Name of the Examination: **BIEE 3rd YEAR 1st SEM. SUPPLEMENTARY EXAMINATION, 2024**

SUBJECT: **PROCESS DYNAMICS AND CONTROL**
(Course code: IEE/PC/B/T/315)

Time: Three hours   **Full Marks 100**

List of Course Outcomes (CO):

CO1: Develop mathematical models of typical processes (K3, A2-model)
CO2: Explain and analyse the performance of different controllers and their tuning methods(K4,A2-examine)
CO3: Differentiate between various control schemes and interpret their necessity (K4,A3)
CO4: Explain the role of final control elements in process control systems (K2, A1)

Instructions to the Examinees:

- Each module in the question paper matches up with the corresponding CO

- **Attempt questions for the attainment of all the COs**

- Alternative questions (if any) exist within a module, not across the modules

- Different parts of same question should be answered together

Attempt ALL Questions

Q1A.   8+7+5+5

   a) For a heat exchanger, find the different time lags starting from the occurrence of disturbance to the correction occur with a clear block diagram.

   b) For a tank having area=0.1 m^2, at steady state the liquid level height is 1m and the discharge is 0.16 x $10^{-3} m^3$/sec, find the height of the tank after 10 min.

   c) For a liquid tank having controlled inflow and controlled outflow, set the mathematical model with process resistance and capacitance.

   d) Define load variable, control variable and manipulated variable with an example.

OR

Q1B.   8+7+5+5

   a) Establish a dynamic model of stirred tank heating process with constant holdup.

   b) Describe a simple thermal system in which incoming liquid is heated by the heater in the tank and going out with higher temperature. Develop first order transfer function of the thermal process.

   c) What is the significance of process reaction rate?

   d) Why mathematical modelling is required for process ?

Q2A.   6+4+5+5 +5

   a) What is the significance of process reaction rate?

   b) Establish the relation between proportional gain and proportional band. Draw the response characteristic of PID control action for a step input.

   c) An integral controller with a value of K_I =0.1/s, has an output of 40% PB at the SP. What will be the output after 2S if there is a sudden change to a constant error of 20%.

   d) Establish the mathematical model for motion balance type ON-OFF controller.

OR

Q2B.   **5+5+5+5+5**

a) Plot the response of a PI controller for the error graph shown below
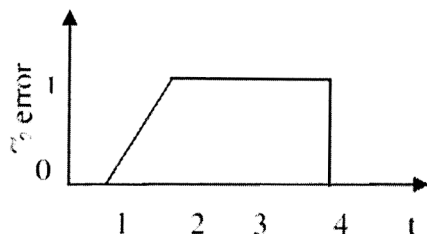
Given $K_p = 5$, $K_i = 1.S^{-1}$, $P(0) = 20$

b) Write down the velocity algorithm for control action.

c) What are the basic criteria to be satisfied in order to obtain tuning of a controller?

d) Give any one method for obtaining controller tuning parameters.

e) Why offset can't be eliminated fully with proportional control alone?

Q3A.   **4+6+5+5+5**

a) What are the drawbacks of feedback control system?

b) How process control mechanism can be improved using feedforward control?

c) What is the problem of integral saturation and how this problem can be reduced using programmable controller?

d) Explain the split-range control system with an example.

e) Explain ratio control scheme with an example.

OR

Q3B.   **5+5+5+5+5**

a) Explain the operation of a pneumatic temperature Transmitter.

b) Give the operating principle of DDC with block diagram.

c) With block diagram define the scheme for cascade control.

d) Explain the operation of relay based annunciator.

e) Why annunciator is used in plant? Explain the major steps of operation of the Annunciator.

Q4A.   6+5+4+6+4

   a) Explain the operation of air failure to open type valve with diagram.

   b) Define the term rangeability of a control valve and its importance.

   c) What is the advantage of using an equal percentage valve over a linear valve?

   d) Write the advantages and disadvantages of double seated valve.

   e) Classify the control valves depending on types of plugs used.

OR

Q4B.   6+6+7+6

   a) With a neat diagram explain the operation of spring actuator with positioner.
   b) Explain the operating principle of pneumatic motor actuator.
   c) Explain the steps of selection of valve size.
   d) Find the ideal flow characteristics equation of control valve in terms of percentage lift of the valve.