ENGINEERING TRIPOS PART IIB

Module 4C8 Examination, 2003

Answers

1. (b)(i)

$a_3 s^3 + a_2 s^2 + a_1 s \ + a_0 = 0,$
with
$a_3 = mI$

$$a_2 = \frac{\left(a^2 C_f + b^2 C_r\right)m + \left(C_f + C_r\right)I}{u}$$

$$a_1 = \frac{\left(C_f + C_r\right)\left(a^2 C_f + b^2 C_r\right)}{u^2} - \frac{\left(aC_f - bC_r\right)^2}{u^2} - \left(aC_f - bC_r\right)m + maC_f K$$

$$a_0 = \frac{\left(C_f + C_r\right)aC_f K}{u} - \frac{\left(aC_f - bC_r\right)C_f K}{u}$$

2. (b) $\ddot{y} + \left[\frac{uk\left(d^2 + a^2\right)}{2d^2 C}\right]\dot{y} + \left[\frac{u^2}{d}\left(\frac{\varepsilon}{r} + \frac{a^2 k^2}{4dC^2}\right)\right]y = 0$

(c) $\lambda = \dfrac{2\pi}{\sqrt{\dfrac{\varepsilon}{dr} + \dfrac{a^2 k^2}{4d^2 C^2}}}$

(d) $\varsigma = \dfrac{1 + a^2/d^2}{4C}\left[\dfrac{k}{\sqrt{\dfrac{\varepsilon}{dr} + \dfrac{a^2 k^2}{4d^2 C^2}}}\right]$

3. (c) $c = \sqrt{\dfrac{\left(m_s + m_u\right)^3 k^2 - 2kk_t m_u m_s\left(m_s + m_u\right) + m_u m_s^2 k_t^2}{\left(m_s + m_u\right)^2 k_t}}$

(d) $\dfrac{1}{2}\dfrac{k_t}{k} = 1 + \dfrac{m_u}{m_s}$

4. (b) $k = U^2 \dfrac{2I\pi^2}{a^2 L^2}$

(c) $I = ma^2\left(n_2 + \dfrac{1}{2}\right)^2$