Ex/ME/T/225/2018

B. E MECHANICAL ENGINEERING SECOND YEAR SECOND SEMESTER EXAM, 2018

Subject: MACHINE DESIGN -I **Time: Three Hours** **Full Marks: 100**

Different parts of the same question should be answered together. Missing data, if any, are to be reasonably chosen.

Module 1 (CO1)

Question No-1: Answer any 04 (four) ***2.5x04=10***

a) What is optimum design? b) Explain four design considerations in detail. c) What is preferred number d) Explain the significance of factor of safety. e) Describe the steps followed in design.

Module 2 (CO2)

Question No-2: Answer any 05 (five) ***03x05=15***

a) Discuss the points to be considered in material selection. b) Describe the properties and application of different types of Cast Iron. c) Explain hardness and impact strength d) Why annealing and tempering are required? e) How Steel is designated? f) Name four alloying elements and their role in improving material property.

Module 3 (CO3, CO4)

Answer Question No-3 and any one from Question No-4 and Question No-5

Question No-3: a) Compare Rankine, von-Mises and Tresca failure theories. b) Explain Mohr Coulomb failure theory. c) Explain the significance of failure theory in design. d) Discuss the procedure of Shaft design following ASME code. ***08+04+04+04***

Question No-4: a) Design a cotter joint based on rational design, b) Discuss the principle of designing long, intermediate and short columns. ***10+05***

Question No-5: a) Compare the relation between yield strength in shear and tensile strength from Von Mises and Trescca failure theories. b) A mild steel shaft of 40 mm diameter is subjected to a bending moment of 100 N-m and torque, T. If the yield point of the steel in tension is 300 MPa, find the maximum value of torque T without causing yielding of the shaft according to von-Mises and Tresca failure theories. ***05+10***

Module 4 (CO5)

Answer any one from Question No-6 and Question No-7.

Question No-6: a) A solid circular shaft made of steel (tensile strength= 580 MPa, yield stress= 360 MPa) is subjected to an alternating torsional moment which varies from -300 N-m to +600 N-m and at the same time shaft is subjected to a bending moment that varies from +100 N-m to +400 N-m. Calculate the shaft diameter using the following data: corrected endurance limit=220 MPa, Factor of safety=2.5. b) Derive the strain life equation applicable to low cycle and high cycle fatigue both. c) What is notch sensitivity factor? ***12+05+03***

Question No-7: a) A machine component made of steel is subjected to a reversed bending stress of 280 MPa for 25% of the time, a fluctuating load having mean stress of 150 MPa and alternating stress of 200 MPa for 35% of the time, and a reversed bending stress of 400 MPa for 40% of the time. Determine the expected life of the component using the following: σ_{yt} =540 N/mm^2, σ_{ut} = 700 N/mm^2, corrected endurance limit: 260 MPa. b) Discuss different factors which affect endurance limit. ***15+05***

Module 5 (CO6)

Answer any one from Question No-8 and Question No-9.

Question No-8: a) Derive the expressions of failure stress from atomic point of view, based on stress concentration and Griffith energy release rate. b) What is $\mathcal{G}$ and prove that it is equal in load controlled and displacement controlled conditions. c) How plane strain fracture toughness is determined? ***10+06+04***

Question No-9: a) Explain the condition for stable and unstable crack growth. b) Calculate the factor of safety based on the following data: maximum allowable crack length = 1.2 mm, σ_{yp} =510 N/mm^2, K_{IC}= 10 MPa$\sqrt{m}$ and loaded to a stress of 300 MPa. c) Explain the creep curve and its significance. d) Discuss Andrade's and Garofalo's equations. e) How creep curve is influenced by temperature and stress level. ***04+04+05+03+04***