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Courses » Compliant Mechanisms : Principles and Design

Announcements Course Ask a Question Progress

Unit 10 - Week 8: Non-dimensional analysis of compliant mechanisms and kinetoelastic maps



Course outline

How to access the home page?

Assignment 0

Week 1: Overview of compliant mechanisms; mobility analysis.

Week 2: Modeling of flexures and finite element analysis

Week 3: Large-displacement analysis of a cantilever beam and pseudo rigid-body modeling

Week 4: Analysis and synthesis using pseudo rigid-body models

Week 5: Structural optimization approach to "design for deflection" of compliant mechanisms

Week 6: Designing compliant mechanisms using continuum topology optimization; distributed compliance

Week 7: Spring-lever (SL) and

Assignment Week 8

The due date for submitting this assignment has passed. **Due on 2018-03-21, 23:59 IST.**
As per our records you have not submitted this assignment.

1) Match the following

1 point

Elliptic Integrals	Expressions
i I kind (incomplete)	a) $\int_0^{\pi/2} \sqrt{1-p^2 \sin^2 \phi} d\phi = \mathbf{E}(p, \pi/2)$
ii I kind (complete)	b) $\int_0^{\phi^*} \sqrt{1-p^2 \sin^2 \phi} d\phi = \mathbf{E}(p, \phi^*)$
iii II kind (incomplete)	c) $\int_0^{\phi^*} \frac{d\phi}{\sqrt{1-p^2 \sin^2 \phi}} = \mathbf{F}(p, \phi^*)$
iv II kind (complete)	d) $\int_0^{\pi/2} \frac{d\phi}{\sqrt{1-p^2 \sin^2 \phi}} = \mathbf{F}(p, \pi/2)$

- i-c, ii-d, iii-b, iv-a
 i-b,ii-c,iii-a, iv- d
 i-c, ii-a,iii-b, iv- d
 i-a, ii-b,iii-c, iv- d

No, the answer is incorrect.

Score: 0

Accepted Answers:

i-c, ii-d, iii-b, iv-a

2) Set up a dimensionless parameter by combining the parameters such as ρ (Density), A (Area), 1 point D (Diameter), Δp (Pressure difference) using the principles of Buckingham pi theorem.

- $\frac{\Delta p}{\rho A^3}$
 $\frac{\Delta p}{\rho A^2}$
 $\frac{\Delta p}{\rho D A}$
 None of the above

spring-mass-lever (SML) models for compliant mechanisms, and selection maps

Week 8: Non-dimensional analysis of compliant mechanisms and kinetoelastic maps

- Lec 43: Non-dimensional analysis of beams
- Lec 44: Deformation index and slenderness ratio of compliant mechanisms
- Lec 45: Kinetoelastostatic maps
- Lec 46: Designing with kinetoelastic maps
- Lec 47: Non-dimensionalization of stress, frequency, and other measures
- Lec 48: Designing compliant suspensions using kinetoelastic maps
- Quiz : Assignment Week 8
- Solutions

Week 9: Instant centre and building-block methods for designing compliant mechanisms

Week 10: Bistable compliant mechanisms and static balancing of compliant mechanisms

Week 11: Compliant mechanisms and microsystems; materials and prototyping of

No, the answer is incorrect.

Score: 0

Accepted Answers:

None of the above

3) Which of the following are sufficient to express most elastic responses of beam-based compliant mechanisms in non-dimensionalized form? **1 point**

$$\frac{FL^2}{Ebd^3}$$

$$\frac{L}{d}$$

$$\frac{FL^2}{Ebd^3}, \frac{L}{d}$$

$$\frac{L}{b}$$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$\frac{FL^2}{Ebd^3}, \frac{L}{d}$$

4) Assertion: The KES maps obtained for the bending of cantilever beam through analytical equations exactly matches with nonlinear finite elemental analysis. **1 point**

Reasoning: The analytical equations accounts for all deformations including axial stretching.

- Assertion and reasoning are correct and the assertion follows from the reasoning.
- Assertion and reasoning are correct but the assertion does not follow from the reasoning.
- Assertion is correct but the statement in the reasoning is incorrect.
- Assertion is wrong and so is the reasoning.

No, the answer is incorrect.

Score: 0

Accepted Answers:

Assertion is wrong and so is the reasoning.

5) Mark the following statements as true or false. **1 point**

The cross-section profile of a mechanism does not affect the kinetoelastic maps as long as the inertia is not altered.

- True
- False

No, the answer is incorrect.

Score: 0

Accepted Answers:

True

6) Find the width b for the suspension shown in figure 6a using the KES maps given in figure 6b **1 point**

Data: $K = 1 \text{ N/m}$

Force = $1 \times 10^{-6} \text{ N}$

Young's modulus = 84.5 GPa

$s = 100$

$l = 1 \text{ mm}$



compliant mechanisms

Week 12: Six case-studies of compliant mechanisms

MATLAB Online Access

MATLAB: Introduction to MATLAB

MATLAB: Vector and Matrix Operations

MATLAB: Advanced Topics

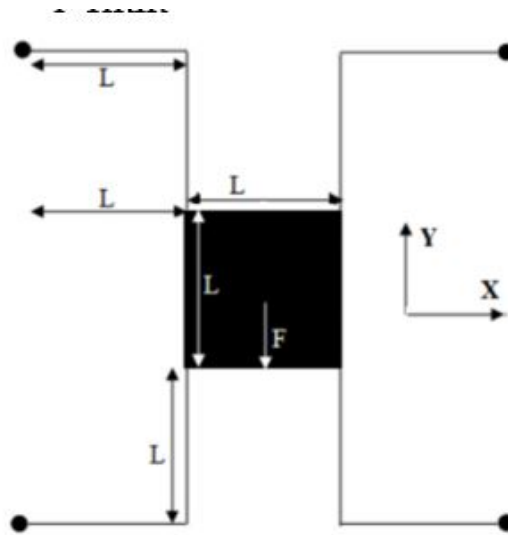


Figure 6a

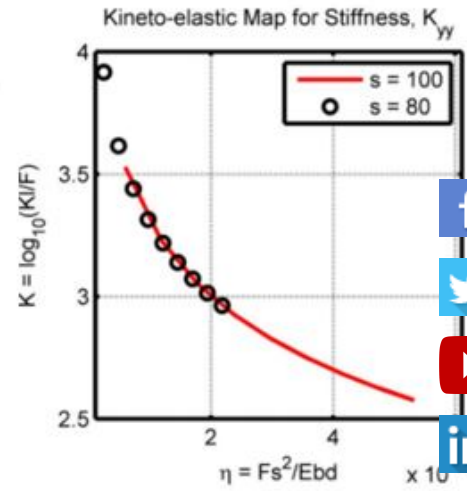


Figure 6b



- 2570nm
- 5917 nm
- 8750 nm
- 9750 nm

No, the answer is incorrect.

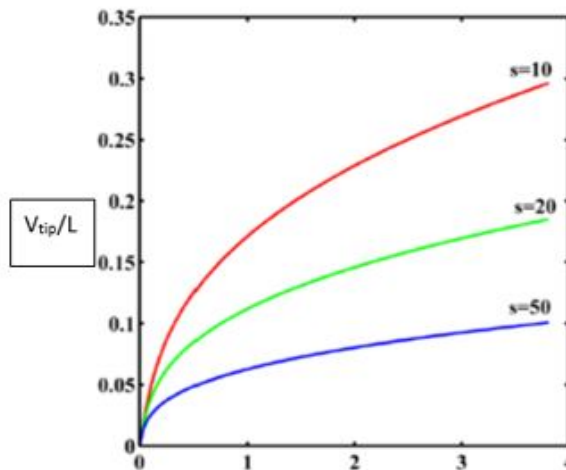
Score: 0

Accepted Answers:

5917 nm

7) If $L = 0.5$ m, $b = 5$ cm, $d = 2.5$ cm, $E = 100$ GPa, and $F = 0.625$ MN, what is the transverse displacement of the tip (closest value)?

1 point



$$\eta = \frac{Fs^2}{Ebd}$$



- 8 cm
- 15 cm
- 8 mm
- 75 mm

No, the answer is incorrect.

Score: 0

Accepted Answers:

75 mm

8) Which statement is true among the following

1 point

- KES maps are not affected by the scale of the mechanism
- Inherent nonlinearity is accounted in KES maps
- Both A and B
- Neither A nor B

No, the answer is incorrect.

Score: 0

Accepted Answers:

Both A and B

9) Which of the following equations supports the assumption of no axial deformation in non-dimensional analysis

1 point

$$\int_0^L ds = L = \int_0^{\theta_L} \frac{d\theta}{\sqrt{\frac{2F}{EI} (\sin \theta_L - \sin \theta)}}$$

$$\int_0^{\theta_L} \frac{d\theta}{\sqrt{(\sin \theta_L - \sin \theta)}} = \sqrt{2\eta}$$

- Both A and B
- Neither A nor B

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$\int_0^L ds = L = \int_0^{\theta_L} \frac{d\theta}{\sqrt{\frac{2F}{EI} (\sin \theta_L - \sin \theta)}}$$

10) Mark the following statements as true or false.

1 point

The more the axial deformation in a mechanism, the narrower the KES maps

- True
- False

No, the answer is incorrect.

Score: 0

Accepted Answers:

False

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