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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 - 2016/Jan - 2017

Measurement and Instrumentation

Time: 3 hrs

Max. Marks: 100

Note: Answer **FIVE** full questions, selecting **ONE** full question from each unit.

UNIT - I

- 1 a. Derive the dimensions in LMTI for the following quantities, 6
- i) Electric flux density ii) EMF iii) Capacitance.
- b. With usual notations, show that equation $\frac{1}{\sqrt{\mu\epsilon}}$ has the dimension of velocity. 6
- c. The torque expression for an electro-dynamometer wattmeter is given by $T \propto M^a E^b Z^c$, where $M =$ Mutual inductance, $E =$ Voltage, $Z =$ Impedance. Find the values of a, b, and c using LMTI system. 8
- 2 a. With neat diagram, explain the construction and working of Electro Dynamometer (EDM) type wattmeter. Also list out errors that occur in EDM type wattmeter. 10
- b. Explain the various types of compensation employed in energy meter to overcome the losses. 6
- c. A single phase, 50 A, 230 V energy meter on full load test makes 61 revolutions in 37 seconds. If the normal disc speed is 520 revolutions per kWh. Determine the percentage error as a percentage of true speed. Is the situation is beneficial to the consumer? Reason out. 4

UNIT - II

- 3 a. Define sensitivity of Wheatstone bridge with necessary circuit diagram. Hence, deduce the expression for sensitivity of the bridge, ' S_B '. 6
- b. With a neat diagram, explain the construction and working of a Megger. 6
- c. A Kelvin double bridge, each of the ratio arms $P = Q = p = q = 1000 \Omega$. The EMF of the battery is 100 V and a resistance of 5Ω is included in the battery circuit. The galvanometer has a resistance of 500Ω and the resistance of the link correcting the unknown resistance to the standard resistance may be neglected. The bridge is balanced when the standard resistance $S = 0.001 \Omega$. Determine; 8
- i) The value by unknown resistance
- ii) The current through the unknown resistance R at balance
- iii) The deflection of the galvanometer when the unknown resistance R is changed by 0.1% from its value at balance. The galvanometer has a sensitivity of $200 \text{ mm}/\mu\text{A}$.

- 4 a. Explain the measurement of self inductance of a coil using Anderson's Bridge. 8
- b. Explain in brief, the sources and detectors used in AC Bridges for measurement of unknown elements. 6
- c. A sheet of bakelite 4.5 mm thick is tested at 50 Hz between electrodes 12 cm in diameter. The Schering Bridge employs a standard air capacitor C_2 of 106 pF capacitance, a non-inductive resistance R_4 of $\frac{1000}{\pi}$ ohms in parallel with a variable capacitor $C_4 = 0.5 \mu\text{F}$ and $R_3 = 260 \Omega$. 6
- Calculate the capacitance, dissipation factor and relative permittivities of the sheet.

UNIT - III

- 5 a. What are shunts and multipliers? Derive an expression for both with reference to the meters used in electrical circuit. 8
- b. A moving coil meter has a resistance of 10Ω and takes 25 mA to produce full scale deflection. How would instrument be used as a voltmeter in the range (0-120)V and ammeter in the range (0 - 20)A. 6
- c. Explain in brief, the need for turn compensation in instrument transformer. 6
- 6 a. Explain the construction and theory of current transformer. Also, write the expression for ratio and phase angle errors of the same. 10
- b. A potential transformer, ratio 1000/100 volt has the following constant :
 Primary resistance = 94.5Ω , Secondary resistance = 0.86Ω , Primary reactance = 66.2Ω , Total equivalent reactance = 110Ω , No load current = 0.02 A at 0.4 power factor. Calculate; 6
- (i) Phase angle error at no load
 (ii) Burden in VA at unity power factor at which the phase angle will be zero.
- c. Mention the advantages of instrument transformers. 4

UNIT - IV

- 7 a. With a neat sketch, explain the true RMS responding voltmeter. 6
- b. With the help of block diagram, explain the working of an electronic energy meter. 8
- c. Write an explanatory notes on digital multi meter and voltmeter. 6
- 8 a. Explain in brief, the classification and selection procedure of the Transducers. 8
- b. What is strain gauge? Obtain an expression for gauge factor in terms of Poisson's ratio. 6
- c. Explain the working principle of LVDT used in displacement measurement. 6

UNIT - V

- 9 a. With the neat block diagram, explain the working of dual trace oscilloscope. 10
- b. With a neat sketch, explain the working of a X-Y recorder. 10
- 10 a. With a neat block diagram, explain the working of digital storage oscilloscope. 10
- b. Write short notes on: i) Lissajous pattern ii) LCD and LED display 10