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## P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Third Semester, B.E. - Electrical and Electronics Engineering

Semester End Examination; Dec. - 2015

**Electrical Measurements and Instrumentation**

Time: 3 hrs

Max. Marks: 100

**Note:** i) Answer **FIVE** full questions, selecting **ONE** full question from each **unit**.  
ii) Assume suitable missing data if any.

### UNIT - I

- 1 a. Derive the dimensional equations of resistance, inductance, capacitance and permeability in LMTI system. 8
- b. Determine the values of m and n from the dimensional analysis of the following equation,  $P = kV^m I^n$ , Where P = Power in watts , V = voltage applied in volts , I = Current in amperes, K = Constant of proportionality. 6
- c. Discuss on the special features of a low power factor wattmeter. 6
- 2 a. With the help of a neat diagram, explain the construction and working of a single phase induction type energy meter. 8
- b. Show that  $(\mu\epsilon)^{-1/2}$  has the dimension of velocity where  $\mu$  = permeability and  $\epsilon$  = permittivity. 6
- c. For a 20 A, 230 V, energy meter the number of revolutions per kwh is 480. If upon test at full load, the disc makes 40 revolutions in 66 seconds. Determine the percentage error in the consumed power as a percentage of the metered value. 6

### UNIT - II

- 3 a. Define the bridge sensitivity of a wheat stone bridge ( $S_B$ ) and hence obtain an expression for the same in terms of voltage sensitivity. 8
- b. A capacitor bushing forms arm AB of a Schering bridge, a standard capacitor of 500 pF capacitance forms arm AD, arm BC has a resistance of 300  $\Omega$ , and the bridge is balanced with arm CD having a resistance of 72.6  $\Omega$  in parallel with a capacitance of 0.148 pF. The supply frequency is 50 Hz. Calculate the capacitance and dielectric loss angle of the test capacitor in arm AB. 6
- c. With a neat sketch explain the working of a megger. 6
- 4 a. Derive the balance equations of Schering bridge circuit and hence obtain the expression for loss angle of test capacitor. Draw the phasor diagram at balance. 8
- b. In a wheat stone bridge, the resistance of various arms are P = 100  $\Omega$ , Q = 10  $\Omega$ , R = 50  $\Omega$  and S = 4  $\Omega$ . Calculate the unbalanced current in the galvanometer of internal resistance 20 $\Omega$ , when the supply voltage is 10 V. Also find the volume of unknown resistance corresponding to the null reading by galvanometer. 6
- c. Explain briefly the Wagner earthing device. 6

**UNIT - III**

- 5 a. Explain how the range of ammeter and voltmeter can be extended using shunts and multipliers. Hence obtain expressions for the same. 8
- b. A moving coil meter has a resistance of  $10\ \Omega$  and takes 25 mA to produce full scale deflection. How can the meter be used to measure, 6
- i) Voltages upto 120 V      ii) Currents upto 20 A.
- c. Write a note on turns compensation in the instrument transformer. 6
- 6 a. Explain the principle, construction and working of current transformers. 8
- b. A CT has turns ratio 1: 399 and is rated as 2000/5A. The core loss component is 3 A and magnetizing component is 8 A under full load conditions. Find the phase angle and ratio errors under full load condition if secondary circuit pf is 0.8 leading. 6
- c. Write the equations for the ratio error and phase angle error of CT and PT by naming all the terms involved. 6

**UNIT - IV**

- 7 a. Mention the different types of digital voltmeters. Hence explain the successive approximation DVM. 8
- b. What is a transducer? Briefly explain the procedure for selecting a transducer. 6
- c. With a neat sketch, explain the true RMS responding voltmeter. 6
- 8 a. Briefly explain the working of LVDT used in displacement measurements. 8
- b. Write a note on the procedure of interfacing resistive transducers to electronic circuits. 6
- c. Briefly explain the working of unbounded strain gauges. 6

**UNIT - V**

- 9 a. With a neat block diagram, explain the working of a digital storage oscilloscope. 8
- b. Explain the significance Lissajous pattern. 6
- c. With a neat sketch, explain the working of X – Y recorder. 6
- 10 a. With a neat sketch, explain the panel details of a dual trace oscilloscope. 10
- b. Discuss on the method of measuring amplitude, phase, frequency and period using on oscilloscope as followed in practice. 10

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