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2006 JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY

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

Apr/May 2006

TIME – 3 HOUR
MARK – 80

Answer any FIVE Questions
All Questions carry equal marks

1. Explain various methods of reducing stress concentration among various shapes and sizes of different members. [16]

2. (a) Distinguish clearly between Notch toughness, notch brittleness and notch sensitivity.

(b) What is notch sensitivity index.

(c) Discuss the effect of *[16]*

i. Surface condition &

ii. stress concentration on fatigue.

3. (a) Explain typical fatigue stress cycles with the help neat sketches.

(b) Represent fatigue data on a probability basis and explain it. *[8+8]*

4. (a) Describe about stress fluctuations and cumulative damage in fatigue failure.

(b) How cumulative fatigue is expressed?

(c) Discuss woods theory of fatigue failure. *[4+4+8]*

5. (a) Crack propagation rate, in general, depends on ∥ k, and R but the Paris law, which ignores the effect of R, is very popular why so?

(b) What is crack closure? Why does it happen?

(c) Explain whether the predictions of crack growth accurate enough for engineering applications with the present, know how. *[4+6+6]*

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? *[16]*

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. A bar of a circular cross section is subjected to alternating tensile forces varying from a minimum of 200kN to a minimum of 500kN. It is to be manufactured of a material with an ultimate tensile strength of 900 MPa and an endurance limit of 700MPa. Determine the diameter of the bar using a safety factor of 3.5 related to ultimate tensile strength 4 related to endurance limit and a stress concentration factor of 1.65 for fatigue load. Use Goodman straight line as basis for design.