Academic year 2025 – 2026 (ODD Sem)

DEPARTMENT OF INDUSTRIAL ENGINEERING& MANAGEMENT

Date	6th November 2025	**Maximum Marks**	50
Course Code	IM235AI	**Duration**	90 Min
Sem	III Semester	CIE – I ***(Scheme & Solutions)***	
Digital Metrology			

Part – A

Sl. No.	Questions	M	BT	CO
1.	**Mechanical:** levers, gears, cams, linkages. **Electrical:** amplifiers, filters, converters.	02	L2	CO1
2.	Repeatability: closeness of agreement between successive measurements under the same conditions (same instrument, observer, environment). Reproducibility: closeness of measurements under different conditions (different operators, instruments, or environments). (1 mark each)	02	L1	CO1
3.	Active: self-generating; produce electrical output without external power (e.g., thermocouple, piezoelectric). Passive: require external power; output varies with change in input (e.g., strain gauge, LVDT). (1 mark each)	02	L1	CO2
4.	Direct comparison: comparing unknown with a standard directly (e.g., using slip gauges). Indirect comparison: using an intermediate device (e.g., dial indicator used with slip gauge). (1 mark each)	02	L1	CO1
5.	When a current-carrying conductor is placed in a perpendicular magnetic field, a voltage (Hall voltage) is developed across the conductor, proportional to magnetic flux density. (2 marks)	02	L1	CO2

Part – B

Sl. No.	Questions	M	BT	CO
1.	**Stages:** (1) Sensing/Transduction element – converts physical quantity to a signal. (2) Signal Conditioning – amplifies or modifies signal. (3) Data Presentation – displays output (pointer, recorder, or digital). (4 marks) **Block diagram:** labelled diagram (2 marks) **Example:** Bourdon tube converts pressure → mechanical motion (sensing); linkage to potentiometer or strain gauge (signal conditioning); digital display/controller (data presentation). (4 marks)	10	L3	CO1
2.	**Static characteristics:** accuracy, precision, sensitivity, linearity, hysteresis, drift. (3 marks) **Dynamic characteristics:** speed of response, fidelity, lag, dynamic error. (3 marks) **Graphs:** typical step response, time constant. (2 marks) **Discussion:** balancing static accuracy and dynamic response improves overall system reliability. (2 marks)	10	L2	CO1
3.	**Construction:** primary coil, two secondary coils, movable soft iron core, AC excitation. (3 marks) **Working:** displacement of core changes differential output voltage; phase indicates	10	L3	CO2

	direction, amplitude indicates magnitude. (3 marks) **Equation:** $e_o = Kx$(proportional relationship). (1 mark) **Applications:** measuring displacement, thickness, load, vibration, pressure (any four × 0.5 = 2 marks). **Neat diagram:** (1 mark)			
4.	**Principle:** electromagnetic induction – alternating current in coil induces eddy currents in nearby metallic surface; change in impedance corresponds to proximity. (3 marks) **Construction:** coil, oscillator, detector, output stage. (2 marks) **Applications:** surface crack detection, thickness measurement, vibration monitoring, tool wear. (2 marks) **Performance factors:** conductivity, permeability, lift-off distance, frequency, temperature. (2 marks) **Diagram:** (1 mark)	10	L3	CO2
5.	**Principle:** electromagnetic induction – rotation of shaft induces voltage proportional to speed. (2 marks) **Construction:** rotor (permanent magnet or armature), stator winding, commutator or slip rings. (3 marks) **Working:** as shaft rotates, changing magnetic flux induces emf $E = K \cdot N$. (2 marks) **Application:** speed feedback in CNC machines, robotics, conveyors. (2 marks) **Advantages:** linear output, robust, quick response. (1 mark)	10	L3	CO2

BT-Blooms Taxonomy, CO-Course Outcomes, M-Marks

Marks Distribution	**Particulars**		**CO1**	**CO2**	**CO3**	**CO4**	**CO5**	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**
	Quiz	**Max Marks**	**06**	**04**	**--**	**--**	**--**	**08**	**02**	**--**	**--**	**--**	**--**
	Test		**20**	**30**	**--**	**--**	**--**	**--**	**20**	**30**	**--**	**--**	**--**

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