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## UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: B. Tech MSENT

Subject (Course): Mechanical Behaviour & Properties of Materials

Course Code : MTEG 311

No. of page/s: 02

Semester – V

Max. Marks : 100

Duration : 3 Hrs

### Section A: 5 marks each- Attempt all questions

1. Two methods for measuring Young's Modulus.
2. Differentiate between Vicker's and Brinell's test.
3. Differentiate between ductile and brittle fracture.
4. Derive expression to calculate theoretical cohesive strength of material.

### Section B: 10 marks each- 5 to 7 are mandatory, attempt either 8 or 9

5. Derive the instability condition for condition for necking in materials and explain the two methods to determine maximum load.
6. Describe Rockwell testing method. Explain all the scales, load and indenters used.
7. Explain Griffith's theory for brittle failure. Derive expression to calculate critical stress. Also discuss Orowan's modification.
8. Discuss R-curve approach. Sketch R,G vs 'a' curve for ductile and brittle materials.

OR

9. A steel plate with a through thickness crack of length  $2a = 20$  mm is subjected to a stress of 400 MPa normal to the crack. If the yield strength of the steel is 1500 MPa, what is the plastic zone size and the stress intensity factor for the crack. Assume that the plate is infinitely wide.

### Section C: 20 marks each- 10 is mandatory, attempt either 11 or 12

10. A. Define Fatigue and Creep. (4)  
B. Discuss various loading cycles for Fatigue. (6)  
C. Sketch deformation mechanism map for various creep mechanisms. (4)  
D. A steel bar is subjected to a fluctuating axial load that varies from a maximum of 330 kN tension to a minimum of 110 kN compression. The mechanical properties of the steel are: UTS: 1090 MPa, Proof stress: 1010 MPa, Fracture stress: 510 MPa  
Determine the bar diameter to give infinite fatigue life based on a safety factor of 2.5 using Goodman's model. (6)
11. A. Define Fracture toughness. (4)  
B. Explain the three modes of fracture. (6)  
C. Differentiate between LEFM and EPFM. Name various LEFM and EPFM approaches. (5)  
D. Discuss Plasticity correction at the crack tip. (5)

**OR**

12. A. Discuss J-Integral approach. (8)  
B. Describe the COD approach for fracture. How COD is determined? (6)  
C. Write equations to calculate  $K_{Ic}$  values for compact tension and bent specimen. (6)