CBCS SCHEME

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18AE/AS44

Fourth Semester B.E. Degree Examination, July/August 2022
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 the following :
i) Kinematic chain
ii) Mechanism
iii) Structure
iv) Inversion
v) DOF **(10 Marks)**

b. With a neat sketch, explain the following inversions of double slider crank chain
i) Elliptical trammels
ii) Scotch Yoke mechanism **(10 Marks)**

OR

2 a. With a neat sketch, explain crank and slotted lever quick return motion mechanism and Geneva wheel mechanism. **(10 Marks)**

b. Sketch and explain Ackerman steering gear mechanism. **(04 Marks)**

c. Determine the degree of freedom of the linkages shown in Fig Q2(c) i and ii. Mention number of links and loops also.

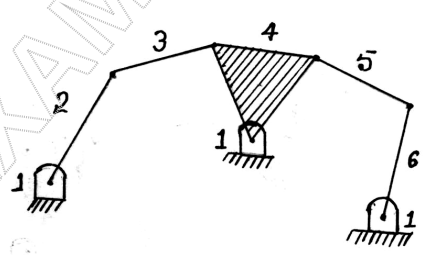


Fig Q2(c) – i

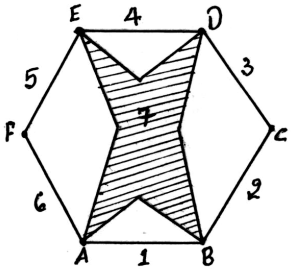
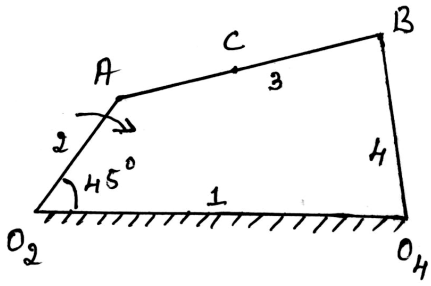


Fig Q2(c) – ii **(06 Marks)**

Module-2

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

b. The Fig Q3(b) shows a four bar mechanism crank O_2A rotates at 200rpm and an angular acceleration of 150rad/sec^2 at an 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. (use Graphical method)



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

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

OR

4 For the static equilibrium of the quick return mechanism shown in Fig Q4. Find the required input torque T_2 for the force of 300N on the slider D. Angle $\theta = 105^o$. Coefficient of friction $\mu = 0.15$ for each sliding pair. The impending motion of the slider is to the left. Solve by Graphical method. Given AB = 200mm ; OC = 800mm ; CD = 300mm.

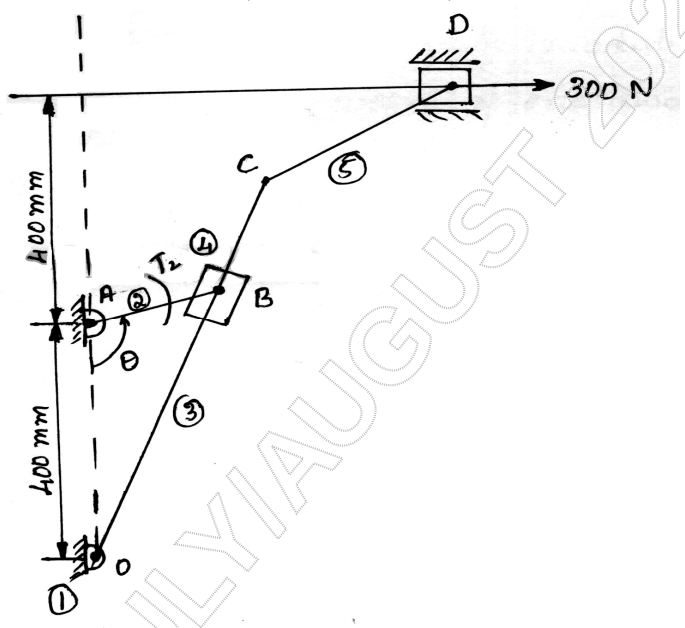


Fig Q4 **(20 Marks)**

Module-3

5 a. State and explain Law of Gearing. **(05 Marks)**

b. Define Interference and mention any four methods to avoid interference in gears. **(05 Marks)**

c. Two gear wheels mesh externally and are to give a velocity ratio of 3. The teeth are involute form with module 6mm and standard addendum of one module. Pressure angle is 18º. Pinion rotates at 90rpm find :

i) Number of teeth on each wheel so that interference is just avoided.
ii) Length of path of contact
iii) Length of arc of contact
iv) Maximum velocity of sliding between teeth
v) Number of pairs of teeth in contact. **(10 Marks)**

OR

6 a. Sketch and explain :

i) Compound gear train
ii) Reverted gear train
iii) Epicyclic gear train **(09 Marks)**

b. 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 are18, C = 28, D = 26.

i) Sketch the arrangement
ii) Find the a number of teeth on A and B
iii) If the arm G makes 150 rpm CW and A is fixed, find speed of B.
iv) If the arm G makes 150rpm CW and the wheel A makes 15rpm CCW, find the speed of B. [Use tabular column method] **(11 Marks)**

Module-4

7 A rotating shaft carries four masses 1, 2, 3 and 4 which are radially attached to it. The mass centers are 30mm, 38mm, 40mm and 35mm respectively from the axis of rotation. The masses 1, 3 and 4 are 7.5kg, 5kg and 4kg respectively. The axial distance between plane 1 and 2 is 400mm and plane 2 and 3 is 500mm. The mass 1 and 3 are at right angle to each other. For a complete balance find :

i) Angle between 1, 2 and 1, 4
ii) Axial distance between plane 3 and 4
iii) Magnitude of mass 2. **(20 Marks)**

OR

8 The piston of a 4 cylinder vertical inline engine reach their uppermost position at 90º interval in order of their axial position. Pitch of cylinder = 0.35m, Crank radius = 0.12m, length of C.R = 0.42m. The engine runs at 600rpm. If the reciprocating parts of each engine has a mass of 2.5kg, 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 :

i) Sensitiveness
ii) Governor effort
iii) Governor power
iv) Hunting
v) Isochronous Governor. **(10 Marks)**

b. The arms of a porter governor are 300mm long the upper arms are pivoted on the axis of rotation and the lower arms are attached to the sleeve at a distance of 35mm from the axis of rotation. The mass of the sleeve is 54kg and the mass of each ball is 7kg. Determine the equilibrium speed. When the radius of rotation of the ball is 225mm. What will be the range of speed for this position if the frictional resistance to the motion of the sleeve is equivalent to a force of 30N at the sleeve? **(10 Marks)**

OR

10 a. In a hartnell governor the length of ball and sleeve arms are 12 and 10cm respectively. The distance of fulcrum of the bell crank lever from the governor axis is 14cm. Mass of each ball is 4kg. When the governor runs at the mean speed of 300rpm, the ball arm vertical and sleeve arm is horizontal. For an increase speed of 4% the sleeve moves 10mm upward. Neglecting friction find :

i) Minimum equilibrium speed if total sleeve movement is 20mm
ii) Spring stiffness
iii) Sensitiveness of Governor
iv) Spring stiffness if governor is to be isochronous at 300rpm **(10 Marks)**

b. An aeroplane make a complete half circle of 40m radius towards left when flying at 175km/hr. The mass of the rotary engine and propeller is 400kg with radius of gyration 300mm. The engine runs at 2500rpm clockwise when viewed from the rare. Find the gyroscopic couple on the aircraft. What will be the effect if the aeroplane turns towards right instead of left? **(10 Marks)**

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