CBCS SCHEME

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17AE/AS44

Fourth Semester B.E. Degree Examination, July/August 2022
Mechanism 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 the following terms:
(i) Link (ii) Inversion (iii) Kinematic pair (iv) Resistant body **(10 Marks)**

b. Determine the mobility of the given mechanism. [Refer Fig.Q1(b)]

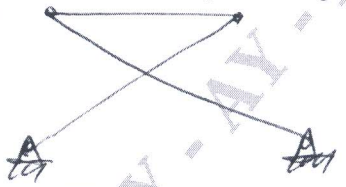

Fig.Q1(b) **(10 Marks)**

OR

2 a. Explain constructive working of :
(i) Crank and slotted link mechanism
(ii) Scotch Yock Mechanism **(10 Marks)**

b. Obtain condition for correct steering for a four wheeled vehicle. **(10 Marks)**

Module-2

3 a. The Fig.Q3(a) shows a four bar mechanism. Crank O_2A rotates of 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 4.

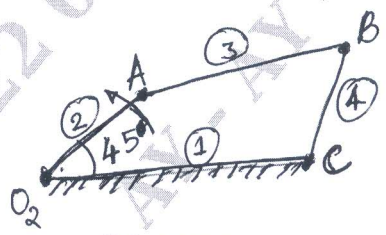

Fig.Q3(a) **(10 Marks)**

b. The Fig.Q3(b) shows a quick return mechanism. Link 2 rotates uniformly at 20 rad/sec in clockwise direction. Determine the angular acceleration of link 3.

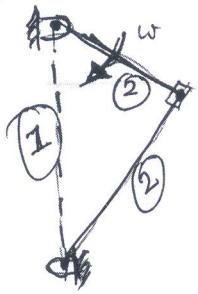

Fig.Q3(b) **(10 Marks)**

OR

4 a. For the mechanism shown in Fig.Q4(a) the crank OA rotates at 20 rpm anticlockwise and gives motion to the sliding blocks B and D. The dimensions of various links are OA = 300 mm, AB = 1200 mm, BC = 450 mm and CD = 450 mm for the given configuration, determine:
(i) Velocity of sliding block at B and D
(ii) Angular velocity of CD
(iii) Linear acceleration of D.

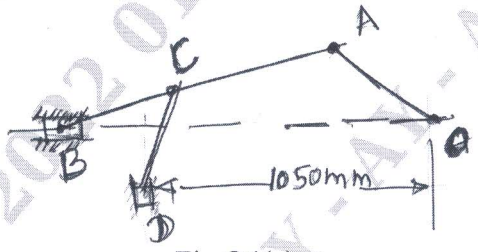

Fig.Q4(a) **(10 Marks)**

b. The crank of a slider crank mechanism is 480 mm long and rotates at 20 rad/sec in the counter clockwise direction. It has a connecting rod of 1600 mm long. Determine the following when the crank is at 60° from the inner dead centre:
(i) Velocity of slider
(ii) Angular velocity of connecting rod
(iii) The position and velocity of a point P on the connecting rod having least absolute velocity. **(10 Marks)**

Module-3

5 a. Obtain an expression for the length of path of contact for two involute profile gears in mesh. **(10 Marks)**

b. For two gears in mesh, with pinion as the driver the arc of approach is not less than 4.0 times the module. If the pressure angle is 20° and velocity ratio is 2.5, find:
(i) Least number of teeth on each gear if interference is just avoided
(ii) Addendum of the gear interms of module.
Data: G = 2.5; $\phi = 20°$; Arc of approach ≥ 4 m **(10 Marks)**

OR

6 a. With neat sketch show the compound gear train and briefly explain how it differs from a simple gear train. **(10 Marks)**

b. An epicyclic gear train consists of a Sunwheel (S), a stationary internal gear (E) and three identical planet wheels (P) carried on a star shaped planet carrier (C). The size of different toothed wheels are such that the planet carrier C rotates at 1/5 of the speed of the 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. Explain with neat sketch the plane of rotating masses. **(10 Marks)**

b. 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 rotation are 0.2 m, 0.15 m and 0.3 respectively the angle between successive masses are 45°, 75° and 135°. Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2 m. **(10 Marks)**

OR

8 a. Explain the terms primary balancing and secondary balancing as used for balancing of reciprocating masses. **(10 Marks)**

b. In a 3 cylinder radial engine all the connecting rods acts on a single crank. The cylinder centre lines are set at 120°. Mass of reciprocating parts per cylinder = 2.5 kg. Crank length = 0.075 m, connecting rod length = 0.275 m and speed = 1800 rpm. Determine:

(i) Maximum unbalanced primary force and the balancing mass to be attached at 100 mm radius to give primary balance

(ii) Maximum unbalanced secondary force and the balancing mass to be attached at 100 mm radius to give secondary balance. **(10 Marks)**

Module-5

9 a. Derive an expression for the power of a porter governor. **(10 Marks)**

b. In a Hartnell governor length of ball and sleeve arms are 15 and 7.5 cm respectively. Mass of each ball is 3 kg. Radius of rotation of ball is 10 cm at 180 rpm, when the ball arm is parallel to the shaft axis. Stiffness of the spring is 14000 N/m. Determine:

(i) Initial load on the sleeve

(ii) Equilibrium speed corresponding to a lift of 1 cm

(iii) If due to friction, variation of speed at the mid position is ±2 rpm, determine the force of friction at the sleeve. **(10 Marks)**

OR

10 a. Explain gyroscopic effect on airplane. **(10 Marks)**

b. An aeroplane make a complete half circle of 40 cm radius towards left when flying at 175 km/hr. The mass of the rotary engine and propeller is 400 kg with radius of gyration of 300 mm. The engine runs at 2500 rpm find the gyroscopic couple on airplane. **(10 Marks)**

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