Faculty of Engineering & Technology

Fifth Semester B.E. (Mechanical Engg.)/Power Engg. (C.B.S.) Examination

DESIGN OF MACHINE ELEMENTS

Time—Three Hours] [Maximum Marks—80

INSTRUCTIONS TO CANDIDATES

(1) All questions carry marks as indicated.

(2) Solve **FOUR** questions as follows :

- Question No. **1 OR** Question No. **2**.
- Question No. **3 OR** Question No. **4**.
- Question No. **5 OR** Question No. **6**.
- Question No. **7 OR** Question No. **8**.

(3) Illustrate your answers wherever necessary with the help of neat sketches.

(4) Use of Non-programmable calculator is permitted.

(5) Use of Design Data Book is permitted.

(6) Assume suitable data wherever necessary.

1. (a) Explain with suitable examples the term the design by evolutions and design by innovations. 6

(b) Discuss the BIS method of designation of steel. 6

8. A screw jack is to lift a load of 80 kN through a height of 400 mm. The elastic strength of screw material in tension and compression is 200 MPa and in shear 120 MPa. The material for nut is phosphor bronze for which the elastic limit may be taken as 100 MPa in tension; 90 MPa in compression and 80 MPa in shear. The bearing pressure between the nut and screw is not to exceed 18 N/mm^2. Design the screw jack. The design should include the design of screw; nut; handle; cup and the body. 20

(c) What are the modes of failure of a component ? 8

OR

2. (a) Design riveted joint for one longitudinal and circumferential seam of a boiler having 1.25 meter diameter to withstand maximum pressure of 2.5 N/mm^2. 12

(b) Design a knuckle joint to connect two mild steel rods which transmit a tensile force of 25 kN. The safe working stresses for tension, shear and crushing are 100 N/mm^2; 60 N/mm^2 and 160 N/mm^2 respectively. 8

3. (a) A solid circular bar of 100 mm diameter is welded to structural member as shown in Fig. 3(a) by a fillet weld all around the bar. Determine the leg dimension of the fillet weld; if P = 16 kN and permissible shear stress in weld is 90 N/mm^2. 10

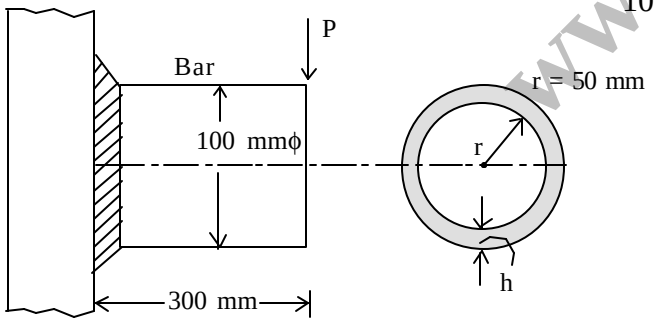

Fig. 3(a)

(b) A rocker arm lever, as shown in Fig. 3(b) is used for opening a valve of an I.C. engine. The lever is supported in the bracket and the maximum load acting on the valve arm end is 3 kN. Design the lever if the allowable tensile strength is 80 N/mm^2 and allowable shear strength is 45 N/mm^2. 10

Fig. 3(b)

OR

4. (a) Give classification of pressure vessels as per at least three criteria. 4

(b) A pressure vessel of cast iron grade 30 is having an inside diameter of 240 mm and is subjected to the internal pressure of 3.6 N/mm^2. By choosing the suitable material for bolts and gasket, determine :

(i) Wall thickness of vessel

(ii) Size and numbers of bolts required

(iii) Type of gasket for leak proof joints

(iv) Top cover plate assuming it to be flat and circular

(v) Integral bottom cover plate with dished shape. 16

5. (a) A direct reading spring balance consists of a helical tension spring, which is attached to a rigid support at one end and carries weights at the other free end. The pointer attached to the free end moves on a scale and indicates the weight. The length of scale is 75 mm. The maximum capacity of the balance is to measure the height of 500 N. The spring index is 6. The spring is made of SAE = 1095 carbon steel. Design the spring and calculate :

(i) wire diameter

(ii) mean coil diameter

(iii) number of active wire coils

(iv) required spring rate

(v) actual spring rate. 10

(b) A semi-elliptic spring used for automobile suspension, consists of two extra full length leaves and eight graduated-length leaves, including the master leaf. The centre-to-centre distance between two eyes is 1 meter. The leaves are made of SAE-9250-Si-Mn-Steel and the factor of safety is 2. The maximum spring load is 30 kN. The leaves are pre-stressed so as to equalize stresses in all leaves under maximum load. Determine the dimensions of the cross-section of the leaves and the deflection at the end of the spring. 10

OR

6. A shaft transmitting 25 kW at 125 rpm from gear G-1 to gear G-2 is mounted on two bearings B_1 and B_2 as shown in Fig. 6. The gear G_1 rotates in anticlockwise direction when viewed from right hand

side and it receives the power from top. The pitch circle diameter of gear G_1 and G_2 are 300 mm and 750 mm respectively. The shaft is made of SAE 1045 carbon steel. Design the shaft using strength criterion assuming factor of safety 2.5. 20

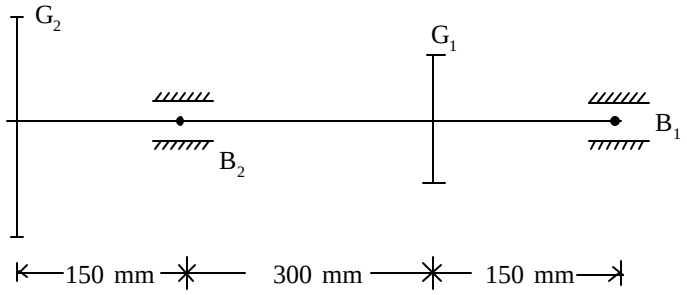

Fig. 6

7. (a) An automotive single plate clutch consists of two pairs of contacting surfaces. The outer diameter of the friction disc is 270 mm. The coefficient of friction is 0.3 and the maximum intensity of pressure is 0.3 N/mm^2. The clutch is transmitting a torque of 531 N-m. Assuming uniform wear theory calculate :

(i) The inner diameter of friction discs and

(ii) Spring force required to keep the clutch engaged. 10

(b) A single block brake with a torque capacity of 15 N-m is shown in Fig. 7(b). The coefficient of friction is 0.3 and the maximum pressure on the brake lining is 1 N/mm^2. The width of block is equal to its length. Calculate :

(i) The actuating force

(ii) The dimensions of block

(iii) The resulting hinge-pin reactions and

(iv) The rate of heat generated if brake drum rotates at 50 rpm. 10

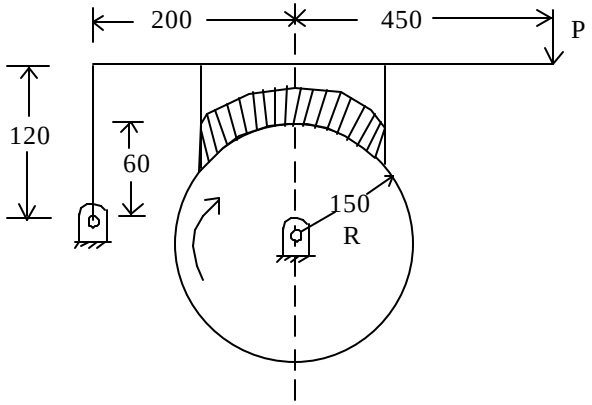

Fig. 7(b)

OR