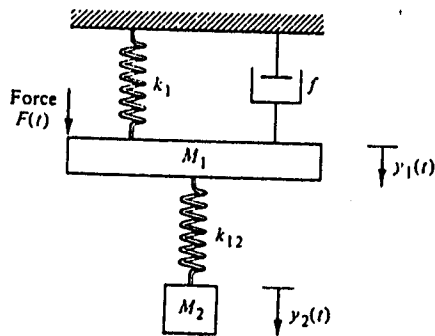1. A dynamic vibration absorber is shown in the figure. The system is representative of many situations involving the vibration of machines containing unbalanced components. The parameters M2 and k12 may be chosen so that the main mass M1 does not vibrate when $F(t) = a \sin w_0 t$.

   (a) Obtain the differential equations describing the system.

   (b) Drawing the analogous electrical circuit based on the force-current analogy. (20%)

2. (a) please explain the "Nyquist criterion" ?

   (b) How can you explain the relative stability by using Nyquist plot?

   (c) What's the meaning of the bandwidh ? Do you get any information of a control system, when you know the bandwidth of the system?

   (d) What's the definition of the frequency response of a control system?

   (e) What's the meaning of the crossover (break) frequency ? from which have you obtained any infornation of a feedback control system?

   (15%)

3. The asymptotic logarithmic magnitude curves for two transfer functions are given in the figure. (a) Sketch the corresponding asymptotic phase shift curves for the system. (b) Determine the transfer function for the system.
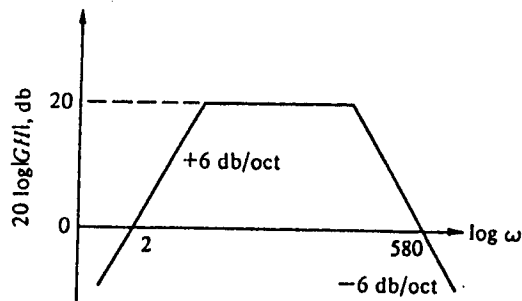
   (15%)

4. Plot root-locus of a second-order system with damping ratio and natural frequency as a parameter, respectively.
(15%)

5. Find stability condition of a third-order linear time-invariant system.
(10%)

6. Give time-domain specifications of a control system. If it is a second-order system, explain techniques for identification of the system.
(15%)

7. Explain the advantages and disadvantages of using feedback in a control system.
(10%)