BE-VII-(CBSGS)/INST/Industrial Process Control/M-18

Q.P. CODE: 37054

(Time: 3 Hours) **[Total Marks: 80]**

N.B: (1) Question No.1 is **compulsory.**
(2) Answer any **three** questions from Question Nos. 2 to 6.
(3) Assume suitable data if necessary.

1 Answer any FOUR of the following questions:- 20
(a) Draw and explain crystallization curve.
(b) Explain capacity and economy with respect to evaporator.
(c) Discuss control parameters in gas turbine.
(d) What do you mean by runway reaction?
(e) Explain intrinsic safety.

2 (a) Draw process flow diagram of iron and steel industry and explain its process description. 10
(b) Discuss feedforward control scheme of steam heater with merits and demerits. 10

3 (a) Draw and explain process flow diagram of refinery industry. 10
(b) What is dryer? Draw its process flow sheet symbol. Explain drying rate curve. 10

4 (a) What is start up heater? Discuss its process and safety control. 10
(b) Discuss cascade control scheme of evaporator. 10

5 (a) Explain the process of Penicillin-G production along with its control parameters. 10
(b) Discuss overhead and top product composition control scheme of distillation column. 10

6 Write short note-
(a) Oxygen trimming combustion control in boiler. 10
(b) IEC and NEC hazardous area classification. 10

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B.E. Sem VII (Inst Engg.) (CBSGS) May-June 2018.
Rev. 2012
Adv. Control Systems

Q. P. Code : 25157

Duration: 3 Hours **Max. Marks 80**

N.B.

1. **Q.1** is compulsory. Attempt **any three** from the remaining questions.
2. All questions carry equal marks.
3. Figures to the Right indicate full marks.
3. Assume suitable data if necessary

Q.1 Attempt **any four** **20**

a. To determine the stability of the system $\dot{x} = Ax$, derive the Lyapunov equation $A^\top P + PA = -Q$ for symmetric positive definite P and Q.

b. Define the singular point in phase-plane. Compute the singular points for the following system.

$$\begin{aligned} \dot{x}_1 &= x_2 \\ \dot{x}_2 &= -x_1 + x_2 + x_1^2 \end{aligned}$$

c. Compute the 2-norm for the following matrices

$$\text{(i) } F = \begin{bmatrix} 1 & 0 \\ 0 & -2 \end{bmatrix}, \quad \text{(ii) } G = \begin{bmatrix} 1 & 0.5 \\ 0.2 & 3 \end{bmatrix}$$

d. Define relative degree for the system $\dot{x} = f(x) + g(x)u$ at $y = h(x)$.

e. Derive the classical control '**c**' from the IMC controller '**q**'.

f. What is describing function? What are the assumptions made to represent the nonlinearity with describing function.

Q.2 A. Design the IMC controller for the system model **10**

$$\tilde{G}_p = \frac{e^{-3s}}{25s+1}$$

to track the step input.

B. Obtain the IMC based PI controller for the model **10**

$$\tilde{G}_p = \frac{1}{5s+1}$$

Q.3 A. Construct the Lyapunov function using Krasovskii's method for the system, **10**

$$\begin{aligned} \dot{z}_1 &= z_2 - z_1^3 \\ \dot{z}_2 &= -z_1 - z_2 \end{aligned}$$

TURN OVER

B. Determine the stability of the system, **10**

$$\begin{aligned} \dot{x}_1 &= x_2 \\ \dot{x}_2 &= -x_1 - 2x_2 \end{aligned}$$

using Lyapunov's method

Q.4 A. Obtain the describing function for Realy-with-deadzone nonlinearity. **10**

B. Linearize the following system using feedback control **10**

$$\begin{aligned} \dot{x}_1 &= x_1 + 2x_2^2 + e^{x_1}u \\ \dot{x}_2 &= x_1 \\ y &= x_2 \end{aligned}$$

Where y is output and u is input.

Q.5 A. Design the optimal control for the system **10**

$$\dot{x} = \begin{bmatrix} -1 & 0 \\ 0 & 1.5 \end{bmatrix} x + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$$

that minimizes the performance index

$$J = \int_0^\infty \left\{ x^\top \begin{bmatrix} 3 & 0 \\ 0 & 2 \end{bmatrix} x + 2u^2 \right\} dt$$

B. Construct the phase trajectory for the system $\ddot{x} + 1 = 0$ using delta method. **10**
Consider an initial condition $x(0) = 1,\ \dot{x}(0) = 1$.

Q.6 A. Write the classification of singular points for second order linear systems with neat diagrams of representative pole locations and corresponding phase trajectory. **10**

B. Explain the limit cycles for Vander Pol's equation. **10**

5157 SEM VII CBSGS) JNST/ Process Automation / MAY2018

Q. P. Code: 37831

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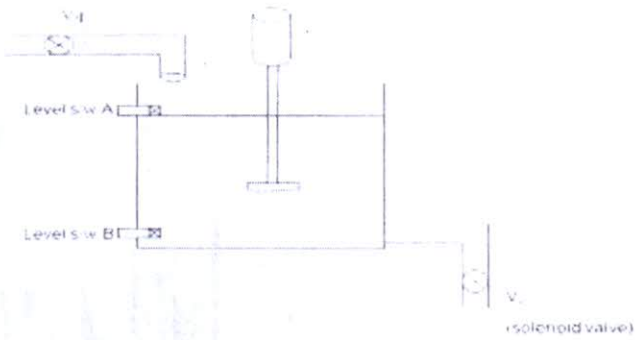
(3 Hours) [Total Marks: 80]

(1) Question No. **1** is compulsory.
(2) Attempt any **Three** questions from remaining.
(3) Figures to the right indicate full marks.

10 1. Answer the following:- [20]

10 a) What do you understand by automation and explain the benefits of automation.
b) What are DCS displays? Explain the Overview display in detail.
c) Explain how RTU communicates by the field and MTU in SCADA with neat sketch.
d) What is the difference between BPCS & SIS?

2. a) Explain with suitable example Data File Representation for "input status file" and
10 "output Status file" in PLC memory for a modular structure of PLC comprising Analog and Discrete I/O. [10]
b) What are IEC standard PLC languages? Write a PLC Program using for a tank which is sequenced to mix the liquid fertilizer according to following sequence:- [10]



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- Start PB is pressed to start operation & V1 is open to fill the tank up to level A.
- As the tank fills, a level s/w A close NO contact to energize stirrer motor to start automatically & operate it for 15 sec to mix the fluid.
- When stirrer stops, V2 opens to empty tank.
- When the tank is completely empty s/w B opens and de-energizes the solenoid valve V2.
- A stop button is pressed to stop operation.

3. a) Draw and explain the working of DCS architecture. Explain the signal flow for one typical ANALOG flow loop. [10]
b) Explain the Lower level computer tasks and Higher level computer tasks in detail. [10]

4. a) What are the different applications of SCADA. Explain how SCADA can be used in the application of the pipeline monitoring system. [10]
b) Explain Protocol structure used in SCADA communication. [10]

5. a) What are independent protection layers? Explain the significance of all these layers with reference to SIS? [10]
b) What is the need of Alarm Management System? Name the standards related to AMS. Elaborate Alarm lifecycle model. [10]

6. a) Compare PLC, DCS and SCADA system. Give an application area of each. [10]
b) Justify the significance of special purpose module in PLC with example. [10]

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