

Total No. of printed pages = 6

EI 181401

Roll No. of candidate

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2023

B.Tech. 4<sup>th</sup> Semester End-Term Examination

ELECTRICAL MEASUREMENTS

New Regulation (w.e.f. 2017-18) & New Syllabus (w.e.f. 2018-19)

Full Marks – 70.

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer Question No. 1 and any *four* from the rest.

1. Select the correct answer :

(10 × 1 = 10)

(i) If an electrodynameometer type wattmeter is used for power measurement with very large value of load current, then

(a) The PC (Potential coil) should be connected to the supply side

☒ (b) The CC (Current coil) should be connected to the supply side

☒ (c) The PC should be connected to the load side

(d) The CC should be connected to the load side

(ii) A single phase energy meter is operating on 239V, 50Hz supply with a load current of 15A for 2 hours at unity power factor(upf). The meter makes 1035 revolutions in that period. The meter constant in rev per kwh is

☒ (a) 144

(b) 500

(c) 635

(d) None of the above

(iii) The focusing anode in a CRO is located

☒ (a) Between pre-accelerating and accelerating anode

(b) Before pre-accelerating anode

(c) After accelerating anode

(d) No specific position

$$239 \times 15 \times 2$$

$$= 7170$$

$$\frac{1035}{7170}$$

$$= 1035$$

$$7170$$

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(iv) A 0-160V voltmeter has an accuracy of 1% Full Scale reading. The indicated voltage is 80V. The limiting error is

(a) 1%

☒ (b) 2%

(c) 2.5%

(d) 3%

$$80 \times \frac{x}{100} = 1.6$$

$$x = 2$$

(v) Match the List I (items) with List II

List I

List II

- |               |   |
|---------------|---|
| A Resolution  | 1 Closeness with which the instrument reading approaches the true value |
| B Sensitivity | 2 Reproducibility of measurement  |
| C Accuracy    | 3 Smallest change in measurand to which the instrument can respond      |
| D Precision   | 4 Ratio of response of the instrument to the input variable             |

	A	B	C	D
(a)	4	3	2	1
(b)	3	4	2	1
<input checked="" type="checkbox"/> (c)	4	3	1	2
(d)	3	4	1	2

(vi) The size of Potential Transformer (PT)

(a) Is much greater than that of Power Transformer of same VA rating

(b) Is much smaller than that of Power Transformer of same VA rating

☒ (c) Is the same for same VA rating

(d) Cannot be determined from VA rating

(vii) The commonly used detectors for AC bridges are

(a) Headphones

(b) Vibration galvanometers

(c) Tunable amplifier detectors

☒ (d) All of the above



(viii) The Maxwell inductance capacitance bridge is used to measure inductance of

- (a) ~~Low Q coils~~
- (b) High Q coils
- (c) Both (a) and (b)
- (d) None of the above

(ix) Slide wire in a potentiometer is made of

- (a) ~~Platinum-silver alloy~~
- (b) Silver alloy
- (c) Chromium alloy
- (d) Lead alloy

(x) Which among the following options is true?

Creeping in a single-phase induction type energy meter may be due to

~~1. Overcompensation of friction~~

2. Vibration

3. Over voltage

- (a) ~~1 and 2 only~~
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

2. (a) Find Transfer Function of a first order system. Also show Input Vs Output characteristics when input is a Step function (2+2)

(b) A thermometer, initially at  $50^{\circ}\text{C}$ , is suddenly dipped in a liquid bath at  $400^{\circ}\text{C}$ . the thermometer reaches  $300^{\circ}\text{C}$  after 3 sec. After what time the thermometer is expected to reach within 5% of its final value? (3)

(c) What will be the (i) gauge pressure and (ii) absolute pressure at a depth of 20m under water? Give answers in  $\text{kg/cm}^2$  and mm of Hg. (3)

(d) Discuss one electrical transducer used to measure any one of the following physical parameters: (5)

(i) Temperature

(ii) Pressure.

Write principle of operation, range, use, advantages and disadvantages.

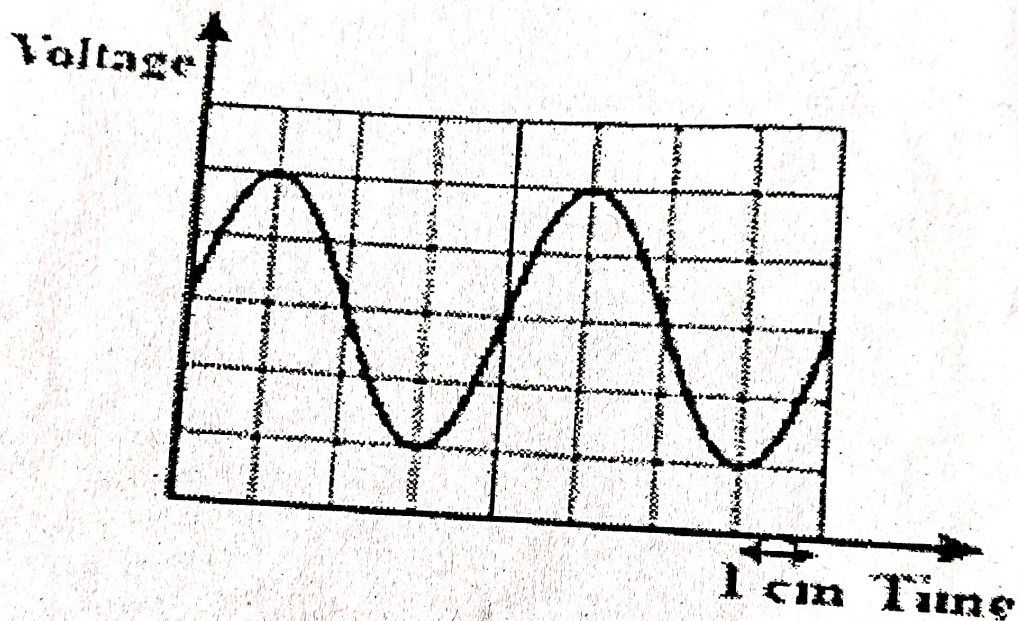
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3. (a) Give the range of Low, Medium and High resistances. Discuss the difficulties faced in measurement of (i) Low and (ii) High resistances. (3+2+2+3) 5.

Define: Volume and Surface resistivity.

- (b) A CRO is a device that converts electrical signals into an active graphical representation on a fluorescent screen. The x-axis is always the time axis, where the 1cm is equal to the present time scale called the time base. A sound wave is displayed on the screen of a cathode-ray oscilloscope. The time base of CRO is set at 2.5ms/cm. What is the frequency of the sound wave? (5)



4. (a) Why magnetic measurements are not as accurate as other types of measurements in electrical engineering? What are iron losses in a material? How do you separate them? Explain measurement of iron losses by Wattmeter method. (1+1+2+3)

- (b) Give the construction of Anderson's Bridge. Show how an unknown inductance can be measured with this bridge. Also draw its phasor diagram. (2+4+2)



5. (a) Name the different types of Digital Voltmeter (DVM). A dual slope integrating type A/D converter has an integrating capacitor of  $0.1 \mu F$  and a resistance of  $100 k\Omega$ . If the reference voltage is 2V and the output of the integrator is not to exceed 10V, what is the maximum time the reference voltage can be integrated? (2+3)
- (b) A two-wattmeter method employed in the measurement of power flowing in a 3-phase, 3-wire balanced load system, wattmeter  $W_1$ , reads 3500W and  $W_2$  reads (-700) W. The circuit is operating at 440V, 50Hz. If the entire power measured was to be appeared on  $W_1$ , find the value of capacitance which must be introduced in each phase. (5)
- (c) Explain the working of a Single-phase induction type energy meter, drawing a neat diagram. (5)
6. (a) "Never open the secondary circuit of a CT while its primary winding is energized". Discuss. (2)
- (b) Define Ratio and Phase angle error of a Potential transformer (PT) How does change in secondary burden of PT affect the ratio and phase angle error? (2+2+2)
- (c) Discuss calibration of voltmeter, ammeter, and wattmeter with a DC potentiometer. (2+2+3)
7. (a) Discuss how you measure insulation resistance with appropriate schematic. (7)
- (b) Why is Kelvins double bridge used to measure low resistance? With appropriate circuit diagram give the working principle of Kelvin's double bridge. (8)

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8. (a) Explain working of any one of the following instruments:

(5)

(i) Synchroscope

(ii) Power factor meter.

(b). (i) Explain testing of a CT using mutual inductance method.

(ii) How do you measure relative permittivity of a specimen of dielectric material using Schering bridge?

(5+5)