Mechanics of Materials-II

6th Semester**----** (Session 2007)

Problem Sheet #5

Pb.1   A material subjected to a simple tension test shows an elastic limit of 200Mpa.calculate the factor of safety if the principal stresses set up in a complex two dimensional stress system are limiting to 100Mpa tensile and 25Mpa compressive. Base your answer on the following theories: (a) maximum shear stress; (b) maximum shear strain energy.

(Ans: (a) 1.6; (b) 1.75)

Pb.2   A tube has a mean diameter of 100mm and a thickness of 3 mm. calculate the torque which can be transmitted by the tube with factor of safety =2.25, elastic limit in tension is 200Mpa and v=0.3, if the criterion of failure is (a)maximum shear stress (b)maximum strain energy (c)maximum shear strain energy

[Ans: (a)2.035kNm;(b)2.524kNm; (c)2.35kNm]

Pb.3   A mild steel shaft of 50mm diameter is subjected to a bending moment of 1.9kNm.if the yield point of the steel in simple tension is 200Mpa, find the maximum torque that can also be applied according to (a) the maximum shear stress (b) the shear strain energy theories of yielding   [Ans: (a) 1.55 kNm; (b) 1.79 kNm]

Pb.4   A metal bar is being compressed along the x_1 axis between two rigid walls such that ϵ_3=0 and σ_2 =0. This process causes an axial stress σ_1 and no shear stresses. Determine the apparent yield value of σ_1 , if the material in a conventional compression test exhibits a yield strength σ_L and Poisson's ratio v. Assume that the material is governed by the von Mises yield condition. Find an alternative expression if the maximum strain energy theory is postulated.   [Ans: $\sigma_L / (1- v+v^2)^{1/2}$]; $\sigma_L / (1-v^2)^{1/2}$]

Pb.5 If the principal stresses at a point in an elastic material are 2σ tensile and $\sigma/2$ compressive, calculate the value of σ at failure according to the following theories: (a) maximum principal stress; (b) maximum shear stress; (c) maximum strain energy ; (d) maximum shear strain energy. The elastic limit in tension is 200Mpa,

Poisson's ratio = 0.3   [Ans: (a) 100Mpa; (b) 80Mpa; (c) 90.8Mpa; (d) 87.3Mpa]

Pb.6 The load on a bolt consists of an axial pull of 10 KN together with a transverse shear force of 5KN. Estimate the diameter of bolt required according to the following theories: (a) maximum principal stress; (b) maximum shear stress; (c) maximum strain energy; (d) maximum shear strain energy. The elastic limit in tension is 270Mpa, and a factor of safety of 3 is to be applied. Poisson's ratio = 0.3

[Ans: (a) 13.07mmMpa; (b) 14.15mm; (c) 13.48mm; (d) 13.68mm]

Pb.7 A shaft subjected to pure torsion yields at a torque of 1.2KNm. A similar shaft is subjected to a torque of 720 Nm and a bending moment M. Determine the maximum allowable value of M according to (a) maximum shear stress theory, (b) maximum shear strain energy.   [Ans: (a) 0.96kNm; (b) 1.025kNm]

Pb.8 A thin walled steel cylinder of 2m diameter is subjected to an internal pressure of 2.5Mpa. Using a safety factor of 2 and a yield stress in simple tension of 400Mpa, calculate wall thickness on the basis of tresca and von Mises yield criteria. It may be assumed that the radial stress in the wall is negligible.

[Ans: (a) 12.5m; (b) 10.8mm]