Reg. No. :

Question Paper Code: 95702

B.E./B.Tech. DEGREE EXAMINATION, NOV 2023

Fifth Semester

Mechanical Engineering

19UME502 – DESIGN OF MACHINE ELEMENTS

(Regulation 2019)

Duration: Three hours   Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The ability of material to resist scratching and indentation is   CO1- U

    (a) Hardness   (b) Stiffness   (c) Resilience   (d) Surface finish

2. This refers to the total energy which can be used before material breaks.   CO1- U

    (a) Hardness   (b) Stiffness   (c) Toughness   (d) Resilience

3. A key in an element which is used to transfer   CO1- U

    (a) Reciprocating motion   (b) Rotary motion

    (c) Loading   (d) None of these

4. _____ joint is used to connect two rods whose axes are either   CO1- U
    coinciding or intersecting and lying in one plane.

    (a) Knuckle   (b) Welded   (c) Cotter   (d) Threaded

5. A stud is a bolt in which one of the following is replaced by a   CO1- U

    (a) Threaded end   (b) Brazed end   (c) Welded end   (d) Bonded end

6. A bolt of uniform strength has _____ at the threaded and shank portion.   CO1- U

    (a) equal strength   (b) no strength

    (c) dual strength   (d) very weak

7. In _____ spring, wires are coiled very closely.   CO1- U

   (a) open coiled   b) cross coiled   (c) close coiled   (d) perpendicular coiled

8. The springs made in the form of a cone disk to carry a high compressive   CO1- U
   force is

   (a) Helical   (b) Belleville   (c) Leaf   (d) none of these

9. Which one of the following is a criterion in the design of hydrodynamic   CO1- U
   journal bearings?

   (a) Sommerfeld number   (b) Rating life

   (c) Specific   dynamic capacity   (d) Rotation factor

10. What is the most important feature of lubrication that determines the life of   CO1- U
    a bearing?
                              (b) grade of grease   (c) E.P. additives   (d) viscosity index
    (a) viscosity

                              PART – B (5 x 2= 10Marks)

11. Explain the methods to reduce stress concentration.   CO1- U

12. Differentiate between keys and splines.   CO2- U

13. Explain the term self-locking of power screws.   CO3- U

14. State any two functions of springs.   CO4- U

15. What is a journal bearing? List any two applications.   CO5- U

                              PART – C (5 x 16= 80 Marks)

16. (a) A leaf spring in an automobile is subjected to cyclic stresses.   CO2-App   (16)
         The average stress is 150 MPa, variable stress is 50 MPa,
         ultimate stress is 630 MPa, yield point stress is 350 MPa and
         endurance limit stress is 150 MPa. Estimate, under what factor
         of safety the spring is working, by Goodman and Soderberg
   relation.

                                      Or

    (b) A shaft of 760mm length is simply supported at its ends. It is   CO2-App   (16)
         supported to a central concentrated cyclic load that varies
         from 12KN to 36KN. Determine the diameter of the shaft
         assuming a factor of safety of 2, size correction factor of 0.8
         and surface correction factor of 0.85. The material properties
         are ultimate strength = 500MPa; yield strength = 280MPa and
         endurance limit = 250MPa. Fatigue stress concentration
         factor = 1.5.

2

95702

17. (a)   A solid circular shaft is subjected to a bending moment of   CO2-App   (16)
3000 N-m and a torque of 10 000 N-m. The shaft is made of
45 C 8 steel having ultimate tensile stress of 700 MPa and a
ultimate shear stress of 500 MPa. Assuming a factor of safety
as 6, determine the diameter of the shaft.

Or

(b)   A factory line shaft is 4.5 m long and transmits 75 kW at 200   CO2-App   (16)
rpm. The allowable stress in shear is 49 MPa and the
maximum allowable twist is 1° in a length of 20 times
diameter. Determine the shaft diameter.

18. (a)   A 50 mm diameter solid shaft is welded to a flat plate as   CO2- App   (16)
shown in Figure. If the size of the weld is 15 mm, find the
maximum normal and shear stress in the weld.
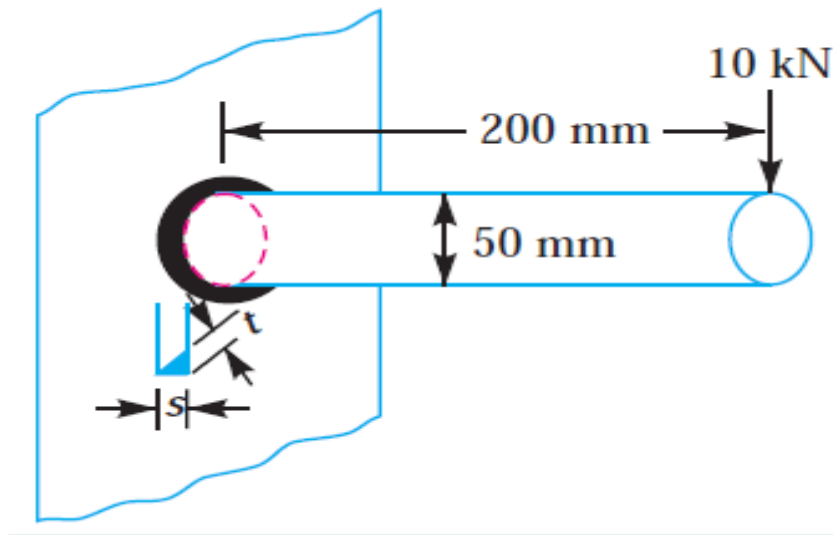
Or

(b)   The cylinder head of a steam engine is subjected to a steam pressure of   CO2- App   (16)
0.7 N/mm2. It is held in position by means of 12 bolts. A soft copper
gasket is used to make the joint leak-proof. The effective diameter of
cylinder is 300 mm. Find the size of the bolts so that the stress in the
bolts is not to exceed 100 MPa.

19. (a)   A compression helical spring is required to exert a minimum force of 200N and   CO2-App   (16)
maximum force of 600N and the deflection for this change in the load is to be 15mm.
The load is static. The ultimate tensile stress is 1393 MPa and the shear is 606 MPa.
Calculate 1) Diameter of the spring wire.2) Mean coil diameter and
3) Number of active turns

Or

95702

(b)   A truck spring has 12 number of leaves, two of which are full length leaves. The spring supports are 1.05 m apart and the central band is 85 mm wide. The central load is to be 5.4 kN with a permissible stress of 280 MPa. Determine the thickness and width of the steel spring leaves. The ratio of the total depth to the width of the spring is 3. Also determine the deflection of the spring.   CO2- App   (16)

20. (a)   Design a journal bearing for a centrifugal pump with the following data.   CO2- App   (16)
Diameter of the journal = 150mm
Load on bearing = 40 kN
Speed of journal = 900 rpm

Or

(b)   If a ball bearing is subjected to a radial load of 10 kN and the expected life for 90% of the bearing is 6000hr, calculate the dynamic load carrying capacity of the bearing when the shaft rotates at 1250rpm.   CO2- App   (16)

95702