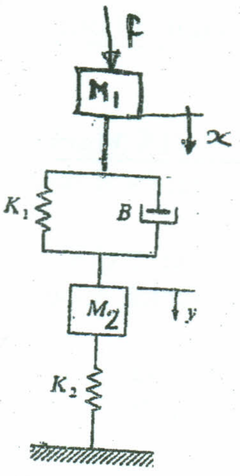
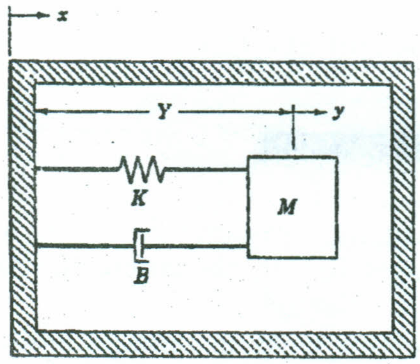
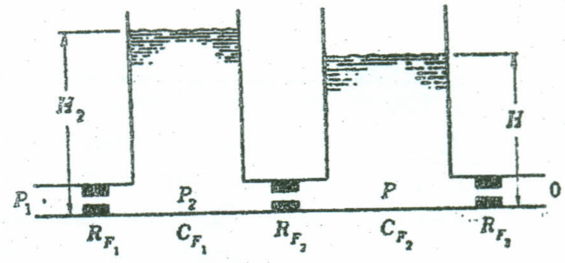
Problem (1)



(a)

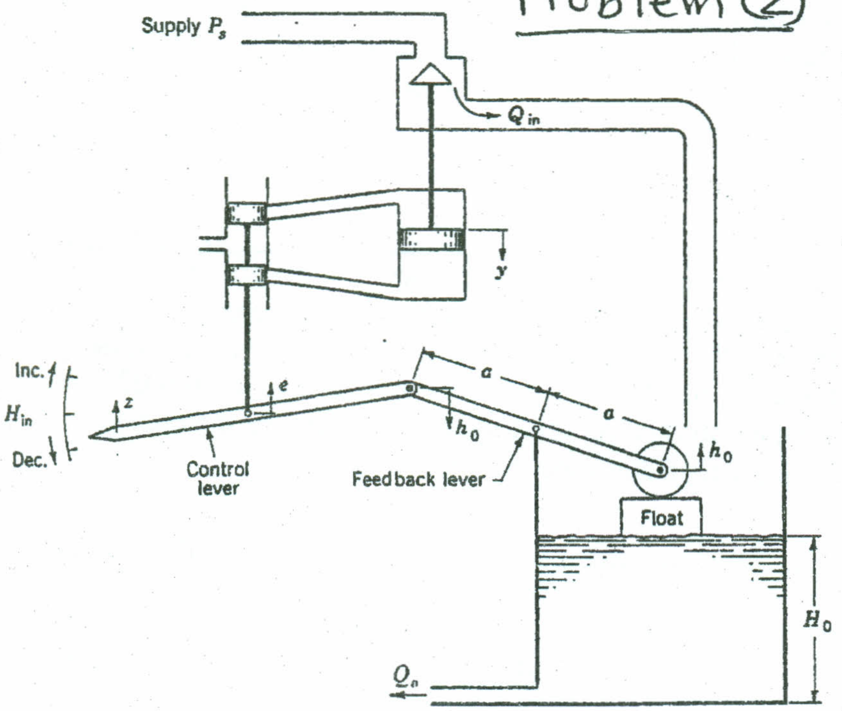


(b)



(c)

Problem (2)



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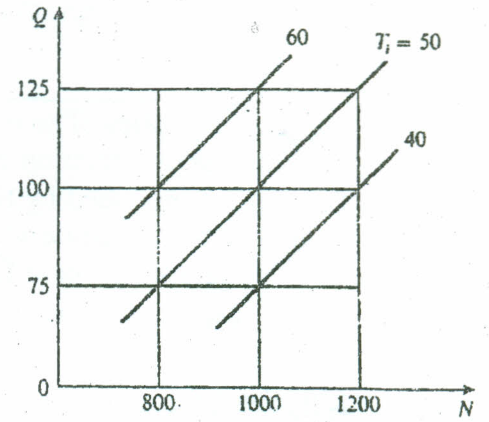
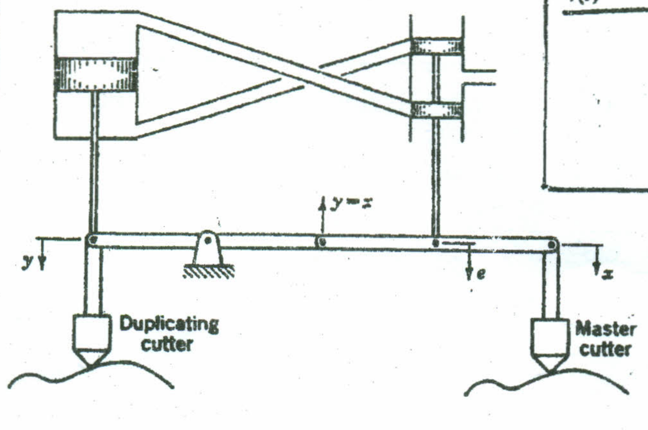
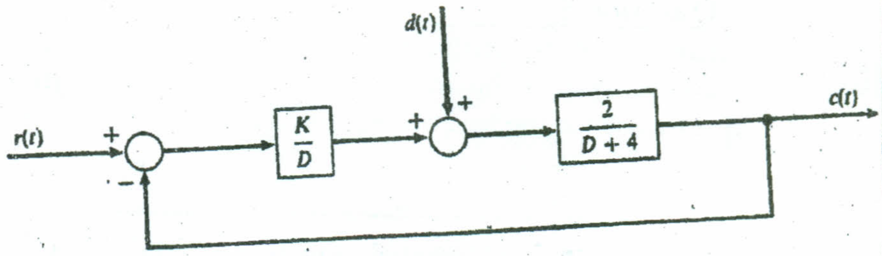


Problem (4)





Problem (5)

f(t)	F(s)	F(t)	F(s)
$\delta(t)$	1	t^n	$n!/s^{n+1}$
$u(t)$	$1/s$	$t^n e^{at}$	$n!/(s-a)^{n+1}$
t	$1/s^2$		
e^{at}	$1/(s-a)$		

Mansoura University Faculty of Engineering Power Mech. Dept	٢.٢	Second Term Exam 4^{th} Year Mech Automatic Control of Power Systems Time 3 hours

Attempt all questions

Question 1 (15 Mark)

a- For the mechanical systems shown write the force equation at each coordinate and then determine the equation which relates: (i) x to f (ii) y to f (iii) y to x.

b-A schematic diagram of an accelerator for measuring the linear acceleration d^2x/dt^2 is shown in figure. Determine the operational form for the differential equation which relates y to the acceleration D^2x of the frame.

C-The figure shows a fluid system of two tanks in series. Construct the fluid system representation for this system. Determine the equation of the pressure P ($H=P/\rho$) as a function of the inlet pressure P_1 (P_2 should not appear in the equation).

Question 2 (15 Mark)

The figure shows a liquid level controller. To raise the level of the fluid, the control lever is moved up (i.e. position z is raised). This raises the valve position $e=(z-h_o)/2$, which increases y, thereby admitting more flow Q_{in}. The flow Q_{in} is a function of the flow valve opening Y and the supply pressure P_s. The change in volume of liquid in the tank is the time integral $(q_{in}-q_o)/D$, which is equal to the cross sectional area of the tank AT times the change in level h_o. The flow out Q_o is seen to depend on the pressure head H_o. Determine the overall block diagram for this system.

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 (15 Mark)

A reproducing shaper is shown in figure. Te position y of the duplicating cutter is seen to follow the position x of the master cutter. Determine the mode of operation of the shaper. What modification would be necessary to convert this to a proportional plus integral controller?

Question 5 (15 Mark)

Robots can be programmed to move tool through path very accurately. For the robotic control system shown in figure, all the initial conditions are zero and k=1.5. Determine the response for the case when both r(t) and d(t) are unit step functions.

Question 6 (15 Mark)

Consider the differential equation $c(t) = \frac{12}{(D+1)(D+3)} r(t)$ Using classical methods, determine the solution when $f(t) = e^{-2t}$ for y(0)= 2 and $y^{\backslash}(0)$ =0

مع اطيب تمنياتي بالتوفيق أ.د. احمد سلطان يونيو 2012