GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: MEASURING INSTRUMENTS AND TRANSDUCERS
(Code: 3342404)

Diploma Programme in which this course is offered	Semester in which offered
Power Electronics Engineering	4th Semester

1. RATIONALE

With the advancement of technology measurement techniques have taken rapid strides with the introduction of different types of instrumentation devices. This course is intended to enable the student to understand the facts, concepts, principles and applications of the measuring instruments and transducers and will be able to apply the same in almost all areas of power electronics required to use, calibrate and maintain different types of electrical and electronic instrumentation systems and transducers used in the industry. More drill and practice in the lab would prove more useful to develop the skills.

2. COMPETENCY

The course content should be taught and curriculum should be implemented with the aim to develop required skills in students so that they are able to acquire following competency:

- **Measure different electric parameters preciously.**

3. COURSE OUTCOMES (COs)

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

i. Use AC and DC bridges for specific applications.
ii. Measure various electrical parameters using relevant instruments.
iii. Measure various electrical quantities using CRO and DSO.
iv. Select the relevant transducers for specific applications.
v. Use signal generators for specific application.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
4	1	2	7	70	30	20	30	150

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

5. COURSE DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I **Measurement and Measurement of Circuit Parameters**	1a. Describe requirement of measurement. 1b. State the tolerance limits for accuracy, precision, sensitivity and resolution. 1c. Discriminate Accuracy and Precision	1.1. Measurement: definition, requirement, advantages 1.2. Define: Accuracy, Precision, Sensitivity and Resolution.
	1d. Differentiate various errors in measurement.	1.3. Errors: gross error, systematic error, random error
	1e. Explain principle of bridge balancing and its need.	1.4. General equation for bridge balance
	1f. Describe the working of Kelvin's double bridge and Wheatstone bridge. 1g. Solve problems using DC bridges.	1.5. DC bridges: Kelvin's double bridge, Wheatstone bridge
	1h. Describe the working of Maxwell Bridge, Anderson Bridge, Hays Bridge, De Sauty's Bridge and Wien Bridge. 1i. Solve problems using AC bridges.	1.6. AC bridges: Maxwell Bridge, Anderson Bridge, Hays Bridge, De Sauty's Bridge, Wien Bridge
Unit – II **Electrical And Electronic Measuring Instruments**	2a. Describe the working of PMMC and moving iron type instruments. 2b. State the criteria for the choice of PMMC and Moving iron type instruments.	2.1. PMMC instrument, Moving iron type instruments
	2c. State the function of different types of meters. 2d. Use the different meters in various circuits. 2e. Describe the construction of Amplified DC voltmeter, AC voltmeter using half wave rectifier and analog electronic voltmeter. 2f. Describe the construction of Ramp type and Integrating type DVM	2.2. Voltmeter, Ammeter, Wattmeter, Energy meter, Frequency meter, phase sequence meter, power factor meter. 2.3. Amplified DC voltmeter, AC voltmeter using half wave rectifier, Analog electronic voltmeter. 2.4. DVM: Ramp type, Integrating type,
Unit – III **CRO And DSO**	3a. Explain the working of CRO using block diagram. 3b. Explain screens, Graticule and Time base generators used in CRO 3c. Describe the measurement of voltage, current, phase and frequency using CRO. 3d. Compare the construction of CRO and DSO with block diagram 3e. State the function of different types of probes and their applications.	3.1. Cathode Ray Oscilloscope (CRO): Block diagram, Construction. 3.2. Measurement: voltage, current, phase and frequency (Lissajous Patterns) 3.3. Digital Storage Oscilloscope (DSO): Construction 3.4. Direct probe: Isolation probe, Detector probe
Unit – IV **Transducers**	4a. State the need of transducers. 4b. Classify transducers.	4.1. Transducers: requirements 4.2. Classification: Active and Passive, Analog and Digital, Electrical and non electrical, Primary and Secondary, Transducer and Inverse Transducer

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	4c. Describe working principle of Resistive, Inductive, Capacitive, LVDT, Piezoelectric, Strain Gauge, Thermocouple, RTD, Thermister. 4d. Select the relevant transducers for specific applications. 4e. State the need of signal conditioning.	4.3. Transducers: Resistive, Inductive, Capacitive, LVDT, Piezoelectric, Strain Gauge, Thermocouple, RTD, Thermister. 4.4. Signal conditioning requirement
Unit – V **Signal Generators**	5a. State the need for signal generator. 5b. Differentiate between pulse wave and square wave generators with their applications. 5c. State the uses of function generator.	5.1. Pulse wave and Square wave generator 5.2. Function generator

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	Measurement and Measurement of Circuit Parameters	14	8	6	4	18
II	Electrical and electronic Measuring Instruments	12	4	4	4	12
III	Oscilloscope	10	4	6	2	12
IV	Transducers	16	5	7	8	20
V	Signal generators	4	2	3	3	8
	Total	**56**	**23**	**26**	**21**	**70**

Legends: R = Remember; U = Understand; A = Application and above levels (Bloom's revised taxonomy)
Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

7. SUGGESTED LIST OF PRACTICALS/EXERCISES

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills **(outcomes in psychomotor and affective domain)** so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

***Note**: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes (**as given in a common list at the beginning of curriculum document for this programme) would be assured.*
Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

S. No.	Unit No.	Practical/Exercise (Outcomes' in Psychomotor Domain)	Apprx. Hrs. Required
1.	I	Build/Test Wheatstone bridge.	2
2.	I	Build/Test Kelvin double bridge.	2
3.	I	Build/Test Maxwell Bridge.	2
4.	I	Build/Test Anderson Bridge.	2
5.	I	Build/Test Hays Bridge.	2
6.	I	Build/Test De Sauty's Bridge.	2
7.	I	Build/Test Wein Bridge.	2
8.	II	Use DC ammeter and voltmeter for different ranges	2
9.	II	Measure different electrical parameters using DVM	2
10.	II	Measure different electrical parameters using DFM	2
11.	III	Measure different voltage using CRO	2
12.	III	Measure phase:(Lissajous Patterns)using CRO	2
13.	III	Measure frequency :(Lissajous Patterns) using CRO	2
14.	III	Measure different voltage using DSO	2
15.	IV	Measure Linear displacement using LVDT.	2
16.	IV	Use strain gauge for different applications.	2
17.	IV	Use Inductive transducer for different applications.	2
18.	IV	Use Capacitive transducer for different applications.	2
19.	IV	Use Piezoelectric transducer for different applications.	2
20.	IV	Use Thermocouple, RTD and Thermister for different applications.	2
21.	V	Build/test square wave and pulse wave generator.	2
22.	V	Test different parameters using Function Generator.	2
Total Hrs(perform practical worth 28 hours so that most units are covered)			**44**

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

i. Prepare chart for understanding various electro-mechanical instruments
ii. Prepare presentation one any one instrument for Seminar
iii. Survey the market and collect the specifications of the latest measuring instruments available in market

9. SPECIAL INSTRUCTIONAL STRATEGY (If Any)

Give numerical problems to students for solving during tutorial classes, and be around them to help them if they get stuck at some stage of the problem.

10. SUGGESTED LEARNING RESOURCES

A. List of Books

S. No.	Title of Books	Author	Publication
1	Electronic Instrumentation	Kalsi, H.S.	Tata McGraw Hill, New Delhi, Latest edition
2	Modern Electronic Instrumentation and Measurement Techniques	Helfrick, Albert D., Cooper ,William D.	PHI Learning , New Delhi, latest publication
3	A course in electrical and	Sawhney A. K.	Dhanput Rai and Co., New

	electronic Measurements and Instrumentation		Delhi, latest publication
4	Electrical Measurements and Measuring Instruments	Gupta J. B.	S. K. Kataria and Sons, New Delhi, latest publication

B. List of Major Equipment/Materials with Broad Specification

i. Digital multimeter (31/2 digit)
ii. Oscilloscope (dual channel)
iii. Function Generator (Operating Modes: Sine, Square, Triangle, Ramp, Pulse, DC, Frequency Range: 0.2Hz to 20MHz)
iv. DC power supply (-30V-0-30V)
v. AC power supply (-30V-0-30V)
vi. DSO (Dual channel, 100 MHz).

C. List of Software/Learning Websites

i. http://freevideolectures.com/Course/2347/Industrial-Instrumentation
ii. http://www.rejinpaul.com/2012/08/measurements-instrumentation-ee2201.html#
iii. http://www.electronics-tutorials.ws/io/io_1.html
iv. http://www.ni.com/white-paper/4045/en/

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof (Smt.) J. M. Patel**, ALPE, Dept. of Power Electronics, Dr. S. and S. S. Ghandhy College of Engg. and Technology, Surat
- **Prof. S. A. Patel,** LPE, Power Electronics Dept. Dr. S. and S. S. Ghandhy College of Engg. and Tech., Surat

Coordinator and Faculty Members from NITTTR Bhopal

- **Prof. A. S. Walkey**, Associate Professor, Department of Electrical and Electronics Engineering
- **Prof. Joshua Earnest**, Professor, Department of Electrical and Electronics Engineering