CBCS SCHEME

USN | | | | | | | | | | |

15ME54

Fifth Semester B.E. Degree Examination, July/August 2022
Design of Machine Elements – I

Time: 3 hrs. Max. Marks: 80

Note: *1. Answer any FIVE full questions, choosing ONE full question from each module.*
2. Use Data hand book is permitted

Module-1

1 a. Explain the general procedure in machine design. **(06 Marks)**

b. A 40mm diameter steel rod supports 8.0kN load and in addition is subjected to a torsional load of 90Nm as shown in Fig.Q1(b). Determine the maximum tensile and maximum shear stress.

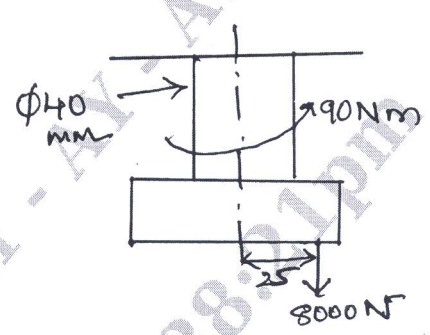

Fig.Q1(b) **(10 Marks)**

OR

2 a. Discuss the statement, in static loading stress concentration in ductile materials is not so serious as in brittle materials. **(04 Marks)**

b. A rectangular plate 15mm thick made of a ductile material is shown in Fig.Q2(b). Calculate the stresses at each of the three holes considering stress concentrations factor.

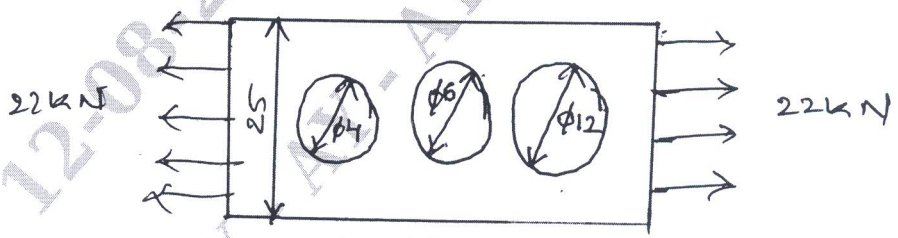

Fig.Q2(b) **(12 Marks)**

Module-2

3 a. Derive an expression for stress induced in the rod due to axial impact of a weight 'w' dropped from a height 'h' on a collar attached at the free end of the rod. **(10 Marks)**

b. An unknown weight falls through 15mm on to a collar rigidly attached to the lower end of a vertical bar 1.5m long and 500sq mm section. If the maximum instantaneous extension is 2mm, what is the corresponding stress and the value of unknown weight? Take E = 200GPa. **(06 Marks)**

OR

4 a. Derive the Soderberg equation for fluctuating loads. **(06 Marks)**

b. A hot rolled steel shaft is subjected to a torsional moment that varies from 250Nm clock wise to 100 Nm counter clockwise and the Bending moment at the critical section varies from 350Nm to 170Nm neglecting stress concentration effect. Determine the required diameter. The material has an ultimate strength of 550MPa and a yield strength of 410MPa. Take the endurance limit as half of ultimate strength and a factor of safety as 2. Assume surface size and load factor for bending as 1.111, 1.1765, 1 and that of torsion as 1.05263, 1.1765 and 1.7 respectively. **(10 Marks)**

Module-3

5 A hoisting drum of 500mm diameter is keyed on to a shaft and is intended for lifting load of 20kN at a velocity of 31.4m/min. The shaft is supported on two bearings and carries a gear of 40mm diameter, overhanging the nearest bearing by 200 mm [i.e 200mm to the right of right hand bearing]. The gear ratio is 12 : 1. Determine the power and revolution per minute of the motor required assuming drive efficiency of 90%. Determine the diameter of the shaft for the hosting drum, assuming that the material of the shaft has an allowable shear stress of 60MPa. The distance between the bearings is 1000mm. Pressure angle = 20°. For suddenly applied load with minor shock the fatigue factor to be applied to the computed bending moment and the numerical combined shock and fatigue factor to be applied to the torsional moment $C_m = K_b = 2$ and $C_t = K_t = 1.3$. Sketch the relevant bending moment diagram. **(16 Marks)**

OR

6 Design a flange coupling (unprotected type) to connect the shafts of a motor and centrifugal pump for the following specifications :
Pump output = 3000 liters per minute, total head = 20m pump speed = 600rpm, pump efficiency = 70%, select C40 steel (σ_y = 328.6MPa) for shaft and key and C35 steel (σ_y = 304MPa) for bolts with factor of safety 2. Use allowable shear stress in flange equal to 15N/mm^2. **(16 Marks)**

Module-4

7 a. Write a note on failure of riveted joints. **(04 Marks)**

b. Design a double riveted butt joint with two cover plates for longitudinal seam of boiler shell of 1.5m diameter subjected to steam pressure of 0.95N/mm^2. Assume efficiency of riveted joint = 75%. Allowable tensile stress is 90MPa, crushing stress = 140N/mm^2 and shear stress = 56MPa. **(12 Marks)**

OR

8 a. What are the advantages of welded joints over riveted joints? **(05 Marks)**

b. A 125 × 95 × 10mm angle shown in Fig.Q8(b) is jointed to a flame by the two parallel welds along the edges of 125mm length. The angle is subjected to a load of 180kN. Find the length of the weld if the permissible load per mm weld length is 430N.

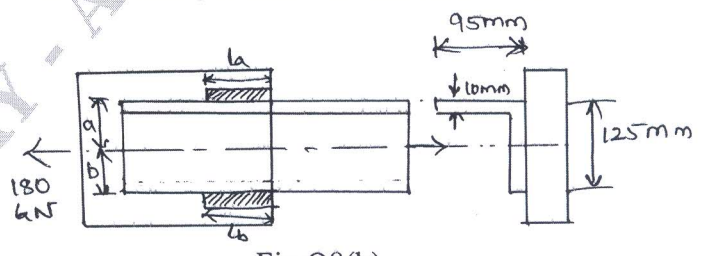

Fig.Q8(b) **(11 Marks)**

Module-5

9 a. A bolt in a steel structure is subjected to a tensile load of 9kN. The initial tightening load on the bolt is 5kN. Determine the size of the bolt taking allowable stress in the bolt material to be 80MPa and K = 0.05. **(04 Marks)**

b. An M10 steel Bolt of 125mm long is subjected to an impact load. The kinetic energy absorbed by the bolt is 2.5J. Determine :

i) Stress in the shank of the bolt if there is no threaded portion between the nut and the bolt head

ii) Stress in the shank if the area of the shank is reduced to that of the root area of the thread or the entire length of the bolt is threaded. **(12 Marks)**

OR

10 A weight of 500kN is raised at a speed of 6m/minute by two screw rods with square threads of 50×8 cut on them the two screw rods are driven through bevel gears drives by a motor, determine :

i) Torque required to raise the load

ii) Speed of rotation of the screw rod assuming the threads are of double start

iii) The maximum stresses induced in the cross section of the screw rod

iv) The efficiency of screw drive

v) The length of the nuts for the purpose of supporting the load

vi) Check for overhaul. **(16 Marks)**

* * * * *