CBCS SCHEME

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18AE/AS44

Fourth Semester B.E. Degree Examination, June/July 2024
Mechanisms and Machine Theory

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define mechanism, kinematic link, kinematic pair and inversions. **(08 Marks)**

b. Explain the three inversions of double slider crank chain. **(12 Marks)**

OR

2 a. With a neat sketch arrive at the condition of correct steering for Ackermann's mechanism. **(08 Marks)**

b. Find the degrees of freedom for the mechanisms shown in Fig.Q2(b).

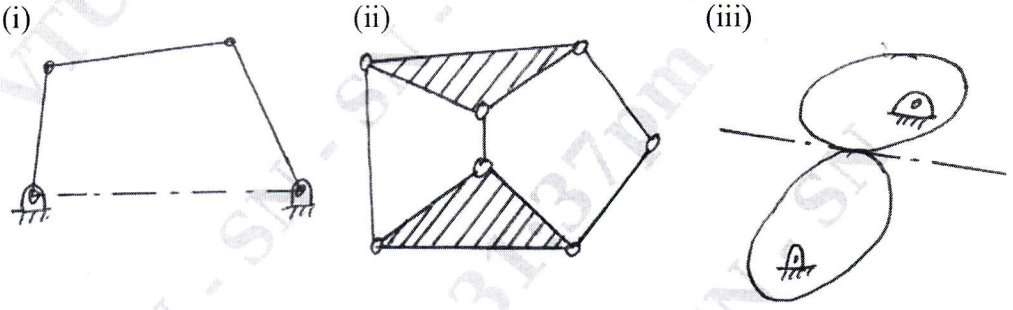

Fig.Q2(b) **(12 Marks)**

Module-2

3 a. Define relative velocity and relative acceleration. **(04 Marks)**

b. Fig.Q3(b) shows a four bar mechanism. Crank O_2A rotates at 200 rpm and an angular acceleration of 150 rad/sec^2 at the instant when the crank makes an angle of 45° to the horizontal. Find the acceleration of points B and C and angular velocities and angular acceleration of link 3 and link 4.

Link O_2O_4 = 120 mm
O_2A = 45 mm
AB = 90 mm
O_4B = 60 mm
AC = 40 mm

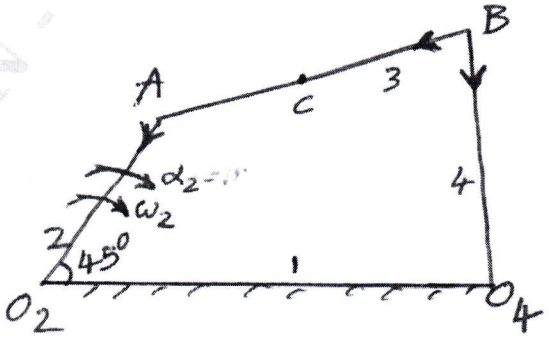

Fig.Q3(b) **(16 Marks)**

OR

4 A four bar mechanism under the action of two external forces is shown in Fig.Q4. Determine the torque to be applied on the link AB for static equilibrium. The dimensions of links are AB = 50 mm, BC = 66 mm, CD = 55 mm, CE = 25 mm, CF = 30 mm, BAD = 60° and AD = 100 mm.

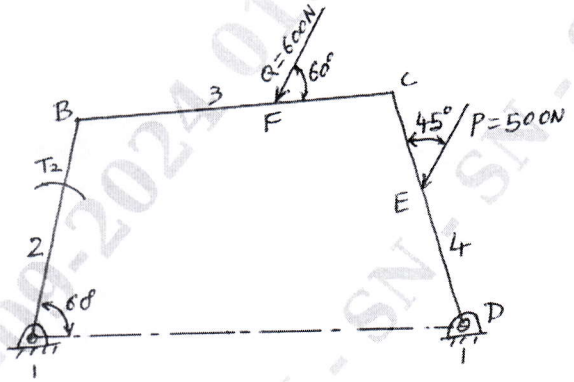

Fig.Q4 **(20 Marks)**

Module-3

5 a. Obtain the equation for the path of contact in a spur gear drive. **(06 Marks)**

b. With a neat sketch, explain the arc of contact in a spur gear drive. **(06 Marks)**

c. Two 20° involute spur gears have a module of 10 mm. The addendum is one module. The larger gear has 50 teeth and pinion has 13 teeth. Does interference occur? If it occurs, to what value should the pressure angle to be changed to eliminate interference? **(08 Marks)**

OR

6 a. In an epicyclic gear train, the internal wheels A, B and the compound wheel C and D rotate independently about the axis 'O'. The wheels E and F rotate on a pin fixed to the arm G. E gears with A and C, and F gears with B and D. All the wheels have same pitch and the number of teeth on E and F are 18, C = 28, D = 26.

(i) Sketch the arrangement

(ii) Find the number of teeth on A and B

(iii) If the arm G makes 150 rpm clockwise and A is fixed, find speed of B. **(10 Marks)**

b. An epicyclic gear train consists of a sun wheel 'S', a stationary internal gear 'E' and three identical planet wheel 'P' carried on a star shaped planet carrier 'C'. The size of different toothed wheels are such that the planet carrier C rotates 1/5 of the speed of sun wheel. The minimum number of teeth on any wheel is 16. The driving torque on the sun wheel is 100 Nm. Determine:

(i) Number of teeth on different wheels of train

(ii) Torque necessary to keep the internal gear stationary. **(10 Marks)**

Module-4

7 A shaft running in bearings carries masses 20, 30, 40 kg in planes A, B and C with CG from the axis of shaft 30 mm, 20 mm and 15 mm respectively. The distances of planes B and C from A are 1000 mm and 2000 mm to the right of A. The relative angular positions of the CG of the unbalanced masses are such that they are in static balance. Find these.

To obtain complete dynamic balance suitable masses are introduced in planes D and E with CG 100 mm from the axis D is 500 mm to the left of A and E 500 mm to the right of C. Determine the position and magnitude of the balancing masses. **(20 Marks)**

OR

8 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 is 0.35 m. Crank radius is 0.12 m, length of CR is 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. Use graphical method. **(20 Marks)**

Module-5

9 a. Define: Sensitivity, controlling force, hunting, stability and isochronous governor. **(10 Marks)**

b. Derive an equation to find height of porter governor using method of resolution of forces. **(10 Marks)**

OR

10 a. An aeroplane flying at a speed of 300 kmph takes right turn with a radius of 50 m. The mass of engine and propeller is 500 kg and radius of gyration is 400 mm. If the engine runs at 1800 rpm in clockwise direction when viewed from tail end, determine the gyroscopic couple and state its effect on the aeroplane. What will be the effect if the aeroplane yaws to its left instead of right? **(08 Marks)**

b. A disc of 5 kg mass with radius of gyration 70 mm is mounted at span on a horizontal shaft spins at 720 rpm in clockwise direction when viewed from the right hand bearing. If the shaft processes about the vertical axis at 30 rpm in clockwise direction when viewed from the top. Determine the reactions at each bearing due to mass of the disc and gyroscopic effect. **(12 Marks)**

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