TED (10)–4022 Reg. No. .....

(REVISION—2010) Signature .....

FIFTH SEMESTER DIPLOMA EXAMINATION IN MECHANICAL ENGINEERING—OCTOBER, 2013

DESIGN OF MACHINE ELEMENTS

[*Time* : 3 hours

(Maximum marks : 100)

Marks

PART—A
(Maximum marks : 10)

I Answer the following questions in one or two sentences. Each question carries 2 marks.

1. Define factor of safety for ductile material.
2. State the difference between Pitch and Lead of a thread.
3. Write the equation to determine the diameter of a shaft subjected to pure torsional load.
4. State the functions of idle gear.
5. What is the function of a governor ? (5×2=10)

PART—B
(Maximum marks : 30)

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

1. Explain simple gear train and compound gear train.
2. Define the following terms related to Cam :

   (i) Cam profile (ii) Trace point (iii) Pressure angle.
3. List any six advantages of gear drive.
4. Define the following terms related to governor :

   (i) Height of governor (ii) Equilibrium speed (iii) Sensitiveness.
5. State the design procedure of a Muff coupling to connect 2 shafts of diameter "d" to transmit power "p".
6. Distinguish between Rectangular key, Square key and Flat saddle key. Write the relationship between diameter "d" of the shaft and width and thickness of above keys.
7. Explain the following stresses induced in a bolt due to external load and write the relation to determine the diameter of bolt :

   (i) tensile stress (ii) Shear stress. (5×6=30)

Marks

PART—C
(Maximum marks : 60)

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

UNIT—I

III (a) A cylinder subjected to a maximum steam pressure of 1.2 MPa has an effective diameter of 320mm. The cylinder cover is fixed with 12 studs. Determine the size of the stud, if the tensile stress in the stud is limited to 24 MPa. 5

(b) Design a sunk key to transmit power from a shaft of 60mm diameter assuming same material for shaft and key. The allowable shear stress and crushing stress of the key material are limited to 30 MPa and 60 MPa respectively. 5

(c) Explain overhauling and self locking of screw jack. 5

OR

IV (a) Determine the torque required to raise a load of 20kN using a square threaded screw jack with 10mm pitch. The mean diameter of the screw is 40mm. Assume coefficient of friction between the screw and nut as 0.13 and the load to rotate with the screw. Also determine the efficiency of the jack. 5

(b) Two shafts of 60mm diameter each are connected by a Flange coupling with 4 bolts at a radius of 120mm. Compute the size of the bolts if the allowable shear stress for bolt is 40 MPa. Assume same material for shaft and bolt. 5

(c) A shaft of 40mm diameter is transmitting 12kW at 240 rpm using a square key of 10mm size and 60mm long. Determine the induced stresses in the key. 5

UNIT—II

V (a) Design a cast iron flange coupling to transmit 12kW at 300rpm. The maximum torque is 20% more than the full load torque. The permissible stresses are as follows :

Shear stress for shaft, bolt and key material – 40 MPa.

Crushing stress for bolt and key material – 80 MPa.

Shear stress for cast iron – 8 MPa. 10

(b) Determine the diameter of a shaft to transmit 80kW at 240 rpm, if maximum shear stress of shaft material is 60 MPa and permissible twist is 1 degree per meter length of the shaft. Assume Modulus of rigidity of the shaft material as 80 GPa. 5

OR

VI (a) Determine the diameter of a shaft to transmit 250 kW at 200 rpm if the shear stress is not to exceed 50 MPa. If a hollow shaft of the same material, length and maximum shear stress replaces the shaft, determine the diameters of the hollow shaft so that its external diameter is twice the internal diameter. 9

(b) Design a muff coupling to transmit 30 kW at 120rpm. The permissible stresses are as follows: Shear stress for shaft and key material –40MPa; Crushing stress for key material–60MPa; shear stress for Muff material–12MPa. 6

Marks

UNIT—III

VII (a) A journal bearing of 240mm diameter is subjected to a load of 40 kN. Determine the heat generated, if the shaft rotates at 120rpm and coefficient of friction is 0.13. 3

(b) Draw the profile of a cam to give reciprocating motion to a knife edge follower using the following data: Lift of follower–40mm during 90 degrees of cam rotation with simple Harmonic Motion; Dwell for the next 60 degrees of cam rotation; During the next 30 degrees of cam rotation the follower returns to its initial position with simple Harmonic Motion; Follower remains rest for the remaining part of cam rotation; Minimum radius of cam is 50mm and the line of stroke of the follower passes through the axis of cam shaft. 9

(c) Explain turning moment diagram of flywheel of a single cylinder 4 stroke IC engine. 3

OR

VIII (a) Draw the profile of a cam to give reciprocating motion to a roller follower using the following data: diameter of roller–20mm; stroke of follower–25mm; least radius of cam—50mm; the line of stroke of the follower is offset by 15mm; follower rises to maximum position during 90 degree of cam rotation with simple Harmonic Motion; follower remains rest for the next 30 degrees of cam rotation; follower returns to its initial position during the next 90 degree of cam rotation with uniform retardation; follower remains rest for the remaining part of cam rotation. 12

(b) A flat foot step bearing 150mm diameter supports a load of 24 kN. If the coefficient of friction is 0.04 and speed of shaft is 100rpm, determine the power lost in overcoming friction. 3

UNIT—IV

IX (a) A shaft running at 450rpm drives another shaft at 750rpm with the help of belt drive. The diameter of driver pulley is 600mm. Assuming slip of 2% on each pulley and 6mm belt thickness , determine the diameter of the driven pulley. 5

(b) The central distance between two pulleys of diameters 320mm and 540mm is 5m. Calculate the length of belt required to rotate the pulleys in same direction and in opposite direction. 5

(c) Six gears A,B,C,D,E and F having 20, 30, 40, 50, 60 and 70 teeth respectively are arranged as follows. Gear A is fitted to driver shaft and is in mesh with gear B. Gears B and C are fitted on the same shaft and gear C is meshed with gear D. Gears D and E are on the same shaft and gear E is meshed with gear F fitted to the driven shaft. If gear A rotates at 300rpm in clockwise direction, determine the speed of the driven shaft. 5

OR

X (a) The axes of two parallel shafts are approximately 800mm apart and are connected by spur gears having circular pitch 25mm. If one shaft is to rotate 3 times the speed of the other, determine the number of teeth on the gears and the exact centre distance between the shafts. 5

Marks

(b) Compare flat belt and V belt drives. 5

(c) Two pulleys of diameters 450mm and 200mm are driven in opposite direction by belt. If the maximum permissible tension in the belt is 1.2 kN and coefficient of friction between belt and pulley is 0.5, determine the power transmitted by the belt when the larger pulley rotates at 180rpm and the distance between the centres of the pulleys is 2m. 5