KUMARAGURU
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Register Number: ……..

B.E DEGREE EXAMINATIONS: APRIL /MAY 2016

(Regulation 2009)

Eighth Semester

AERONAUTICAL ENGINEERING

AER146**:** Fatigue And Fracture

(Use of approved data book is permitted)

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Carburization and Nitrating process leads to

   a) Increase the mean stress b) Increase the endurance limit

   c) Accelerate low cycle fatigue d) Accelerate High cycle fatigue

2. For a specific geometry, according to Neuber's theoretical stress concentration factor,

   a) $K_t = \sqrt{K_\sigma + K_\varepsilon}$ b) $K_t = \sqrt{K_\sigma / K_\varepsilon}$

   c) $K_t = \sqrt{K_\sigma K_\varepsilon}$ d) $K_t = \sqrt{K_\sigma^2 / K_\varepsilon}$

3. For high strength materials, Cyclic strain hardening and softening stabilize to a constant level immediately through

   a) Rolling process b) heat treatment process

   c) Milling Process d) Grinding Process

4. According to Miner-rule, the fatigue damage can be fully characterized by ……..which is fundamentally incorrect.

   a) Stress amplitude plots b) Mean stress plots

   c) Residual stress plots d) a single damage parameter

5. Which one of the following is not an environmental effect that causes the fatigue crack propagation?

   a) Erosion b) Nitration

   c) Corrosion d) gas phase embrittlement

6. If the Burger's vector is parallel to the line of dislocation, then the defect is known as

   a) Stacking defect b) Edge dislocation

   c) Electronic defect d) Screw dislocation

7. Griffith's theory of brittle fracture is applicable for the following material

a) Mild Steel b) Glass

c) Titanium Alloys d) Copper

8. In Linear Elastic Fracture Mechanics, the testing procedure is limited to

a) Perfectly brittle Materials b) Perfectly Elastic Materials

c) Materials with limited ductility d) Perfectly Plastic Materials

9. Miner's linear damage rule was demonstrated for

a) Aircraft skins b) Fuselage rings

c) Longerons d) Ribs

10. The stress due to suddenly applied load as compared to stress due to same load gradually applied to the same rod is

a) half b) same

c) three times d) double

PART B (10 x 2 = 20 Marks)

11. What is the effect of mean stress on cycles to failure?
12. Why reinforcement of open holes is necessary in airplane structures?
13. State Coffin- Manson's relationship? Write its significance.
14. Differentiate strain hardening and softening.
15. What is void coalescence?
16. Define fatigue notch factor.
17. What is energy release rate?
18. What is surface energy?
19. What is the role of fasteners in fatigue resistance design?
20. Define Fail safe and safe life designs.

PART C (5 x 14 = 70 Marks)

21. a) (i). A machine component is subjected to a flexural stress which fluctuates between +300 MN/m^2 and -150 MN/m^2. Determine the value of minimum ultimate strength according to 1.Gerber relation 2. Modified Goodman relation 3. Soderberg relation. Take, yield strength = 0.55 x ultimate strength; Endurance strength = 0.5 x Ultimate strength; and factor of safety = 2. (7)

(ii). What is stress concentration factor? Explain the factors affecting stress concentration and sources of stress concentration. (7)

(OR)

b) (i). Discuss in detail about the influence of mean stress on fatigue life of materials by the Goodman diagram. (7)

(ii). Write the importance of S-N curve, equations used to define endurance limit. (7)

22. a) Explain in detail about the different types of Cycle counting techniques with suitable illustrations.

(OR)

b) (i). Describe briefly about strain hardening and softening with neat sketches. (7)

(ii). Write a short note about low cycle fatigue and explain miner's rule for cumulative damage calculation. (7)

23. a) Enumerate the different phases of fatigue life with a neat block diagram.

(OR)

b) Write down the factors affecting the crack propagation phenomena? Explain few essential factors to be considered for crack growth prediction.

24. a) (i). Explain briefly about the Griffith's theory for brittle materials. (7)

(ii). What is fracture toughness? Explain how the specimen thickness affects the fracture toughness. (7)

(OR)

b) (i). What is stress intensity factor? How it is determined by numerical and theoretical methods? (7)

(ii). What is transition life of a material? Derive an expression for transition life. (7)

25. a) What is the need for Fracture mechanics in design of airplane components and discuss a few fatigue problems encountered in subsonic and supersonic aircraft.

(OR)

b) Write short notes on the following:

(i) Damage – tolerant designs (7)

(ii) Infinite – life structural design (7)

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