  
 Also find the maximum velocity and acceleration during outward and inward or return stroke. (20 Marks)

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