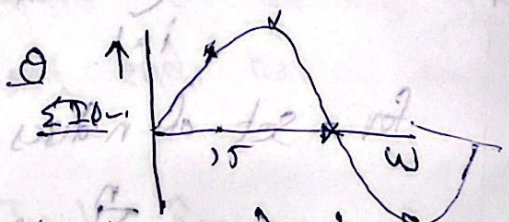
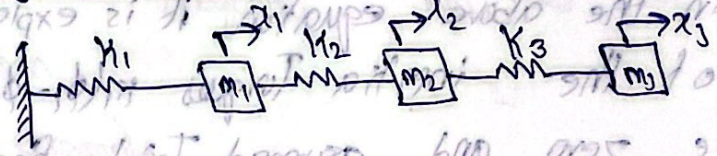
5). prepare a table.

Row	I.	ϕ	$I\phi\omega^2$	$\Sigma I\phi\omega^2$	K	$\frac{1}{K}\Sigma I\phi\omega^2$
1.	I_1	ϕ_1	$I_1\phi_1\omega^2$ →	Summation →	K_1	Summation
2.	I_2	ϕ_2	$I_2\phi_2\omega^2$ →		K_2	
3.	I_3	ϕ_3	$I_3\phi_3\omega^2$ →		K_3	
4.		ϕ_4				

and so on.



① Using Holzer method to find the natural frequency of the system shown.



Assuming the initial displacement

$x_1 = 1$

the natural frequency

$\omega = 0.30$ rad/sec

$\omega^2 = 0.3 \times 0.3$

$\lambda = \omega^2 = 0.09$

$$x_2 = x_1 - \frac{m_1 x_1 \omega^2}{K_1}$$

$$x_2 = 1 - \frac{1 \times 0.09}{1} = 0.91$$

$$x_3 = x_2 - \omega^2 \frac{(m_1 x_1 + m_2 x_2)}{K_2}$$

$$x_3 = 0.91 - 0.09 (1 + 0.91) = 0.74$$

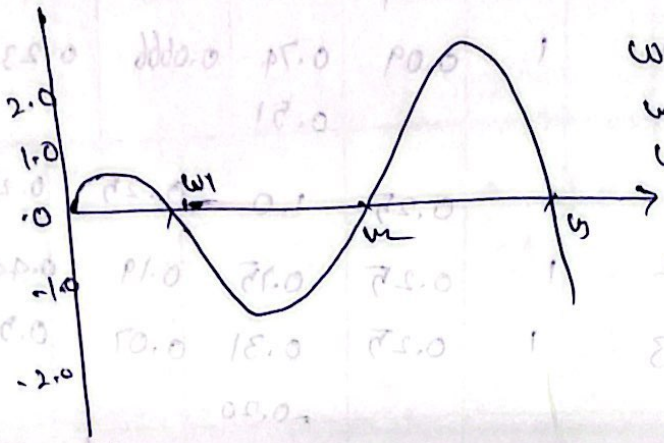
$$x_4 = x_3 - \omega^2 \frac{(m_1 x_1 + m_2 x_2 + m_3 x_3)}{K_3}$$

$$= 0.74 - 0.09 (1 + 0.91 + 0.74)$$

$$= 0.51$$

Assumed Frequency	ROW	m	$m\omega^2$	x	$mx\omega^2$	$\Sigma mx\omega^2$	K	$\frac{1}{K}\Sigma mx\omega^2$
$\omega = 0.30$	1	1	0.09	1.0	0.09	0.99	1	0.09
$\omega^2 = 0.09$	2	1	0.09	0.91	0.0819	0.17	1	0.17
	3	1	0.09	0.74	0.0666	0.23	1	0.23
				0.51				
$\omega = 0.50$	1	1	0.25	1.0	0.25	0.25	1	0.25
$\omega^2 = 0.25$	2	1	0.25	0.75	0.19	0.44	1	0.44
	3	1	0.25	0.31	0.07	0.51	1	0.51
				-0.20				
$\omega = 0.75$	1	1	0.56	1.0	0.56	0.56	1	0.56
$\omega^2 = 0.56$	2	1	0.56	0.44	0.24	0.80	1	0.80
	3	1	0.56	-0.36	-0.20	0.60	1	0.60
				-0.96				
$\omega = 1.0$	1	1	1	1	1	1	1	1
$\omega^2 = 1.0$	2	1	1	0	0	1	1	1
	3	1	1	-1	-1	0	1	0
$\omega = 1.25$	1	1	1.56	1.0	1.56	1.56	1	1.56
$\omega^2 = 1.56$	2	1	1.56	-0.56	-0.87	0.69	1	0.69
	3	1	1.56	-1.25	-1.95	-1.26	1	-1.26
				0.01				
$\omega = 1.50$	1	1	2.25	1.0	2.25	2.25	1	2.25
$\omega^2 = 2.25$	2	1	2.25	-1.25	-2.82	-0.57	1	-0.57
	3	1	2.25	-0.68	-1.53	-2.10	1	-2.10
				1.40				
$\omega = 1.75$	1	1	3.06	1.0	3.06	3.06	1	3.06
$\omega^2 = 3.06$	2	1	3.06	-2.06	-6.30	-3.24	1	-3.24
	3	1	3.06	1.18	3.61	0.36	1	0.36
				-0.81				
$\omega = 2.0$	1	1	4.0	1	4	4	1	4
$\omega^2 = 4.0$	2	1	4.0	-3	-12	-8	1	-8
	3	1	4.0	5	20	12	1	12
				-7				

Similarly other deflections can be calculated and are directly put in the table for different assumed frequency. The results for frequency are obtained by drawing a curve between ω and displacement x.



$\omega_1 = 0.44$ rad/sec
$\omega_2 = 1.24$ rad/sec
$\omega_3 = 1.80$ rad/sec

$\therefore \omega_1 = 0.44$ rad/sec
$\omega_2 = 1.24$ rad/sec
$\omega_3 = 1.80$ rad/sec.

① Two ends of a string of length l are rigidly fixed. It carries a lumped mass m at a distance a from left end. Find its natural frequency of transverse vibration of the string.

Given data:

mass of the lumped mass $= m$
length of the string $= L$.

To solve.