3. Virtual Fabrication of a NPN Transistor.
4. Virtual Fabrication of PNP Transistor.
5. Virtual Fabrication of N-channel MOSFET.
6. Virtual Fabrication of P-channel MOSFET.
7. Virtual Fabrication of a Silicon Photovoltaic (Solar) Cell.
8. Industry visit

Essential/recommended readings

1. "Introduction to Microfabrication" by Sami Franssila 2nd Edition, published in November 2010 by Wiley.
2. S.K.Gandhi, VLSI Fabrication principles,2nd Edition, published in April 1994 by Wiley-VCH
3. S.M. Sze, VLSI Technology, 2nd Edition, published in July 2017 by McGraw Hill Education
4. W.R. Runyan, Silicon Semiconductor Technology, 2nd Edition, published in 1990 by McGraw Hill.
5. P.Van Zant, Microchip Fabrication, A Practical Guide to Semiconductor Processing, 6th Edition, published in January 2014 by McGraw Hill.

Suggestive readings

1. BenG. Streetman, Solid State Electronic Devices, Prentice Hall.
2. "Microchip Fabrication: A Practical Guide to Semiconductor Processing" by Peter Van Zant
3. "Fundamentals of Semiconductor Manufacturing and Process Control" by Gary S. May and Costas J. Spanos
4. "Advanced Semiconductor Fundamentals" by Robert F. Pierret
5. "Semiconductor Manufacturing Technology" by Michael Quirk and Julian Serda
6. "Semiconductor Devices: Physics and Technology" by Simon M. Sze and Kwok K.Ng
7. "Process Technology for VLSI and ULSI" by C. Y. Chang and S. M. Sze

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

DISCIPLINE SPECIFIC ELECTIVE – : Measurement Technology (INDSE7E)

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Measurement Technology (INDSE7E)	04	03	-	01	Course admission eligibility	Industrial instruments

Learning Objectives

The Learning Objectives of this course are as follows:

- To provide in-depth knowledge about various techniques used for the measurement of industrial parameters and processes.
- Discussion of different types of speed and acceleration measuring instruments and their application in various Industrial processes.
- To have adequate knowledge of construction and working of various pressure measuring instruments
- Exposure to construction and working of various flow and level measurement devices used for industrial purposes.
- To have extensive knowledge about the calibration of various industrial instruments

Learning Outcomes

After successful completion of the course, students will be able to:

- Apply pressure measurement techniques using Bourdon gauges, manometers, and vacuum systems in practical settings.
- Explore various flow measurement devices such as orifice plates, rotameters, and ultrasonic flow meters for accurate flow rate measurements.
- Measure speed and acceleration using tachometers and accelerometers, and document data using recorders and printers.
- Implement humidity and moisture measurement systems including hygrometers, psychrometers, and infrared systems in diverse environments.

Syllabus of DSE

UNIT-I **(12 hours)**

Pressure measurement: Units of pressure, Manometers-different types, elastic type pressure gauges, Bourdon type, bellows, diaphragms, measurement of vacuum, McLeod gauge, Pirani Gauge, thermal conductivity gauges, Hot cathode Ionization gauge, dead weight tester. Vacuum pumps- rotary and diffusion pumps.

UNIT-II **(12 hours)**

Flow Measurement: Introduction, definitions and units, classification of flow meters, Mechanical type flowmeters, orifice plate, venturi tube, Rotameter, thermal mass flow meter, Principle and constructional details of electromagnetic flow meter, ultrasonic flow meters, laser doppler anemometer systems, vortex shedding flow meter, guidelines for selection of flow meter.

UNIT-III **(11 hours)**

Measurement of Speed and Acceleration: Tachometers, Mechanical, Contact-less, Stroboscopic tachometers. Accelerometers, Elementary, Seismic and Practical

accelerometers. Recorders: strip chart, circular and XY. Printers: Dot matrix, inkjet and laser.

UNIT-IV **(10 hours)**

Measurement of Humidity and Moisture: Basic principles, hygrometers, psychrometers, humidity charts, dew point, measurement systems for humidity, Infrared moisture measuring systems, radioactive moisture measuring systems.

Practical component: **(30 hours)**

1. Flow rate measurement using orifice plate flowmeter.
2. Calibration of pressure gauge using dead weight calibrator.
3. To find out the level of water using level transmitters.
4. Measurement of conductivity of test solutions using electrical conductivity meter.
5. To find the flow rate using electromagnetic flowmeter
6. To find the flow rate using an ultrasonic flowmeter.
7. To record the temperature variations using Circular chart recorder

Essential/recommended readings

1. Process Measurement and Analysis, 4th Edition (1995), Liptak B. G., Chilton Book Company, Pennsylvania.
2. Principles of Industrial Instrumentation, 3rd Edition (1997), D.Patranabis, Tata McGraw Hill Publishing Co., New Delhi.
3. A Course in Electrical and Electronic Measurements and Instrumentation, (2005), A.K. Sawhney, Dhanpat Rai & Co.
4. Mechanical and Industrial Measurements, 3rd Edition, Tenth Edition (1996), R.K. Jain, Khanna Publishers.
5. Measurement Systems: Application and Design, 5 th Edition (2003), Doeblin E. O, McGraw Hill, Singapore.
6. Instrumentation Measurement and Analysis, 4th Edition (2017), B.C. Nakra, K.K. Chaudhry, McGraw Hill Education Pvt. Ltd.
7. Instrumentation and Control Systems: 1st Edition (2016), K. Padma Raju, Y.J. Reddy, McGraw Hill Education Pvt. Ltd.

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