Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

I SEMESTER M.TECH (CAAD) END SEMESTER EXAMINATIONS, NOVEMBER 2018

SUBJECT: FATIGUE OF MATERIALS [MME 5104]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions
- Missing data, if any, may be appropriately assumed
- Assumptions made must be clearly mentioned
- Fatigue Data Handbook is permitted

1A. Discuss as how fatigue life extension is carried out. **3**

1B. Endurance strength of a material is influenced by several factors. Justify **3**

1C. A component undergoes a cyclic stress with a maximum value of 700 MPa and a minimum value of 250 MPa. The component is made of steel with an ultimate strength of 1120 MPa, yield strength 810 MPa, endurance limit of 525MPa and has fully reversed stress at 1000 cycles as 910 MPa. Using Goodman relation, predict the life of component. Interpret the predicted life. Also fit an S-N equation. **4**

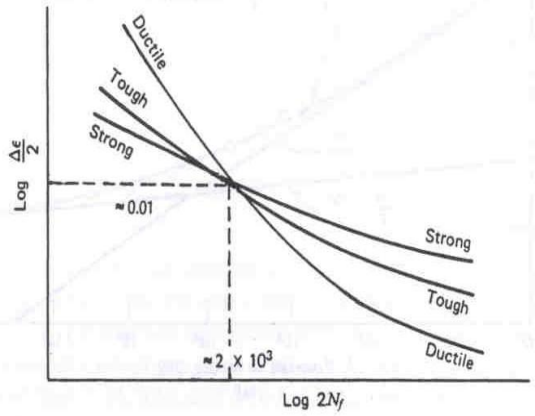
2A. Discuss the significance of critical plane approach in predicting the fatigue life under multiaxial loading. **3**

2B. Differentiate between cyclic and fatigue properties. How they are used in characterizing material behavior? **3**

2C. At the transition life ($2N_t$) determine the stress and strain amplitude ($\Delta\sigma/2$, $\Delta\varepsilon/2$) in terms of the cyclic stress-strain properties (E, K', n') of a material. **4**

3A. What is Massing's hypothesis. Derive an expression for hysteresis curve. **3**

3B. How transition life of a material is used in selecting the material for various fatigue related applications. Discuss with reference to the following figure. **3**



3C. A steel material has ultimate strength of 490 MPa, an endurance limit of 240 MPa and a true fracture strength of 805 MPa. Determine the allowable zero to maximum (R=0) stress which can be applied for 10^5 cycles. Make predictions using Marrow relation. **4**

4A. Steel (S_u = 800 MPa, S_y = 690 MPa) is used in the form of plate (80 mm x 10mm) with a notch. What amplitude of bending moment M_a will result in a life of 10^6 cycles if cycling is applied at notch mean stress value = $900N^{-0.065}$. K_t = 1.9, K_f = 1.85. **5**

4B. Discuss the Manson double linear damage rule used to predict the fatigue life **3**

4C. Why frequency of loading plays an important role in high temperature fatigue compared to fatigue behavior at room temperature? **2**

5A. A metal has the monotonic tension properties E = 193 GPa, S_y (0.2 % offset) = 325 MPa, S_u = 650 MPa, σ_f = 1400 MPa, ε_f = 1.73, % RA = 80, n = 0.193 . Under cyclic loading, will the material harden or soften? **6**

Calculate strain reached on the first half cycle for a stress amplitude of 200 MPa. Given that the material has the following cyclic properties. K' = 1660 MPa, n' = 0.287. Determine the stable total strain and plastic strain amplitude for a stress amplitude of 200 MPa. Determine the stress response for a strain amplitude of 0.01.

5B. Explain the methods by which weldment fatigue resistance is improved? **2**

5C. Compare stress life and strain life approached considering fatigue life of 10^3 to 10^4 cycles. **2**