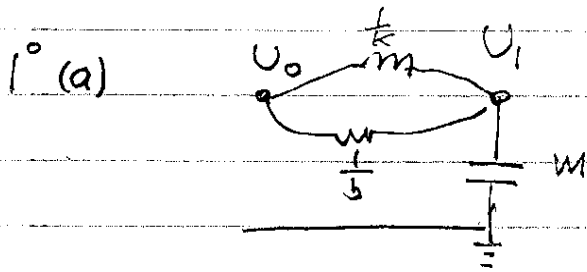


Solu



$$\frac{U_1}{U_0} = \frac{\frac{1}{ms}}{\frac{s}{k} \parallel \frac{1}{b} + \frac{1}{ms}} = \frac{bs+k}{s^2m+bs+k}$$

(b)

$$\left. \begin{aligned} y = h(x) &= h_0 \cos\left(\frac{2\pi}{L} x\right) \\ x &= U_{vech} t \end{aligned} \right\} y(t) = h_0 \cos\left[\frac{2\pi}{L} U_{vech} t\right]$$

$$u_0(t) = \frac{dy}{dt} = -h_0 \frac{2\pi}{L} U_{vech} \sin\left[\frac{2\pi}{L} U_{vech} t\right]$$

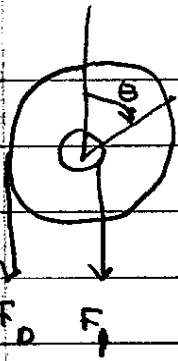
$$\omega_0 = \frac{2\pi}{L} U_{vech} \text{ rad/sec}$$

$$f_0 = \frac{U_{vech}}{L} \text{ Hz}$$

$$u_0(t) = \text{Re} \left\{ j\omega_0 h_0 e^{j\omega_0 t} \right\}$$

$$u_1(t) = \text{Re} \left[\frac{sh_0 e^{st}}{ms^2 + bs + k} \right] \Big|_{s=j\omega_0}$$

2

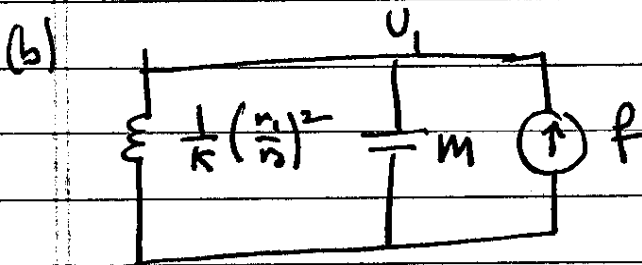
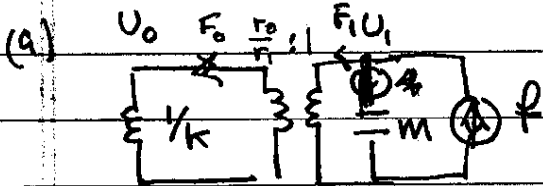
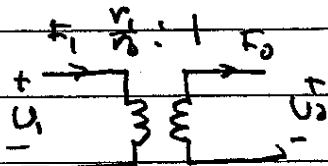


$$u_1 = r_1 \frac{d\theta}{dt}$$

$$u_0 = r_0 \frac{d\theta}{dt}$$

$$\frac{u_1}{r_1} = \frac{u_0}{r_0}$$

$$F_1 r_1 = F_0 r_0$$

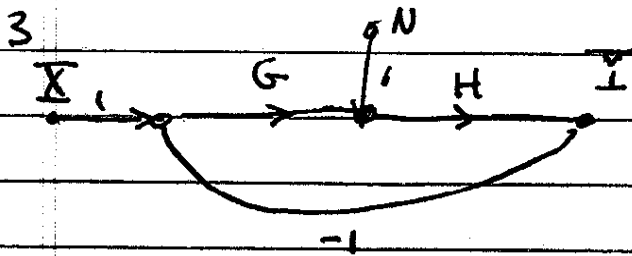


$$U_1(s) = F(s) \frac{1}{Ms} \parallel \frac{s}{k \left(\frac{r_1}{r_0}\right)^2} \Rightarrow U_1 = F(s) \left[\frac{s}{Ms^2 + k \left(\frac{r_0}{r_1}\right)^2} \right]$$

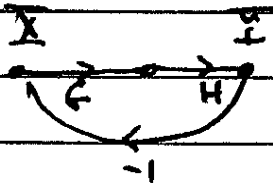
(c)

$$Ms^2 + k \left(\frac{r_0}{r_1}\right)^2 = 0 \Rightarrow s = \pm j \sqrt{\frac{k}{M} \left(\frac{r_0}{r_1}\right)^2}$$

$$\omega = \sqrt{\frac{k}{M}} \frac{r_0}{r_1} \text{ s/s}$$



Find $\left(\frac{Y}{X}\right) \Big|_{N=0}$



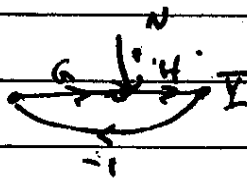
FP
 $P_1 = GH$
 Loop
 $L_1 = -GH$

$$\Delta = 1 - L_1 = 1 + GH$$

$$A_1 = 1$$

$$\left(\frac{Y}{X}\right) \Big|_{N=0} = \frac{GH}{1+GH} = \frac{P_1 A_1}{\Delta}$$

Find $\left(\frac{Y}{N}\right) \Big|_{X=0}$



FP
 $P_2 = H$
 Loop
 $L_1 = -GH$

$$\Delta = 1 - L_1 = 1 + GH$$

$$A_1 = 1$$

$$\left(\frac{Y}{N}\right) \Big|_{X=0} = \frac{P_2 A_1}{\Delta} = \frac{H}{1+GH}$$

$$Y(s) = \left(\frac{GH}{1+GH}\right) X + \left(\frac{H}{1+GH}\right) N$$