CODE NO: NR422102.SET NO. 3

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2005 JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY

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

JULY- 2005

TIME: 3 HOURS

MAX MARKS: 80

Answer any FIVE Questions
All Questions carry equal marks

1. The fatigue data for a ductile cast iron are given as follows:
Stress amplitude (S) (MPa) Cycles to failure (N)
248 1 × 105
236 3 × 105
224 1 × 106
213 3 × 106
201 1 × 107
193 3 × 107
193 1 × 108
193 3 × 108
(a) Make an S-N plot using the above data.

(b) What is the fatigue limit for the alloy.

(c) Determine the fatigue life for stress amplitudes of 230MPa and 175MPa.

(d) Estimate fatigue strengths at 2 ×105 and 6 × 106 cycles.

2. (a) Why certain materials like ferrous alloys & Titanium alloys Exhibit a fatigue/endurance limit and many non-ferrous alloys do not exhibit? Explain properly.

(b) What is a master diagram? Explain how a designer might utilize a master diagram.

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) Explain the theory of Miners law.

(b) Express Miners law in mathematical terms.

(c) In a smooth bar rotating beam fatigue test, under fully reversed loading it is found that failure of a mild steel occurs on loading (at 1/4 cycle) at a stress of 420 MPa. At a stress amplitude of 210 MPa the number of cycles to failure is 106. How long a part will last at a stress amplitude of 280MPa if it is first subjected to a stress amplitude of 315 MPa for 1000 cycles
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5. (a) Explain the plastic blunting process in stage II fatigue crack propagation with the help of sketches.

(b) Diffusion of Vacancies is not essential for fatigue failure'. Explain.

6. (a) Sketch typical fatigue fracture surface and explain.

(b) Explain some of the methods of protection of materials from surface crack propagation.

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. Identify and explain several problems a designer must recognize when dealing with fatigue loading as compared with static loading.