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# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal-500043, Hyderabad

**B.Tech VII SEMESTER END EXAMINATIONS (REGULAR) - FEBRUARY 2022**

Regulation: R18

## MECHANISM AND MACHINE DESIGN

Time: 3 Hours

(AE)

Max Marks: 70

Answer FIVE Questions choosing ONE question from each module  
(NOTE: Provision is given to answer TWO questions from any ONE module)

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

### MODULE – I

- What is meant by degrees of freedom of a mechanism? List the applications of Kutzbach criterion to plane mechanisms. [7M]
  - A crank and slotted lever mechanism used in a shaper has a centre distance of 300 mm between the centre of oscillation of the slotted lever and the centre of rotation of the crank. The radius of the crank is 120 mm. Find the ratio of the time of cutting to the time of return stroke. [7M]
- Explain the following mechanism:
    - Steam engine
    - Beam engine
    - Whitworth quick return motion mechanism [7M]
  - A Whitworth quick return motion mechanism, has the following particulars: Length of stroke = 150mm; Driving crank length = 40 mm, time of cutting stroke = 2, time of return stroke. Relate the lengths of connecting rod and slotted lever. [7M]

### MODULE – II

- Explain instantaneous centre method for calculation of velocity of a point on a link. [7M]
  - In a pin jointed four bar mechanism, as shown in Figure 1, AB = 300 mm, BC = CD = 360 mm and AD = 600 mm. The angle BAD = 60°. The crank AB rotates uniformly at 100 r.p.m. Locate all the instantaneous centres and find the angular velocity of the link BC. [7M]

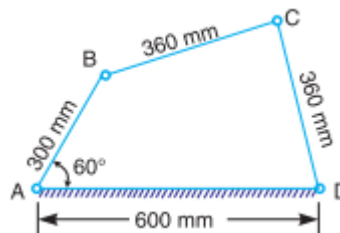


Figure 1

- Write about rubbing velocity at a pin joint. What will be the rubbing velocity at pin joint when the two links move in the same and opposite directions? [7M]

- (b) An engine mechanism, The crank  $CB = 100$  mm and the connecting rod  $BA = 300$  mm with centre of gravity  $G$ , 100 mm from  $B$ . For this position, the crankshaft has a speed of 75 rad/s and an angular acceleration of  $1200 \text{ rad/s}^2$ . Solve
- Velocity of  $G$  and angular velocity of  $AB$ .
  - Acceleration of  $G$  and angular acceleration of  $AB$ . [7M]

### MODULE – III

- Describe different types of cams and followers with suitable sketches. [7M]
  - A shaft rotating at 200 rpm. drives another shaft at 300 rpm and transmits 6 kW through a belt. The belt is 100 mm wide and 10 mm thick. The distance between the shafts is 4m. The smaller pulley is 0.5 m in diameter. Calculate the stress in the belt, if it is i) An open belt drive, and ii) Cross belt drive. Take  $\mu = 0.3$ . [7M]
- Enumerate the following terms as applied to cam with a neat sketch :-  
i) Base circle, ii) Pitch circle, iii) Pressure angle, and iv) Stroke of the follower. [7M]
  - A cam is to give the following motion to a knife edged follower: (a) Outstroke during  $60^\circ$  of cam rotation (b) Dwell for the next  $60^\circ$  of cam rotation (c) Return stroke during next  $60^\circ$  of cam rotation and (d) Dwell for the remaining of cam rotation The stroke of the follower is 80 mm and the minimum radius of the cam is 50 mm. The follower moves with uniform velocity during both the outstroke and return strokes. Develop the profile of the cam when i) The axis of the follower passes through the axis of the cam shaft, and ii) The axis of the follower is offset by 10 mm from the axis of the cam shaft. [7M]

### MODULE – IV

- Explain the terminology associated with gears, also draw a neat sketch. [7M]
  - A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with  $20^\circ$  pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact, arc of contact and the contact ratio. [7M]
- Explain briefly about compound gear train with neat sketch. [7M]
  - In an epi-cyclic gear train, an arm carries two gears  $A$  and  $B$  having 36 and 45 teeth respectively. If the arm rotates at 150 r.p.m. in the anticlockwise direction about the centre of the gear  $A$  which is fixed, determine the speed of gear  $B$ . If the gear  $A$  instead of being fixed, makes 300 r.p.m. in the clockwise direction, what will be the speed of gear  $B$ ? [7M]

### MODULE – V

- Discuss the effect of gyroscopic couple on a naval ship during steering. [7M]
  - The heavy turbine rotor of a sea vessel rotates at 1500 r.p.m. clockwise looking from the stern, its mass being 750 kg. The vessel pitches with an angular velocity of 1 rad/s. Determine the gyroscopic couple transmitted to the hull when bow is rising, if the radius of gyration for the rotor is 250 mm. Show in what direction the couple acts on the hull? [7M]
- Why balancing of rotating parts necessary for high speed engines? Explain the method of balancing of different masses rotating in different planes. [7M]
  - $A$ ,  $B$ ,  $C$  and  $D$  are four masses carried by a rotating shaft at radii 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of  $B$ ,  $C$  and  $D$  are 10 kg, 5 kg, and 4 kg respectively. Find the required mass  $A$  and the relative angular settings of the four masses so that the shaft shall be in complete balance. [7M]