Reg. No. : | | | | | | | | | | |

Question Paper Code: 95702

B.E./B.Tech. DEGREE EXAMINATION, NOV 2022

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. If the diameter of a solid shaft is increased two times, the torque transmitted will be CO1- U

   (a) two times (b) four times (c) eight times (d) sixteen times

4. The torque required to produce a twist of one radian per unit length of the shaft is known as CO1- U

   (a) polar modulus (b) torsional rigidity (c) flexural rigidity (d) torsional rigidity

5. Welded joint is called as CO1- U

   (a) permanent joint (b) linked joint (c) temporary joint (d) movable joint

6. For riveted joints, the type of joint preferred is CO1- U

   (a) Lap joint (b) Butt joint (c) Over lapping joint (d) All of the above

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 force is CO1- U

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

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

(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 a bearing? CO1- U

(a) viscosity (b) grade of grease (c) E.P. additives (d) viscosity index

PART – B (5 x 2= 10Marks)

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

12. Differentiate between keys and splines. CO1- U

13. Explain the term self-locking of power screws. CO1- U

14. When two concentric springs of stiffness 100N/mm respectively are subjected to an axial load of 750N, what will be the deflection of each spring? CO2- App

15. Explain about life anti-friction bearings? CO1- U

PART – C (5 x 16= 80 Marks)

16. (a) Derive the various theories of failure CO2-App (16)

Or

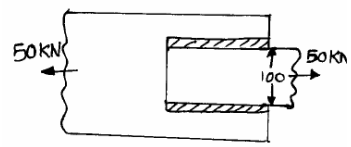
(b) A shaft of 200mm length is cantilever rod of circular section. It is subjected to a cyclic transverse load that varies from -50 to 150 KN. Determine the diameter of the shaft assuming a factor of safety of 2, size correction factor of 0.85 and surface correction factor of 0.9. The material properties are ultimate strength = 550MPa; yield strength = 320MPa and endurance limit = 275MPa. Theoretical stress factor = 1.4, Notch sensitivity factor = 0.9. CO2-App (16)

17. (a) Design a muff or sleeve coupling for a shaft to transmit 35KW at 350 rpm. The safe shear stress for the steel shaft is $50N/mm^2$ and it is 15 N/mm^2 for the cast iron muff. The allowable shear and crushing stress for the key material are 42 N/mm^2 and 120 N/mm^2 respectively CO3-App (16)

Or

(b) Design a knuckle joint to transmit 150 kN. The design stresses may be taken as 75 MPa in tension, 60 MPa in shear and 150 MPa in compression. CO3-App (16)

18. (a) A plate 100m wide and 12.5mm thick is to be welded to another plate by means of two parallel fillet welds. The plates are subjected to a load of 50KN. Find the length of the weld so that the maximum stress does not exceed 56N/mm^2. CO2- App (16)



Or

(b) Two rods, made of plain carbon steel 40C8 (S_{yt} = 380N/mm^2) are connected by means of a cotter joint. The diameter of each rod is 50mm and the cotter is made from a steel plate of 15mm thickness. Calculate the dimensions of the socket end making the following assumptions. 1. The yield strength in compression is twice of the tensile yield strength and 2. The yield strength in shear is 50% of the tensile yield strength. CO2- App (16)

19. (a) A helical compression spring made of oil tempered carbon steel is subjected to a load which varies from 400 N to 1000 N. The spring index is 6 and the design factor of safety is 1.25. If the yield stress in shear is 770 MPa and endurance stress in shear is 350 MPa, find: (i) Size of the spring wire, (ii) Diameter of the spring, (iii) Number of turns of the spring, and (iv) Free length of the spring. The compression of the spring at the maximum load is 30 mm. The modulus of rigidity for the spring material may be taken as 80 kN/mm^2 CO3- App (16)

Or

(b) The turning moment diagram of a multi cylinder engine is drawn with a scale of (1mm - 1º) on the abscissa and (1mm =250N-m) on the ordinate. The intercepted areas between the torque developed by the engine and the mean resisting torque of the machine, taken in order from one end are -350, +800, -600, +900, -550, +450 and -650mm^2. The engine is running at a mean speed of 750rpm and the coefficient of speed fluctuations is limited to 0.02 a rimmed flywheel made of grey cast iron FG200(ρ = 7100kg/m^3) is provided. The spokes, hub and shaft are assumed to contribute 10% of the required moment of inertia. The rim has rectangular cross section and the ratio of width to thickness is 1.5. Determine the dimensions of rim. CO3- App (16)

20. (a) Design a journal bearing for a centrifugal pump with the following data: CO3- App (16)

Diameter of the journal = 150mm
Load on bearing = 40KN
Speed of journal = 900rpm

Or

(b) Select a suitable ball bearing for a drilling machine spindle of diameter 40mm rotating at 3000rpm. It is subjected to radial load of 200N and axial thrust of 1000N. It is to work for 45 hours a week for one year. CO3- App (16)