Questions for practice in machine design
(For Forth Engineering students)

PART I

Q.1.   A machine element made of cast iron is loaded in a way that the stresses at a critical location are found to have following values.

$\sigma_x = 60$ MPa $\sigma_y = -10$ MPa $\tau_{xy} = 40$ MPa $\sigma_z = \tau_{yz} = \tau_{zx} = 0$

Properties of cast iron: $\sigma_{ut} = 70$ MPa $\sigma_{uc} = -140$ MPa

Determine the factor of safety. Give your comment on the value of factor safety you have computed.

Q.2.   A machine element made of ductile material is loaded in a way that the stresses at a critical location are found to have following values.

$\sigma_x = -90$ MPa $\sigma_y = 270$ MPa $\tau_{xy} = 240$ MPa $\sigma_z = \tau_{yz} = \tau_{zx} = 0$

Properties of ductile material: $\sigma_{yield} = \pm 460$ MPa $\sigma_{ut} = 840$ MPa

Determine the factor of safety. Also give your comment on the value of factor safety you have computed.

Q.3.   A round steel rod will be subjected to a system of loads that consists of an axial tension and an axial torsion. When the axial tension acts alone, an axial tensile stress of 50 MPa is produced. When the axial torsion acts alone, a maximum shear stress of 100 MPa is produced. When the system of loads will act on the rod, determine the value of factor of safety.

Properties of ductile material: $\sigma_{yield} = \pm 500$ MPa $\sigma_{ut} = 925$ MPa

Give your comment on the value of factor safety you have computed.

Q.4   A critical point at the free surface of a steel machine member is subjected to principal stresses of 200 MPa and 100MPa. What tensile yield strength is required to provide a factor of safety of 2? Justify you answer.