Roll No: ----------

UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: M.Tech Energy Systems & Renewable Energy Engineering
Semester – I
Subject (Course): Instrumentation control & Automation **Max. Marks: 100**
Course Code : EPEC7003 **Duration : 3 Hrs**
No. of page/s: 3

Section A (5x4=20)

Q.1 [CO4,5] Draw the PLC block diagram and describe its architecture in brief. (4)

Q.2 [CO2,3] What do you understand by 'Type' and 'Order' of a system? List out their significance and give their examples with the transfer function. (4)

Q.3 [CO4] Describe the importance of data acquisition in measurement and instrumentation also justify this statement by citing suitable points. (4)

Q.4 [CO1,4] It is required to measure the pressure in terms of the electric voltage. Suggest the appropriate methodology for this measurement with the help of suitable diagrams. (4)

Q.5 [CO1,2] For the measurement of force, simple electrical strain gauge of resistance 120Ω and having a gauge factor of 2 is bonded to steel having an elastic limit stress of 400 MN/m^2 and modulus of elasticity is 200 GN/m^2. Calculate the change in resistance. (4)

I. Due to change in stress equal to 1/10 of the elastic range.
II. Due to temperature of 200C if the material is advance alloy. The resistance temperature coefficient of advance alloy is 20 x $10^{-6}/^0C$.

Section B (4x10=40)

Q.6 [CO1,2] Describe the charge generator model of a piezoelectric crystal. Define the related parameters and derive the expressions also. (10)

Q.7(A) [CO1,4]]A moving coil galvanometer employed in a plant deflects 240 mm on a scale at a distance of 1.2 m from the mirror when a current of 1.2 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 16500 Ω. Determine the moment of inertia of the galvanometer moving system. (5)

Q.7(B) [CO1,2] Following is the relationship between inductance of moving iron ammeter the current and the position of pointer from an experiment in the laboratory. (5)

S. No	Readings (A)	Deflection (degree)	Inductance (H μ)
1	1.2	36.5	575.2
2	1.4	49.5	576.5
3	1.6	61.5	577.8
4	1.8	74.5	578.8

Calculate the deflecting torque and the spring constant when the current is 1.5A?

Q.8 [CO2,3] Block diagram for the flow control of a plant is given in fig 1with one minor feedback and feed forward loop. Find the overall transfer function G(s) for this. Then derive the closed loop expression of the process when it is to be controlled by PI Controller. (10)

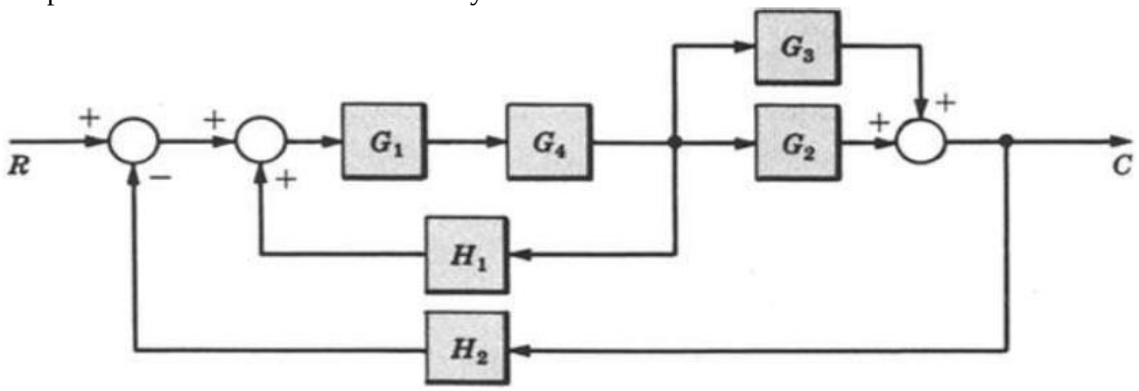
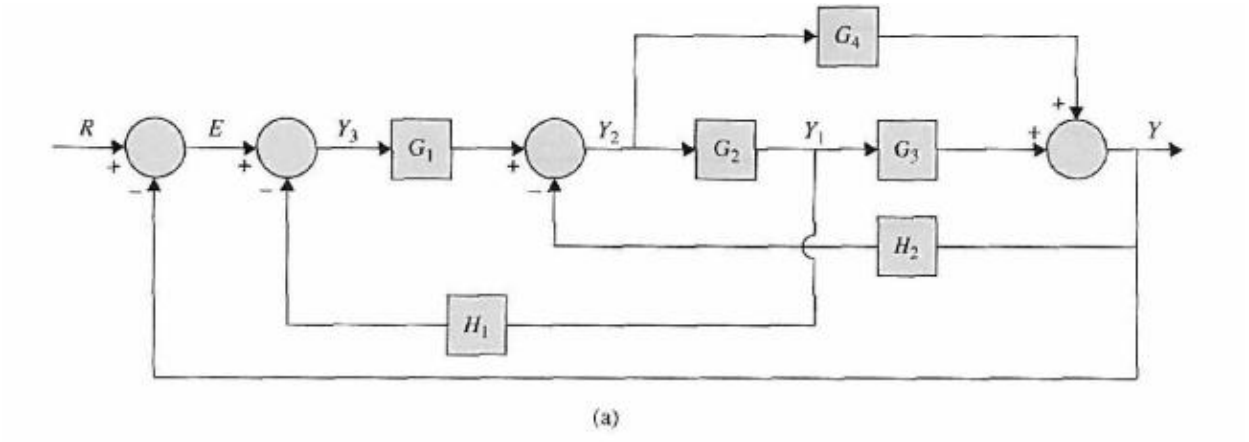


Fig:1

Q.9 [CO2,3] Block diagram for the temperature control of an industrial process is shown below. Draw the SFG for this and obtain the overall transfer function using Mason's gain formulae. (10)



(a)

Section C (2x20=40)

Q.10 (a) [CO1,4,5] Convert the following Boolean equations to the simplest possible ladder logic. (10)

a. $\left(\left(A.\overline{B}\right)+\left(\overline{\overline{B}+A}\right)\right).C+\left(\overline{B.C}+B.C\right)$

b. $\overline{\left(A.B.\overline{C}.D+A.B.\overline{C}.\overline{D}+\ \overline{A}.B.C.D+\ \overline{A}.\overline{B}.C.D\right)}+\ D$

.

Q.10 (b) [CO2,3] Describe the PID Controller. Draw the block diagram and write the transfer function of PID controller. Explain each term P, I, D in with their relative advantages and disadvantages. (10)

OR

Q.10 [CO1,2,3,4] Present a comparative study for the measurement of following parameters with relative advantages and disadvantages. (20)

I. Pressure
II. Temperature
III. Flow

Q.11 [CO1,4,5] Discuss the importance of SCADA in automation. Explain in detail with proper example architecture. List and describe the major areas in which SCADA finds the application. (20)

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Section A (5x4=20)

Q.1 [CO1,4] Explain the methods of vibration measurements in industrial applications. (4)

Q.2 [CO2,3] Draw the system response for different damping ratio values. Justify the significance of each case. (4)

Q. 3[CO 1,4]] Describe with neat sketches the following types of primary detecting element. (4)

(i) Bourdon Tubes (ii) Bellows (iii) Diaphragms

Q.4 [CO 2,3] Design the PID Controller for the system shown in Fig:1 above for unity feedback. Also draw the block diagram. (4)

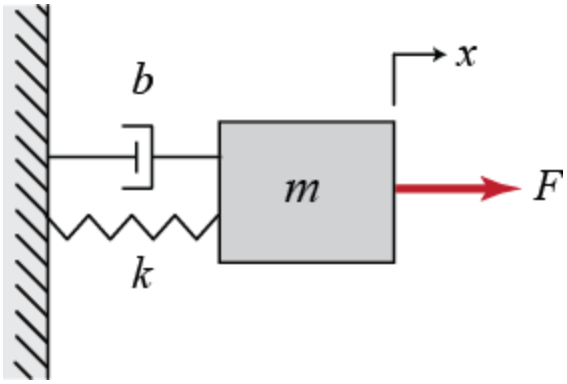

Fig:1

Q.5[CO1,2,3,4,5] Draw the measurement and control schematic diagram for thermal power plant. (4)

P.T.O

Section B (4x10=40)

Q.6 [CO1,2]Suggest the devices for power measurement in an industrial application and discuss the various types of errors introduced in the dynamometer type wattmeter. Also describe how the error due to inductance of pressure coil is compensated also derive the expression for correction factor. (10)

Q.7 [CO1,2] Describe the working principle and classification of moving iron instruments. Derive the expression for deflection of the instruments. Explain compensation for error due to change in frequency. Mention their advantages and disadvantages. (10)

Q.8 [CO1,2] The Inductance of a moving iron ammeter with a full scale deflection of 90^0 at 1.5A is given by the expression: $L = (1900 + 40\theta - 4\theta^2 - \theta^3)\mu H$ (10)

Where, θ is the deflection in radians from the zero position, calculate:

I. Spring Constant.

II. The angular deflection of the pointer for a current of 2.0A

Q.9 [CO 2,3] Obtain analytically the rise time, peak time, maximum overshoot, and settling time and the time response with unit-step input of a closed-loop system given by

$$\frac{C(S)}{R(S)} = \frac{36}{S^2 + 2S + 36}$$

where *R(s)* and *C(s)* are Laplace transforms of the input *r(t)* and output *c(t)*, respectively**.** (10)

Q.9 [CO 2,3] Sketch the free body diagram for the given mechanical system shown in fig:2 and derive transfer functions $X_1(s)/U(s)$. For the same system obtain the electrical analogous system using force voltage and Force current analogy. (10)

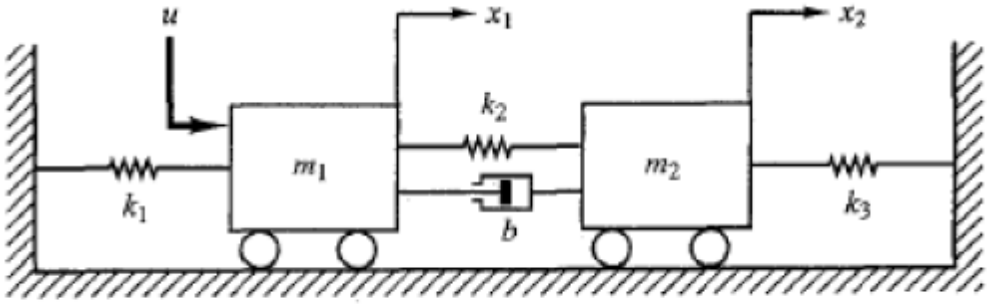

Fig: 2

P.T.O

Section C (2x20=40)

Q.10(A) Illustrate and compare the different types of temperature measuring devices and enumerate each of them in the tabular form given here under. (10)

S No	Temperature measuring devices	Principle of Operation	Specification Range	Merits	Classification
1.					

Q.10 (B) Describe the methods of measurement of force/weight/stress by working principle of change in resistance. Also derive the expression for the change in resistance with respect to the original resistance. Mention Piezo-resistive effect. (10)

OR

Q.10 (A) [CO1,4,5] Describe the architecture of PLCs. Discuss and explain the I/O module for PLC in detail including types of input and outputs. (10)

Q.10 (B) [CO1,4,5] Write the Boolean expression and draw the gate logic diagram and typical PLC ladder logic for A control system wherein a fan is to run only when all of the following conditions are met: (10)

I. Input A is OFF
II. Input B is ON or Input C is ON or both B and C are ON
III. Input D and E are both ON
IV. One or more of inputs F,G, or H are ON

Q.11 (A) [CO1,4,5] Describe the applications of SCADA systems. Also discuss the objectives and architecture of SCADA. (10)

Q.11 (B) [CO1,4,5] 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 . (10)

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