

Enroll No

Q.P.Code
E1185

Course Code: RA205

Course Name: Sensors and Instrumentation

Day & Date: Friday 07/11/2025

Time : 2:30 To 5:30

Max Marks: 100

- Instructions:**
- 1) All questions are compulsory.
 - 2) Figures in rounded () brackets within the question, indicate the scheme of marking for respective part of the question, whereas, figures in the first right column indicate total marks for that whole question.
 - 3) CO is the index number of the Course Outcome statement.
 - 4) The Bloom's taxonomy level (BL) for 1,2,3,4,5 and 6 is remember, understand, apply, analyze, evaluate and create respectively.
 - 5) Assume suitable data if necessary.
 - 6) Use of non-programmable calculators is allowed

Q.1	Marks	COs	BT Level
(a) Evaluate the suitability of direct (2) and indirect (2), active (1) and passive (1), and absolute (1) and relative (1) types of sensors for different industrial measurement applications, supporting your answer with suitable examples	8	1	5
OR			
(a) Evaluate the effect of different types of measurement errors on system performance and propose suitable error compensation techniques. (4 types 2 marks each)	8	1	5
(b) Describe the static and dynamic characteristics of a transducer (4) and discuss the various methods used for sensor calibration (3).	7	1	2

Q.2

(a) Analyze the construction (2) and working principle (2) of a Rotary Variable Differential Transformer (RVDT). With neat diagrams (2), explain how the output signal varies with the angular displacement of the rotor (1), and discuss two major industrial applications (1).	8	2	4
OR			
(a) Analyze how proximity sensors differ in detecting metallic and non-metallic targets under varying environmental factors. (4 sensors 2 marks each)	8	2	4



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| (b) | Explain how a resolver is used for detecting angular motion in control systems (3) and compare optical, magnetic, inductive, and capacitive encoders in terms of their working principles (4) | 7 | 2 | 2 |
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Q.3

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|-----|---|---|---|---|
| (a) | Apply the principle of the Hall Effect to design a system for measuring electromagnetic (2) and current-induced force(2). Explain the working principle, describe the configuration of the setup (2). diagram (2) | 8 | 3 | 3 |
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OR

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| (a) | Apply the working principles (2) of magneto-resistive sensors to explain how magnetic field variations can be used for force (2) and torque (2) measurement in industrial systems. (Dia 2) | 8 | 3 | 3 |
| (b) | Explain how gyroscopes and inclinometers differ (3) in their working principles (2+2) for measuring orientation. | 7 | 3 | 2 |

Q.4

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|-----|--|---|---|---|
| (a) | Illustrate the working principles of photoconductive, photovoltaic, and photo-resistive sensors, and explain how each type is utilized in optical sensing systems for industrial or automation applications (2). (3 * 2) | 8 | 4 | 4 |
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OR

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| (a) | Analyze how Smart Sensors (2) and MEMS-based Nano Sensors (2) enhance measurement accuracy (1) and system intelligence (1) in modern sensing technologies. (Dia 2) | 8 | 4 | 4 |
| (b) | Explain Light Dependent Resistor (LDR) and its basic working principle (4). Also, what is a fiber optic sensor? Mention any three advantages of fiber optic sensing (3). | 7 | 4 | 2 |

Q.5

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| (a) | Analyze the working of a smart sensor system designed for industrial temperature monitoring (2), highlighting how self-calibration (2) and self-testing features contribute to its performance (2) and fault detection (2). | 8 | 5 | 4 |
| (b) | Describe how self-communicating smart sensors enhance automation (3) and real-time control in robotic applications with suitable examples (3). | 6 | 5 | 2 |



	(c) Discuss how smart sensor networks support predictive maintenance (3) and improve efficiency in industrial automation systems (3).	6	5	2
Q.6	(a) Analyze and design a signal conditioning circuit incorporating amplification, filtering, and sample-and-hold stages (4) for precise strain gauge measurement, explaining how each stage contributes to measurement accuracy (4).	8	6	4
	(b) Explain how sample-and-hold circuits (3) support ADCs in measuring rapidly changing signals accurately (3).	6	6	2
	(c) Describe how data logging (3) and real-time monitoring (3) are carried out in DAQ-based environmental monitoring systems.	6	6	2



