

Code No: R31022

R10

Set No: 1

III B.Tech. I Semester Supplementary Examinations, June/July - 2014

ELECTRICAL MEASUREMENTS

(Electrical and Electronics Engineering)

Time: 3 Hours**Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks

1. a) Derive the expression for torque equation for a moving iron attraction type instrument and comment up on the nature of scale [8]
b) Define the terms current sensitivity, voltage sensitivity and megohm sensitivity as applied to D'Arsonval galvanometers. Explain how current sensitivity of a galvanometer can be increased. [7]
2. a) Define the following terms as applied to instrument transformers:
i) Burden of an instrument transformer ii) Actual Transformation ratio [8]
iii) Nominal Transformation ratio iv) Turn ratio
b) The primary winding of a 1000/5 A, 50 Hz current transformer has a single turn. Its secondary burden consists of a non-inductive impedance of 1.4Ω . If the iron loss in the core is 1.4 W at full load and magnetizing mmf is 80AT, Calculate: i) Flux in the core ii) Ratio error at full load. Neglect leakage reactance [7]
3. Derive an expression for the power factor of a balanced three phase load with the help of two wattmeter reading. What will be the power factors?
i) When the readings of the two wattmeters are equal
ii) When the reading of one of the wattmeter is zero
iii) When the readings of two wattmeters are equal and opposite [15]
4. a) Explain the connection diagram of Crompton Potentiometer and bring out its salient features. How is it standardized [8]
b) Explain how does an ac potentiometer differ from a dc potentiometer [7]
5. a) What are the problems associated with measurement of low resistances? How are they overcome through use of Kelvin's Double bridge? Derive the expression for the unknown resistance in the case of Kelvin's double bridge [8]
b) A resistance is measured by the Ammeter – Voltmeter method. With the voltmeter connected across the resistance the readings on the ammeter and voltmeter are 0.4 A and 3.2 V respectively. The resistance of the voltmeter is 500Ω . Calculate: i) True value of resistance ii) Percentage error in the value of the resistance if the voltmeter current is ignored. [7]
6. a) Explain how the inductance can be measured by using Maxwell bridge with a neat diagram
b) List the applications of Wien bridge
c) Explain the different types of detectors used in ac bridges [7+4+4]
7. Explain with the help of neat diagram, a method for the determination of B-H curve of a magnetic sample List out the various sources of errors and methods of minimizing them [15]

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8. Write short notes on the following
- a) Integrating type digital voltmeters
 - b) Creeping in energy meter
 - c) Torque weight ratio of an indicating instrument

[5 x3 = 15]

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1. a) Explain the constructional details and principle of operation of a D'Arsonval galvanometer. Derive the expression for steady state deflection [8]
b) In a moving coil galvanometer with a free time period of 3 seconds, a current of $2.5\mu\text{A}$ gives a deflection of 300 mm on a scale at a distance of 1.5 m. The moving system has a moment of inertia of $4 \times 10^{-6} \text{ Kg-m}^2$. Calculate the total resistance in the galvanometer circuit for critical damping [7]
2. Derive the expression for Ratio error and phase angle error in current transformer with a neat vector diagram and explain briefly how they can be compensated [15]
3. a) Explain friction compensation and creep prevention in an energy meter [7]
b) Two Wattmeters connected to read the total power in a 3- phase system supplying a balanced load read 10.5 KW and $- 2.5\text{KW}$ respectively. Calculate the total power and power factor. Also explain the significance of i)equal wattmeter reading and ii)a zero reading on one wattmeter [8]
4. a) Explain volt – ratio box and its significance with respect to potentiometer [7]
b) Explain the construction and working of a polar type potentiometer. Explain the method for standardizing it [8]
5. a) Explain Carey Foster's slide wire bridge for the measurement of medium resistances [8]
b) Calculate the insulation resistance of a short length of cable which was tested for insulation resistance by loss of charge method. An electrostatic voltmeter of infinite resistance is connected between the cable and earth forming a joint capacitance of $0.0006 \mu\Omega$. It is observed that the charging voltage falls from 300 Volts to 100 Volts in one minute. [7]
6. a) With help of neat circuit diagram ,explain how capacitance can be measured by the use of Schering bridge and also draw the required vector diagram under balanced conditions. [10]
b) List the advantages and disadvantages of Maxwell's Bridge [5]
7. a) Define the following terms relating to magnetic materials/
i) Magnetic susceptibility ii) Coercive force iii) curie temperature iv) Remanence [8]
b) A laminated iron cylinder is rotated in a magnetic field. The iron loss is 500W at 480 rpm and 700 W at 600 rpm. Find the loss if the laminations were twice as thick, the induction density increased by 20 % and speed were 720 rpm. Take Steinmetz coefficient as 1.6 [7]
8. Write short notes on the following: [8+7]
a) Dual slope integrating type digital voltmeter
b) Digital multimeter

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1. a) Explain briefly about the following damping methods
i) Air friction damping ii) Eddy current damping iii) Fluid friction damping [8+7]
b) The resistance of a moving voltmeter is $11\text{K}\Omega$. The moving coil has 100 turns and is 40mm long and 30mm wide. The flux density in the air gap is 0.05 Wb/m^2 . Calculate the deflection produced by 220V if the spring control gives a deflection 1θ for a torque of $20 \times 10^{-7}\text{Nm}$.
2. a) Explain the advantages of instrument transformers over ammeter shunts and voltmeter multipliers? [7]
b) Explain the 'Absolute null method' for testing of a Potential transformer with a neat diagram [8]
3. Explain the constructional details and working of a single phase electro-dynamometer type of wattmeter. Derive the expression for deflection for a.c operation if the instrument is spring controlled. [15]
4. a) Explain with the help of suitable diagram, how a dc potentiometer can be used for
i) Calibration of a voltmeter ii) Calibration of a wattmeter [7]
b) A basic slide wire potentiometer has a working battery voltage of 3 volts with negligible resistance. The resistance of the slide wire is 400Ω and its length is 200 cm. A 200 cm scale is placed along the slide wire. The slide wire has 1mm scale divisions and it is possible to read up to $1/5$ of a division. The instrument is standardized with 1.018V standard cell with sliding contact at the 101.8 cm mark on scale. Calculate: i) Working current ii) Resistance of series rheostat iii) Measurement range iv) Resolution of instrument [8]
5. a) Explain with the help of diagram the loss of charge method for determining the insulation resistance of a length of cable [8]
b) Explain the limitations of Wheatstone Bridge [7]
6. a) Explain how the inductance can be measured by using Hay bridge with a neat diagram [7]
b) A balanced 1 KHz bridge has the following configuration:
Arm AB : $R_1 = 1000\Omega$ in parallel with $C_1 = 0.053\mu\text{F}$
BC : $R_2 = 1500\Omega$ in series with $C_2 = 0.53\mu\text{F}$
CD : the unknown
DA : Pure capacitance $C_4 = 0.265\mu\text{F}$
Calculate the unknown R and C of the unknown. Draw the phasor diagram of the above bridge under balanced condition. [8]

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7. a) List the advantages and disadvantages of ring and bar specimens used in magnetic testing of materials [7]
b) Explain how magnetizing and loss components of no load current of a transformer be determined by using an A.C. Potentiometer. [8]
8. Write short notes on the following:
a) Ramp type Digital voltmeter
b) Errors in moving iron instruments
c) Turns compensation with respect to instrument transformers [5 x3 = 15]



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1. a) Explain the factors to be taken in to consideration while selecting the measuring instruments. [7]
b) The full scale deflecting torque of a 10 A moving – iron ammeter is 4×10^{-5} Nm. Calculate in $\mu\text{H}/\text{rad}$, the rate of change of self inductance of the instrument at full scale [8]
2. Explain with a neat sketch the construction and principle of a dynamometer type single phase power factor meter. How would the accuracy of such an instrument be affected of frequency and wave form variation? [15]
3. a) Explain the construction and working of a single – phase induction type energy meter with a neat diagram [8]
b) A meter whose constant is 750 revolutions per KWH makes 15 revolutions in 30 seconds. Calculate the load in KW. [7]
4. Explain the construction and working of a co-ordinate type of potentiometer. Explain the procedure for standardization of the potentiometer. Explain how this potentiometer can be used for : i) Measurement of self inductance of a coil ii) Calibration of a voltmeter and A.C .energy meters [15]
5. a) Explain the arrangement necessary in order that the greatest precision possible may be obtained using Kelvin’s double bridge for the comparison of two low resistances [8]
b) In a Kelvin double bridge, there is error due to mismatch between the ratios of outer and inner arm resistances. The following data relate to this bridge:
Standard resistance = $100.03 \mu\Omega$; inner ratio arms = 100.31Ω and 200Ω ; outer ratio arms = $100.24\mu\Omega$ and 200Ω ; The resistance of connecting leads from standard to unknown resistor is $680\mu\Omega$. Calculate the unknown resistance [7]
6. a) Explain how the frequency can be measured by using Wein bridge with a neat diagram [8]
b) A sample of Bakelite was tested by the Schering bridge method at 25 KV , 50 Hz. Balance was obtained with a standard condenser of 109 PF capacitance, a condenser of capacitance $0.5 \mu\text{F}$ in parallel with a non reactive resistor of 309Ω and a non reactive resistor of 100Ω . Determine the equivalent series resistance and the power factor of the specimen [7]
7. a) Explain the ‘Lloyd Fisher square’ method of measuring iron losses in ferromagnetic material [8]
b) Explain the method for determination of B-H curve of a magnetic materials using step by – step method [7]
8. Write short notes on the following: [5 x3 = 15]
a) Features of Digital voltmeters b) UPF Wattmeter c) Phantom loading in Energy meters

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