College of Engineering, Pune

(An Autonomous Institute of Govt. of Maharashtra)

End-Semester Examination

EE402– Control Systems-II

Year: - Final Year B. Tech	Branch: Electrical
Academic Year: 2013-14	Date: **12-11-2013**
Time: 2.00 PM – 5.00 PM	Max. Marks: - 60

Instructions:

1) **All Questions are Compulsory and needs to be answered in the same sequence as they appear in question paper.**
2) Figures to the **RIGHT** indicate **FULL** marks.
3) Make suitable assumptions, if necessary and state the same.
4) Use of non-programmable pocket calculator is allowed.

Que. No. 1 For the unity feedback system described by,

$$G(s) = \frac{K}{(s+1)(s+4)}$$

a. Design a PID controller that will yield a peak time 1.047 seconds a damping ratio of 0.8 and eliminate steady state error for a step input.

b. Can we use Ziegler-Nichols method for tuning PID controller for system? If yes, find PID parameters using Ziegler-Nichol method.

---------- (15)

Que. No.2 **a)** What is state feedback control? For the system described by the differential equation,

$$\frac{d^3y}{dt^3} + 5\frac{d^2y}{dt^2} + 3\frac{dy}{dt} + 2y = u$$

A state variable feedback scheme is to be implemented for this system to yield Peak overshoot of 1.52% and settling time of 1 second. Find its closed loop transfer function and draw a diagram to show the implementation. --------- (10)

b) What is Ackermann's Formula? For the system described by

$$\frac{d^2y}{dt^2} = u(t)$$

Determine the feedback gain to place the closed-loop poles at s=-1±i. ------ (05)

Que. No.3

a) Derive an expression for describing function for "Saturation Nonlinearity". Draw neat sketch showing relationship between input and output with nonlinearity.

---------- (06)

b) For the nonlinear system shown in Fig. 3(b),

i) Evaluate Describing function for the given nonlinearity.

ii) Determine System's Stability

ii) Determine the value of "K" and oscillation frequency ω when self oscillation amplitude is 0.637.

---------- (09)

$$G(s) = \frac{K}{s(5s+1)(10s+1)}$$

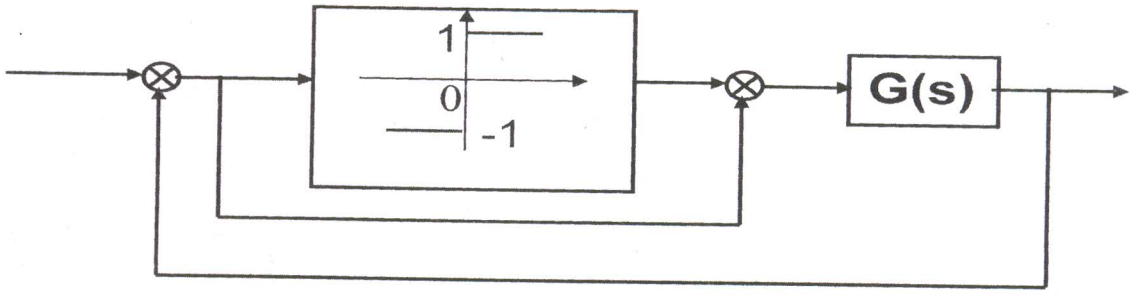

Fig. 3(b)

Que. No.4 **a)** Apply Jury's test for stability to the system whose characteristic equation is given by the polynomial $f(z) = z^4 - 1.7z^3 + 1.04z^2 + 0.268z + 0.024$ -- (05)

b) Find the inverse *Z*-transform of the following ---------- (10)

1) $\dfrac{3z^2 + 2z + 1}{z^2 - 3z + 2}$

2) $\dfrac{2z}{(2z-1)^2}$

3) $\dfrac{z - 0.4}{z^2 + z + 2}$

4) $\dfrac{z^{-1}}{(1 - a^{z-1})^2}$