Total No. of Questions : 12]

SEAT No. :

P1107

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B.E. (Chemical Engineering)

PROCESS DYNAMICS & CONTROL

(Semester - I) (409343) (2008 Course)

Time : 3 Hours] *[Max. Marks : 100*

Instructions to the candidates:

1) ***Answer 3 questions from Section I and 3 questions from Section II.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Assume suitable data, if necessary.***

SECTION - I

Q1) Derive the transfer function and the final time-response equation of a first order mercury thermometer system to a unit step input. A mercury thermometer having a time constant of 1 minute is at steady state temperature of 85ºC. At time t = 0, thermometer is placed in a temperature bath maintained at 105ºC. Determine the time required for the thermometer to read 90ºC, 95ºC and 100ºC. Assume unit gain for the thermometer. **[16]**

OR

Q2) a) Derive transfer function of liquid level tank with constant outlet and find the time response equation for a unit step input. Assume linear system. **[8]**

b) Derive the time response equation for a unit ramp input to a first order system starting from the transfer function. **[8]**

Q3) a) Explain linearization of nonlinear functions and linearize the nonlinear function: $F = C_D\sqrt{h}$. **[8]**

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b) For a second order system with following transfer function: **[8]**

$$G(s)=\frac{15}{(16s^2+3s+1)}$$

When a step change of magnitude 5 is introduced into the system find

i) Rise time,

ii) Ultimate value of response,

iii) Decay ratio,

iv) Overshoot.

OR

Q4) a) Derive transfer function of servo problem for negative feedback control system. **[8]**

b) Derive transfer function of two-tank liquid level non-interacting system. **[8]**

Q5) a) Explain notion of stability in terms of BIBO with some example pole placements on the complex plane. **[8]**

b) What is a root locus diagram and how is it used to find stability of a system? Describe all the rules of drawing a root locus diagram through an example graph. **[10]**

OR

Q6) Draw the root locus of the system with the following transfer function,

$$G(s)=\frac{12K_c(s+0.5)}{(s+1)(s+2)(s+3)}$$

Mention all the steps and comment on the stability of the system. **[18]**

SECTION - II

Q7) Give all the steps to draw a Nyquist plot through an example graph and draw nature of Nyquist plots of **[16]**

a) first order system,

b) PI controller.

Comment on the nature of plots of the systems.

OR

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Q8) Sketch the Bode plots of the following system, mentioning each step in detail,

$$G(s)=\frac{(2s+1)}{(4s+1)(s+1)}$$ **[16]**

Q9) a) Differentiate between feed-back and feed-forward control systems. **[8]**

b) Explain feed-forward control of a three tank composition control system with a neat process diagram. **[8]**

OR

Q10)a) What is Smith predictor control system? Explain with the block diagram. **[8]**

b) Explain the override control system for a compressor with a neat diagram. **[8]**

Q11)a) Write a short note on SCADA systems for a large area control of systems. **[9]**

b) Explain the conversion of analog signals to digital signals in a digital control system. **[9]**

OR

Q12)a) Explain the use and working of an hold element in a digital control loop. Give the equations of a zero-order and first-order hold elements. **[9]**

b) Describe the details of working of PLCs and its programming procedure through a simple ladder diagram. **[9]**

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