

**DIPLOMA EXAMINATION IN ENGINEERING/TECHNOLOGY/MANAGEMENT/  
COMMERCIAL PRACTICE, NOVEMBER - 2024**

**DESIGN OF MACHINE ELEMENTS**

[Maximum marks: 100]

[Time: 3 Hours]

**PART – A**  
**Maximum marks: 10**

**I.** (Answer *all* the questions in one or two sentences. Each question carries **2** marks)

1. Define the term Factor of safety.
2. What is meant by torsional rigidity of a shaft?
3. Write the expression for bearing characteristic number.
4. What is maximum fluctuation of speed in governors?
5. List the types of belts.

**(5 x 2 = 10)**

**PART – B**  
**Maximum marks: 30**

**II.** (Answer any *five* of the following questions. Each question carries **6** marks)

1. Explain (a) Major diameter (b) Pitch (c) depth related to threads
2. Explain any two types of keys with sketches.
3. Explain the types of shaft couplings.
4. What are the advantages of rolling contact bearings?
5. Explain any three types of cam followers with sketches.
6. List the advantages of gear drives.
7. Explain compound gear train with a neat sketch.

**(5 x 6 = 30)**

**PART – C**  
**Maximum marks: 60**

(Answer *one full* question from each unit. Each full question carries **15** marks)

**UNIT – I**

- III.** (a) A steam engine cylinder has an effective diameter 250mm. It is subjected to a maximum steam pressure of 1.5 Mpa. The cylinder cover is fixed to the cylinder flange by means of 12 studs. The permissible tensile stress in the studs is limited to 30 Mpa. Determine the size of the studs.

**(7)**

- (b) A screw press is used to compress bales of cotton. The screw is of double square thread with a pitch of 6mm and mean radius of 30mm. Determine the torque required to produce a force of 500 N if the coefficient of friction for the contact surfaces of the thread is 0.3. (8)

**OR**

- IV. (a) Explain the types of stresses induced in a bolt due to external load. (7)
- (b) A Shaft of 50mm diameter is transmitting 150 KW at 2000 rpm. A square key having 12 mm side and 75 mm long is used for the shaft. Determine the induced shear stress and compression stress in the key. (8)

**UNIT – II**

- V. (a) Explain the procedure to design a solid shaft used for power transmission considering torsion only. (7)
- (b) Design a muff coupling which is used to connect two steel shafts transmitting 40Kw at 350 rpm. Design the shaft and muff from the strength point of view and other dimensions by empirical formulae. Shear stresses for muff and shaft are respectively  $15 \text{ N/mm}^2$  and  $30 \text{ N/mm}^2$ . Assume maximum torque to be 25% more than the average torque. (8)

**OR**

- VI. (a) Sketch an unprotected type flange coupling and write the usual proportions. (7)
- (b) A solid circular shaft is used to transmit a torque of 9.6 Nm. The Angle of twist over a length of 2m is  $2^\circ$ . Estimate the required diameter of the shaft and the shear stress induced in the material. Take  $G = 0.8 \times 10^5 \text{ N/mm}^2$ . (8)

**UNIT - III**

- VII. (a) A journal bearing of diameter 50mm and length 100 mm is subjected to a bearing load of 7KN. The speed of the journal is 900rpm and coefficient of friction is 0.004. The temperature of lubricating oil is  $75^\circ\text{C}$  and the room temperature is  $35^\circ\text{C}$ . Find the amount of the artificial cooling required. Assume coefficient of heat dissipated as  $0.00167 \text{ kJ/min/cm}^2/^\circ\text{C}$  (7)
- (b) Draw the profile of a cam operating a knife edged follower from following data:
1. Outstroke during  $60^\circ$  of cam rotation.
  2. Dwell for next  $30^\circ$  of cam rotation.
  3. Return stroke during next  $60^\circ$  of cam rotation.
  4. Dwell for the remaining  $210^\circ$  of cam rotation.

The axis of the follower passes through the axis of the cam shaft. The stroke of the follower is 40mm and the minimum radius of the cam is 50mm. The follower moves with uniform velocity during both outstroke and return strokes. (8)

**OR**

**VIII.** (a) Explain the following terms related to governors

(a) height (b) Equilibrium speed (c) sensitiveness (d) stability (7)

(b) A Horizontal steam engine develops 294kW at 90rpm. The coefficient of fluctuation of energy found from the turning moment diagram is to be 0.1 and speed is to be kept within  $\pm 0.5\%$  of mean speed. Find the mass of fly wheel required, if the radius of gyration is 2 metres. (8)

#### **UNIT – IV**

**IX.** (a) With a neat sketch explain a compound belt drive and its velocity ratio. (7)

(b) The axes of two parallel shafts are approximately 0.6m apart. The motion is transmitted from one shaft to the other by spur gears, whose module be 8mm. One shaft is to rotate 3 times fast as the other. Find the number of teeth on gears and the exact distance between the centres of the gears. (8)

**OR**

**X.** (a) The power is transmitted from a pulley 1.2m diameter running at 250 rpm to a pulley 2.75m diameter by means of belt. Find the speed of the driven shaft considering the creep. Assume the stresses on tight side and slack side of the belt are  $1 \text{ N/mm}^2$  and  $0.5 \text{ N/mm}^2$  respectively. Assume modulus of elasticity for belt material as  $100 \text{ N/mm}^2$ . Also find the percentage loss in speed of the driven pulley due to creep. (7)

(b) With a neat sketch explain a reverted gear train and its speed ratio. (8)

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