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CODE NO: NR422102.SET NO. 3

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. Explain the following terms in connection with design of machine members subjected to variable loads.
(a) Endurance limit.
(b) Size factor.
(c) Surface finish factor.
(d) Notch sensitivity.

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 why fatigue strength is a statistical quantity.

(b) Based on dislocation theory, explain how dislocations are multiplied and strain hardening occurs.

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.

5. (a) Describe the conditions that increase the susceptibility of a metal component to failure by fatigue. How metal fatigue resistance can be measured?

(b) Fatigue is effected by temperature Discuss the effects of high and low temperatures on it.

6. (a) A sample has a crack length of 2μm. The Young's modulus the sample is 70GN/m2 and the specific surface energy is 1J/m2 Estimate the fracture strength and compare it with its young's modulus.

(b) A heat treated steel chisel and a glass window pane are both brittle. Explain why chisel is strong and the window pane is weak.

7. (a) Determine the critical crack length in a centered cracked plate loaded in mode. If critical intensity factor KIC = 60MPapm and the far field stress is 120 Mpa.

(b) Cite the significant differences between the following.
i. Stress intensity factor
ii. Plane stress fracture toughness
iii. Plane strain fracture toughness.

8. Determine the thickness of a 120mm wide uniform plate for safe continuous oper- ation if the plate is to be subjected to a tensile load that has a maximum value of 250kN and a minimum value of 100KN. The properties of the plate material are as follows.

Endurance limit stress : 225MPa
Yield point stress : 300MPa
Factor of safety based on
yield point ⁄ 1.5