Ref No:

< Sri Krishna Institute of Technology, Bangalore>

COURSE PLAN

Academic Year 2019

Program:	B E – Electrical and Electronics Engineering
Semester :	3
Course Code:	18EE36
Course Title:	ELECTRICAL AND ELECTRONIC MEASUREMENTS
Credit / L-T-P:	4 / 4-0-0
Total Contact Hours:	50
Course Plan Author:	Vinutha S

Academic Evaluation and Monitoring Cell

< Sri Krishna Institute of Technology
#29, Hesaraghatta Main Road
Chimney Hills, Chikkabanavara Post>
<Bangalore– 560090,Katakana, India.>
<Phone / Fax :+91-STD-080 >
<Web: skit.org.in, e-mail: >

Table of Contents

Note : Remove “Table of Content” before including in CP Book
Each Course Plan shall be printed and made into a book with cover page
Blooms Level in all sections match with A.2, only if you plan to teach / learn at higher levels

A. COURSE INFORMATION

1. Course Overview

Degree:	BE	Program:	EE
Semester:	3	Academic Year:	2019
Course Title:	ELECTRICAL AND ELECTRONIC MEASUREMENTS	Course Code:	18EE36
Credit / L-T-P:	4-0-0	SEE Duration:	180 Minutes
Total Contact Hours:	50 Hours	SEE Marks:	60 Marks
CIA Marks:	40 Marks	Assignment	1 / Module
Course Plan Author:	Vinutha S	Sign ..	Dt:
Checked By:		Sign ..	Dt:
CO Targets	CIA Target : ..... %	SEE Target:	..... %

Note: Define CIA and SEE % targets based on previous performance.

2. Course Content

Content / Syllabus of the course as prescribed by University or designed by institute. Identify 2 concepts per module as in G.

Module	Content	Teaching Hours	Identified Module Concepts	Blooms Learning Levels
1	**Measurement of Resistance:** Wheatstone's bridge, Sensitivity, Limitations. Kelvin's double bridge. Earth resistance measurement by fall of potential method and by using Megger. **Measurement of Inductance and Capacitance:** Sources and detectors, Maxwell's inductance bridge, Maxwell's inductance and capacitance bridge, Hay's bridge, Anderson's bridge, Desauty's bridge, Schering bridge. Shielding of bridges. Problems.	10 (3, 11)	-Measurement of Resistance - Measurement of Inductance and Capacitance	Appllying L3 Appllying L3
2	**Measurement of power and energy** Torque expression, Errors and minimization, UPF and LPF wattmeters. Measurements of real and reactive power in 3 phase circuits. Review of Induction type energy meter construction and operation (No question shall be set from the review portions)].Errors, adjustments and calibration of single and three phase energy meter Problems. **Measurement of power factor and frequency** Construction and operation of single-phase and three phase dynamometer type power factor meter. Weston frequency me ter and phase sequence indicator	10 (6, 5)	-Energy meter -Power factor -frequency meter	Applying L3, Applying L3, Applying L3
3	**Extension of Instrument Ranges:** Desirable features of ammeters and voltmeters. Shunts and multipliers. Construction and theory of instrument transformers, Desirable characterises, Errors of CT and PT. Turns compensation, Illustrative examples, Silsbee's method of testing CT. **Magnetic measurements:** Introduction, Measurement of flux/ flux density, Magnetising force and leakage factor.	10 (8, 4)	-Extension Instrument range -Magnetic measurement	Analyzing L4, Analyzing L4
4	**Electronic and digital Instruments:** Introduction. Essentials of electronic instruments, Advantages of electronic instruments. True rms reading voltmeter. Electronic multimeters. Digital voltmeters (DVM) - Ramp type DVM, Integrating type DVM, Continuous –	10 (4, 8)	-Electronic instrument -Digital devices	Applying L3, Applying L3

	balance DVM and Successive - approximation DVM. Q meter Principle of working of electronic energy meter (block diagram treatment), Extra features offered by present day meters and their significance in billing			
5	**Display Devices:** Introduction, Character formats, Segment displays, Dot matrix displays, Bar graph displays. Cathode ray tubes, Light emitting diodes, Liquid crystal displays, Nixes, Incandescent, Fluorescent, Liquid vapour and Visual displays. Display multiplexing and zero suppression. **RecordingDevices:** Introduction, Strip chart recorders, Galvanometer recorders, Null balance recorders, Potentiometer type recorders, Bridge type recorders, LVDT type recorders, Circular chart and X – Y recorders. Magnetic tape recorders, Direct recording, Frequency modulation recording, Pulse duration modulation recording, Digital tape recording, Ultraviolet recorders. Biomedical recorders, Electro Cardio Graph (ECG),Electroencephalograph, Electromyographg. Noise in reproduction.	10 (6, 5)	Display device Recording devices	Analyzing L4, Analyzing L4
-	**Total**	**50**	-	-

3. Course Material

Books & other material as recommended by university (A, B) and additional resources used by course teacher (C).

1. Understanding: Concept simulation / video ; one per concept ; to understand the concepts ; 15 – 30 minutes
2. Design: Simulation and design tools used – software tools used ; Free / open source
3. Research: Recent developments on the concepts – publications in journals; conferences etc.

Modules	Details	Chapters in book	Availability
A	**Text books (Title, Authors, Edition, Publisher, Year.)**	-	-
	Electrical and Electronic Measurements and Instrumentation, A. K. Sawhney, Dhanpatrai and Sons, New Delhi.	1, 2, 3, 4, 5	In Lib
	A Course in Electronics and Electrical Measurements and Instrumentation J. B. Gupta Katson Books 2013 Edition		In Lib
	Electrical and electronic Measurements and Instrumentation Er.R.K. Rajput S Chand 5th Edition 2012		In Lib
B	**Reference books (Title, Authors, Edition, Publisher, Year.)**	-	-
	Electrical Measuring Instruments and MeasurementsS.C. Bhargava BS Publications 2013		In Dept
	Modern Electronic Instrumentation and Measuring Techniques, Cooper D. and A.D. Heifrick, PHI, 2009 Edition.		In Lib
	Electronic Instrumentation and Measurement, David A. Bell, oxford Publication, 2nd Edition, 2009.		In Lib
	Electrical Measurements and Measuring Instruments, Golding and Widdies, Pitman		In Lib
C	**Concept Videos or Simulation for Understanding**	-	-
C1	https://www.youtube.com/watch?v=uy9lZCdkQIM Lecture Series on Power System Generation, Transmission and Distribution		
C2	https://www.youtube.com/watch?v=gd1nruo4_iA Insulators for Overhead Lines		
C3	https://www.youtube.com/watch?v=lr1jgbR5ca8 https://www.youtube.com/watch?v=dhmYOIBcwOU Transmission Line parameters		
C4	https://www.youtube.com/watch?v=lr1jgbR5ca8 https://www.youtube.com/watch?v=dhmYOIBcwOU		

	Transmission Line parameters		
C5	https://nptel.ac.in/courses/108102047/12 Performance of transmission lines		
C6	https://nptel.ac.in/courses/108102047/12 Performance of transmission lines		
C7	https://nptel.ac.in/courses/108105104/21 Disruptive critical voltage for single and three phase transmission lines, Formula for disruptive critical voltage, Visual critical voltage		
C8	https://nptel.ac.in/courses/108102047/18 Underground cable		
C9	https://www.youtube.com/watch?v=_iz8ZkjD7z8 Distribution Systems		
C10	https://nptel.ac.in/courses/108107112/3 Distribution Systems		
D	**Software Tools for Design**	**-**	**-**
1	Auto CAD		
E	**Recent Developments for Research**	**-**	**-**
	https://ieeexplore.ieee.org/document/7836860		
F	**Others (Web, Video, Simulation, Notes etc.)**	**-**	**-**
1			
?			

4. Course Prerequisites

Refer to GL01. If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.
Students must have learnt the following Courses / Topics with described Content . . .

Modules	Course Code	Course Name	Topic / Description	Sem	Remarks	Blooms Level
1	18EL13	Basic Electrical Engineering	To understand the concepts of current, power, resistance,voltage	1		L2

5. Content for Placement, Profession, HE and GATE

The content is not included in this course, but required to meet industry & profession requirements and help students for Placement, GATE, Higher Education, Entrepreneurship, etc. Identifying Area / Content requires experts consultation in the area.
Topics included are like, a. Advanced Topics, b. Recent Developments, c. Certificate Courses, d. Course Projects, e. New Software Tools, f. GATE Topics, g. NPTEL Videos, h. Swayam videos etc.

Modules	Topic / Description	Area	Remarks	Blooms Level
3	Analysis of current transformer and potential transformers	Advanced Topics		L3,L4
4	Electronic meters- multimeters, energymeters	Advanced Topics		L5
5	Demonstration on display devices	Advanced Topics		L3

B. OBE PARAMETERS

1. Course Outcomes

Expected learning outcomes of the course, which will be mapped to POs. Identify a max of 2 Concepts per Module. Write 1 CO per Concept.

Modules	Course Code.#	Course Outcome **At the end of the course, student should be able to . . .**	Teach. Hours	Concept	Instr Method	Assessment Method	Blooms' Level
1	18EE36.1	Demonstrate bridge balancing technique to measure the unknown resistance.	4	Resistance bridge	Lecture	Slip Test	L3 Apply
1	18EE36.2	Analyze the measurement of Inductance, Capacitor by maxwell's Desautys bridge.	06	Inductance capacitance bridges	Lecture	Assignment	L4 Analyze
2	18EE36.3	Demonstrate measurement of energy using energy meter and calibrate the error by compare with standard values.	06	Energy meter	Lecture	Assignment and Slip Test	L4 Analyze
2	18EE36.4	Analyze the measurement of power factor, frequency by using dynamo meter and Weston frequency meter.	04	Power factor frequency meter	Lecture / PPT	Assignment	L3 Apply
3	18EE36.5	Illustrate the extension ranges of instrument by instrument transformer.	05	Extension Instrument range	Lecture	Slip test	L4 Analyze
3	18EE36.6	Apply the magnetic measurement of flux using magnetic meter.	05	Magnetic measurement	Lecture and Tutorial	Assignment	L3
4	18EE36.7	Apply the principle and working of Electronic meter	05	Electronic instrument	Lecture	Assignment and Slip Test	L5 Evaluate
4	18EE36.8	Analyze the measurement of voltage by using digital meter.	05	Digital meters	Lecture	Assignment	L2
5	18EE36.9	Demonstrate the display devices of LED,LCD, liquid vapour devices.	05	Display device	Lecture	Assignment	L2
5	18EE36.10	Illustrate the working of recording devices .	05	Recording devices	Lecture	Assignment	L4 Analyze
-	**-**	**Total**	**50**	**-**	**-**	**-**	**L2-L5**

2. Course Applications

Write 1 or 2 applications per CO.
Students should be able to employ / apply the course learnings to . . .

Modules	Application Area Compiled from Module Applications.	CO	Level
1	Wheatstone bridge along with operational amplifier can be used to measure the physical parameters like light temperature strain.	CO1	L2
1	Able to understand various AC bridges and their applications[	CO2	L2
2	Knowledge of digital energy meters	CO3	L3
2	Analyze the measurement of power factor, frequency by using dynamo meter and Weston frequency meter.	CO4	L3
3	Illustrate the extension ranges of instrument by instrument transformer.	CO5	L4

3	Apply the magnetic measurement of flux using magnetic meter.	CO6	L4
4	Apply the principle and working of Electronic meter	CO7	L2
4	Analyze the measurement of voltage by using digital meter.	CO8	L4
5	Demonstrate the display devices of LED,LCD, liquid vapour devices.	CO9	L4
5	Illustrate the working of recording devices .	CO10	L2

3. Mapping And Justification

CO – PO Mapping with mapping Level along with justification for each CO-PO pair.
To attain competency required (as defined in POs) in a specified area and the knowledge & ability required to accomplish it.

Modules	Mapping		Mapping Level	Justification for each CO-PO pair	Level
-	**CO**	**PO**	-	**'Area': 'Competency' and 'Knowledge' for specified 'Accomplishment'**	-
1	CO1	PO1		Basic knowledge on bridges	L2
1	CO1	PO2		Analysing the method of measuring unknown resistance	L4
1	CO2	PO1		Basic knowledge on AC bridges	L2
1	CO2	PO2		Analysing the method of measuring unknown inductance and capacitance	L4
2	CO3	PO1		Basic knowledge on measurement of energy	L2
2	CO3	PO4		Compare and calibrate the enrgy meter with standard values	L4
2	CO4	PO1		Fundamental of frequency and power factor	L2
2	CO4	PO2		Analyse the measurement of power factor and frequency by modern meters	L4
3	CO5	PO1		Fundamental knowledge on CT and PT	L4
3	CO5	PO3		Development of CT and PT for extension of range of ammeters and volmeters	L3
3	CO6	PO1		Knowledge on magnetic flux, magnetic field	L2
4	CO7	PO1		Applying knowledge of science and engineering to overcome the problems associated with conventional meters by using electronic meters	L3
4	CO8	PO1		Basic knowledge on digital meters	L2
4	CO8	PO2		Analyse the problems associated with analog voltmeters	L4
4	CO8	PO5		Selecting appropriate digital meters to overcome the problems associated with analog meters	L3
5	CO9	PO1		Knoweldge on operation of LED LCD	L2
5	CO9	PO5		Replacing the conventonal displays by modern IT tools	L3
5	CO10	PO1		Basic knowledge on recording systems.	L2

4. Articulation Matrix

CO – PO Mapping with mapping level for each CO-PO pair, with course average attainment.

-	-	Course Outcomes	Program Outcomes														-
Modules	CO.#	**At the end of the course student should be able to . . .**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	Level
1	18EE36.1	Demonstrate bridge balancing technique to measure the unknown resistance.	x	x														L3
1	18EE36.2	Analyze the measurement of Inductance, Capacitance by maxwell's Desautys bridge.	x	x														L4
2	18EE36.3	Demonstrate measurement of energy using energy meter and	x			x												L4

		calibrate the error by compare with standard values.																	
2	18EE36.4	Analyze the measurement of power factor, frequency by using dynamo meter and Weston frequency meter.	x	x															L3
3	18EE36.5	Illustrate the extension ranges of instrument by instrument transformer.	x		x														L4
3	18EE36.6	Apply the magnetic measurement of flux using magnetic meter.	x																L3
4	18EE36.7	Apply the principle and working of Electronic meter	x																L5
4	18EE36.8	Analyze the measurement of voltage by using digital meter.	x	x			x												L2
5	18EE36.9	Demonstrate the display devices of LED,LCD, liquid vapour devices.	x				x												L2
5	18EE36.10	Illustrate the working of recording devices .	x																L4
-	**15EE81**	**Average attainment (1, 2, or 3)**																	**-**
-	*PO, PSO*	*1.Engineering Knowledge; 2.Problem Analysis; 3.Design / Development of Solutions; 4.Conduct Investigations of Complex Problems; 5.Modern Tool Usage; 6.The Engineer and Society; 7.Environment and Sustainability; 8.Ethics; 9.Individual and Teamwork; 10.Communication; 11.Project Management and Finance; 12.Life-long Learning; S1.Software Engineering; S2.Data Base Management; S3.Web Design*																	

5. Curricular Gap and Content

Topics & contents not covered (from A.4), but essential for the course to address POs and PSOs.

Modules	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1					
2					
3					
4					
5					

6. Content Beyond Syllabus

Topics & contents required (from A.5) not addressed, but help students for Placement, GATE, Higher Education, Entrepreneurship, etc.

Modules	Gap Topic	Area	Actions Planned	Schedule Planned	Resources Person	PO Mapping

C. COURSE ASSESSMENT

1. Course Coverage

Assessment of learning outcomes for Internal and end semester evaluation. Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

Modules	Title	Teach. Hours	No. of question in Exam						CO	Levels
			CIA-1	CIA-2	CIA-3	Asg	Extra Asg	SEE		
1	Units and Dimensions Measurement of Resistance, inductance and Capacitance:	10	2	-	-	1	1	2	CO1, CO2	L3, L4
2	Measurement of power and energy	10	2	-	-	1	1	2	CO3, CO4	L4L4
3	Measurement of power factor frequency	10	-	2	-	1	1	2	CO5, CO6	L3, L4
4	Electronic and digital Instruments	10	-	2	-	1	1	2	CO7, C08	L2, L3
5	Display Devices, recording Devices	10	-	-	4	1	1	2	CO9, CO10	L2, L4
-	**Total**	**50**	**4**	**4**	**4**	**5**	**5**	**10**	**-**	**-**

2. Continuous Internal Assessment (CIA)

Assessment of learning outcomes for Internal exams. Blooms Level in last column shall match with A.2.

Modules	Evaluation	Weightage in Marks	CO	Levels
1, 2	CIA Exam – 1	30	CO1, CO2, CO3, CO4	L3, l4, l4
3, 4	CIA Exam – 2	30	CO5, CO6, CO7, C08	L3, L4L2, L3,
5	CIA Exam – 3	30	C09, CO10	L2, L4
1, 2	Assignment - 1	10	CO1, CO2, CO3, CO4	L3, l4, l4
3, 4	Assignment - 2	10	CO5, CO6, CO7, C08	L3, L4L2, L3,
5	Assignment - 3	10	C09, CO10	L2, L4
1, 2	Seminar - 1		**-**	**-**
3, 4	Seminar - 2		-	-
5	Seminar - 3		-	-
1, 2	Quiz - 1		-	-
3, 4	Quiz - 2		-	-
5	Quiz - 3		-	-
1 - 5	Other Activities – define – Slip test	-	CO1 to Co9	L2, L3, L4 . ..
	Final CIA Marks	**40**	**-**	

D1. TEACHING PLAN - 1

Module - 1

Title:	**Units and dimensions Measurement of Resistance**	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Demonstrate bridge balancing technique to measure the unknown resistance.	CO1	L3
2	Analyze the measurement of Inductance, Capacitor by maxwell's Desautys bridge.	CO2	L4
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
1	Measurement of Resistance: Wheatstone's bridge	C01	L3

2	Sensitivity, Limitations.	Co1	L3
3	Kelvin's double bridge.	Co1	L3
4	Earth resistance measurement by fall of potential method	Co1	L3
5	Earth resistance measurement by using Megger.	Co1	L3
6	Sources and detectors, Maxwell's inductance bridge,	Co2	L4
7	Maxwell's inductance and capacitance bridge,	Co2	L4
8	Desauty's bridge,	Co2	L4
9	Hay's bridge, Anderson's bridge	Co2	L4
10	Schering bridge. Shielding of bridges. Problems.	Co2	L4
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Bridges are used to measure the resistance.	CO1	L3
2	Bridges are used to measure the Inductance	CO2	L4
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	With a neat sketch explain the working of a megger	CO1	L1
2	Explain kelvin's bridge?	CO1	L3
3	Explain the fall of potential of measurement of earth resistance	CO1	L3
4	Derive the expression for the measurement of unknown resistance using Kelvin's double bridge. How the effect of connecting lead resistance is eliminated in this arrangement	CO1	L3
5	Write short notes on Megger	CO1	L3
6	Write briefly on the significance of shields used in ac bridge circuit. Hence discuss on the shielding of resistors and capacitors of the circuit	CO1	L3
7	Explain how a megger is used for the measurement of earth resistance	CO1	L3
8	Define voltage sensitivity of a galvanometer and hence obtain an expression for whetstone's bridge sensitivity. When will be Sb maximum?	CO2	L3
9	State and explain sensitivity of whetstone's bridge?	CO2	L4
10	Explain maxwell's bridge?	CO1	L1
11	Explain the importance of Wheatstone bridge?	CO1	L4
12	Explain the Capacitance Comparison Bridge?	CO2	L3
13	Explain the Maxwell's bridge?	CO2	L4
	Explain the Wagner's earth connection?		
14	Deriving equation for resistance is Hay's bridge, the following expression is obtained. R = w2R1R2e2/ 1+w2R22C Find whether the equation is dimensionally correct or not. Incase there is an error find the error and correct equation accordingly	CO2	L3
15	Derive the dimensional equation for resistance R, inductance and capacitance C. hence check for dimensionally correctness of the expression below obtained for inductance from ac bridge measurements , point out the error, if any in the expression and suggest the required correction that makes the expression dimensionally valid L = C (R3/R4) (R2+R4 +R2R4)	CO2	L4
16	Expression for eddy current loss p/meter length of wire may be written as p α fa Bmb dc ρg Where f = frequency, Bm = Max. flux density, d= diameter of wire, ρ – resistivity of material. Find the values a, b,c,and g using L,M,T,I system P = k fa Bmb dc ρg	CO1	L1
17	Derive the balance equations of the Schering bridge circuit configuration used for measurement of capacitances and hence derive at the expression for loss angle of the test capacitor. Draw the phasor diagram at balance.	CO1	L4
18	Derive the expression for the measurement of capacitance and loss angle of a lossy capacitor using Schering bridge. Draw the phasor diagram at balance condition. What modifications are introduced when the bridge is used at high voltages	CO2	L3
19	Write short notes on source and detectors	CO2	L3
e	**Experiences**	-	-
1		CO1	L2

2			
3			
4		CO2	L3
5			

Module – 2

Title:	**Measurement of power and energy Measurement of power factor and frequency**	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Demonstrate measurement of energy using energy meter and calibrate the error by compare with standard values.	CO3	L4
2	Analyze the measurement of power factor, frequency by using dynamo meter and Weston frequency meter.	CO4	L3
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
11	Torque expression, Errors and minimization	CO3	L4
12	UPF and LPF wattmeters	CO4	L3
13	Measurements of real and reactive power in 3 phase circuits	CO3	L4
14	Review of Induction type energy meter construction and operation (No question shall be set from the review portions)].	CO4	L3
15	Errors, adjustments and calibration of single and three phase energy meters,	CO3	L4
16	Problems.	CO4	L3
17	Construction and operation of single-phase power factor meter.	CO3	L4
18	Three phase dynamometer type power factor meter.	CO4	L3
19	Weston frequency meter	CO3	L4
20	Phase sequence indicator.	CO4	L3
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to	-	-
1	Weston frequency meter are used to measure the frequency	CO3	L3
2	single-phase power factor meter are used to measure the power factor	CO4	L4
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	Explain with the help of neat sketch, construction and working of induction type energy meter	CO4	L3
2	Explain the adjustments done in energy meter to read accurately.	CO3	L4
3	How overload and voltage compensations are provided in energy meters? Explain.	CO4	L3
4	With a neat diagram explain LPF wattmeter	CO4	L3
5	Explain electrodynamometer type wattmeter	CO3	L4
6	Explian errors and minimisaton in electrodynamometer	CO3	L4
7	Explain weston frequency meter	CO4	L3
8	Explain phase sequence indicator	CO4	L3
9	Explain single phase power factor meter	CO4	L3
10	Derive torque equation of a single phase electrodynamometer type wattmeter	CO3	L3
11	With a neat diagram explain two wattmeter method of measuring power	CO3	L4

E1. CIA EXAM – 1

a. Model Question Paper - 1

Crs Code:	18EE36	Sem:	III	Marks:	50	Time:	90 minutes
Course:	Electrical and Electronics Measurements						

-	-	Note: Answer all questions, each carry equal marks. Module : 1, 2	Marks	CO	Level
1	a	Define sensitivity of Wheatstone bridge and obtain the expression for sensitivity of Wheatstone bridge.	CO1	L2	8
	b	Draw the circuit of a Kelvin's double bridge used for the measurement of low resistances. Derive the condition for balance.	CO1	L2	6
	c	The four arms of the Wheatstone bridge have the following resistances AB=1000 Ω, BC=1000Ω, CD=120 Ω, DA=120 Ω. The bridge is used for strain measurement and supplied from 5V ideal battery. The galvanometer has sensitivity of 1mm/ μA with internal resistance of 200Ω. Determine the deflection of the galvanometer if arm DA increases to 121Ω and arm CD decreases to 119Ω.	CO1	L3	7
	d	Explain sources and detectors in a.c. bridges	CO2	L1	4
		OR			
2	a	With neat circuit diagram, explain the operation of modified Desautys bridge. Also draw the phasor diagram.	CO2	L2	8
	b	With a neat diagram, explain the working of a Megger, used for the measurement of earth resistance.	CO1	L2	7
	c	With neat circuit diagram derive the balancing equation for Maxwell Inductance Capacitance bridge.	CO2	L2	5
	d	Explain the limitations of Wheatstone bridge.	CO1	L1	5
3	a	Explain the construction and working principle of electrodynamometer wattmeter for the measurement of power in the circuit.	CO3	L2	8
	b	Discuss the errors and their compensating techniques used in dynamometer wattmeter.	CO3	L3	6
	c	Derive the torque equation of single phase electrodynamometer wattmeter.	CO3	L3	6
	d	With a neat sketch explain the operation of Weston frequency meter.	CO4	`L2	5
		OR			
4	a	Explain the construction and working principle of single phase induction type energy meter. What are the adjustments required for error calibration?	CO4	L2	10
	b	With the neat phasor diagram explain the measurement of real power in 3 phase circuits.	CO4	L3	8
	c	Explain the construction and working of a LPF wattmeter.	CO3	L3	7

b. Assignment -1

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	18EE36	Sem:	III	Marks:	10	Time:	90 – 120 minutes
Course:	Electrical and Electronics Measurements				Module : 1, 2		
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	USN	Assignment Description	Marks	CO	Level
1	1KT18EE001	Give classification of measuring instruments on the basis of operating principle.	10	CO1	L2
2	1KT18EE002	Explain the working principle of A.C. potentiometer. State the application of AC potentiometer	10	CO2	L3
3	1KT18EE003	Describe construction and working of PMMC instrument.	10	CO1	L2
4	1KT18EE004	State and explain errors in induction watt hour meter	10	CO2	L3
5	1KT18EE006	Describe construction and working of a phase sequence indicator	10		
6	1KT17EE001	Explain the measurement of three phase power using two watt meter method with necessary diagrams	10	CO1	L2
7	Diploma	Calculate the total power and reading of the two wattmeter's connected to measure power in 3-phase balance load, if the reactive power is 15 KVAr and load power factor is 0.8 lagging.	10	CO1	L3
8	Diploma	Write a short note on single phase electrodynamometer type power factor meter.	10	CO2	L4

9	Diploma	Explain construction and working principle of operation of induction type wattmeter	10	CO2	L4
10	Diploma	The expression for Eddy currents produced in a metallic former moving in the field of a permanent magnet is found as I e $=kBlbA/(2b+l)\varrho$ where B= flux density, l=length of former b=width of former A=area of former ρ= resistivity of former k=constant It is suspected that term anguler velocity is missing I the expression. Using LMTI system of dimensional analysis find the error.	10	CO3	L4
11	Diploma	A Kelvin double bridge has each of the ratio arm P=Q=p=q=1000Ω. The e.m.f of the battery is 100V and a resistance of 5Ω is included in the battery circuit. The galvanometer has a resistance of 500Ω and the resistance of the link, connecting the unknown resistance to the standard resistance may be neglected. The bridge is balanced when the standard resistance S=0.001Ω.	10	CO4	L3
12	1KT18EE001	Explain with the help of neat sketch, construction and working of induction type energy meter	10	CO3	L4
13	1KT18EE002	Explain the adjustments done in energy meter to read accurately.	10	CO4	L3
14	1KT18EE003	How overload and voltage compensations are provided in energy meters? Explain.	10	CO3	L4
15	1KT18EE004	What is creep in enegy meter and how to overcome it	10	CO3	L4
16	1KT18EE006	A 230 V, single phase watt-hour meter has a constant load of 4A passing through it for 6 hours at unity p.f., if the meter disc makes 2208 revolutions during this period what is the meter constant in revolution/KWh? Calculate the p.f of the load if the number of revolutions made by the meter are 1472 when operating at 230V,5A for 4 hours	10	CO4	L3
17	1KT17EE001	A 259 volts,1-φ energy meter has constant load of 6 amps passing through it for 8 hours at 0.75 pf. If the disc makes 3200 revolution during this period, what is the energy meter constant in revolutions/kilowatt hour? Calculate the power factor of the load, if the number of revolutions made by energy meter is 600, when operating at 250 volts, 6 amps for 2 hours.	10	CO3	L4
18	Diploma	For a 20A, 230V energy meter, the revolutions per kilowatt-hour is 480. If upon test at full load UPF the disc makes 40 revolutions in 66 seconds, calculate the error.	10	CO4	L3

D2. TEACHING PLAN - 2

Module – 3

Title:	Performance of transmission lines	Appr Time:	12 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Illustrate the extension ranges of instrument by instrument transformer.	CO5	L2
2	Apply the magnetic measurement of flux using magnetic meter.	CO6	L3
b	***Course Schedule***		
Class No	**Portion covered per hour**	**-**	**-**
21	Desirable features of ammeters and voltmeters.	CO5	L3
22	Shunts and multipliers.	CO5	L4
23	Construction and theory of instrument transformers	CO5	L1
24	Desirable characterises, Errors of CT and PT	CO5	L3

25	Turns compensation, Illustrative examples,	CO5	L2
26	Silsbee's method of testing CT.	CO6	L1
27	Introduction, Measurement of flux/ flux density	CO6	L3
28	Magnetising force and leakage factor. Hopkinson permeameter.	CO6	L2
29	Measurement of iron loss by wattmeter method.	CO6	L4
30	A brief discussion on measurement of air gap flux and field strength.	CO6	L3
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learning to . . .	-	-
1	Silsbee's method used of testing Current Transformers	CO5	L3
2	Instrument transformers are used to measure high voltage and current.	CO6	L4
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	Explain clearly how shunts and multipliers are used to extend the range of instruments	CO5	L1
2	A moving coil instrument gives a full scale deflection for a current of 20 mA with a potential difference of 200 mV across it. Calculate a. Shunt required to use it as an ammeter to get arrange of 0-200A b. Multiplier required to use it as a voltmeter of range 0-500V.	CO6	L3
3	A moving coil ammeter has the coil circuit resistance of 1000Ω. The range of the ammeter is 0500μA. Calculate the value of shunt resistance to give a full scale deflection with a current of i) 10mA; ii) 75mA. Find the value of shunt resistance if 40% deflection is obtained with a current of100 mA.	CO5	L2
4	Explain the construction of CT and PT with necessary phasor diagrams.	CO6	L4
5	Compare current transformer and potential transformer.	CO5	L2
6	Draw the equivalent circuit and vector diagram of a current transformer and hence write the expressions for its ratio error and phase angle errror.	CO6	L5
7	Write a note on turns compensation used in current transformer	CO5	L2
8	Briefly explain different errors in current transformer.	CO6	L3
9	Write the advantages of CT and PT over shunts and multipliers.	CO5	L4
10	Define the following terms with respect to instrument transformer: a. Transformation ratio(R) b. Nominal ratio(kn) c. Ratio correction Factor.	CO6	L1
11	A current transformer with a bar primary has 500 turns in the secondary winding. The secondary circuit burden is (2+j1) Ω with 5A flowing in the secondary winding, the magnetizing mmf is 80A and iron loss is 1.6W. Determine the ratio and phase angle errors. Find also the maximum value of the flux density in the core.	CO5	L4
12	A 1000/5A, 50 Hz current transformer has a bar primary and a rated secondary burden of 15VA. The secondary winding has 195 turns and a leakage reactance of 0.96 mH. The load burden is purely resistive. At rated load, the magnetization mmf is 20A and core loss excitation is 12 A. Find the ratio and phase angle errors.	CO5	
e	**Experiences**	-	-
1		CO6	L2
2			
3			
4		CO6	L3
5			

Module – 4

Title:	Corona and underground cable	Appr Time:	13 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Apply the principle and working of Electronic meter	CO7	L3
2	Analyze the measurement of voltage by using digital meter.	CO8	L2

b	***Course Schedule***		
Class No	**Portion covered per hour**	**-**	**-**
31	Introduction. Essentials of electronic instruments	CO7	L3
32	Advantages of electronic instruments. True rms reading voltmeter	CO8	L2
33	Electronic multimeters.	CO7	L3
34	Digital voltmeters (DVM) - Ramp type DVM,	CO8	L2
35	Integrating type DVM,	CO7	L3
36	Continuous – balance DVM.	CO8	L2
37	Successive - approximation DVM	CO7	L3
38	Q meter and problems	CO7	L3
39	Principle of working of electronicenergy meter (block diagram treatment),	CO8	L2
40	Extra features offered by present day meters and their significance in billing	CO7	L3
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	significance in billing by present day smart meters	CO7	L3
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	With a neat sketch, describe true R.M.S voltmeter.	CO7	L1
2	Write the asdvantages of electronic instruments over conventional instrument	CO7	L3
3	Explain electronic multimeter with a neat diagram	CO8	L2
4	Write the advantages of electronic voltmeter	CO7	L4
5	Explain ramp typr and successive approximation type digital voltmeter	CO8	L2
6	Expain integrating type voltmeter	CO8	L5
7	Derive the relevant measurement w.r.t Q meter while measuring high impedance component in parallel connection.	CO7	L2
8	Explain with a circuit, the determination of the distributed capacitance of the Q-meter	CO8	L3
9	A coil with a resistance of 12 Ω is connected across the test terminals of a Q-meter circuit and resonance occurs when the frequency of the oscillator is 1000 KHz and the capacitance of resonating capacitor is 75pf. Calculate the percentage error introduced in the calculated value of Q due to an insertion resistance of 0.02Ω across the oscillator.	CO7	L4
10	With a neat sketch explain electronic energymeters	CO8	L3
e	**Experiences**	-	-
1		CO7	L2
2			
3			
4		CO8	L3
5			

E2. CIA EXAM – 2

a. Model Question Paper - 2

Crs Code:	18EE36	Sem:	III	Marks:	50	Time:	90 minutes
Course:	Electrical and Electronics measurement						

-	-	**Note: Answer all questions, each carry equal marks. Module : 3, 4**	**Marks**	**CO**	**Level**
1	a	Explain the RAMP type and successive approximation type digital voltmeters.	CO7	L3	7
	b	With a neat sketch, explain the construction and working of Q meter.	CO7	L4	7
	c	With a neat diagram explain electronic Energymeter.	CO8	L4	7
	d	List the advantages of Instrument transformers.	CO5	L2	4
		OR			

2	a	Explain with a neat diagram, working principle of true RMS voltmeter.	CO8	L3	7
	b	Explain the principle of operation of electronic multi-meter.	CO8	L4	8
	c	What are the advantages of electronic instruments over conventional meters.	CO7	L2	5
	d	Compare Current Transformer and Potential Transformer.	CO6	L2	5
3	a	Explain silsbee's method of testing a current transformer.	CO6	L3	10
	b	Explain the measurement of leakage factor using search coil .	CO6	L4	5
	c	What is shunt? How it is used to extend the range of an ammeter?	CO5	L3	5
	d	Write a note on turns compensation method used in instrument transformer.	CO6	L3	5
		OR			
4	a	Explain the current transformer with the help of an equivalent circuit diagram and a phasor diagram. Write expression for ratio error and phase angle error.	CO6	L4	10
	b	Define the terms with reference to a current transformer i) Transformation ratio ii) Nominal ratio iii) Turns ratio iv) Ratio correction factor	CO5	L3	5
	c	What is Multiplier? How it is used to extend the range of a volmeter?	CO5	L3	5
	d	Describe the method of experimental measurement of flux density in a specimen of magnetic material using ballistic galvanometer.	CO6	L4	5

b. Assignment – 2

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	18EE36	Sem:	IV	Marks:	10	Time:	90 – 120 minutes
Course:	Electrical and Electronics measurement						
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	USN	Assignment Description	Marks	CO	Level
1	1KT18EE001	Mention the advantages of electronic instruments over conventional instruments.	10	CO7	L2
2	1KT18EE002	A moving coil instrument gives a full scale deflection for a current of 20 mA with a potential difference of 200 mV across it. Calculate a. Shunt required to use it as an ammeter to get arrange of 0-200A b. Multiplier required to use it as a voltmeter of range 0-500V.	10	CO6	L3
3	1KT18EE003	A moving coil ammeter has the coil circuit resistance of 1000Ω. The range of the ammeter is 0500μA. Calculate the value of shunt resistance to give a full scale deflection with a current of i) 10mA; ii) 75mA. Find the value of shunt resistance if 40% deflection is obtained with a current of100 mA.	10	CO6	L4
4	1KT18EE004	Explain the construction of CT and PT with necessary phasor diagrams.	10	CO6	L3
5	1KT18EE006	Compare current transformer and potential transformer.	10	CO5	L2
6	1KT17EE001	Draw the equivalent circuit and vector diagram of a current transformer and hence write the expressions for its ratio error and phase angle errror.	10	CO6	
7	Diploma	Write a note on turns compensation used in current transformer	10	CO6	L3
8	Diploma	Briefly explain different errors in current transformer.	10	CO5	L3
9	Diploma	Write the advantages of CT and PT over shunts and multipliers.	10	CO5	L2
10	Diploma	Define the following terms with respect to instrument transformer: a. Transformation ratio(R) b. Nominal ratio(kn) c. Ratio correction Factor.	10	CO5	L2
11	Diploma	A current transformer with a bar primary has 500 turns in the secondary winding. The secondary circuit burden is (2+j1) Ω with 5A flowing in the secondary winding, the magnetizing mmf is 80A and iron loss is 1.6W. Determine the ratio and	10	CO5	L3

		phase angle errors. Find also the maximum value of the flux density in the core.			
12	1KT18EE001	A 1000/5A, 50 Hz current transformer has a bar primary and a rated secondary burden of 15VA. The secondary winding has 195 turns and a leakage reactance of 0.96 mH. The load burden is purely resistive. At rated load, the magnetization mmf is 20A and core loss excitation is 12 A. Find the ratio and phase angle errors.	10	CO5	L3
13	1KT18EE002	With a neat sketch, describe true R.M.S voltmeter.	10	CO7	L4
14	1KT18EE003	With a neat sketch, explain the construction and working of electro dynamometer type 1-Φ power factor meter.	10	CO5	L4
15	1KT18EE004	Compute the value of distributed capacitance of a coil when the following measurements were made. At frequency f1= 2 MHz, the tuning capacitor is set at 450 pf. When the frequency is increased to 5 MHz, the tuning capacitor is tuned at 60 pf.	10	CO6	L3
16	1KT18EE006	Explain the two types of phase sequence indicators.	10	CO5	L3
17	1KT17EE001	Derive the relevant measurement w.r.t Q meter while measuring high impedance component in parallel connection.	10	CO6	L3
18	Diploma	Explain with a circuit, the determination of the distributed capacitance of the Q-meter	10	CO6	L3
19	Diploma	A standard coil is connected across the terminals of Q meter and resonance is obtained, when the frequency of the supply is 160 KHz and the value of the resonant capacitor is 200 pf and the Q factor read is 80. An unknown impedance is connected in series with the standard coil and the resonance is obtained when the value of the resonant capacitor is 180 pf and Q factor read is 50, frequency of the supply being the same. Calculate the inductance and resistance of the coil.	10	CO6	L2
20	Diploma	A coil of resistance 10 Ω is connected in the Q meter circuit. Resonance occurs at a frequency of 1 MHz with the tuning capacitor set at 65 pf. Calculate the percentage error introduced in the calculated value of Q if a resistance of 0.02Ω is used across the oscillator circuit.	10	CO6	L3
21	Diploma	Explain the principle of operation of electronic multi-meter.	10	CO8	L3
22	Diploma	A digital voltmeter is used on a 41/2 digit display. Find its resolution. How would 11.87 V be displayed on a 10V range? Also how would 0.5573 be shown on a 1V and 10 V range?	10	CO7	L3
23	1KT18EE001	With the help of the block diagram explain Ramp type digital voltmeter.	10	CO7	L4
24	1KT18EE002	Explain digital voltmeter using successive approximation method.	10	CO8	L3

D3. TEACHING PLAN - 3

Module – 5

Title:	Display Devices, Recording Devices	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Demonstrate the display devices of LED,LCD, liquid vapour devices.	CO9	L2
2	Illustrate the working of recording devices .	CO10	L4
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
41	Introduction, Character formats	CO9	L2
42	Segment displays, Dot matrix displays	CO10	L4
43	Bar graph displays. Cathode ray tubes,	CO9	L2
44	Light emitting diodes, Liquid crystal displays	CO10	L4

45	Nixes, Incandescent, Fluorescent Liquid vapour and Visual displays	CO9	L2
46	display multiplexing and zero suppression.	CO10	L4
47	introduction, Strip chart recorders, Galvanometer recorders, Null balance recorders, Potentiometer type recorders	CO9	L2
48	Bridge type recorders, LVDT type recorders, Circular chart and X – Y recorders.	CO10	L4
49	Magnetic tape recorders, Direct recording, Frequency modulation recording,	CO9	L2
50	Pulse duration modulation recording, Biomedical recorders, Electro Cardio Graph (ECG)	CO10	L4
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Recording devices can be used in aircraft recorders, tape recordings	CO9	L4
2	Display devices are employed in television sets and computes	CO10	L2
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	Explain with a block diagram, working of digital storage oscilloscope.		
2	Explain the measurement of phase and frequency using Lissajous patterns	CO10	L1
3	Explain in brief front panel details of a dual trace oscilloscope	CO10	L3
4	With a neat block diagram, explain the working of a digital storage oscilloscope.	CO9	L2
5	With a neat block diagram, explain the working of dual trace oscilloscope	CO9	L4
6	Explain the method of measuring voltage, current and phase using oscilloscope.	CO9	L2
7	Write a brief note on current probes.	CO9	L5
8	A Lissajous pattern on an oscilloscope is stationary and has 5 horizontal tangencies and 2 vertical tangencies. The frequency of horizontal input is 1000 Hz. Determine the frequency of vertical input.	CO9	L2
9	Explain with neat sketch the working of the LVDT.	CO9	L3
10	What do you mean by DAS(Data Acquisition System)? Explain with a block diagram, functional operation of digital data acquisition system. Mention the uses of data acquisition system.	CO10	L4
11	Explain briefly the difference between analog and digital data acquisition system?	CO10	L1
12	With a neat sketch, explain the working of a X-Y recorder.	CO10	L2
13	Explain with a neat diagram, the working of function generator.	CO10	L3
14	Write a note on following display device. a. LCD, b. LED c. Nixie Tube	CO10	L4
15	With block diagram, explain the working of standard signal generator.	CO10	L1
e	**Experiences**	-	-
1		CO10	L2
2		CO9	
3			
4		CO9	L3
5			

E3. CIA EXAM – 3

a. Model Question Paper - 3

Crs Code:	18EE36	Sem:	III	Marks:	50	Time:	90minutes		
Course:	Electrical and electronics Measurement								
-	**-**	**Note: Answer all questions, each carry equal marks. Module : 5**					**Marks**	**CO**	**Level**
1	a	Explain in brief front panel details of a dual trace oscilloscope.					7	CO9	L1
	b	With a neat block diagram, explain the working of a digital storage oscilloscope.					10	CO9	L2
	c	A Lissajous pattern on an oscilloscope is stationary and has 5 horizontal tangencies and 2 vertical tangencies. The frequency of horizontal input is					8	CO9	L3

		1000 Hz. Determine the frequency of vertical input.			
2	a	Explain the working principle and constructional details of photo conductive and photo voltaic cell.	10	CO9	L2
	b	Explain with neat sketch the working of the LVDT.	8	CO9	L4
	c	Write a brief note on current probes.	7	CO9	L3
3	a	What do you mean by DAS(Data Acquisition System)? Explain with a block diagram, functional operation of digital data acquisition system. Mention the uses of data acquisition system.	10	CO10	L1
	b	With a neat sketch, explain the working of a X-Y recorder.	8	CO10	L2
	c	With a neat block diagram, explain the working of dual trace oscilloscope	7	CO10	L3
4	a	Write a note on following display device. a. LCD, b. LED c. Nixie Tube	7	CO10	L2
	b	With block diagram, explain the working of standard signal generator.	10	CO10	L2
	c	Explain with a neat diagram, the working of function generator.	8	CO10	L2

b. Assignment – 3

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	18EE36	Sem:	III	Marks:	10	Time:	90 – 120 minutes
Course:	Electrical and electronics Measurement				Module : 5		
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	USN	Assignment Description	Marks	CO	Level
1	1KT18EE001	Explain with a block diagram, working of digital storage oscilloscope.	10	CO9	L2
2	1KT18EE002	Explain the measurement of phase and frequency using Lissajous patterns	10	CO9	L3
3	1KT18EE003	Explain in brief front panel details of a dual trace oscilloscope	10	CO10	L4
4	1KT18EE004	With a neat block diagram, explain the working of a digital storage oscilloscope.	10	CO10	L3
5	1KT18EE006	With a neat block diagram, explain the working of dual trace oscilloscope	10	CO9	L2
6	1KT17EE001	Explain the method of measuring voltage, current and phase using oscilloscope.	10	CO10	L2
7	Diploma	Write a brief note on current probes.	10	CO9	L2
8	Diploma	A Lissajous pattern on an oscilloscope is stationary and has 5 horizontal tangencies and 2 vertical tangencies. The frequency of horizontal input is 1000 Hz. Determine the frequency of vertical input.	10	CO10	L3
9	Diploma	Explain with neat sketch the working of the LVDT.	10	CO9	L3
10	Diploma	What do you mean by DAS(Data Acquisition System)? Explain with a block diagram, functional operation of digital data acquisition system. Mention the uses of data acquisition system.	10	CO10	L3
11	Diploma	Explain briefly the difference between analog and digital data acquisition system?	10	CO10	L2
12	1KT18EE001	With a neat sketch, explain the working of a X-Y recorder.	10	CO9	
13	1KT18EE002	Explain with a neat diagram, the working of function generator.	10	CO10	L3
14	1KT18EE003	Write a note on following display device. a. LCD, b. LED c. Nixie Tube	10	CO10	L2
15	1KT18EE004	With block diagram, explain the working of standard signal generator.	10	CO9	L3

F. EXAM PREPARATION

1. University Model Question Paper

Course:	Electrical and electronics Measurement					Month / Year	May /2019	
Crs Code:	18EE36	Sem:	III	Marks:	60	Time:	180 minutes	
Module	**Note**	Answer all FIVE full questions. All questions carry equal marks.				**CO**	**Level**	**Marks**
1	a	Define sensitivity of Wheatstone bridge and obtain the expression for sensitivity of Wheatstone bridge.				CO1	L2	8
	b	Draw the circuit of a Kelvin's double bridge used for the measurement of low resistances. Derive the condition for balance.				CO1	L2	6
	c	The four arms of the Wheatstone bridge have the following resistances AB=1000 Ω, BC=1000Ω, CD=120 Ω, DA=120 Ω. The bridge is used for strain measurement and supplied from 5V ideal battery. The galvanometer has sensitivity of 1mm/ μA with internal resistance of 200Ω. Determine the deflection of the galvanometer if arm DA increases to 121Ω and arm CD decreases to 119Ω.				CO1	L3	7
	d	Explain sources and detectors in a.c. bridges				CO2	L1	4
		OR						
1	a	Derive balance equation for Maxwell's Inductance –Capacitance bridge. Draw the phasor diagram at balance condition .				CO2	L2	10
	b	A condenser bushing forms arm AB of a Schering bridge and a standard capacitor of 500pf capacitance and negligible loss forms AD. Arm BC consists of a non-inductance resistance of 300Ω. When this bridge is balanced arm CD has resistance of 72.6Ω in parallel with capacitance of 0.148μf. The supply frequency is of 50 Hz. Calculate the capacitance and dielectric loss angle of capacitor.				CO2	L2	10
	c	Explain fall of potential method for measuring earth resistance				CO1	L2	5
2	a	Explain the construction and working principle of electrodynamometer wattmeter for the measurement of power in the circuit.				CO3	L2	8
	b	Discuss the errors and their compensating techniques used in dynamometer wattmeter.				CO3	L3	6
	c	Derive the torque equation of single phase electrodynamometer wattmeter.				CO3	L3	6
	d	With a neat sketch explain the operation of Weston frequency meter.				CO4	`L2	5
		OR						
2	a	Explain the construction and working principle of single phase induction type energy meter. What are the adjustments required for error calibration?				CO4	L2	10
	b	With the neat phasor diagram explain the measurement of real power in 3 phase circuits.				CO4	L3	8
	c	Explain the construction and working of a LPF wattmeter.				CO3	L3	7
3	a	Explain the RAMP type and successive approximation type digital voltmeters.				CO7	L3	7
	b	With a neat sketch, explain the construction and working of Q meter.				CO7	L4	7
	c	With a neat diagram explain electronic Energymeter.				CO8	L4	7
	d	List the advantages of Instrument transformers.				CO5	L2	4
		OR						
3	a	Explain with a neat diagram, working principle of true RMS voltmeter.				CO8	L3	7
	b	Explain the principle of operation of electronic multi-meter.				CO8	L4	8
	c	What are the advantages of electronic instruments over conventional meters.				CO7	L2	5
	d	Compare Current Transformer and Potential Transformer.				CO6	L2	5
4	a	Explain silsbee's method of testing a current transformer.				CO6	L3	10

	b	Explain the measurement of leakage factor using search coil .	CO6	L4	5
	c	What is shunt? How it is used to extend the range of an ammeter?	CO5	L3	5
	d	Write a note on turns compensation method used in instrument transformer.	CO6	L3	5
		OR			
4	a	Explain the current transformer with the help of an equivalent circuit diagram and a phasor diagram. Write expression for ratio error and phase angle error.	CO6	L4	10
	b	Define the terms with reference to a current transformer i) Transformation ratio ii) Nominal ratio iii) Turns ratio iv) Ratio correction factor	CO5	L3	5
	c	What is Multiplier? How it is used to extend the range of a volmeter?	CO5	L3	5
	d	Describe the method of experimental measurement of flux density in a specimen of magnetic material using ballistic galvanometer.	CO6	L4	5
5	a	Explain in brief front panel details of a dual trace oscilloscope.	7	CO9	L1
	b	With a neat block diagram, explain the working of a digital storage oscilloscope.	10	CO9	L2
	c	A Lissajous pattern on an oscilloscope is stationary and has 5 horizontal tangencies and 2 vertical tangencies. The frequency of horizontal input is 1000 Hz. Determine the frequency of vertical input.	8	CO9	L3
		OR			
5	a	Explain the working principle and constructional details of photo conductive and photo voltaic cell.	10	CO9	L2
	b	Explain with neat sketch the working of the LVDT.	8	CO9	L4
	c	Write a brief note on current probes.	7	CO9	L3

2. SEE Important Questions

Course:		Transmission and Distribution					Month / Year	May /2018	
Crs Code:		17EE43	Sem:	IV	Marks:	60	Time:	180 minutes	
	Note	Answer all FIVE full questions. All questions carry equal marks.					-	-	
Module	Qno.	Important Question					**Marks**	**CO**	**Year**
1	1	With a neat sketch explain the working of a megger					CO2	L3	July/ Aug 2004
	2	Explain the fall of potential of measurement of earth resistance					CO1	L2	July/ Aug 2005
	3	Derive the expression for the measurement of unknown resistance using Kelvin's double bridge. How the effect of connecting lead resistance is eliminated in this arrangement					CO2	L3	Jan / Feb 2005, July/ Aug 2006
	4	Write short notes on Megger					CO2	L3	July/ Aug 2008
	5	Explain how a megger is used for the measurement of earth resistance					CO2	L3	July/ Aug 2007
	6	Define voltage sensitivity of a galvanometer and hence obtain an expression for whetstone's bridge sensitivity. When will be Sb maximum?					CO1	L2	Jan / Feb 2008
	7	State and explain sensitivity of whetstone's bridge?					CO1	L2	Jan/ Feb 2012,

					July/ Aug 2008
	8	Explain maxwell's bridge?	CO1	L2	une/ July2 009
	9	Explain kelvin's bridge?	CO1	L2	Dec/ Jan20 08
	10	Explain the importance of Wheatstone bridge?	CO1	L2	May/ June 2010
	11	4. Explain the Capacitance Comparison Bridge?	CO1	L2	Dec/ Jan20 10
	12	Explain the Maxwell's bridge?	CO1	L2	June /July 2009
	13	Write a short note on the Wagner earthing device	CO2	L3	2004 2011
	14	Explain the Wagner's earth connection?	CO2	L3	Dec/ Jan0 8 2012
	15	Deriving equation for resistance is Hay's bridge, the following expression is obtained. R = w2R1R2e2/ 1+w2R22C Find whether the equation is dimensionally correct or not. Incase there is an error find the error and correct equation accordingly	CO2	L3	Jan/ Feb 2012
	16	Derive the balance equations of the Schering bridge circuit configuration used for measurement of capacitances and hence derive at the expression for loss angle of the test capacitor. Draw the phasor diagram at balance.	CO2	L3	July/ Aug 2004, Jan/ Feb- 2008
	17	Derive the expression for the measurement of capacitance and loss angle of a lossy capacitor using Schering bridge. Draw the phasor diagram at balance condition. What modifications are introduced when the bridge is used at high voltages			Jan/ Feb- 2005, July/ Aug 2004
	18	Write briefly on the significance of shields used in ac bridge circuit. Hence discuss on the shielding of resistors and capacitors of the circuit			July/ Aug 2005, Jan/ Feb 2005
	19	Draw a neat sketch to explain the theory and measurement of unknown inductance and resistance by Anderson bridge. What is type of null detector used in this bridge? What are the sources of errors? Draw phasor diagram at balance			July/ aug 2006, 2006, 2012
	20	Write short notes on source and detectors			July /Aug 2008, 2007
2	1	Explain the construction of CT and PT with necessary phasor diagrams	16 / 20		July/ Aug 2007
	2	A moving coil instrument gives a full scale deflection for a current of 20			Jan /

		mA with a potential difference of 200 mV across it. Calculate a. Shunt required to use it as an ammeter to get arrange of 0-200A b. Multiplier required to use it as a voltmeter of range 0-500V.			Feb 2008
	3	A moving coil ammeter has the coil circuit resistance of 1000Ω. The range of the ammeter is 0500μA. Calculate the value of shunt resistance to give a full scale deflection with a current of i) 10mA; ii) 75mA. Find the value of shunt resistance if 40% deflection is obtained with a current of100 mA.			Jan/ Feb 2012, July/ Aug 2008
	4	Explain clearly how shunts and multipliers are used to extend the range of instruments.			une/ July2 009
	5	Define the following terms with respect to instrument transformer: a. Transformation ratio(R) b. Nominal ratio(kn) c. Ratio correction Factor.			Dec/ Jan20 08
3	1	Explain with a neat figure, construction and working of dynamometer type wattmeter.	16 / 20		Dec/ Jan20 10
	2	Explain with the help of neat sketch, construction and working of induction type energy meter.			June /July 2009
	3	Explain the adjustments done in energy meter to read accurately			2004
	4	A 259 volts,1-φ energy meter has constant load of 6 amps passing through it for 8 hours at 0.75 pf. If the disc makes 3200 revolution during this period, what is the energy meter constant in revolutions/kilowatt hour? Calculate the power factor of the load, if the number of revolutions made by energy meter is 600, when operating at 250 volts, 6 amps for 2 hours.			Dec/ Jan0 8, Jan/ Feb 2012
	5	For a 20A, 230V energy meter, the revolutions per kilowatt-hour is 480. If upon test at full load UPF the disc makes 40 revolutions in 66 seconds, calculate the error.			July/ Aug 2007
4	1	With a neat sketch, describe true R.M.S voltmeter.	16 / 20		Jan/ Feb 2012, 2008
	2	Explain the two types of phase sequence indicators.			une/ July2 009
	3	Derive the relevant measurement w.r.t Q meter while measuring high impedance component in parallel connection.			Dec/ Jan20 08
	4	A Lissajous pattern on an oscilloscope is stationary and has 5 horizontal tangencies and 2 vertical tangencies. The frequency of horizontal input is 1000 Hz. Determine the frequency of vertical input.			May/ June 2010
	5	A standard coil is connected across the terminals of Q meter and resonance is obtained, when the frequency of the supply is 160 KHz and the value of the resonant capacitor is 200 pf and the Q factor read is 80. An unknown impedance is connected in series with the standard coil and the resonance is obtained when the value of the resonant capacitor is 180 pf and Q factor read is 50, frequency of the supply being the same. Calculate the inductance and resistance of the coil.			Dec/ Jan 2010
	6	A coil with a resistance of 12 Ω is connected across the test terminals of a Q-meter circuit and resonance occurs when the frequency of the oscillator is 1000 KHz and the capacitance of resonating capacitor is 75pf. Calculate the percentage error introduced in the calculated value of Q due to an insertion resistance of 0.02Ω across the oscillator.			June /July 2009
5	1	With a neat sketch, explain the working of a X-Y recorder.	16 / 20		July/ Aug 2007
	2	What do you mean by DAS(Data Acquisition System)? Explain with a			Jan /

		block diagram, functional operation of digital data acquisition system. Mention the uses of data acquisition system.			Feb 2008
	3	Write a note on following display device. a. LCD, b. LED			Jan/ Feb 2012, 2008
	4	Prove that gauge factor of strain gauge is given by k= 1+2μ, where μ is Poission's ratio			june/ July2 009
	5	Explain different strain gauge and their principle of operations.			Dec/ Jan20 08

G. Content to Course Outcomes

1. TLPA Parameters

Table 1: TLPA – Example Course

Module-#	Course Content or Syllabus (Split module content into 2 parts which have similar concepts)	Content Teaching Hours	Blooms' Learning Levels for Content	Final Blooms' Level	Identified Action Verbs for Learning	Instruction Methods for Learning	Assessment Methods to Measure Learning
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*
1	**Measurement of Resistance:** Wheatstone's bridge, Sensitivity, Limitations. Kelvin's double bridge. Earth resistance measurement by fall of potential method and by using Megger.	04	- L1 - L2	L2	- Remembering - Explaining	- Lecture	-Unit Test - Assignment
1	**Measurement of Inductance and Capacitance:** Sources and detectors, Maxwell's inductance bridge, Maxwell's inductance and capacitance bridge, Hay's bridge, Anderson's bridge, Desauty's bridge, Schering bridge. Shielding of bridges. Problems.	06	- L1 - L2	L2	- Remembering - Explaining	- Lecture	-Unit Test - Assignment
2	**Measurement of power and energy** Torque expression, Errors and minimization, UPF and LPF wattmeters. Measurements of real and reactive power in 3 phase circuits. Review of Induction type energy meter construction and operation (No question shall be set from the review portions)].Errors, adjustments and calibration of single and three phase energy meter Problems.	06	- L2 - L3	L3	- Understanding - Calculate	- Lecture	-Unit Test - Assignment
2	**Measurement of power factor and frequency** Construction and operation of single-phase and three phase dynamometer type power factor meter. Weston frequency me ter and phase sequence indicator	04	- L2 - L3	L3	- Understanding - Calculate	- Lecture -	-Unit Test - Assignment
3	**Extension of Instrument Ranges:** Desirable features of ammeters and voltmeters. Shunts and multipliers. Construction and theory of instrument transformers, Desirable characterises, Errors	05	- L2 - L4	L4	- Understanding - Explainin	- Lecture -	-Unit Test - Assignment

	of CT and PT. Turns compensation, Illustrative examples, Silsbee's method of testing CT.				g & analyzing		
3	**Magnetic measurements:** Introduction, Measurement of flux/ flux density, Magnetising force and leakage factor. Hopkinson permeameter. Measurement of iron loss by wattmeter method. A brief discussion on measurement of air gap flux and field strength.	05	- L2 - L4	L4	- Understanding - Explaining & analyzing	- Lecture -	-Unit Test - Assignment
4	**Electronic and digital Instruments:** Introduction. Essentials of electronic instruments, Advantages of electronic instruments. True rms reading voltmeter. Electronic multimeters. Digital voltmeters (DVM) - Ramp type DVM,	05	- L1 - L2	L2	- Remembering - Explaining	- Lecture	-Unit Test - Assignment
4	Integrating type DVM, Continuous – balance DVM and Successive - approximation DVM. Q meter Principle of working of electronicenergy meter (block diagram treatment), Extra features offered by present day meters and their significance in billing	05	- L2 - L4	L4	- Understanding - Explaining	- Lecture	-Unit Test - Assignment
5	**Display Devices:** Introduction, Character formats, Segment displays, Dot matrix displays, Bar graph displays. Cathode ray tubes, Light emitting diodes, Liquid crystal displays, Nixes, Incandescent, Fluorescent, Liquid vapour and Visual displays. Display multiplexing and zero suppression.	05	- L2 - L4	L4	- Understanding - Explaining	- Lecture - -	-Unit Test - Assignment
5	**Recording Devices:** Introduction, Strip chart recorders, Galvanometer recorders, Null balance recorders, Potentiometer type recorders, Bridge type recorders, LVDT type recorders, Circular chart and X – Y recorders. Magnetic tape recorders, Direct recording, Frequency modulation recording, Pulse duration modulation recording, Digital tape recording, Ultraviolet recorders. Biomedical recorders, Electro Cardio Graph (ECG),Electroencephalograph, Electromyograph9. Noise in reproduction.	05	- L1 - L2	L2	- Remembering - Explaining	- Lecture - -	-Unit Test - Assignment

2. Concepts and Outcomes:

Table 2: Concept to Outcome – Example Course

Module-#	Learning or Outcome from study of the Content or Syllabus	Identified Concepts from Content	Final Concept	Concept Justification (What all Learning Happened from the study of Content / Syllabus. A short word for learning or outcome)	CO Components (1.Action Verb, 2.Knowledge, 3.Condition / Methodology, 4.Benchmark)	Course Outcome **Student Should be able to ...**
A	*I*	*J*	*K*	*L*	*M*	*N*

1	Units and Dimensions Measurement of Resistance:	Resistance bridge	Resistance bridge	Learning the bridge balancing technique to measure the unknown resistance by fall of potential method and Megger.	1. Demonstrate 2. bridge balancing technique 3.to measure the unknown resistance.	Demonstrate bridge balancing technique to measure the unknown resistance.
1	Measurement of Inductance and Capacitance:	Inductance capacitance bridges	Inductance capacitance bridges	measurement of Inductance, Capacitor by maxwell's Desautys bridge using null deflection methods and proved by solving the problems.	1. Analyze the 2. measurement of Inductance, Capacitor 3. by using maxwell's Desautys bridge.	Analyze the measurement of Inductance, Capacitor by maxwell's Desautys bridge.
2	Measurement of power and energy	Energy meter	Energy meter	Demonstrate measurement of energy using energy meter and calibrate the error by compare with standard values by theoretically and Experimentally.	1. Demonstrate 2. measurement of energy 3. using energy meter and calibrate the error by compare with standard values.	Demonstrate measurement of energy using energy meter and calibrate the error by compare with standard values.
2	Measurement of power factor and frequency	Power factor frequency meter	Power factor frequency meter	measurement of power factor, frequency by using dynamo meter , Weston frequency meter by theoretically and Experimentally.	1. Analyze the 2. measurement of power factor, frequency 3. by using dynamo meter and Weston frequency meter.	Analyze the measurement of power factor, frequency by using dynamo meter and Weston frequency meter.
3	Extension of Instrument Ranges:	Extension Instrument range	Extension Instrument range	Study the Desirable features of ammeters and voltmeters. Errors of CT and PT.	1. Illustrate the 2. extension ranges of instrument 3. by instrument transformer.	Illustrate the extension ranges of instrument by instrument transformer.
3	Magnetic measurements:	Magnetic measurement	Magnetic measurement	Apply the magnetic measurement of flux using magnetic meter	1. Apply the 2. magnetic measurement of flux 3. using magnetic meter.	Apply the magnetic measurement of flux using magnetic meter.
4	Electronic and digital Instruments:	Electronic instrument	Electronic instrument	principle and working of Electronic meter True rms reading voltmeter, Electronic multimeters.	1. Apply the 2. principle and working of Electronic meter	Apply the principle and working of Electronic meter

4	Integrating type DVM, Continuous – balance DVM and Successive	Digital meters	Digital meters	Analyze the measurement of voltage by using digital meter	1. Analyze the 2. measurement of voltage by using digital meter.	Analyze the measurement of voltage by using digital meter.
5	Display Devices:	Display device	Display device	Demonstrate the display devices of LED,LCD, liquid vapour devices.	1. Demonstrate 2. the display devices of LED,LCD, liquid vapour devices.	Demonstrate the display devices of LED,LCD, liquid vapour devices.
5	Recording Devices:	Recording devices	Recording devices	understanding the working of recording devices, Magnetic tape recorders, Direct recording.	1. Illustrate the 2. working of recording devices .	Illustrate the working of recording devices .