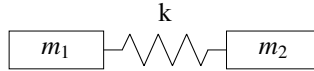
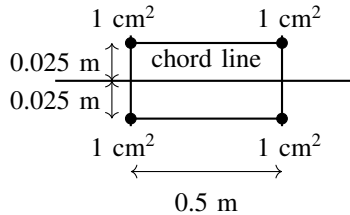




- 4) For the spring-mass system shown below, the natural frequencies are (GATE AE 2009)

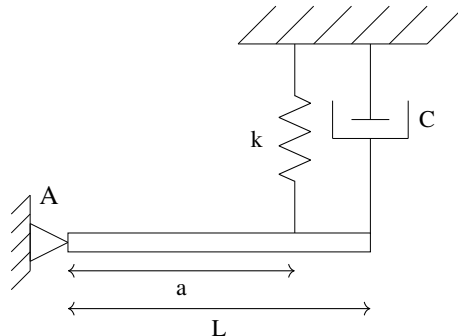


- a) 0 and  $\sqrt{\frac{k(m_1+m_2)}{m_1 m_2}}$       c) 0 and  $\sqrt{\frac{k}{(m_1+m_2)}}$   
 b) 0 and  $\sqrt{\frac{k(m_1+m_2)}{2m_1 m_2}}$       d) 0 and  $\sqrt{\frac{k}{2(m_1+m_2)}}$
- 5) The buckling load for a simply supported column of rectangular cross section of dimensions 1 cm  $\times$  1.5 cm and length 0.5 m made of steel ( $E = 210 \times 10^9$  N/m<sup>2</sup>) is approximately (GATE AE 2009)
- a) 10 kN      b) 4 kN      c) 23 kN      d) 46 kN
- 6) A wing root cross section is idealized using lumped areas (booms) as shown below.



The wing root bending moment in steady level flight is  $M_y = 10$  N-m. If the airplane flies at a load factor  $n = 3.5$ , the maximum bending stress at the root is: (GATE AE 2009)

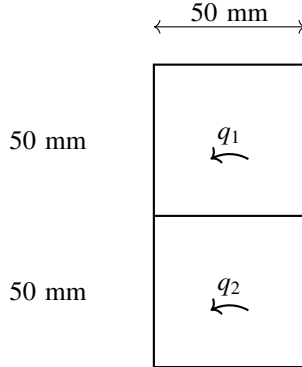
- a)  $1 \times 10^6$  N/m<sup>2</sup>      b)  $3.5 \times 10^6$  N/m<sup>2</sup>      c)  $7 \times 10^6$  N/m<sup>2</sup>      d)  $0.286 \times 10^6$  N/m<sup>2</sup>
- 7) A uniform rigid bar of mass  $m = 1$  kg and length  $L = 1$  m is pivoted at A. It is supported by a spring of stiffness  $k = 1$  N/m and a viscous damper of damping constant  $C = 1$  N-s/m, with  $a = \frac{1}{\sqrt{3}}$  m as shown below. The moment of inertia of the rigid bar is  $I_A = \frac{mL^2}{3}$ .



The system is:

(GATE AE 2009)

- Overdamped
  - Underdamped with natural frequency  $\omega_n = 1 \text{ rad/s}$
  - Critically damped
  - Underdamped with natural frequency  $\omega_n = 2 \text{ rad/s}$
- 8) A 2-celled tube with wall thickness 0.5 mm is subjected to a torque of 10 N-m. The resulting shear flows in the two cells are  $q_1$  and  $q_2$  as shown below.



The torque balance equation (Bredt-Batho formula) for this section leads to: (GATE AE 2009)

- $q_1 - q_2 = 2000 \text{ N/m}$
  - $q_1 + 2q_2 = 2000 \text{ N/m}$
  - $q_1 + q_2 = 2000 \text{ N/m}$
  - $2q_1 + q_2 = 2000 \text{ N/m}$
- 9) The value of the integral  $\int_0^\pi \frac{dx}{1+x+\sin x}$  evaluated using the trapezoidal rule with two equal intervals is approximately (GATE AE 2009)
- 1.27
  - 1.81
  - 1.41
  - 0.71
- 10) The product of the eigenvalues of the matrix  $\begin{pmatrix} 2 & 1 & 1 \\ 1 & 3 & 1 \\ 1 & 1 & 4 \end{pmatrix}$  is (GATE AE 2009)
- 20
  - 24
  - 9
  - 17
- 11) In the interval  $1 \leq x \leq 2$ , the function  $f(x) = e^{\pi x} + \sin \pi x$  is (GATE AE 2009)
- maximum at  $x = 1$
  - maximum at  $x = 2$
  - maximum at  $x = 1.5$
  - monotonically decreasing
- 12) The inverse Laplace transform of  $F(s) = \frac{(s+1)}{(s+4)(s-3)}$  is (GATE AE 2009)

a)  $\frac{3}{7}e^{4t} + \frac{4}{7}e^{-3t}$

b)  $\frac{3}{7}e^{-4t} + \frac{4}{7}e^{3t}$

c)  $\frac{5}{7}e^{-4t} + \frac{6}{7}e^{3t}$

d)  $\frac{5}{7}e^{4t} + \frac{6}{7}e^{-3t}$