Q1. Choose the correct alternative by examining the assertions and reasoning:

Assertions: (i) The equation governing buckling of a column is an eigenvalue problem.

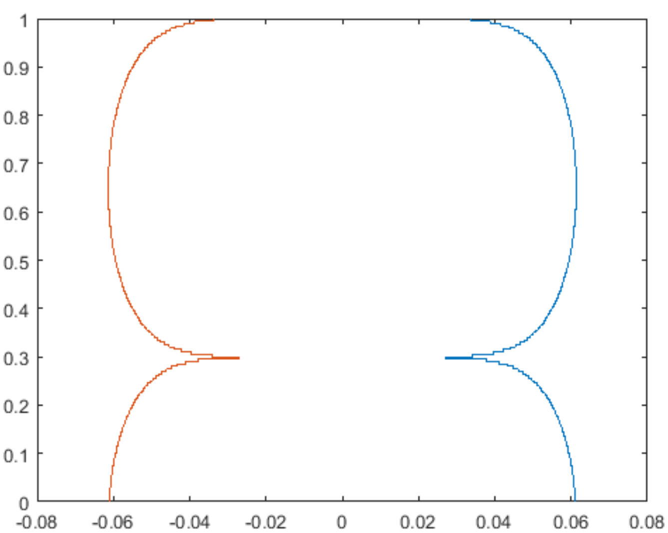
(ii) There is always a unique solution for pinned-pinned column under a compressive load.

Reasoning: An eigenvalue problem has a unique solution.

a) Both assertions are correct and the reasoning is correct.
b) Both assertions are correct but the reasoning is not correct.
c) Assertion (i) is correct but not the second.
d) Assertion (ii) is correct but not the first.

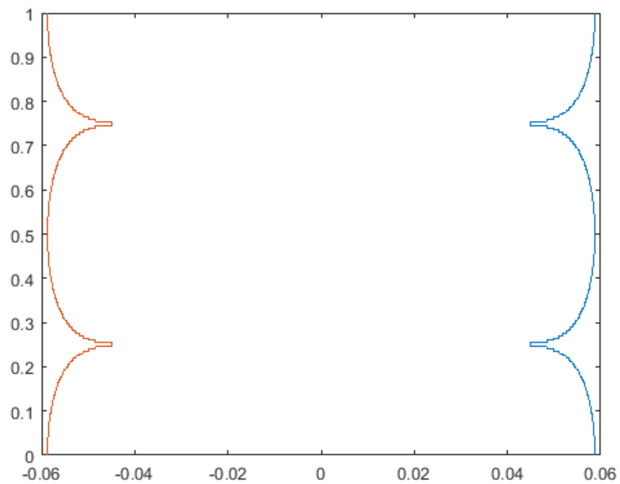
Download Matlab code based on optimality criterion for column buckling problem. Study and run the code for different boundary conditions and identify the boundary conditions of the optimal columns given in Questions 2-5.

Q2.



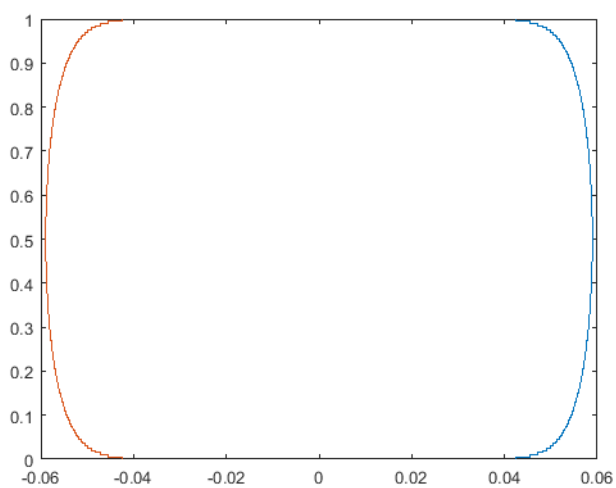
a) Fixed-fixed
b) Fixed-free
c) Pinned-pinned
d) Fixed-guided

Q3.



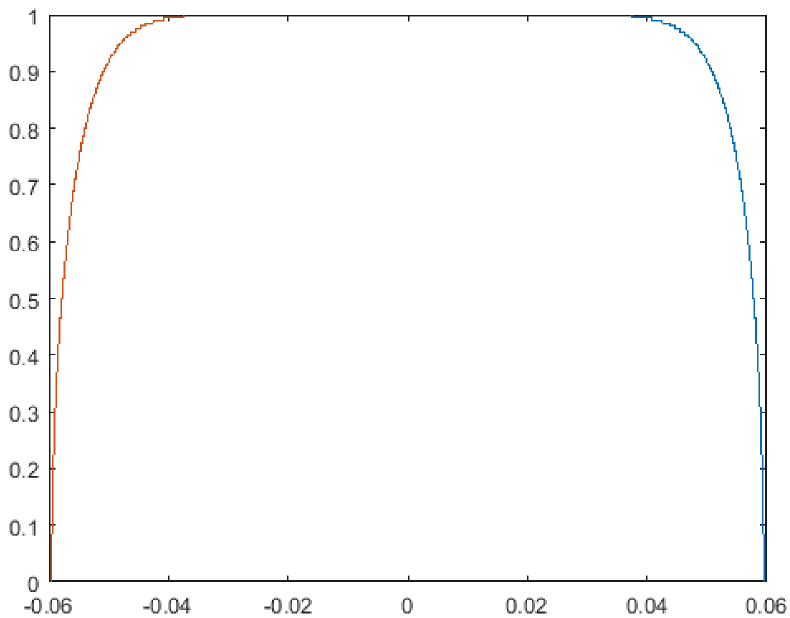
a) Fixed-fixed
b) Fixed-free
c) Pinned-pinned
d) Fixed-guided

Q4.



a) Fixed-fixed
b) Fixed-free
c) Pinned-pinned
d) Fixed-guided

Q5.



a) Fixed-fixed
b) Fixed-free
c) Pinned-pinned
d) Fixed-guided

Q6. Which one of the following expression indicates dynamic compliance of beam under transverse loading q(x,t) and transverse displacement w(x,t)?

a) $\int_0^L qw\,dx$
b) $\int_0^L \frac{1}{2} qw^2 dx$
c) $\int_0^T \int_0^L qw\,dx\,dt$
d) $\int_0^T \int_0^L \frac{1}{2} qw^2 dx\,dt$

Q7. Choose the correct alternative by examining the assertions and reasoning:

Assertions: (i) In electro-thermal-elastic structural optimization, the analysis for computing the state variables should be done in the sequence: electrical, thermal, and then elastic.

(ii) Adjoint variables for the same problem are to be computed in the reverse sequence: elastic, thermal, and then electrical.

Reasoning: The rationale for computing state and adjoint variables in the aforementioned sequence is computational efficiency.

a) Both assertions are correct and the reasoning is correct.
b) Both assertions are correct but the reasoning is not correct.
c) Assertion (i) is correct but not the second.
d) Assertion (ii) is correct but not the first.

Idenitfy the extremization problem(s) of the differential equations given in Questions 8-10.

A. $\underset{x(t)}{\text{Extremize}}\ J = \int_{t_1}^{t_2} \left(\frac{1}{2} m\dot{x}^2 - \frac{1}{2} kx^2 \right) dt$

B. $\underset{x(t)}{\text{Extremize}}\ J = \int_{t_1}^{t_2} e^{\frac{b}{m}t} \left(\frac{1}{2} m\dot{x}^2 - \frac{1}{2} kx^2 \right) dt$

C. $\underset{x(t),y(t)}{\text{Extremize}}\ J = \int_{t_1}^{t_2} \left(m\dot{x}\dot{y} - \frac{b}{2}(y\dot{x} - x\dot{y}) - kxy \right) dt$

D. $\underset{x(t)}{\text{Extremize}}\ J = \int_{t_1}^{t_2} \left(\frac{1}{2} m\dot{x}^2 - Fx \right) dt$

Q8. $F + m\ddot{x} = 0$

a) D
b) C
c) B
d) A

Q9. $m\ddot{x}+b\dot{x}+kx=0$

a) A and B
b) C and D
c) A and C
d) B and C

Q10. $m\ddot{x}+kx=0$

a) A
b) B
c) C
d) D