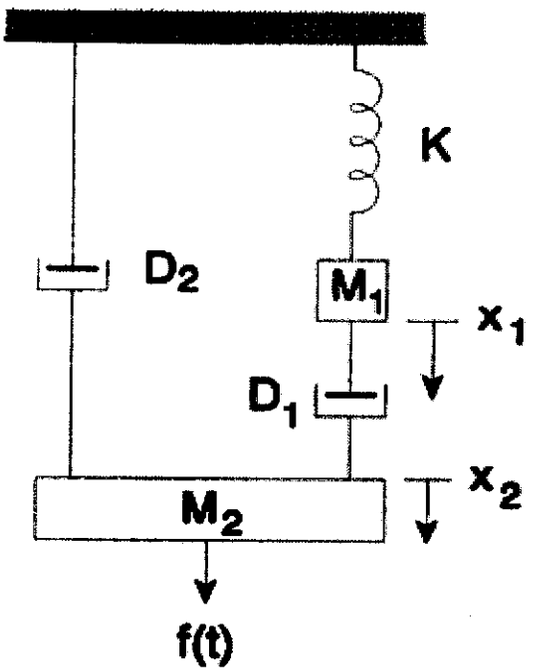
KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
ELECTRICAL ENGINEERING DEPARTMENT

EE380 [091] sec # _____		quiz # 3
Name: Key Solution	ID: _____	Grade: _____

Determine the transfer function $X_2(s)/F(s)$



$$M_1\ddot{x}_1 + D_1(\dot{x}_1 - \dot{x}_2) + Kx_1 = 0$$

$$(M_1 s^2 + D_1 s + K)X_1(s) = D_1 s X_2(s) \quad (*)$$

$$M_2\ddot{x}_2 + D_2\dot{x}_2 + D_1(\dot{x}_2 - \dot{x}_1) = F(t)$$

$$[M_2 s^2 + (D_1 + D_2)s]X_2(s) - D_1 s X_1(s) = F(s) \quad (**)$$

From $(*)$ $\quad X_1(s) = \dfrac{D_1 s}{M_1 s^2 + D_1 s + K} X_2(s)$

Substitute into $(**)$

$$[M_2 s^2 + (D_1 + D_2)s]X_2(s) - \frac{(D_1 s)^2}{M_1 s^2 + D_1 s + K} X_2(s) = F(s)$$

$$(s^2 M_2 + sD_2 + sD_1)X_2(s) - sD_1 X_1(s) = F(s)$$

$$-sD_1 X_2(s) + (s^2 M_1 + sD_1 + K)X_1(s) = 0 \qquad 1$$

If we want to obtain the transfer function relating $X_2(s)$ to $F(s)$, we simply solve equation 1 for $X_2(s)$. This gives us

$$\frac{X_2(s)}{F(s)} = \frac{s^2 M_1 + sD_1 + K}{(s^2 M_1 + sD_1 + K)(s^2 M_2 + sD_2 + sD_1) - s^2 D_1^2}$$