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2005 JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY

IV B.TECH II SEMESTER SUPPLEMENTARY EXAMINATIONS
FATIGUE AND FRACTURE MECHANICS
(AERONAUTICAL ENGINEERING)

TIME: 3 HOURS

JULY- 2005

MAX MARKS: 80

Answer any FIVE Questions
All Questions carry equal marks

1. (a) Discuss the procedure for determining an S-N curve and draw the S-N curve for steel explaining its importance.

(b) Discuss a typical fatigue testing procedure. Explain how the effect of mean stress can be studied.

2. (a) Explain how the effect of notches on fatigue failure can be experimentally studied.

(b) What are the potential locations for stress concentration in a given material? Explain them fully.

3. (a) Explain the reasons for well defined fatigue limit in certain materials.

(b) The endurance limit of a steel member is 112 Mpa and the tensile strength is 385 MPa. What is the fatigue strength corresponding to a life of 70 x 103 cycles.

4. (a) What is linear cumulative damage rule. What is the other name for this rule? Explain it fully.

(b) What is the name of the theory which is used to explain cumulative fatigue damage? Explain the theory fully.

5. (a) Many metallic materials obey an equation of the type.
da
dn = R(∆ k)4
If the initial crack size is a0 and that the final crack size is af , show that the total fatigue life may be increased much more by decreasing a0 than by increasing the fracture toughness KIC.

(b) Why do fatigue failures often originate from the surface? Under what conditions would you expect the fatigue failures to initiate from the interior of the component.

6. (a) Why is a surface of a solid associated with surface energy (or free energy)? What is an approximate value of the free energy of surface of a metal

(b) Actual energy required in a ductile material to create two new surfaces through the crack growth is several orders higher than the surface energy of solids. Why so?

7. (a) How does improved, alloy cleanliness develop the fracture toughness of the parts?

(b) How does the micro-structure of the materials optimize the fracture toughness?

8. Discuss in detail the historical remarks about fatigue failure with suitable examples.