Code No: RT31021 **R13** SET - 1

III B. Tech I Semester Regular/Supplementary Examinations, October/November -2017

ELECTRICAL MEASUREMENTS

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1	a)	How dynamometer instrument can be realized as a transfer instrument?	[3M]
	b)	Enumerate the errors introduced by dynamometer type wattmeter.	[4M]
	c)	Distinguish between dc and ac type potentiometer.	[4M]
	d)	What are the difficulties associated with the measurement of very high resistance?	[3M]
	e)	List out the advantages and disadvantages of flux meter.	[4M]
	f)	A lissajous pattern on an oscilloscope is stationary and has 5 vertical maximum values and 4 horizontal maximum values. The frequency of the horizontal input is 1200 Hz. Determine the frequency of vertical input.	[4M]

PART -B

2	a)	Give the basic principle of working of an electrostatic voltmeter. Explain how would you increase (i) the operating forces and (ii) voltage range of the voltmeter.	[8M]
	b)	A 1 mA full scale permanent magnet moving coil meter with a coil resistance of 100 Ω is to be converted into (i) 0-1 A dc ammeter and (ii) 0-30 V dc voltmeter by connecting external series/parallel resistances. Show the connections and find out the values of the external resistances in each case.	[8M]
3	a)	Draw the possible methods of connections of the pressure coil of a wattmeter and compare the errors.	[8M]
	b)	A 230 V, 50 Hz single phase energy meter has a constant of 200 revolutions per kWh. While supplying a non-inductive load of 4.4 A at normal voltage, the meter takes 3 minutes for 10 revolutions. Calculate the percentage error of the instrument.	[8M]
4	a)	Draw a connection diagram of Crompton potentiometer and bring out its salient features. How is it standardised?	[8M]
	b)	Measurements for determination of the impedance of the coil are made on a coordinate type of potentiometer. The results are: voltage across 1 Ω standard resistance in series with the coil +0.952 V on in-phase dial and -0.340 V on quadrature dial; voltage across 10:1 potential divider connected to the terminals of the coil: +1.35 V on in phase dial and +1.28 V on quadrature dial. Calculate the resistance and reactance of the coil.	[8M]
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5 a) For Anderson's bridge, derive the relation for unknown impedance. What are the advantages and limitations of this bridge? [8M]

b) The four arms of a Wheatstone bridge are as follows: AB=100 Ω; BC=1000 Ω; CD=4000 Ω; and DA=400 Ω. The galvanometer has a resistance of 100 Ω, a sensitivity of 100 mm/μA and is connected across AC. A source of 4 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 400 Ω to 401 Ω. [8M]

6 a) Describe the method for determination of B-H curve of a magnetic material using method of reversals with neat sketch. [10M]

b) In a test on a specimen of total weight 13 kg the measured of iron loss at a given value of peak flux density were 17 W at 40 Hz and 30 W at 60 Hz. Estimate the values of hysteresis and eddy current losses W/kg at 50 Hz for the same value of peak flux density. [6M]

7 a) Explain with block diagram how a digital multimeter can measure dc and ac signals and various electrical parameters. [8M]

b) Explain the working of successive approximation DVM with a neat sketch. [8M]

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Code No: RT31021 **R13** SET - 2

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PART –A

1 a) What are the main conditions that must be fulfilled by ammeter shunts so that readings are independent of frequency and temperature ? [3M]

b) Why an ordinary electro-dynamometer wattmeter is not suitable for measurement of power in low power factor circuits? [4M]

c) What do you understand by standardization in a dc potentiometer? [3M]

d) Why is Kelvin's double bridge superior to the Wheatstone bridge for the purpose of low resistance measurement? [4M]

e) What are the differences in construction of a ballistic galvanometer and a d'Arsonval galvanometer? [4M]

f) What are the advantages of a digital voltmeter? [4M]

PART -B

2 a) Describe with neat sketch, the constructional details of a moving coil instrument and explain how control and damping forces are controlled. [8M]

b) A 1000/5, 50 Hz current transformer has a secondary burden comprising a non-inductive burden of 1.6 Ω. The primary winding has 1 turn. Calculating the flux in the core and current ratio error at full load. Neglect leakage reactance and assume the iron loss in core to be 1.5 W at full load. [8M]

3 a) Derive the equation for average power over a cycle. Prove that it can be measured by a electrodynamometer type of wattmeter. [8M]

b) A 230V, single phase watt-hour meter has a constant load of 4A 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 numbers of revolutions made by the meter are 1472 when operating at 230V, 5A for 4 hours. [8M]

4 a) What are the problems associated with ac potentiometer? Describe the working of any one ac potentiometer with neat sketch. [8M]

b) 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 which is 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 1/5 of its span, calculate the resolution of the potentiometer in volt. [8M]
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5 a) Why is Hay's bridge suited for measurement of inductance of high Q-coils? Derive the equation for balance condition. [8M]

b) In a Carey- Foster bridge a resistance of 1.0125 Ω is compared with a standard resistance of 1000 Ω, the slide-wire has a resistance of 0.0250 Ω in 100 divisions. The ratio arms nominally each 10 Ω are actually 10.05 and 9.95 Ω respectively. How far (in scale divisions) are the balance positions from those which would obtain if the ratio-arms were true to their nominal values. [8M]

6 a) Prove that in a ballistic galvanometer, the charge is proportional to first swing of the moving coil. [8M]

b) In a power loss test on a 10 kg specimen of sheet steel laminations, the maximum flux density and wave form factor are maintained constant and the following results are obtained: [8M]

Frequency (Hz)	25	40	50	60	80
Total loss (Watts)	18.5	36	50	66	104

Calculate the eddy current loss per kg at frequency of 50 Hz.

7 Write short note on the following: [16M]
(a) Ramp type DVM
(b) Digital tachometer

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SET - 3

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PART –A

1 a) Why the secondary of a CT should not be opened when the primary winding is energised? [3M]
b) How will you test the single phase energy meter? [4M]
c) What is the difference between polar and coordinate potentiometer? [4M]
d) Why Hay bridge is not suited for the measurement of low Q factor of the inductors? [4M]
e) What are the different types of tests that are used for testing of magnetic materials? [3M]
f) How is phase difference between two voltages of same frequency measured with a CRO? [4M]

PART -B

2 a) Differentiate between a CT and PT. Mention some precautions to be taken while using CT. What measures should be taken to reduce the ratio error? [8M]
b) The control spring of a moving iron ammeter exerts a torque of 5×10^{-7} Nm per degrees and the inductance of the coil varies with the pointer deflection as given below [8M]

Deflection in degrees	20	40	60	80
Inductance in µH	657	700	750	790

Determine the deflection produced by a current of 0.5 A

3 a) Describe the working of a single phase induction type energy meter. Show that the total number of revolutions made by its disc during a particular time is proportional to the energy consumed. [8M]
b) A dynamometer type wattmeter with its voltage coil connected across the load side of the instrument reads 250 watts. If the load voltage be 200 volts, what power is being taken by load? The voltage coil branch has a resistance of 2000Ω. [8M]

4 a) Explain the term standardization of a potentiometer. Describe the procedure of standardization of dc and ac potentiometers. [8M]
b) A slide wire potentiometer of 150 cm in length has a resistance of 150 Ω, the working battery has an emf of 4.2 volts and negligible internal resistance. The galvanometer resistance is 20 Ω. The standard cell has an emf of 1.018 V and internal resistance of 1.5 Ω. The rheostat in the circuit is adjusted so that the standard cell is in balance with the slide wire contact set at 101.8 cm. Find the resistance of the rheostat. [8M]
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5 a) Describe how an unknown capacitance can be measured with the help of D'Sauty's bridge. What are the limitations of this bridge and how are they overcome by using modified D'Sauty's bridge? [8M]

b) The insulation resistance of 2 metre cable was measured by the loss of charge method. The voltage across the standard capacitor of 0.003 μF falls from 222 V to 155 V in one minute. Calculate the insulation resistance of the cable. Derive the formula used. [8M]

6 a) Explain the working of flux meter. Prove that the flux is proportional to the deflection of the flux meter. [8M]

b) The coil of a ballistic galvanometer has 115 turns of mean area 25×40 mm^2. The flux density in the air gap is 0.12 Wb/m^2 and the moment of inertia is 0.5×10^{-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 100^0 and what resistance must be added in series with the movement to give critical damping. [8M]

7 Explain the following with neat sketch: [16M]
(a) Integrating type DVM.
(b) Digital multimeter.

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PART –A

1	a)	What are the major differences between attraction and repulsion type of moving iron instruments?	[3M]
	b)	Why is moving iron power factor meter generally used?	[4M]
	c)	How is dc potentiometer made direct reading?	[4M]
	d)	What is the purpose of Wagner earthing device?	[3M]
	e)	A transformer is operated on 1000 V, 50 Hz and gives a total loss 1000W, of which 700 W is due to hysteresis. If the transformer were to operate at 2000 V and 100 Hz. What would be losses due to eddy currents?	[4M]
	f)	What are the advantages of successive approximation DVM?	[4M]

PART -B

2	a)	Explain the principle of operation of attraction type moving iron instrument, showing how it is suitable for ac and dc measurements.	[8M]
	b)	The dimensions of the coil of a PMMC voltmeter are 4 cm×2.6 cm. The number of turns in the coil are 80 and the flux density in the gap is 0.15T. The resistance of the instrument is 15000 Ω. Calculate the deflecting torque produced in the instrument when a voltage of 300 V is applied to its terminals.	[8M]
3	a)	Describe the working of a single phase electrodynamic power factor meter. Compare its working with a moving iron type power factor meter.	[8M]
	b)	Two wattmeters are connected to measure power in a 3-phase network. The two readings are 2000 watts and 1000 watts respectively. If another wattmeter be connected such that its current coil is in one phase and the potential coil is across the other two phase terminals. What will it read? Also estimate the reactive power of the network.	[8M]
4	a)	With the help of a neat diagram, explain how a dc potentiometer is standardised and used to measure the current flowing in the circuit.	[8M]
	b)	Calculate the inductance of a coil from the following measurements on an ac potentiometer. Voltage drop across a 0.3 Ω standard resistor connected in series with the coil=$0.612\angle 12^0 6'$ V. Voltage across the test coil through 100/1 volts-ratio box=$0.781\angle 50^0 48'$ volt. Frequency of supply is 50 Hz.	[8M]
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5 a) What is the principle of using loss of charge technique for measurement of high resistance? Derive necessary relation. [8M]

b) In an Anderson bridge for measurement of inductance L_x and resistance R_x in the arm AB, the arms CD and DA have resistance of 600 Ω each and the arm CE has a capacitor of 1 μF capacitance. With ac supply at 100 Hz supplied across A and C balance is obtained with a resistance of 400 Ω in arm DE and 800 Ω in the arm BC. Calculate the value of L_x and R_x. [8M]

6 a) What are the different methods used for measurement of core losses? Explain any one method. [8M]

b) A certain flux meter has the following constants: Air gap flux density=0.05 Wb/m^2, turns on moving coil=40, area of moving coil=750 mm^2, If the flux linking a10 turn search coil of 200 mm^2 area connected to the flux meter is reversed in a uniform field of 0.5 Wb/m^2, calculate the deflection of the flux meter. [8M]

7 a) Draw and explain the circuit of a digital frequency meter. What are the different methods used for high frequency determination? [10M]

b) The lissajous pattern in measurement of phase difference between two voltages of same frequency is an ellipse. How is the phase difference computed? [6M]

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