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21AE/AS51

## Fifth Semester B.E. Degree Examination, June/July 2024 Mechanism & 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.

(iii) Structure

(v) Degrees of freedom.

(ii) Mechanism

(iv) Inversions

(10 Marks)

b. Sketch and explain the working of an Elliptical trammel. Prove that it traces an Ellipse. (10 Marks)

OR

- 2 a. Explain with a neat sketch, pantograph mechanism, state its applications. (06 Marks)
- b. Determine the mobility of the mechanism given below :

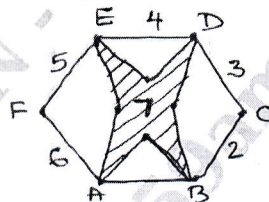


Fig. Q2 (b)

- c. Derive an expression for necessary condition of correct steering and explain Ackermann steering gear with neat sketch. (10 Marks)

### Module-2

- 3 a. Describe Angular velocity and relative velocity. (04 Marks)
- b. For the Mechanism shown in Fig. Q3, crank OA rotates at 20 rpm anticlock wise and gives motion to sliding blocks B and D, OA = 300 mm, AB = 1200 mm, BC = 450 mm and CD = 450 mm. Determine :
 

(i) Velocity of B and D

(ii) Angular velocity of CD

(iii) Linear acceleration of D.

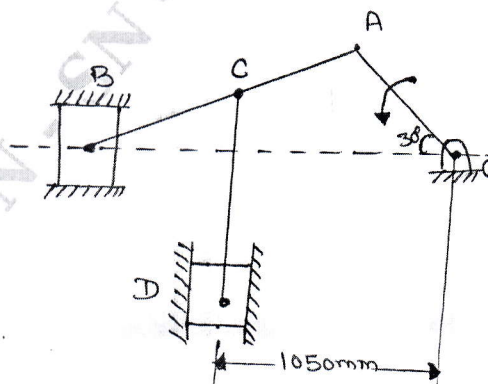


Fig. Q3  
1 of 3

(16 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

OR

- 4 a. Explain principle of virtual work application of static force analysis. (06 Marks)  
 b. A four bar mechanism under the action of External forces is shown in Fig. Q4 (b). Determine the torque  $T_2$  and various forces on links for the equilibrium of the system.

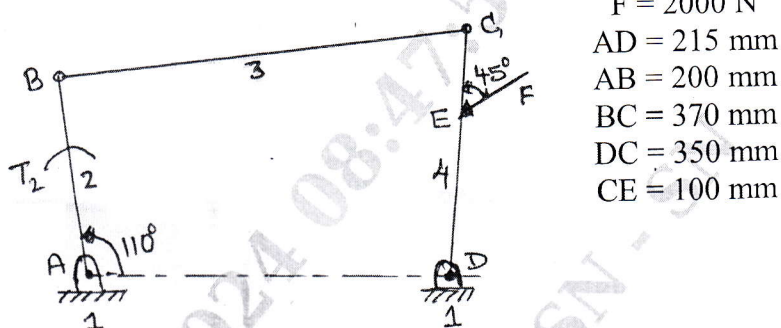


Fig. Q4 (b)

(14 Marks)

**Module-3**

- 5 a. Derive an expression for length of arc of contact for a pair of mating gears. (10 Marks)  
 b. A pair of gears 40 and 30 teeth respectively are of  $25^\circ$  involute form, Addendum = 5 mm, Module = 2.5 mm if the smaller wheel is the driver and rotate at 1500 rpm, find the velocity of sliding at the point of Engagement at pitch point and at the point of disengagement, length of path of contact and length of Arc of contact. (10 Marks)

OR

- 6 a. Explain the following with neat sketches:  
 (i) Compound gear train  
 (ii) Epicyclic gear train. (06 Marks)  
 b. In an Epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively, if the arm rotates at 150 rpm in anticlockwise direction about the centre of gear A which is fixed. Determine the speed of the gear B, if the gear A. Instead of being fixed makes 300 rpm in the clockwise direction what will be the speed of gear B.

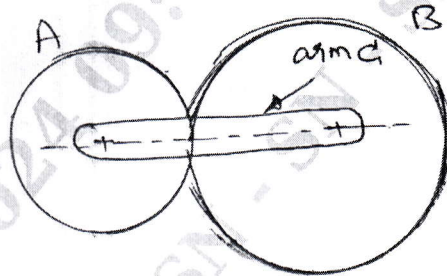


Fig. Q6 (b)

(14 Marks)

**Module-4**

- 7 a. Explain static and dynamic balancing of rotating masses. (05 Marks)  
 b. A shaft carries four rotating masses A, B, C and D which are completely balanced. The masses B, C and D are 50 kg, 80 kg and 70 kg respectively. The masses C and D makes an angles of  $90^\circ$  and  $195^\circ$  respectively with mass B in the same sense. The masses A, B, C and D are concentrated at radius 75 mm, 100 mm, 50 mm and 90 mm respectively. The plane of rotation of masses B and C are 250 mm apart. Determine (i) Mass A and its angular position. (ii) Position of planes A and D. (15 Marks)



OR

- 8 The cranks and connecting Rod of a 4-cylinder In-line Engine running at 1800 rpm are 60 mm, 240 mm each respectively and the cylinders are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, The crank appears at intervals of  $90^\circ$  in an end view in the order 1-4-2-3. The reciprocating mass corresponding to each cylinder is 15 kg.

Determine

- (i) Unbalanced primary and secondary forces. If any.
- (ii) Unbalanced primary and secondary couples with reference to central plane of engine.

(20 Marks)

**Module-5**

- 9 a. Define the following with respect to the working of Governors :

- (i) Sensitiveness.
- (ii) Isochronism
- (iii) Hunting of governors
- (iv) Effort of a governors
- (v) Stability of a governors.

(10 Marks)

- b. A porter governor has all four arms 300 mm long. The upper arms are pivoted on the axis of rotation and lower arms are attached to the sleeve at a distance of 35 mm from axis. The mass of each ball is 7 kg and the load on the sleeve is 540 N. Determine the equilibrium speed for the two extreme radii of 200 mm and 260 mm of rotation of governor balls.

(10 Marks)

OR

- 10 a. Describe the gyroscopic effect on an aeroplane. (10 Marks)
- b. An aeroplane makes a complete half circle of 50 meter radius towards left when flying at 200 km/hr. The rotary engine and the propeller of plane has a mass of 400 kg with a radius of gyration of 300 mm. The engine runs at 2400 rpm clockwise, when viewed from the rear. Find the gyroscopic couple on the aircraft and state its effect on it what will be the effect if the aeroplane turn towards right instead of left. (10 Marks)

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