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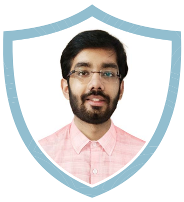

K SUNIL
IIST TRIVANDRUM
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ACHARYA INSTITUTE, B'LORE
AIR - 6

HARIHARAN R
MIT, CHENNAI
AIR - 9

VIGNESH CG
IIST TRIVANDRUM
AIR - 11

ADITYA ANIL KUMAR
IIST TRIVANDRUM
AIR - 17

And Many More ....

GATE-2023 AE

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SSN COLLEGE CHENNAI
AIR - 2

Akriti
PEC, CHANDIGARH
AIR - 6

SHREYASHI SARKAR
IIEST, SHIBPUR
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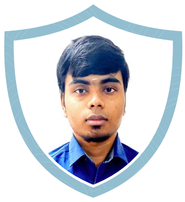

YOKESH K
MIT, CHENNAI
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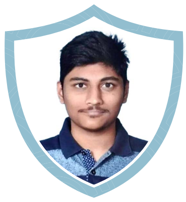

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RVCE, BANGALORE
AIR - 14

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IIEST, SHIBPUR
AIR - 4

SANJAY. S
AMRITA UNIV, COIMBATORE
AIR - 7

AKILESH . G
HITS, CHENNAI
AIR - 7

D. MANOJ KUMAR
AMRITA UNIV, COIMBATORE
AIR - 10

DIPAYAN PARBAT
IIEST, SHIBPUR
AIR - 14

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OUR PSU JOB ACHIEVERS

HAL DT ENGINEER 2023

S.S Sanjay
Amrita Univ - Coimbatore

Shashi Kanth M
Sastra Univ - Tanjore

Vagicharla Dinesh
Lovely Professional Univ - Punjab

Anantha Krishan A.G
Amrita Univ - Coimbatore

HAL DT ENGINEER 2022

Fathima J
MIT - Chennai

Mohan Kumar H
MVJCE - Bangalore

HAL DT ENGINEER 2021

Arathy Anilkumar Nair
Amrita Univ - Coimbatore

Sadsivuni Tarun
Sastra Univ - Tanjore

DRDO & ADA Scientist B

Job Position for Recruitment (2021-23) Based on GATE AE score

Abhilash K
Amrita Univ - Coimbatore

Ajitha Nishma V
IIST - Trivendrum

Dheeraj Sappa
IIEST - Shibpur

F Jahangir
MIT - Chennai

Goutham
KCG College - Chennai

M Kumar
MVJ College - Bangalore

Mohit Kudal
RTU - Kota

Niladhari Pahari
IIEST - Shibpur

Nitesh Singh
Sandip Univ - Nashik

Ramanathan A
Amrita Univ - Coimbatore

Shruti S Rajpara
IIEST - Shibpur

RAM GOPAL SONI
GVIET - PUNJAB

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DGCA Air Safety & Worthiness Officer

Job Position for Recruitment (2023)

Abhishek Shukla
FGIET - Raebareli

Aishwarya PS
BMS College - Bangalore

Anil Kumar Nakkala
Malla Reddy College - Hyderabad

Ayush Boral
KIIT - Bhubaneswar

Dhiraj Rajendra Kapte
Priyadarshini College - Nagpur

Govardhan K
RVCE - Bangalore

R Selvaraj
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ACS College - Bangalore

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Amity University - Noida

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S Komesh
Sathyabama University - Chennai

Shrenith Suhas
IIEST - Shibpur

Ankur Vats
School Of Aeronautics - Neemrana

4. Mechanical Vibrations

GATE AE - 2007

One Mark Questions.

1. A spring-mass-damper system with a mass of 1kg is found to have a damping ratio of 0.2 and a natural frequency of 5 rad/s. The damping of the system is given by

   (A) 2 Ns/m (C) 0.2 kg/s
   (B) 2 N/s (D) 0.2 N/s

2. The number of natural frequencies of an elastic beam with cantilever boundary conditions is

   (A) 1 (C) 1000
   (B) 3 (D) Infinite

Two Marks Questions.

3. A 1kg mass attached to a spring elongates it by 16 mm. The mass is then pulled from its equilibrium position by 10 mm and released from rest. Assuming the acceleration due to gravity of 9.81 m/s^2, the response of the mass in mm is given by

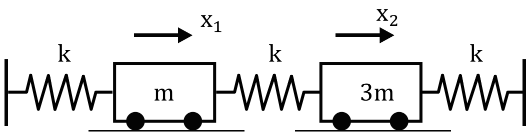
   (A) $x = 10 \sin 24.76t$ (C) $x = \sin 16t$
   (B) $x = 10 \cos 24.76t$ (D) $x = 10 \cos 16t$

4. A spring-mass-damper system is excited by a force $F_0 \sin \omega t$. The amplitude at resonance is measured to be 1 cm. At half the resonant frequency, the amplitude is 0.5 cm. The damping ratio of the system is

   (A) 0.1026 (C) 0.7211
   (B) 0.3242 (D) 0.1936

Common Data for Questions 5 and 6:

Consider the spring mass system shown in the figure below. This system has two degrees of freedom representing the motions of the two masses.



5. The system shows the following type of coordinate coupling

   (A) static coupling
   (B) dynamic coupling
   (C) static and dynamic coupling
   (D) no coupling

6. The two natural frequencies of the system are given as

   (A) $\sqrt{\frac{4 \pm \sqrt{5}}{3}\frac{k}{m}}$ (C) $\sqrt{\frac{4 \pm \sqrt{7}}{3}\frac{k}{m}}$
   (B) $\sqrt{\frac{4 \pm \sqrt{3}}{3}\frac{k}{m}}$ (D) $\sqrt{\frac{4 \pm \sqrt{11}}{3}\frac{k}{m}}$

GATE AE - 2008

One Mark Questions.

7. In a spring-mass-damper single degree of freedom system, the mass is 2 kg and the undamped natural frequency is 20 Hz. The critical damping constant of the system is

   (A) 160π N.s/m (C) 1 N.s/m
   (B) 80πN. s/m (D) 0 N.s/m

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Two Marks Questions.

8. An engineer is asked to test a system which can be idealized as SDOF (single degree of freedom) with viscous damping. A frequency response test was conducted and it is found that the quality factor Q is equal to 10. What will be the logarithmic decrement if a free vibration test is performed?

(A) $\pi/40$ (C) $\pi/10$
(B) $\pi/20$ (D) $\pi/5$

9. The equation of motion of a uniform slender beam of length L in flexural vibration is given as $EI\frac{\partial^4 w}{\partial x^4} + \rho A\frac{\partial^2 w}{\partial t^2} = 0$, where EI is the flexural rigidity, w is the lateral displacement and ρA is the mass per unit length. The beam is simply supported at the two ends $x = 0$ and $x = L$. Assuming the mode shape in fundamental mode to be $\sin\left(\frac{\pi x}{L}\right)$, the natural frequency in fundamental mode is

(A) $0.5\sqrt{\frac{EI}{\rho AL^4}}\pi^2$ (C) $2\sqrt{\frac{EI}{\rho AL^4}}\pi^2$
(B) $\sqrt{\frac{EI}{\rho AL^4}}\pi^2$ (D) $4\sqrt{\frac{EI}{\rho AL^4}}\pi^2$

GATE AE - 2009

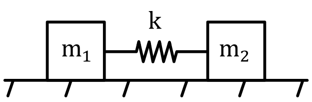
One Mark Questions.

10. For a critically damped single degree of freedom spring - mass - damper system with a damping constant c of 4 Ns/m and spring constant k of 16 N/m, the system mass m is

(A) 0.5 kg (C) 2 kg
(B) 0.25 kg (D) 4 kg

Two Marks Questions.

11. For the spring-mass system shown below, the natural frequencies are



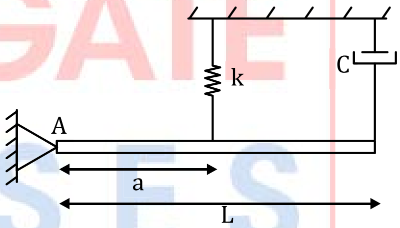
(A) 0 and $\sqrt{\frac{k(m_1+m_2)}{m_1m_2}}$

(B) 0 and $\sqrt{\frac{k(m_1+m_2)}{2m_1m_2}}$

(C) 0 and $\sqrt{\frac{k}{(m_1+m_2)}}$

(D) 0 and $\sqrt{\frac{k}{2(m_1+m_2)}}$

12. A uniform rigid bar of mass $m = 1kg$ and length L = 1m is pivoted at A. It is supported by a spring of stiffness $k = 1N/m$ and a viscous damper of damping constant $C = 1N\text{-}s/m$ with $a = 1/\sqrt{3}m$ as shown below. The moment of inertia of the rigid bar is $I_A = mL^2/3$.



The system is

(A) overdamped

(B) underdamped with natural frequency $\omega_n = 1$ rad/s

(C) critically damped

(D) underdamped with natural frequency $\omega_n = 2$ rad/s

Common Data for Questions 13 and 14

The partial differential equation for the torsional vibration of a shaft of length L, torsional rigidity GJ, and mass polar moment of inertia per unit length I, is $I\frac{\partial^2\theta}{\partial t^2} = GJ\frac{\partial^2\theta}{\partial x^2}$, where θ is the twist

13. If the shaft is fixed at both ends, the boundary conditions are:

(A) $\left.\frac{\partial\theta}{\partial x}\right|_{x=0} = 0$ and $\left.\frac{\partial\theta}{\partial x}\right|_{x=L} = 0$

(B) $\theta(0) = 0$ and $\theta(L) = 0$

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(C) $\left.\frac{\partial\theta}{\partial x}\right|_{x=0} = 0$ and $\theta L = 0$

(D) $\theta(0) = 0$ and $\left.\frac{\partial\theta}{\partial x}\right|_{x=L} = 0$

14. If the n^{th} mode shape of torsional vibration of the above shaft is $\sin\left(\frac{n\pi x}{L}\right)$ then the n^{th} natural frequency of vibration i.e., ω_n, is given by

(A) $\omega_n = \frac{n\pi}{L}\sqrt{\frac{GJ}{I}}$

(B) $\omega_n = \frac{(2n+1)\pi}{2L}\sqrt{\frac{GJ}{I}}$

(C) $\omega_n = \frac{n\pi}{2L}\sqrt{\frac{GJ}{I}}$

(D) $\omega_n = \frac{(2n+1)\pi}{L}\sqrt{\frac{GJ}{I}}$

GATE AE - 2010

Two Marks Questions.

15. During an under-damped oscillation of a single degree of freedom system, in the time-displacement plot the third peak is of magnitude 100 and the tenth peak is of magnitude 10. The damping ratio ζ is approximately:

(A) 0.052 (C) 0.366
(B) 0.023 (D) 0.159

GATE AE - 2011

One Mark Questions.

16. Consider a single degree of freedom spring-mass-damper system with mass, damping and stiffness of m, c and k, respectively. The logarithmic decrement of this system can be calculated using

(A) $\frac{2\pi c}{\sqrt{4mk - c^2}}$ (C) $\frac{2\pi c}{\sqrt{mk - c^2}}$

(B) $\frac{\pi c}{\sqrt{4mk - c^2}}$ (D) $\frac{2\pi c}{\sqrt{mk - 4c^2}}$

17. Consider a single degree of freedom spring-mass system of spring stiffness k_1 and mass m which has a natural frequency of 10 rad/s. Consider another single degree of freedom spring-mass system of spring stiffness k_2 and mass m which has a natural frequency of 20 rad/s. The spring stiffness k_2 is equal to

(A) k_1 (C) $k_1/4$
(B) $2k_1$ (D) $4k_1$

GATE AE - 2012

One Mark Questions.

18. The logarithmic decrement measured for a viscously damped single degree of freedom system is 0.125. The value of the damping factor in % is closest to

(A) 0.5 (C) 1.5
(B) 1.0 (D) 2.0

Two Marks Questions.

19. The mode shapes of an un-damped two degrees of freedom system are $\{1\ \ 0.5\}^T$ and $\{1\ \ -0.675\}^T$. The corresponding natural frequencies are 0.45 Hz and 1.2471 Hz. The maximum amplitude (in mm) of vibration of the first degree of freedom due to an initial displacement of $\{2\ \ 1\}^T$(in mm) and zero initial velocities is ____.

20. The boundary condition of a rod under longitudinal vibration is changed from fixed-fixed to fixed-free. The fundamental natural frequency of the rod is now k times the original frequency, where k is

(A) 1/2 (C) $1/\sqrt{2}$
(B) 2 (D) $\sqrt{2}$

21. A spring-mass system is viscously damped with a viscous damping constant c. The energy dissipated per cycle when the system is

undergoing a harmonic vibration $X \cos \omega_d t$ is given by

(A) $\pi c \omega_d X^2$ (C) $\pi c \omega_d X$

(B) $\pi \omega_d X^2$ (D) $\pi c \omega_d^2 X$

GATE AE - 2013

One Mark Questions.

22. A damped single degree-of-freedom system is vibrating under a harmonic excitation with an amplitude ratio of 2.5 at resonance. The damping ratio of the system is ___________

GATE AE - 2014

One Mark Questions.

23. A damped single degree of freedom system whose undamped natural frequency, ω_n =10Hz, is subjected to sinusoidal external force. Power is half of the maximum for the two frequencies of 60.9469 rad/s and 64.7168 rad/s. The damping factor associated with the vibrating system (in %) is ______.

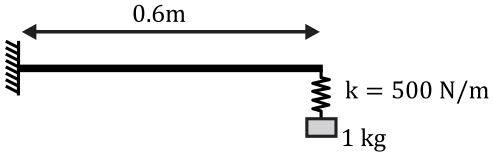
24. The boundary conditions for a rod with circular cross-section, under torsional vibration, are changed from fixed-free to fixed-fixed. The fundamental natural frequency of the fixed-fixed rod is k times that of fixed-free rod. The value of k is

(A) 1.5 (C) 2.0

(B) π (D) 0.5

Two Marks Questions.

25. 1kg mass is hanging from a spring of stiffness 500N/m attached to a massless, symmetric beam of length 0.6m, moment of inertia about the bending axis $I = 8.33 \times 10^{-10} m^4$ and Young's modulus E = 210GPa as shown in the figure. The fundamental natural frequency (in rad/s) of the system is



(A) 3.24 (C) 22.36

(B) 20.36 (D) 3.56

26. A single degree of freedom system is vibrating with initial (first cycle) amplitude of 5cm. The viscous damping factor associated with the vibrating system is 2%. Vibration amplitude of the fifth cycle (in cm) is

(A) 1.65 (C) 2.67

(B) 4.41 (D) 3.02

GATE AE - 2015

One Mark Questions.

27. A linear mass-spring-dashpot system is over-damped. In free vibration, this system undergoes

(A) non-oscillatory motion

(B) random motion

(C) oscillatory and periodic motion

(D) oscillatory and non-periodic motion

28. A 0.5 kg mass is suspended vertically from a point fixed on the Earth by a spring having a stiffness of 5 N/mm. The static displacement (in mm) of the mass is _____.

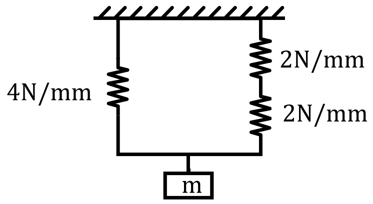
Two Marks Questions.

29. The following data is for a single degree of freedom system with viscous damping:
mass, m = 10 kg; spring stiffness, k = 2.25 k/mm; damping coefficient, c= 0.0125 Ns/mm.
The ratio of any two successive amplitudes is _________.

GATE AE - 2016

One Mark Questions.

30. The effective stiffness of the spring-mass system as shown in the figure below is ___ N/mm.



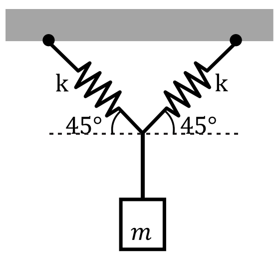
Two Marks Questions.

31. The governing differential equation of motion of a damped system is given by $m\frac{d^2x}{dt^2} + c\frac{dx}{dt} + kx = 0$. If m = 1 kg, c = 2 Ns/m and k = 2 N/m then the frequency of the damped oscillation of this system is ___ rad/s.

GATE AE - 2017

Two Marks Questions.

32. The natural frequency of the system suspended by two identical springs of stiffness k as shown in the figure is given by $\omega_n = a\sqrt{\frac{k}{m}}$ for small displacement. Both the springs make an angle of 45° with the horizontal. The value of a is ___ (in two decimal places).

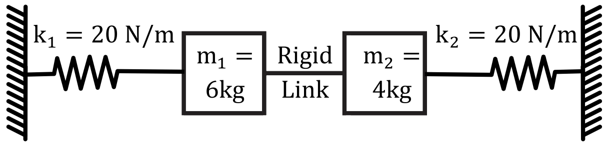


GATE AE - 2018

One Mark Questions.

33. For a damped single degree of freedom system with damping ratio of 0.1, ratio of two successive peak amplitudes of free vibration is _________ (accurate to two decimal places).

34. The natural frequency (in rad/s) of the spring-mass system shown in the figure below is ___ (accurate to one decimal place).



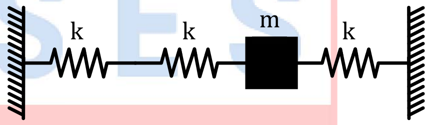
Two Marks Questions.

35. A 1 m long massless cantilever beam oscillates at 2Hz, while a 60 kg mass is attached at the tip of it. The flexural rigidity of the beam (in kN-m^2) is _____________ (accurate to two decimal places).

GATE AE - 2019

One Mark Questions.

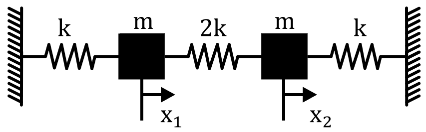
36. In the spring-mass system, shown in the figure, mass m = 3 kg and the spring stiffness k = 20 kN/m. The natural frequency of the system is _______ Hz (round off to the nearest integer).



Two Marks Questions.

37. For a damped spring-mass system, mass m = 10 kg, stiffness $k = 10^3$ N/m, and damping coefficient c = 20 kg/s. The ratio of the amplitude of oscillation of the first cycle to that of the fifth cycle is________(round off to 1 decimal place).

38. For the system of springs and masses shown below, k = 1250 N/m and m = 10 kg. The highest natural frequency, ω, of the system is ________radians/s (round off to the nearest integer).



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GATE AE - 2020

One Mark Questions.

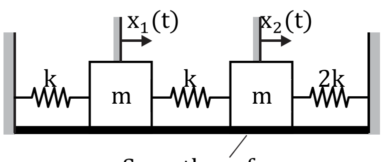
39. The natural frequency of the first mode of a rectangular cross section cantilever aluminum beam is ω rad/s. If the material and cross-section remain the same, but the length of the beam is doubled, the first mode frequency will become

(A) ω/4 rad/s (C) ω/16 rad/s
(B) 4ω rad/s (D) 16ω rad/s

Two Marks Questions.

40. A critically damped single degree of freedom spring-mass-damper system used in a door closing mechanism becomes overdamped due to softening of the spring with extended use. If the new damping ratio (ξ_{new}) for overdamped condition is 1.2, the ratio of the original spring stiffness to the new spring stiffness (k_{org}/k_{new}), assuming that the other parameters remain unchanged, is _______ (round off to two decimal places).

41. The two masses of the two degree of freedom system shown in the figure are given initial displacements of 2 cm (x_1) and 1.24 cm (x_2). The system starts to vibrate in the first mode. The first mode shape of this system is $\phi_1 = [1 \;\; a]^T$, where a = ___ (round off to two decimal places).



GATE AE - 2021

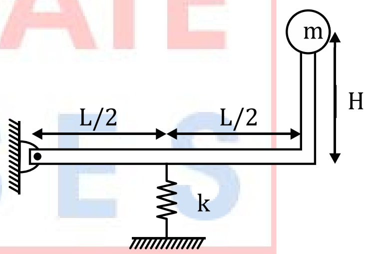
One Mark Questions.

42. A single degree of freedom spring-mass-damper system is designed to ensure that the system returns to its original undisturbed position in minimum possible time without overshooting. If the mass of the system is 10 kg, spring stiffness is 17400 N/m and the natural frequency is 13.2 rad/s, the coefficient of damping of the system in Ns/m is _______ (round off to nearest integer).

43. Two cantilever beams (Beam 1 and Beam 2) are made of same homogenous material and have identical cross sections. Beam 1 has length ℓ and Beam 2 has length 2ℓ. Ratio of the first natural frequency of Beam 1 to that of Beam 2 is _____ (round off to nearest integer).

Two Marks Questions.

44. A rigid massless rod pinned at one end has a mass m attached to its other end. The rod is supported by a linear spring of stiffness k as shown in the figure.



The natural frequency of this system is:

(A) $\frac{1}{2\pi}\sqrt{\frac{kL^2}{4m\left(L^2+H^2\right)}}$

(B) $\frac{1}{2\pi}\sqrt{\frac{kL^2}{m\left(L^2+H^2\right)}}$

(C) $\frac{1}{2\pi}\sqrt{\frac{4kL^2}{m\left(L^2+H^2\right)}}$

(D) $\frac{1}{2\pi}\sqrt{\frac{k\left(L^2+H^2\right)}{4mL^2}}$

45. A two degree of freedom spring-mass system undergoing free vibration with generalized coordinates x_1 and x_2 has natural frequencies $\omega_1 = 233.9$ rad/s and $\omega_2 = 324.5$ rad/s,

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respectively. The corresponding mode shapes are $\phi_1 = \begin{bmatrix} 1 \\ -3.16 \end{bmatrix}$ and $\phi_2 = \begin{bmatrix} 1 \\ 3.16 \end{bmatrix}$. If the system is disturbed with certain deflections and zero initial velocities, then which of the following statement(s) is/are true?

(A) An initial deflection of $x_1(0) = 6.32$ cm and $x_2(0) = -3.16$ cm would make the system oscillate with only the second natural frequency.

(B) An initial deflection of $x_1(0) = 2$ cm and $x_2(0) = -6.32$ cm would make the system oscillate with only the first natural frequency.

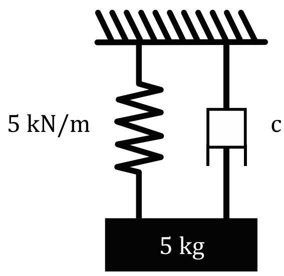
(C) An initial deflection of $x_1(0) = 2$ cm and $x_2(0) = -2$ cm would make the system oscillate with a linear combination of first and second natural frequency.

(D) An initial deflection of $x_1(0) = 1$ cm and $x_2(0) = -6.32$ cm would make the system oscillate with only the first natural frequency.

GATE AE - 2022

Two Marks Questions.

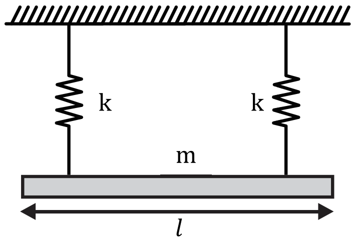
46. A damper with damping coefficient, c, is attached to a mass of 5 kg and spring of stiffness 5 kN/m as shown in figure. The system undergoes under-damped oscillations. If the ratio of the 3rd amplitude to the 4th amplitude of oscillations is 1.5, the value of c is ____ Ns/m (rounded off to the nearest integer).



47. A uniform rigid prismatic bar of total mass m is suspended from a ceiling by two identical springs as shown in figure.

Let ω_1 and ω_2 be the natural frequencies of mode I and mode II respectively ($\omega_1 < \omega_2$).

The value of ω_2/ω_1 is ________ (rounded off to one decimal place).



GATE AE - 2023

One Mark Questions.

48. Which of the following statement(s) is/are true about harmonically excited forced vibration of a single degree-of-freedom linear spring-mass-damper system?

(A) The total response of the mass is a combination of free vibration transient and steady-state response.

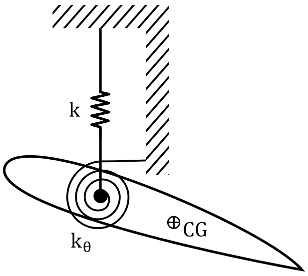
(B) The free vibration transient dies out with time for each of the three possible conditions of damping (under-damped, critically damped, and over-damped).

(C) The steady-state periodic response is dependent on the initial conditions at the time of application of external forcing.

(D) The rate of decay of free vibration transient response depends on the mass, spring stiffness and damping constant.

49. For studying wing vibrations, a wing of mass M and finite dimensions has been idealized by assuming it to be supported using a linear spring of equivalent stiffness k and a torsional spring of equivalent stiffness k_θ as shown in the figure.

The centre of gravity (CG) of the wing idealized as an airfoil is marked in the figure. The number of degree(s) of freedom for this idealized wing vibration model is ________. (Answer in integer)



Two Marks Questions.

50. A single degree-of-freedom spring-mass-damper system has viscous damping ratio of 0.1. The mass is given an initial displacement of 10 cm without imparting any velocity. After exactly two complete cycles of oscillation (i.e., after time $2T_d$, where T_d is the period of the damped vibration), the amplitude of the displacement is _____ cm. (round off to two decimal place)

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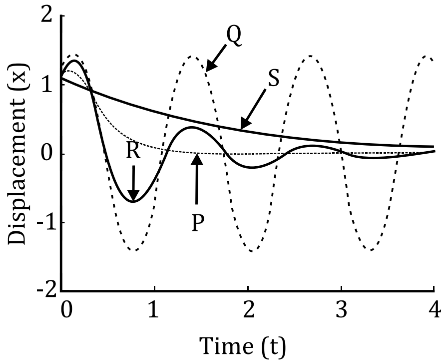
One Mark Questions.

51. Consider the free vibration responses P, Q, R and S (shown in the figure) of a single degree of freedom spring-mass-damper system with the same initial conditions. For the different damping cases listed below, which one of the following options is correct?

1. Overdamped
2. Underdamped
3. Critically damped
4. Undamped



(A) P – 1, Q – 4, R – 2, S – 3

(B) P – 1, Q – 2, R – 4, S – 3

(C) P – 3, Q – 4, R – 2, S – 1

(D) P – 3, Q – 2, R – 4, S – 1

52. For a single degree of freedom spring-mass-damper system subjected to harmonic forcing, the part of the motion (response) that decays due to damping is known as:

(A) transient response

(B) steady-state response

(C) harmonic response

(D) non-transient response

Two Marks Questions.

53. The equations of motion for a two degrees of freedom undamped spring-mass system are:

$m\ddot{x}_1 + 2kx_1 - kx_2 = 0$

$m\ddot{x}_2 - kx_1 + 2kx_2 = 0$

where m and k represent mass and stiffness respectively, in corresponding SI units, and x_1 and x_2 are the degrees of freedom. The larger of the two natural frequencies is given by: $\omega = \alpha\sqrt{k/m}$ rad/s. The value of α is _______ (rounded off to 2 decimal places).

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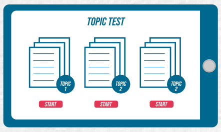

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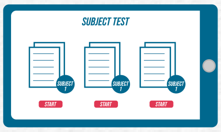

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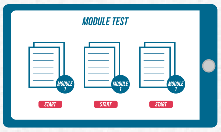

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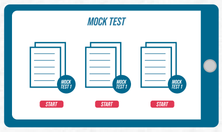

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1	A	2	D	3	B	4	D	5	A
6	C	7	A	8	C	9	B	10	B
11	A	12	A	13	B	14	B	15	A
16	A	17	D	18	D	19	2 to 2	20	A
21	A	22	0.2 to 0.2	23	2.95 to 3.05	24	C	25	B
26	D	27	A	28	0.97 to 1.01	29	1.27 to 1.32	30	5.0 to 5.0
31	0.99 to 1.01	32	0.95 to 1.05	33	1.75 to 1.95	34	2.0 to 2.0	35	3.10 to 3.20
36	16 to 16	37	12.3 to 12.6	38	25 to 25	39	A	40	1.43 to 1.45
41	0.61 to 0.63	42	264 to 264 or 833 to 835	43	4 to 4	44	A	45	B; C
46	19 to 21	47	1.7 to 1.8	48	A, B, D	49	2 to 2	50	2.80 to 2.86
51	C	52	A	53	1.72 to 1.74				

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