

Name of the Examination: **BIEE 3rd YEAR 1st SEM. EXAMINATION, 2025**

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

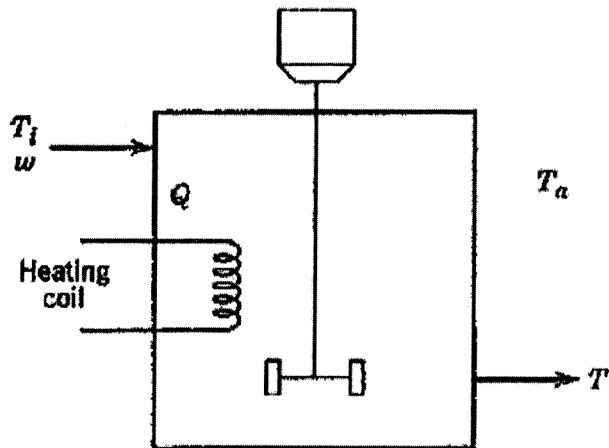
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Attempt ALL Questions

Q1A.

3+3+7+4+3

- i) What is the significance of "degree of freedom"?
- ii) Why the mathematical modeling for process control is required?
- iii) An enclosed stirred tank heating process is used to heat an incoming stream with variable flow rate. The heating rate from this coil and the volume are both constant. w , denote mass flow rate.



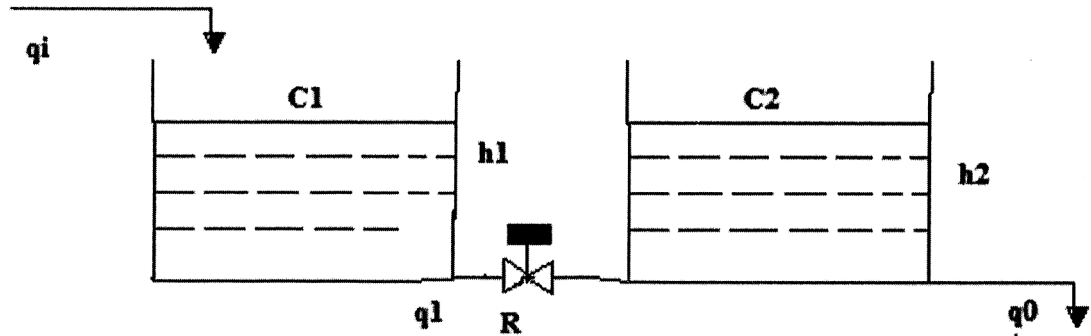
- a) Develop a mathematical model that describes the exit temperature if heat losses to the ambient occur and if the ambient temperature (T_a) and incoming stream temperature (T_i) both can vary.
- b) Discuss qualitatively what you expect to happen as T_i and w varies (increase or decrease) referring your model.
- iv) Explain the self regulation process with an example.
- v) Establish the mathematical model for a liquid tank having controlled inflow and controlled outflow with process resistance and capacitance.

OR

Q1B.

7+6+4+3

- i) 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.
- ii) Derive the mathematical model for the given process



- iii) Define load variable, control variable, error signal and manipulated variable with an example.
- iv) Define process reaction rate.

Q2A.

4+5+6+4+6+5

- i) Define ON-OFF control action with differential gap.
- ii) With the dynamic response of ON-OFF controller, explain the significance of using differential band gap in ON-OFF controller.
- iii) Establish the relation between proportional gain and proportional band in proportional control action.
- iv) Why integral control action is used along with proportional control action?
- v) 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%.
- vi) With a neat sketch explain the different symbols used for piping & instrumentation (P&I) diagrams for a level control loop.

OR

Q2B.

6+5+4+5+6+4

- i) What are the advantages and drawbacks of position algorithm for control action?
- ii) Where the derivative control action is required and why?
- iii) What are the basic criteria to be satisfied in order to obtain tuning of a controller?
- iv) Explain Damped oscillation tuning method by Harriot for PID controller.
- v) What is the issue related to integral wind up and how it can be prevented using programmable controller?
- vi) Draw the response characteristic of PID control action for a step input.

Q3A.

6+6+5+7+6

- i) What are the advantages and drawbacks of feedback control system.
- ii) How process control mechanism can be improved using feedforward control?
- iii) Explain the operation of cascade control system.
- iv) How the relay based annunciator can operate?
- v) Write a short note on override control.

OR

Q3B.

6+6+6+6+6

- i) Explain the operation of a pneumatic pressure transmitter.
- ii) Explain the split-range control system with an example.
- iii) Give the operating principle of DDC with block diagram.
- iv) What is the function of annunciator in plant? Explain the major steps of operation of the annunciation process.
- v) With neat diagram explain the operation of smart transmitter.

Q4A.

6+4+4+3+3

- i) Write the advantages and disadvantages of single seated valve.
- ii) When would you recommend an air-to-close control valve? Give an example.
- iii) What is the advantage of using an equal percentage valve over a linear valve?
- iv) Explain the purpose of using valve positioner.
- v) Explain the principles of working of I/P converter.

OR

Q4B.

5+5+5+5

- i) Why the installed characteristics of control valve are different from its inherent characteristics?
- ii) With a neat diagram explain the operation of spring actuator with positioner.
- iii) Define the term rangeability of a control valve and its importance.
- iv) How to determine the size of a control valve suitable for an application?