Exam.Code:0943
Sub. Code: 6742

2123
B.E. (Mechanical Engineering)
Seventh Semester
MEC-702: Automatic Controls

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: Attempt five questions in all, including Question No. I which is compulsory.

x-x-x

1 Attempt the following

a What are the main differences between the classical and the modern control approaches?
b Write Laplace transfer function for $f(t) = e^{-at}$ for $t \geq 0$.
c Define relative stability.
d Calculate error at corner frequency to the term $(1 + j\omega T) \pm N$.
e Differentiate between Regulators and servo mechanism. 5*2

2 a Figure 1, shows a gas pressure system. Volume of the vessel = 1.2 m^3, Gas temp. = 257°C, Gas resistance R_1 = 1.8 x 105 NS/Kgm^2, Find the transfer function of the system relating 'p' and 'm'; 'p' being the pressure in the vessel and 'm', the inflow mass flow rate. Gas constant, R = 297 J/Kgk. 5

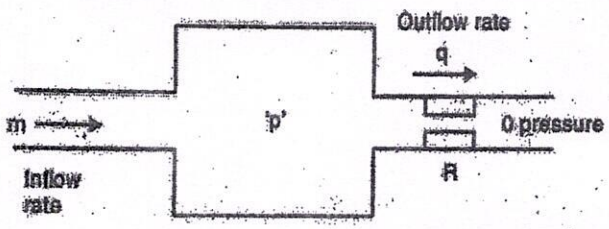

fig. 1

b What is feedback? What type of feedback is preferred for control system? 5

3 a Write the differential equations governing the mechanical system shown in figure 2. Also draw the force-voltage and force-current analogous circuit. 5

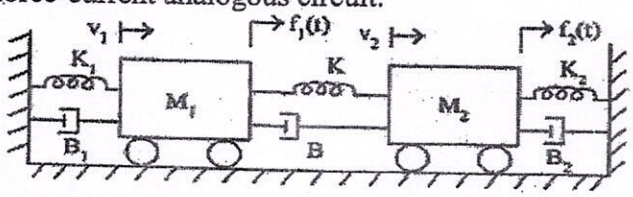

fig. 2

b Give the comparison between open loop and closed loop System. 5

4 a A unity feed-back control system has its open-loop transfer function given by 5

$G(s) = \frac{(4s+1)}{4s^2}$, Determine an expression for the time response, when the system is subjected to Unit impulse input function.

b A second order control system is represented by $\frac{\theta_0(s)}{T(s)} = \frac{1}{(Js^2 + fs + K)}$, transfer function. 5

Where θ_0 is the proportional output and T is the input torque. A step input of 10 Nm is applied to the system and test results are given; M_p = 6%, t_p = 1 sec and the steady state value of the output is 0.5 radian. Determine the values of J, f and K.

5 a For a unity feedback system, the open loop Transfer function $G(s) = 4/(s^2 + 2s + 4)$. 5
b Find the condition for the stability of forward transfer function of a unity feedback system $G(s) = K(s^2 + 1)/(s + 1)(s + 2)$. 5

6 a Consider the system with characteristic equation, $P(s) = s^3 + s^2 + 2s + 2$, Determine stability of the system using Routh's criteria. 5

b What do you mean by virtual instrumentation? Why is Virtual Instrumentation necessary? 5

7 a Verify whether the following system in controllable: 5

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} -2 & 0 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$$

b Check observability of the given system: 5

$\dot{X}_1 = X_2$

$\dot{X}_2 = -2X_1 - 3X_2 + u$

$y = X_1 + X_2$

x-x-x