Visvesvaraya Technological University, Belagavi

CBCS Scheme: 2015-16

MODEL QUESTION PAPER

15EI53

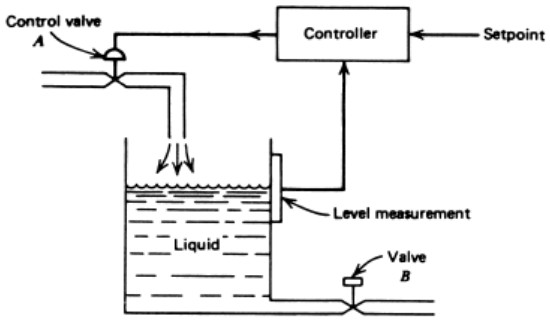
Fifth Semester Electronics & Instrumentation Engineering

Process Control Systems

Time: 3 Hrs Max. Marks: 80

Note: Answer FIVE FULL Questions, selecting ONE FULL Question from each Module

Question Number	Question	Marks Allotted
	Module -1	
1a	Draw the block diagram of a general process control system. Taking an example explain the functions of each block.	6
1b	Discuss the following requirements to achieve objectives of a process control system. i) Stability ii) Steady state regulation iii)Transient regulation	6
1c	With a neat sketch and necessary equations, explain the following control system evaluation criteria i) Minimum area criteria ii) Quarter amplitude criteria	4
	OR	
2a	Draw the block diagram and explain the function of elements used in final control operation.	6
2b	With a neat schematic, explain the operation of current to pressure converter	4
2c	A 4-bit digital word is intended to control the setting of a 2Ω dc resistive heater, Heat output varies as a 0 to 24 V input to the heater. Using a 10-V DAC followed by an amplifier with a high-current output, calculate **(i)**The settings from minimum to maximum heat dissipation and **(ii)** How the power varies with LSB changes.	6
	Module -2	
3a	Define the following terms 1. Process equation 2. Process load 3. Dead time 4. Process lag 5. Self regulation	10

3b	The temperature of water in a tank is controlled by a two-position controller. When the heater is off *the* temperature drops at 2 K per minute. When the heater is *on* the temperature rises at 4 K per minute. The setpoint is 323 K and the neutral zone is ±4% of the setpoint. There is a 0.5-min lag at both the *on* and *off* switch points. Find the period of oscillation and plot the water temperature versus time.	6
	OR	
4a	Consider the proportional-mode level-control system of Figure 4.a. Value *A* is linear, with a flow scale factor of 10 m^3/h per percent controller output. The controller output is nominally 50% with a constant of K_p = 10% per %. A load change occurs when flow through valve *B* changes from 500 m^3/h to 600 m^3/h . Calculate the new controller output and offset error.  Fig. 4a	6
4b	With a neat graph of error and controller output, discuss working of integral control mode.	8
4c	Summarize the characteristics of the derivative mode.	2
	Module -3	
5a	Design a proportional-integral controller with a proportional band of 30% and an integration gain of 0.1%/(%–s). The 4- to 20-mA input converts to a 0.4- to 2-V signal, and the output is to be 0–10 V. Calculate values of Gp ,GI ,R 2,R1 , and C, respectively.	8
5b	With a neat circuit diagram and necessary equations explain the design implementation of op-Amp PID control	8
	OR	
6a	Draw a neat block diagram of a computer supervisory control, explain its operation considering an example of strongly interacting process.	12
6b	A proportional mode has K_p = 2.4, input range of 255, and setpoint of 130. The output maximum is 180, and the output fraction with no error is 0.45. **i.** Develop the control equations. (What is the output for no error?) **ii.** Find the output for an input of 124.	

	Module -4	
7a	With a block diagram, explain working of cascade process control system.	8
7b	Explain Ziegler-Nichols method as applied to P, PI and PID controller.	8
	OR	
8a	In a compound control system, the ratio between two variables is to be maintained at 3.5 to 1. If each has been converted to a 0–5-V range signal, devise a signal conditioning system that will output a zero signal to the controller when the ratio is correct.	8
8b	Illustrate and explain with a block diagram and wave forms, how process control loop can cause instability for some frequency, if Gain margin and phase margin is not properly designed.	8
	Module -5	
9a	Define the terms ‘modeling’ and ‘simulation’	4
9b	Explain the need of system modeling for plant automation	4
9c	Explain the steps followed to build the mathematical model of a plant	8
	OR	
10a	With block diagrams briefly explain the following i) Model reference adaptive control ii) Model identification adaptive control	8
10b	With a diagram and flow chart, show the difference in working of conventional EDP system and AI system	8