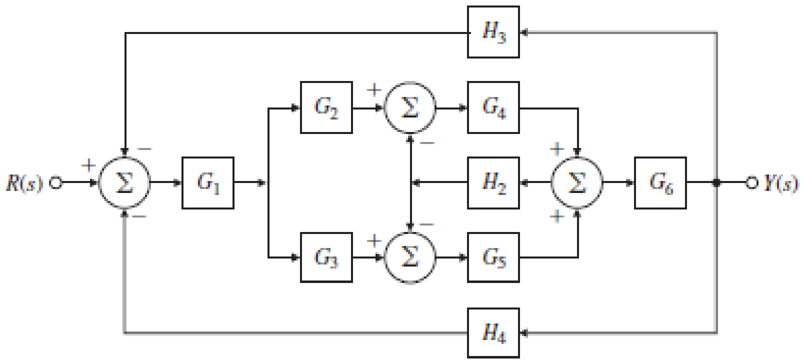
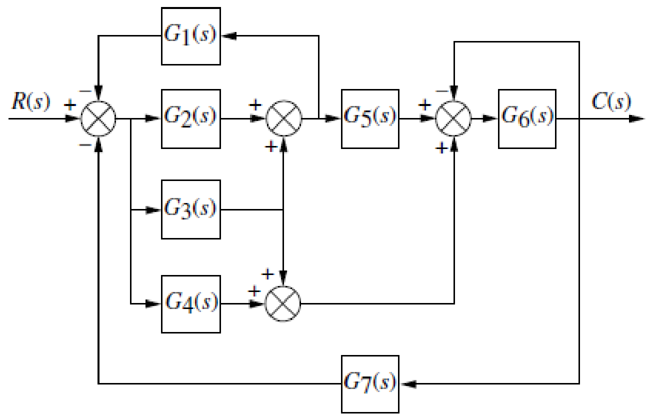
ME325_Control Systems: Assignment 01 (Total:100 marks)

Q1. Find the transfer function of the following systems. (30 marks)

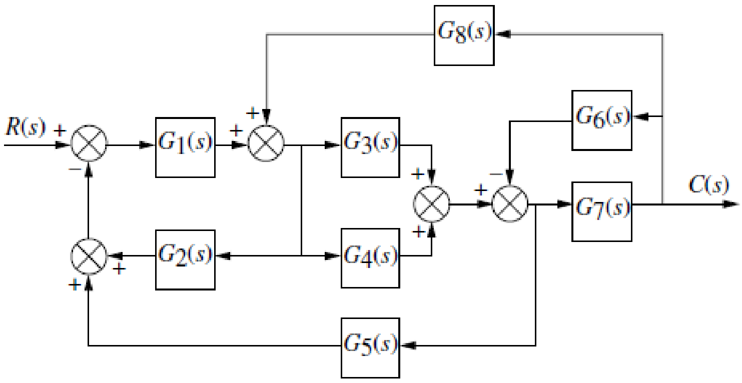
a) (8 marks)



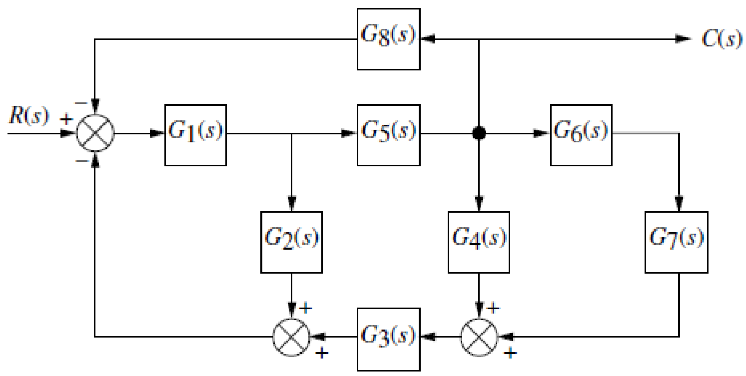
b) (8 marks)



c) (7 marks)

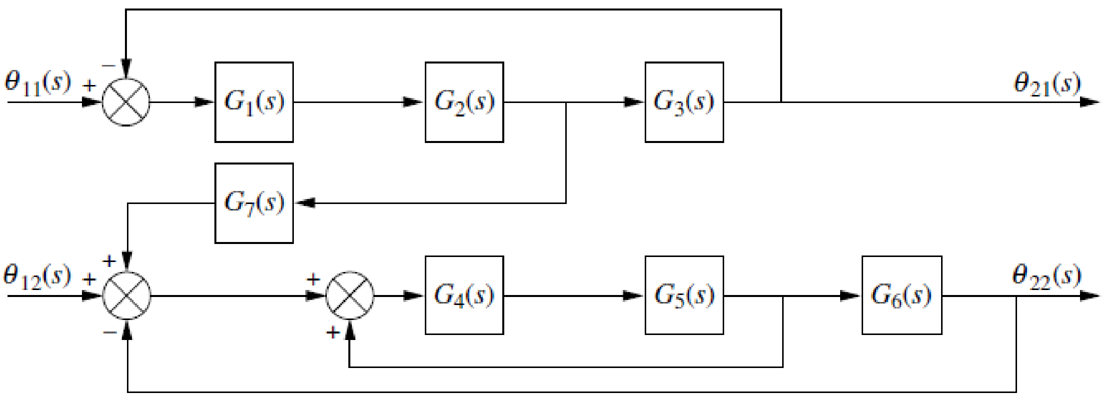


d) (7 marks)



Q2. Given the block diagram of a system shown in, find the transfer function. G(S) = $\frac{\theta_{22}(S)}{\theta_{11}(S)}$

(10 marks)

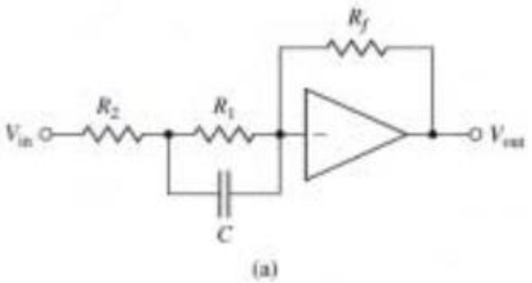


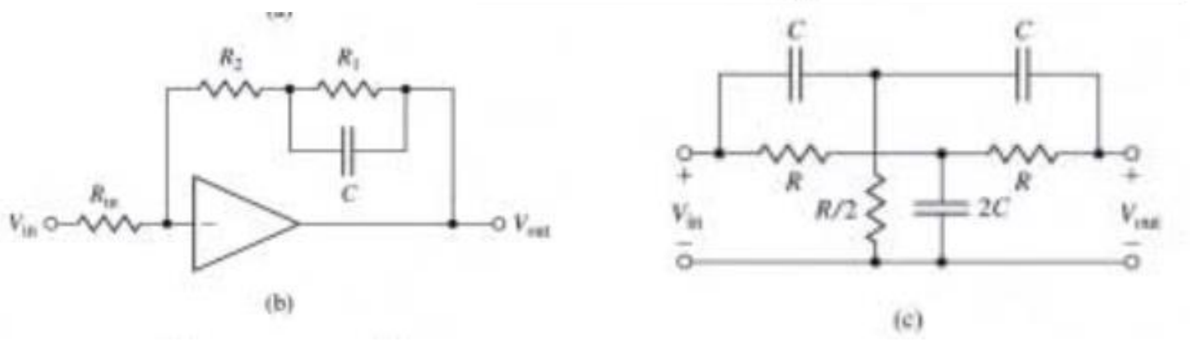
Q3. Write the dynamic equations and find the transfer functions for the circuits shown in Fig below. (15 marks)

(a) lead circuit

(b) lag circuit.

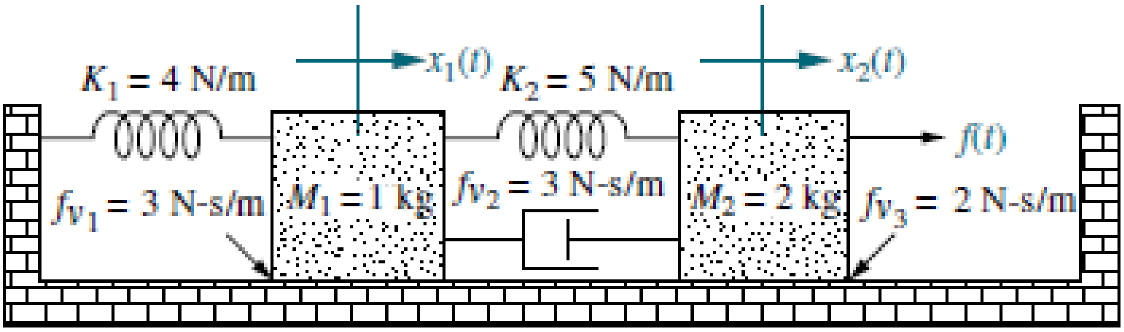
(c) notch circuit





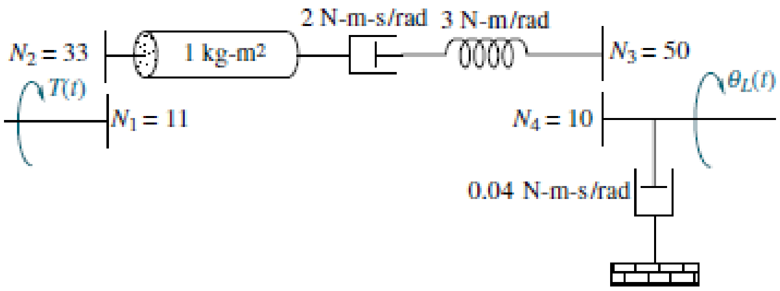
Q4. (a) Find the transfer function G(S) = $X_1(S)/F(S)$ (reduced form) of system shown in fig,

(8 marks)



(b) Find the transfer function G(S) = θ_L(S)/T(S) (reduced form) of the system shown in Fig,

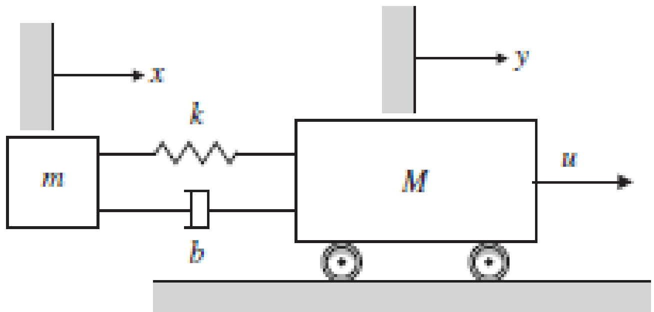
(7 marks)



Q5. In many mechanical positioning systems, there is flexibility between one part of the system and another. An example is shown in Fig, where there is flexibility of the solar panels. Figure depicts such a situation, where a force *u* is applied to the mass *M* and another mass *m* is connected to it. The coupling between the objects is often modeled by a spring constant *k* with a damping coefficient *b*, although the actual situation is usually much more complicated than this.

(a) Write the equations of motion governing this system.

(b) Find the transfer function between the control input *u* and the output *y*. (10 marks)



Q6. The Electromechanical system shown in fig below, represents a simplified model of a capacitor microphone. The system consists in part of a parallel plate capacitor connected into an electric circuit. Capacitor plate 'a' is rigidly fastened to the microphone frame. Sound waves pass through the mouthpiece and exert a force $f_e(t)$ on plate b, which has mass M and is connected to the frame by a set of springs and dampers. The capacitance C is a function of the distance x between the plates, as follows: $C(x) = \frac{\varepsilon A}{x}$

Where, ε = dielectric constant of the material between the plates,

A = surface area of the plates.

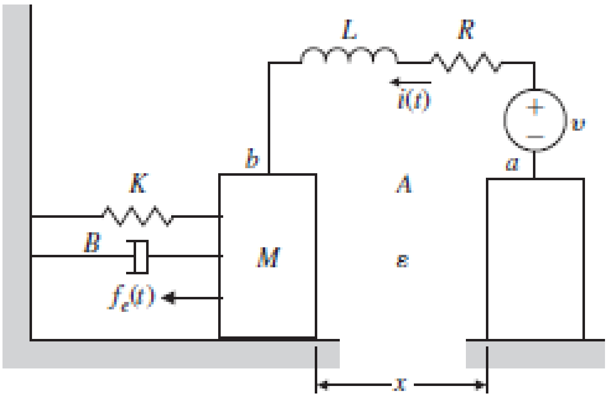
The charge q and the voltage e across the plates are related by q = C(x)e.

The electric field in turn produces the following force f_e on the movable plate that opposes its motion: $$f_e = \frac{q^2}{2\varepsilon A}$$

a) Write differential equations that describe the operation of this system. (It is acceptable to leave in nonlinear form.)

b) Can one get a linear model?

c) What is the output of the system? (10 marks)



Q7. Compute the transfer function for the block diagram shown in fig below. Note that ai and bi are constants.

a) Write the third-order differential equation that relates y and u. (Hint: Consider the transfer function.)

b) Write three simultaneous first-order (state-variable) differential equations using variables x1, x2, and x3, as defined on the block diagram in Fig. Notice how the same constant parameters enter the transfer function, the differential equations, and the matrices of the state-variable form. (10 marks)