

**GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT**  
**COURSE CURRICULUM**

**Course Title: Electronics Instruments and Measurement**  
**(Code: 3341104)**

<b>Diploma Programme in which this course is offered</b>	<b>Semester in which offered</b>
Electronics and Communication Engg.	4 <sup>th</sup> Semester

### 1. RATIONALE

Troubleshooting of electronic equipment is an essential requirement of Service sector industry. This course will help students to develop skills to become professional technician with capability to measure electrical parameters using various instruments. By learning this course students will able to know basics of various instruments, transducers & working of electronic circuits used in electronic test and measuring instruments.

### 2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of following competency:

- Maintain various test and measuring electronics equipments.

### 3. COURSE OUTCOME

1. Measure various electrical parameters with accuracy, precision, resolution.
2. Apply AC & DC bridges for relevant parameter measurement.
3. Select appropriate passive or active transducers for measurement of Physical phenomenon.
4. Use Signal Generator, frequency counter, CRO and digital IC tester for appropriate measurement.
5. Test and troubleshoot electronic circuits using various measuring instruments.
6. Maintain various types of test and measuring instruments.

### 4. TEACHING AND EXAMINATION SCHEME

<b>Teaching Scheme (In Hours)</b>			<b>Total Credits (L+T+P)</b>	<b>Examination Scheme</b>				
				<b>Theory Marks</b>		<b>Practical Marks</b>		<b>Total Marks</b>
<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>ESE</b>	<b>PA</b>	<b>ESE</b>	<b>PA</b>	
3	-	2	5	70	30	20	30	

**Legends:** L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical;  
C - Credit; ESE - End Semester Examination; PA - Progressive Assessment

## 5. Detail Course Contents

Unit	Major Learning Outcomes	Topics and Sub-topics
<b>Unit – I</b> Characteristic of Measurements and Bridges	1a. Define accuracy, precision, resolution	1.1 Accuracy, precision, resolution, error and noise
	1b. Classify types of error	1.2 Types of errors 1.3 Limiting of errors
	1c. Explain working and application of DC bridges	1.4 Wheatstone bridge 1.5 Kelvin's double arm bridge
	1d. Explain working and application of AC bridges	1.6 Maxwell's bridge 1.7 Hay bridge 1.8 Schering bridge
<b>Unit – II</b> Basic Parameter Measurements	2a. Differentiate Moving iron and Moving coil type instruments	2.1 Moving coil and moving iron type instruments
	2b. Measure DC voltage and current using analog meter.	2.2 DC voltmeter 2.3 AC voltmeter using three terminal rectifier and half wave rectifier
	2c. Measure AC voltage and current using analog meter	
	2d. Extend measuring range.	2.4 Amplified DC meter
	2e. Draw the block diagram of DVM and explain its working .	2.5 Electronic multimeter (DVM)
	2f. Describe working and advantage of digital multi meter	2.6 Principle of DVM 2.7 Types- ramp type, integrating type and successive approximation type DVMs
	2g. Define Energy and Power. 2h. Describe the construction of hot wire instrument . 2i. Measure energy and power using Watt meter and Energy Meter.	2.8 Watt meter, Energy meter, clip-on meter 2.9 Hot wire instrument
2j. Draw the block diagram of LCR –Q meter and describe its working . 2k. Measure quality factor of a coil and a capacitor .	2.10 LCR- Q meter : Basic circuit , applications 2.11 Series and parallel connection of Capacitor and Inductor.	
<b>Unit – III</b> Oscilloscopes	3a. Describe functions of basic building of CRO	3.1 Block diagram of C.R.O. 3.2 Cathode ray tube: construction, operation, screens, graticules

Unit	Major Learning Outcomes	Topics and Sub-topics
	3b.Explain deflection systems	3.3 Vertical deflection system: Delay line, multiple trace CRO 3.4 Horizontal deflection system
	3c. Measure parameters viz. Amplitude, frequency and time period using CRO.	3.5 Oscilloscope probe: structure of 1:1 and 10:1 probes 3.6 Measurement of frequency, time delay, phase angle and modulation index (trapezoidal method)
	3d.Explain working principal of digital storage oscilloscope.	3.7 Block diagram of digital storage oscilloscope and its features
<b>Unit – IV</b> Transducers	4a. Differentiate the following: active and passive, primary and secondary transducers.	4.1 Classification of transducers 4.2 Unbonded strain gauge 4.3 Displacement transducers
	4b. Explain the principal of Capacitive and Inductive transducer	4.4 Capacitive transducers 4.5 Inductive transducers 4.6 Resistive & capacitive touch screen transducer (Used in mobile)
	4c. Describe working of LVDT transducer.	4.6 Linear variable differential transformer (LVDT) transducer
	4d. Describe functionality of miscellaneous transducers.	4.7 Piezo-electric transducer 4.8 Velocity transducer
	4e. Classify temperature measuring transducers. 4f. Explain principle of Thermocouple. 4g. Describe construction of RTD and Thermister 4h.	4.9 Temperature measurement 4.9.1 Thermocouples – Seebeck & Peltier Effect, Types J,K,R,S,T 4.9.2 Thermostats 4.9.3 Resistance thermometer (RTDs) – PTC,PT-100 (2-3-4 Wire systems-only circuit, no derivation)
<b>Unit – V</b> Test and Measuring Instruments	5a. Describe function of audio signal generator.	5.1 Audio frequency signal generation (Block diagram) 5.2 Sweep frequency generator(Block diagram)
	5b. Define pulse parameters viz. pulse duration ,pulse width, duty cycle, On and off time of pulse	5.3 Pulse and square wave generator (Block diagram and circuit)
	5c. List applications of Function generator	5.4Function generator (Block Diagram & Circuit)
	5d. Draw the block diagram of frequency counter and explain functions of each	5.5 Simple frequency counter 5.6 Display counter 5.7 Cascading counters

Unit	Major Learning Outcomes	Topics and Sub-topics
	block in brief.	5.8 Multiplexing of display in frequency counter 5.9 Period measurement
	5e. Explain working of digital IC tester.	5.10 Digital IC tester
	5f. List functions of Logic analyzer	5.11 Block diagram and Operation of Logic analyzer
	5g. Explain working function of Spectrum analyzer.	5.12 Block diagram and Operation of Spectrum analyzer
	5e. Describe advance measuring instruments.	5.13 Block diagram and operation of Harmonic distortion analyzer 5.14 Block diagram & operation of Field strength meter (dB meter)

## 6. SUGGESTED SPECIFICATION TABLE WITH HOURS and MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Characteristic of Measurements and Bridges	05	04	03	03	10
II	Basic Parameter Measurements	10	03	06	07	16
III	Oscilloscopes	07	02	08	02	12
IV	Transducers	10	03	05	08	16
V	Test and Measuring Instruments	10	02	08	06	16
<b>Total</b>		<b>42</b>	<b>14</b>	<b>30</b>	<b>26</b>	<b>70</b>

**Legends:** R = Remember; U = Understand; A = Apply and above levels (Bloom's revised taxonomy)

**Note:** This specification table shall be treated as only general guideline for students and teachers. The actual distribution of marks in the question paper may vary from above table.

## 7. SUGGESTED LIST OF PRACTICAL EXERCISES/EXPERIMENTS

Following is the list of experiments for guidance. Minimum Twelve experiments must be performed using appropriate Trainer Board.

S. No.	Unit No.	Practical/Exercise	Apprx. Hrs. Required
1	I	Measure various parameters viz. voltage, current, resistance using Digital Multimeter.	2
2	I	Measure the value of unknown resistor using Wheatstone bridge.	2
3	II	Convert given galvanometer to DC/AC current- meter.	2
4	II	Convert given galvanometer to DC/AC Volt-Meter.	2
5	II	Measure quality Factor of given Inductor and Capacitor using LCR Q-Meter.	
6	IV	Obtain characteristic of LVDT.	2
7	IV	Obtain characteristics of strain gauge.	2
8	IV	Obtain characteristics of thermocouple.	2
9	IV	Obtain characteristics of thermistor.	2
10	IV	Obtain characteristics of RTD transducer.	2
11	IV	Control temperature using RTD in any specific application.	2
12	III	Measure voltage, frequency, phase and modulation index (trapezoidal method) using CRO.	2
13	III	Measure Unknown frequency using Lissajous patterns.	2
14	III	Demonstrate features of digital storage oscilloscope.	2
15	V	Analyse sine/square wave in frequency domain using spectrum analyser.	
16	V	Test various digital IC using I.C. Tester.	2
17	V	Measure various RF signal strength using field strength meter.	
<b>Total</b>			34

## 8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities:

1. Explore data sheets/ technical specifications of transducers.
2. Present seminar on advanced instrumentation topic.
3. Mini project based on transducer.
4. Explore & build circuit of temperature/pressure control.

## 9. SUGGESTED LEARNING RESOURCES

### (A) List of Books:

S. No.	Title of Books	Author	Publication
1	Electronic Instruments and Measurement Techniques	Cooper, W.D. Halfrick, A.B.	PHI, 2003, or latest edition
2	Electrical & Electronic Measurements	Sahani, A.K.	Dhanpat Rai, 2001, or latest edition
3	Elements of Electronic Instrumentation and Measurement	Joseph, J.Carr	Pearson, 13E, 2013
4	Electronic Instrumentation and	David, Bell	PHI, 2006, or latest

	Measurements		edition
5	Electronic Measurements and Instrumentation	Kishor, K Lal	Pearson, 1 <sup>st</sup> Ed, 2011, or latest edition

### B. List of Major Equipment/Materials

1. Function generator
2. Digital multimeter
3. D.C. power supply
4. Cathode Ray Oscilloscope
5. Digital Storage Oscilloscope
6. LCR-Q meter
7. Field strength meter(dB meter)
8. Experimental trainer kits, Bread board, Computers

### C List of Software/Learning Websites

1. Electronic Workbench/MultiSIM/Circuit Maker
2. www.ocw.mit.edu
3. www.home.agilent.com

### 10. Instructional Strategies

1. Computer based CBT describing operation of transducer.
2. Bridge simulation using Software like Electronic Workbench/multiSIM.
3. Seminars /experts lecture and group discussion.
4. Visit of Electronics Instruments calibration laboratories.

## 11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

### Faculty Members from Polytechnics :

- Shri B.P.Raval, Sr.Lecturer, EC Department, Government Polytechnic, Rajkot
- Shri B.B.Renuka, Sr.Lecturer, EC Department, Government Polytechnic, Ahmadabad
- Shri A.R.Chandegara, Sr.Lecturer, EC Department, Government Polytechnic, Palanpur

### Coordinator and Faculty Members from NITTTR Bhopal

Dr. (Mrs.)Anjali potnis ,Assistant Professor , DEEE, NITTTR, Bhopal