Ref. No: Ex/IEBE/T/321/2018

Name of the Examination: **B.E. Instrumentation & Electronics Engineering. 3rd Year 2nd Semester Examination, 2018**

SUBJECT: **PROCESS CONTROL-I**

Time: Three hours **Full Marks 100**

Q1.

I) a) Give the basic block diagram of an industrial process control system and explain.

b) How many types of mathematical modeling are there in process control and describe their uses.

c) Derive the state equations for a stirred tank heater.

d) What is a feed forward control?

e) Explain self regulatory system. **3+3+3+7+2+2**

OR

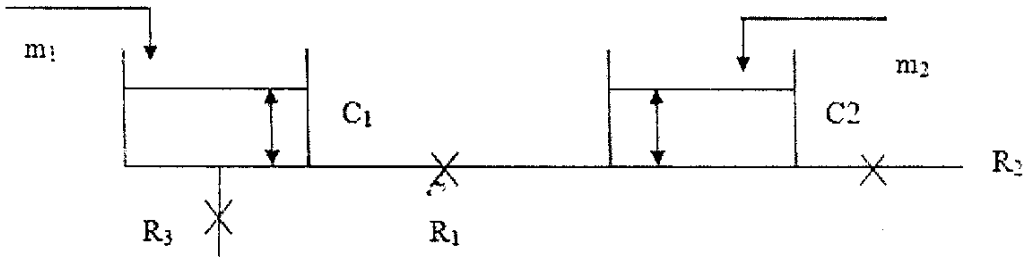
Q1.

II) a) Explain the basic requirement for developing a process plant.

b) Explain MIMO system.

c) Explain the process control elements (G_{11}, G12, G21, and G22) in the figure below.

Given: $A_1=1m^2$ $A_2=0.5m^2$ $R1=0.5sec/m^2$ $R_2=2sec/m^2$ $R_3=1sec/m^2$



d) Explain degrees of freedom and find its value for a stirred tank heater.

4+3+8+2+3

Q2.

I) a) What do you mean by controller tuning.

b) Explain ISE, IAE and ITAE.

c) Explain process reaction curve method and find different types of optimally tuned parameters. **4+6+10**

Q2.

II) a) Describe Ziegler-Nichols ultimate methods and express the optimum tuned parameters.

b) What are the performance criteria's for the selection and tuning of the controllers.

c) For a unity feedback system, process T.F. is given by $G(s) = 1/s(s+1)(s+5)$

The controller is in PID mode. Calculate the optimal values of controller parameters based on Z-N method of tuning. **8+6+6**

Q3. Attempt any **FOUR:** **4x5**

a) Describe cavitation and flashing and describe the basic difference between them.
b) Give the working principle of flapper nozzle system with diagram.
c) Explain air-to-open and air-to-close valves with diagram.
d) Explain pressure control valves.
e) Sketch and discuss different inherent characteristics of control valve plugs.
f) Explain globe valve and its different applications
g) What do you mean by valve sizing and valve capacity?

Q4.

I) a) Determine the response of the 1st order system with respect to ramp and impulse forcing functions mathematically.

b) A unity feedback system is characterized by an open-loop transfer function, $G(s) = K/s(s+10)$. The system has a damping ratio of 0.5. Determine the steady state gain and natural frequency of the closed loop system.

c) Determine the stability of the system with closed loop transfer function

$C(s)/R(s) = 10/s^5+2s^4+3s^3+6s^2+5s+3$ **10+4+6**

OR

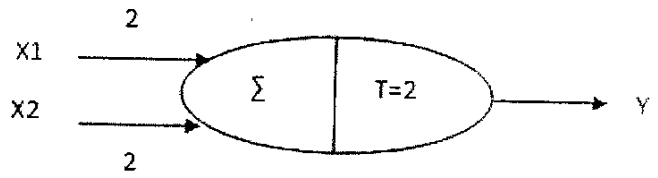
Q4.

II) a) Explain in detail the basic addressing scheme of Programmable logic controller.

b) Explain the single layer perceptron model. Differentiate it with multiple layers perceptron model.

c) What are the basic activation functions used in ANN?

d) Identify the logic gates realized in the following figure. Make a table of inputs and outputs and plot the values. **4+4+2+4+6**



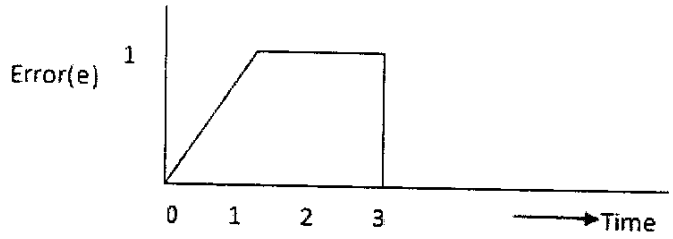
Q5.

I) a) Explain any discontinuous controller.

b) What is offset?

c) Why offset cannot be removed using proportional control action? But which control action offset can be eliminated?

d) Draw a plot of the PI controller o/p for the given error plot given below:
Assume $K_p=5$, $K_I=1s^{-1}$ and $P_I(0)=20\%$.



e) Describe split range control. Under what circumstances is it recommended?

f) What is selector control? Describe any one of the selector control with an example.

2+1+2+2+5+4+4

OR

Q5.

II) a) Explain on-off controller.

b) A liquid level control system linearly converts a displacement of 2-3 meters into 4-20 mA control signal. A relay serves as a two position controller to open or close an inlet valve. The relay closes at 12 mA and opens at 10mA. Find

i) The relation between the displacement and current

ii) The neutral zone in meters

c) What is proportional band, explain with diagram.

d) Explain cascade control with a block diagram and example.

e) Draw a plot of the 3-mode (PID) controller output for the error curve given below.

Assume K_p=5, K_I=0.7 s^{-1}, K_D=0.5s and P_1 (0) =20%. **2+4+2+4+8**

EX/ B.E. Ins. & Elec. ENGG. 3RD YEAR 2ND SEM. EXAMINATION, 2018

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Different parts of the same question should be answered together.

CO1 [20]	Answer any one from (I) and (II) in this block [1] (I) (II)	[3+3+3+7+2+2]
CO2 [20]	Answer any one from (I) and (II) in this block [1] (I) (II)	[4+3+8+2+3] [4+6+10]
CO3 [20]	*Answer any* **four(4)** from **seven(7)** *questions in this block:*	[8+6+6] [4x5]
CO4 [20]	Answer any one from (I) and (II) in this block [1] (I) (II)	[10+4+6]
CO5 [20]	Answer any one from (I) and (II) in this block [1] (I) (II)	[4+4+2+4+6] [2+1+2+2+5+4+4] [2+4+2+4+8]

CO1: Describe and examine process dynamics of process control and develop mathematical model of a particular system (K2, K3, A2)

CO2: Describe and analyse controller tuning based on performance criteria's (K3, K4, A1)

CO3: Characterize the detailed instrumentation for final control elements and categorise various valve parameters like valve sizing, valve characteristics etc.(K3, K4, A2)

CO4: Explain and examine the dynamic behaviour of a control system and analyse the stability of closed loop control systems (K5, A2)

CO5: Differentiate between various control schemes and interpret their necessity (K3, K4, A3)