of the shaft is 45 mm. The motor pull out torsional moment is 3.4 times the average full load torsional moment of the motor. Assuming failure shear stress = 55 N/mm^2, failure crushing stress = 110 N/mm^2, and factor of safety is 2.4. Find the size of key. Check the shear strength of the key against the normal shear strength of the shaft. **8**

(b) Explain the design procedure for motor and pulley shafts. **7**

Section C

5. A pressure vessel of the boiler consists of cylindrical shell of 0.8 m inner diameter. It is subjected to internal steam pressure of 2 MPa. Triple-riveted double-strap longitudinal butt joint is used to make the shell. The straps are of unequal width. The pitch of the rivets in outer row is twice of the pitch of rivets in middle and inner rows. A zig-zag pattern is used for arrangement of rivets. The efficiency of the joint should be at least 80%. The corrosion allowance is 2 mm. The permissible stresses for rivets and shell in tension, shear and compression are 80, 60 and

Roll No. ..... **Total Pages : 07**

J-21-0022

B. Tech. EXAMINATION, 2021

Semester V (CBCS)

MACHINE DESIGN—I (ME, AE)

ME-504

Time : 2 Hours *Maximum Marks : 60*

The candidates shall limit their answers precisely within 20 pages only (A4 size sheets/assignment sheets), no extra sheet allowed. The candidates should write only on one side of the page and the back side of the page should remain blank. Only blue ball pen is admissible.

Note : Attempt *Four* questions in all, selecting *one* question from any of the Sections A, B, C and D. Q. No. **9** is compulsory. Design Data Book compiled by PSG College of Engineering and Technology, Coimbatore is permitted.

Section A

1. (a) Explain the stages of machine element design with suitable example. **8**

(b) Explain how the factor of safety is determined under steady and varying loading by different methods. **7**

2. Explain the design criteria for fluctuating loading and also drive expression for these theories. **15**

Section B

3. A solid steel shaft is supported on two bearings 1800 mm apart and rotates at 250 rpm. A 20° involute gear D, 300 mm in diameter, is keyed to the shaft at a distance of 150 mm to the left of the right hand bearing. Two pulleys B and C are located on the shaft at distances of 450 mm and 1200 mm, respectively, to the right of the left hand bearing as shown in Fig. 1. The diameters of the pulleys B and C are 600 mm and 750 mm, respectively. 29.5 kW (40 H.P.) is supplied to the gear, out of which 18.5 kW (25 HP) is taken off at the pulley B and 11 kW (15 H.P.) is delivered from pulley C. The drive from C is vertically downwards while drive from B is downward at an angle of 60° to the horizontal. In both cases, the ratio of the belt tensions is 2 and

angle of wrap is 180°. The gear receives power from a direction such that the components of the normal tooth load act opposite to the components of forces due to belt pull at B. The shaft is made of plain carbon steel 45C8 (Ultimate tensile strength and yield stress = 540 N/mm^2 and 320 N/mm^2). The combined shock and fatigue factors for torsion and bending may be taken as 1.5 & 2 respectively. Design the shaft. Also, determine the shaft diameter on the basis of torsional rigidity, if the permissible angle of twist between two pulleys is 0.5° and modulus of rigidity is 79300 N/mm^2. (Assume : $F_r = F_t \tan(20°)$). **15**

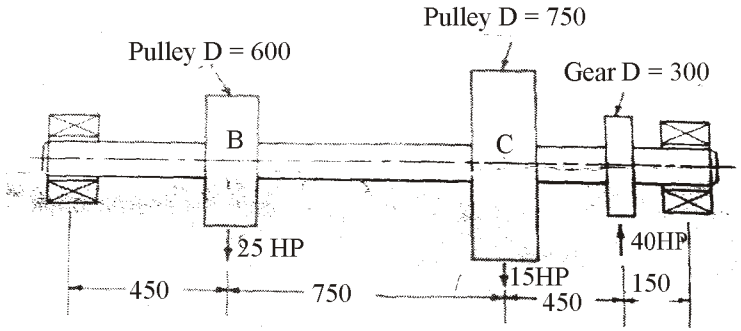

Figure 1

4. (a) A 18.7 kW, 1400 rpm motor has a steel shaft; the extension of the shaft is 75 mm. Diameter

120 N/mm^2 respectively. Calculate : (i) thickness of the shell; (ii) diameter of the rivets, (iii) pitch of the rivets in outer row; (iv) distance between outer and middle rows; (v) distance between middle and inner rows; (vi) thickness of inner strap; (vii) thickness of outer strap; (viii) efficiency of the joint. **15**

6. (a) Derive the relation for the strength of a transverse fillet welded joint. **7.5**

(b) A steel plate 75 mm wide and 10 mm thick is connected with another steel plate by means of single transverse and double parallel fillet welds. The strength of welded joint is equal to the strength of the plates. The permissible level of tensile stress and shear stress is 70 MPa and 50 MPa respectively. What is the length of parallel fillet weld ? **7.5**

Section D

7. It is required to design a cotter joint to connect two steel rods of equal diameter. Each rod is subjected to an axial tensile force of 50 kN. Design the joint and specify its main dimensions. **15**

8. (a) A seamless pipe carries 2500 m^3 of steam per hour at a pressure of 1.4 MPa. The velocity of flow is 32 m/s. Assuming the tensile stress as 40 N/mm^2, find the inside diameter of pipe and its wall thickness. **5**

(b) Describe with sketches, the various types of pipe joints commonly used in engineerig practice. **10**

(Compulsory Question)

9. (a) What are the important considerations that govern the choice of a material ?

(b) State the difference between cotter and knuckle joints.

(c) How is grey cast iron designated as per Indian standards ? Give *one* example.

(d) "When a thick leather belt is bent, cracks appear on the outer surface, while folds on the inside." Why ?

(e) How will you account for stress concentration in design of machine parts ?

(f) Why are riveted joints replaced by welded joints ?

(g) What are the four basic elements of weld symbol ?

(h) What are the types of stresses produced in pipes ?

(i) What is the role of gib in cotter joint ?

(j) What are splines ? Where do you use them ?

1.5×10=15