

**123****April 2023**

**Time – Three hours**  
**(Maximum Marks: 100)**

- [N.B.** 1. Answer all questions under Part-A. Each question carries 3 marks.  
2. Answer all the questions either (A) or (B) in Part-B. Each question carries 14 marks.  
3. PSG Design Data Book is permitted.]

**PART – A**

1. What is preferred number?
2. Define stress concentration.
3. Compare transmission shaft and machine shaft.
4. List types of keys.
5. What are the points to be noted for better transmission of power by belt drive?
6. What is known as ply in flat belts?
7. List out the types of gears.
8. List the materials used for bearing.
9. What is product cycle?
10. List the entities of solid modeling.

**PART – B**

11. (a) (i) What is Free cutting steel? How is it designated? (4)  
(ii) Calculate the force required to punch a circular blank 60 mm. diameter in plate 5 mm thick. The ultimate shear stress of the plate is  $350 \text{ N/mm}^2$  (10)

(Or)

- (b) Design a knuckle joint to transmit 150 kN. The design stress may be taken as 75 MPa in tension, 60 MPa in shear and 150 MPa in compression.

[Turn over.....

12. (a) A mild steel shaft transmits 20 kW at 200 rpm. It carries a central load of 1000 N and is simply supported between the bearings 20 m. apart. Determine the size of the shaft, if the allowable shear is 42 MPa and the maximum tensile or compressive stress is not to exceed 56 MPa. What size of the shaft will be rewired, if it is subjected to gradually applied loads?

(Or)

- (b) A rectangular sunk key 40 mm length is required to transmit 10 kW at 900 rpm. Determine the size of the key, if permissible shear stress and crushing stress are limited to 65 N/mm<sup>2</sup> and 110 N/mm<sup>2</sup> respectively. Assume that the shaft and key are made of same material.

13. (a) Select a flat belt from manufacturers catalogue to transmit power of 15 kW at 1200 rpm. The speed of the driven pulley is 450 rpm. Maximum centre distance between the shaft is 2m. Assume steady load.

(Or)

- (b) A belt drive consist of two V- belts in parallel on grooved pulley of the same size. The angle of groove is 30°. The cross-sectional area of each belt is 750 mm<sup>2</sup> and co-efficient of friction is 0.12. The density of belt material is 1.2 mg/m<sup>3</sup> and the maximum stress in the material is 7 MN/m<sup>2</sup>. Calculate the power that can be transmitted between pulley of 300 mm diameter rotating at 1500 rpm. Find also the shaft speed in rpm at which the power transmitted would be maximum.

14. (a) (i) What is bearing characteristic number or bearing modulus? (4)  
(ii) In a bearing the load on the journal is 40000 N, Diameter 150 mm, Speed 900 rpm, Ambient temperature 15.5°C, Temperature of oil film for SAE 10 oil is 50°C, L/D ratio = 1.6, Bearing pressure is  $111.1 \times 10^4$  N/ mm<sup>2</sup>, C/D=0.0013. Absolute viscosity of SAE 10 oil is 0.17 N/ms. Determine (1) co-efficient of friction (2) Heat generated.(10)

(Or)

- (b) A journal bearing is proposed for a centrifugal pump. The diameter of the journal is 75 mm and the load on it is 11.5 kN and its speed is 1440 rpm. Design and give the complete calculations for the bearing.

15. (a) (i) What are the advantages of finite element analysis?(4)  
(ii) Explain sequential engineering with sketches.(10)

(Or)

- (b) Explain 2-D transformation and 3-D transformation with sketches.

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