

## Fourth Semester B.E. Degree Examination, Jan./Feb. 2023 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 :  
 i) Kinematic link    ii) Machine    iii) Structure    iv) Inversion    v) Degree of freedom. (05 Marks)
- b. Determine the DOF of the mechanism shown below in Q1(b).

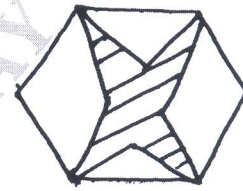
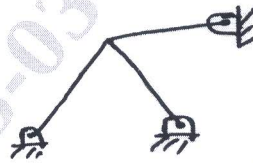


Fig Q1(b)

- c. Explain crank and slotted lever mechanism with a neat diagram. (10 Marks)

**OR**

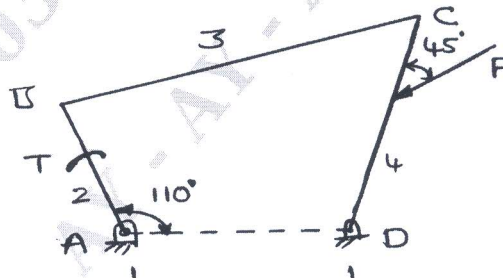
- 2 a. Explain : i) Ratchet and pawl mechanism    ii) Geneva wheel mechanism. (10 Marks)
- b. Explain Whit worth quick return motion mechanism with a neat diagram. (10 Marks)

### Module-2

- 3 A Four bar mechanism ABCD is made up of four links, pin jointed at the ends, AD is a fixed link which is 180mm long. The link AB, BC and CD are 90mm, 120mm and 120mm long respectively. At a certain instant, the link AB makes an angle of  $60^\circ$  with the link AD. If the link AB rotates at a uniform speed of 100rpm clockwise, determine :  
 i) Angular velocity of link BC and CD  
 ii) Angular acceleration of link CD and CB. (20 Marks)

**OR**

- 4 a. Determine the torque 'T' and various Force on link for the equilibrium of the system.



$F = 2000N$   
 $AD = 215mm$   
 $AB = 200mm$   
 $BC = 370mm$   
 $DC = 350mm$   
 $CE = 100mm$

Fig Q4(a)

- b. Explain the condition for the equilibrium of the following system  
 i) Two force member    ii) Three force member. (04 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.

**Module-3**

- 5 a. State and prove law of gearing. (10 Marks)
- b. Two mating involute spur gear and  $20^\circ$  pressure angle have a gear ratio at 2. The number of teeth on the pinion is 20 and its speed is 250rpm. The module of the teeth is 12mm. If the addendum on each wheel is such that the path of approach and the path of recession on each side are half the maximum possible length. Determine :
- The addendum for pinion and gear
  - Length of arc at contact
  - Maximum velocity of sliding during approach and recession (10 Marks)

**OR**

- 6 a. Fig Q6(a) shows an epicyclic gear train which consists of an annular gear D having internal teeth, a compound gear B-C, the sun gear A and the arm E. The compound gear B-C is known as a planet gear as it moves around sun gear A. The sun gear A and annular gear D are coaxial, one shaft is connected to sun gear A and another shaft is connected to the arm. These two shafts are also coaxial. The sun gear A meshes with compound gear C and annular gear D meshes with compound gear B. The gear A, B and C are having 60, 40 and 25 external teeth respectively. If all the gears have the same module, find the number of teeth on the fixed annular gear D. Also find the speed of the shaft connected to the arm, if the speed of the shaft connected to the sun gear A is 100rpm.

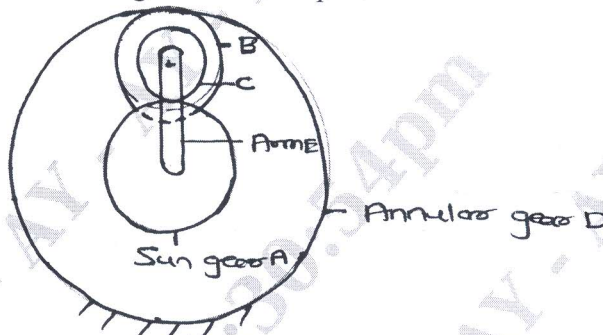


Fig Q6(a)

- (14 Marks)
- b. Explain Simple and compound gear train with neat sketch. (06 Marks)

**Module-4**

- 7 a. The masses  $M_1 = 100\text{Kg}$ ,  $M_2 = 175\text{Kg}$ ,  $M_3 = 200\text{Kg}$  and  $M_4 = 125\text{Kg}$  are fixed to the crank at 200mm radius and revolve in plane 1, 2, 3 and 4 respectively. The angular position of plane 2, 3 and 4 with respect to 1 are  $75^\circ$ ,  $135^\circ$  and  $240^\circ$  taken in the square sense. Distance of the plane 2, 3 and 4 from 1 are 600mm, 1800 and 2400mm. Determine the magnitude and position of the balancing mass at radius of 600 (six hundred)mm in plane L and M located in the middle of 1 and 2 and in the middle of 3 and 4 respectively. (16 Marks)
- b. Explain briefly static and Dynamic balancing. (04 Marks)

**OR**

- 8 a. The following data refer to a single cylinder engine. Speed = 250rpm, stroke = 350mm, mass of reciprocating part = 60Kg, mass of revolving part at 175mm radius is 40Kg. If  $\frac{2}{3}$  of reciprocating parts and all the revolving parts are to be balanced. Find :
- Balancing mass required at 400mm radius
  - Residual unbalanced force when the crank has rotated  $60^\circ$  from Top dead center. (08 Marks)



- b. In a four cylinder engine the two outer cranks are at  $120^\circ$  to each other and their reciprocating mass are each 100Kg. The distance between the plan a rotation of adjacent crank are 450mm, 750mm and 450mm length of each crank is 300mm and length of each connecting rod is 1200mm speed of engine is 240rpm, Find the reciprocation mass and their relative angular position for each of the inner crank. (12 Marks)

**Module-5**

- 9 a. Derive an expression for the height and speed or porter governor. (10 Marks)
- b. The arm at a porter governor are 300mm long. The upper arm are pivoted on axis of rotation. The lower arms are attached to a sleeve of distance of 40mm from the axis of rotation. The mass of the load on the sleeve is 70Kg and the mass of each ball is 10kg. Determine the equilibrium speed when the radius at rotation of the ball is 200mm. If the friction is equivalence to a load at 20N at the sleeve, what will be the range at speed for this position? (10 Marks)

**OR**

- 10 a. Explain the effect of gyroscopic couple on an aeroplane when propeller turn in counter clockwise direction when viewed from the rear end and aeroplane takes.  
i) Left turn ii) Right turn. (10 Marks)
- b. In a spring loaded Hartnell type governor the extreme radii of rotation at ball are 80mm and 120mm. The ball arm and sleeve arm of the bell crank lever are equal in length. The mass of each ball is 2Kg. If the speed at the two extreme position are 400 and 420rpm. Find :  
i) Load on the spring at the lower and highest equilibrium speech  
ii) Stiffness of the spring. (10 Marks)

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