

# CBCS SCHEME

USN

--	--	--	--	--	--	--	--	--	--

21MT51

## Fifth Semester B.E. Degree Examination, Dec.2023/Jan.2024 Theory of Machines and Machine Design

Time: 3 hrs.

Max. Marks: 100

- Note:** 1. Answer any FIVE full questions, choosing ONE full question from each module.  
2. Use of data hand book is permitted.

### Module-1

- 1 a. Define the following: (10 Marks)
- Kinematic link
  - Kinematic pair
  - Inversion
  - Mechanism
  - Machine.
- b. Explain with worth quick return mechanism with a help of neat sketch. (10 Marks)

OR

- 2 a. Explain working of Geneva wheel with a help of neat sketch. (10 Marks)
- b. Explain working of Ackerman steering mechanism with neat sketch, mention any two advantages of this steering mechanism. (10 Marks)

### Module-2

- 3 a. Derive an expression for ratio of belt tensions in flat belt drive. (10 Marks)
- b. A leather belt is required to transmit 9kW from a pulley 1.2m in diameter running at 200rpm, the angle embraced is  $165^\circ$  and the co-efficient of friction between leather belt and pulley is 0.3. The safe working stress for the leather belt is  $1.4\text{N/mm}^2$ , mass of leather is  $0.001\text{ gm/mm}^3$  and the thickness of the belt is 10mm. Determine the width of the belt taking centrifugal tension in to account. (10 Marks)

OR

- 4 a. Discuss briefly the various types of followers used for cam profile. (04 Marks)
- b. A cam with 3cm as minimum radius is rotating clock-wise at a uniform speed of 1200rpm and has to give the motion to the knife edge follower as defined below. (16 Marks)
- Follower to move outward through 3cm during  $120^\circ$  of cam rotation with SHM.
  - Dwell for the next  $60^\circ$ .
  - Follower to return to its starting position during the next  $90^\circ$  with VARM.
  - Dwell for the remaining period.
- Draw the cam profile. Follower axis passes through cam axis. Also find the maximum velocity and acceleration during out word and inward or return stroke.

### Module-3

- 5 a. Define machine design. Explain briefly design considerations. (10 Marks)
- b. Explain modes of failure with neat sketches. (10 Marks)



OR

- 6 a. Explain the following theories of failure:
- Maximum shear stress theory. (10 Marks)
  - Distortion energy theory. (10 Marks)
- b. A machine element is loaded so that  $\sigma_1 = 120\text{MPa}$ ,  $\sigma_2 = 0$  and  $\sigma_3 = -90\text{MPa}$ , the material has a yield strength in tension and compression of  $360\text{MPa}$ . Find the factor of safety for each of the following failure theories:
- Maximum normal stress theory. (10 Marks)
  - Maximum shear stress theory. (10 Marks)
  - Distortion energy theory. (10 Marks)

**Module-4**

- 7 a. Explain stress concentration, explain the methods of reducing stress concentration with the help of neat sketches. (10 Marks)
- b. Determine the safe load that can be carried by a bar of rectangular cross section as shown in Fig.Q.7(b). Limiting the maximum stress to  $130\text{MPa}$  taking stress concentration in to account. (10 Marks)

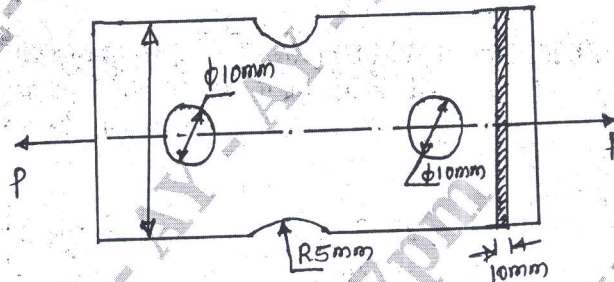


Fig.Q.7(b)

OR

- 8 a. Define endurance limit. Explain low fatigue and high fatigue cycles with the help of S-N curve. (10 Marks)
- b. A steel rod (SAE 9260 oil quenched,  $\sigma_{ut} = 1089.5\text{MPa}$ ,  $\sigma_{yt} = 689.4\text{MPa}$ ,  $\sigma_{-1} = 427.6\text{MPa}$ ) is subjected to a tensile load which varies from  $120\text{kN}$  to  $40\text{kN}$ . Design the safe diameter of the rod using "Soderberg diagram". Adopt factor of safety as 2, take stress concentration factor as unity and correction factor for load, size and surface as 0.75, 0.85 and 0.91 respectively. (10 Marks)

**Module-5**

- 9 Design a pair of spur gear to transmit a power of  $18\text{kW}$  from a shaft running at  $1000\text{rpm}$  to a parallel shaft to be run at  $250\text{rpm}$ . Maintaining a distance of  $160\text{mm}$  between the shaft centers, suggest suitable surface hardness for the gear pair. (20 Marks)

OR

- 10 Design a pair of helical gear to transmit power of  $15\text{kW}$  at  $3200\text{rpm}$  with a speed reduction of 4:1. Pinion is made of cast steel 0.4% C untreated. Gear made of high grade CI. Helix angle is limited to  $26^\circ$  and not less than 20 teeth are to be used on either gear. Suggest suitable surface hardness for the gear pair. (20 Marks)

\*\*\*\*\*