R13

Code No: 118AB

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech IV Year II Semester Examinations, May - 2017

ADVANCED CONTROL SYSTEMS

(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART - A

(25 Marks)

1.a) What is meant by compensation? [2]
b) Define the Nyquist stability criterion. [3]
c) States the Lyapunov's instability theorem. [2]
d) What are the conditions for asymptotically stable at the origin? [3]
e) What is meant by singular points? [2]
f) What is stable node. Draw the phase portrait of a stable node? [3]
g) What is the behavior of non linear system? [2]
h) What is meant by sub harmonic oscillations in non linear system? [3]
i) Define the Controllability. [2]
j) Define the Concepts of state and state variables. [3]

PART - B

(50 Marks)

2. The open loop transfer function of unity feedback system is $G(s) = \frac{1}{s(s+1)(s+2)}$. Draw the Nyquist plot test the stability. Also find gain margin and phase margin. [10]

OR

3. Design a phase lag network for a plant with the open loop transfer function $G(s) = \frac{120}{s(1+0.2s)^2}$ to have a phase margin of 35^0. Verify the performance of the compensated system with the specification. [10]

4.a) Explain the sufficient conditions of stability of non-linear autonomous system
b) Observe whether the following quadratic form is positive definite
$Q = x_1^2 + 2x_2^2 + x_3^2 + 4x_1x_2 - 8x_2x_3 - 2x_1x_3$ [5+5]

OR

5. The non-linear system described by the following equations
$\dot{x}_1 = -2x_1 + 4x_2$
$\dot{x}_2 = x_1 - 3x_2 - x_2^3$
Observe the stability of equilibrium state. [10]

6. A position control system comprises of a dc servomotor, potentiometer, error detector a relay amplifier and tachogenerator coupled to the motor shaft. The differential equation governing this system is

a) Reaction torque $= \ddot{\theta} + 0.5\dot{\theta}$

b) Drive torque $= 3\,sign(e + 0.5\dot{e}); e = \theta_R - \theta$

c) Draw the block diagram of the system.

d) Construct a phase trajectory on $(e, \dot{e})$ plane with e(0)=3 and $\dot{e}(0) = 1$ and comment upon the system stability. [10]

OR

7. A simple servo is described by the following equations

Reaction torque $= \ddot{\theta}_c + 0.5\dot{\theta}_c$

Drive torque $= 2\ sign(e + 0.5\dot{e})$

$e = \theta_R - \theta_c$

$e(0) = 2\ and\ \dot{e}(0) = 0$

Construct the phase trajectory using the delta method. [10]

8. Explain the describing function for saturation of non-linearity. [10]

OR

9.a) Discuss the basic concept of describing function methods.

b) Derive the necessary expression for describing functions. [5+5]

10. A feedback system has the following closed loop transfer function $\frac{C_{(s)}}{U_{(s)}} = \frac{4(s+1)}{s(s+2)(s+4)}$

Construct three different state models for this system and draw the block diagram representation for each state model. [10]

OR

11.a) States and prove the properties of state transaction matrix

b) Determine the state model of the system for the following transfer function

$$\frac{Y_{(s)}}{U_{(s)}} = \frac{2s^2 + s + 5}{s^3 + 6s^2 + 11s + 4}$$ [10]

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