Techno India NJR Institute of Technology

Course File

Electronic Measurement and Instrumentation (4EE3-04)

Mr. Rajkumar Soni

(Assistant Professor)

Department of Electrical Engineering

Syllabus:

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

SYLLABUS

2nd Year - IV Semester: B.Tech. (Electrical Engineering)

4EE3-04: Electronic Measurement and Instrumentation

Credit: 2 **Max. Marks: 100(IA:20, ETE:80)**

2L+0T+0P **End Term Exam: 2 Hours**

SN	CONTENTS	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Measuring Instruments:** Moving coil, moving iron, electrodynamic and induction instruments-construction, operation, torque equation and errors. Applications of instruments for measurement of current, voltage, single-phase power and single-phase energy. Errors in wattmeter and energy meter and their compensation and adjustment. Testing and calibration of single-phase energy meter by phantom loading.	4
3	**Polyphase Metering:** Blondel's Theorem for n-phase, p-wire system. Measurement of power and reactive kVA in 3-phase balanced and unbalanced systems: One-wattmeter, two- wattmeter and three-wattmeter methods. 3-phase induction type energy meter. Instrument Transformers: Construction and operation of current and potential transformers. Ratio and phase angle errors and their minimization. Effect of variation of power factor, secondary burden and frequency on errors. Testing of CTs and PTs. Applications of CTs and PTs for the measurement of current, voltage, power and energy.	6
5	**Potentiometers:** Construction, operation and standardization of DC potentiometers– slide wire and Crompton potentiometers. Use of potentiometer for measurement of resistance and voltmeter and ammeter calibrations. Volt ratio boxes. Construction, operation and standardization of AC potentiometer in-phase and quadrature potentiometers. Applications of AC potentiometers.	5
6	**Measurement of Resistances:** Classification of resistance. Measurement of medium resistances – ammeter and voltmeter method, substitution method, Wheatstone bridge method. Measurement of low resistances – Potentiometer method and Kelvin's double bridge method. Measurement of high resistance: Price's Guard-wire method. Measurement of earth resistance.	6
7	**AC Bridges:** Generalized treatment of four-arm AC bridges. Sources and detectors. Maxwell's bridge, Hay's bridge and Anderson bridge for self-inductance measurement. Heaviside's bridge for mutual inductance measurement. De Sauty Bridge for capacitance measurement. Wien's bridge for capacitance and frequency measurements. Sources of error in bridge measurements and precautions. Screening of bridge components. Wagner earth device.	6
	Total	28

Course Overview:

The student will learn Technical communication, Comprehension of Technical Materials/Texts and Information Design & Development, Technical Writing, Grammar and Editing and Advanced Technical Writing from this 26-hour course. After going through this course, they will be able to write technical documents, articles and research papers, and technical communication, which is very important during the recruitment process. It also improves the formal email writing skill required in the industry.

This course is very important for the student to grow as an individual in any industry and put their point of view accurately and precisely. Technical communication helps them represent themself as a company representative. In the present scenario, the market has become global. Student needs to learn the skills that required for global trade and this course serve that purpose.

Course Outcome:

Subject Code : 4EE5A	Subject Name: Measurement and Instrumentation
CO1	Analyze the mechanism of torque production and operation of permanent magnet and electro-magnetic measuring instruments.
CO2	Understand the working of potentiometer and different DC and AC bridges for accurate measurement of electrical quantities.
CO3	Determine the magnitude of electrical quantities like resistance, inductance, capacitance, power, energy etc. over wide range of magnitude.
CO4	Explain the working principle of Current transformer and Potential transformer and also can define the ratio error and phase angle error.
CO5	Applications of instruments for measurement of current, voltage, single-phase power and single-phase energy. Errors in wattmeter and energy meter and their compensation and adjustment.

Prerequisites:

1. Fundamentals of English reading and writing.
2. Students should be efficient in basic grammar.
3. Students should be familiar with email.
4. Students should be familiar with fundamental writing tools like word, excel, PowerPoint etc.

Course Outcome Mapping with Program Outcome:

Course Outcome	Program Outcomes (PO's)											
CO. NO.	Domain Specific (PSO)					Domain Independent (PO)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	-	-	-	-	-	-	-	-
CO2	2	2	1	2	-	-	-	-	-	-	-	-
CO3	1	2	1	2	-	-	-	-	-	-	-	-
CO4	2	1	2	1	-	-	-	-	-	-	-	-
1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)												

Course Coverage Module Wise:

Lect. No.	Unit	Topic
1	**1**	**INTRODUCTION:** Objective, scope and outcome of the course
2	**2**	**MEASURING INSTRUMENTS:** Moving coil, moving iron meter construction, operation, torque equation and errors
3	2	Electrodynamic meter-construction, operation, torque equation and errors
4	2	Induction meter construction, operation, torque equation and errors
5	2	Applications of instruments for measurement of current, voltage, single-phase power and single-phase energy
6	2	Errors in wattmeter and energy meter and their compensation and adjustment
7	2	Testing and calibration of single-phase energy meter by phantom loading
8	2	Numerical on Moving coil, moving iron, electrodynamic, Induction meter
9	**3**	**POLYPHASE METERING:** Blondel's Theorem for n-phase, p-wire system. Measurement of power and reactive kVA in 3-phase balanced and unbalanced systems
10	3	One-wattmeter, two- wattmeter and three-wattmeter methods. 3-phase induction type energy meter
11	3	Instrument Transformers: Construction and operation of current and potential transformers.
12	3	Ratio and phase angle errors and their minimization. Effect of variation of power factor, secondary burden and frequency on errors
13	3	Testing of CTs and PTs. Applications of CTs and PTs for the measurement of current, voltage, power and energy
14	3	Numerical on One-wattmeter, two- wattmeter and three-wattmeter methods.
15	**4**	**POTENTIOMETERS:** Construction, operation and standardization of DC potentiometers– slide wire and Crompton potentiometers
16	4	Use of potentiometer for measurement of resistance and voltmeter and ammeter calibrations, Volt ratio boxes
17	4	Construction, operation and standardization of AC potentiometer in-phase and quadrature potentiometers
18	4	Applications of AC potentiometers

19	4	Numerical on potentiometer
20	**5**	**MEASUREMENT OF RESISTANCES:** Classification of resistance. Measurement of medium resistances – ammeter and voltmeter method
21	5	Substitution method, Wheatstone bridge method
22	5	Measurement of low resistances - Potentiometer method and Kelvin's double bridge method
23	5	Measurement of high resistance: Price's Guardwire method
24	5	Measurement of earth resistance
25	5	Numerical on - ammeter and voltmeter method
26	5	Numerical on Wheatstone bridge method, Wheatstone bridge method
27	**6**	**AC BRIDGES:** Generalized treatment of four-arm AC bridges. Sources and detectors
28	6	Maxwell's bridge, Hay's bridge for selfinductance measurement
29	6	Anderson bridge for self-inductance measurement
30	6	Heaviside's bridge for mutual inductance measurement
31	6	De Sauty Bridge for capacitance measurement
32	6	Wien's bridge for capacitance and frequency measurements
33	6	Sources of error in bridge measurements and precautions
34	6	Screening of bridge components. Wagner earth device
35	6	Numerical on AC Bridges
36		Revision to course work

Text/Reference Books:

1. H. S. Kalsi, Electronic Inst. & Measurement, TMH 2004
2. Morris, Electrical Measurements & Instrumentation, ELSEVIER
3. Bell, Electronic Instrumentation And Measurement, Oxford 1994
4. W. D. Cooper, Electronic Inst. & Measurement Techniques, Prentice Hall, India.

Teaching and Learning resources:

NPTEL Course Link	https://nptel.ac.in/courses/108/105/108105153/
Quiz	https://quizizz.com/admin/quiz/5f44a0bf42a092001c5fa642/instrumentation-introduction https://quizizz.com/admin/quiz/5fdc831c66d58a001bf73587/instrumentation
Notes	https://drive.google.com/file/d/0B60UImVSouo5X253d0JJX3RFQkU/view?resourcekey=0-dEmc83p9GCBOWSpY18J2eQ

Assessment Methodology:

1. Assignments one from each unit.
2. Midterm subjective paper where they have to solve the given problem. (Twice during the semester)
3. Final paper at the end of the semester subjective

Previous Year Question Paper:

4E1225

Total No of Pages: 3

Roll No.

4E1225

B. Tech. IV - Sem. (Main) Exam., May - 2019

ESC Electrical Engineering

4EE3 – 04 Electronic Measurement & Instrumentation

EE, EX

Time: 2 Hours **Maximum Marks: 80**

Instructions to Candidates:

Attempt all five questions from Part A, four questions out of six questions from Part B and two questions out of three from Part C.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL 2. NIL

PART – A

(Answer should be given up to 25 words only) **[5×2=10]**

All questions are compulsory

Q.1 Explain comparison between Current transformer and Potential transformer.

Q.2 Explain the term 'standardization' of a potentiometer.

Q.3 What is the importance of the value of earth's resistance?

Q.4 Why is it preferable in bridge circuits, that the equations of balance are independent of Frequency? Explain.

Q.5 Explain why PMMC instruments are the most widely used instruments.

PART – B

(Analytical/Problem solving questions) **[4×10=40]**

Attempt any four questions

Q.1 What are the sources of errors in bridge circuit? What are the precautions and methods used to minimize the errors?

Q.2 Explain the working principle of single phase energy meter.

Q.3 Explain classification of Resistance, how Wheatstone bridge method is employed to measure Resistance?

Q.4 Discuss the measurement of power by two Wattmeter method.

Q.5 Explain construction and operation of slide wire DC potentiometer.

Q.6 Explain the following AC bridges with phasor diagrams.

(A) Heaviside Bridge

(B) Anderson Bridge

PART – C

(Descriptive/Analytical/Problem Solving/Design Questions) **[2×15=30]**

Attempt any two questions

Q.1 Draw the equivalent circuit and phasor diagram of a current transformer. Also derive the expression for ratio and phase angle errors.

Q.2 Explain the working of Co-ordinate AC potentiometer. How is it standardized? What are the functions of the transfer instrument and the phase shifting transformer?

Q.3 What are the different problems associated with measurement of low resistance? Explain the principle of working of a Kelvin's double bridge and explain how the effect of contact resistance and resistance of leads is eliminated?
