

CBCS SCHEME

17MT45

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 inversion of single slides crank mechanism. (10 Marks)
- b. Explain the inversion of four bar chain mechanism. (10 Marks)

OR

- 2 a. Explain Whitworth quick returns motion mechanism with neat sketch. (10 Marks)
- b. Explain types of constrained motions. (10 Marks)

Module-2

- 3 a. Explain law of gearing with neat sketches. (10 Marks)
- b. A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with 20° pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact, arc of contact and contact ratio. (10 Marks)

OR

- 4 a. An epicyclic train of gears is arranged as shown in Fig.Q4(a). How many revolutions does the arm, to which is pinions B and C are attached make
i) When A makes one revolution clockwise and D makes half a revolution anticlockwise
ii) When A makes one revolution clockwise and D is stationary.
The number of teeth on the gears A and D are 60 and 105 respectively.

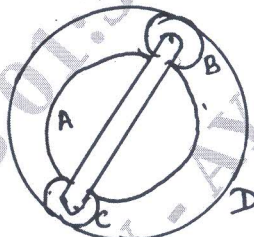


Fig.Q4(a)

(10 Marks)

- b. The Fig.Q4(b) shows diagrammatically a compound epicyclic gear train wheels A, D and E are free to rotate independently on spindle O, while B and C are compound and rotate together on spindle P, on the end of arm OP. All the teeth on different wheels have the same module. A has 12 teeth, B has 30 teeth and C has 14 teeth cut externally. Find the number of teeth on wheels D and E which cut internally. If the wheel A is driven clockwise at 1 RPS. While D is driven counter clockwise at 5 RPS. Determine the magnitude and direction of the angular velocities of ARM OP and wheel E.

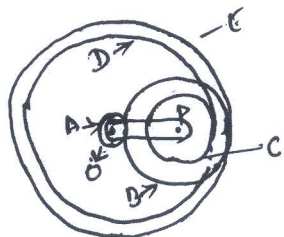


Fig.Q4(a)

(10 Marks)

Module-3

- 5 a. Explain radial cam with neat sketch and explain terms used in radial cam. (10 Marks)
 b. Derive the expression for velocity and acceleration when the follower moves with cycloidal motion. (10 Marks)

OR

- 6 A cam with a minimum radius of 250 mm, rotating clockwise at a uniform speed is to be designed to give a roller follower, at the end of a valve rod, mention described below.
 1. To raise the valve through 50 mm during 120° rotation of the cam.
 2. To keep the valve fully raised through next 30°
 3. To lower the valve fully raised through next 60°
 4. To keep the valve closed during rest of the revolution i.e. 150°

The diameter of the roller is 20 mm and the diameter of the cam shaft is 25 mm. Draw the profile of the cam when:

- i) The line of stroke of the valve rod passes through the axis of cam shaft and
 ii) The line of the stroke is offset 15 mm from the axis of the cam shaft.

The displacement of the valve, while being raised and lowered, is to take place with simple harmonic motion. Determine the maximum acceleration of the valve rod when the cam shaft rotates at 100 rpm. Draw the displacement, the velocity and the acceleration diagram for one complete revolution of the cam. (20 Marks)

Module-4

- 7 a. Four masses M_1 , M_2 , M_3 and M_4 are 200 kg, 300 kg, 240 kg and 260 kg respectively. The corresponding radii of rotations are 0.2 m, 0.15m, 0.25m and 0.3 m respectively and the angle between successive masses are 45° , 75° and 135° . Find the position and magnitude of balance mass required, if its radii of rotation is 0.2 m in both analytical and graphical method. (10 Marks)
 b. A, B, C and D are four masses carried by a rotating shaft at radii 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the masses of B, C and D are 10 kg, 5 kg and 4 kg respectively. Find the required masses A and the relative angular settings of the four masses so that the shaft shall be in complete balance. The angle between $BD = 100^\circ$, $BC = 240^\circ$. (10 Marks)

OR

- 8 a. An open belt running over two pulleys 240 mm and 600 mm diameter connects the parallel shaft 3m apart and transmits 4 KW from the smaller pulley that rotates at 300 rpm. Coefficient of friction between the belt and the pulleys 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 iii) Length of the belt required. (10 Marks)
 b. i) Derive the expression for centrifugal tension of the flat belt drive and
 ii) Condition for the transmission of maximum power. (10 Marks)

Module-5

- 9 a. Derive an expression for heel angle of a motor cycle to avoid skidding. (10 Marks)
 b. Explain the gyroscopic effect of steering, pitching and rolling of a ship moving in a heavy sea and assume the rotor turn clockwise and viewing from stern (or) aft. (10 Marks)

OR

- 10 a. Explain the term height of the governor and derive an expression for height of portor governor considering sleeve friction into account. (10 Marks)
 b. The radius of rotation of the balles of a Hartnell governor is 8cm at the minimum speed of 300rpm. Neglecting gravity effect determine the speed after the sleeve is lifted by 6cm, also determine the initial compression of spring, governor effort and power. The particulars of the governor are, length of ball arm = 15cm, length of sleeve arm = 10cm, mass of each ball = 4kg and stiffness = 25000N/m. (10 Marks)