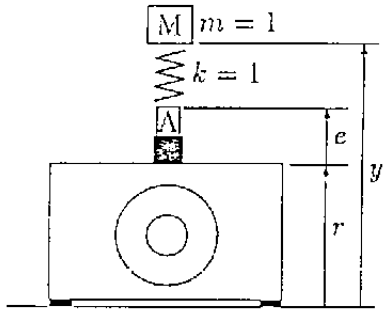
1、 一　下圖所示爲一輪胎偏心校正機之示意圖，圖中質塊M高 y，可由位置感測器量得，經微分器微分後可得到質塊的速度 v，而 e 所示爲一致動器A之長度其值由回授質塊高及速度決定 $e = K_p y + K_d v$，r 所代表是機器的高。假如輪胎掛在校正器上以1Hz頻率轉動，由於輪胎的偏心將造成 r 以1Hz的正弦波上下振動（假設機器相較於上面所附之致動器彈簧及質塊大而且重使得 r 不受 y 影響）。爲求質塊在輪胎以1Hz的轉速轉動下對偏心最敏感，且希望閉迴路系統有0.707的阻尼以免系統不穩定，請問 K_p, K_d 各應是多少？(提示：用 pole Assignment) (20%)

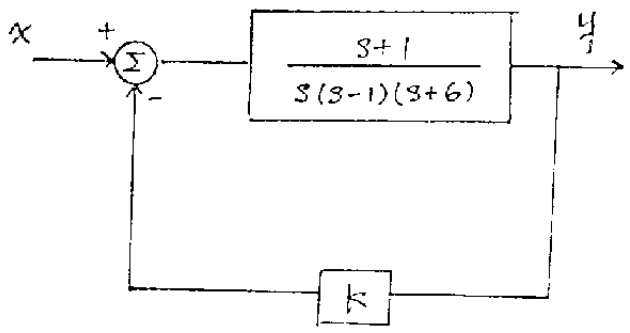


2、 (15 %) Given the following homogeneous state equation

$$\dot{X} = \begin{bmatrix} 2 & 0 & 0 \\ -1 & 4 & 0 \\ -3 & 6 & 2 \end{bmatrix} X = AX \text{ , where X is an 3x1 vector}$$

find its solution and explain the geometrical significance in terms of its eigenvalues and eigenvectors.

3、 (15 %) Given the following block diagram, find the range of K such that the closed-loop system is stable



4、 The state equation of a third order system is shown below

$$\dot{x}_1 = 2x_1 + 3x_2 + 2x_3 + u$$
$$\dot{x}_2 = -2x_1 - 3x_2 - 2u$$
$$\dot{x}_3 = -2x_1 - 2x_2 - 4x_3 + 2u$$

And the output equation is shown below

$$y = 7x_1 + 6x_2 + 4x_3$$

Use similarity transformation to decouple the state model and explain the observability and controllability for each of the subsystems. (15 %)

5、 The characteristic equation of a linear control system is given as

$$S^3 + 2S^2 + 20S + 14K = 0$$

Apply the Nyquist criterion to determine the value of K for system stability. (15%)

6、 The block diagram of a control system is shown below.

(a) Determine the minimum value of the amplifier gain K so that the steady state value of the output c(t) due to a unit step disturbance is ≤ 0.01. (10%)

(b) Find the values of the phase margin and gain margin. (10%)