

## Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025 Theory of Machine and Machine Design

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) Structure
- iii) Machine
- iv) Mechanism
- v) Degrees of freedom
- vi) Joints.

(06 Marks)

- b. Find the DoF for the following mechanism. Refer Fig.Q1(b).

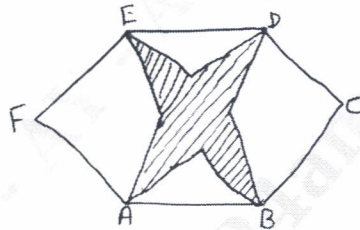


Fig.Q1(b)

(04 Marks)

- c. With a neat diagram, explain Whitworth mechanism and Geneva wheel mechanism.

(10 Marks)

OR

- 2 a. What is Inversion? Explain any one inversion of four bar mechanism with neat sketch and example.

(10 Marks)

- b. Explain the following with neat diagram :

- i) Ratchet and Paul mechanism
- ii) Peaucellier's mechanism.

(10 Marks)

### Module-2

- 3 a. Derive an equation for ratio of belt tension in belt drives.

(12 Marks)

- b. A prime mover running at 400 rpm drives a generator at 600 rpm through a belt drive. The diameter of driving pulley is 600 mm. Assuming a total slip of 3% determine the diameter of the generator pulley if belt thickness is 5 mm.

(08 Marks)

OR

- 4 a. Explain different types of Cams.

(10 Marks)

- b. A cam rotating clockwise at uniform speed of 300 rpm operates a reprobing follower through a roller 15 mm dia. The following motion is defined as below :

- i) Outward during  $150^\circ$  with UA RM
- ii) Dwell for next  $30^\circ$
- iii) Return during next  $120^\circ$  with 5 HM
- iv) Dwell for the remaining period.

Stroke of the follower is 30 mm. Minimum radius of the cam is 30 mm. Draw the cam profile when the follower axis passes through the cam axis.

(10 Marks)

**Module-3**

- 5 a. Define factor of safety and explain codes and standards. (08 Marks)  
 b. Explain factors to be considered while designing the machine element and define machine design. (12 Marks)

OR

- 6 a. Explain different phases of machine design with a neat diagram. (10 Marks)  
 b. State and explain following theories of failure :  
 i) Maximum normal stress theory  
 ii) Distortion energy theory  
 iii) Maximum shear stress theory. (10 Marks)

**Module-4**

- 7 a. Define stress concentration factor and explain methods of reducing stress concentration factor. (05 Marks)  
 b. Determine the maximum stress induced in a stepped shaft with a maximum dia of 50 mm and minimum dia of 25 mm, fillet radius is 5 mm, subjected to a tensile load of 12 kN. (05 Marks)  
 c. A bar of rectangular cross section is shown in below Fig.Q7(c) is subjected to an axial pull of 500 kN. Calculate its thickness if the allowable stress in the bar material is 200 MPa.

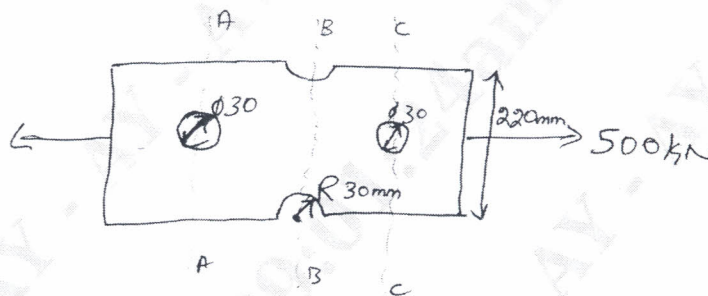


Fig.Q7(c)

(10 Marks)

OR

- 8 a. Define endurance limit. Explain the factors affecting endurance limit. (08 Marks)  
 b. Sketch and explain SN diagram. (06 Marks)  
 c. Explain Goodman and Soderberg relationship. (06 Marks)

**Module-5**

- 9 Design a pair of cast steel spur gear of  $14\frac{1}{2}^\circ$  involute profile to transmit 20 kW at 1400 rpm of the pinion. The number of teeth on pinion and gears are respectively 25 and 125. (20 Marks)

OR

- 10 A pair of helical gear to transmit 15 KW. The teeth are  $20^\circ$  stub form and have a helix angle of  $45^\circ$ . The pinion has pitch diameter of 80 mm and operates at 10,000 rpm. The gear has 320 mm pitch circle diameter. The gear one made of cast steel. Design the gear completely. (20 Marks)

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