Quiz 3 – Sample questions

1. Describe in detail a processing method for the fabrication of fiber-reinforced polymer-matrix composites. Why is application of pressure necessary in producing high-performance laminates?
2. Develop expressions for the transverse and fiber-direction moduli for a transversely isotropic composite lamina.
3. Plot and explain the variation of fiber-direction strength of a unidirectionally-reinforced lamina as a function of fiber fraction.
4. Explain the variation of normal and shear stress in a short reinforcing fiber. What is the "critical fiber length?"
5. Write out the 2-D compliance matrices for isotropic and transversely isotropic laminae. Define the various elastic parameters.
6. Develop an expression for the compliance matrix of a transversely isotropic lamina in term of the matrix referenced to the principal material directions and the angle between the fiber direction and an arbitrary direction.
7. Give the matrix equation relating the in-plane strain and curvature of a composite laminate to the applied tractions and bending moments.
8. Outline the concepts in deriving the matrix equation above.
9. Explain the terms *gelation* and *vitrification* relevant to cure of thermosetting resins. Describe the Gillham torsional braid technique of monitoring these phenomena. Draw a typical Gillham TTT diagram for cure and explain it.
10. Draw and explain the biaxial yield locus for the Tresca and von Mises criteria. Draw and explain how the v. Mises locus is effected by the hydrostatic stress state.
11. What is a craze? How is it both a yield and a fracture mechanism? Justify the Sternstein equation for craze initiation: $\sigma_1 - \sigma_2 = A(T) + B(T)/(\sigma_1 + \sigma_2)$ and show how it appears on a $\sigma_1 - \sigma_2$ yield locus.
12. Develop a rate-process model for the effect of rate and temperature on the tensile yield strength. How can the

parameters in this model be determined experimentally? What is the physical significance of the activation energy and volume?

13. Outline a rate-process fracture model leading to Zhurkov's equation. Describe the physical significance of the materials parameters in this model, and experimental methods for determining them. Describe experimental methods for determining directly the atomistic mechanisms postulated in this model, and their drawbacks.
14. Derive the Griffith equation and explain how it can be used in design.
15. Outline the stress-intensity view of fracture, and explain how it differs from the Griffith energy-balance approach.
16. Describe a significant fracture event (your choice), such as the Comet disasters, the Boston molasses tank, the S.S. Schenectady.
17. Explain the meaning of the expression "critical strain energy release rate, G_c." What molecular mechanisms lead to high, or small, values of G_c? Why do thick specimens have lower values of G_c than thin ones?
18. Explain the compliance calibration method of determining the critical strain energy release rate.