GENERIC ELECTIVES (GE-1): Fundamentals of Instrumentation (INGE1A)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department offering the course
		Lecture	Tutorial	Practical / Practice			
Fundamentals of Instruments (INGE1A)	**04**	**03**	**-**	**01**	**Class XII pass**	**Physics and Mathematics in 10+2**	**Instrumentation**

Learning Objectives

The Learning Objectives of this course are as follows:

- To learn about basic concepts of Instrumentation.
- To understand the basic concept of errors and study different types of errors present in measurement systems.
- To study different characteristics of measurement systems.
- To study different types of transducers – resistive, capacitive and inductive
- To study signal conditioning.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Understand the basics of concepts of Instrumentation and measurement systems
- 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, motion, and light
- Be conversant in construction and working of signal conditioning circuits

SYLLABUS OF GE-1

UNIT – I **(12 Hours)**

Basic concepts of Instrumentation: Generalized instrumentation systems block diagram representation, Error in measurement- Gross Errors, Systematic Errors and Random Errors. Statistical analysis of error in measurement-Arithmetic mean, Deviation, standard deviation

UNIT – II **(9 Hours)**

Measurement systems: static characteristics (accuracy, sensitivity, linearity, precision, resolution, threshold, range, hysteresis, dead band, backlash, drift), dynamic characteristics (types, fidelity, speed of response, dynamic error)

UNIT – III **(12 Hours)**

Transducers: Classification, Active and Passive. Principle and working of following types: Resistive (Strain Gauge) Capacitive, Inductive (LVDT), Piezoelectric, Light (LDR),

Temperature (RTD, Thermocouple, Thermistor)

UNIT – IV **(12 Hours)**

Signal Conditioning: Introduction to Op-Amp, Basic Instrumentation Amplifier, Application of Instrumentation Amplifiers

Practical component- 30 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. Design and study basic circuit of Op-Amp.

Essential/recommended readings

1. Doeblin&Manek, Measurement Systems, McGraw Hill, New York, 1992, 5th edition.
2. Nakra& Choudhary, Instrumentation Measurements and Analysis, Tata McGraw-Hill, 2nd edition.
3. A.K. Sawhney, Electrical & Electronic Measurements & Instrumentation, 19th revised edition.
4. Rangan, Sarma, and Mani, Instrumentation- Devices and Systems, Tata-McGraw Hill, 2nd edition.
5. H.S Kalsi, Electronic Instrumentation, McGraw Hill, 4th edition.
6. DVS Murthy, Measurement & Instrumentation, PHI, 2nd edition.

Suggestive readings:

1. D. Patranabis, Sensors and Transducers, PHI, 2nd edition.
2. A Course in Electrical and Electronic Measurements and Instrumentation, (2005), A.K. Sawhney, DhanpatRai& Co.
3. Mechanical and Industrial Measurements, 3rd Edition, Tenth Edition (1996), R.K. Jain, Khanna Publishers.

GENERIC ELECTIVES (GE-2): Engineering Physics (INGE1B)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
Engineering Physics (INGE1B)	04	03	-	01	Class XII pass with Mathematics	Mathematics in 10+2	Instrumentation

Learning Objectives

The Learning Objectives of this course are as follows:

- To develop an intuitive understanding of semiconductor physics
- To provide the students a thorough understanding of the fundamentals of optics
- To introduce fundamental aspects of photonics

Learning outcomes

The Learning Outcomes of this course are as follows:

- Gain in-depth knowledge about basic concepts of semiconductor physics
- Understand the physics behind various phenomena in optics
- Understand the photonics

SYLLABUS OF GE-2

UNIT – I **(12 Hours)**

Semiconductor physics: Energy bands in semiconductors, Types of semiconductors, Charge carriers, Intrinsic and extrinsic materials. Carrier concentration: Fermi Level, Electron and hole concentration equilibrium, the temperature dependence of carrier concentration, Compensation, and charge neutrality. Conductivity and mobility, Effect of temperature, Doping, and high electric field.

UNIT – II **(12 Hours)**

Interference: Interference of light, Fringe formation, interference in thin films, wedge-shaped film, Newton's rings, Michelson interferometer.

Diffraction - Single, Double & N- Slit, Diffraction grating, grating spectra, Rayleigh's criterion, and resolving power of grating.

UNIT – III **(12 Hours)**

Polarization: Phenomena of double refraction, Nicol prism, Production and analysis of plane, circular and elliptical polarized light, Fresnel's theory of optical activity, Polarimeters.

Laser: Basic principle, Spontaneous and stimulated emission of radiation, Einstein's Coefficients, Laser applications.

UNIT – IV **(3 Weeks)**

Photonics: Light Emitting Diodes, Construction, materials, and operation, Photodetectors: Photomultiplier tube. Phototransistors and Photodiodes (p-i-n, avalanche).

LCD Displays: Types of liquid crystals, Principle of Liquid Crystal Displays, applications, advantages over LED displays.

Fiber optics: Principles and applications

Practical component-

1. To determine the type (n or p) and mobility of semiconductor material using Hall-effect
2. To determine the refractive index of a prism using a spectrometer

3. To determine the dispersive power of prism using spectrometer and mercury source.
4. To determine the wavelength of sodium light by Newton's Ring.
5. To determine the wavelength of sodium light using Michelson's Interferometer.
6. To determine the resolving power of diffraction grating
7. To determine the specific rotation of cane sugar using a polarimeter.
8. To find the wavelength of He-Ne Laser using a transmission diffraction grating.
9. To determine characteristics of LEDs and Photodetector.
10. To measure the numerical aperture of an optical fibre.

Essential/recommended readings

1. B. G. Streetman and S. Banerjee "Solid-state electronics devices", 5th Edition, PHI.
2. Donald A Neaman, "Semiconductor Physics and Devices Basic Principles" 3rd Ed TMH India.
3. Alok Dutta, "Semiconductor Devices and circuits", Oxford University Press.
4. Robert F. Pierret, Semiconductor Device Fundamentals, Pearson Education (2006)
5. AjoyGhatak –Optics, Fourth Edition, McGraw-Hill (2008).

Suggestive readings

1. Arthur Beiser -Concepts of Modern Physics, 6th Edition, Mc-Graw Hill.
2. S. O. Kasap, Optoelectronics, and Photonics: Principles and Practices, Pearson Education (2009)
3. Ghatak A.K. and Thyagarajan K., Introduction to fiber optics, Cambridge Univ. Press. (1998)

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