ELECTRICAL MEASUREMENTS

GEETHANJALI COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF EEE

Name of the Subject : Electrical Measurements

JNTU CODE : 56009 **Programme : UG / PG**

Branch: Electrical & Electronics Engineering **Version No :**

Year: III **Updated on :27/12/2014**

Semester: II **No. of pages :**

Classification status (Unrestricted / Restricted)

Distribution List :

Prepared by : 1) Name : K.Mahender

2) Sign :

3) Design : Associate Professor

4) Date : 27/12/2014

1) Name :

2) Sign :

3) Design :

4) Date :

Verified by : 1) Name :

2) Sign :

3) Design :

4) Date :

*** For Q.C Only.**

1) Name :

2) Sign :

3) Design :

4) Date :

Approved by : (HOD) 1) Name : Dr. S.Radhika

2) Sign :

3) Date :

SYLLABUS

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD

III Year B.Tech EEE II-Semester

T	P	C
4+1	*0	4

Unit -I

Classification of measuring instruments-deflecting, controlling and damping systems, ammeters and voltmeters, PMMC,MI and MC instruments, Expression for the deflecting torque and control torque. Expression for the deflecting torque and control torque, Errors and compensation and extension of range using shunts and series resistance, Electrostatic voltmeters-electrometer type and attracted disc type. Extension of range of electrostatic voltmeters

Unit-II

Introduction to CT & PT- Design considerations, Ratio and phase angle errors, Types of P.F meters-dynamometer and moving iron type, I ph and 3 ph meters, Frequency meters- resonance type and Weston type, Synchroscopes

Unit-III

Single phase dynamometer wattmeter-LPF & UPF, Double element and three element dynamometer wattmeter, Expression for deflecting and controlling torques and extension of range of wattmeter using instrument transformers, Measurement of active in balanced systems, Measurement of reactive powers in unbalanced systems.

Unit-IV

Single phase induction type energy meter- driving and braking torques, Errors and compensation, Testing of energy meter by phantom loading using RSS meter, Three phase energy meter-Tri-vector meter, Maximum demand meters.

Unit-V

Principle and operation of D.C Crompton's potentiometer, Standardization, Measurement of unknown resistance, current, voltage, AC Potentiometers polar and coordinate type, Standardization- applications.

Unit-VI

Method of measuring low, medium and high resistances, Sensitivity of wheat stone's bridge, Carey Foster' bridge for measuring low resistance, Kelvin's double bridge for measuring low resistance, Measurement of high resistance- loss of charge method.

Unit-VII

Measurement of inductance and quality factor using Maxwell's bridge and Hay's bridge, Anderson's bridge, Owen's bridge, Measurement of capacitance and loss angle using Desauty's bridge, Wien's bridge, Schering bridge.

Unit-VIII

Ballistic galvanometer- equation of motion and flux meter, Constructional details and comparison of flux meter with ballistic galvanometer, Determination of B-H loop methods of reversals six point method, AC testing- iron loss of bar samples, Core loss measurements by bridges and potentiometers.

Text books:-

1. Electrical measurements and measuring instruments by E.W Golding ad F.C Widdis fifth edition.

2. Electrical and electronic measurement and instruments by A.K Sawhney Dhanpat Rai and co

3. Electrical measuring instruments by R.K Raj put.

Reference Text Books:-

1. Electrical measurements and measuring instruments by Bakshi-Technical publications

Vision of the Department

To provide excellent Electrical and electronics education by building strong teaching and research environment

Mission of the Department

1. To offer high quality graduate program in Electrical and Electronics education and to prepare students for professional career or higher studies.
2. The department promotes excellence in teaching, research, collaborative activities and positive contributions to society

Programme Educational Objectives (EEE)

PEO 1. Graduates will excel in professional career and/or higher education by acquiring knowledge in Mathematics, Science, Engineering principles and Computational skills.

PEO 2. Graduates will analyze real life problems, design Electrical systems appropriate to the requirement that are technically sound, economically feasible and socially acceptable.

PEO 3.Graduates will exhibit professionalism, ethical attitude, communication skills, team work in their profession, adapt to current trends by engaging in lifelong learning and participate in Research & Development.

Programme Outcomes (EEE)

PO 1. An ability to apply the knowledge of Mathematics, Science and Engineering in Electrical and Electronics Engineering.

PO 2. An ability to design and conduct experiments pertaining to Electrical and Electronics Engineering.

PO 3. An ability to function in multidisciplinary teams

PO 4. An ability to simulate and determine the parameters such as nominal voltage current, power and associated attributes.

PO 5. An ability to identify, formulate and solve problems in the areas of Electrical and Electronics Engineering.

PO 6. An ability to use appropriate network theorems to solve electrical engineering problems.

PO 7. An ability to communicate effectively.

PO 8. An ability to visualize the impact of electrical engineering solutions in global, economic and societal context.

PO 9. Recognition of the need and an ability to engage in life-long learning.

PO 10. An ability to understand contemporary issues related to alternate energy sources.

PO 11. An ability to use the techniques, skills and modern engineering tools necessary for Electrical Engineering Practice.

PO 12. An ability to simulate and determine the parameters like voltage profile and current ratings of transmission lines in Power Systems.

PO 13. An ability to understand and determine the performance of electrical machines namely speed, torque, efficiency etc.

PO 14.An ability to apply electrical engineering and management principles to Power Projects.

Course objectives

1. Recognize the importance of testing and measurements in electric circuits. Appreciate the essential devices comprising an analogue instrument.

2. Explain the operation of an attraction and a repulsion type of moving-iron instruments.

3. Explain the operation of a moving-coil rectifier instruments. Compare moving-coil, moving-iron and moving coil rectifier instruments.

4. Calculate values of shunts for ammeters and multipliers for voltmeters.

5. Understand the operation of an ohmmeter/megger & Appreciate the operation of multimeters/voltmeters

6. Understand Appreciate the operation of a wattmeter & instrument ‘loading’ effects

7. Understand null methods of measurement for a Wheatstone bridge and d.c. potentiometers.

8. Understand the operation of a.c. bridges & the operation of a Q-meter. Appreciate the most likely source of errors in measurements.

Course outcomes:

1. Graduates will have a good overview of the test, display and analysis equipment used, as well as suitable data acquisition systems.
2. Graduates will be aware of various types of measurements; requirement of calibrations, instruments used errors in measurement etc.
3. Graduates will be able to perform accurate measurements and measuring instrument for any engineering system.
4. This knowledge helps the graduates to build, assemble and use the instruments & Devices for the relevant measurement.
5. Graduates will be able to choose the size of an electrical machine with a time varying load (torque).
6. Graduates will be able to calculate the speed, torque, power, current and voltage in different parts of an electrical motor drive (consisting of mechanical load, electric machine and drive), at constant speed.
7. Graduates will be able to estimate deviations in measurements due to the influence of the instrument on the measurement object and due to the accuracy of the instrument.
8. Graduates will show the ability to participate and try to succeed in competitive examinations.

Importance of the course

Measurement skills are very important for science. Accuracy of measurement is one of the main parameter in industrial development because ability to control depends upon ability to measure.

Various electrical quantities are required to be measured for testing commissioning, operation, maintenance and fault finding of electrical equipment and installations. Measurements are also necessary for safety requirements'.

Many non-electrical quantities (pressure, temperature and flow….) are required for process control in process industry

The result of any measurement is interpreted according to the method of measurement and specification of instrument used

Objectives of the course:

- Basic principles of all measuring instruments.
- Measurement of R L C parameters voltage, current, power factor.
- Measurement of Power & energy.
- Magnetic Measurements.

Prerequisites

1. Electrical machines-I,II,III
2. Network theory
3. Power electronics.

Instructional Learning Outcomes

Unit-1: MEASURING INSTRUMENTS

- ❖ Students can identify the applications
- ❖ Students learn about different types of measuring instruments
- ❖ Students can identify the importance of use of measuring instruments.
- ❖ Students learn about how to operate measuring instruments.
- ❖ Students learn about various rotational variables.

Unit-2: INSTRUMENT TRANSFORMERS.

- ❖ Students will be able to learn working principle of Instrument Transformers.
- ❖ Students will be able to know operation of Current Transformer & Potential Transformer.
- ❖ Students will be able to identify the different types of instruments.
- ❖ Students will be able to know the operation of wattmeter.
- ❖ Students will be able to know the operation of 1-phase and 3-phase frequency meters.

Unit-3: MEASUREMENT OF POWER

- Students will be able to learn about Different types of measurement of power.
- Students will be able to find mathematical equations.
- Students will be able to identify the different types of power.
- Students will be able find measurement of active and reactive power.
- Students will be able to find advantages of balanced systems.

Unit-4: MEASUREMENT OF ENERGY.

- Students will be able to identify the different types of energy measurements.
- Students will be able to identify single phase induction type energy meter.
- Students will be able to identify the behavior of the systems.
- Students will be able to find testing of energy meter by phantom loading using RSS meter.
- Students will be able to find concept of Trivector meter, maximum demand meters.

Unit-5: POTENTIOMETERS

- Students will be able to know how to operate DC potentiometers.
- Students will be able to use while solving the numerical.
- Students will be able to know how to operate AC potentiometers.
- Students will be able to know the concept of polar and coordinate types standardization..
- Students will be able to determine different real time applications.

Unit-6: RESISTANCE MEASUREMENTS.

- Students will be able to find methods for measuring different types of resistances.
- Students will be able to use while solving the numerical.
- Students will be able to know how to find resistances levels.
- Students will be able to find low resistances

- Students will be able to determine the value of high resistances by loss of charge method

Unit-7: A.C.BRIDGES

- Students will be able to identify the controlling of the systems.
- Students will be able to find behavior of the system.
- Students will be able to find measurement of capacitance and loss angle..
- Students will be able to find measurement of inductance and loss angle
- Students will be able to find the advantages and disadvantages of bridges.

Unit-8: MAGNETIC MEASUREMENTS

- Students will be able to identify the definitions.
- Students will be able to find operations of ballistic galvanometer.
- Students will be able to identify how to operate flux meter
- Students will be able to find constructional details.
- Students will be able to find the comparison with different galvanometer.

COURSE MAPPING WITH PEOS AND POS

Mapping of Course with Programme Educational Objectives

S.No	Course component	code	course	Semester	PEO 1	PEO 2	PEO 3
1	Professional Core		EM	II		√	√

Mapping of Course outcomes with Programme outcomes:

- When the course outcome weightage is < 40%, it will be given as moderately correlated(1)
- When the course outcome weightage is >40%, it will be given as strongly correlated (2).

PO'S	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
EHV AC															
CO1: Student will have a good overview of the test, display and analysis equipment used, as well as suitable data acquisition systems.	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	
CO2: Student will be aware of various types of measurements, requirement of calibrations, instruments used errors in measurement etc.	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	
CO3: Student will be able to perform accurate measurements and measuring instrument for any engineering system.	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	
CO4: This knowledge helps them to build, assemble and use the instruments & Devices for the relevant measurement	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	
CO5: Student will be able to choose the size of an electrical machine with a time varying load (torque).	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	

CO6: Student will be able to calculate the speed, torque, power, current and voltage in different parts of an electrical motor drive (consisting of mechanical load, electric machine and drive), at constant speed.	1	1	2	2	2	2	1	2	2	1	2	2	1	2	
CO7: Student will be able to estimate deviations in measurements due to the influence of the instrument on the measurement object and due to the accuracy of the instrument.	1	1	2	2	2	2	1	2	2	1	2	2	1	2	
CO8: Graduates will show the ability to participate and try to succeed in competitive examinations.	1	1	2	2	2	2	1	2	2	1	2	2	1	2	

INDIVIDUAL TIME TABLE

Individual Faculty Work Load

Faculty Name: Mr.K.MAHENDER						Acad Year 2013-14,	WEF: 03-02-2014	
Time	09.30-10.20	10.20-11.10	11.10-12.00	12.00-12.50	12.50-13.30	13.30-14.20	14.20-15.10	15.10-16.00
Period	1	2	3	4		5	6	7
Monday	PS-I				LUNCH	EM-I LAB-II EEE		
Tuesday						PS-I		Mentoring-II EEE
Wednesday	EM-I LAB-II EEE							PS-I*
Thursday			PS-I			EE LAB-II ECE-C		
Friday		EE LAB-II ECE-C						
Saturday		PS-I						Mentoring-II EEE

No	Subject(T/P)	Periods Per Week		
1	PS-I	5		
2	EM-I LAB-II EEE	6		
3	EE LAB-II ECE-C	6		

CLASS TIME TABLE

Geethanjali College of Engineering & Technology

Department of Electrical & Electronics Engineering

Year/Sem/Sec: III-B. Tech-II Semester(Versi Room No: LH-12 Acad Year 2014-15, WEF: 29-12-2014

Class Teacher: Dr.S.Radhika

Time	09.30-10.2	10.20-11.10	11.10-12.00	12.00-12.50	12.50-13.30	13.30-14.20	14.20-15.10	15.10-16.00
Period	1	2	3	4		5	6	7
Monday	RES	PSD	CMPS	ES	LUNCH	MPMC	CMPS	EMS
Tuesday	RES	PSD	ES	EMS		PE LAB/AELCS LAB		
Wednesday	EMS	MPMC	PSD	RES		ES	CMPS	MPMC
Thursday	CMPS	PE LAB/AELCS LAB				EMS	RES	LIB/SPORTS/MEN
Friday	PSD	PSD	EMS	MPMC		CMPS	ES	MPMC
Saturday	RES	TECH. MAHINDRA				TECH. MAHINDRA		

No	Subject(T/P)	Faculty Name	Mobile Number	Periods/Week
1	EMS	Mr.K.Mahender	9866161712	4+1*-Periods
2	PSD	Dr.S.Radhika	9989741025	4+1*-Periods
3	RES	Mr.N.V.Bhardwaj	9492030271	4+1*-Periods
4	CMPS	Mrs.V.Padmaja	9885135480	4+1*-Periods
5	ES	Ms.Janaka		4+1*-Periods
6	MPMC	Mrs.M.Lakshmi	9392422999	4+1*-Periods
7	AELCS LAB	Mrs.B.Nagamani	9493284882	3+3-Periods
8	PE LAB	M.Pradeep/V.Padmaja/PCR	9885135480	3+3-Periods
9	LOGICAL REASONING(LR)/QUANTITATIVE APTITUDE(QA)			2-Periods
10	SOFT SKILLS (SS)/VERBAL ABILITY(VA)			2-Periods
11	LIBRARY/MENTORING			1 Period
	SPORTS/MENTORING			1 Period

Date: 29.12.2014 Dept. Coord:_________ HOD:___________ Dean Acad:___________ Principal:_____________

Lecture schedule

S. L no	Unit No	Topics to be covered	Total no of Periods	Teaching aids
1	1	Classification of measuring instruments-deflecting, controlling and damping systems, ammeters and voltmeters	2	BB
		PMMC, MI and MC instruments	2	BB
		Expression for the deflecting torque and control torque	1	BB
		Errors and compensation and extension of range using shunts and series resistance	1	BB
		Electrostatic voltmeters-electrometer type and attracted disc type, Extension of range of electrostatic voltmeters	1	BB
		Tutorial-1	1	BB
2	2	Introduction to CT & PT- Design considerations	1	BB
		Ratio and phase angle errors	1	BB
		Types of P.F meters-dynamometer and moving iron type,	1	BB
		I ph and 3 ph meters	1	BB
		Frequency meters- resonance type and Weston type	1	BB
		Synchroscopes	1	BB
		Additional Topic-1	1	LCD
		Tutorial-2	1	BB
		Solve University Question Papers	1	BB
		Assignment Test-I	1	
3	3	Single phase dynamometer wattmeter-LPF & UPF	1	BB
		Double element and three element dynamometer wattmeter	1	BB
		Expression for deflecting and controlling torques and extension of range of wattmeter using instrument transformers	1	BB
		Measurement of active in balanced systems	1	BB
		Measurement of reactive powers in unbalanced systems	1	BB
		Tutorial-3	1	BB
4	4	Single phase induction type energy meter- driving and braking torques	1	BB
		Errors and compensation	1	BB
		Testing of energy meter by phantom loading using RSS meter	1	BB
		Three phase energy meter-Tri-vector meter	1	BB
		Maximum demand meters.	1	BB

		Additional Topic-2	1	LCD
		Tutorial-4	1	BB
		Solve University Question Papers	1	BB
		Assignment Test-II	1	
		Mid Test-I	1	
5	5	Principle and operation of D.C Crompton's potentiometer	1	BB
		Standardization	1	BB
		Measurement of unknown resistance, current, voltage	1	BB
		AC Potentiometers polar and coordinate type	1	BB
		Standardization- applications	1	BB
		Tutorial-5	1	
6	6	Method of measuring low, medium and high resistances	1	BB
		Sensitivity of wheatstone's bridge	1	BB
		Carey Foster' bridge for measuring low resistance	1	BB
		Kelvin's double bridge for measuring low resistance	1	BB
		Measurement of high resistance- loss of charge method	1	BB
		Additional Topic-3	1	LCD
		Tutorial-6	1	BB
		Solve University Question Papers	1	BB
		Assignment Test-III	1	
7	7	Measurement of inductance and quality factor using Maxwell's bridge and Hay's bridge	1	BB
		Anderson's bridge, Owen's bridge	1	BB
		Measurement of capacitance and loss angle using Desauty's bridge	1	BB
		Wien's bridge	1	BB
		Schering bridge	1	BB
		Tutorial-7	1	BB
8	8	Ballistic galvanometer- equation of motion and flux meter	1	BB
		Constructional details and comparison of flux meter with ballistic galvanometer	2	BB
		Determination of B-H loop methods of reversals six point method	2	BB
		AC testing- iron loss of bar samples	2	BB

		Core loss measurements by bridges and potentiometers.	2	BB
		Additional Topic-4	1	LCD
		Tutorial-8	1	BB
		Solve University Question Papers	1	BB
		Assignment Test-IV	1	
		Mid Test-II	1	
		Total No of classes required	69	

1.6 Micro Plan:-

SL. No	Period No	Unit No	Date	Topic to be covered in One lecture	Reg/Additional	Teaching aids used LCD/OHP/ BB	Remarks
1	1	1	29,30/12	Classification of measuring instruments-deflecting, controlling and damping systems, ammeters and voltmeters	Regular	LCD/ BB	
			31/12, 01/01	PMMC, MI and MC instruments	Regular	LCD/ BB	
			02/01	Expression for the deflecting torque and control torque	Regular	LCD/ BB	
			05/01	Errors and compensation and extension of range using shunts and series resistance	Regular	LCD/ BB	
			06/01	Electrostatic voltmeters-electrometer type and attracted disc type, Extension of range of electrostatic voltmeters	Regular	LCD/ BB	
			07/01	Tutorial-1		BB	
	1	2	08,09/01	Introduction to CT & PT- Design considerations, Ratio and phase angle errors	Regular	LCD/ BB	
			12/01	Types of P.F meters-dynamometer and moving iron type,	Regular	LCD/ BB	
			13/01	I ph and 3 ph meters	Regular	LCD/ BB	
			16/01	Frequency meters- resonance type and Weston type	Regular	LCD/ BB	
			19/01	Synchroscopes	Regular	LCD/ BB	
			20/01	**SPEED DETECTION CAMERA**	Additional	LCD/ BB	
			21/01	Tutorial-2		BB	
			22/01	Solve University Question Papers		BB	
			23/01	Assignment Test-I			
	1	3	27/01	Single phase dynamometer wattmeter-LPF & UPF	Regular	LCD/ BB	
			28/01	Double element and three element dynamometer wattmeter	Regular	LCD/ BB	
			29/01	Expression for deflecting and controlling torques and extension of range of wattmeter	Regular	LCD/ BB	

				using instrument transformers			
			30/01	Measurement of active in balanced systems	Regular	LCD/ BB	
			02/02	Measurement of reactive powers in unbalanced systems	Regular	LCD/ BB	
			03/02	Tutorial-3		BB	
	1	4	04/02	Single phase induction type energy meter-driving and braking torques	Regular	LCD/ BB	
			05/02	Errors and compensation	Regular	LCD/ BB	
			06/02	Testing of energy meter by phantom loading using RSS meter	Regular	LCD/ BB	
			09/02	Three phase energy meter-Tri-vector meter	Regular	LCD/ BB	
			10/02	Maximum demand meters.	Regular	LCD/ BB	
			11/02	**GYROSCOPE**	Additional	LCD/ BB	
			12/02	Tutorial-4		BB	
			13/02	Solve University Question Papers		BB	
			16/02	Assignment Test-II			
			18/02	Mid Test-I			
	1	5	24/02	Principle and operation of D.C Crompton's potentiometer	Regular	LCD/ BB	
			25/02	Standardization	Regular	LCD/ BB	
			26/02	Measurement of unknown resistance, current, voltage	Regular	LCD/ BB	
			27/02	AC Potentiometers polar and coordinate type	Regular	LCD/ BB	
			02/03	Standardization- applications	Regular	LCD/ BB	
			03/03	Tutorial-5			
	1	6	04/03	Method of measuring low, medium and high resistances	Regular	LCD/ BB	
			06/03	Sensitivity of wheat stone's bridge	Regular	LCD/ BB	
			09/03	Carey Foster' bridge for measuring low resistance	Regular	LCD/ BB	
			10/03	Kelvin's double bridge for measuring low resistance	Regular	LCD/ BB	
			11/03	Measurement of high resistance- loss of charge method	Regular	LCD/ BB	
			12/03	Additional Topic-3	Additional	LCD/ BB	
			13/03	Tutorial-6		BB	
			16/3	Solve University Question Papers		BB	
			17/3	**ELECTRONIC VOTING MACHINE**			
	1	7	18, 19/3	Measurement of inductance and quality factor using Maxwell's bridge and Hay's bridge	Regular	LCD/ BB	
			20/3	Anderson's bridge, Owen's bridge	Regular	LCD/ BB	
			23/3	Measurement of capacitance and loss angle using Desauty's bridge	Regular	LCD/ BB	
			24/3	Wien's bridge	Regular	LCD/ BB	
			25/3	Schering bridge	Regular	LCD/ BB	
			26/3	Tutorial-7		BB	
	1	8	27/3	Ballistic galvanometer- equation of motion and flux meter	Regular	LCD/ BB	

			30,31/03	Constructional details and comparison of flux meter with ballistic galvanometer	Regular	LCD/ BB	
			01, 02/04	Determination of B-H loop methods of reversals six point method	Regular	LCD/ BB	
			06, 07/04	AC testing- iron loss of bar samples	Regular	LCD/ BB	
			08, 09/04	Core loss measurements by bridges and potentiometers.	Regular	LCD/ BB	
			10/04	**MEMRISTOR**	Additional	LCD/ BB	
			13/04	Tutorial-8		BB	
			15/04	Solve University Question Papers		BB	
			16/04	Assignment Test-IV			
			17/04	Mid Test-II			
				Total No of classes required	69		

DETAILED NOTES

University Question papers of previous years

Code No: 09A60201

R09

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD
B. Tech III Year II Semester Examinations, November/December-2013
ELECTRICAL MEASUREMENTS
(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) With the help of a neat sketch describe the construction and working principle of PMMC instrument . Also derive the equation for deflection if the instrument is spring controlled.

b) The coil of a 300 V moving iron voltmeter has a resistance of 550 ohm and an inductance of 0.8 H. The instrument reads correctly at 50 Hz ac supply and takes 100 mA at full scale deflection. What is the percentage error in the instrument reading when it is connected to 200 V dc supply. [15]

2.a) Define the following terms as used for instrument transformers:
i) Transformation ratio
ii) Nominal ratio
iii) turns ratio
iv) ratio correction factor and (v)burden.

b) A 100/5 A. 50 Hz current transformer has a bar primary and rated secondary burden of 12.5 VA. The secondary winding has 196 turns and a leakage inductance of 0.96 mH. With a purely resistive burden at rated full load, the magnetization mmf is 16 A and the loss excitation requires 12 A. Find the ratio and phase angle errors.

c) What is the effect of the following on the characteristics of a potential transformer;
(i) burden (ii) power factor of secondary winding circuit and (iii) frequency. [15]

3.a) Two wattmeters connected to measure the input to a balanced three phase circuit indicate 2000 W and 500 W respectively. Find the power factor of a circuit.
i) when both the readings are positive and
ii) when the latter reading is obtained after reversing the connections to the current coil of first instrument.

b) Derive the expression for torque when the Electrodynamometer instrument is used on ac.

c) Draw a neat sketch of the three phase wattmeter and how the mutual effects between the two elements of the wattmeter are eliminated. [15]

4.a) Mention the functions of the following in single phase induction type energy meter.

(i) shunt and series magnets (ii) moving disc (iii) permanent magnet (iv) holes in the disc.

b) Explain the working principles of a Trivector meter.

c) What is phantom loading? Explain with an example how is it more advantageous than testing with direct loading. [15]

5.a) Explain the term "standardization" of a potentiometer. Describe the procedure of a standardization of a dc potentiometer.

b) The emf af a standard cell is measured with a potentiometer which gives a reading of 1.01892 V. When in 1 MΩ resistor is connected across the standard cell terminals, the potentiometer reading drops to 1.01874 V. Calculate the internal resistance of the cell.

c) Explain how "true zero" is obtained in a Crampton's Potentiometer. [15]

6.a) Draw the circuit of a Kelvin's double bridge used for measurement of low resistances. Derive the condition for balance.

b) What is the importance of the value of earth's resistance? What are the factors which influence its value?

c) Mention the difficulties in the measurement of high resistances. [15]

7.a) Draw the phasor diagram of Maxwell's inductance capacitance bridge for balance conditions.

b) With a neat sketch explain the principle of operation of
(i) Wein's bridge and
(ii) Schering bridge. [15]

8. Write short notes on
(i) Flux meter (ii) Ballastic galvanometer and
(iii) Determination of B-H curve of a magnetic material. [15]

B. Tech III Year II Semester Examinations, April/May - 2012
ELECTRICAL MEASUREMENTS
(ELECTRICAL AND ELECTRONICS ENGINEERING)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) What are the different types of errors taking place in moving iron type instruments?
b) Derive expression for deflection torque of PMMC instrument. [15]

2.a) Explain the types of errors in current transformer.
b) A single phase potential transformer has a turns ratio of 3810:63. The nominal secondary voltage is 63 V and the total equivalent resistance and leakage reactance referred to the secondary side are 2.5 Ω and 1.5 Ω respectively. Calculate the ratio and phase angle errors when the transformer is supplying a burden of $(125+j250)\Omega$. [15]

3. With neat circuit diagram prove that in three phase circuit, power can be measured using two wattmeters. [15]

4. Draw the diagram two element energy meter. Explain its principle of operation. [15]

5. Explain the procedure of measurement of
a) Resistance and b) Power, using potentiometer. [15]

6. A highly sensitive galvanometer can detect a current as low as 0.1 μA. This galvanometer is used in a Wheatstone bridge as a detector. The resistance of galvanometer is negligible, each arm of the bridge has a resistance of 1 kΩ. The input voltage applied to the bridge is 25V. Calculate the smallest change in the resistance which can be detected. [15]

7. Draw the Modified desauty Bridge circuit, and derive expression for unknown capacitance. [15]

8. Write short notes on the following
a) Weston type synchroscope
b) Working principle of Ballistic galvanometer. [15]

Code No: 09A60201	R09	SET-2

B. Tech III Year II Semester Examinations, April/May - 2012
ELECTRICAL MEASUREMENTS
(ELECTRICAL AND ELECTRONICS ENGINEERING)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) Draw the diagram for attraction type Moving Iron instrument and explain its principle of operation.
b) Explain the procedure of extension of range of Moving Iron type ammeters. [15]

2. Derive an expression for actual ratio of potential transformer. [15]

3.a) Explain the theory of dynamometer type wattmeter.
b) A three phase, 440V load has power factor of 0.8 lagging. The two wattmeters read a total input power of 25KW. Find the reading of each wattmeter. [15]

4. Draw the circuit diagram for energy meter calibration. Also explain the procedure. [15]

5. Draw the circuit diagram of Crompton's D. C. Potentiometer and explain its principle of operation. [15]

6. A Kelvin double bridge has each of the ratio arms $P = Q = p = q = 1000\Omega$. The e.m.f of the battery is 110 V and resistance of 4Ω is included in the circuit. The galvanometer has a resistance of 490 Ω and the resistance of link connecting the unknown resistance to the standard resistance may be neglected the bridge is balanced with standard resistance $S = 0.0012\Omega$.
a) Determine the value of unknown resistance.
b) Determine the current through the unknown resistance and at balance.
c) Determine the deflection of the galvanometer when the unknown resistance 'R' is changed by 0.1% from its value at balance.
The galvanometer has a sensitivity of 205 mm/ μA. [15]

7. Draw the Owen's Bridge circuit, also draw it phasor diagram and derive expression for unknown inductance. [15]

8. Write short notes on the following
a) Resonance type frequency meter
b) Comparison of flux meter with Ballistic galvanometer. [15]

****

Code No: 09A60201 | R09 | SET-3

B. Tech III Year II Semester Examinations, April/May - 2012
ELECTRICAL MEASUREMENTS
(ELECTRICAL AND ELECTRONICS ENGINEERING)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) Derive expression for controlling torque in PMMC instruments.
b) What are the different methods of providing damping torque in electrical instruments? [15]

2. Derive an expression for actual ratio of current transformer. [15]

3.a) Derive the torque equation for an electrodynamometer type wattmeter. Comment on the shape of the scale if spring control is used.
b) Discuss how the errors in a dynamometer wattmeter can be reduced. [15]

4.a) Explain the construction of induction type single phase energy meter.
b) Derive the torque equation for induction type single phase energy meter. [15]

5. With the help of circuit diagram explain the principle of operation of Gall-Tinsley co-ordinate type A.C potentiometer. [15]

6. A modified wheatstone bridge network is constituted as follows:
AB is resistance P in parallel with resistance 'p' BC is resistance Q in parallel with resistance 'q' CD and DA are resistances R and S respectively the nominal values of P,Q and S are each 10 W. With resistance 'R' in circuit, balance is obtained with p=30,000W and q = 25,000W. With R replaced by standard resistance of 10W, balance is obtained when p=15,000W and q=40000W. Calculate value of R. [15]

7. Draw the Maxwell's Inductance Bridge circuit. Also draw it's phasor diagram & derive expression for unknown inductance. [15]

8. Write short notes on the following:
a) Extension of range of Electrostatic voltmeters
b) Flux meter. [15]

Code No: 09A60201	R09	SET-4

B. Tech III Year II Semester Examinations, April/May - 2012
ELECTRICAL MEASUREMENTS
(ELECTRICAL AND ELECTRONICS ENGINEERING)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

---

1. The coil of a Moving Coil Voltmeter is 50 mm × 40 mm wide and has 100 turns wound on it. The control spring exerts a torque of 0.3×10^{-3} N-m, when the deflection is 50 divisions on the magnetic field in the air gap is 1 Wb/m^2. Estimate the resistance that must be put in series with Coil to give 1 V/division. Resistance of voltmeter is 10,000 ohms. [15]

2.a) Write the advantages of current transformers.
b) Derive expression for ratio error of current transformer. [15]

3. How to extend the range of wattmeter, using Instrument transformer. Explain with the circuit diagram. [15]

4. Explain the theory of single phase induction type energy meter. [15]

5. Explain the following with the help of circuit diagram:
a) Calibration of Voltmeter
b) Calibration of Wattmeter. [15]

6. Draw the circuit of Kelvin double bridge used for measurement of low resistance. Derive the condition for balance. [15]

7. Draw the circuit diagram for Maxwell's Inductance capacitance bridge, also derive expression for unknown inductance. [15]

8. Write short notes on the following:
a) Attracted disc type electrostatic voltmeters
b) Ballistic galvanometer. [15]

******

QUESTION BANK

UNIT-1

1. Give the classification of measuring instruments and list the basic essential requirements? Discuss in detail about eddy current damping

2. Discuss in detail about PMMC derive the torque equation and list its merits and demerits?

3. Discuss in detail about MI instruments and derive the torque equation?

4. Explain the heterostatic connection of electrostatic voltmeter and derive an expression for torque.

5. Explain in detail about capacitance multiplier method in detail.

UNIT-2

1. Derive an expression for actual ratio and phase angle for a potential transformer?

2. Give the remedies for reduction of errors in an instrument transformer?

3. Discuss in detail with neat diagram NALDAR-LIPMAN power factor meter?

4. Give the classification of frequency meters and discuss in detail about electrical resonance type frequency meter?

5. Explain about Weston frequency meter.

UNIT-3

1. List the errors in a wattmeter and discuss in detail about error produced due to pressure coil inductance.

2. Explain the necessity of LPF wattmeter and discuss about LPF wattmeter in detail.

3. State and prove BLONDEL's theorem.

4. Derive an expression for power factor (Ø) and reactive power using two wattmeter method?

5. Explain about three phase wattmeter?

UNIT-4

1. Give the construction of energy meter and explain its principle of operation with neat diagram?

2. Derive the torque equation for a single phase energy meter?

3. List the errors in a energy meter? Discus in detail about lag adjustment?

4. What is creeping and discuss the compensation for creeping error?

UNIT- 5

1a).Explain the operation of a basic dc slide wire potentiometer in detail.

b). A basic slide wire potentiometer has a working battery voltage of 3v with negligible internal resistance. The resistance of slide wire is 400Ω and its length is 200cm. A 200 cm scale is placed along the slide wire. The slide wire has 1 mm scale divisions and is possible to read up to $1/5^{th}$ of a division. The instrument is standardized with 1.018v standard cell with sliding contact at 101.8 cm mark on scale. Calculate: 1) working current 2) resistance of series rheostat 3) measurement range. 4) Resolution of the instrument.

2a). What is standardization and explain about Crompton's dc potentiometer.

b). A single range potentiometer has 18 step dial switch where each step represents 0.1v. The dial resistors are 10Ω. The slide wire of potentiometer is circular and has 11 turns and resistance of 11 Ω. The slide wire has 100 divisions and interpolation can be done to to $1/4^{th}$ of division. The working battery has a voltage of 6v and negligible internal resistance.

Calculate.1) The measuring range of potentiometer 2) The resolution 3) Working current 4) Setting of the rheostat.

3a). Explain in detail about dry dale Tinsley potentiometer.

b). Measurement for the determination of the impedance of a coli were made on a coordinate potentiometer are as follows.

i) Voltage across 1 Ω standard resistance in series with the coil is (0.952-j0.34) Volts.

ii) Voltage across a 10:1 potential divider connected to the terminals of the coil is (1.35+j1.28) volts.

Calculate the resistance and reactance of the coil.

4a). Explain in detail about gal Tinsley potentiometer.

b) Calculate the inductance of the coil from the following measurements on an ac potentiometer

i) Voltage drop across a 0.1 Ω standard resistance connected in series with the coil $=0.613<12^{0}6'$volts

ii) Voltage across test coil through 100:1 voltage ratio box $=0.781<50^{0}48'$volts

Frequency is 50 Hz.

5a). Give the applications of ac potentiometers in detail.

b) In the measurement of power by a polar potentiometer the following readings were obtained.

i) Voltage across 0.2 Ω standard resistance in series with load $=1.46<32^{0}$ Volts.

ii) Voltage across 200:1 potential divider across the line $=1.37<56^{0}$

Estimate the current, voltage, power and power factor of the load.

UNIT-6

1 a) Discuss in detail about sensitivity of Wheatstone bridge.

b) A Kelvin double bridge is balanced with the following constants:

Outer ratio arm=100 Ω and 1000 Ω,

Inner ratio arm= 99.92 Ω and 1000.6 Ω,

Resistance of the link=0.1 Ω,

Standard resistance =0.00377 Ω,

Calculate the value of unknown resistance.

2a) Discuss the operation of Wheatstone bridge under small unbalance condition its limitations.

b) A highly sensitive galvanometer can detect a current as low as 0.1nA. This galvanometer is used in Wheatstone bridge as a detector. The resistance of the galvanometer is negligible. Each arm of the bridge has a resistance of 1kΩ. The input voltage applied to the bridge is 20v. Calculate the smallest change in the resistance which can be detected.

3a) Discuss in detail about Carey foster slide Wire Bridge with necessary equations.

b) In a Carey foster bridge a resistance of 1.0125 Ω is compared with a standard resistance of 1.0000 Ω, the slide wire has a resistance of 0.250 Ω in 100 divisions. The ratio arms normally each of 10 Ω , are actually 10.05 Ω and 9.95 Ω respectively. How far (in scale divisions) are the balance positions from those which would obtain of ration arms were true to their normal value? The slide wire is 100cm long.

4a) What are the practical difficulties for the measurement of high resistances.

b) In a laboratory voltmeter of 200 Ω resistances and an ammeter of 0.02 Ω resistance are available. Calculate the value of resistance that can be measured by ammeter voltmeter method for which the two different circuit arrangements give equal errors.

5a) What are the various methods used for the measurement of high resistance and discuss in detail about loss of charge method.

b) The length of the cable is tested for insulation by loss of charge method. An electrostatic voltmeter of infinite resistance is connected between the cable conductor and earth, forming there with a joint capacitance of 600pf. It is observed that after charging the voltage falls from 250v to 92 v in 1 minute. Calculate the insulation resistance of the cable.

UNIT-7

1a) Explain in detail about Maxwell's inductance capacitance bridge with relevant derivations and list its advantages and disadvantages.

b) The four arms of a-b-c-d has following impedances.

Arm ab $Z_1=200<60^0$ arm ad $Z_2=400<-60^0$ Ω arm bc $Z_3=300<0^0$ arm cd $Z_4=600<30^0$

Determine whether it is possible to balance the bridge under above conditions.

2a) Explain in detail about Anderson's bridge with relevant derivations and list its advantages and disadvantages.

b) The four arms of the bridge are as follows:

Arm ab: an imperfect capacitor C_1 with an equivalent series resistance of r_1

Arm bc: a non-inductive resistance R_3

Arm cd: a non-inductive resistance R_4

Arm da: an imperfect capacitor C_2 with an equivalent resistance of r_2 in series with resistance R_2.

A supply at 450 hz is connected between terminals a and c the detector is connected between b and d. At the balance condition:

R_2=4.8 Ω, R_3=200 Ω R_4=2850 Ω and C_2=0.5μf, r_2=0.4 Ω

Calculate values of C_1 and r_1 and also the dissipating factor for the capacitor.

3a) Explain in detail about Hay's bridge with relevant derivations and list its advantages and disadvantages

b) The four arms of Hays Bridge are arranged as follows:

AB: coil of unknown impedance.

BC: non-reactive resistance of 100 Ω

CD: non-reactive resistance of 833 Ω in series with 0.38 μf capacitor.

DA: non-reactive resistor of 16800 Ω

If the supply frequency is 50 Hz determine the resistance and inductance at the balance condition.

4a) Explain in detail about De sauty bridge with relevant derivations.

b) In a heavy side Campbell bridge used for the measurement of a self inductance Lx with the equal ratio ieR3=R4, the following results were obtained. With switch open M-15.8mH, r=25.7 Ω with switch closed M=0.2mH and r= 1.2 Ω. Find the resistance and self inductance of the coil.

5a) Explain in detail about Owens bridge with relevant derivations and list its advantages and disadvantages

b) An ac bridge circuit is used to measure the properties of sample sheet steel at 2 kHz. At balance arm ab is test specimen. Arm bc is 100 Ω . Arm cd is 0.1μf capacitor and branch da is 834 Ω is series with 0.124μf capacitor. Calculate the effective impedance of the specimen under test conditions.

UNIT-8:

1. **Explain in detail about ballistic galvanometer with a neat diagram.**
2. **Explain in detail about fluxmeter with a neat diagram.**
3. **Derive an equation for motion.**
4. **Give the comparison between fluxmeter and ballistic galvanometer.**

Assignment Questions

UNIT-1

1. Give the classification of measuring instruments and list the basic essential requirements? Discuss in detail about eddy current damping

2. Discuss in detail about PMMC derive the torque equation and list its merits and demerits?

3. Discuss in detail about MI instruments and derive the torque equation?

4. Explain the heterostatic connection of electrostatic voltmeter and derive an expression for torque.

5. Explain in detail about capacitance multiplier method in detail.

UNIT-2

1. Derive an expression for actual ratio and phase angle for a potential transformer?

2. Give the remedies for reduction of errors in an instrument transformer?

3. Discuss in detail with neat diagram NALDAR-LIPMAN power factor meter?

4. Give the classification of frequency meters and discuss in detail about electrical resonance type frequency meter?

5. Explain about Weston frequency meter.

UNIT-3

1. List the errors in a wattmeter and discuss in detail about error produced due to pressure coil inductance.

2. Explain the necessity of LPF wattmeter and discuss about LPF wattmeter in detail.

3. State and prove BLONDEL's theorem.

4. Derive an expression for power factor (Ø) and reactive power using two wattmeter method?

5. Explain about three phase wattmeter?

UNIT-4

1. Give the construction of energy meter and explain its principle of operation with neat diagram?

2. Derive the torque equation for a single phase energy meter?

3. List the errors in a energy meter? Discus in detail about lag adjustment?

4. What is creeping and discuss the compensation for creeping error?

UNIT- 5

1a).Explain the operation of a basic dc slide wire potentiometer in detail.
b). A basic slide wire potentiometer has a working battery voltage of 3v with negligible internal resistance. The resistance of slide wire is 400Ω and its length is 200cm. A 200 cm scale is placed along the slide wire. The slide wire has 1 mm scale divisions and is possible to read up to $1/5^{th}$ of a division. The instrument is standardized with 1.018v standard cell with sliding contact at 101.8 cm mark on scale. Calculate: 1) working current 2) resistance of series rheostat 3) measurement range. 4) Resolution of the instrument.

2a). What is standardization and explain about Crompton's dc potentiometer.
b). A single range potentiometer has 18 step dial switch where each step represents 0.1v. The dial resistors are 10Ω. The slide wire of potentiometer is circular and has 11 turns and resistance of 11 Ω. The slide wire has 100 divisions and interpolation can be done to to $1/4^{th}$ of division. The working battery has a voltage of 6v and negligible internal resistance. Calculate.1) The measuring range of potentiometer 2) The resolution 3) Working current 4) Setting of the rheostat.

3a). Explain in detail about dry dale Tinsley potentiometer.
b). Measurement for the determination of the impedance of a coli were made on a coordinate potentiometer are as follows.
i) Voltage across 1 Ω standard resistance in series with the coil is (0.952-j0.34) Volts.
ii) Voltage across a 10:1 potential divider connected to the terminals of the coil is (1.35+j1.28) volts.
Calculate the resistance and reactance of the coil.

4a). Explain in detail about gal Tinsley potentiometer.
b) Calculate the inductance of the coil from the following measurements on an ac potentiometer
i) Voltage drop across a 0.1 Ω standard resistance connected in series with the coil =$0.613<12^{0}6'$volts
ii) Voltage across test coil through 100:1 voltage ratio box =$0.781<50^{0}48'$volts
Frequency is 50 Hz.

5a). Give the applications of ac potentiometers in detail.
b) In the measurement of power by a polar potentiometer the following readings were obtained.
i) Voltage across 0.2 Ω standard resistance in series with load =$1.46<32^{0}$ Volts.
ii) Voltage across 200:1 potential divider across the line =$1.37<56^{0}$
Estimate the current, voltage, power and power factor of the load.

<u>UNIT-6</u>

1 a) Discuss in detail about sensitivity of Wheatstone bridge.
b) A Kelvin double bridge is balanced with the following constants:
Outer ratio arm=100 Ω and 1000 Ω,
Inner ratio arm= 99.92 Ω and 1000.6 Ω,
Resistance of the link=0.1 Ω,
Standard resistance =0.00377 Ω,
Calculate the value of unknown resistance.

2a) Discuss the operation of Wheatstone bridge under small unbalance condition its limitations.
b) A highly sensitive galvanometer can detect a current as low as 0.1nA. This galvanometer is used in Wheatstone bridge as a detector. The resistance of the galvanometer is negligible. Each arm of the bridge has a resistance of 1kΩ. The input voltage applied to the bridge is 20v. Calculate the smallest change in the resistance which can be detected.

3a) Discuss in detail about Carey foster slide Wire Bridge with necessary equations.
b) In a Carey foster bridge a resistance of 1.0125 Ω is compared with a standard resistance of 1.0000 Ω, the slide wire has a resistance of 0.250 Ω in 100 divisions. The ratio arms normally each of 10 Ω , are actually 10.05 Ω and 9.95 Ω respectively. How far (in scale divisions) are the balance positions from those which would obtain of ration arms were true to their normal value? The slide wire is 100cm long.

4a) What are the practical difficulties for the measurement of high resistances.
b) In a laboratory voltmeter of 200 Ω resistances and an ammeter of 0.02 Ω resistance are available. Calculate the value of resistance that can be measured by ammeter voltmeter method for which the two different circuit arrangements give equal errors.

5a) What are the various methods used for the measurement of high resistance and discuss in detail about loss of charge method.

b) The length of the cable is tested for insulation by loss of charge method. An electrostatic voltmeter of infinite resistance is connected between the cable conductor and earth, forming there with a joint capacitance of 600pf. It is observed that after charging the voltage falls from 250v to 92 v in 1 minute. Calculate the insulation resistance of the cable.

<u>UNIT-7</u>

1a) Explain in detail about Maxwell's inductance capacitance bridge with relevant derivations and list its advantages and disadvantages.
b) The four arms of a-b-c-d has following impedances.
Arm ab $Z_1=200<60^0$ arm ad $Z_2=400<-60^0\ \Omega$ arm bc $Z_3=300<0^0$ arm cd $Z_4=600<30^0$
Determine whether it is possible to balance the bridge under above conditions.

2a) Explain in detail about Anderson's bridge with relevant derivations and list its advantages and disadvantages.
b) The four arms of the bridge are as follows:
Arm ab: an imperfect capacitor C_1 with an equivalent series resistance of r_1
Arm bc: a non-inductive resistance R_3
Arm cd: a non-inductive resistance R_4
Arm da: an imperfect capacitor C_2 with an equivalent resistance of r_2 in series with resistance R_2.
A supply at 450 hz is connected between terminals a and c the detector is connected between b and d. At the balance condition:
$R_2=4.8\ \Omega$, $R_3=200\ \Omega$ $R_4=2850\ \Omega$ and $C_2=0.5\mu f$, $r_2=0.4\ \Omega$
Calculate values of C_1 and r_1 and also the dissipating factor for the capacitor.

3a) Explain in detail about Hay's bridge with relevant derivations and list its advantages and disadvantages
b) The four arms of Hays Bridge are arranged as follows:
AB: coil of unknown impedance.
BC: non-reactive resistance of 100 Ω
CD: non-reactive resistance of 833 Ω in series with 0.38 μf capacitor.
DA: non-reactive resistor of 16800 Ω
If the supply frequency is 50 Hz determine the resistance and inductance at the balance condition.

4a) Explain in detail about De sauty bridge with relevant derivations.
b) In a heavy side Campbell bridge used for the measurement of a self inductance Lx with the equal ratio ieR3=R4, the following results were obtained. With switch open M-15.8mH, r=25.7 Ω with switch closed M=0.2mH and r= 1.2 Ω. Find the resistance and self inductance of the coil.

5a) Explain in detail about Owens bridge with relevant derivations and list its advantages and disadvantages
b) An ac bridge circuit is used to measure the properties of sample sheet steel at 2 kHz. At balance arm ab is test specimen. Arm bc is 100 Ω . Arm cd is 0.1μf capacitor and branch da is 834 Ω is series with 0.124μf capacitor. Calculate the effective impedance of the specimen under test conditions.

<u>UNIT-8:</u>

1. Explain in detail about ballistic galvanometer with a neat diagram.

2. Explain in detail about fluxmeter with a neat diagram.
3. Derive an equation for motion.
4. Give the comparison between fluxmeter and ballistic galvanometer.

UNIT WISE QUIZ QUESTIONS AND LONG QUESTIONS

Multiple Choice Questions

Unit – 1

1. In d'Arsonal galvonometer, an iron core is usually used between the permanant magnet pole faces. This is used so that

a) Flux density in the air gap becomes high thereby a large deflecting torque is produced.

b) The effect of stray magnetic fields is reduced

c) Moment of inertia of moving parts becomes smaller

d) None of the above

Ans : (a)

2. If the damping in a d'Arsonval galvonometer is only due to electromagnetic effects, the resistance required for critical damping is:

a) G^2 / √ CJ

b) G / √ CJ

c) G / 2 √ CJ

d) G^2 / : √ CJ

Ans : (d)

3. Ayrton shunt is used in d' Arsonval Galvanometers so as to limit the current in the galvanometer coil to its maximum permissible value. The relative value of current through the galvonometer coil and the shunt.

a) Depends upon the value of resistance of galvonometer coil only

b) Depends upon the value of resistance of galvonometer coil and the shunt.

c) Does not depends upon the value of resistance of galvanometer coil.

d) Non of the above.

Ans : (C)

4. Electronic type instruments are primarily used as

a) Ammeter

b) Waltmeter

c) Voltmeter

d) Ohm meter

Ans : (c)

5. The range of the electronic voltmeter can be extended by using

a) A capacitor in series with the voltmeter whose capacitance is grater than the capacitance of the voltmeter

b) A capacitor in series with the voltmeter whose capacitance is smaller than the capacitance of the voltmeter

c) A resistor in series with the voltmeter

d) An inductor in series with the voltmeter

Ans : (b)

6. The high torque to weight ratio in an anolog indicationg instrument indicates

a) High friction loss

b) Low friction loss

c) Nothing regards friction loss

d) None of the above

Ans : (b)

7. Which meter has the highest accuracy in the prescribed limit of frequency range:

a) PMMC

b) Moving iron

c) Electrodynomometer

d) Rectifier

Ans : (c)

8.Which instrument is the cheapest disregarding the accuracy?

a) PMMC

b) Moving iron

c) Electrodynomometer

d) Rectifier

Ans : (b)

9. Which instrument has the highest frequency range with accuracy with in reasonable limits?

a) Moving iron

b) Electrodynomometer

c) Thermocouple

d) Rectifier

Ans : (c)

10. Swamping resistance is connected

a) In series with the shunt to reduce temperature error in shunted ammeter.

b) In series with the ammeter to reduce errors on account of friction.

c) In series with meter and have a high resistance of temperature co-efficient in order to reduce temperature errors in ammeters.

d) In series with the meter and have a negligible resistance co-efficient in order to reduce temperature error in shunted ammeters.

Ans : (d)

11. A quardrant type dectostatic instruments uses two types of connections (i) Heterostatic and (ii) Idiostatic. An external battery is used.

a) For idiostatic connection

b) For heterostatic connection

c) For both idiostatic and heterostatic connections

d) None of the above.

Ans : (b)

12. Horizontally mounted moving iron instruments use.

a) Eddy curent damping

b) Electromagnetinc clamping

c) Fluid friction damping

d) Air friction damping

Ans : (d)

13. The eddy current damping cannot be used in moving iron instruments due to:

a) They have a strong operating magnetic feild

b) They are not normally used in vertical position

c) They need a large damping force which can only be provided by air friction.

d) They have a very weak operating magnetic feild and introduction of a permanant magnet required for eddy current damping would distort the operating magnetic field.

Ans : (d)

14. An electrostatic voltmeter draws a small value of current on d.c

a) Under steady state condition respective of the applied voltage

b) When switched on irrespective of the applied voltage

c) When measuring low voltages

d) When measuring high voltages

Ans : (a)

15. Why are multimeters provided with separate scale for low a.c voltages ?

a) To improve the readability of the scale

b) To have high accuracy

c) To take in to account the high value of resistance of rectifier at low voltages (and current) and also the fact that at low voltages (an current) the value of rectifier resistance ifs not constant but varies considerably even for small change in voltages (or Current)

d) None of the above.

Ans : (c)

16. A voltmeter has resistance of 2000 Ω. when it is connect accross a d.c circuit its power consumption is 2mw Suppose this voltmeter is replaced by a voltmeter of 4000 Ω resistance, the power consumption will be.

a) 4mw

b) I mw

c) 2 mw

d) None of the above

Ans : (b)

17. A 1mA d'Arsonval movement has a resistance of 100. It is to be converted to a 10 v voltmeter. The value of multipliers resistance is.

a) 900 Ω

b) 9999 Ω

c) 9900 Ω

d) 990 Ω

Ans : (c)

18. A d'Arsonval movement is rated at 50μA. Its sesitivity is

a) 20000 Ω /v

b) 200000 Ω /v

c) 200 Ω/v

d) Cannot be determined

Ans : (a)

19. In order that an electrodynamometer type of instrument exhibits a pure square law response, the meter range should be limited to :

a) -45 to +45 about the position for zero mutual inductance between fixed and mousing coils.

b) -45 to +45 about the position for maximum mutual inductance between fixed and moving coil

c) -22.5 to 22.5 about the position for zero inductance between fixed and moving coils

d) -90 to 90 about the position for maximum mutual inductance between fixed and moving coils

Ans : (a)

20. Moving iron type of instrument can be used as

a) Standard instruments for calibration of other instruments

b) Transfer type instrument

c) Indicator type instrument as on pands

d) All of the above

Ans : (c)

21. Moving iron instruments when measuring voltages are currents

a) Indicate the same values of the measurement for both ascending and descending values.

b) Indicate higher value of measurement for both ascending values.

c) Indicate higher value of measurement and for descending values

d) None of the above

Ans : (c)

22. An electrodynomometer type of instruments finds its major use as

a) Standard instruments only

b) Transfer instruments only

c) Both as standard and transfer instrument

d) An indicator type of instrument

Ans : (b)

23. The power consumption of PMMC instruments is typically about.

a) 0.25 w to 2w

b) 0.25 mw to 2 mw

c) 25 µw to 200 µw

d) None of the above

Ans : (c)

24. The frequency range of moving iron instrument is

a) Audio frequency band 20Hz to 20 KHz

b) Very low frequency band 10Hz to 30 KHz

c) Low frequency band 30Hz to 300 KHz

d) Power frequency 0 to 125 Hz

Ans : (d)

25. Spring controlled moving iron instruments exhibit a square law response resulting in non-linear scale, the shape of the scale can be made almost linear by.

a) Reducing rate of change of inductance, L, with deflection, Ø, as constant.

b) Keeping 1/Ø, dl/dØ as constant

c) Keeping 1/kØ as constant where k is the spring constant

d) Keeping o, dl/dØ as constant.

Ans : (d)

26. A megger is used for measurement of

a) Low valued resistance

b) Medium value resistance

c) High value resistance, particularly insulation resistance

d) All the above

Ans : (d)

27. A make before break switch is provided to disconnect the battery when the meter is not in use is

a) Both series and shunt type ohmmeters

b) Only series type ohmmeters

c) Only in shunt type ohmmeters

d) None of the above

Ans : (c)

28. A moving iron instrument can be used for current and voltage measurments.

a) In a.c circuits only

b) In d.c circuits only

c) In both a.c and d.c circuits for any value of frequency (in case of a.c circuits)

d) In both a.c and d.c circuits for any frequency upto about 125Hz (in case of a.c circuits)

Ans : (d)

29. In spring control measuring instruments, the scale is

a) Uniform

b) Cramped at the lower end and expanded at the upper end

c) Expanded at the lower end and cramped at the upper end

d) Cramped both at the lower and upper ands.

Ans : (b)

30. The moving iron voltmeter indicates

a) The same value of d.c and a.c voltages

b) Lower values for a.c voltage than for corresponding d.c voltages

c) Higher values for a.c voltage than for corresponding d.c voltages

d) None of the above

Ans : (b)

31. A moving iron voltmeter reacts low for a.c voltmeter than for corresponding values of d.c voltages. The meters can be made to read equally for both a.c and d.c voltages.

a) If the resistance of the multiplier is made very high

b) If the induction of the coil is made small

c) The resistance of the coil made very large.

d) If the multiplier resistance is shunted by a capacitor of appropriate value to make the circuit non-inductive

Ans : (d)

Unit – 2:

1. The ratio of transformation in the case of potential transformers.

a) Increases with the incresase in power factor of secondary burden

b) Remains constant irrespective of the power factor of secondary burden

c) Decreases increase in power factor of secondary burden

d) Non of the above.

Ans (C)

2.In case of potential transformers

a) The phase angle error is always positive

b) The phase angle error is always negetive

c) The phase angle error is usually zero.

d) The phase angle error is always positive when the secondary winding voltage reversed leads the primary winding voltage and is negative when the secondary winding voltage reversed logs behind the primary winding voltage.

Ans (d)

3.The disadvantages of using multipliers with voltmeters at high voltages are :

a) The power consumption of multipliers becomes large at large voltages.

b) The multipliers at high voltages have to be shieled in order to present capacitive currents.

c) The metering circuit is not electrically isolated from the power circuit.

d) All the above.

Ans (b)

4. The nominal ratio of current transformer is

a) **Primary windingcurrent / secondary winding current**

b) **Rated Primary winding current / Rated secondary winding current**

c) **Number of Primary winding turns / number of secondary winding turns**

d) **All the above**

Ans (b)

5.The error in the current transformers can be reduced by designing them with

a) **High permeability and low loss core materials, avoiding any joints in the core and also keeping the flux density to a low value.**

b) **Using primary and secondary winding as close to each other as possible**

c) **Using a large cross section for both primary and secondary winding conductiors**

d) **All the above**

Ans (a)

6. Capacitive potential tranformers are used

a) **For primary wing phase voltage above 100 KV**

b) **For keeping the value of transformation ratio constant irrespective of the burden by making certain adjustment**

c) **Because they are cheper than the electromagnetic transformers above a certain voltage range**

d) **All the above**

Ans (a)

7. The size of potential transformers

a) **Is the same as power transformers of the same VA rating**

b) **Is much greater than that of power transformers of the same VA ratings because they are designed for low ratio and phase angle errors which require large sized cores and winding conductors**

c) **Is smaller than that of power transformers of the seme VA rating**

d) **Non of the above**

Ans (b)

8. The transformation ratio in the case of a potential transformer is defined as ratio of

a) Primary winding voltage / secondary winding voltage

b) Rated primary winding voltage / rated secondary winding voltage

c) Number of turns of primary winding / number of turns of secondary windings

d) All the above

Ans (a)

9.The burden of current transformers is expressed in terms of

a) Secondary winding current

b) VA rating of transformers

c) Voltage, current and power factor of secondary winding circuit

d) None of the above.

Ans (b)

10. The current in the primary winding of a current transformer depends upon

a) Burden of the secondary winding of transformer

b) Load connect to the system in which the C.T is installed

c) Both burderns of the transformers secondary winding and load connected to the system

d) Non of the above

Ans (b)

11. Turns compensation is used in current transformers primarily for reduction of

a) Phase angle error

b) Both ratio and phase angle errors

c) Rato error reduction in phase angle error is incidental

d) Non of the above

Ans (b)

12. The advantages of instruments transformers are:

a) The readings of instruments used in conjuction with then do not depend upon their resistance, inductance etc.

b) The rating of instrument transformers have been standarized and the rating of instruments used in conjuction with them also get standardized. Therefore is reduction of cost and case in replacement

c) The metering circuit is electrically isolated from the power circuit there by providing safly to operating personnel

d) All the above

Ans (d)

13. The disadvantages of shunts for use at high currents are :

a) It is difficult to achieve good accuracy with shunts

b) Power consumption of the shunts is large

c) The metering circuit is not electrically isolated from the power circuit.

d) All the above.

Ans (d)

14. When the secondary winding of a current transformer is open – circuited with the primary winding energized

a) The whole of the primary current produces large value of flux in the core (limited to only saturation) there by producing a large voltage in the secondary winding.

b) The large voltage may act as safety hezard for the operators and may even ruptured the insulation

c) When the large magnetizing force is taken off its leaves a large value of residual magnetism

d) All the above.

Ans (d)

15. A short circuiting link is provided on the secondary side of a current transformer because.

a) When the secondary winding of the CT is short – circuited by the link with the primary winding energized and very high current of flows on the primary side.

b) When the secondary winding of the CT is short circuited by the link with the primary winding energized, it is possible to make any adjustments in the secondary winding circuits like replacing a faculty ammeter.

c) When sort circuiting link is opened with the secondary winding open circuited , the current on the primary side falls to almost zero.

d) All the above.

Ans (b)

16. When the secondary winding of a potential transformer is suddenly open circuited with primary winding excited.

a) **Large voltages are produced in the secondary winding which may be a safety hazard to operating personal**

b) **The large voltagees so produced may rupture the insulation.**

c) **The primary winding draws only the no load current.**

d) **Non of the above.**

Ans (c)

17. The ratio and phase angle errors in potential transformers may be reduced by.

a) **Increasing in the exciting current**

b) **Increasing the resistance and leekage reactance in the transformer.**

c) **Not employing turns compensation**

d) **Non of the above.**

Ans (d)

18. R.C.F = -----------

a) **Kact / Knom**

b) **Knom / Kact**

c) **Kt / Knom**

d) **Knom / Kt**

Ans (a)

19. -------- methode is employed for the reduction of magneting and loss components of instrument transformers

a) **Using meterial of high permeability**

b) **Keeping flux density in the core to low value**

c) **Choosing low reactent score**

d) **All the above.**

Ans (d)

20. A Potential transformer is a ----------transformer used along with a low range voltmeter for measuring a high voltage

a) **Step up transformer**

b) **Step down transformer**

c) **Auto transformer**

d) **Two winding transformer**

Ans (b)

21. Rotating field type moving iron power factor meter is also called as.

a) **D arsonval galvanometer**

b) **Naldar Lipman P.F meter**

c) **Westing House P.F Meter**

d) **Ferozlianemic P.F meter**

Ans (c)

22. Alternating field type M.I P.F meter is also called as ---------

a) **D' arsonval galvanometer**

b) **Nelder lipman P.F meter**

c) **Westing house P.F meter**

d) **Ferodianemic P.F meter**

Ans (b)

23. Machanical Resistance type frequency meter is also called as

a) **Fero dianemic**

b) **Naldor Lipmon**

c) **P.H.H.C**

d) **Vibrating read**

e) **Ans (d)**

Unit-3

1. The power in a dc circuit is measured with the help of ammeter and a voltmeter . The voltmeter is connected on the load side. The power indicated by the product of readings of the two instruments (VI) is :

a) The power consumed by the load

b) The sum of the power consumed by the load and the voltmeter

c) The sum of the power consumed by the load and the ammeter

d) None of the above

Ans:b

2. In an electrodynamometer type wattmeter:

a) The current coil is made fixed

b) The pressure coil is fixed

c) Any of the two coils is fixed

d) Both coils should be movable

Ans:a

3. In electrodynamometer type wattmeters, current coils are designed for carrying heavy currents use stranded wire or laminated conductors:

a) To reduce iron losses

b) To reduce hysteresis losses

c) To reduce eddy current and hysteresis losses

d) All the above

Ans: c

4. In a electrodynamometer type wattmeters, the inductance of the pressure coil circuit produces error:

a) Which is constant irrespective of the power factor of the load

b) Which is higher at low powe factors

c) Which is lower at low power factors

d) None of the above

Ans: b

5. A capacitor is connected across a portion of resistance of the multiplier in order to make the pressure coil circuit non-inductive. The value of the resistance is r while the total resistance and inductances of pressure circuit are respectively R_p and L. The value of capacitance C is :

a) $0.41L/r^2$

b) $0.41L/R^2_p$

c) L/R^2_p

d) L/r_2

Ans: d

6. When measuring the power with an electrodynamometer type wattmeter in a circuit where the load current is small:

a) The current coil should be connected on the load side

b) The pressure coil should be connected on the load side

c) It is immaterial whether current coil or pressure coil is connected on the load side

d) None of the above

Ans: a

7. When measuring power with an electrodynamometer watmeter in a circuit where the load voltage is large:

a) The current coil is connected on the load side

b) The pressure col is connected on the load side

c) The pressure coil is connected on the supply side

d) It is immaterial whether the pressure coil or current coil is on the load side

Ans: b

8. When measuring the power with an electrodynamometer wattmeter in a circuit having a low power factor:

a) The current coil should be connected to the load side

b) The current coil should be connected to the supply side

c) The pressure coil should be connected to the load side

d) A compensated wattmeter with pressure coil connected on the load side should be used

Ans: d

9. BLONDEL'S Theorem signifies:

a) Single wattmeter method

b) Three wattmeter method

c) Four wattmeter method

d) No of wattmeters used for the measuement of power in a n-phase system

Ans: d

10. Major diadvantage of single wattmeter mehod for star/delta connected load:

a) Non-availability of neutral point for star connected load

b) Insertion of current coil in one of the phases of the star connected load

c) Both a and b

d) None of the above

Ans: c

11.Blondel''s theorem is applicable to:

a) 3 Ø and 3 wire system

b) 3 Ø and 4 wire system

c) 1 Ø and 2 wire system

d) 2 Ø and 3 wire system

Ans: b

12. Blondel's theorem is not applicable to:

a) 3 Ø and 3 wire system

b) 3 Ø and 4 wire system

c) Both a and b

d) None of the above

Ans: a

13.If W_1 and W_2 are the two wattmeter readings obtained by two wattmeters method then power factor cosØ is given by the formula: $\sqrt{3}Tan^{-1}[(W_1-W_2)/(W_1+W_2)$

14. The power in a three phase four wire system can be measured by using :

a) 2 wattmeters

b) 4 wattmeters

c) 3 wattmeters

d) 1 wattmeter

Ans:c

15. the power in a 3 phase circuit is measured with the help of 2 wattmeters. The readings of one wattmeter is positive and that of the other is negative. The magnitude fo readings are different. It can be concluded that the power factor of the circuit is:

a) unity

b) Zero (lagging)

c) 0.5(lagging)

d) less than 0.5 (lagging)

Ans:d

Unit-4

MULTIPLE CHOICE QUESTIONS:

1. A merz- price maximum demand indicator indicates:

a) Maximum demand

b) Average maximum demand over a specified period of time

c) Maximum energy consumption

d) All the above

Ans: b

2. Creeping in a single – phase induction type energy meter may be due to:

a) Over compensation for friction

b) Over voltage

c) Vibrations

d) All the above.

Ans: d

3.VAh metering can be done by using

a) A ball and disc friction gearing

b) Trivector meter

c) Bridge connected rectifier

d) All the above

Ans: d

4. In a single phase induction type energy meter, in order to obtain true value of energy, the shunt magnet flux should lag behind the applied voltage by:

a) 90^0

b) 0^0

c) 45^0

d) None of the above

Ans: a

5. In an induction type meter, maximum torque is obtained when the phase angle between the two fluxes is :

a) 0^0

b) 45^0

c) 60^0

d) 90^0

Ans: d

6. In an induction type energy meter, maximum torque is obtained when the parameters of rotating disc are:

a) R=0

b) X=0

c) R=X

d) None of the above

Ans:b

7. In a single phase induction type energy meter the lag adjustment is done :

a) To make the curret coil flux to lag 90^0 behind the applied voltage.

b) To make the pressure coil flux to lag 90^0 behind the applied voltage

c) To bring the pressure coil flux in phase with the applied voltage

d) None of the above.

Ans: b

8. In a circuit of a single phase induction type energy meter the pressure coil lags the voltage by 88^0, the errors while measuring power in two circuits having power factors of unity and 0.5 lagging are respectively are:

a) -0.061% + 6.1%

b) +0.061% -6.1%

c) -0.061%-6.1%

d) -6.1%-6.1%

Ans: c

9. The reason why the eddy current damping cannot be used in moving iron instrument is :

a) They have a strong operating magnetic field

b) They are not normally used in vertical position

c) They need a large damping force which can only be provided by air-friction damping

d) They have very weak operating magnetic field and introduction of a permanent magnet required for eddy current damping would distort the operating magnetic field.

Ans: d

10. Phantom loading for testing of energy meters is used :

a) To isolate the current and potential circuits

b) To reduce power loss during testing

c) For meters have low power rating

d) They test meters having a large current rating for which loads may not be available in the laboratory this also reduces power losses during testing.

Ans: d

11. In a house hold single phase induction type energy wattmeter, the meter can be reversed by:

a) Reversing the supply terminals

b) Reversing the load terminals

c) Opening the meter connections and reversing the connections of both current and potential coil circuits.

d) None of the above

Ans:c

12. The errors due to voltage variations are:

a) Linear magnetic characteristics of the shunt magnet core

b) Linear magnetic characteristics of the series magnet core

c) Self braking torque

d) Driving torque.

Ans: a and c

13.Compensation for variation in supply voltage is provided by:

a) Saturable magnetic shunt

b) Swamping resistors

c) Series resistors

d) Shunt resistors

Ans:a

14. The phase error can be compensated by the means of

a) Lag adjustment

b) Lead adjustment

c) Shuntresistor

d) Adjustable copper bands

Ans:b

15. To overcome creeping error:

a) Three holes are drilled

b) Four holes are drilled

c) Two holes are drilled

d) None of the above

Ans:c

16. The braking torque is prportional to:

a) Square of the speed

b) Square if the load current

c) Speed

d) load current

Ans:b

17. Energy in three phase four wire system can be meacured by:

a) Two wattmeter method

b) Three element wattmeter

c) Three element energy meter

d) Two element energy meter.

Ans:c

18. Energy in three phase three wire system can be measured by:

a) Two wattmeter method

b) Three element wattmeter

c) Three element enrgy meter

d) Two element energy meter.

Ans:d

19. A Trivector meter directly reads :

a) KVA and KVAR

b) KVA and KW

c) KWHr and KVA

d) All the above

Ans:c

20. The main functioning of msgnetic shunt is :

a) To aid series magnetic flux

b) Nullify series magnetic flux

c) Divert the series mgnetic flux

d) None of the above.

Ans:c

Unit-5

MULTIPLE CHOICE QUESTIONS

1)Potentiometer is a

a. device for measuring voltage while presenting a very high impedance to the voltage under test.
b. device for measuring voltage while presenting a very low impedance to the voltage under test.
c. Device for measuring current while presenting a very high impedance to the current under test.
d. Device for measuring current while presenting a very low impedance to the current under test.

ANS: a

2) Slide wires are made of manganin. This is because maganin has
a. high stability
b. low stability
c. high temperature
d. low resisitivity
ANS: a

3) Potentiometer is a device used to measure

a. known voltage by comparing unknown voltage
b. unknown voltage by comparing known voltage
c. unknown voltage
d. flux

ANS: b

4) A potentiometer is basically a

a. deflection as well as null type instrument
b. null type instrument
c. deflection type instrument
d. digital instrument

ANS: a

5) For measurement of emf of a standard cell we use

a. galvanometer
b. electro-dynamic voltmeter
c. potentiometer
d. zener reference

ANS: c

6) The potentiometer wire should be of

a. high resisitivity and low temperature coefficient
b. low resisitivity and high temperature coefficient
c. high resisitivity and high temperature coefficient
d. low resisitivity and low temperature coefficient

ANS: a

7) After standardizing, the position of the rheostat, R in the battery circuit

a. should not be changed
b. should be changed
c. kept in maximum position
d. kept in minimum position

ANS: a

8) Voltbox is basically a device used for

a. extending the voltage range of the potenetiometer
b. measuring the current
c. measuring the voltage
d. measuring the power

ANS: a

9) The power drawn by a potentiometer from the source, whose voltage is under measurement , under null condition is

a. ideally zero

b. small
c. high
d. very high
ANS: a

10) The standardization of ac potentiometers is done by
a. directly using ac standard voltage sources.
b. using dc standard sources and trAnsfer instruments.
c. using dc standard sources and d Arsonval galvanometer
d. using ac standard sources and trAnsfer instruments.
ANS: b

11) Different type of potentiometers are
wire wound potentiometer
carbon film potentiometer
plastic film potentiometer

12) Standardization of potentiometer is done in order that, they becomes
a. accurate and direct reading
b. precise
c. accurate
d. accurate and precise.
ANS: a

13) consider the following statements:
DC potentiometers is the best meAns available for measurement of dc voltages because
i) The precision in measurement is independent of the type of detector used
ii) It is based on null balance technique
iii) It is possible to standardize before a measurement is undertaken.
iv) It is possible to measure dc voltages ranging in value from mV to hundreds of volts
Of these statements

a. 2 and 4 are correct
b. 1 and 4 are correct
c. 2 and 3 are correct
d. 3 and 4 are correct
ANS: a

14) A direct current can be measured by
a. a D.C. potentiometer in conjunction with a standard resistance
b. a D.C potentiometer directly
c. a D.C potentiometer in conjunction with a Volt ratio box
d. a D.C potentiometer in conjunction with a voltmeter
ANS: a

15) Phase angle in polar type potentiometer is measured from the position of ………….
<u>phase shifter</u>

16) The sensitivity of a potentiometer can be improved by
a. reducing the current flowing through the potentiometer wire
b. reducing the length of potentiometer wire
c. increasing the length of potentiometer wire
d. reducing the resistance of the rheostat connected in series with the battery
<u>ANS: c</u>

17) How does D.C. potentiometer differ from A.C. potentiometer
<u>difference between working of the two instruments is that in D.C. potentiometer only the unknown emf is balanced against a known potential drop, where as in case of A.C. potentiometer these two voltages are balanced in magnitude as well as phase.</u>

18) The potentiometer method of measurement of resistance is suitable for measurement of
a. low resistances only
b. high resistances only
c. medium resistances only
d. very low resistances only
<u>ANS: a</u>

19) In coordinate type potentiometer , if and are the two measured values from the two potentiometers, then the phase angle of the unknown voltage is given by
a. $\tan^{-1}(v_1/v_2)$
b. $\tan^{-1}(v_2/v_1)$
c. $\tan^{-1}(v_1)$
d. $\tan^{-1}(v_2)$
<u>ANS: b</u>

20) A phase shifting trAnsformer is used in conjunction with a
a. Drysdale potentiometer
b. as coordinate potentiometer
c. Crompton potentiometer
d. simple Larsen potentiometer
<u>ANS: a</u>

21) The most commonly used detector in ac potentiometer work is
a. vibration galvanometer
b. ballistic galvanometer
c. ear phone
d. D'Arsonval galvanometer
<u>ANS: a</u>

22) A trAnsfer instrument employed in the standardization of a polar type a.c potentiometer is
a. a thermal instrument

b. an electrostatic instrument
c. a dynamometer instrument
d. a moving coil instrument
ANS: a

23) In drysdale a.c potentiometer, the two phase supply for the stator is obtained from a single phase supply by employing a phase splitting device consisting of a
a. capacitor and a resistor
b. inductor and a capacitor
c. resistor and a inductor
d. inductance only
ANS: a

24) For measuring an ac voltage by an ac potentiometer, it is desirable that the supply for the potentiometer is taken from
a. a source other than the source of unknown voltage
b. capacitor
c. the same source as the unknown voltage
d. a battery
ANS: d

25) The stator of the phase shifting trAnsformer for use in conjunction with an ac potentiometer usually has _ _ _ _ _ _ _ winding
a. single phase
b. two phase
c. three phase
d. six phase
ANS: c

26) For standardization of Drysdale ac potentiometer the instrument used is
a. thermo-couple instrument
b. rectifier ammeter
c. Precision type electro-dynamometer ammeter
d. PMMC ammeter
ANS: b

27) In a.c ammeter calibration, the current is given by
a. (voltage drop across standard resistor) / (Resistance of the standard)
b. (Resistance of the standard) / (voltage drop across standard resistor)
c. voltage drop across standard resistor
d. Resistance of the standard
ANS: c

28) The method of calibration of a.c voltmeter is similar to that adopted for calibration of
a. d.c ammeter with d.c potentiometer
b. wattmeter with d.c potentiometer

c. d.c voltmeter with d.c potentiometer
d. p.f meter with d.c poteniometer

ANS: a

29) The main difference between a simple potentiometer and vernier potentiometer is ………
a. uses two measuring dials
b. uses three measuring dials
c. uses four measuring dials
d. uses no measuring dials

ANS: c

30) The actual voltage measured using potentiometer is given by
V_{act} = (potentiometer reading)/(V.R.box ratio)

31) A.C potentiometers are broadly classified as
polar type ac potentiometer and coordinate type potentiometer

32) In standardization of A.C. potentiometer, the D.C. standardization is done first by replacing
vibration galvanometer by D'Arsonval galavanometer

33) Applications of A.C. potentiometers are
calibration of voltmeter
calibration of ammeter
testing of energy meter and wattmeter
measurement of self reactance of coil

34) Potentiometer is a three terminal device

35) If a polar A.C. potentiometer is used , give the equations for self reactance of the coil
$X = Z \sin(\varnothing_c - \varnothing_s) = (R_s V_c / V_s) \sin(\varnothing_c - \varnothing_s)$

36) Continuously changing voltage can be measured by
Brook's deflectional potentiometer

37) The voltage along the slide wire at any point is proportional to the
length of the slide wire where the point is obtained by moving sliding contact along the wire to get null deflection in the galvanometer for any battery whose EMF is to be measured

38) In potentiometer with true zero the typical range of slide wire is from
-0.005 volts to + 0.15 volts

39) Suppose a length of resistive material (such as nichrome wire) had three points of electrical contact: one at each end (points 1 and 3), plus a movable metal "wiper" making contact at some point between the two ends (point 2):

Describe what happens to the amount of electrical resistance between the following points, as the wiper is moved toward the left end of the resistive element (toward point 1)? State your Answers in terms of increase," "decrease," or "remains the same,"
…Between points 1 and 2, resistance . . .•Between points 2 and 3, resistance . . .•Between points 1 and 3, resistance . . .
As the wiper moves to the left (toward point 1):
•Between points 1 and 2, resistance *decreases*
•Between points 2 and 3, resistance *increases*
•Between points 1 and 3, resistance remains the same

Unit-6

MULTIPLE CHOICE QUESTIONS

1) Which instrument has the lowest resistance ?
a. Ammeter
b. Voltmeter
c. Frequency meter
d. Megger
Ans: a

2) Which bridge is used for the measurement of low resistance
a. Kelvin
b. Wheatstone
c. Hay's
d. Wagner ground bridge
Ans: a

3) Which bridge is used for the measurement of medium resistance
a. Wheat stone bridge
b. Hay`s bridge
c. Wagner ground bridge
d. Anderson's bridge
Ans: a

4) Medium resistances in the range from
a. 1Ω to 0.1MΩ
b. 1Ω to 0.5 MΩ
c. 1Ω to 0.1kΩ
d. 1.Ω to 0.01MΩ
Ans: a

5) A Wheatstone bridge cannot be used for precision measurements because errors are introduced into an account of
a. Stray losses

b. magnetic field
c. Galvanometer
d. Resistance of connecting leads
Ans: d

6) The Wheatstone bridge is said to be balanced when the potential difference across the galvanometer is
a. 1 volt
b. 2 volts
c. 0 volts
d. 4 volts
Ans: c

7) The sensitivity of a Wheatstone bridge depends upon
a. connecting wires
b. galvanometer current sensitivity
c. parameters of the bridge
d. contact resistances
Ans: b

8) R_1 and R_4 are the opposite arms of a wheat stone bridge as the R_3 and R_2. The source voltage is applied across R_1 and R_3. Under balanced conditions which are of the following is true.
a. $R_1=(R_2R_3)/R_4$
b. $R_1=(R_3R_4)/R_2$
c. $R_1=(R_2R_4)/R_3$
d. $R_1=R_2+R_3+R_4$
Ans: a

9**) Carey Fosters bridge is used for determining the difference between**
a. the standard S and unknown resistance R
b. ratio arms P and Q
c. the resistance P and unknown resistance R
d. the resistance Q and unknown resistance R
Ans: a

10) In Carey Fosters bridge resistance P and Q are first adjusted so that the ratio P/Q is approximately equal to the ratio
a. S/R
b. Q/P
c. R/S
d. R
Ans: c

11) Carey Fosters bridge is used to determine
a. very low resistances
b. low resistances
c. medium resistances

d. high resistances
Ans: b

12) In a Carey Fosters bridge supply voltage is
a. fixed
b. variable
c. not required
d. first variable and then fixed
Ans: a

13) Carey Fosters bridge is a modification of
a. Wheatstone bridge
b. Kelvin's double bridge
c. Andersons bridge
d. Hays bridge
Ans: a

14) Carey Fosters bridge method gives a direct comparison between S and R
a. in terms of lengths only
b. in terms of P and Q
c. in terms of galvanometer reading
d. in terms of contact resistance
Ans: a

15) In Carey Fosters bridge a slide wire of length 'L' is included between
a. ratio arms P and Q
b. the resistance P and unknown resistance R
c. the resistance Q and unknown resistance R
d. unknown resistance R and the standard S
Ans: d

16) In Carey Fosters bridge the sliding contact is being connected to the
a. Galvanometer
b. Unknown resistance R
c. Standard resistance S
d. ratio arm P
Ans: a

17) Balancing of the Carey Fosters bridge is obtained by varying the
a. Standard resistance S
b. Sliding contact on the slide wire
c. Ratio arm P
d. Ratio arm Q
Ans: b

18) A Kelvin's double bridge is best suited for the measurement of
a. Capacitance
b. Low resistance
c. High resistance
d. inductance
Ans: b

19) The Kelvin bridge is a modification of the wheat stone bridge and provides greatly increased accuracy in the measurement of

a. medium values
b. high values
c. low values
d. very low values
Ans: c

20) In measurement of low resistance by Kelvin's double bridge two sets of readings are taken. One with the current in one direction and the other with direction of current reversed. This is done to eliminate the effect of

a. thermo-electric emf
b. stray magnetic fields
c. accuracy
d. constant supply
Ans: a

21) The measurement of resistance of earth connection is carried out by

a. loss of charge method
b. potential fall method
c. ohmmeter
d. volt ammeter method
Ans: b

22) Megger is essentially a

a. dynamometer
b. series type ohm meter
c. shunt type ohmmeter
d. megohmmeter
Ans: d

23) The effect of leakage paths on the measurement are usually removed by some form of

a. guard circuit
b. capacitors
c. resistance
d. Inductors
Ans: a

24) The loss of charge method is used for

a. High R
b. Low R
c. Low L
d. High L
Ans: a

25) Guard circuit is used in measurement of high resistance in order to

a. eliminate the error owing to leakage current over insulation
b. eliminate the capacitive effect
c. guard the resistance against stray electrostatic field
d. avoid damage caused by high voltage used in measurement
Ans: a

Unit-7

1)The bridge circuits use the _____________ methods and operate on ___________ principle.

Ans:- comparison measurement, null-indication

2) In a bridge circuit when no current flows through the null detector which is generally galvanometer ,the bridge is said to be __________

Ans:- Balanced

3) In an ac.bridge for high frequencies __________ are used as a source.

Ans:- oscillators

4) Electronic oscillators They are used as a source of supply universely because
A) The output waveform is very close to sine wave.
B) The output frequency is very stable
C) The output power is sufficient to drive the bridge circuits.
D) All the above

Ans:- D

5) Which of the following detectors can be used effectively below 200Hz with greater sensitivity
A) Headphones
B) Vibration galvanometers
c) Tuneable amplifier detectors
D) Any of the above

Ans:-B

6) Which of the following bridges is also called as Maxwells Wien bridge?
A) Maxwells capacitance bridge
B) Andersons bridge
C) Maxwells inductance capacitance bridge
D) Hays bridge

Ans:- C

7) The advantage (s) of anderson bridge are
A) can be used for accurate measurement of capacitance interms of inductance
B) the bridge is easy to balance from convergence point of view compared to maxwells bridge in case of low values of Q
C) other bridges require variable capacitor but a fixed capacitor can be used for Andersons bridge
D) all the above

Ans:-D

8) what is the main disadvantage of de sauty bridge

A) it is suitable only for the capacitors with high dielectric losses

B) when the capacitors are with dielectric losses, then it is highly impossible to achieve balance condition

C) construction is very complicated

D) all the above

Ans:-B

9)Which of the following bridges can be used for high Q values

A) Maxwells inductance bridge

B) Wiens bridge

C) Andersons bridge

D) Heys bridge

Ans:- D

10) Which of the following is used for measuring incremental inductance

A) Hays bridge

B) Andersons bridge

C) Maxwells bridge

D) Owens bridge

Ans:- D

11) The detector used in high voltage Schering bridge is

A) Headphones

B) Vibration galvanometer

C) Tuneable amplifier

D) Any of the above

Ans:- B

12) The bridge used for testing small capacitances at low voltages with very high precision and less losses is

A) Schering bridge

B) High voltage schering bridge

C) De sauty bridge

D) Modified De Sauty bridge

Ans:- B

13) The advantage(s) of owens bridge is

A) The balance equations are of simple form

B) The balance equations are independent of the frequency

C) It is possible to use this bridge over a wide range of inductances values

D) All the above

Ans:- D

14) A capacitance comparison bridge is used to measure the capacitive impedance at a frequency of 3kHz. The bridge constants at bridge balance are
C3=10uF,
R1=1.2kohms,
R2=100kohms &
R3=120kohms
find the equivalent series circuit of the unknown impedance. (Rx ,Cx)
A) 10Mohms,0.12uF B)12mohms,0.16uF
C)14Mohms,0.14uF D)13Mohms,0.10uF
Ans:- A

15) Lx value for Maxwell inductance bridge is

A)R2R3C1 B)R3L3/R1

C)R1L2/R2 D)R3L2/R2

Ans:- B

16) Cx value for Schering bridge is

A)R4C2/R3 B)R2C2/R4

C)R4C2/R2 D)R3C2/R4

Ans:-A

17)For a series combination of Rx & Cx ,the angle between the voltage across the series combination and voltage across the capacitor Cx, is called _________
Ans:- Loss angle

18)Lx value for hays bridge is

A)R2R3C1 B)R1R3C1

C)(R2/R3)C1 D)(R1/R3)C1

Ans:- A

19) Lx value for inductance bridge is

A)R2R3C1 B)R3R1C1

C)(R3/R2)C1 D)(R3/R1)C1

Ans:- A

20)In Maxwell inductance bridge Q=

A)wR1C1 B)wR2C3

C)wR2/C3 D)wR1/C1

Ans:- A

Unit-8

MAGNETIC MEASUREMENTS

MULTIPLE CHOICE QUESTIONS

1. In case of ballistic galvanometer time period should be
a. very large
b. small
c. medium
d. large

2. Ballistic tests are used in magnetic measurements for determination of
a. flux density B, magnetic force H and B-H curve and hysteresis loop of the specimen
b. iron losses in the specimen
c. B-H curve of the specimen
d. Hysteresis loop of the specimen

3. The ballistic galvanometer is usually lightly damped so that
a. it may oscillate
b. it may remain stable
c. amplitude of first swing is large
d. amplitude of first swing is small

4. A Ballistic galvanometer is used to measure
a. charge
b. current
c. voltage
d. frequency

5. In a ballistic galvanometer, the inertia of the moving system is large so that
a. it is accelerating fast as soon as the coil is energized
b. it is practically stationary during the period the electricity is passing through the coil
c. the amplitude of oscillations is small
d. the frequency of oscillation is large

6. Ballistic galvanometer, can be calibrated by which of these one method?
a. standard solenoid

b. standard resistor

c. Diode

d. BJT

7. The construction of a ballistic galvanometer is similar to a
a. MI meter
b. vibration galvanometer
c. PMMC meter
d. D'Arsonval galvanometer

8. In magnetic measurements this galvanometer is usually connected across a _ _ _ _ _ _
a. search coil
b. emf
c. resistor
d. inductor

9. Flux meter has
a. high electro magnetic damping
b. eddy current damping
c. air friction damping
d. fluid friction damping

10. An advantage of flux meter is
a. The industrial form of flux meter is very large
b. Its scale is calibrated in weber directly
c. The deflection is dependent of the time taken by the flux change
d. Its scale is calibrated in Weber-turns directly

11. Which of the following measures the magnetic flux density?
a. Grassot flux meter
b. Ballistic galvanometer
c. Permeameter
d. ammeter

12. A PMMC instrument can be used as a flux meter by
a. removing the control springs
b. using a low resistance shunt
c. making the control springs of large moment of inertia
d. using a high series resistance

13. The flux meter is a special type of ballistic galvanometer provided with
a. large controlling torque damping ratio
b. heavy electro-magnetic damping and large controlling torque
c. small electro-magnetic damping and small controlling torque
d. heavy electro-magnetic damping and very small controlling torque

14. Flux meter is _ _ _
a. portable
b. not portable
c. more sensitive
d. not accurate

15. The flux meter is _ _ _ _ _ _ _ _ _ than ballistic galvanometer
a. less sensitive

b. more sensitive
c. not accurate
d. not portable

16. The flux meter is accurate than the
a. Ballistic galvanometer
b. Vibration galvanometer
c. D'Arsonval meter
d. PMMC meter

17. _ _ _ _ _ _ _ factor is the ratio of the total flux to the useful flux.
a. Leakage
b. Form
c. Utility
d. Dispersion
18. B-H curve can be used for determination of
a. eddy current losses
b. iron losses
c. Hysteresis losses
d. stray losses

19. The method available for the determination of BH curve of a specimen is
a. step by step method
b. flux meter
c. Ballistic galvanometer
d. A.C. Potentiometer

20. In step by step method (BH curve determinations) , the specimen must be _ _ _ _ _ _ _ _ _ before the test is started.
a. demagnetized
b. magnetized
c. heated
d. cool

21. In determination of BH curve ,the magnetising winding is supplied from a _ _ _ _ _ _ _ _ _ _ _ supply in step by step method
a. d.c
b. a.c
c. full rectified voltage
d. half rectified voltage

22. In determination of BH curve by method of reversals, a _ _ _ _ _ _ _ specimen is first wound with a search coil.
a. ring
b. square
c. rectangular
d. triangular

23. In determination of BH curve by method of reversals , after demagnetization the test is started by setting the magnetising current at its
a. lowest test value

b. highest test value
c. zero value
d. infinite value

24. In a Lloyd Fisher square used for determination of iron loss in a specimen of iron laminations, the current coil of the wattmeter is connected in the primary winding circuit, while the pressure coil is connected in the secondary winding circuit. This is done so that
a. the I2R losses in the current coil are not included in wattmeter reading
b. the I2R losses in the pressure coil circuit are not included in the wattmeter reading
c. the I2R losses both in current coil and pressure coil circuit are not included in the wattmeter reading
d. the wattmeter reads only the iron losses in the specimen of laminations

25. The method for iron loss measurement is
a. Ammeter method
b.Wattmeter method
c. Voltmeter method
d. energy meter method
26. In an Epstein square, used for finding the iron loss in a stack of laminations, the laminations are so arranged that
a. plane of each lamination is parallel to the plane of the square
b. plane of each lamination is perpendicular to the plane of the square
c. the plane of laminations may be either parallel or perpendicular to the plane of the square
d. the plane of laminations may be at any angle to the plane of square

27. Lloyd Fisher magnetic square method , the bundles of strips are placed inside four similar magnetising coils of heavy wire, connected in _ _ _ _ _ _ _ to form the primary winding.
a. series
b. parallel
c. cascade
d. series-parallel

28. Electrical energy is consumed in alternating current circuits, due to presence of iron, in the form of _ _ _ _ _ _ _
a. iron losses
b. copper losses
c. stray losses
d. rotational losses

29. The strips in L loyd Fisher magnetic square method are built up into
a. one bundles
b. three bundles
c. two bundles
d. four bundles

30. Lloyd Fisher magnetic square method , strips used are usually
a. 25 cm long and 5 to 6 cm wide
b. 100 cm long and 25 to 50 cm wide
c. 1 cm long and 1 to 2 cm wide
d. 100 cm long and 100 to 200 cm wide

31. In the measurement of iron loss by a.c bridge , the test is to be carried out at

a. Nyquist frequency
b. radio frequencies
c. resonant frequency
d. audio frequencies

32. The _ _ _ _ _ _ _ _ a.c bridge network , can be used for the measurement of iron loss.
a. Maxwell bridge
b. Andersons bridge
c. Hays bridge
d. Owens bridge

33. The type of potentiometer which is used to measure iron loss is
a. Gall-Tinsley
b. rectangular type
c. cromptons
d. slide wire

34. Campbell bridge is used to measure
a. Iron losses
b. stray losses
c. copper losses
d. rotational losses

35. In A.C. Potentiometer method for the measurement of iron loss, a variable resistor and a standard resistor are connected in series with
a. primary winding
b. secondary winding
c. Tertiary winding
d. Three phase winding

36. Maxwell's bridge is applied to
a. Iron loss and permeability measurements
b. Copper loss
c. Stray loss
d. Rotational loss

37. In measurement of iron loss by a.c potentiometer method, the ring specimen carries
a. two windings
b. one winding
c. three windings
d. four windings

38. Iron losses in a specimen of iron are determined by using a co-ordinate type of potentiometer The loss component of no load current is read by
a. Inphase potentiometer
b. Quadrature potentiometer
c. polyphase potentiometer
d. d.c potentiometer

Tutorial Problems

Unit-1

Example 1.24 : *The inductance of a moving iron instrument is given by* $L = (10 + 5\theta - \theta^2)\ \mu H$ *where* θ *is the deflection in radians from zero position. The spring constant is* 12×10^{-6} *Nm/rad. Estimate the deflection for a current of 5 A.*

(JNTU, May-04, Set - 4)

Example 1.25 : *The deflecting torque of an ammeter varies as the square of the current passing through it. If a current of 5 A produces a deflection of 90°, what will be the deflection for a current of 10 A when the instrument is, i) spring controlled ii) gravity controlled.* **(JNTU, May-04, Set - 1)**

Example 1.26 : *A moving coil instrument whose resistance is 25 Ω gives a full scale deflection with a current of 1 mA. This instrument is to be used with a manganin shunt to extend its range to 100 mA. Calculate the error caused by a 10 °C rise in temperature when,*

i) Copper moving coil is connected directly across the manganin shunt.

ii) A 75 Ω manganin resistance is used in series with the instrument moving coil. The temperature coefficient of copper is 0.004/°C and that of manganin is 0.00015/°C.

(JNTU, May-05, Set - 4)

Example 1.27 : *The spring constant of 3000 V electrostatic voltmeter is* 7.06×10^{-6} *Nm/rad. The full scale deflection of the instrument is 80°. Assuming the rate of change of capacitance with the angular deflection to be constant over the operating range, calculate the total change of capacitance from zero to full scale.*

(JNTU, May-05, Set - 1)

Example 1.28 : *An electrostatic voltmeter is constructed with six parallel, semicircular fixed plates equispaced at 4 mm intervals and five interleaved semicircular movable plates that move in plane midway between the fixed plates in air. The instrument is spring controlled. If the radius of the movable plates is 40 mm, calculate the spring constant if 10 kV corresponds to full scale deflection of 100°. Neglect edge effects and plate thickness. The permittivity of air is* 8.85×10^{-12} *F/m.*

(JNTU, May-05, Set - 3)

Unit-2

Example 2.16 : *A power primary C.T. has 300 secondary turns. The total resistance and reactance for the secondary circuit are 1.5 Ω and 1.0 Ω respectively. When 5 A flows through the secondary winding, the magnetizing m.m.f. is 100 AT and the iron loss component is 40 A. Determine the ratio and phase angle errors of the C.T. at this load.*

(JNTU, Nov.-2004, Set-4)

Example 2.17 : *A 800/5 A, 50 Hz current transformer with a single turn primary has a secondary burden comprising a non reactive resistance of 4 Ω. The secondary winding of 160 turns has a resistance of 0.2 Ω. At the rated secondary current, calculate : i) flux in the core, ii) the actual ratio of primary to secondary current iii) the phase angle between the primary and secondary currents. No load primary current of 6 A lags by 30° to the reversed secondary voltage.*

(JNTU, Nov.-2003, Set-2)

Example 2.18 : *A potential transformer has a primary resistance of 300 Ω, a primary reactance of 600 Ω, a secondary resistance of 0.75 Ω and a secondary reactance of 1.5 Ω. The primary to secondary turns ratio is 20 : 1, the primary voltage is 2000 V. Neglect the magnetizing and core loss current. Determine the voltage ratio correction factor, ratio error and the phase angle error when the burden on the secondary of the transformer is, a) 50 VA at 0.6 p.f. lagging b) 50 VA at unity p.f. and c) 25 VA at 0.6 p.f. leading.*

(JNTU, May-2004, Set - 3)

Unit-3

Example 3.8 : *A reading of 400 W is indicated on a 100 V / 5 A wattmeter used in connection with voltage and current transformers of nominal ratio 100 / 1 and 20 / 1 respectively. If the wattmeter pressure coil has a resistance of 400 Ω and an inductance of 20 mH and the ratio errors and the phase differences of the voltage and current transformers are + 1% and 50 min and – 0.5% and 100 min respectively. Compute the true value of the power measured. The load phase angle is 60° lagging and the frequency is 50 Hz.* **[JNTU, Nov.-2003, Set-3]**

Example 3.9 : *A potential transformer with a nominal ratio of 2000/100 V, Ratio correction factor of 0.995 and a phase angle of – 22′ is used with a current transformer of nominal ratio 100/5 A, ratio correction factor of 1.005 and a phase angle error of 10′, to measure the power (I_s leads I_p) to a single phase inductive load. The meters connected to these instrument transformers read correct readings of 102 volts, 4 amperes and 375 watts. Determine the true values of voltage, current and power supplied to the load.* **[JNTU, May-2004, Set-4]**

Example 3.10 : *A 500 V, 20 A dynamometer instrument is used as a wattmeter. Its current coil has 0.1 Ω resistance and pressure coil has 25 kΩ resistance with 0.1 H inductance. The meter was calibrated on d.c. supply. What is the error in the instrument if it is used to measure the power in a circuit with supply voltage of 500 V, load current of 24 A at 0.2 p.f. Assume that pressure coil is connected across load.*
[JNTU, May-2004, Set-1]

Example 3.11 : *A certain circuit takes 10 A at 200 V and the power absorbed is 1000 W. If the current coil of the wattmeter has a resistance of 0.15 Ω and its pressure coil has a resistance of 5000 Ω and inductance of 0.3 H, find.*
i) the error due to resistance for each of the two possible methods of connection.
ii) the error due to the inductance if the frequency of 50 Hz.
iii) the total error in each case. **[JNTU, May-2004, Set-2]**

Example 3.12 : *The power in a single phase high voltage circuit is measured by using instrument transformers with voltmeter, ammeter and wattmeter. Observed readings on the instruments (assuming no errors) are 115 V, 4.5 A and 200 W. Characteristics of the transformers are,*

P.T. : Nominal ratio : 11500/115 V, ratio correction factor 0.995, phase angle −25′

C.T. : Nominal ratio : 25/5 A, ratio correction factor 0.997, phase angle +15′.

Neglecting the voltage phase angle in the voltmeter, calculate the true power.
[JNTU, Nov.-2003, Set-1]

Unit-4

Example 4.3 : *A correctly adjusted 240 V, induction watt-hour meter has meter constant of 600 revolutions per kWh. Determine the speed of the disc for a current of 10 A, at a power factor of 0.8 lagging. If the lag adjustment is altered so that the phase angle between flux and applied voltage is 86°, calculate the error introduced at*
1) unity p.f., 2) 0.5 p.f. lagging. **[JNTU, May-2004, Set-1, Nov.-2003, Set-1]**

Example 4.4 : *The meter constant of a 230 V, 10 A watt-hour meter is 1800 revolutions per kWh. The meter is tested at half load and rated voltage and unity power factor. The meter is found to make 80 revolutions in 138 seconds. Determine the meter error at half load.* **[JNTU, May-2004, Set-3]**

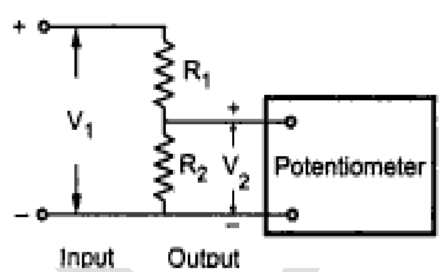
Example 4.5 : *An energymeter is designed to make 100 revolutions of disc for one unit of energy. Calculate the number of revolutions made by it when connected to load carrying 40 A at 230 V and 0.4 p.f. for an hour. If it actually makes 360 revolutions, find the percentage error.* **[JNTU, May-2004, Set-4]**

Unit-5

Example 5.3 : *A Crompton's potentiometer consists of a resistance dial having 15 steps of 10 Ω each and a series connected slide-wire of 10 Ω divided into 100 divisions. If the working current of the potentiometer is 10 mA and each division of slide wire can be read accurately upto $\frac{1}{5}^{th}$ of its span, calculate the resolution of the potentiometer in volts.*

Example 5.2 : *Design a volt-ratio box with a resistance of 20 Ω/V and ranges 3 V, 10 V, 30 V, 100 V. The volt-ratio box is to be used with a potentiometer having a measuring range of 1.6 V.*

Example 5.4 : *The voltage-ratio box shown in the Fig. 5.25 is designed in such a way that when 200 V is applied to the input terminals, the output voltage of 4 V is available at the output terminals of the box. Additionally the total resistance at input terminals must be equal to 1 MΩ. Determine voltage box ratio and values of R_1 and R_2.*



Examaple 5.9 : *A potentiometer that is accurate to ± 0.0001 volts (standard deviation) is used to measure current through a standard resistance of 0.1 ± 0.1 Ω % (standard deviation). The voltage across the resistance is measured to be 0.2514 volts. What is the current and to what accuracy it has been determined.* **[Nov.-2004, Set-2]**

Example 5.10 : *During the measurement of a low resistance using a potentiometer the following readings were obtained. Voltage drop across the low resistance under test = 0.4221 V.*

Voltage across the 0.1 Ω standard resistance = 1.0235 V

Calculate the value of unknown resistance, current through it and power lost in it.

Example 5.15 : *In the measurement of power by a polar potentiometer, the following readings were obtained.*

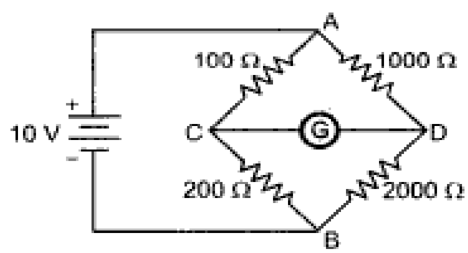
i) *Voltage across a 0.2 Ω standard resistance in series with load = 1.46 ∠ 32° V.*

ii) *Voltage across a 200 : 1 potential divider across the line = 1.37 ∠ 56° V.*

Estimate the current, voltage, power and power factor of the load. **[May-2005, Set-1]**

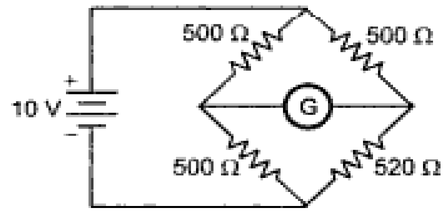
Unit-6

Example 6.5 : *The wheatstone bridge is shown in the Fig. 6.33. The galvanometer has a current sensitivity of 12 mm/μA. The internal resistance of galvanometer is 200 Ω. Calculate the deflection of the galvanometer caused due to 5 Ω unbalance in the arm BD.*



Example 6.6 : *The four arms of the Wheatstone bridge have the following resistances, AB = 1000 Ω, BC = 1000 Ω, CD = 120 Ω, DA = 120 Ω. The bridge is used for strain measurement and supplied from 5 V ideal battery. The galvanometer has sensitivity of 1 mm/μA with internal resistance of 200 Ω. Determine the deflection of the galvanometer if arm DA increases to 121 Ω and arm CD decreases to 119 Ω.*

Example 6.7 : *Using the approximation of slightly unbalanced bridge, calculate the current through the galvanometer having internal resistance of 125 Ω, for the bridge shown in the Fig. 6.35.*



Example 6.16 : *A highly sensitive galvanometer can detect a current as low as 0.1 nA. This galvanometer is used in Wheatstone bridge as a detector. The resistance of galvanometer is negligible. Each arm of the bridge has a resistance of 1 kΩ . The input voltage applied to the bridge is 20 V. Calculate the smallest change in the resistance, which can be detected.* **[JNTU, Nov.-2003, Set-2]**

Unit-7

Example 7.19 : *In a Maxwell's inductance comparison bridge arm ab consists of a coil with inductance L_1 and resistance r_1 in series with a non-inductive resistance R. The arm bc and ad are each of non-inductive resistances of 100 Ω . Arm ad consists of standard variable inductor L_2 of resistance 32.7 Ω. Balance is obtained when $L_2 = 47.8$ mH and R = 1.36 Ω. Find resistance and inductance of the coil in arm ab.*

Example 7.20 : *The four impedances of an a.c. bridge are*

$Z_{AB} = 400\angle 50^\circ\ \Omega$, $Z_{AD} = 200\angle 40^\circ\ \Omega$,

$Z_{BC} = 800\angle -50^\circ\ \Omega$, $Z_{CD} = 400\angle 20^\circ\ \Omega$

Find out whether the bridge is balanced under these conditions are not.

Example 7.21 : *A four arm a.c. bridge a-b-c-d has following impedances.*

Arm ab : $Z_1 = 200\angle 60°\ \Omega$, *Arm ad :* $Z_2 = 400\angle -60°\ \Omega$

Arm bc : $Z_3 = 300\angle 0°\ \Omega$, *Arm cd :* $Z_4 = 600\angle 30°\ \Omega$

Determine whether it is possible to balance the bridge under above conditions.

Example 7.23 : *The arms of five node bridge are as follows :*

Arm ab : an unknown impedance (R_1, L_1) *in series with a non-variable resistor* r_1

Arm bc : a non-inductive resistor $R_3 = 100\ \Omega$

Arm cd : a non-inductive resistor $R_4 = 200\ \Omega$

Arm da : a non-inductive resistor $R_2 = 250\ \Omega$

Arm de : a variable non-inductive resistor r.

Arm ec : a lossless capacitor $C = 1\ \mu F$, .

An a.c. supply is connected between a and c. Detector is between b and e. Calculate the resistance R_1 *and inductance* L_1 *when under balance condition* $r_1 = 43.1\ \Omega$ *and* $r = 229.7\ \Omega$. **[JNTU, Nov.-2003, Set-1]**

Example 7.24 : *The four arms of the bridge are as follows :*

Arm ab : An imperfect capacitor C_1 *with an equivalent series resistance of* r_1

Arm bc : A non-inductive resistance R_3

Arm cd : A non-inductive resistance R_4

Arm da : An imperfect capacitor C_2 *with an equivalent resistance of* r_2 *in series with resistance* R_2.

A supply at 450 Hz is connected between terminals a and c and the detector is connected between b and d. At the balance condition :

$R_2 = 4.8\ \Omega$, $R_3 = 200\ \Omega$, $R_4 = 2850\ \Omega$, *and* $C_2 = 0.5\ \mu F$, $r_2 = 0.4\ \Omega$

Calculate values of C_1 *and* r_1 *and also of the dissipating factor for the capacitor.*

Example 7.25 : *An a.c. bridge circuit is used to measure the properties of a sample sheet steel at 2 kHz. At balance arm ab is test specimen. Arm bc is 100 Ω . Arm cd is 0.1 μF capacitor and branch da is 834 Ω is series with 0.12 μF capacitor. Calculate the effective impedance of the specimen under test conditions.* **[JNTU, May-2004, Set-3]**

Unit-8

Example 8.10 : *In loss tests on a sample of iron laminations the following results were recorded,*

a) At 60 Hz, 250 V, total iron loss = 200 W

b) At 40 Hz, 100 V, total iron loss = 40 W.

Calculate the eddy current and hysteresis loss for each test. The steinmetz index is 1.6.

Example 8.11 : *In a test on a specimen of total weight 13 kg, the measured values of iron loss at a given value of flux density were 17.2 W at 40 Hz and 28.9 W at 60 Hz. Estimate the values of hysteresis and eddy current losses at 50 Hz for the same value of peak flux density.* **(JNTU, May-2004, Set-3)**

Example 8.12 : *The mutual inductance between magnetising winding and a search coil wound on a specimen is 9 mH. The search coil has 20 turns. The area of cross-section of specimen is 5000 mm^2. The reversal of current of 3 A in magnetising winding produces the throw of 60 galvanometer divisions. Calculate the value of flux density in the specimen if the reversal of current in the magnetising winding produces a galvanometer deflection of 36 divisions.* **(JNTU, May-2004, Set-1)**

Example 8.13 : *An iron ring has a mean diameter of 0.15 m and a cross-sectional area of 34.5 mm^2. It is wound with a magnetising winding of 330 turns and a secondary winding of 220 turns. On reversing a current of 12 A in a magnetising winding, a ballistic galvanometer gives a throw of 272 divisions. With a Hibbert's magnetic standard with 10 turns and flux of 0.00025 Wb, gives a reading of 102 scale divisions. Other conditions remain same. Find the relative permeability of the specimen.* **(JNTU, May-2004, Set-4)**

Known Gaps if any

Known gaps: No gaps

Action taken:

DISCUSSION TOPICS IF ANY (GROUP WISE TOPICS)

S.No	Group	Topic
1	I	Electrostatic voltmeters
2	II	Power factor meters

3	III	Frequency meters
4	IV	LPF Wattmeters
5	V	Errors in energy meters
6	VI	Applications of AC,DC potentiometers
7	VII	Kelvin’s bridge and its modifications
8	VIII	Bridges used for measuring inductance
9	IX	Bridges used for measuring capacitance
10	X	Ballistic galvanometer, fluxmeter

REFERENCES, JOURNALS, WEBSITES AND E-LINKS

TEXT BOOKS:-

1. Electrical measurements and measuring instruments by E.W Golding ad F.C Widdis fifth edition.

2. Electrical and electronic measurement and instruments by A.K Sawhney Dhanpat Rai and co

3. Electrical measuring instruments by R.K Raj put.

REFERENCE TEXT BOOKS:-

1. Electrical measurements and measuring instruments by Bakshi-Technical publications

WEBSITES:-

1. www.iitm.ac.in/resources/nptel/electrical

2. www.iitk.ac.in/electrical

JOURNALS:-

1. Mobile *Data Communications Systems*. - Peter Wong and David Britland Artech House Inc.

2. *DATA. COMMUNICATION SYSTEM*. Dr.S.S.Riaz Ahamed.

3. "Future Tactical Military *Communications Systems*" from the IEEE *Communications* Society

QUALITY MEASUREMENT SHEETS

A. COURSE END SURVEY

B. TEACHING EVALUATION

Student List

S.No	Roll no	Student name
1	12R11A0201	A AKHILA
2	12R11A0202	ADICHERLA MAHESH
3	12R11A0203	B KALYAN CHAKRAVARTHY
4	12R11A0204	BALLA RAVI TEJA
5	12R11A0205	BANDARU MANIRATHNAM
6	12R11A0206	BANDIKATLA CHARAN
7	12R11A0207	BANOTHU VIJAY
8	12R11A0208	BASVAPATHRUNI VIJAY KUMAR
9	12R11A0209	BHAMIDIPATI SRI HARSHA
10	12R11A0210	CHINNAPAGA SRINIVAS
11	12R11A0211	D V S KRISHNA DATTA
12	12R11A0212	DANDEM GIRIDHAR
13	12R11A0213	DAYALWAR ARCHANA
14	12R11A0214	G MADHAVI
15	12R11A0215	GONDHI SHRUTHI
16	12R11A0216	GORTHY YESASWINI
17	12R11A0217	GOSANGI PRASANTH BABU
18	12R11A0218	GUGULOTH KAVITHA
19	12R11A0220	GUNDLA BHARGAVI
20	12R11A0221	IREDDY ASHOK
21	12R11A0222	K AKASH BABU
22	12R11A0223	KARRE SHRUTHI

23	12R11A0224	KASULA SREENIJA
24	12R11A0225	KODIMALA SAI PRASANTHI
25	12R11A0226	KRUTHI VENTI NAGA SAI VARUN
26	12R11A0227	MACHARLA RAJU
27	12R11A0228	MARELLA N V S S SATYA SRIVATHSA
28	12R11A0230	MITTA KAVYA GOUD
29	12R11A0231	MOLUGURAM DEVI VARA PRASAD
30	12R11A0232	MUDAM PRASHANTH KUMAR
31	12R11A0233	NEERAJ RANJAN
32	12R11A0234	PABBATHI UMAKANTH
33	12R11A0235	PARTIBHAN ROHIT
34	12R11A0236	PASAM KUMARASWAMY
35	12R11A0237	PUJARI RAMYA KEERTHI
36	12R11A0238	RAIPALLI PRAVEEN KUMAR
37	12R11A0239	RODDA MEGHA HARSHINI
38	12R11A0241	SHAIK KARIMULLAH ARAFAT
39	12R11A0242	SHAIK NISAR AHMED
40	12R11A0243	T SAI RAHUL REDDY
41	12R11A0244	THAKUR NITHIN SINGH
42	12R11A0245	TUMMA SAIKRISHNA
43	12R11A0246	VADDEPALLI RAJANI
44	12R11A0247	VADDEPALLY SAICHANDRA
45	12R11A0248	VATTIMALLA GOUTHAM
46	12R11A0249	VENKAT RAJU V

47	12R11A0250	YANADI KARTHIK
48	12R11A0251	THANGALLAPALLY SURYA VAMSHI
49	12R11A0252	KODEBOYINA VIJAY SAI PHANEENDRA
50	12R11A0253	VADEGHAR RAKESH KUMAR
51	12R11A0255	K SAI KIRAN
52	13R15A0201	KONDIPARTHI SAI KUMAR
53	13R15A0202	CHAKILAM SAI KIRAN
54	13R15A0203	MADHIREDDY SRIKANTH REDDY
55	13R15A0204	ANUSANDHANAM SANTHOSH KUMAR
56	13R15A0205	NARSINGA DEVENDER
57	13R15A0206	CHIKKA NAGENDRA BABU
58	13R15A0207	MD AZHARUDDIN
59	13R15A0208	CHIGILIPALLI SAI SANKAR
60	13R15A0209	N PRABHAKAR
61	13R15A0210	MALOTH SANTHOSH
62	13R15A0211	PUDARIE RAHUL GOUD
63	13R15A0212	GANDAM PRAVEENKUMAR
Total: 63 Males: 49 Females: 14		

GROUP-WISE STUDENTS LIST FOR DISCUSSION TOPICS

Group 1

12R11A0201	A AKHILA
12R11A0202	ADICHERLA MAHESH
12R11A0203	B KALYAN CHAKRAVARTHY
12R11A0204	BALLA RAVI TEJA
12R11A0205	BANDARU MANIRATHNAM
12R11A0206	BANDIKATLA CHARAN

Group 2

12R11A0207	BANOTHU VIJAY
12R11A0208	BASVAPATHRUNI VIJAY KUMAR
12R11A0209	BHAMIDIPATI SRI HARSHA
12R11A0210	CHINNAPAGA SRINIVAS
12R11A0211	D V S KRISHNA DATTA
12R11A0212	DANDEM GIRIDHAR

Group 3

12R11A0213	DAYALWAR ARCHANA
12R11A0214	G MADHAVI

12R11A0215	GONDHI SHRUTHI
12R11A0216	GORTHY YESASWINI
12R11A0217	GOSANGI PRASANTH BABU
12R11A0218	GUGULOTH KAVITHA

Group 4

12R11A0220	GUNDLA BHARGAVI
12R11A0221	IREDDY ASHOK
12R11A0222	K AKASH BABU
12R11A0223	KARRE SHRUTHI
12R11A0224	KASULA SREENIJA
12R11A0225	KODIMALA SAI PRASANTHI

Group 5

12R11A0226	KRUTHI VENTI NAGA SAI VARUN
12R11A0227	MACHARLA RAJU
12R11A0228	MARELLA N V S S SATYA SRIVATHSA
12R11A0230	MITTA KAVYA GOUD
12R11A0231	MOLUGURAM DEVI VARA PRASAD
12R11A0232	MUDAM PRASHANTH KUMAR

Group 6

12R11A0233	NEERAJ RANJAN
12R11A0234	PABBATHI UMAKANTH
12R11A0235	PARTIBHAN ROHIT
12R11A0236	PASAM KUMARASWAMY
12R11A0237	PUJARI RAMYA KEERTHI
12R11A0238	RAIPALLI PRAVEEN KUMAR

Group 7

12R11A0239	RODDA MEGHA HARSHINI
12R11A0241	SHAIK KARIMULLAH ARAFAT
12R11A0242	SHAIK NISAR AHMED
12R11A0243	T SAI RAHUL REDDY
12R11A0244	THAKUR NITHIN SINGH
12R11A0245	TUMMA SAIKRISHNA

Group 8

12R11A0246	VADDEPALLI RAJANI
12R11A0247	VADDEPALLY SAICHANDRA
12R11A0248	VATTIMALLA GOUTHAM
12R11A0249	VENKAT RAJU V
12R11A0250	YANADI KARTHIK
12R11A0251	THANGALLAPALLY SURYA VAMSHI
12R11A0252	KODEBOYINA VIJAY SAI PHANEENDRA

Group 9

12R11A0253	VADEGHAR RAKESH KUMAR
12R11A0255	K SAI KIRAN
13R15A0201	KONDIPARTHI SAI KUMAR
13R15A0202	CHAKILAM SAI KIRAN
13R15A0203	MADHIREDDY SRIKANTH REDDY
13R15A0204	ANUSANDHANAM SANTHOSH KUMAR
13R15A0205	NARSINGA DEVENDER

Group 10

13R15A0206	CHIKKA NAGENDRA BABU
13R15A0207	MD AZHARUDDIN
13R15A0208	CHIGILIPALLI SAI SANKAR
13R15A0209	N PRABHAKAR
13R15A0210	MALOTH SANTHOSH
13R15A0211	PUDARIE RAHUL GOUD
13R15A0212	GANDAM PRAVEENKUMAR