

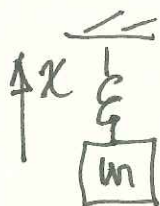
Help for Test

Sun 24 Nov: 4-6 pm SH CO2A tubing
5-6 " EPC (Daniels) MASH

Mon 25 Nov: 2-3 pm SL 115 - class
Noon-1 pm SH CO2A

Tues 26 Nov: Conf. @ 9, 10, noon, 1:00
(Crash any one!)

Test 2 - graded Mon 2 Dec - returned conf. 3 Dec
WW - Model Order 2

Test 2 topicsModels:

• Spring-mass: $mx'' + \overset{\text{damping}}{b}x' + \underset{\text{spring}}{k}x = f(t)$ wobble top



• Pendulum: $L\theta'' + g\theta = 0$

Methods: $b_2 y'' + b_1 y' + b_0 y = f(t)$

• CC, L, H - solve via Charac Eqn: $y_h = e^{rt}$

• CC, L, NH - " " UDC:

y_p "looks like" RHS

(table p. 293)

Ideas:

• Linear 2nd order DE, LI Homo Sol'n's, Gen'l Sol'n, Superposition

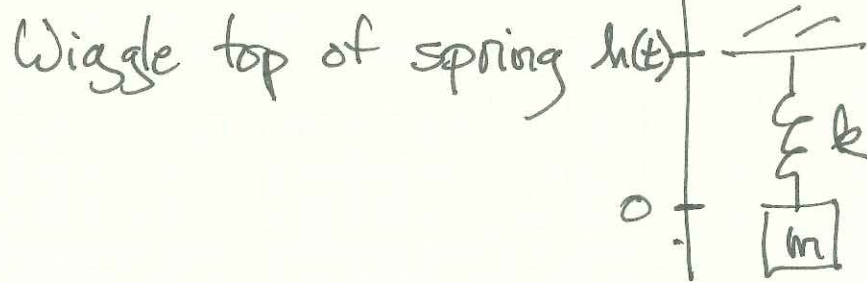
• Homo DE: growth, decay, oscillation in sol'n

• Forced DE: resonance

Osc a

 k variesNot $H - k_p$

Find forcing term:



$$mx'' + bx = k[h(t) - h(0)]$$

Osc'ns:Homogeneous
CE

1. Natural: $mx'' + bx = 0$

$L\theta'' + g\theta = 0$



$$\left. \begin{matrix} x \\ \theta \end{matrix} \right\} \stackrel{=}{\neq} e^{rt} \Rightarrow Lr^2 e^{rt} + g e^{rt} = 0$$

$$r^2 = -\frac{g}{L} \Rightarrow r = \pm i \underbrace{\sqrt{\frac{g}{L}}}_{\omega_n}$$

$$\boxed{\theta_g = C_1 \sin \underbrace{\sqrt{\frac{g}{L}} t}_{\omega_n t} + C_2 \cos \underbrace{\sqrt{\frac{g}{L}} t}_{\omega_n t}}$$

 $\omega_n = \text{natural freq.}$

Period: $\sqrt{\frac{g}{L}} t = 2\pi \Rightarrow t = 2\pi \sqrt{\frac{L}{g}}$

Non-H
UDC

2. Forcing: $b_2 y'' + b_1 y' + b_0 y = 3A \sin 19t$

$$y_p = A \cos 19t + B \sin 19t$$

Vary k - oscillations?

Undamped: $mx'' + kx = 0$

r values always pure imag, $m, k > 0$
 $\Rightarrow$ always osc.

Damped: $mx'' + px' + kx = 0$

CE: $r = \frac{-p \pm \sqrt{p^2 - 4mk}}{2m}$

$$p^2 - 4mk \begin{cases} > 0 \Rightarrow \text{real} \\ = 0 \Rightarrow \text{" , =} \\ < 0 \Rightarrow \alpha \pm i\beta \end{cases}$$