Name:

Enrolment No:

UPES
UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

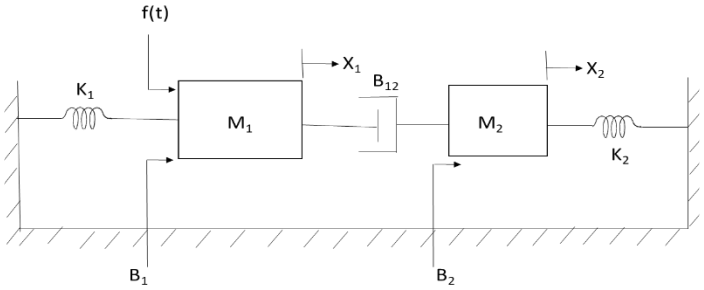
Program: B.Tech, Fire & Safety Engineering
Semester: VI
Course: Process Instrumentation and Control Engineering
Time: 03 hrs.
Course Code: ECEG 3009 **Max. Marks: 100**
No. of pages: 2

SECTION A (20 marks)
(All questions are compulsory)

S. No.		Marks	CO
Q1	A thermocouple gives the following readings for temperature. Determine its sensitivity. Temperature (°C): 5, 8, 11, 14, 17 Voltage (mV): 0.3, 0.5, 0.7, 0.9, 1.1	**4**	**CO1**
Q2	a) An example of a head type flow meter is _____. b) Give the expression to determine the flow rate through a head type flow meter and mention what each term represents.	**1+3**	**CO4**
Q3	Define the following a) Sensitivity of an instrument b) Zero drift	**2+2**	**CO1**
Q4	Distinguish between: a) Accuracy and precision b) Repeatability and reproducibility	**2+2**	**CO1**
Q5	Draw the diagram and write the force balance equation of an ideal spring with a) Displacement at one end b) Displacement at both ends	**2+2**	**CO2**

SECTION B (40 marks)
(All questions are compulsory)

Q6	The medical condition for **hyperpyrexia** is described as when someone is running a body temperature of more than 106.7°F. Express the level of hyperpyrexia in **(a) K** **(b) °C** **(c) R**	**10**	**CO1**
Q7	Explain a simple thermal system with the help of a diagram and define capacitance	**10**	**CO2**

	and resistance of a thermal system.		
Q8	Draw the block diagram of a closed loop control system and derive the expression which relates the closed-loop system dynamics to the dynamics of the feedforward elements and feedback elements of such a system.	**10**	**CO3**
Q9	A manometer using oil with relative density 0.864 as measuring liquid has a well of diameter 20 mm and tube diameter 2 mm. If the angle at which the tube is to the horizontal is 16.22^{o}, determine the scale deflection for a pressure of 1mm head of water.(Assume 1mm of water =9.81 Pa) OR What is meant by time of flight method of level measurement? List the instruments that are based on this principle? With the help of a diagram explain the working of one such level indicator system. Also mention two advantages.	**10** **10**	**CO4**
	SECTION-C (40 marks) **(All questions are compulsory)**		
Q10	Give the classifications of industrial controllers. Explain their characteristics. Which controller is best suited for a process which requires frequent shut-down and start-ups and why? OR Write the differential equations governing the mechanical system shown in fig. and determine its transfer function.  	**20**	**CO1, CO3**
Q11	Give the appropriate temperature sensor/instrument for the following applications, and describe its working principle with the help of a diagram. a) Temperature detector in a fire alarm requiring high sensitivity b) The sensor arrangement which can be used to provide portable power in spacecraft applications c) A furnace interior clouded with fumes d) Temperature sensing inside a reactor operating between 200-600 ^{0}C at a point which is difficult to access e) Metals being hot- worked at temperatures of about 3500 ^{o}C	**20**	**CO5**

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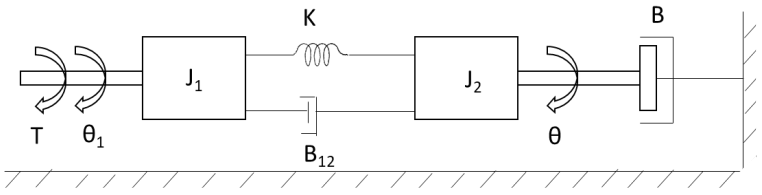
SECTION A (20 marks)
(All questions are compulsory)

S. No.		Marks	CO
Q1	A thermocouple gives the following readings for temperature. Determine its sensitivity. Temperature (°C): 3, 6, 9, 12, 18 Voltage (mV): 0.2, 0.4, 0.6, 0.8, 1.0	4	CO1
Q2	a) The open channel refers to any conduit in which liquid flows with a _____. b) Give two examples of open channel flows. c) Mention two instruments used to measure the flow in open channels.	4	CO4
Q3	Explain the following a) Linearity of an instrument b) Hysteresis error	2+2	CO1
Q4	Distinguish between open loop and closed loop systems.	2+2	CO1
Q5	Draw the diagram and write the force balance equation of an ideal dashpot with a) Displacement at one end b) Displacement at both ends	2+2	CO2

SECTION B (40 marks)
(All questions are compulsory)

Q6	Hyperthermia of 5°C (i.e., 5°C rise above the normal body temperature) is considered fatal. Express this fatal level of hyperthermia in (a) K, (b) °F (c) R.	10	CO1
Q7	Explain liquid level control system with the help of a diagram and define capacitance and resistance of a liquid level control system.	10	CO2
Q8	What is the advantage of using block diagrams to represent control systems? With the help of suitable illustrations, mention the various components of a block diagram.	10	CO3

	Also give the generalized expression for the closed loop transfer function of a control system.		
Q9	A thermocouple is known to have poor sensitivity. Justify this statement. Also state the thermocouple laws and thermo-electric effects based on which the thermocouple operates. OR A Paper manufacturing industry stores saw-dust in a cylindrical tank of height 15m. In the process of filling the tank, a level indicator is required to be installed. Which instrument will be best suited for this? With the help of a diagram explain the working of such a level indicator system. Also mention two advantages.	**10**	**CO4**
	SECTION-C (40 marks) **(All questions are compulsory)**		
Q10	Give the appropriate temperature sensor/instrument for the following applications, and describe its working principle with the help of a diagram. a) Temperature detector in a fire alarm requiring high sensitivity b) The sensor arrangement which can be used to provide portable power in spacecraft applications c) A furnace interior clouded with fumes d) Temperature sensing inside a reactor operating between 200-600 ^{0}C at a point which is difficult to access e) Metals being hot- worked at temperatures of about 3500 ^{o}C	**20**	**CO5**
Q11	Write the differential equations governing the mechanical system shown in fig. and determine its transfer function.  OR Between a pneumatic and a hydraulic controller which one more accurate? List comparative features of the two types of controllers.	**20**	**CO1, CO3**