Ref No: EE/5/T/514/2019

BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING)
5TH YR 1ST SEMESTER EXAMINATION, 2019

SUBJECT: - PROCESS INSTRUMENTATION AND CONTROL

Time: Three hours | Full Marks: 100 (50 marks for each part)

Use a separate Answer-Script for each part

PART I

Answer any **FIVE** questions. 5×10

1. a) Draw the circuit diagram of a simple electronic analog PID controller with one OPAMP. 4+6
   b) Find the transfer function of the controller.

2. a) Realize a digital PI controller using incremental form. 5+5
   b) What is meant by Anti Integral Wind-up action? Illustrate a scheme for incorporating Anti Integral Wind-up action for PID controller.

3. a) Realize P-I-D controller using flapper nozzle, bellows and restrictions. Find the transfer function, expression of proportional gain, derivative time and integral time in terms of system parameters. 7+3
   b) State the advantages and disadvantages of electronic process controller.

4. a) Distinguish between Direct acting and reverse acting control valve showing functional diagram. 5+5
   b) Describe the working principle of rotary plug and butterfly valves with neat diagram.

5. a) Explain with the help of diagram, why large force is needed for driving single seated control valve than double seated control valve. 5+5
   b) Compare the performance among quick opening, linear and equal percentage control valves.

6. a) What is meant by 'Bumpless' transfer in auto-manual mode of operation in process controller? 2+8
   b) After describing the operation of auto-tuning method, how critical gain K_c and time period T_c of a closed loop controlled process can be determined?

7. a) Why are relay valves employed in pneumatic proportional controllers? 5+5
   b) Describe a scheme for implementation of pneumatic P-controllers with direct acting relay.

8. a) A controller having transfer function $G_c(S)$ is used for delay free process having open loop transfer function G(S). If the process is subjected to dead time (T_D), then what will be change in model of controller transfer function according to Smith's principle? 10

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No. of Questions	PART II	Marks
	Answer any three. ***Two marks reserved for neatness and well organized answers.***	
1.(a)	Derive the mathematical model of liquid level system with nonlinear resistance element. State the assumptions for the modelling.	8
(b)	Outflow (q_0) from a tank is equal to $3h^{3/2}$. Inflow is 'm'. Steady state level in tank is 6m, the area of the tank is 4 m^2. Find [H(s)/M(s)] and characterizing parameters of the transfer function.	8
2.	Consider a closed loop system in which the process comprises of two first order systems connected in series with time constants 1min and ½ min, respectively. Measuring element is also a first order system with time constant of ½ min. Controller is of proportional mode with gain Kp. (i)Draw the process control loop. (ii)Using direct substitution method, comment on the stability with the limiting range of Kp.	16
3(a).	Discuss the advantage of applying cascade control in jacketed CSTR.	8
(b)	Discuss different methods of ratio control.	8
4. (a)	Describe the Process Reaction Curve (PRC) method for tuning of PID controller.	8
(b)	Derive the mathematical model of CSTR.	8
5.	Write short notes on following: (i)Integral Windup (ii) Feed Forward Control	16