



# PRESIDENCY UNIVERSITY

BENGALURU

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| Roll No. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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## End - Term Examinations – May / June 2026

Date: 26 – 05- 2026

Time: 09:30am – 12:30pm

|                             |                                                                             |                       |
|-----------------------------|-----------------------------------------------------------------------------|-----------------------|
| <b>School:</b> SOE          | <b>Program:</b> B.Tech.-PET                                                 |                       |
| <b>Course Code:</b> PET2111 | <b>Course Name:</b> Fundamentals of Instrumentation and Control Engineering |                       |
| <b>Semester:</b> IV         | <b>Max Marks:</b> 100                                                       | <b>Weightage:</b> 50% |

| CO - Levels  | CO1         | CO2         | CO3       | CO4       | CO5       |
|--------------|-------------|-------------|-----------|-----------|-----------|
| <b>Marks</b> | <b>N.A.</b> | <b>N.A.</b> | <b>28</b> | <b>22</b> | <b>50</b> |

### Instructions:

- (i) Read all questions carefully and answer accordingly.
- (ii) Do not write anything on the question paper other than roll number.

### Part A

Answer ALL the Questions. Each question carries 2 marks.

10Q x 2M=20M

|    |                                                                                                                                                 |         |    |     |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------|---------|----|-----|
| 1. | Describe cascade control system with a neat labeled diagram.                                                                                    | 2 Marks | L1 | CO3 |
| 2. | A proportional controller has a gain $K_p=10$ . If the error signal is 3 units, reproduce the control action (output signal of the controller). | 2 Marks | L1 | CO3 |
| 3. | <p>Outline the transfer function from the above closed-loop system.</p>                                                                         | 2 Marks | L1 | CO3 |
| 4. | List two difference Between Proportional and Proportional Integral Derivative Controller (2 points only).                                       | 2 Marks | L1 | CO3 |
| 5. | Consider four liquid tanks connected in a noninteracting way, label the diagram $Y(t)$ vs $\frac{t}{\tau}$ .                                    | 2 Marks | L1 | CO4 |

|     |                                                                      |         |    |     |
|-----|----------------------------------------------------------------------|---------|----|-----|
| 6.  | Reproduce the Laplace transform when $f(t) = \frac{2}{s+3}$          | 2 Marks | L1 | C05 |
| 7.  | Reproduce the diagram for closed-loop system with negative feedback. | 2 Marks | L1 | C05 |
| 8.  | Describe ON/OFF control system with a suitable example.              | 2 Marks | L1 | C05 |
| 9.  | Describe the term "Over shoot" in an underdamped response.           | 2 Marks | L1 | C05 |
| 10. | Reproduce the mathematical expression for "rise time".               | 2 Marks | L1 | C05 |

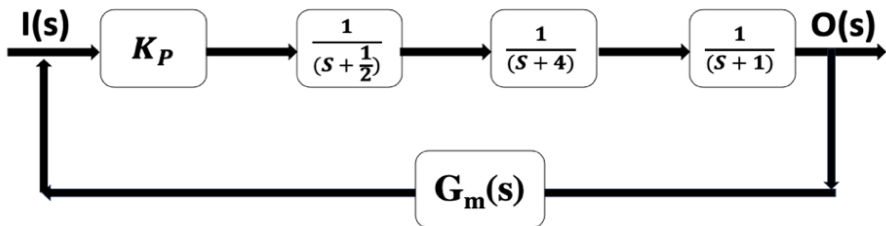
## Part B

### Answer the Questions.

Total Marks 80M

|     |    |                                                                                                                                                                                                                                                                                                        |          |    |     |
|-----|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----|-----|
| 11. | a. | Consider, you have a single tank reactor which is following first-order system. The transfer function of the tank is given by $\frac{1}{\tau s + 1}$ . After sometimes a step change of magnitude A is introduced into the system. Solve the output response of the given system at time t i.e., Y(t). | 10 Marks | L3 | C03 |
|     | b. | The below diagram shows a closed-loop control system, having an open-loop transfer function of $\frac{5}{6s^2 + 12s + 6}$ .<br><br>Solve the followings:<br><br>i) Decay ratio<br>ii) Overshoot<br>iii) Rise time<br>iv) Period of oscillation<br>v) Natural period of oscillation                     | 10 Marks | L3 | C03 |

Or

|     |                                                                                                                                                                                                                                                                                                                                                                          |          |    |     |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----|-----|
| 12. | <p>A closed-loop control system is shown in the below figure. A unit step impulse is introduced into the system.</p> <p>Solve the output value at time "t" i.e., O(t) (<b>consider only forward path</b>).</p> <p>[Consider the feedback transfer function of this system is 1]</p>  | 20 Marks | L3 | C03 |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----|-----|

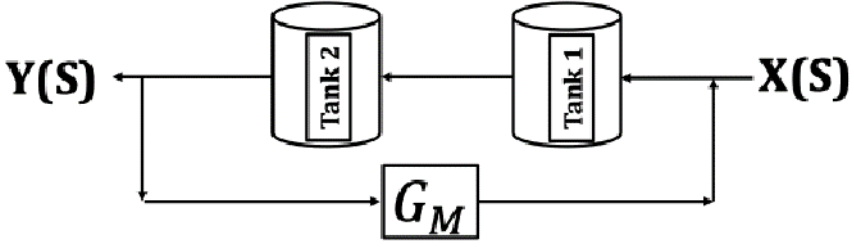
|     |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |    |     |
|-----|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----|-----|
| 13. | a. | <p><b>Case I: Fixed-Time Traffic Signal Control System</b></p> <p>Sketch a block diagram representing a traffic signal system that operates solely based on a predetermined fixed time interval. Clearly identify and interconnect key system components such as the timer unit, controller, and signal actuator. Analyze how the input (time setting) propagates through the system to produce the output (signal switching). Based on reasonable assumptions for system elements (e.g., gain blocks, delay elements), solve the overall transfer function of the system.</p> <p><b>Case II: Traffic Density-Based Signal Control System</b></p> <p>Prepare a block diagram for an advanced traffic signal system that incorporates both fixed time intervals and real-time traffic density measurements. Include components such as sensors (e.g., vehicle density detectors), signal processing units, controllers, final control element, and measuring element. Based on reasonable assumptions for system elements solve the overall transfer function of the system.</p> | 10 Marks | L4 | CO4 |
|     | b. | Examine the dynamic behavior of a first order lag system while unit step input will be introduced into the system.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 10 Marks | L4 | CO4 |
| Or  |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |    |     |
| 14. |    | <p>The below mentioned figure represents process for the pneumatic valve which is a first order system.</p> <p>i) Examine the overall transfer function of the system</p> <p>ii) Determine the output (<math>Y(t)</math>) when unit step change of magnitude A is introduced into the system.</p> <div style="text-align: center;"> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 20 Marks | L4 | CO4 |
| 15. |    | <p>Examine the overall transfer function of the system while considering servo and regulator problems.</p> <div style="text-align: center;"> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 20 Marks | L4 | CO5 |
| Or  |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |    |     |

|     |                                                                                                                            |          |    |     |
|-----|----------------------------------------------------------------------------------------------------------------------------|----------|----|-----|
| 16. | Examine the transfer function for tank 1 and tank 2, respectively of the two-tank chemical reactor system, as shown below. | 20 Marks | L4 | C05 |
|-----|----------------------------------------------------------------------------------------------------------------------------|----------|----|-----|

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                |          |    |     |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----|-----|
| 17. | <p>a. In block diagram reduction examine the following block diagrams (only draw the block diagrams, no discussion is required)</p> <ul style="list-style-type: none"> <li>i) Combining the blocks in cascade</li> <li>ii) Moving the branch point ahead of the block</li> <li>iii) Moving the branch point before the block</li> <li>iv) Moving summing point ahead of the block</li> <li>v) Moving summing point before the block</li> </ul> | 10 Marks | L4 | C05 |
|     | <p>b. A thermometer having a time constant of 0.4 minute is at a steady-state temperature of 80°F. At time <math>t=0</math> the thermometer is placed in a temperature bath and maintained at 100°F. Calculate the time needed for the thermometer to read 90°F.</p>                                                                                                                                                                           | 10 Marks | L4 | C05 |

Or

|     |                                                                                                                                                                                                                                                                                     |          |    |     |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----|-----|
| 18. | <p>a.</p> <div style="text-align: center; margin: 20px 0;"> </div> <p>Four stirred tank reactor is connected parallelly as shown in figure below. "G" in the figure represents the process of each tank system. Analyze the overall transfer function for the following system.</p> | 10 Marks | L4 | C05 |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----|-----|

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|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----|-----|
|  | <p><b>b.</b></p>  <p>The two-tank liquid system is connected in series in a feedback control system (as depicted in the above figure). The transfer function for Tank 1 is given as <math>\frac{2}{\tau_1 s + 1}</math>, for Tank 2 the transfer function is given by <math>\frac{4}{\tau_2 s + 1}</math>. The measuring element value was found to be 1. Calculate the output response of the given system at time t i.e., Y(t).</p> | 10 Marks | L4 | C05 |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----|-----|