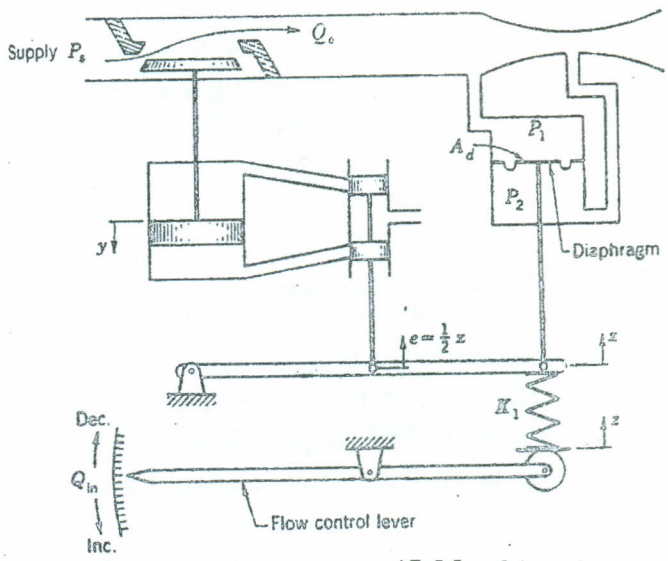
Mansoura University	Second Term Exam 4th Year Mech
Faculty of Engineering	Automatic Control of Power Systems
Power Mech. Dept	Time 3 hours

Attempt all questions

Question 1 (20 Mark)

A system for controlling flow is shown in Figure. Increasing the desired flow setting increases the compression of spring K_1, which causes X and the position e of the balanced valve to move up. This in turns causes the flow valve to move down, which increases the flow. The amount of flow out is measured by a Venturi-type flow meter, so that the pressure drop (P_1-P_2) is a function of Q_o. The diaphragm prevents leakage from the high pressure P_1 to the low pressure P_2, but it permits motion, just as a piston would. The effective area of the diaphragm is A_d. The flow Q_o is seen to be a function of the flow valve opening Y and the supply pressure P_o. Determine the overall block-diagram representation for this system.

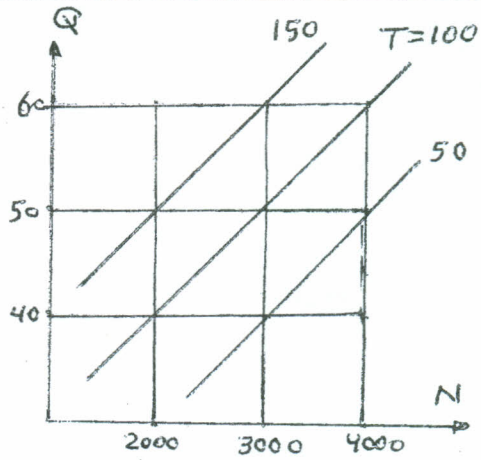


Question 2 (5 Mark)

The equation of the area of parallelogram is $A = W L \sin\theta$, where L and W are two adjacent sides and θ the angle between them. Determine the linear approximation to the area for $W_i=12$, $L_i=8$ and $\theta_i=60^o$, what is the approximate area when W=14, L=9 and $\theta=58^o$.

Question 3 (15 Mark)

The characteristics of an engine are described by the family of curves in Figure. Determine the linear approximation of the torque t delivered by the engine. The difference between the torque t produced by the engine and the load toque t_L is used to accelerate the engine J dn/dt and to overcome viscous force B n. Thus, $t-t_L = J\,dn/dt + B\,n$. For j=0.02 and B=0.03, determine the differential equation relating the change in speed n to the change in fuel flow q and the change in load torque t_L. Determine the time constant τ.



Question 4 (10 Mark)

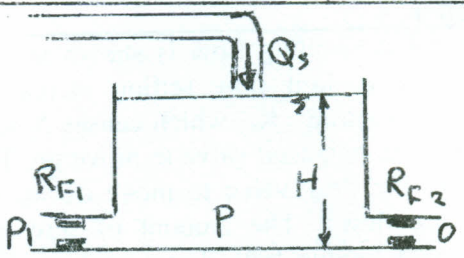
For any thermometer, the temperature of surrounding medium is T_1, the temperature of the glass enclosure is T_2, and the temperature of the fluid in the thermometer is T. The rate of heat flow from the surrounding medium to the glass is $Q_1=(T_1-T_2)/R_{T1}$. The rate of heat flow from the glass to the fluid is $Q_2=(T_2-T)/R_{T2}$.

The rate of temperature change of the glass is $DT_2=(Q_1-Q_2)/C_{T1}$, and the rate of change of temperature of the fluid is $DT=Q_2/C_{T2}$.

Construct the thermal circuit representation for the system and then determine the equation for the temperature T of the fluid as a function of the surrounding temperature T_1.
Construct the block-diagram representation for this system in which T1 is the input and T is the output. Determine the time constant τ.

Question 5 **(10 Mark)**

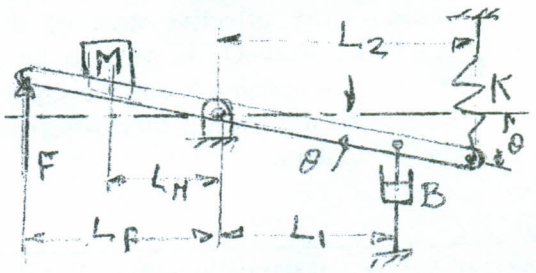
The figure shows a tank in which flow is supplied at a rate of Q_s. Construct the fluid circuit representation for this system. Determine the equation for the pressure P (head $H=P/\rho$) as a function of P_1 and Q_s. Draw the block-diagram of the system and identify the time constant and the steady state gain.



Question 6 **(10 Mark)**

For the lever shown in figure, the variation in the applied force is f, and the variation in the spring position is x. The horizontal line represents the reference positionof the lever. Determine a)-the equation relating f and x.

b)- the relationship between t and θ (where $t = f L_f$ is the variation in applied torque and $x = L_2 \theta$



مع اطيب تمنياتي بالتوفيق أ.د. احمد سلطان مايو 2014

جـــامـــعة المنصـــــورة
كليـــــــة الهندســـــــة
قسم هندسة الحاسبات والنظم

امتحـان :التحكم فى منظومات القوى
الفرقة الرابعة هندسة ميكانيكا قوى
الزمن ســـاعة – مايو 2014

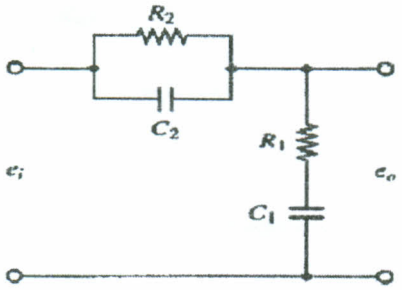
[1-a] Define the following terms :-

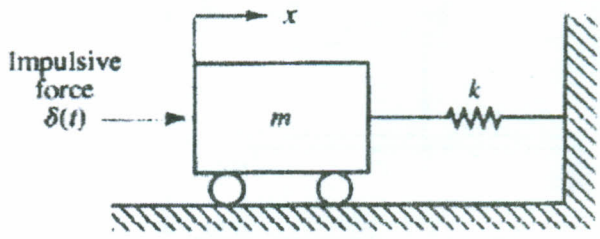
Transfer function. **Steady state error.** **Types of controller.**

[1-b] A closed loop control system has a forward path gain $G(S)=\frac{10}{S(S+5)}$ **, and the feedback gain** $H(S)=3$. **i- Drive a mathematical expression for the error function E(S).**

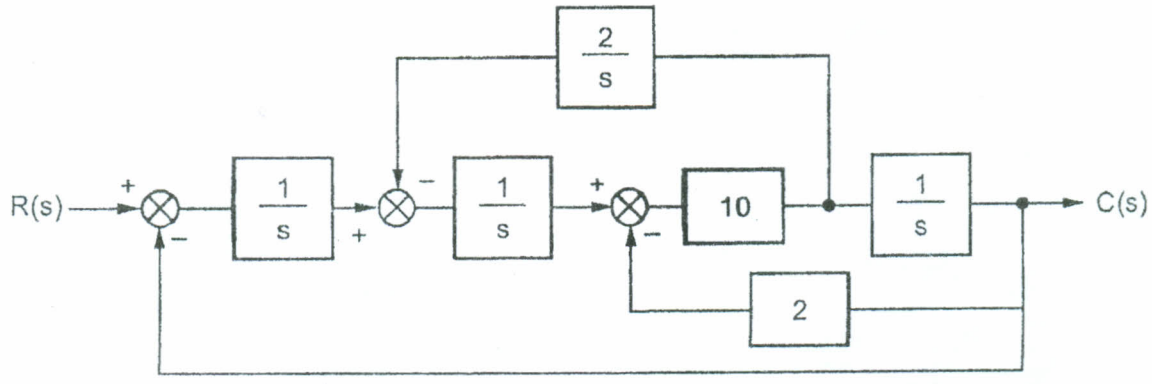
ii- find the steady state error if the input signal is $r(t)=t$.

[1-c] Obtain the transfer function of the following systems :





[1-a] For the following block diagram find the overall transfer function .



[1-b] Find the range of K that make the system stable . The system characteristic equation is given by : $S(S^2+S+1)(S+2)+k=0$

GOOD LUCK

Ass. Prof. Dr. M.S.M.ELKSASY