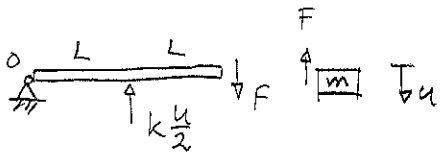
Theory exam. - 07 :

1) Free body diagram :

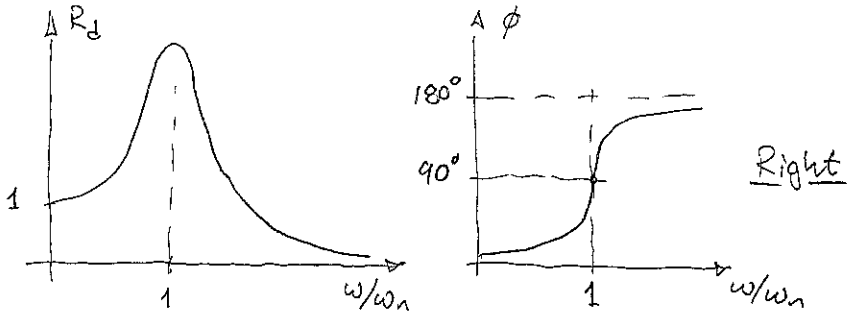


$\curvearrowleft O$: $k\frac{u}{2}\cdot L - F\cdot 2L = 0$; $F = k\frac{u}{4}$

NII : $-F = m\ddot{u}$ $\Rightarrow$ $m\ddot{u} + \frac{k}{4}u = 0$

$\omega_n^2 = \frac{k}{4m}$ wrong

2)



Right

3) The assumed deflection Ψ will be to stiff

$\Rightarrow$ $\omega_{approx} = \sqrt{\frac{k}{m}} > \omega_{exact}$ wrong

4) orthogonality : $\begin{cases} \phi_i\, m\, \phi_j = 0 & \text{if } i \neq j \\ \phi_i\, k\, \phi_j = 0 \end{cases}$

wrong

5) $(3-\lambda)^2 - 1 = 0 \Rightarrow \lambda = 2$ or $\lambda = 4$

$\lambda = \omega^2 \frac{m}{k}$ Right

Exam - 07 cont.

6) Definition Right

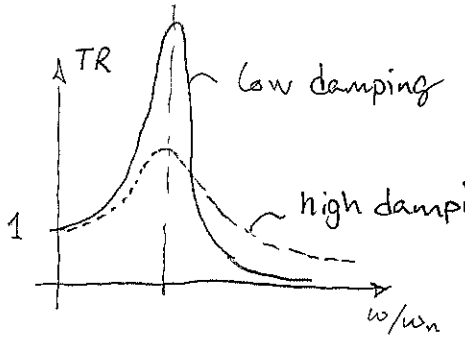
7) $u = u_0 \sin\omega t \Rightarrow (k - \omega^2 m)\, u_0 = p_0$

wrong

8) ok according to Lecture V Right

9) The statement concerns the designspectrum $\Rightarrow$ wrong

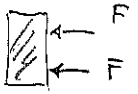
10)



$\Rightarrow$ wrong

$TR = \left|\frac{F_0}{p_0}\right|$

Theory exam – 08 :

1)  $F = ku$ $\omega^2 = \frac{3k}{m}$ Right

2) $\omega_D = \omega_n \sqrt{1-\xi^2}$ ⇒ Wrong

3) $\frac{du}{dt} \rightsquigarrow i\omega u$ ⇒ $(-\omega^2 m + i\omega c + k) u^* = p^*$

wrong

4) Approximate stiffer ⇒ Right

5) Set up $(K - \omega^2 M)\Phi = 0$

$\det(\cdot) = 0$ ⇒ $\omega_1\ \omega_2$ Wrong

6) Check $\Phi_1^T m \Phi_2$ and $\Phi_1^T K \Phi_2$ Right

7) Complex calculations are valid for stationary forced vibrations Right

8) Lecture V ⇒ $\frac{u_{i+1} - 2u_i + u_{i-1}}{(\Delta t)^2}$ (!) Wrong

9) Structural displacements Right

10) Check R_d Right

Theory exam. : 09.

1) u is total displacements ⇒

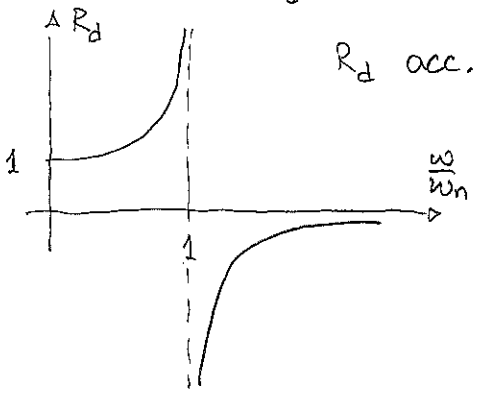
$-m\ddot{u}_g$ wrong

2) $m\ddot{u} + ku = p_0 \sin\omega t$; Put $u = u_0 \sin\omega t$

$\Rightarrow \left(-\omega^2 + \frac{k}{m}\right) u_0 = \frac{p_0}{m}$ $\quad \omega_n^2 = \frac{k}{m}$ ⇒

$u_0 = \frac{p_0}{k} \underbrace{\frac{1}{1 - \left(\frac{\omega}{\omega_n}\right)^2}}_{R_d}$ ← ?

wrong

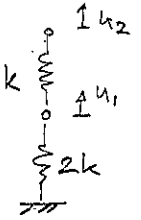
3) 

R_d acc. to 2) above

4) $m\ddot{u} + c\dot{u} + ku = 0 \rightsquigarrow \ddot{u} + 2\xi\omega_n\dot{u} + \omega_n^2 u = 0$

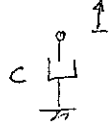
$\omega_n^2 = \frac{k}{m}$ and $\xi = \frac{c}{2m\omega_n}$ Right

ξ is the damping factor

5) 

$\begin{cases} u_1 = 1 \\ u_2 = 0 \end{cases} \Rightarrow \begin{cases} f_1 = 3k \\ f_2 = -k \end{cases}$ and $\begin{cases} u_1 = 0 \\ u_2 = 1 \end{cases} \Rightarrow \begin{cases} f_1 = -k \\ f_2 = k \end{cases}$

Right

6) Damping : 

$\Rightarrow C = \begin{bmatrix} c & 0 \\ 0 & 0 \end{bmatrix}$ wrong

7) $u = \sum_1^N \phi_i q_i$ in general Right

8) $(k - \omega^2 m)\,\phi = 0$; $\begin{bmatrix} 2-2\lambda & -1 \\ -1 & 1-\lambda \end{bmatrix} \begin{bmatrix} \phi_1 \\ \phi_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$

with $\lambda = \omega^2 \frac{k}{m}$

$\det(\cdot) = 0 \Rightarrow 2(1-\lambda)^2 - 1 = 0$; $1 - \lambda = \pm \frac{1}{\sqrt{2}}$

Right

9) Definition of classical damping Right

10) Response spectrum yields peak displacements

⇒ Wrong