U.S.N | | | | | | | | | | |

P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fifth Semester, B.E. - Industrial and Production Engineering

Semester End Examination; Dec - 2017 / Jan - 2018

Design of Machine Elements

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each **unit**.*

UNIT - I

1 a. Explain the following theories of failure :
i) Maximum Principal stress Theory ii) Maximum Shear stress Theory
iii) Distortion energy Theory. 9

b. Find the diameter of a rod subject to a bending moment of 3 kNm and a twisting moment of 1.8 kNm according to the following theories of failure, taking σ_{yp} = 420 MPa and F.O.S as 3; 11
i) Normal Stress Theory ii) Shear Stress Theory.

2 a. A Grooved shaft of diameter D has a semicircular groove of radius 0.1D. It is required to transmit 60 kW at 300 rpm. Determine the suitable diameter of shaft taking allowable shear stress at 75 MPa. 10

b. Determine the safe load that can be carried by bar of rectangular cross section in Fig. Q. 2(b). Limiting the Max. Stress to 130 MPa taking stress concentration in to account. 10

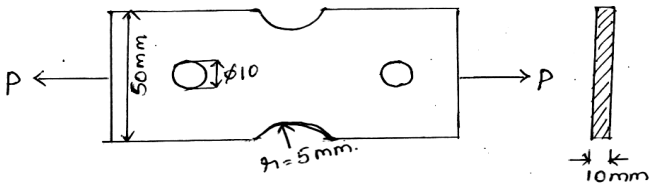

Fig. Q 2(b).

UNIT - II

3 a. Derive the Goodman relationship. 10

b. A flat bar as shown in Fig. Q 3(b) is machined from cold drawn steel. The axial load shown is completely reversed. Determine the F.O.S they may be expected, if the thickness of the flat bar is 6 mm. Take σ_{yp} = 310 MPa, σ_{en} = 289 MPa, A = 1 and B = 0.85. 10

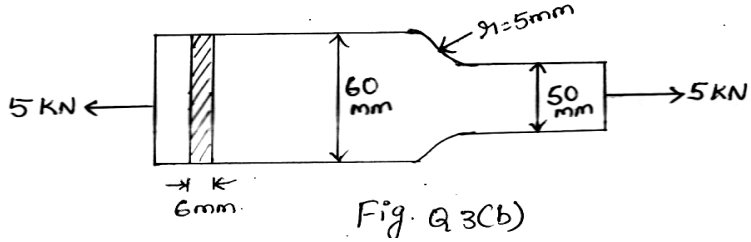

Fig. Q 3(b)

4 a. Define Endurance strength. Explain low and high fatigue cycle with sketch. 8

b. Determine the maximum load for the simply supported beam. Load acting at center W to 3 W with diameter 50 mm. Take σ_u = 690 MPa, σ_{yp} = 520 MPa, F.O.S = 1.3, A =1, B = 0.85 and C = 0.9 length of the beam is 400 mm. 12

Contd…2

UNIT - III

5. A solid steel shaft running at 600 rpm is supported on bearings 600 mm apart. The shaft receives 40 kW through a 400 mm diameter pulley weighing 400 N located 300 mm to the right of left bearings by a vertical flat belt drive. The power is transmitted from the shaft through another pulley of diameter 600 mm weighing 600 N located 200 mm to the right of right bearing. The belt drives are at right angles to each other and ratio of belt tensions is 3. Determine the size of shaft necessary, if the allowable shear stress in the shaft material is 40 MPa and the load are steady. Assume C_m = 1.5 and C_t = 1.0. 20

6 a. A rectangular parallel key to transmit 9 kW at 300 rpm. The yield stress for the steel used is 310 MPa. Take F.O.S as 2.5. Determine the required length of key. 10

b. Design a flange coupling to connect the shafts of a motor and a centrifugal pump for the following specification; Pump output = 3000 liter / min, Total head = 20 m, speed = 600 rpm. Pump efficiency = 70%. Take C40 steel shaft, C30 for bolts and key F.O.S = 2. Allowable shear stress for CI flange is 15 MPa. 10

UNIT - IV

7 a. Sketch and Explain different modes of failure in riveted joint. 8

b. Design a double riveted butt joint with two cover plates for the longitudinal seam of a boiler shell 1.5 m in diameter subjected to a steam pressure of 0.95 MPa. Assume on Efficiency 75% take σ_t = 90 N/mm^2, σ_c = 140 N/mm^2, τ = 56 N/mm^2. 12

8 a. Derive an Expression for strength of transverse fillet welded joint. 8

b. A welded connection of steel plates on shown in Fig. Q 8(b) is subjected to a load of 10 kN. Determine the dimension of weld, If the stress is limited to 95 MPa

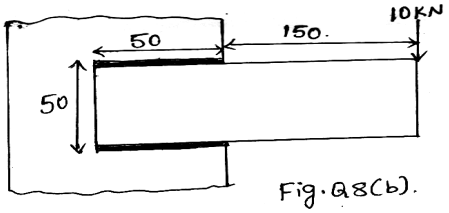

Fig. Q8(b).

12

UNIT - V

9. Design a pair of steel spur gears required to transmit 12 kW at 2000 rpm of pinion. The velocity ratio received is 2.5:1 the allowable static stress for both may be taken as 138 MPa. Take 24 teeth are to be used on either gear. The teeth are 20° stub in-volute. Assume C_s = 1.5. Check the gear for wear. 20

10 a. Design a helical compression spring to support an axial load of 3000 N. The deflection under load is limited to 60 mm. The spring index is 6. The spring is made of Chorme-Vanadium steel .F.O.S is 2. 10

b. Design a helical spring to support a tensile load of 6 kN and to have stiffeners of 100 N/mm. The spring index is 6. The spring is made of steel having allowable stress of 300 MPa. Take G = 80 GPa. 10

* * *