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DEPARTMENT OF MECHATRONICS III SEMESTER B.TECH. (MECHATRONICS ENGINEERING) MAKE-UP EXAMINATIONS, JULY 2021

SUBJECT: SENSORS AND INSTRUMENTATION [MTE 2155]

Time: 3 Hours

MAX. MARKS: 50

	Instructions to Candidates:				7	
	✤ Answer ALL the questions.					
	 Missing data (if any) may be suitably assumed and justified. 					
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IA.	Fig. QIA shows the hierarchy of an Industrial Automation & Control System plant which consists of five levels. Identify the levels for each of	2	4	1,2,3	5,6,13	111
	the following:			,5,12		
	i. Materials & resource planning					
	ii. Preliminary Binary Signals					
	Level-5					
	Level-4					
	Level-5					
	Level-2					
	/ HART/ FIELDBUS					
	1 1-20 mA FIELD 1 Image: Sensors and actuators 1 Image: Sensors and actuators					
	Fig. Q1A					

1B.	The solution for the unknown resistance for a Wheatstone bridge is:	3	1	1,2,3	1,2	III
	$R_{\rm X} = \frac{R_2 R_3}{R_1}$,5,12		
	Where $R_1 = 100 \pm 0.5 \% \Omega$ $R_2 = 1000 \pm 0.5\% \Omega$ $R_3 = 842 \pm 0.5\% \Omega$					
	 Determine the following: The Magnitude of the unknown resistance The limiting error in percent and in ohm for the unknown resistance R_X. III. The range of the guaranteed values of the unknown resistance. 					
1C.	Construct a ladder logic diagram that will implement the following function:	5	3	1,2,3 ,5,12	1,6,18	III
	$x = \operatorname{atan}\left(y\left(\frac{y + \log(y)}{y + 1}\right)\right)$					
2A	Mention the four types of registers used in MODBUS communication protocols.	2	4	1,2,3 ,5,12	5,6,13	Ι
28	The monitoring of cylinders by means of position sensors is of high importance during automated production processes. The stroke movement is measured by voltage division position transducers. These position transducers are mounted externally to a hydraulic cylinder and provide a signal proportional to the stroke movement. The control system compares the target stroke with the actual stroke. Suggest and elaborate on the most appropriate transducer for this application with neatly labelled figure. [Note: elaboration-Working principle, operation, figure, materials used for mounted stroke is applied.]	4	2	1,2,3 ,5,12	1,6,7, 8,9,13 ,18	П
2C	Electronic equipment, as well as signal and power transmission lines, are subject to voltage surges from radio frequency transmissions, lightning strikes and spikes in the power supply. To avoid such disruptions, a safe interface between high-voltage components and low-voltage devices is required. Explain with necessary diagram the operation of the isolation process which could be utilized in such scenario.	4	3	1,2,3 ,5,12	1,6,18	Π
3A	A production unit produces 100 parts/hr. Two conveyor belts (Conveyor 'A', and Conveyor 'B') feed into a main Conveyor 'C'. Parts on the conveyors ('A' and 'B') are counted by each sensor – 'Sensor -1' and 'Sensor-2' respectively and then the total number of parts is counted at the main conveyor 'C'. When more than one fourth of the total parts has been counted (on the main conveyor), a green light must go ON. Design ladder logic for this operation.	3	3	1,2,3 ,5,12	1,6,18	III

38	Explain the working principle of the transducer with the help of a diagram, for the scenario where a group of students built a small remote controlled (RC) car and planned to measure the vibrations on the RC car. Due to torque constraints they could not afford for an additional power supply on the board. (explanation:1M, diagram:1M)	2	2	1,2,3 ,5,12	1,6,7, 8,9,13 ,18	III
3C	The modern vehicles as shown in Fig. Q3C are embedded with many functionalities including steering and braking data which are communicated electronically from the driver to the actuators. The implementation strongly depends on the choice of braking mechanics (e.g., hydraulics, pneumatics, electro-hydraulics, or even electro-mechanics), the availability of a transmission ECU, and the interface to the engine ECU. Therefore, in order to have a smooth and bumpless transfer of data within all the ECUs of such vehicles, a standardized protocol is required for proper communication within the control system. Suggest and elucidate the most suitable communication protocol for this purpose. (Note: ECU- Electronic Control Unit)	5	4	1,2,3 ,5,12	5,6,13	Ι
	Interview control Every control Interview control					
4A	In an automotive manufacturing plant, risks that go unaddressed can lead to missed production targets, safety hazards, and vehicle recalls. Therefore, the process of document preparation and standardization is extremely crucial. As a result each manufacturing plant has its own risk assessment sheet stating all safety, environmental and ergonomic risks. Mention any <i>three documents</i> that need to be reviewed in the process of Risk – assessment and risk management of such manufacturing plant.	3	2	1, 2 ,3 ,5,12	1, 6 ,7, 8,9,13 ,18	IV

Draw ladder logic for the below given operation: When a switch 'A' is pressed, the light 'P' should glow after 5s. If switch 'A' is pressed 4 times, then light 'P' should be OFF and light 'Q' should glow after 20s. Light 'Q' should remain ON only for 5 s.	5	3	1,2,3 ,5,12	5,6,13	III
State the role of Shedder bar or Bluff body von Kármán effect for measurement of flow velocity using Vortex flow-meter.	2	2	1,2,3 ,5,12	1,6,7, 8,9,13 ,18	Ι
Identify the OSI model layer for each of the below given services in networking systems: a) Time-out of Student Life Cycle Management (slcm) b) External cable connection to the computer or controller c) Mozilla Firefox, Instagram	3	4	1,2,3 ,5,12	5,6,13	III
Blood glucose monitoring is done to measure the concentration of glucose in the blood (glycaemia) over time, and is important in the care of patients with diabetes mellitus The better the patient's blood glucose control, the less likely it is that the diabetes will cause damage in the body and lead to complications such as loss of vision and amputation. Elaborate with an example of biomedical sensor how glucose in human blood could be detected. (Explanation- 3M, diagram- 2M)	5	2	1,2,3 ,5,12	1,6,7, 8,9,13 ,18	III
For a 16-bit Bit Shift Left Register, the initial condition of the bit register is shown below. With the given information: i. Fill the missing bit-data of b) and c). ii. Mention the lost bit in each of them. a) Initial condition of the bit register 1 0 1 0 1 0 1 b) After one shift of a) Lost bit: Data-in= High b) After two shifts of a) Lost bit: Data-in=Low	2	3	1,2,3 ,5,12	1,6,18	Ι
	Draw ladder logic for the below given operation: When a switch 'A' is pressed, the light 'P' should glow after 5s. If switch 'A' is pressed 4 times, then light 'P' should be OFF and light 'Q' should glow after 20s. Light 'Q' should remain ON only for 5 s. State the role of Shedder bar or Bluff body von Kármán effect for measurement of flow velocity using Vortex flow-meter. Identify the OSI model layer for each of the below given services in networking systems: a) Time-out of Student Life Cycle Management (slcm) b) External cable connection to the computer or controller c) Mozilla Firefox, Instagram Blood glucose monitoring is done to measure the concentration of glucose in the blood (glycaemia) over time, and is important in the care of patients with diabetes mellitus The better the patient's blood glucose control, the less likely it is that the diabetes will cause damage in the body and lead to complications such as loss of vision and amputation. Elaborate with an example of biomedical sensor how glucose in human blood could be detected. (Explanation- 3M, diagram- 2M) For a 16-bit Bit Shift Left Register, the initial condition of the bit register is shown below. With the given information: a) Fill the missing bit-data of b) and c). d) 1 1 0 0 1 1 0 1 0 1 d) 1 1 0 0 1 1 b) After one shift of a) Lost bit:	Draw ladder logic for the below given operation: 5 When a switch 'A' is pressed, the light 'P' should glow after 5s. If switch 'A' is pressed 4 times, then light 'P' should be OFF and light 'Q' should glow after 20s. 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With the given information: a) Initial condition of the bit register b) After one shift of a) Lost bit: Data-in= High 	Draw ladder logic for the below given operation: 5 3 When a switch 'A' is pressed, the light 'P' should glow after 5s. If switch 'A' is pressed 4 times, then light 'P' should be OFF and light 'Q' should glow after 20s. Light 'Q' should remain ON only for 5 s. 5 3 State the role of Shedder bar or Bluff body von Kármán effect for measurement of flow velocity using Vortex flow-meter. 2 2 Identify the OSI model layer for each of the below given services in networking systems: a) Time-out of Student Life Cycle Management (slcm) b) External cable connection to the computer or controller c) Mozilla Firefox, Instagram 5 2 Blood glucose monitoring is done to measure the concentration of glucose in the blood (glycaemia) over time, and is important in the care of patients with diabetes mellitus The better the patient's blood glucose control, the less likely it is that the diabetes will cause damage in the body and lead to complications such as loss of vision and amputation. Elaborate with an example of biomedical sensor how glucose in human blood could be detected. (Explanation- 3M, diagram- 2M) 2 3 For a 16-bit Bit Shift Left Register, the initial condition of the bit register is shown below. With the given information: a) Initial condition of the bit register d) 1 d) 1	Draw ladder logic for the below given operation: 5 3 1,2,3 When a switch 'A' is pressed, the light 'P' should be OFF and light 'Q' should glow after 20s. Light 'Q' should remain ON only for 5 s. 5 3 1,2,3 State the role of Shedder bar or Bluff body von Kármán effect for measurement of flow velocity using Vortex flow-meter. 2 2 1,2,3 Identify the OSI model layer for each of the below given services in networking systems: 3 4 1,2,3 a) Time-out of Student Life Cycle Management (slcm) 3 4 1,2,3 b) External cable connection to the computer or controller c) Mozilla Firefox, Instagram 5 2 1,2,3 Blood glucose monitoring is done to measure the concentration of glucose fire the blod (glycaemia) over time, and is important in the care of patients with diabetes mellitus. 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(Explanation- 3M, diagram- 2M) 3 1,2,3 1,6,18 For a 16-bit Bit Shift Left Register, the initial condition of the bit register 1 0 1 1 0 1 ii. Mention the lost bit in ea