CBCS SCHEME

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17AE/AS44

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
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. Prove that the minimum number of binary links in a constrained mechanism with simple hinges is four. **(04 Marks)**

b. With a neat sketch explain Ackermann steering gear mechanism and condition for correct steering. **(10 Marks)**

c. Give the classification of kinematic pairs according to relative motion between links. Also indicate the DoF associated with each pair. **(06 Marks)**

OR

2 a. Show how a pantograph mechanism can be used to draw enlarged or reduced size of a circle. **(07 Marks)**

b. With a neat sketch, explain whitworth quick return motion mechanism, also show that return stroke is quicker than cutting stroke. **(09 Marks)**

c. Determine the mobility of the mechanism give below. **(04 Marks)**

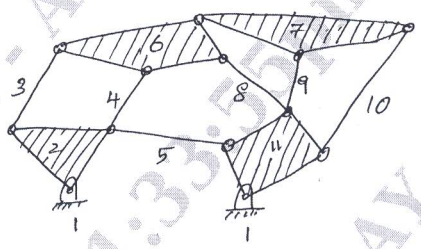

Fig.Q.2(c)

Module-2

3 A four bar mechanism as shown in the Fig.Q.3 below crank BC rotate with an angular velocity of 100 rad/sec and angular acceleration of 4400 rad/sec^2 of the instant when the crank makes an angle of 53° to the horizontal. Draw the velocity and acceleration polygon and determine the linear acceleration of point E and R, and the angular acceleration of link 3. **(20 Marks)**

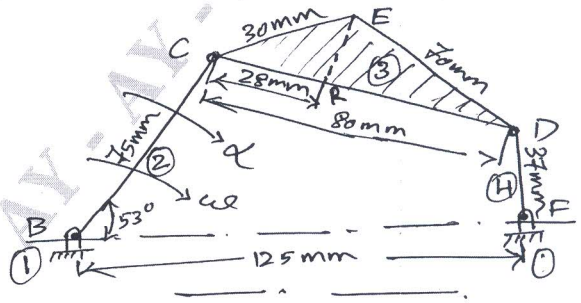

Fig.Q.3

OR

4 a. For the static equilibrium of the mechanism, as shown, find the required input torque T. DC = 300mm, CE = 100mm. **(14 Marks)**

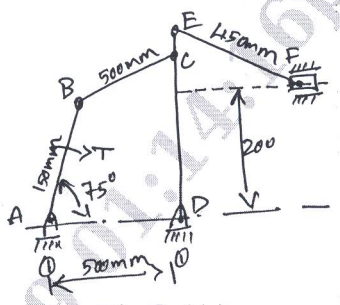

Fig.Q.4(a)

b. A 4 bar mechanism as shown. Determine the torque T for state equilibrium by virtual work method. AB = 50mm, BC = 66mm, CD = 55mm, CE = 25mm, CF = 30mm, AD = 100mm, P = 500N, Q = 600N. **(06 Marks)**

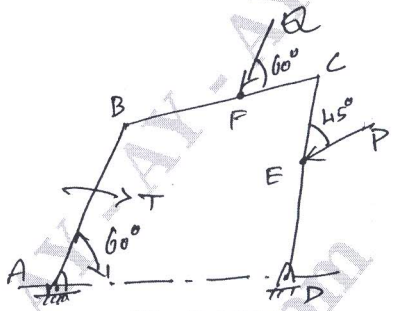

Fig.Q.4(b)

Module-3

5 a. With a neat sketch explain spur gear terminology. **(08 Marks)**

b. Pair of spur gears, with number of teeth on pinion = 19, number of teeth on gear = 47, $\phi = 20°$, m = 6.5mm, Addendum constant = 1 module. Determine:

i) Number of pairs of teeth in contact.

ii) Angle turned through by pinion and gear when one pair of teeth is in contact.

iii) Ratio of velocity of sliding to rolling velocity of engagement begins, engagement terminates and at pitch point.

iv) The length of arc of contact. **(12 Marks)**

OR

6 a. Explain interference and methods to avoid interference. **(06 Marks)**

b. In on epicyclic gear train, the internal wheel A, B and the compound wheel C and D rotate independently about the axis '0', the wheels E and F rotate on a pin fixed to the arm G. E gears with A and C, F gears with B and D. All have some pitch and number of teeth an E and F are 18, C = 28 and D = 26.

i) Sketch the arrangement

ii) Find the number of teeth on A and B

iii) If the arm G makes 150rpm CW and A is fixed, find speed of B

iv) If the arm G makes 150rpm CW and A makes 15rpm CCW. Find speed of B. **(14 Marks)**

Module-4

7 A six cylinder two stroke single acting diesel engine with cylinder center lines are spaced at 650mm, in the end view the cranks are 60° apart and in order 1-4-5-2-3-6, the stoke of each piston is 400mm and the crank to C.R. ratio is 1:5. The mass of reciprocating port is 250kg per cylinder and that of rotating part is 100 kg per crank. The engine rotates at 240rpm. Investigate the engine for out of balance primary and secondary force and couples. **(20 Marks)**

OR

8 A shaft carries 4 masses, A = 200kg, B = 300kg, C = 240kg and D = 360kg revolving at 90mm, 70mm, 100mm and 120mm respectively. The distance of plane B, C and D from plane A are 270mm, 420mm and 720mm respectively. Angle between the crank A and B is 45°, B and C is 75°, C and D is 130°. Balancing masses are placed 120mm and 100mm from D and A respectively. The distance between them being 500mm. Find the balancing masses and their angular position if they are placed at a radius of 100mm. **(20 Marks)**

Module-5

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

b. In a hartnell governor the length of ball and sleeve arms are 12 and 10cm respectively. The distance of fulcrum of the hell crank lever from the governor axis is 14cm. Mass of each ball in 4kg. At 300rpm, the ball arm is vertical and sleeve arm is horizontal. For an 4% increase in speed, the sleeve moves up by 10mm. Neglect friction, find:

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

OR

10 a. With neat sketch explain gyroscopic effect on aeroplane. **(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 30mm. The engine runs of 2500rpm CW when viewed from rear. Find the gyroscopic couple and what will be the effect if plane turn right instead of left. **(04 Marks)**

c. Aeroplane engine rotor is supported by bearing 2.14m apart, weighing 688kg (compressor, turbine and shaft). C.G. being at 0.92m from left and radius of gyration 0.229m. Find maximum bearing force on plane when undergoes pullout at 1830 m radius curve at 960km/hr and vector speed 10000rpm. Include centrifugal force effect and gyroscopic effect due to pullout. **(06 Marks)**

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