

**Course name** : Electrical Engineering Group      **Course Code:** EE/EP

**Semester** : Fourth

**Subject Title** : Instrumentation      **Subject Code:** 9062

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme						
TH	TU	PR	Paper Hrs	TH	TEST	PR	OR	TW	TOTAL
03	-	02	03	80	20	-	-	25@	125

**Rationale:**

This is classified under Technology Group in electrical power system, Electrical machine control, Industrial process control and many other systems such as Biomedical, environmental, defense etc. Nowadays sophisticated Instruments and their related systems are developed for fast, accurate and reliable measurements, operations and control. Being Electrical Diploma Holders has a role of supervisor, Maintenance engineer and to assist in carrying out testing and R & D work in electrical, Industrial, Electronics and communication field. He must understand the basics, facts, concepts and principles of Instrumentation, various modern Instruments.

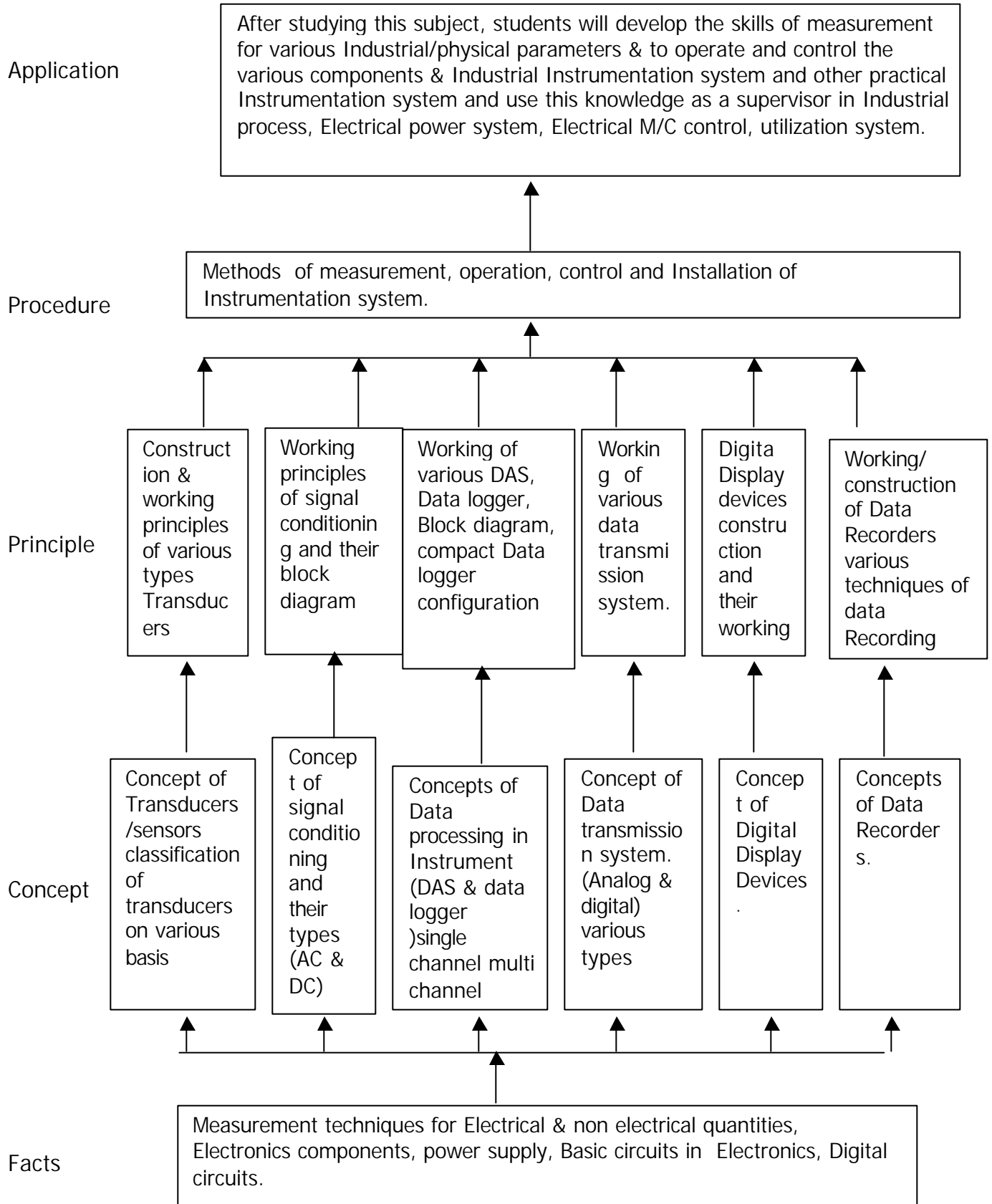
**Objectives:**

The Students will be able to:

1. Identify the components of Instrumentation system for processing given Input to get desired Output.
2. Identify appropriate transducers/sensors for given application.
3. Identify signal conditioning circuit for Instrumentation system in Industrial process, Electrical power system, Electrical machine operation, Measurement and control.
4. Select data processors for given Instrumentation system.

5. Select appropriate data transmission system.
6. Identify the digital display devices and recorders for various applications.
7. Select the appropriate transducers/sensor for various applications of  
Measurement of non-electrical quantity in Industrial process, Electrical Power  
system, Electrical machines, utilization system.

## Learning Structure:



## Contents: Theory

Chapter	Topics	Hours	Marks
01	<b>Introduction to Instrumentation system</b> Facts and concept of Instrumentation Basic block diagram of Instrumentation system & its function Static and dynamic characteristics Accuracy and precision Sensitivity and Resolution Linearity and nonlinearity Repeatability and reproductivity Hysteresis and Drift Speed of Response, lag, fidelity, dynamic error	03	06
02	<b>Transducers</b>  2.1 Concept of Transducers 2.2 Classification of Transducers 2.2.1 Primary and Secondary Transducers 2.2.2 Electrical and Mechanical Transducers 2.2.3 Analog and Digital Transducers 2.2.4 Active and passive Transducers 2.3 Construction and working principles of Transducers 2.3.1 Resistive, Inductive and capacitive transducers 2.3.2 Potentiometer (various) and strain gauge (No derivation only formula) 2.3.3 Types of strain gauges:- unbounded, bounded, Semiconductor 2.3.4 Bourden tube, Bellows, Diaphragm. 2.3.5 LVDT and RVDT. 2.3.6 Piezoelectric transducer, photoconductive cell, photovoltaic cells, load cell. 2.3.7 RTD, Thermistor, Thermocouple. 2.3.8 Pyrometers (Radiation, optical, photoelectric), ultrasonic temperature Transducers. 2.3.9 Contacting and non contacting Transducers, Digital tachometer 2.3.10 Accelerometer, 2.3.11 Electromagnetic and turbine flow meter, ultrasonic flow meter 2.3.12 Digital encoders disc type, frequency output type transducer, and Reluctance pulse pick-ups.	12	18

03	<p><b>Signal conditioning</b></p> <p>3.1 Concept of signal conditioning</p> <p>3.2 Block diagram of AC and DC signal conditioning and working</p> <p>3.3 Operational Amplifiers, OP AMP - 741, signal conditioning circuits using OPAMP, its working and function</p> <p>3.3.1 Integrator, Differentiator, adder, subtractor, Inverter etc.</p> <p>3.3.2 V to I converter, I to V converter , V to F converter</p> <p>3.3.3 Instrumentation Amplifier, Differential amplifier, chopper stabilized amplifier</p> <p>3.4 Filters:- Types and frequency response (No derivation)</p> <p>3.5 Multiplexing</p> <p>3.6 Use of signal conditioning circuit for Instrumentation system for Industrial applications.</p>	05	12
04	<p><b>Data Processors &amp; Data transmission</b></p> <p>4.1 Necessity of data processing in Instrumentation.</p> <p>4.2 Generalized Data acquisition system: Block diagram. &amp; explanation</p> <p>4.3 Objectives of DAS</p> <p>4.4 Signal conditioning in DAS, Radiometric conversion, Logarithmic conversion</p> <p>4.5 Single channel and multi channel Data acquisition system</p> <p>4.6 A/D and D/A converters using OPAMPS</p> <p>4.7 Data loggers, its characteristics, Basic operation of data logger</p> <p>4.8 Block diagram of data logger and explanation</p> <p>4.9 Comparison Between DAS and data logger.</p> <p>4.10 Concept of Modular DAS, compact data logger configuration</p> <p>4.11 Concept of Data transmission</p> <p>4.12 Block diagram of data transmission system &amp; explanation</p> <p>4.13 Advantages and disadvantages of digital data transmission over analog transmission</p> <p>4.14 Time Division multiplexing (TDM), pulse Modulation.</p>	08	12

	4.15 Digital Modulation, pulse code format, Modem.		
05	<p><b>Display Devices and Recorders</b></p> <p>5.1 Digital display devices (LED, seven segment only)</p> <p>5.2 Concept of 3 ½ ,4 ½ digit</p> <p>5.3 Digital voltmeter, Ramp type, Integrating type, successive approximation Only.</p> <p>5.4 Necessity of Recorder in Instrumentation</p> <p>5.5 Classification of Recorders.</p> <p>5.6 Block diagram and working principles of strip-chart, X-Y recorder, Magnetic tape recorder &amp; their applications.</p> <p>5.7 Frequency Modulation Recording (FM)</p> <p>5.8 Digital Data Recording, Techniques of Digital data Recording (RZ &amp; NRZ techniques)</p> <p>5.9 Advantages and disadvantages of digital data recording</p> <p>5.10 Comparison between analog and digital Recording techniques</p> <p>5.11 Recorders selection for particular applications.</p>	08	12
06	<p><b>Operation of Instrumentation system</b></p> <p>6.1 Points to be considered while selecting a transducer for its intended applications.</p> <p>6.2 Diagram, explanation and working of Instrumentation system for:-</p> <p>6.2.1 Temperature Measurement by RTD, Thermistor, Thermocouple</p> <p>6.2.2 Pressure Measurement by Mechanical devices, Photoelectric, piezoelectric, Bourden tube, LVDT</p> <p>6.2.3 Speed measurement by contacting and non contacting methods</p> <p>6.2.4 Force, velocity, Acceleration and technique measurement.</p> <p>6.2.5 Displacement measurement by LVDT, RVDT.</p> <p>6.2.6 Vibration measurement by accelerometer</p> <p>6.2.7 Flow measurement by electromagnetic &amp; turbine flow meter.</p> <p>6.2.8 Liquid level measurement by Resistive, Inductive, capacitive and ultrasonic methods, digital methods</p> <p>6.2.9 Thickness measurement by Resistive, inductive,</p>	08	16

	capacitive, ultrasonic and Nuclear method. 6.2.10 Humidity Measurement.		
07	<b>Pilot Devices</b> 7.1 – Pilot Devices : - What are pilot devices? - Function of pilot devices. - List of different pilot devices. 7.2 – Construction, working and applications of: Push Button, Limit Switches, Float Switches, Electromagnetic Relay, Pressure Switches, Thermostats Plugging Switches	04	04
	Total	48	80

### **PRACTICAL:**

Skills to be developed:

Intellectual skills:

1. Selection of equipment
2. selection of transducers

Motor Skills:

1. Accuracy of measurement
2. Proper connection
3. Draw Graphics

#### **List of Practical:**

- 1 Measurement of Linear displacement by LVDT & plot characteristics.
- 2 Measurement of strain/force using strain gauge/Load cell.
- 3 Measurement of temperature by pt-100, thermistor and thermocouple along with simple resistance bridge.
- 4 To plot characteristics of potentiometer and observe the loading effect on output of potentiometer (translation potentiometer and rotational potentiometer)

- 5 Study the following signal conditioning circuits and observe and plot the output (any four)
- I) Adder                      II) Sub tractor                      III) Differentiator
- IV) Integrator                      V) V to I Converter                      VI) I to V Converter
- VII) V to F Converter using Op-AMP 741
- 6 Measurement of speed by contacting, non- contacting and Digital Tachometer
- 7 Measurement of PH value by Digital PH Meter of
- I) Water              II) Chemical solution
- 8 Demonstration of A/D and D/A converter using OPAMP.
- 9 To plot frequency response of Active filters (any two):-
- I) Low pass filter              II) High pass filter              III) Band pass filter
- IV) Band stop filters
- 10 Demonstration of pilot devices like – Push Button Switches, Limit Switches, Selector switches, Pressure switches, Float switches etc.

**Learning Resources:**

**Books:**

Sr. No.	Author	Book	Publication
1.	H.S.Kalsi	Electronic Instrumentation	Tata McGraw Hill
2.	D.Patranabis	Principles of Industrial Instrumentation	Tata McGraw Hill
3.	A.K.Sawhney	Electrical and Electronics Measurement and Instrumentation	Dhanpat Rai & co.
4.	Alan s. morris	Principles of Measurement & Instrumentation	Prentice Hall India
5.	Donald P. Eckman	Industrial Instrumentation	Wiley Eastern Ltd.
6.	S.K. Bhattachrya Brijinder Singh	Control of Electrical Machines	New Age International