



**DEPARTMENT OF MECHATRONICS**  
**III SEMESTER B.TECH. (MECHATRONICS ENGINEERING)**  
**END SEMESTER EXAMINATIONS**  
**SUBJECT: SENSORS AND INSTRUMENTATION [MTE 2155]**

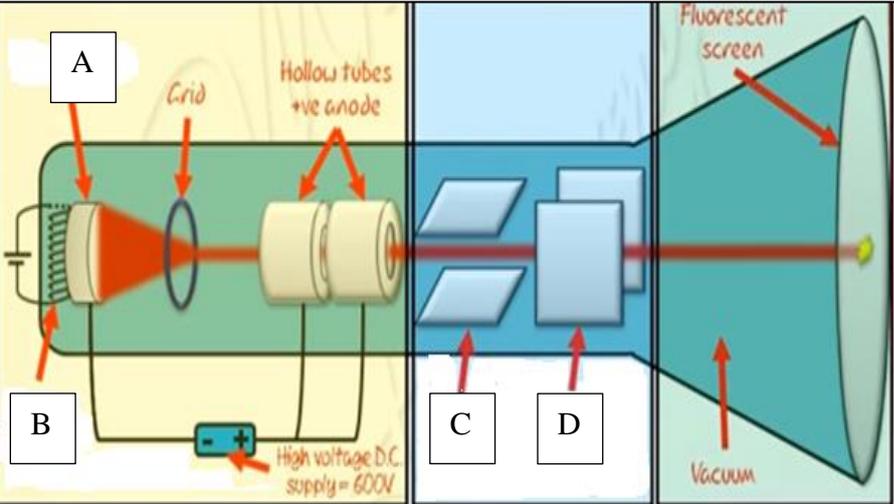
**Time: 3 Hours**

**MAX. MARKS: 50**

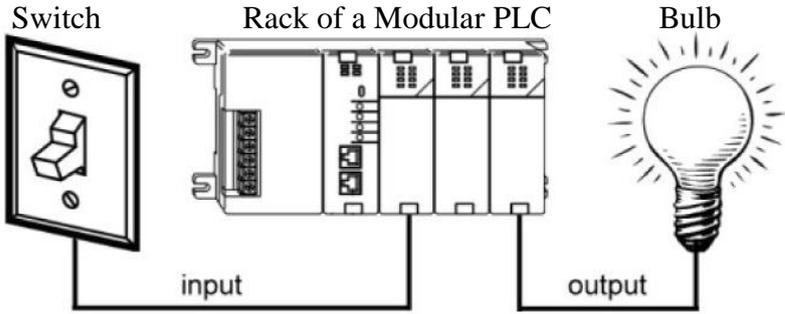
**Instructions to Candidates:**

- ❖ Answer **ALL** the questions.
- ❖ Missing data (if any) can be suitably assumed and justified.

Q. No		M	C O	PO	LO	BL
1A.	<p>Fig. Q1A shows the hierarchy of an Industrial Automation &amp; Control System plant which consists of five levels. Identify the levels for each of the following:</p> <ol style="list-style-type: none"> <li>i. SCARA Robot</li> <li>ii. Relays</li> </ol>	2	4	1,2,3 ,5,12	5,6,13	III
	Fig. Q1A					

1B.	<p>Three resistors have the following ratings:  <math>R_1 = 37 \Omega \pm 5\%</math>  <math>R_2 = 75 \Omega \pm 5\%</math>  <math>R_3 = 50 \Omega \pm 5\%</math></p> <p>Determine the magnitude and limiting error in ohm and in percent of the resistance connected in series.</p>	3	1	1,2,3 ,5,12	1,2	III
1C.	<p>Construct a ladder logic diagram that will implement the following function:  <math>X = \ln [10 + A(B \cos^{-1} (4C + 5))^2]</math></p> <p>If the result is greater than 100, then an output light 'P' will be turned ON. A, B and C are inputs.</p>	5	3	1,2,3 ,5,12	1,6,18	III
2A	<p>Sketch the diagrammatic representation of MODBUS communication protocol using RS-485 as reference. Name the type of network.</p>	2	4	1,2,3 ,5,12	5,6,13	I
2B	<p>Explain the construction and operation of the pressure sensor used as part of Tyre pressure monitoring systems in automotive industry. These miniaturized pressure sensors are integrated into the tyres of the vehicles, either internally or externally to measure and monitor the pressure of tyres, and accordingly the driver gets the warning signal to avoid sudden tyre failure.</p>	4	2	1,2,3 ,5,12	1,6,7,8, 9,13,18	I
2C	<p>(i) Identify what is A, B, C, D in Fig. Q2C.  (ii) Mention any two signal conditioning operation. (2M+2M)</p>  <p style="text-align: center;">Fig. Q2C</p>	4	3	1,2,3 ,5,12	1,6,18	I
3A	<p>Draw ladder logic for the process in a production factory where a system produces certain number of yellow-colored and green-colored products. The system is limited to produce 348 products/day (including both the colors). The production unit is shut down once the desired count is reached. An LED is turned ON till the total number is 348 or less.</p>	3	3	1,2,3 ,5,12	1,6,18	III

<b>3B</b>	Illustrate how rotational speed of ceiling fan can be measured using a non-contact type measurement technique using light. (Working principle: 1M, Operation: 1M)	2	2	1,2,3 ,5,12	1,6,7,8, 9,13,18	III
<b>3C</b>	Elaborate on the sensor level communication protocol: <b>AS-i</b> , and sketch the diagram of the Actuator-Sensor wiring with different components. (3M+ 2M)	5	4	1,2,3 ,5,12	5,6,13	I
<b>4A</b>	IEC 61508 has become a foundation for international standard of safety-related system such as airborne systems, railway, nuclear power plants, medical equipment, energy and process systems, machinery, furnaces and automobiles emphasizing the complete safety installation from sensor to actuator with its technical as well as management issues. The failure of such system could have significant impact on the safety of humans and/or the environment. Mention the three major steps which are involved in such risk assessment procedure.	3	2	1,2,3 ,5,12	1,6,7,8, 9,13,18	IV
<b>4B</b>	Write a ladder logic program that will turn ON light when a count reaches 20. The light has to go OFF when the count 30 is reached. (Use appropriate Comparator function block)	5	3	1,2,3 ,5,12	5,6,13	I
<b>4C</b>	Specify the role of Drag force and Buoyancy in the flow rate measurement using Rotameter.	2	2	1,2,3 ,5,12	1,6,7,8, 9,13,18	I
<b>5A</b>	Identify one OSI layer of networking for each of the below given services in industrial process automation: a) Sending E-mail b) Secured data transmission c) Error detection in the data	3	4	1,2,3 ,5,12	5,6,13	III
<b>5B</b>	Regular glucose monitoring is one way people with diabetes can learn more about their condition such as when it's time to make important decisions about medication dosage, exercise, and diet. By checking blood glucose levels routinely, a patient gets to know when the blood sugar is too high or too low, both of which can cause symptoms and serious health problems. With an example of a biomedical sensor, elaborate how glucose in human blood sample can be measured.  (Explanation: 3M, Diagram: 2M)	5	2	1,2,3 ,5,12	1,6,7,8, 9,13,18	III

5C	<p>Fig. Q5C shows the input component and output component connected to the rack of modular PLC. Identify to which module of the Modular PLC the switch is connected? Mention any three major functions of that Module of the PLC.</p>  <p>The diagram shows a rack of a modular PLC with several modules. On the left, a switch is connected to the 'input' terminal of the first module. On the right, a glowing bulb is connected to the 'output' terminal of the second module. The labels 'Switch', 'Bulb', 'input', and 'output' are placed near their respective components.</p> <p style="text-align: center;">Fig. Q5C</p>	2	3	1,2,3 5,12	1,6,18	I