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MANIPAL INSTITUTE OF TECHNOLOGY Manipal University, Manipal – 576 104



## VI SEM. B.Tech. MECHATRONICS ENGG. DEGREE EXAMINATIONS MAKEUP JUNE/JULY- 2016

## SUBJECT: ELECTRONIC MEASUREMENTS AND INSTRUMENTATION (ICE 330) REVISED CREDIT SYSTEM

Time: 3 Hours.

MAX.MARKS: 50

## Instructions to Candidates:

- ✤ Answer ANY FIVE FULL questions.
- ✤ All calculations are to be shown.
- ✤ All sketches should be neat and labelled clearly.
- ✤ Any missing data can be assumed suitably.
- 1A. With a neat diagram explain the construction and working of a Permanent (04) Magnet Moving Coil (PMMC).
- A basic d'Arsonval meter movement is to be converted into a multi-range D.C. (03) voltmeter with ranges 0-50V, 0-250V and 0-500V. Find the values of various resistances using the potential divider arrangement and design the circuit.
- The following expression was found for eddy currents produced in a metallic (03) former moving in the field of a permanent magnet

$$l_e = \frac{KBlbA}{(2b+l)\rho}$$

*K* – Constant; *B* – Flux Density, l – Length of former, b – Breadth of the former, A – Area of former,  $\rho$  – Resistivity

It is suspected that term angular frequency is missing on RHS. Use LMTI (Length, Mass, Time, Current) system for dimensional analysis. Detect the error and give the correct dimensions.

2A. A simple slide wire is used for measurement of current in a circuit. The voltage (02) drop across a standard resistor of 0.1  $\Omega$  is balanced at 75 cm. Find the magnitude of the current if the standard cell emf of 1.45 V is balanced at 50 cm.

- 2B. Describe the theory and method of measurement of low resistance using (04) Kelvin's double Bridge. How it is different from Wheatstone bridge?
- 2C. Draw & identify the bridge circuit, for the following constants: (04) Arm AB- capacitance of 2.2  $\mu$ F in parallel with 1.8 k $\Omega$  resistance Arm AD- resistance of 5.7 k $\Omega$ Arm BC- capacitor of 0.8  $\mu$ F Arm CD- unknown capacitor C<sub>x</sub> and R<sub>x</sub> If the frequency of supply is 0.8 kHz, calculate the unknown capacitance and its dissipation factor for the same.
- 3A. Solution for the unknown resistance for a Wheatstone Bridge is

$$R_x = \frac{R_2 R_3}{R_1} \tag{03}$$

 $R_1 = 150 \pm 0.5\%\Omega$ ;  $R_2 = 2000 \pm 0.5\%\Omega$   $R_3 = 947 \pm 0.8\%\Omega$ . Determine Magnitude of unknown resistance and limiting error in percent and in ohm for unknown resistance.

- **3B.** Design an Ayrton Shunt to provide an ammeter with current ranges of 1A, 5A, (03) and 10A. A basic meter with an internal resistance of  $80 \Omega$  and a full scale deflection current of 1.5 mA is to be used
- **3C.** With neat diagrams, explain any two methods of Cold Junction compensation **(04)** for a Thermocouple.
- 4A. When a step pressure input is applied to a U-Tube Manometer, a steady state (04) displacement of 40mm of manometric fluid is observed. 1<sup>st</sup>, 2<sup>nd</sup> & 3<sup>rd</sup> overshoots have values of 20mm, 10mm & 5mm respectively. Observed period of oscillation is 1.2s. Determine the following.
  - (a) Damping factor
  - (b) Natural Frequency of Oscillation
  - (c) Error when pressure difference is decreasing at the rate of 10mm per second
- **4B.** A pressure sensor typically used in the range  $10^{-5}$  to  $10^{-1}$  torr is to be **(04)** calibrated. Identify a standard suitable device for calibrating this pressure sensor and explain its working and construction in detail using a neat diagram.

- 4C. Calculate the insulation resistance of a cable in which the voltage falls from (02) 150V to 90V in 18s. The capacitance is 330pF.
- **5A.** With a neat block diagram, elucidate the controls of a CRO **(05)**
- 5B. A pressure sensor working on the principle of thermal conductivity is to be used (03) for measurement of vacuum pressure. Identify a suitable sensor and illustrate its working principle using a neat sketch.
- 5C. A Lissajous pattern has 5 horizontal tangencies and 1 vertical tangency. (02) Frequency of the horizontal input is 1000Hz. Determine frequency of vertical input and draw the pattern.
- **6A.** Enumerate the construction & working of Pirani Gauge used for low pressure **(05)** measurement.
- **6B.** The following observations were made for a loss of charge method for the **(03)** determination of a high resistance R. The charged capacitor of  $C = 12.5\mu F$  was connected across an electrostatic voltmeter and R in parallel and the voltage was measured after intervals of time (Table 1)

Time (s)	Voltage (V)
0	150
100	121
200	97

Time (s)	Voltage (V)
0	150
200	143
400	133

Table 1

Table 2

(02)

A further set of readings was taken with resistor R removed from circuit (Table 2). The readings of the voltmeter were subject to random errors. Calculate the value of R.

6C. Briefly describe the following controls in a CRO:

(i) Z-Axis Modulation

(ii) Astigmatism