CBCS SCHEME

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18MR42

Fourth Semester B.E. Degree Examination, June/July 2023
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. Explain the kinematic pairs based on type of relative motion. **(08 Marks)**

b. Define : (i) Link (ii) Kinematic pair (iii) Kinematic chain (iv) Mechanism **(06 Marks)**

c. With neat sketch, explain Geneva wheel mechanism. **(06 Marks)**

OR

2 a. With neat sketch, explain : (i) Whitworth mechanism (ii) Oldham's coupling **(14 Marks)**

b. Write down the differences between machine and mechanism. **(06 Marks)**

Module-2

3 a. Explain D'Alembert's principle. **(06 Marks)**

b. With the help of velocity polygon and acceleration polygon explain the inertia forces on a engine mechanism. **(09 Marks)**

c. State the laws of solid friction. **(05 Marks)**

OR

4 a. Derive an expression for ratio of belt tensions. **(10 Marks)**

b. A line shaft is driven by an electric motor through an open belt drive. The speed of the motor is 1500 rpm and the line shaft should rotate at 600 rpm. The maximum linear speed at which the belt should run is 1200 m/min. Determine the diameters of the pulleys when,

(i) Thickness of belt is neglected.

(ii) Thickness of belt is 12 mm.

(iii) 5% total slip is taken by considering thickness of belt. **(10 Marks)**

Module-3

5 a. Explain balancing of single revolving mass in two different planes. **(10 Marks)**

b. A shaft carries four masses M_1, M_2, M_3 and M_4 attached to it. They all revolve in the same plane. The magnitude of the masses are 6, 5, 9 and 7.5 kg respectively. The C.G of the masses are located at a radial distance of 100, 125, 150 and 75 mm from the axis of the shaft. The angular positions of the masses 60°, 135° and 270° from M_1. Determine the position and magnitude of mass M_5 at 250 mm radius to balance the system. **(10 Marks)**

OR

6 a. Explain the balancing in multicylinder inline engines. **(10 Marks)**

b. The pistons of a 4 cylinder vertical inline engine reach their uppermost position at 90° interval in order of their axial position. Pitch of cylinder = 0.35 m, Crank radius = 0.12 m, Length of C.R = 0.42 m. The engine runs at 600 rpm. If the reciprocating parts of each engine has a mass of 2.5 kg, find the unbalanced primary and secondary forces and couples. Take central plane of engine as reference plane. **(10 Marks)**

Module-4

7 a. Define the terms : (i) Sensitiveness (ii) Stability (iii) Isochronism (iv) Effort (v) Power in connection with governors **(10 Marks)**

b. A porter governor has all faces 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 rotation of governor balls. **(10 Marks)**

OR

8 a. Explain with neat sketch the gyroscopic effect on a ship. **(10 Marks)**

b. A ship propelled by a turbine rotor which has a mass of 5000 kg and has a speed of 2100 rpm. The rotor has a radius of gyration of 0.5 m and rotates in clockwise direction when viewed from stern. Find the gyroscopic effect in the following conditions :

(i) The ship runs at a speed of 16 knots (1 knot = 1860 m/hr). It steers to the left in a curve of 60 m radius.

(ii) The ship pitches 6° above and 6° below the horizontal position. The bow descends with maximum velocity. The motion due to pitching is SHM and periodic time is 20 secs.

(iii) The ship rolls at a certain instant has an angular velocity of 0.03 rad/sec clockwise when viewed from the stern. **(10 Marks)**

Module-5

9 a. With neat sketch explain the types of followers used in cams. **(06 Marks)**

b. A vertical spindle supplied with a plane horizontal face at its lower end is actuated by a cam keyed to a uniformly rotating shaft. The spindle is raised through a distance of 30 mm in one fourth, remains at rest in one fourth, is lowered in one third and remains at rest for the remainder of a complete revolution. Draw the profile assuming the least radius of the cam profile as 25 mm and that the spindle moves with uniform acceleration and retardation on both during ascent and descent. However during descent deceleration period is half the acceleration period. The axis of the spindle passes through cam axis. The cam rotates in anticlockwise direction. **(14 Marks)**

OR

10 a. 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) Follows to move outward through 3 cm during 120° of cam rotation with SHM.

(ii) Dwell for next 60°

(iii) Follows to return to its starting position during the next 90° with UARM.

(iv) Dwell for the remaining period.

Draw the cam profile

- Follwer axis passes through cam axis.
- 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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