**Sub Code: BMET-502** **ROLL NO……..……..**

**V SEMESTER EXAMINATION, 2022 – 23**

# (3rd Year, B.Tech. – Mechanical Engineering)

**MACHINE COMPONENT DESIGN –I**

**Duration: 3:00 hrs** **Max Marks: 100**

***Note: - Attempt all questions. All Questions carry equal marks. In case of any ambiguity or missing data, the same may be assumed and state the assumption made in the answer.***

*****Design Data Handbook is Allowed***

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| Q 1. | Answer any four parts of the following.<br>a) What are the factors to be considered while designing machine parts to avoid fatigue failure?<br>b) What is meant by eccentric loading and eccentricity?<br>c) Explain the following: (1) Resilience (2) Proof resilience (3) Bulk modulus (4) Poisson's ratio<br>d) Write Soderberg's equation and state its application to different type of loadings.<br>e) A hollow shaft of 40 mm outer diameter and 25 mm inner diameter is subjected to twisting moment of 120 N-m, simultaneously; it is subjected to an axial thrust of 10kN and a bending moment of 80 N-m. Calculate the maximum compressive and shear stresses. | 5x4=20 |
| Q 2. | Answer any four parts of the following.<br>a) Define equivalent twisting moment and equivalent bending moment. State when these two terms are used in design of shafts.<br>b) Explain the procedure of a design of shafts on the basis of rigidity.<br>c) A hollow shaft is subjected to a maximum torque of 1.5 kN-m and a maximum bending moment of 3 kN-m. It is subjected, at the same time, to an axial load of 10 kN. Assume that the load is applied gradually and the ratio of the inner diameter to the outer diameter is 0.5. if the outer diameter of the shaft is 80mm, find the shear stress induced in the shaft. [Given: fatigue factor for bending is 1.5 and fatigue factor for torsion is 1.0.]<br>d) A solid circular shaft is subjected to a bending moment of 3000 N-m and a torque of 10000 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.<br>e) Derive expression for the diameter of a shaft subjected to combined bending and twisting. | 5x4=20 |
| Q 3. | Answer any two parts of the following.<br>a) What do you understand by full length and graduated leaves of leaf spring? Write | 10x2= 20 |

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| | the expression for determining the stress and deflection in full length and graduated leaves.<br>b) Derive expression for stress and deflection in helical springs of non-circular wire.<br>c) A compression coil spring made of an alloy steel is having the following specifications:<br>Mean diameter of coil = 50 mm; Wire diameter = 5 mm; Number of active coils = 20.If this spring is subjected to an axial load of 500 N; calculate the maximum shear stress (neglect the curvature effect) to which the spring material is subjected. | |
| Q 4. | Answer any two parts of the following.<br>a) Describe, with the help of neat sketch, a centrifugal clutch and deduce an expression for the total frictional torque transmitted. How the shoes and springs are designed for such a clutch?<br>b) Derive the expression for the braking torque.<br>c) An engine developing 45 kW at 1000 r.p.m. is fitted with a cone clutch built inside the flywheel. The cone has a face angle of 12.5° and a maximum mean diameter of 500 mm. the coefficient of friction is 0.2. The normal pressure on the clutch face is not to exceed 0.1 $N/mm^2$. Determine: (i) The face width required, and (ii) The axial spring force necessary to engage the clutch. | 10x2= 20 |
| Q 5. | Answer any two parts of the following.<br>a) What are the various terms used in journal bearings analysis and design? Give their definitions in brief.<br>b) Design a self-aligning ball bearing for a radial load of 7000 N and a thrust load of 2100 N. The desired life of the bearing is 160 million of revolutions at 300 r.p.m. Assume uniform and steady load. [Given: for self-aligning ball bearing, for $W_A/W_R$ value of radial factor is 0.65 and value of thrust factor is 3.5]<br>c) The following data is given for a 360º hydrodynamic bearing:<br>radial load = 3.2 kN<br>journal speed = 1490 rpm<br>journal diameter = 50 mm<br>bearing length = 50 mm<br>radial clearance = 0.05 mm<br>viscosity of lubricant = 25 centi-poise<br>Assume that the total heat generated in the bearing is carried by the total oil flow in the bearing, calculate (i) coefficient of friction (ii) power lost in friction<br>(iii) minimum oil film thickness (iv) flow requirement in liters/min<br>(v) temperature rise | 10x2= 20 |

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