

2. Thomas L. Flyod, Digital Fundamentals, Pearson Education Limited, 11th Edition, Global Edition (2015)
3. Kumar A. Anand, Fundamentals of Digital Circuits, 3rd Edition (2014), PHI Learning Private Ltd.
4. R. J. Tocci, Neal.SWindmer, Gregory L Moss, Digital Systems, Principles and Applications, 10th Edition, Pearson (2009)

Note: Students shall sincerely work towards completing all the above listed practicals for this course. In any circumstance, the completed number of practicals shall not be less than eight.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 5 (DSC-5): Sensors and Actuators

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Sensors and Actuators	4	2	0	2	Class XII pass with Science	Nil

Learning Objectives

The Learning Objectives of this course are as follows:

- To study different types of transducers – resistive, capacitive, inductive, light and temperature
- Be conversant in construction and working of various pressure and flow measuring instruments
- Get an exposure to actuators, micro actuators, and their different types

Learning outcomes

At the end of this course, students will be able to

Identify and comprehend various sensors used in the real-life applications and paraphrase their importance

Classify and explain with examples of transducers, including those for measurement of temperature, strain, light, capacitance and inductance

Be conversant in construction and working of various pressure and flow measurement devices used for industrial purposes

Classify and explain the different types of actuators
To study various processing techniques of micro actuators

SYLLABUS

Unit 1 (7 Hours)

Classification of transducers: Active, Passive, Mechanical, Electrical and their comparison. Selection of Transducers, Principle and working of following types: Resistive (Strain Gauge), Capacitive, Inductive (LVDT), Piezoelectric, light (photo-conductive, photovoltaic, LDR), Temperature (RTD, Thermocouple, Thermistor)

Unit 2 (7 Hours)

Sensors in nature (Vision, Hearing, touch, and smell) and how we can learn from nature. Principles of Sensing, Classification and Terminology of Sensors, Measurands. Some basic discussion about electric field, potential, capacitance, resistance etc. Biomedical sensor, Mechanical Sensors, Acoustic sensors, Magnetic Sensors, Radiation detector (Gas-filled & Scintillation detectors), Chemical and Biosensors, Proximity sensor, Flow Sensor, Level Sensor.

Unit 3 (8 Hours)

Actuators: Definition, types and selection of Actuators; linear; rotary; Electrical actuators: Electric motors, DC servomotors, AC motors, Stepper motors, Solenoids, Hydraulic actuators - Control valves, Construction, Characteristics and Types - Directional Control valves, Pressure control valves, proportional control valves and Process control valves.

Unit 4 (8 Hours)

Micro Actuators: Actuation principle, Types of micro actuators- Electrostatic, Magnetic and Fluidic, Inverse piezo effect. Materials for sensors: Silicon, Plastics, metals, ceramics, glasses, nano materials. Processing techniques: Vacuum deposition, sputtering, chemical vapor deposition and photolithography.

Practical component (if any) - Sensors and Actuators Lab – 60 Hours

1. Measurement of strain using strain gauge/load cells.
2. Measuring change in resistance using LDR
3. Measurement of displacement using LVDT.
4. Measurement using capacitive transducer.
5. Measurement of Temperature using Temperature Sensors.
6. Measurement of flow rate using electromagnetic flow meter.
7. Measurement of flow rate measurement using orifice plate flow meter.
8. System identification of any one of the actuators

- (a) Electrical Actuator
- (b) Electromechanical Actuator
- (c) Electromagnetic Actuator
- (d) Hydraulic and Pneumatic Actuator

Note: Students shall sincerely work towards completing all the above listed practicals for this course. In any circumstance, the completed number of practicals shall not be less than ten.

Essential/recommended readings

1. Nakra & Choudhary, Instrumentation Measurements and Analysis, Tata McGraw-Hill, 2nd edition.
2. A.K. Sawhney, Electrical & Electronic Measurements & Instrumentation, 19th revised edition.
3. H.S Kalsi, Electronic Instrumentation, McGraw Hill, 4th edition.
4. DVS Murthy, Measurement & Instrumentation, PHI, 2nd edition.
5. D. Patranabis, Sensors and Transducers, PHI, 2nd edition.
6. A Course in Electrical and Electronic Measurements and Instrumentation, (2005), A.K. Sawhney, Dhanpat Rai & Co.
7. Mechanical and Industrial Measurements, 3rd Edition, Tenth Edition (1996), R.K. Jain, Khanna Publishers.
8. Andrzej M. Pawlak, "Sensors and Actuators in Mechatronics, Design and Applications", Taylor & Francis Group, 2006.
9. Andrew Parr, "Hydraulics and Pneumatics", Jaico Publishing House, Mumbai
10. Robert H. Bishop, "Mechatronic systems, Sensors and Actuators Fundamentals and Modeling, Taylor & Francis Group, 2007.

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