Code No: 07A50201 **R07** **Set No. 2**

III B.Tech I Semester Examinations,November 2010
ELECTRICAL MEASUREMENTS
Electrical And Electronics Engineering

Time: 3 hours Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Derive the equations of balance for an Anderson's bridge. Draw the phasor diagram for conditions of under balance.

   (b) In an Anderson's bridge for the measurement of inductance the arm AB consists of an unknown impedance with inductance L and R, a unknown variable resistance in arm BC, fixed resistance of 600Ω each in arms CD and DA, a unknown variable resistance in arm DE and a capacitor with fixed capacitance of 1μFin the arm CE. The a.c.supply of 100Hz is connected across A and C and the detector is connected between B&E. If the balance is obtained with a resistance of 400Ω in the arm DE and a resistance of 800Ωin the arm BC, Calculate the value of R and L. [8+8]

2. Prove that in a ballistic galvanometer the charge is proportional to first swing of the moving coil? [16]

3. (a) What are electrostatic instruments? What is the basic principle on which they operate?

   (b) Discuss the working of a repulsion type electrostatic instrument with a neat sketch. [8+8]

4. (a) State and explain the essential features of construction of one type of A.C. potentiometer with the help of neat sketch.

   (b) How the D.C. potentiometer is standardized? [8+8]

5. (a) Explain about friction in an energy meter.

   (b) A 230 V, single phase, watt hour meter has a constant load of 4 A passing through it for 6 hours at unity power factor. If the meter disc makes 2208 revolutions during this period, what is the meter constant in revolutions per kWh. Calculate the power factor of the load if the number of revolutions made by the meter are 1472 when operating at 230 V and 5 A for 4 hours. [8+8]

6. (a) Describe briefly the different errors present in an electrodynamometer type of wattmeter.

   (b) A 3 phase 500 V motor load has a power factor of 0.4. Two wattmeters connected to measure the input. They show the input to be 30 kW. Find the reading of each instrument. [8+8]

7. (a) Derive the expression for the ratio error and phase angle error of a current transformer.

(b) A 500/100 V potential transformer has the following constants:
Primary winding resistance = 47.25 ohms
Secondary winding resistance = 0.43 ohms
Primary winding reactance = 33.1 ohms
Secondary winding reactance is negligible.
No load primary current = 0.1 Amp at 0.6 p.f

Calculate:

i. The phase angle between primary winding and reversed secondary winding voltage.
ii. The values of secondary winding current at unity power factor when the phase angle is zero. [8+8]

8. (a) Explain the working of a Carey Foster slide wire bridge with a neat circuit diagram.
(b) In a Carey Foster's bridge a resistance of 1.0125Ω is compared with a standard resistance of 1.0000Ω, the slide wire has a resistance of 0.250Ω in 100 divisions. The ratio arms normally each 10Ω, are actually10.05 and 9.95Ω respectively. How far(in scale divisions) are the balance positions from those which would obtain of ratio arms were true to their nominal value? The slide wire is 100cm long. [8+8]

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Code No: 07A50201 **R07** **Set No. 4**

III B.Tech I Semester Examinations,November 2010
ELECTRICAL MEASUREMENTS
Electrical And Electronics Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Derive the equations for balance in the case of Maxwell's Inductance Capacitance bridge. Draw the phasor diagram for balance conditions. State the advantages of this bridge.

   (b) A 1000Hz bridge has the following constants:
   Arm AB, R1= 1000Ω in parallel with C1 =0.5μF;
   Arm BC, R3=1000Ω in series with C3 = 0.5μF;
   Arm CD, L4 =30mH in series with R4 = 200 Ω. Find the constants of arm DA to balance the bridge. Express the result as a pure resistance R in series with a pure inductance L or Capacitance C. [+8+8]

2. Explain the construction and working principle of a ballistic galvanometer with a neat sketch? [16]

3. (a) What are portable electrostatic instruments? Explain with necessary theory, working of Kelvin absolute electrometer.

   (b) Explain with the diagram Kelvin multi cellular voltmeter. [8+8]

4. (a) Explain the constructional features used in potential transformers to reduce the ratio and phase angle errors.

   (b) With neat sketch, explain how high currents and voltages can be measured with the help of instrument transformers. Describe the advantages of instrument transformers for extension of range of current and voltage on high voltage a.c systems. [8+8]

5. (a) Describe the constructional details of an Electrodynamometer type wattmeter.

   (b) Derive the expression for torque when the instrument is used on A.C. Explain why it is necessary to make the potential coil circuit purely resistive. [8+8]

6. (a) Explain about Braking system in an energy meter.

   (b) The constant for a three phase, 3 element integrating wattmeter is 0.12 revolution of disc per kWh. If the meter is normally used with a potential transformer of ratio 22,000/110 V and a current transformer of ratio 500/5 A; find the error expressed as a percentage of the correct reading. From the following test figures for the instrument only: Line Voltage = 100 V: Current = 5.25 A; Power factor = 1;
   Time to complete 40 revolutions = 61 s. [8+8]

7. (a) What are the different factors which affect the precision measurement of medium resistances with Wheatstone bridge? Explain how their effects are minimized or eliminated?

   (b) In Wheatstone bridge the four arm resistances are as follows:
   AB = 1000 Ω; BC = 100 Ω; AD = 2005 Ω; DC =200 Ω
   The battery has an emf of 5V and negligible internal resistance. The galvanometer has a current sensitivity of 10mm/μA and internal resistance of 100Ω. Calculate the deflection of the galvanometer and the sensitivity of the bridge interms of deflection per unit change in resistance? [8+8]

8. (a) Explain the reasons why a separate "standard cell dial circuit" is provided in modern D.C. potentiometers?

   (b) Draw the circuit diagram of a basic slide wire D.C. potentiometer. Explain its working? [8+8]

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Code No: 07A50201 **R07** **Set No. 1**

III B.Tech I Semester Examinations,November 2010
ELECTRICAL MEASUREMENTS
Electrical And Electronics Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Describe how high currents and voltages are measured with help of instrument transformers. Draw diagrams to illustrate your answer. Describe the advantages of instrument transformers as regards extension of range of current and voltage on high voltage A.C systems. [16]

2. (a) What is a PMMC instrument? Explain with a neat sketch working of such an instrument when used as an ammeter.
   (b) The coil of a moving coil voltmeter is 40mm$\times$ 30mm wide and has 100turms wound on it. The control spring exerts a torque of 0.25×10^{-3} Nm when the deflection is 50 divisions on the scale. If the flux density of the magnetic field in the air gap is 1 wb/m^2, estimate the resistance that must be put in series with the coil to give 1V/division. Resistance of volt meter is 10,000 ohms. [8+8]

3. (a) What are the differences between Flux meter and Ballistic galvanometer?
   (b) The coil of ballistic galvanometer has 115 turns of mean area 25×40mm^2. The flux density in the air gap is 0.12Wb/m^2 and the moment of inertia is 0.5 $\times 10^{-6}$ Kg-m^2.
   The stiffness constant of spring is 45×10^{-6} Nm/rad. What current must be passed to give a deflection of 1000 and what resistance must be added in series with the movement to give critical damping. [8+8]

4. (a) Draw the circuit of a Kelvin's double bridge used for measurement of low resistances. Derive the condition for balance.
   (b) A highly sensitive galvanometer can detect a current as low as 0.1nA. This galvanometer 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 20V. Calculate the smallest change in resistance which can be detected. The resistance of the galvanometer can be neglected as compared with the internal resistance of bridge. [8+8]

5. (a) Write short notes on:
      i. Voltage compensation:
      ii. Temperature compensation.
   (b) A 230 V, single phase, watt hour meter has a constant load of 4 A passing through it for 6 hours at unity power factor. If the meter disc makes 2208

revolutions during this period, what is the meter constant in revolutions per kWh. Calculate the power factor of the load if the number of revolutions made by the meter are 1472 when operating at 230 V and 5 A for 4 hours. [8+8]

6. (a) Draw the circuit diagram and phasor diagram of Owen's bridge under balance conditions. Derive the equations under balance conditions.

   (b) An Owen's bridge is used to measure the properties of a sample of sheet steel at 2 KHz. At balance, arm AB is test specimen; arm BC is R3 = 100 Ω; arm CD is C4 = 0.1μF and arm DA is R2 = 834 Ω in series with C2 = 0.124μF. Calculate the effective impedance of the specimen under test conditions.[8+8]

7. (a) Describe the steps when D.C. Crompton's potentiometer is used to measure an unknown resistance?

   (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 200cm scale is placed along the slide wire. The slide wire has 1mm scale division and it is possible to read upto 1/5th of a division. The instrument is standardized with 1.018V standard cell with sliding contact at the 101.8cm mark on the scale. Calculate:

      i. Working current
      ii. The resistance of a series rheostat
      iii. The measurement range and
      iv. The resolution of the instrument. [16]

8. (a) From fundamentals, derive the formula for power in A.C circuits.

   (b) The current coil of a wattmeter is connected in series with an Ammeter and an inductive load. A voltmeter and the voltage coil are connected across a 100 Hz supply. The ammeter reading is 4.5 A and the voltmeter and wattmeter readings are 240V and 23 watts. The inductance of voltage circuit is 10 mH and its resistance 2000Ω. If the voltage drops across the ammeter and the current coil are negligible, what is the percentage error in the wattmeter reading? [8+8]

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Code No: 07A50201 **R07** **Set No. 3**

III B.Tech I Semester Examinations,November 2010
ELECTRICAL MEASUREMENTS
Electrical And Electronics Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. The four arms of a wheatstone bridge as follows:

   AB = 200Ω; BC = 20Ω; CD = 4Ω; and DA = 50Ω The galvanometer has resistance of 150Ω, a sensitivity of 100 mm/μA and is connected across AC. A sourec of 5 V d.c. is connected across BD. Calculate the current through the galvanometer and its deflection if the resistance of arm DA is changed from 200Ω to 210Ω. [16]

2. (a) Explain the working of a 3-phase wattmeter. Draw a neat sketch of the wattmeter and also its connections. Describe how the mutual effects between the two elements of the wattmeter are eliminated.

   (b) The power flowing in a 3-phase, 3 wire balanced load system is measured by two wattmeter method. The reading of wattmeter A is 7500 W and of wattmeter B is -1500 W.

      i. What is the power factor of the system?
      ii. If the voltage of the circuit is 400 V, what is the value of capacitance which must be introduced in each phase to cause the whole of the power measure to appear on wattmeter A. The frequency is 50 Hz. [8+8]

3. (a) Derive the general equations for balance of an A.C bridge?

   (b) Why is it preferable in bridge circuits, that the equations of balance are independent of frequency? Explain.

   (c) A four arm A.C bridge has the following impedances:
   Arm AB = Z1 = $200\angle 60^0\Omega$ (inductive impedance)
   Arm AD = Z2 = $400\angle 60^0\Omega$ (inductive impedance)
   Arm BC = Z3 = $300\angle 0^0\Omega$ (purely resistive)
   Arm CD = Z4 = $600\angle 30^0\Omega$ (inductive impedance). Determine whether it is possible to balance the bridge under above conditions? Give the reason. [16]

4. (a) Derive the functions of the following in a single phase induction type energy meter:

      i. Shunt and series magnets
      ii. Moving disc
      iii. Holes in the disc
      iv. Shading bands.

   (b) A 50 A, 230 V, 1-phase energy meter on full load test makes 61 revolutions in 37 secs. If the normal disc speed is 520 revolutions per kwh, find the percentage error?

   [8+8]

5. (a) Explain primary and secondary method of measurements. How are primary and secondary standards defined for purpose of measurement?
   (b) Explain deflecting system, controlling system and damping system with reference to an electrical indicating instrument. . [8+8]
6. (a) What are the advantages of Instrument Transformers?
   (b) A current transformer has a single turn primary and a 200 turns secondary winding. The secondary winding supplies a current of 5A to a non-inductive burden of 1 ohm resistance. The requisite flux is set up in the core by an mmf of 80 A. The frequency is 50 Hz and the net cross-section of the core is 1000 mm^2. Calculate the ratio and phase angle of the transformer. Also find the flux density in the core. Neglect the effects of magnetic leakage, iron losses and I^2R losses. [8+8]
7. (a) Explain with the help of suitable diagrams, how a D.C. potentiometer can be used for
      i. Calibration of voltmeter
      ii. Calibration of ammeter
   (b) A single range potentiometer has a 18 step dial switch where each step represents 0.1V. The dial resistors are 10Ω. The slide wire of the potentiometer is circular and has 11 turns and a resistance of 11Ω each. The slide wire has 100 divisions and interpolation can be done to 1/4th of division.The working battery has a voltage of 6V and negligible internal resistance. Calculate
      i. The measuring range of a potentiometer
      ii. the resolution
      iii. Working current and
      iv. Setting of rheostat. [16]
8. Expalin the constructional details of the following:
   (a) Ballastic galvanometer.
   (b) Flux meter. [8+8]

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