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Question Paper Code : D 2005

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2010.

Eighth Semester

Aeronautical Engineering

AE 1011 — FATIGUE AND FRACTURE

(Regulation 2004)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is an SN Curve? Explain the significant points in the curve.

2. What are the effects of notches and cutouts in the loaded structures?

3. Distinguish between low cycle and high cycle fatigue behaviour of structures.

4. Explain the methods of reducing stress concentrations.

5. What are the different phases of a crack with respect to fatigue life?

6. Explain the dislocation theory.

7. What is fracture toughness?

8. Explain the fracture failure in terms of energy?

9. Define safe life and fail safe design.

10. List down the factors that are to be considered while designing the components to avoid fatigue failure.

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PART B — (5 × 16 = 80 marks)

11. (a) (i) What do you understand by fluctuating stresses, repeated stresses and alternating stresses.

(ii) Explain a method, in detail, to increase the fatigue life of a structure.

Or

(b) (i) What is the need for using factor of safety in the design of components?

(ii) Using Soderberg method, determine the required diameter of a solid circular rod of a ductile material having endurance strength has 265 MPa and a tensile yield strength has 350 MPa. The rod is subjected to varying axial load from 300 kN compression to 700 kN tension. The stress concentration factor is 1.8 and factor of safety is 2.0.

12. (a) (i) What do you understand by strain hardening? How does that change the mechanical properties of a material?

(ii) Explain Miner's theory to estimate the life of a component.

Or

(b) (i) Describe any one of counting techniques used in fatigue study.

(ii) Explain the relevance of Coffin – Manson theory in the study of fatigue behaviour of materials.

13. (a) (i) With neat sketches, explain different modes of crack growth.

(ii) Explain in detail the dislocations happening in a material.

Or

(b) (i) Explain the informations you may get about the materials from the fatigue fracture surfaces.

(ii) Explain the linear cumulative damage law for predicting the number of cycles to failure.

14. (a) (i) Explain the effect of thickness on fatigue toughness.

(ii) Obtain the strain energy release rate on a plate with a crack subjected to a tensile load.

Or

(b) (i) Explain the Griffith's theory for obtaining the failure stress.

(ii) What is stress intensity factor? Discuss the theoretical and experimental values of the factors for different geometries.

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15. (a) (i) What is the need for Fracture Mechanics study in design of aircraft components?

(ii) Explain a procedure to predict the fatigue life of an aircraft.

Or

(b) Give suitable examples of aircraft structural components of composite materials and discuss their fatigue behaviour.

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