B.E. METALLURGICAL AND MATERIAL ENGINEERING

Fourth Year, Second Semester – 2022

Subject: CREEP & FRACTURE MECHANICS OF MATERIALS (HONS.)

Time: 4 hours   **Full marks: 70**

Answer any eight from Question No. 1 and any two from the rest:

1 (a). Whether valid plane strain fracture toughness of a material will vary if the tests are done in inert environment and corrosive environment? – Justify in support of your answer.

(b) What differences would you expect about fracture toughness value of a high-strength steel and steel with good amount of ductility? – Give reason in support of your answer.

(c) What is the importance of grain size in creep deformation of a material?

(d) What are the differences between creep test and stress rupture test?

(e) Between Gray Cast Iron and Nodular cast iron in which case ductility is more and why?

(f) What is the limitation of Griffith's theory and how can it be overcome?

(g) Why does lead undergo creep deformation at ambient temperature?

(h) What is the difference beween K_{IC} and K_{ISCC}?

(i) Why is 'true fatigue limit' not observed in all types of materials? In which materials 'true fatigue limit' is observed and why?

(j) How does the presence of "mean stress" influence the fatigue resistance behaviour of a material? – Discuss.

(k) Write a short note on "cumulative fatigue damage."   **5 x 8 = 40**

2 (a) Find the relationship for theoretical cohesive strength of metals.   **10**

(b) Determine the cohesive strength of silica fiber.   **5**

Given: $E = 95$ GPa, $g_s = 1$ J mt^{-2} and $a_o = 0.16$ nm

3 (a) What is the importance of studying Fracture Mechanics?

(b) What is known as "residual strength?" Schematically draw and discuss the "residual strength" diagram.

(c) What is the difference between Plane Stress and Plane Strain conditions of loading? Between Plane Strain and Plane Stress loading conditions whether there will be any difference in the fracture toughness of any material? – Justify your answer. $\qquad$ 3 + 5 + 3 + 4 = 15

4 (a) State and explain Griffith's Theory for Brittle fracture.

(b) What is the limitation of Griffith's theory and how can it be overcome?

(c) What is "strain energy release rate?" How can you graphically explain the "strain energy release rate" in case of fixed grip loading condition? $\qquad$ 5 + 5 + 5 = 15