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Courses » Compliant Mechanisms : Principles and Design

Announcements

Course

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Unit 5 - Week 3: Large-displacement analysis of a cantilever beam and pseudo rigid-body modeling

Course outline

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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

- Lec 13: Deformation of a cantilever under a tip-load, using elliptic integrals
- Lec 14: Elliptic integrals and their use in elastica analysis
- Lec 15: Frisch-Fay's approach to large deformation of beam
- Lec 16: Burns-Crossley's kinematic model
- Lec 17: Howell-Midha's elastic model
- Lec 18: Putting together the pseudo rigid-body model
- Quiz : Assignment Week 3
- Solutions

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

Assignment Week 3

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2018-02-14, 23:59 IST.

1) A Pseudo Rigid Body (PRB) model of a compliant parallel-stage mechanism...

1 point

- is similar to that of a cantilever beam.
- is similar to that of a fixed-fixed beam.
- contains two half-PRBs.
- contains four half-PRBs.

No, the answer is incorrect.

Score: 0

Accepted Answers:

contains four half-PRBs.

2) The complete elliptical integrals $F(k)$ are special cases of the incomplete elliptical integrals $F(\phi, k)$, when ϕ is

1 point

- $\pi/4$
- $\pi/2$
- π
- $2/\pi$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$\pi/2$

3) *Assertion:* The large-displacement behavior of a cantilever beam with end load can be obtained as an elliptical integral solution.

1 point

Reasoning: The beam equation can be converted to a single-variable equation for linearly elastic, inextensible, rigid-in-shear, and of constant-cross-section conditions.

- Assertion is correct but not the reasoning.
- Assertion is incorrect but the reasoning is correct.
- Neither assertion nor reasoning is correct.
- Both assertion and reasoning are correct.

No, the answer is incorrect.

Score: 0

Accepted Answers:

Both assertion and reasoning are correct.

4) A complete integral of I kind is given by:

1 point

- $$F(p, \phi) = \int_0^{\phi} \frac{d\phi}{\sqrt{1-p^2 \sin^2 \phi}}$$
- $$F(p, \pi/2) = \int_0^{\pi/2} \frac{d\phi}{\sqrt{1-p^2 \sin^2 \phi}}$$
- $$E(p, \phi) = \int_0^{\phi} \sqrt{1-p^2 \sin^2 \phi} d\phi$$

Week 7: Spring-lever (SL) and spring-mass-lever (SML) models for compliant mechanisms, and selection maps

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

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 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

$$E(p, \pi/2) = \int_0^{\pi/2} \sqrt{1 - p^2 \sin^2 \phi} d\phi$$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$$F(p, \pi/2) = \int_0^{\pi/2} \frac{d\phi}{\sqrt{1 - p^2 \sin^2 \phi}}$$

5) The non-dimensional quantity $\eta = \frac{FL^2}{EI}$ is an index of

- Transverse displacement
- Stretching
- Bending
- Axial displacement

No, the answer is incorrect.
Score: 0

Accepted Answers:

Bending

6) The next five questions are based on the following figure.



1 point
b = 2 r
d = 4 r
L = 50 r
E = 2.2
P = 5 N

For a cantilever beam as shown in the figure, the index of bending is

- 0.2837
- 0.5326
- 0.7298
- 1

No, the answer is incorrect.
Score: 0

Accepted Answers:

0.5326

7) In a pseudo rigid body model of a cantilever beam, the torsion spring is attached at what distance(mm) from the fixed end of the beam **1 point**

- 8.33
- 12.40
- 41.67
- 37.50

No, the answer is incorrect.
Score: 0

Accepted Answers:

8.33

8) The torsion stiffness κ at the joint in Nm is given by **1 point**

- 1.056
- 3.168
- 10.56
- 31.68

No, the answer is incorrect.
Score: 0

Accepted Answers:

1.056

9) The equation of the locus of the loaded tip of the cantilever in a rectangular coordinate system is **1 point**
Note: Take the origin (0,0) at the fixed end of the cantilever beam.

$$x^2 + y^2 = 50^2$$

$$\frac{1}{x^2} + \frac{1}{y^2} = 50^2$$

$$x^2 + y^2 = \left(\frac{125}{3}\right)^2$$

$$\left(x - \frac{25}{3}\right)^2 + y^2 = \left(\frac{125}{3}\right)^2$$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$\left(x - \frac{25}{3}\right)^2 + y^2 = \left(\frac{125}{3}\right)^2$$

10)The pseudo rigid-body model is based on:

- A. Kinematic approximation: The locus of deflection of the loaded tip traces a circular arc for small deformations only.
 B. Elastostatic approximation: The resistance to deflection of the beam is captured with a torsion spring whose stiffness is constant over a small range only.

- Only A is correct.
 Only B is correct.
 Both A and B are correct.
 Both A and B are incorrect.

No, the answer is incorrect.

Score: 0

Accepted Answers:

Both A and B are incorrect.



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