NSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LABORATORY**				
Course Code	AEE107				
Programme	B.Tech				
Semester	IV	EEE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Mr. P. Shivakumar, Assistant Professor, EEE				
Course Faculty	Mr. P. Shivakumar, Assistant Professor, EEE				

I. COURSE OVERVIEW:

The objective of this lab is to teach students to know the procedure and perform experiments to measure temperature, speed, distance, level, position, strain, and linear displacement. To design experiments for calibration of energy meter, power factor meter, LPF wattmeter and to measure three phase reactive power.

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II. COURSE PRE-REQUISITES:

Level	Course code	Semester	Prerequisites	Credits
UG	AHS006	I	Engineering Physics	4
	AEE002	II	Electrical Circuits	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total marks
Electrical measurements and instrumentation laboratory	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

X	Chalk & talk	X	Quiz	X	Assignments	X	MOOCs
√	LCD / PPT	X	Seminars	X	Mini project	√	Videos
√	Open ended experiments						

V. EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the Principal from the panel of experts recommended by Chairman, BOS.

The emphasis on the experiments is broadly based on the following criteria:

20 %	To test the preparedness for the experiment.
20 %	To test the performance in the laboratory.
20 %	To test the calculations and graphs related to the concern experiment.
20 %	To test the results and the error analysis of the experiment.
20 %	To test the subject knowledge through viva – voce.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Table 1: Assessment pattern for CIA

Component	**Laboratory**		**Total Marks**
Type of Assessment	Day to day performance	Final internal lab assessment	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):
One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

Preparation	**Performance**	**Calculations and Graph**	**Results and Error Analysis**	**Viva**	**Total**
2	2	2	2	2	10

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		**Strength**	**Proficiency assessed by**
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Calculations of the observations
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences,	2	Characteristic of devices

Program Outcomes		Strength	Proficiency assessed by
	and engineering sciences.		
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	3	Seminar
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Conducting experiments
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	3	Simulation

3= High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Strength	Proficiency assessed by
PSO1	**Problem Solving Skills:** Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	-	-
PSO2	**Professional Skills:** Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	2	Term observations
PSO3	**Modern Tools in Electrical Engineering** To be able to utilize of technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test , maintain power systems and industrial applications.	3	Conducting experiments

3= High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Understand various measurement techniques used in electrical engineering
II	Analyse waveforms using LabVIEW to measure various parameters
III	Demonstrate the use of sensors and transducers in electrical and nonelectrical measurements.
IV	Apply knowledge of virtual instruments in measurement of analysis of electrical parameters.

IX. COURSE LEARNING OUTCOMES:

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's mapped	Strength of mapping
CAEE107.01	CLO 1	Measurement of temperature using transducers like thermocouple, thermistors and resistance temperature detector with signal conditioning; Speed measurement using proximity sensor	PO1, PO3	3
CAEE107.02	CLO 2	Distance measurement using ultrasonic	PO1, PO3	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's mapped	Strength of mapping
		transducer; Measurement of level using capacitive transducer		
CAEE107.03	CLO 3	Strain measurement using strain gauge; Measurement of pressure using differential pressure transducer	PO1, PO3	3
CAEE107.04	CLO 4	To measure the displacement using linear variable differential transformer	PO1, PO3	3
CAEE107.05	CLO 5	To calibrate LPF wattmeter by phantom loading method and compare the power consumed with direct loading.	PO1, PO2	2
CAEE107.06	CLO 6	To calibrate and testing of single phase induction type energy meter.	PO1, PO2	2
CAEE107.07	CLO 7	To find the turns ratio of transformer by using A.C bridge.	PO2, PO3	2
CAEE107.08	CLO 8	To measure 3 - phase reactive power using single phase wattmeter	PO1, PO2	2
CAEE107.09	CLO 9	Study of bidirectional energy measurement using net metering.	PO2, PO3	3
CAEE107.10	CLO 10	Determination of frequency and Total Harmonic Distortion (THD) using LabVIEW	PO2, PO3	2
CAEE107.11	CLO 11	Measurement and display of voltage and current wave forms and analysis of waveforms using LabVIEW.	PO2, PO3	2
CAEE107.12	CLO 12	Measurement of real and reactive powers of an electrical load using two wattmeter method and verification using LabVIEW.	PO1, PO3	2
CAEE107.13	CLO 13	Measurement of energy using a static energy meter and verification using LabVIEW	PO2, PO3	3
CAEE107.14	CLO 14	Resistance measurement using Kelvin's double bridge; Inductance measurement using Anderson bridge and capacitance measurement using Schering bridge and verification using LabVIEW	PO2, PO3	3

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3		3												3
CLO 2	3		3												3
CLO 3	3		3												3
CLO 4	3		3												3
CLO 5	2	2													
CLO 6	2	2													
CLO 7		2	2												
CLO 8		2	2												
CLO 9		3	3												
CLO 10		2	2												
CLO 11		2	2												

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 12	2		2												
CLO 13		3	3												
CLO 14		3	3												

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT:

CIE Exams	PO1, PO2, PO3	SEE Exams	PO1, PO2, PO3	Assignments	-	Seminars	-
Laboratory practices	PO1, PO2, PO3	Student viva	PO1, PO2, PO3	Mini project	-	Certification	-
Term paper	-						

XII. ASSESSMENT METHODOLOGIES – INDIRECT:

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS:

LIST OF EXPERIMENTS	
Week-1	**SENSING OF TEMPERATURE AND SPEED**
Measurement of temperature using transducers like thermocouple, thermistors and resistance temperature detector with signal conditioning; Speed measurement using proximity sensor	
Week-2	**CALCULATION OF DISTANCE AND LEVEL**
Distance measurement using ultrasonic transducer; Measurement of level using capacitive transducer	
Week-3	**MEASUREMENT OF STRAIN AND PRESSURE**
Strain measurement using strain gauge; Measurement of pressure using differential pressure transducer.	
Week-4	**MEASUREMENT OF POSITION AND LINEAR DISPLACEMENT**
Masurement of postion using encoder; Measurement of displacement using linear variable differential transformer	
Week-5	**PHANTOM LOADING ON LPF WATTMETER**
To calibrate LPF wattmeter by phantom loading method and compare the power consumed with direct loading	
Week-6	**CALIBRATION OF SINGLE PHASE ENERGY METER AND POWER FACTOR METER**
To calibrate and testing of single phase induction type energy meter and power factor meter	
Week-7	**MEASUREMENT OF TURNS RATIO AND APPLICATION OF CTS**
To find the turns ratio of transformer by using A.C bridge	
Week-8	**MEASUREMENT OF REACTIVE POWER**
To measure 3 - phase reactive power using single phase wattmeter	
Week-9	**NET METERING**
Study of bidirectional energy measurement using net metering.	

LIST OF EXPERIMENTS	
Week-10	**MEASUREMENT OF FREQUENCY AND THD USING DIGITAL SIMULATION**
Determination of frequency and Total Harmonic Distortion (THD) using LabVIEW	
WeeK-11	**ANALYSIS OF ALTERNATING QUANTITIES USING DIGITAL SIMULATION**
Measurement and display of voltage and current wave forms and analysis of waveforms using LabVIEW.	
Week-12	**TWO WATTMETER METHOD USING DIGITAL SIMULATION**
Measurement of real and reactive powers of an electrical load using two wattmeter method and verification using LabVIEW	
Week-13	**WORKING OF STATIC ENERGY METER USING DIGITAL SIMULATION**
Measurement of energy using a static energy meter and verification using LabVIEW	
Week-14	**MEASUREMENT OF PASSIVE PARAMETERS USING AC AND DC BRIDGES USING DIGITAL SIMULATION**
Resistance measurement using Kelvin's double bridge; Inductance measurement using Anderson bridge and capacitance measurement using Schering bridge and verification using LabVIEW.	

Text Books:

1. A K Sawhney, "Electrical and Electronic measurement and instruments", Dhanpat Rai and Sons Publications, 2002.
2. E W Golding and F C Widdis, "Electrical measurements and measuring instruments",Wheeler publishing, 5th Edition, 2006.

Reference Books:

1. Buckingham and Price, "Electrical measurements", Prentice Hall, 1nd Edition, 2000.
2. D V S Murthy, "Transducers and Instrumentation", Prentice Hall of India, 2nd Edition, 2009.

Web References:

1. https://www.gnindia.dronacharya.info/EEEDept/Downloads/Labmanuals/EMI_Lab.pdf.
2. https://www.scribd.com/doc/25086994/electrical-measurements-lab

XIV. COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Week No	Topics to be covered	CLOs	References
1	Understand Measurement of temperature using transducers like thermocouple, thermistors and resistance temperature detector with signal conditioning; Speed measurement using proximity sensor	CLO 1	T1: 25.20
2	Understand Distance measurement using ultrasonic transducer; Measurement of level using capacitive transducer	CLO 2	T1: 25.28
3	Understand Strain measurement using strain gauge; Measurement of pressure using differential pressure transducer.	CLO 3	T1: 25.16.1
4	Understand Masurement of postion using encoder; Measurement of displacement using linear variable differential transformer	CLO 4	T1: 25.36, 25.24
5	Calibrate LPF wattmeter by phantom loading method and compare the power consumed with direct loading	CLO 5	T1: 11.5
6	Calibrate and testing of single phase induction type energy meter and power factor meter	CLO 6	T1: 12.1
7	Understand calculation of turns ratio of transformer by using A.C bridge	CLO 7	T1: 10.5

Week No	Topics to be covered	CLOs	References
8	Understand measurement of 3 - phase reactive power using single phase wattmeter	CLO 8	T1: 11.3
9	Study of bidirectional energy measurement using net metering	CLO 9	T1: 12 .2
10	Understand calculation of frequency and Total Harmonic Distortion (THD) using LabVIEW	CLO 10	T1: 23.3
11	Understand measurement and display of voltage and current wave forms and analysis of waveforms using LabVIEW	CLO 11	T1: 14.1
12	Understand measurement of real and reactive powers of an electrical load using two wattmeter method and verification using LabVIEW	CLO 12	T1: 11.3
13	Understand measurement of energy using a static energy meter and verification using LabVIEW	CLO 13	T1: 12.1
14	Understand Resistance measurement using Kelvin's double bridge; Inductance measurement using Anderson bridge and capacitance measurement using Schering bridge and verification using LabVIEW.	CLO 14	T1: 14.1

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Energy measurement of Net meter using MATLAB	NPTEL videos	PO5	PSO2

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