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14CAE421

Fourth Semester M.Tech. Degree Examination, June/July 2018
Fracture Mechanics

Time: 3 hrs.

Max. Marks:100

Note: Answer any FIVE full questions.

- 1
 - a. Explain historical development of Fracture mechanics. (06 Marks)
 - b. Distinguish between brittle fracture and ductile fracture. (06 Marks)
 - c. Derive an expression for fracture strength of a brittle solid containing an elliptical crack using Griffith's energy balance criterion. (08 Marks)

- 2
 - a. List the various NDT methods used in fracture mechanics. With neat sketch, explain any two NDT methods of testing. (10 Marks)
 - b. Explain Airy stress function with relevant equation. (06 Marks)
 - c. Determine the critical maximum Cohesive strength of steel having $E = 207 \text{ GPA}$ and $\nu_0 = 1/3$. Equilibrium separation of two atoms is 2.5 amstrong units. (04 Marks)

- 3
 - a. Derive an expression for the plastic zone using first order and second order estimate according to Irwin's approach. (10 Marks)
 - b. A wide sheet of aluminium alloy has a central crack of 25mm long. If the fracture stress for sheet is 200MPa and the σ_y is 400MPa. Calculate the K_{IC} of the material i) Using LEFM ii) Using plastic zone correction. (04 Marks)
 - c. Derive expression for relationship between G and K. (06 Marks)

- 4
 - a. Explain with neat sketch the detailed experimental procedure to evaluate plain strain fractures toughness K_{IC} using the 3-point bent specimen. (15 Marks)
 - b. Discuss the effect of thickness on fracture to toughness. (05 Marks)

- 5
 - a. Explain J-integral and show that the J-integral is path independent. (10 Marks)
 - b. Explain R-curve and write the significance of it. (05 Marks)
 - c. Give difference between J-integral and energy release rate. (05 Marks)

- 6
 - a. What is CTOD? Explain the experimental determination of CTOD with neat sketch. (10 Marks)
 - b. Derive a relation between CTOD, K_{IC} and G_I using Irwin's collection. (10 Marks)

- 7
 - a. Explain with sketch of principles of crack arrest and mention types of crack arresting. (10 Marks)
 - b. Write a short note on :
 - i) Crack branching
 - ii) Dynamic fracture toughness (10 Marks)

- 8
 - a. Explain fail life and safe life approach to Design in fracture mechanics. (10 Marks)
 - b. Explain the factor that affects crack propagation. (10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
 2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

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14MDE41

Fourth Semester M.Tech. Degree Examination, June/July 2018
Tribology and Bearing Design

Time: 3 hrs.

Max. Marks:100

Note: 1. Answer any FIVE full questions.
2. Use of Design data Hand book is permitted.

- 1 a. State and explain the Newton's law of viscous flow. Derive an expression for Hagen-Poiseuille law for flow through capillary. (10 Marks)
- b. Explain the following with a neat sketch:
- Michael viscometer.
 - Oswald's viscometer. (10 Marks)
- 2 a. State the assumptions made in the derivation of Petroff's equation. Derive the Petroff's equation for the co-efficient of friction in a lightly loaded bearing. (10 Marks)
- b. A lightly loaded journal bearing has the following specifications:
- Diameter of journal = 50 mm
 - Bearing length = 80 mm
 - Diametral clearance ratio = 0.002
 - Radial load = 750 N
 - Viscosity of the lubricant = 10 CP.
 - Speed = 4000 rpm.
- Determine: (i) Frictional torque on journal (ii) Co-efficient of friction (iii) Power loss (10 Marks)
- 3 State clearly the assumptions made in the derivation of Reynold's equation in two dimensions. Derive the equation. (20 Marks)
- 4 a. Derive an expression for the load carrying capacity of an idealized plane slider bearing with the fixed shoe. (10 Marks)
- b. A rectangular plane slider bearing with fixed shoe has the following specifications:
- Bearing length in the direction of flow = 75 mm
 - Bearing width = 62.5 mm,
 - Load = 17.25 KN
 - Velocity of moving surface = 2.5 m/sec.
 - Viscosity = 7 CP,
 - Inclination = 2.667×10^{-4} rad (10 Marks)
- Determine : (i) Film thickness (ii) Frictional force acting on moving member (iii) Co-efficient of friction (iv) Power loss
- 5 a. Derive an expression for load carrying capacity of an externally pressurized hydrostatic step bearing. (10 Marks)
- b. A hydrostatically step bearing for the turbine rotor has the following specifications: Diameter of shaft = 150 mm, Diameter of pocket = 100 mm, Vertical thrust of the bearing = 70 KN, Shaft speed = 1000 rpm, Viscosity of lubricant under operating condition = 0.025 pa-s, Oil film thickness = 0.125 mm. Determine
- Rate of oil flow through the bearing.
 - Power loss due to viscous friction.
 - Co-efficient of friction. (10 Marks)

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14MDE41

- 6 a. Explain the different regimes of EHL constraint and Grubin type solution. (10 Marks)
b. Explain the working principle of gas lubricated bearing. (10 Marks)
- 7 a. Explain briefly the ideal properties of bearing material. (10 Marks)
b. Explain with a neat sketch, the working of an active magnetic bearing. (10 Marks)
- 8 Write short notes on (any four):
a. Porous bearings.
b. Significance of Sommerfeld number.
c. Antifriction bearings.
d. Effect of temperature and pressure on viscosity.
e. Bearing failure. (20 Marks)

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