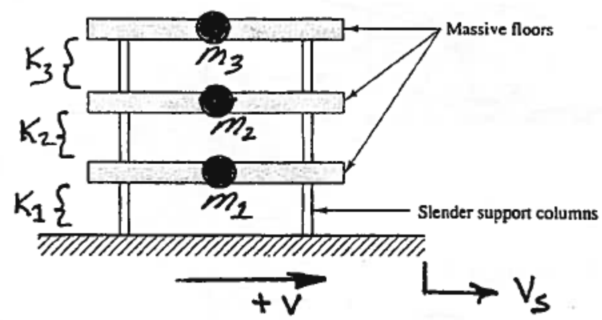
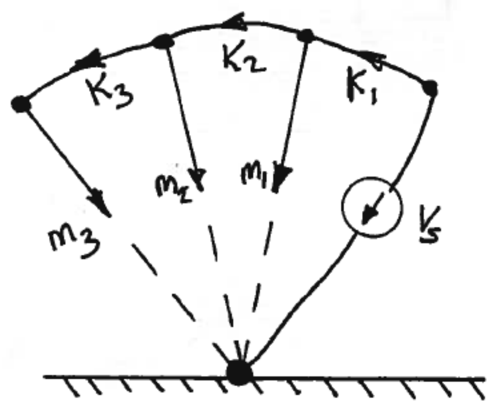
4-4

PROBLEM 4.4

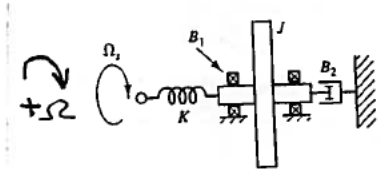


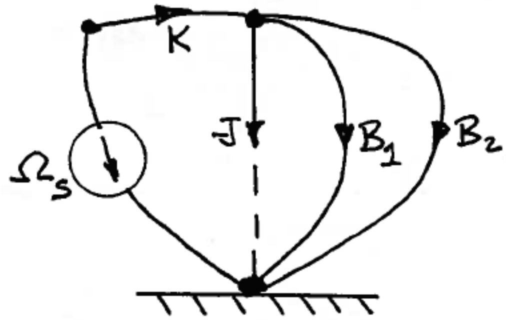


4-6

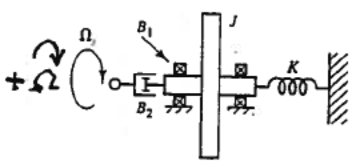
PROBLEM 4.6

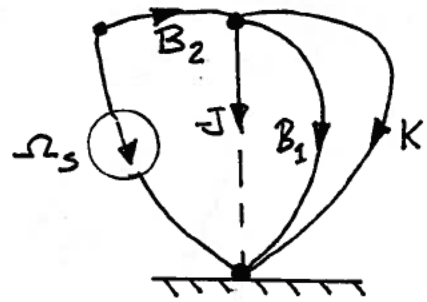
(a)



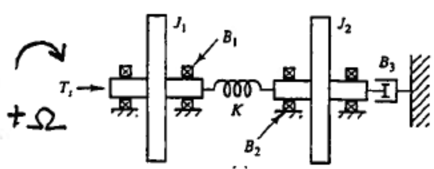


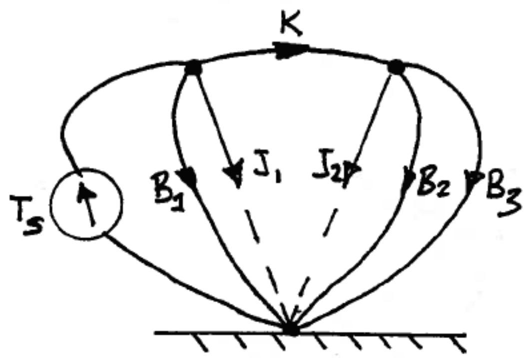
(b)



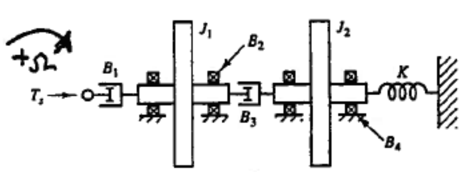


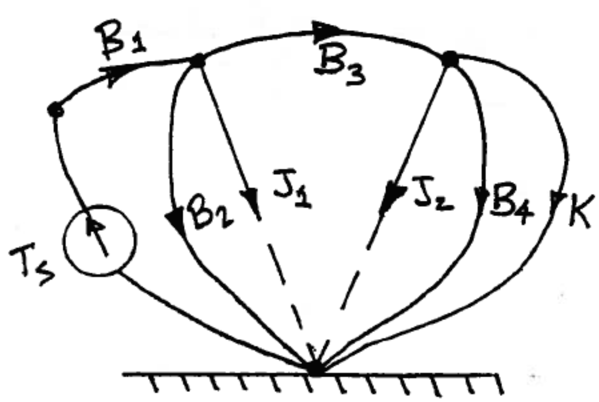
(c)





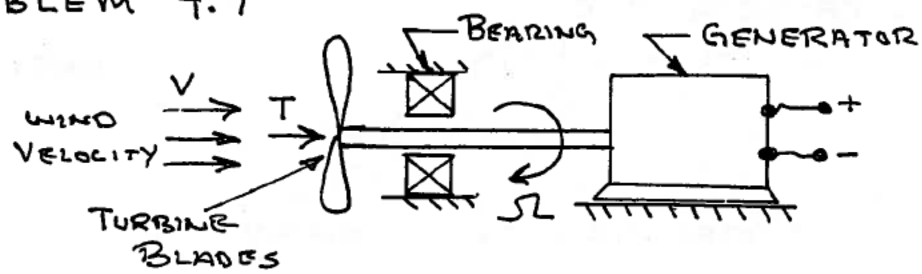
(d)





PROBLEM 4.7

(a)



TORQUE ON TURBINE: $T_S = \alpha V$

BEARING: DRAG TORQUE $T_B = B_B \Omega$

GENERATOR LOAD TORQUE $T_L = B_L \Omega$

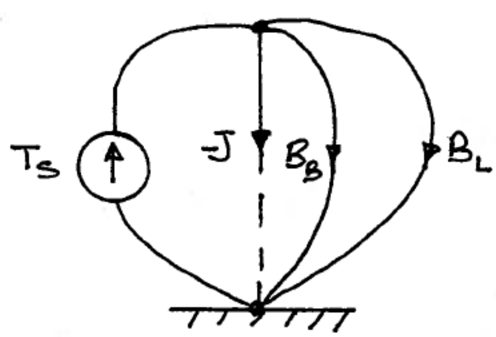
(b) WIND ⟹ TORQUE SOURCE T_S

TURBINE & GENERATOR ROTATING PARTS ⟹ Total effective inertia J

BEARINGS ⟹ DAMPER B_B

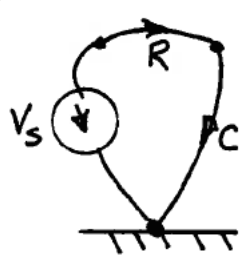
GENERATOR ⟹ DAMPER B_L i.e. LOAD TORQUE PROPORTIONAL TO ANGULAR VELOCITY

(c)

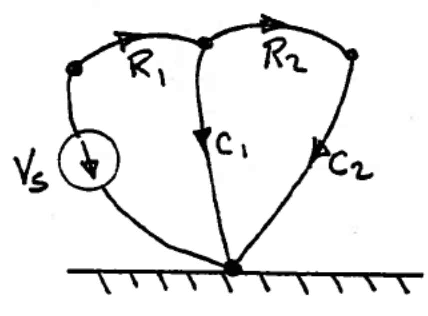


PROBLEM 4.9

(a)



(b)



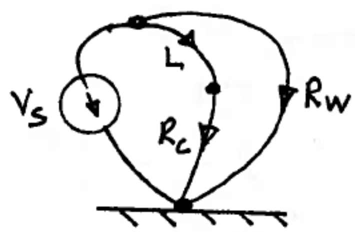
PROBLEM 4.10

(a)

Coil $\begin{cases} \text{INDUCTOR} : L \\ \text{RESISTOR} : R_c \end{cases}$

WORK PIECES $\{$ RESISTOR: R_W

(b) SWITCH CLOSED



Assume $R_W >> R_L$

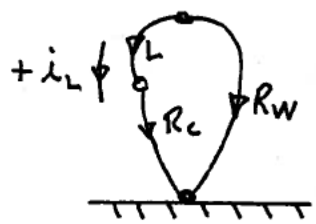
IN STEADY - STATE

$$V_L = \frac{d i_L}{dt} = 0$$

COIL CURRENT $= \frac{V_s}{R_c}$

WORKPIECE CURRENT ≈ 0

(c) SWITCH OPEN



AT $t=0$, SWITCH OPEN

SINCE i_L CANNOT CHANGE, CURRENT IN R_W IS $-\frac{V_s}{R_c}$ at $t=0^+$

(d) BEFORE – SWITCH CLOSED

CURRENT IN COIL IS $+i_L$

CURRENT IN $R_W \approx 0$ SINCE R_W very large

AFTER – SWITCH OPEN

CURRENT IN COIL IS $+i_L$

CURRENT IN $R_W = -i_L$

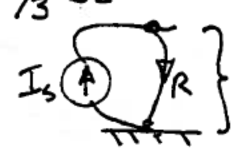
PROBLEM 4.16

(i) ELECTRIC POWER SOURCE

THÉVENIN $\quad R = 25/3\ \Omega \qquad V_s = 25$ volts

NORTON $\quad R = 25/3\ \Omega \qquad I_s = 3$ AMPS

THÉVENIN



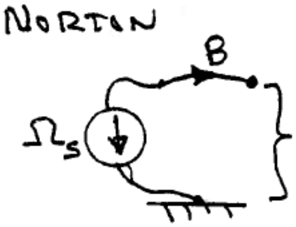
NORTON

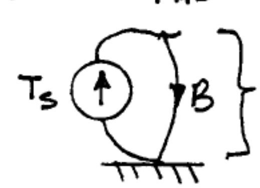
(ii) ROTATIONAL POWER SOURCE

THÉVENIN $\quad B = 45/1000\ \dfrac{\text{N-m-s}}{\text{rad}} \qquad \Omega_s = 1000$ rad/s

NORTON $\quad B = 45/1000\ \dfrac{\text{N-m-s}}{\text{rad}} \qquad T_s = 45$ N-m.

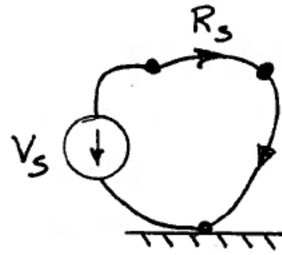
THÉVENIN





NORTON

PROBLEM 4.17



$R_s = R_o$

THÉVENIN SOURCE

VALUE OF R FOR MAX POWER DISSIPATED IN R

$$P = V_R\, i_R \qquad \text{MAX AT } \frac{dP}{dR} = 0$$

$$i_R = \frac{V_s}{R_s + R}\,,\quad V_R = V_s - R_s\, i_R\,,\quad i_R = i_s$$

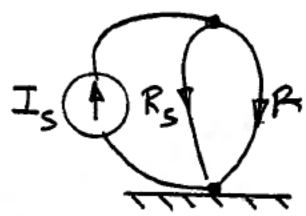
$$P = \frac{V_s^2}{R_s+R} - \frac{R_s V_s^2}{(R_s+R)^2} = V_s^2\left[\frac{R}{(R_s+R)^2}\right]$$

$$\frac{dP}{dR} = 0 = V_s^2\left[\frac{1}{(R_s+R)^2} + \frac{-2R}{(R_s+R)^3}\right]$$

$$= V_s^2\left[\frac{R_s + R - 2R}{(R_s+R)^3}\right] = V_s^2\left[\frac{R_s - R}{(R_s+R)^3}\right] = 0$$

AND $\therefore$ P IS MAX at $\frac{dP}{dR} = 0$ OR at $R_s = R$

NORTON SOURCE



$R_s = R_o$

$$V_R = V_s \qquad i_R = I_s - i_{R_s}$$

$$V_R = \frac{R R_s}{R + R_s} I_s \qquad i_R = I_s - \frac{V_R}{R_s} = I_s - \frac{R}{R + R_s} I_s$$

$$P = I_s^2\left[\frac{R R_s}{R + R_s} - \frac{R_s R^2}{(R+R_s)^2}\right] \qquad \frac{dP}{dR} = I_s^2\left[\frac{d}{dR}\left[\frac{R_s^2 R}{(R+R_s)^2}\right]\right]$$

$$\frac{dP}{dR} = 0 = I_s^2 R_s^2 \frac{d}{dR}\left[\frac{R}{(R+R_s)^2}\right] = I_s^2 R_s^2\left[\frac{1}{(R_s+R)^2} + \frac{-2R}{(R_s+R)^3}\right]$$

OR $\frac{dP}{dR} = 0$ at $R = R_s$ AS ABOVE

4-16

PROBLEM 4.18

LINE HAS TOTAL VALUES R, L, C

THEN IF MODELED AS N SECTIONS,

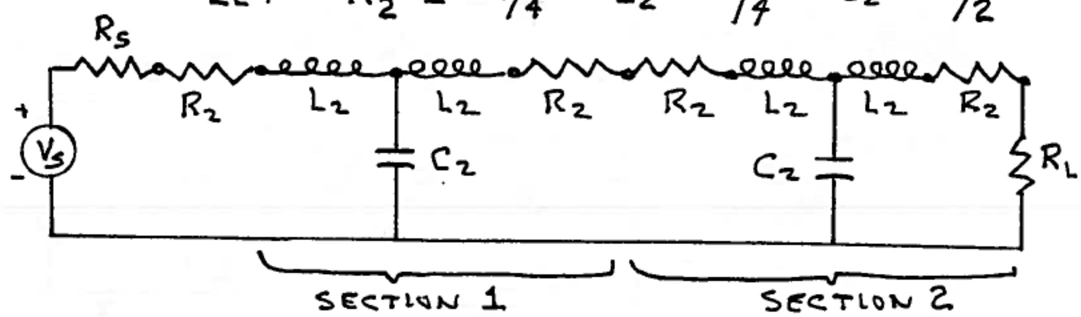
EACH SECTION HAS TOTAL VALUES $\frac{R}{N}, \frac{L}{N}, \frac{C}{N}$

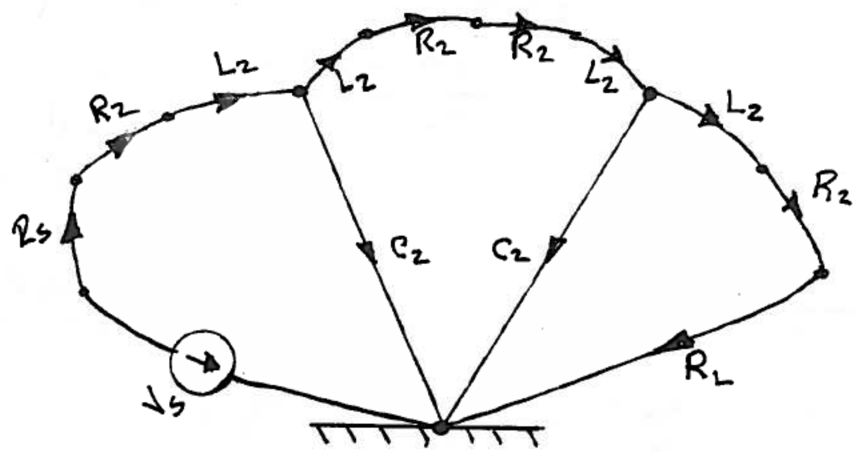
EACH SECTION HAS SPLIT R, L AND ONE C

SPLIT $R_S = R/2N$; SPLIT $L_S = L/2N$; $C_S = C/N$

FOR 2 SECTION MODEL $N=2$

LET $R_2 = R/4 \quad L_2 = L/4 \quad C_2 = C/2$





FOR 3 SECTION MODEL $N=3$

LET $R_3 = R/6 \quad L_3 = L/6 \quad C_3 = C/3$