

Unit 12 - Week 10

Course outline

How to access the portal

Pre-Requisite Assignment

Week 1

Week 2

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Week 4

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Week 7

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Week 9

Week 10

- Plane Strain Fracture Toughness Testing
- Plane Stress Fracture Toughness Testing
- Paris Law and Sigmoidal Curve
- Engineering Fracture Mechanics : Week 10 Feedback form
- Quiz : Assignment 10

Week 11

Week 12

Video Download

Text Transcripts

Assignment 10

The due date for submitting this assignment has passed. **Due on 2019-10-09, 23:59 IST.**
 As per our records you have not submitted this assignment.

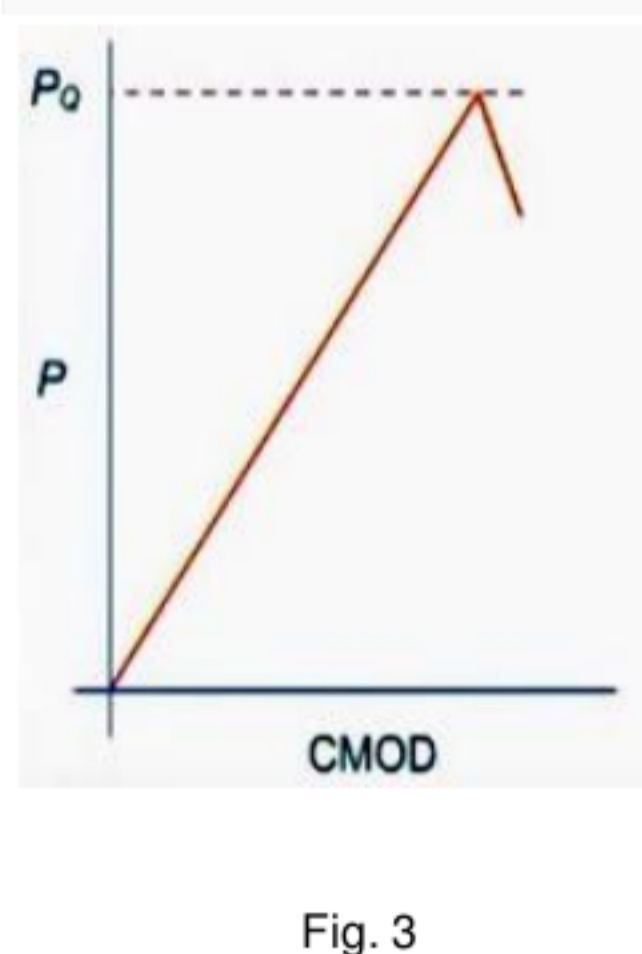
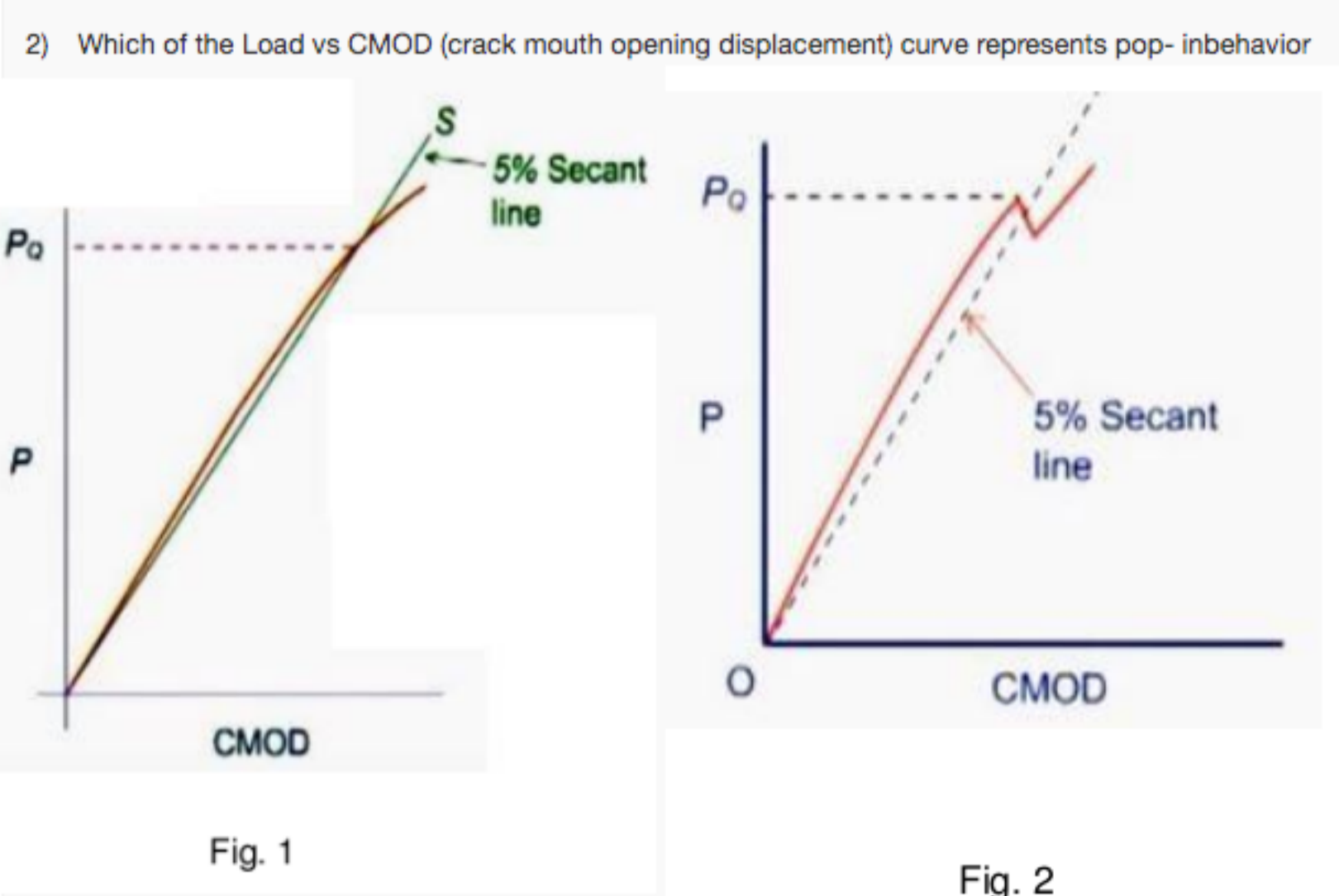
Instructions for answering numerical questions

- In all numerical type questions, you are expected to round off the answers to two decimal places accuracy unless otherwise specified.
 Examples: 1. Ans: 9.825, you report as 9.83
 2. Ans: 9.8, you report as 9.80
 3. Ans: 9, you report as 9.00
- This style of reporting is essential for computer based automated correction of your answers.
- The answers for various quantities asked are to be reported in the following units unless otherwise specified, Stress- MPa, Stress Intensity Factor- MPa/m, Strain energy- Nmm, Energy release rate- J/m², deflection - mm

1) Fracture toughness acts as a material property in 1 point

plane stress condition
 plane strain condition
 Does not depend on state of stress
 Neither in plane stress nor in plane strain condition

No, the answer is incorrect.
 Score: 0
 Accepted Answers: plane strain condition



2) Which of the Load vs CMOD (crack mouth opening displacement) curve represents pop-in behavior 1 point

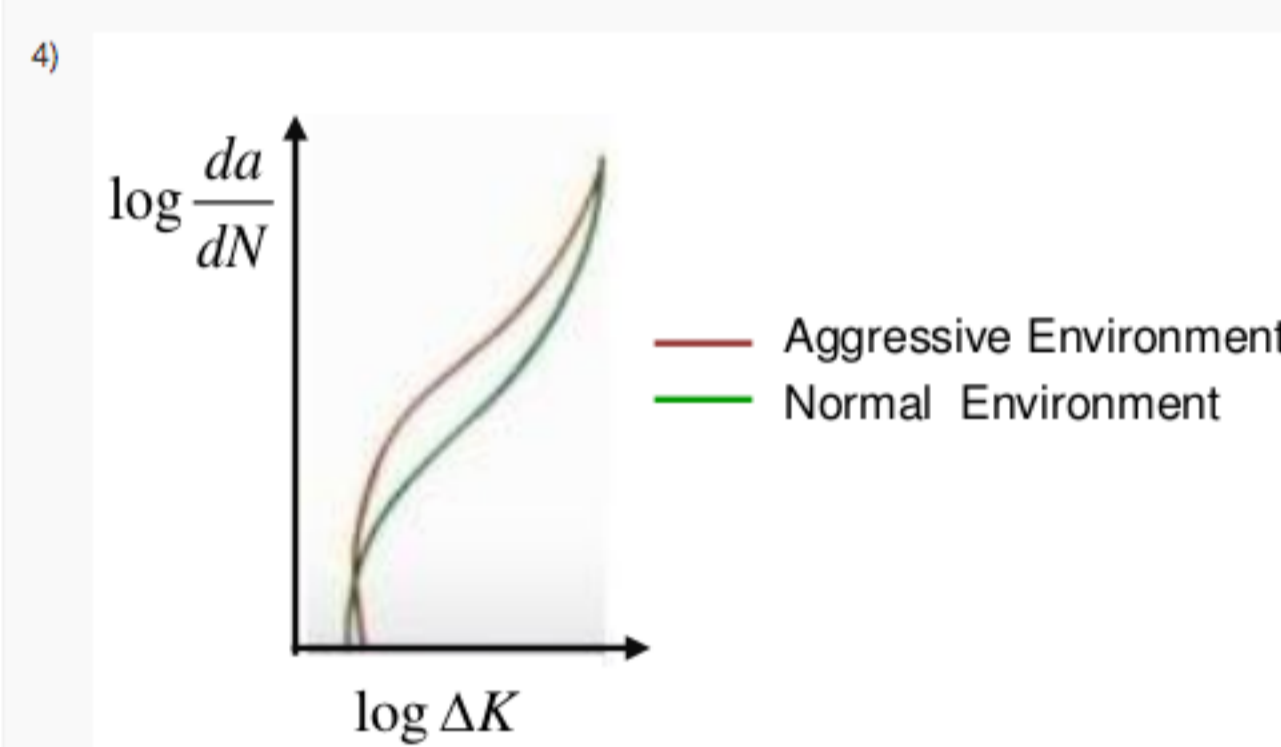
Fig. 1
 Fig. 2
 Fig. 3
 None of these

No, the answer is incorrect.
 Score: 0
 Accepted Answers: Fig. 2

3) In Fedderson's approach for obtaining Residual strength diagram, the screening criteria in terms of width of the panel 'w' and crack length '2a' is given 1 point

$2a > \frac{w}{3}$
 $2a < \frac{w}{3}$
 $2a < \frac{w}{6}$
 $2a > \frac{w}{6}$

No, the answer is incorrect.
 Score: 0
 Accepted Answers: $2a < \frac{w}{3}$



4) What condition would have caused a deviation as shown in the figure to the Sigmoidal curve 1 point

Liquid environments that causes stress corrosion
 Corrosion products contributing to crack closure
 Gaseous environment usually hydrogen
 None of these

No, the answer is incorrect.
 Score: 0
 Accepted Answers: Corrosion products contributing to crack closure

5) Which of the statements regarding the plane stress Fracture toughness testing are false 2 points

A) Compact tension specimen can be used for evaluating plane stress fracture toughness
 B) No standard specimen has yet been proposed for the test.
 C) Plane stress specimens must be fatigue cracked.
 D) A saw cut itself changes into a real crack due to stable fracture.
 E) Plane stress fracture toughness is independent of panel width.

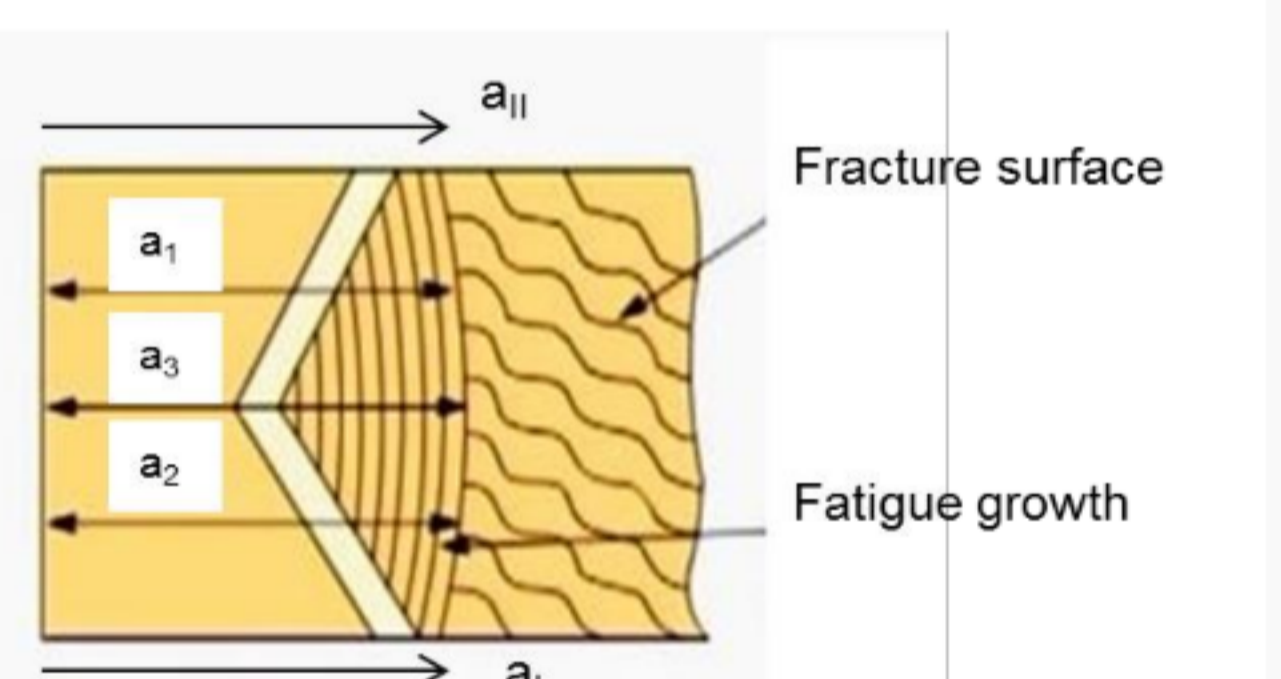
B, D, E
 A, C, D
 B, C, D, E
 A, C, E

No, the answer is incorrect.
 Score: 0
 Accepted Answers: A, C, E

6) In the Fedderson's residual strength diagram, the extension of tangent from the yield strength of the material meets the crack length axis at a value of 210 mm. If the toughness of the specimen material is $89 MPa(m)^{1/2}$, what is the yield strength of the material in MPa 2 points

No, the answer is incorrect.
 Score: 0
 Accepted Answers: (Type: Range) 395.00,405.00

7) From the figure of broken CT specimen with the Chevron notch after the fracture toughness test given below, select the statements that satisfies the acceptance criteria of crack length 0 points



A) The difference between any of the three crack size measurements among a_1, a_2, a_3 should not exceed 15% of average of a_1, a_2, a_3
 B) a_1 or a_1 should not differ more than 15% of average of a_1, a_2, a_3
 C) $|a_1 - a_1|$ should not exceed 10% of average of a_1, a_2, a_3
 D) The difference between any of the three crack size measurements among a_1, a_2, a_3 should not exceed 10% of average of a_1, a_2, a_3

A, C, E
 B, C, D, E
 A, B, C
 A, C, D, E

No, the answer is incorrect.
 Score: 0
 Accepted Answers: B, C, D, E

A three-point bend specimen ($\sigma_{ys} = 1100 MPa, E = 220 GPa$) was tested according to the ASTM E399 procedure. The specimen dimensions were $S = 40 mm, W = 120 mm,$ and $B = 50 mm$. The specimen was tested at a loading rate ($\Delta P/\Delta t$) of $110 kN/min$. A Chevron starter notch was machined and the specimen was subjected to 30,000 cycles at $P_{max} = 50 kN$ and $P_{min} = 0$. The final stage of fatigue crack growth was conducted for 50,000 cycles at $P_{max} = 40 kN$ and $P_{min} = 0$. The maximum load and the secant load of the test record were measured as $P_{max} = 95 kN$ and $P_Q = 90 kN$. Take average crack length, $a = 60 mm$. The candidate fracture toughness K_{IQ} is given by:

$$K_{IQ} = \frac{P_Q S}{B W^{3/2}} \left[\frac{a}{W} \right]^{1/2} \left[1.99 - \frac{a}{W} \left(1 - \frac{a}{W} \right) \left(2.15 - 3.93 \frac{a}{W} + 2.7 \left(\frac{a}{W} \right)^2 \right) \right]$$

$$2 \left(1 + 2 \frac{a}{W} \right) \left(1 - \frac{a}{W} \right)^{3/2}$$

8) The value of K_{max}/E is $\times 10^{-3} (m)^{1/2}$ 2 points

No, the answer is incorrect.
 Score: 0
 Accepted Answers: (Type: Range) 3.00,4.00

9) The value of $\Delta K_{IY}/\Delta t$ is $MPa(m)^{1/2} s^{-1}$ 2 points

No, the answer is incorrect.
 Score: 0
 Accepted Answers: (Type: Range) 0.88,0.99

10) Comment whether K_{IQ} qualifies as K_{IC} ? 1 point

Yes
 No

No, the answer is incorrect.
 Score: 0
 Accepted Answers: Yes

For a 450 mm wide centre cracked panel of thickness 16 mm, fracture toughness is $87.5 MPa(m)^{1/2}$ and yield stress is $400 MPa$

11) What is the minimum panel width (in mm) 1 point

No, the answer is incorrect.
 Score: 0
 Accepted Answers: (Type: Range) 200.00,210.00

12) For a crack length $2a = 50 mm$, the residual strength in MPa is given by: 2 points

No, the answer is incorrect.
 Score: 0
 Accepted Answers: (Type: Range) 295.00,305.00

13) Will a crack length of 150 mm lie in one of the two straight portions or in the curved portion of the Fedderson's diagram 2 points

straight
 curve

No, the answer is incorrect.
 Score: 0
 Accepted Answers: curve