Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2018

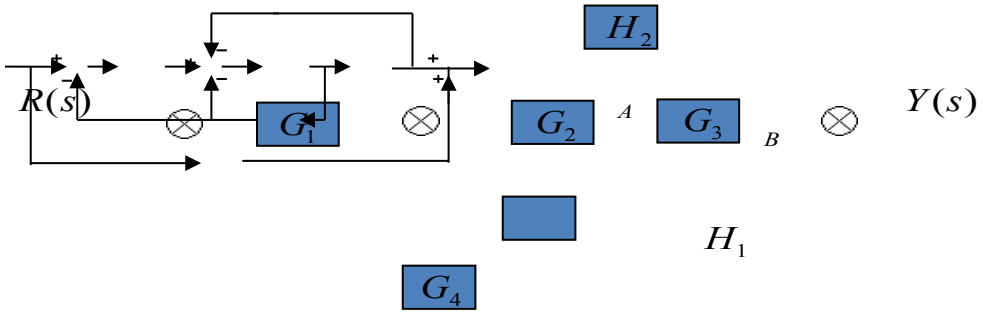
Programme Name: M.Tech **Semester: I**
Course Name: Energy Systems and REE **Time: 03 hrs**
Course Code: EPEC7003 **Max. Marks: 100**
Nos. of page(s): 4
Instructions: Attempt all the questions.

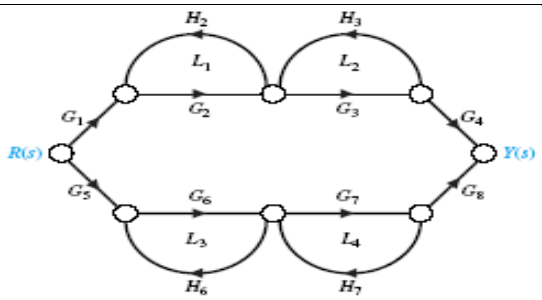
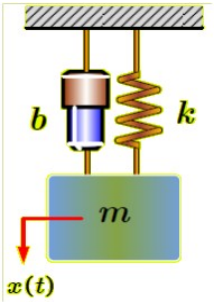
SECTION A

S. No.		Marks	CO
Q 1	Define the following: 1. Accuracy 2. Precision 3. Type and Order of a System 4. Transient Response	4	CO1
Q 2	Define the individual P, I, D, controller and derive the transfer function of PID controller. Mention the individual advantages and disadvantages of individual controllers.	4	CO2
Q 3	Suggest the device for the measurement of displacement in the terms of electrical voltage. Briefly explain the working with the help of circuit diagrams.	4	CO1
Q 4	List down the properties, which need to be consider while choosing the material for piezo electric crystals. Write the expression for the emf generated when a certain force is applied on the crystal.	4	CO1
Q 5	Present the model for interfacing the transducer with the process computers. List down the available tools for this. Mention and describe the types of communication in these processes.	4	CO4

SECTION B

Q 6	(A) List the instruments that are used in the renewable energy. (B) The Inductance of a moving iron ammeter with a full scale deflection of 90 degrees at 1.5A is given by the expression: $L=(58+40\theta-4\theta^2-\theta^3)\mu H$ Where, θ is the deflection in radians from the zero position, calculate: 1. Spring Constant. 2. The angular deflection of the pointer for a current of 2.0A	2+4+4	CO1, CO4

	(C) List the PMMC meter intrinsic constants, define them and write the equation for each constant, analyze the dynamic response by using these galvanometer constants.		
Q 7	(A) Consider the energy balance equation in the case of moving iron instruments and derive the expression for the deflection of the pointer. (B) Following data relates to a galvanometer used in an industrial application for the measurement of electrical quantities: Number of turns = 320 Flux Density = 0.12 Wb/m^2 Control constant = 0.12 x 10^{-6} Nm/rad Coil size = 21 mm x 22 mm Moment of inertia = 0.2 x 10^{-6} kg-m^2 Galvanometer resistance (including external resistance) = 2100 Ω. Determine: 1. Total resistance for critical damping 2. Damping ratio 3. Frequency of undamped oscillations 4. Frequency of damped oscillations 5. Deflection for the measurement of current 1 A.	**5+5**	**CO1**
Q 8	(A) An industrial application uses the block diagram for temperature control as shown in Figure: 1. Find the overall transfer function using block diagram reduction techniques..  Figure: 1 (B) Obtain the overall closed loop transfer function of the graph shown in Figure:2 by using signal flow graph.	**6+4**	**CO2, C03**

	 Figure: 2		
Q 9	Write the general equation for a second order system. Describe the various terms involved. Classify the output behavior according to the damping ratio. For the following system shown in Figure: 3 kept in zero gravity derive the transfer function if m=100g, b=0.4 N/ms, k=4N/m and find out damping ratio and natural frequency of the system.  Figure: 3 Design the PID controller for the transfer function obtained in above steps.	**1+2+2 +2+3**	**CO2, CO3**
	SECTION-C		
Q 10	(A) Describe the objectives, features and economic benefits of SCADA system. Mention the detailed application of SCADA systems. (B) An indicating light is to go ON when a count reaches 22.The light is then go off when a count of 30 is reached. Design, construct, and test PLC circuits for this process. **OR** (A) Three conveyors feed a main conveyor. The count from each feeder conveyor is fed into an input register in the PLC. Construct a PLC program to obtain the total count of parts on the main conveyor. Use a time to update the total every 15 seconds. Design, construct, and test PLC circuits for this process. (B) Explain the hierarchical structure of automation in detail. Discuss the importance of each component in brief.	**10+10**	**CO5**

<table>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>Q 11</td><td>(A) Illustrate and compare the different types of temperature measuring devices and enumerate each of them in the tabular form given here under.

<table><tr><td>S No</td><td>Temperature measuring devices</td><td>Principle of Operation</td><td>Specification Range</td><td>Merits</td><td>Classification</td></tr><tr><td>1.</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>
(B) Describe the working principle of strain gauges. Derive the expression of gauge factor. List down the types of strain gauges.</td><td>10+10</td><td>CO1, CO4</td></tr>
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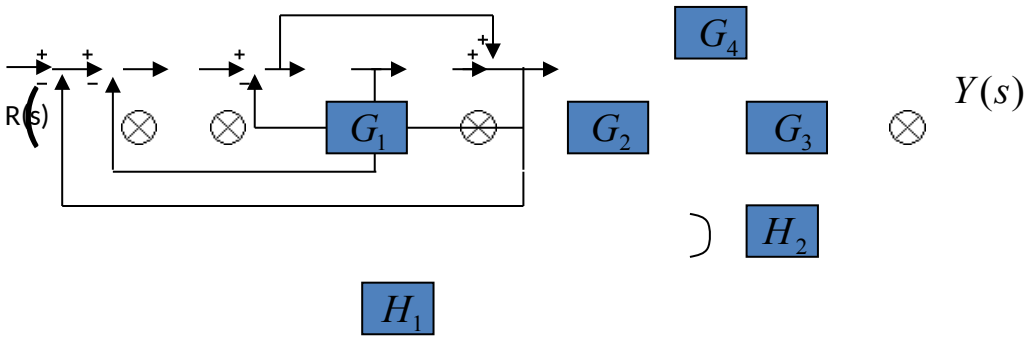
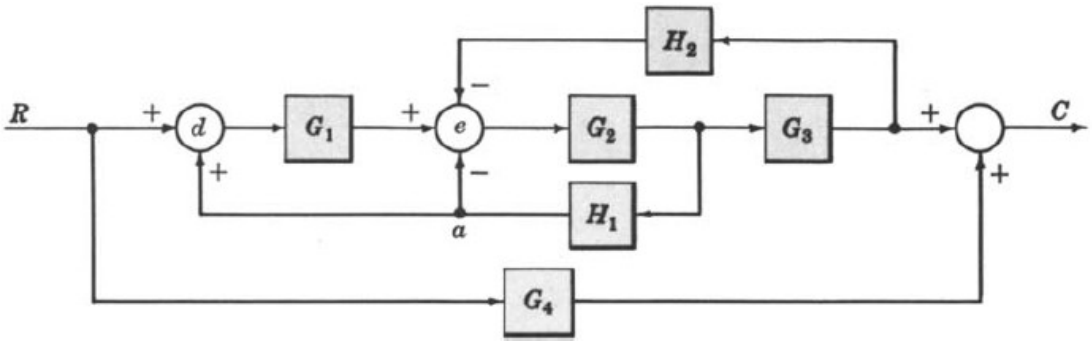
Programme Name: M.Tech **Semester: I**
Course Name: Energy Systems & REE **Time: 03 hrs**
Course Code: EPEC7003 **Max. Marks: 100**
Nos. of page(s): 3
Instructions: Attempt all the questions.

SECTION A

S. No.		Marks	CO
Q 1	Define the following: 1. Loading Effect 2. Resolution 3. Threshold 4. Dead Time and Dead Zone.	4	CO1
Q 2	Describe the properties of the materials to be used as an RTD element. Draw the construction diagram of an RTD.	4	CO1
Q 3	Draw the closed loop control of a plant using PID controller. Mention the individual advantages and disadvantages of these controllers.	4	CO2
Q 4	Describe the pressure sensitive elements by drawing their diagrams. Mention their properties and materials used for their construction	4	CO1
Q 5	Take any transfer function of your choice, define and calculate its pole and zeros. Draw the pole zero map. Also identify the type and order of the assumed transfer function.	4	CO2

SECTION B

Q 6	(A) The inductance of a moving iron instruments is given by the expression: $L=(0.01+K\theta)(0.01+K\theta)\mu H$ where θ is the angular deflection in radians from zero position. The instrument angular deflection corresponding to currents of 2 A and 5 A are 45^0 and 90^0 respectively. Determine the value of K. (B) A millimeter of 2.5 ohms resistance reads up to 100 miliamperes. Calculate the resistance which is necessary to enable it to be used as: 1. A voltmeter reading upto 10 V 2. An ammeter reading upto 10 A.	6+4	CO1

Q 7	(A) A moving coil galvanometer employed in a plant deflects 220 mm on a scale at a distance of 1.2 m from the mirror when a current of 2.2 μA passes through it. The free time period of the galvanometer is 3.8 seconds. The galvanometer is dead beat when the total resistance in the galvanometer is 19500 Ω. Determine the moment of inertia of the galvanometer moving system. (B) A capacitive transducer uses two quartz diaphragms of area 750 mm^2 separated by a distance of 3.5mm. A pressure of 950 kN/m^2 when applied to the top diaphragm produces a deflection of 0.6mm. The capacitance is 370 pF when no pressure is applied to diaphragms. Find the value of capacitance after the application of a pressure of 950 kN/m^2	**6+4**	**CO1**
Q 8	Determine the overall closed loop transfer function of the system shown below in Figure: 1  Figure:1	**10**	**CO2**
Q 9	Determine the transfer function C/R for the block diagram below by signal flow graph techniques shown in Figure:2  Figure:2	**10**	**CO2**

SECTION-C			
Q 10	(A) The second order system is given by C(s) /R(s) = 25 / s^2 + 6s +25. Find its rise time, peak time, peak overshoot and settling time if subjected to unit step input. Also calculate expression for its output response? (B) Describe the architecture of PLCs. Mention the inputs and outputs of a PLC and list the applications. OR (A) Present a comparative study for the measurement of following parameters with relative advantages and disadvantages. ➢ Temperature ➢ Flow (B) There is 3 mixing devices on a processing line A, B, C. After the process begin mixer-A is to start after 7 seconds elapse, next mixer-B is to start 3.6 second after A. Mixer-C is to start 5 seconds after B. All then remain ON until a master enable switch is turned off. Write PLC ladder diagram, timing diagram and realize the same.	**10+10**	**CO3, CO5**
Q 11	(A) Recommend the communication methods in Supervisory Control and Data Acquisition system owing to avoid the propagation delay in the signal. Also, enlist the communication devices to attain the aforementioned objective. (B) Describe the applications of SCADA systems. Also discuss the objectives and architecture of SCADA.	**10+10**	**CO4, CO5**