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**MANIPAL INSTITUTE OF TECHNOLOGY**
Manipal University, Manipal – 576 104

**VI SEM. B.Tech. MECHATRONICS ENGG. DEGREE EXAMINATIONS**
**MAY 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 sh
- own.
- All sketches should be neat and labelled clearly.

**1A.** The following measurements are made using a PMMC instrument which has a full scale deflection of 90° = 100 scale divisions with a current of 1mA. The period of free oscillations is 0.55s. In order to measure the spring constant, a small weight having a gravitational force of $98.1 \times 10^{-6}$N is placed at a distance of 100mm from the horizontal axis of rotation with the horizontal pointer acting as a lever arm; the resulting deflection being 35 divisions. Value of flux density in the air gap measured is 0.24 Wb/$m^2$. The length of the coil is 15mm and the average diameter of the coil is 14mm. From the above data, calculate the following: **(04)**

(i) Spring Constant (ii) Moment of Inertia (iii) Number of turns

**1B.** With a neat general block diagram, explain the controls of a CRO. **(05)**

**1C.** What are the major limitations of a Wheatstone Bridge with respect to their range of measurement? **(01)**

**2A.** Vacuum pressure measurements often rely on inferential methods that measure pressure indirectly using some pressure dependent parameters. Identify a suitable pressure gauge that measures pressure by using the property of thermal conductivity. Draw a suitable diagram and explain the working. **(04)**

**2B.** The focusing system in a CRT is usually referred to as an 'electron lens'. Briefly describe the electrostatic focusing arrangement with necessary equations and diagrams to support the above statement. **(03)**

**2C.** Identify and explain a suitable technique for the measurement of high resistances (1M Ω and above). What is the advantage of Varley's loop test over Murray's loop test? **(03)**

**3A.** With a neat circuit diagram explain the construction and derive the equations for balance for an Anderson's bridge. **(05)**

**3B.** Thermistors are used for a wide variety of applications apart from temperature measurement. Explain the current-time characteristics of a thermistor with a neat diagram and state a suitable application for thermistor based on this property. **(03)**

**3C.** Develop the characteristic shape of the Lissajous patterns for two sinusoidal outputs that have the same amplitude but with following phase difference: **(02)**
(i) 270° (ii) 45° (iii) 180° (iv) 300°

**4A.** **(04)**
Using the following values of resistance versus temperature for an RTD, find the linear and quadratic approximations of resistance between 80℃ and 100℃.

| T℃ | 60℃ | 65℃ | 70℃ | 75℃ | 80℃ | 85℃ | 90℃ | 95℃ | 100℃ | 105℃ |
|---|---|---|---|---|---|---|---|---|---|---|
| R Ω | 435 | 443 | 452 | 460 | 468 | 476 | 484 | 492 | 500 | 508 |

**4B.** In the smelter industry, measurement and control of temperatures of metallurgical furnaces is a crucial process. Identify a suitable non-contact temperature sensor for this operation and describe its working with a neat diagram. **(03)**

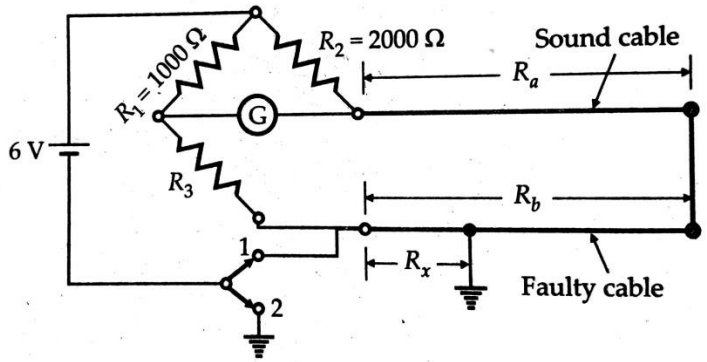
**4C.** Three resistors have the following ratings: $R_1 = 200\Omega \pm 5\%$; $R_2 = 100\Omega \pm 5\%$; $R_3 = 50\Omega \pm 5\%$. Determine the magnitude of resultant resistance and the limiting errors in percentage and in ohm if above resistances are connected in (i) series (ii) parallel. **(03)**

**5A.** Why is cold junction compensation necessary during measurement of temperature using a thermocouple? With neat diagrams, explain one software and one hardware type of compensation technique for cold junction compensation of a thermocouple **(04)**

**5B.** A moving coil ammeter has a fixed shunt of 0.02Ω. With a coil resistance of R=1000Ω and a potential difference of 500mV across it, full scale deflection is obtained. **(03)**
(i) To what shunt current does this correspond?
(ii) Calculate R to give full scale deflection when shunted current I is 75A.
(iii) With what value of R is 40% deflection obtained when I = 100A?

**5C.** A Wheatstone bridge is connected in Varley loop test as shown below. When the switch is in position 1, bridge is balanced with $R_1 = 1000\Omega$, $R_2 = 2000\Omega$,, $R_3 = 100\Omega$. When **(03)**

the switch is in position 2, bridge is balanced with $R_1 = 1000\Omega$, $R_2 = 2000\Omega$, $R_3 = 99\Omega$. If the resistance of earthed wire is 0.15km, how many metres away from the bridge has the ground fault occurred?




**6A.** A pressure sensor typically used in the range $220\,{}^{kN}/_{m^2} - 300\,{}^{kN}/_{m^2}$ is to be calibrated. Identify a standard suitable device for calibrating this pressure sensor and explain its working and construction in detail using a neat diagram. **(04)**

**6B.** An A.C. bridge consists of the following components: **(04)**
Arm AB: An imperfect capacitor $C_1$ with an equivalent series resistance $r_1$
Arm BC: A non-inductive resistance $R_3$
Arm CD: A non-inductive resistance $R_4$
Arm DA: An imperfect capacitor $C_2$ with an equivalent series resistance $r_2$ in series with a resistance $R_2$
At balance: $R_2 = 4.8\Omega$, $R_3 = 2000\ \Omega$, $R_4 = 2850\ \Omega$, $C_2 = 0.5\mu F$, $r_2 = 0.4\Omega$
A supply of $450\ Hz$ is placed between AC. Draw the circuit diagram, write the balance conditions and calculate the value unknown parameters in arm AB. Also calculate dissipating factor for the unknown capacitor

**6C.** How does A.C. sensitivity of rectifier type of instruments compare with D.C. sensitivity? Explain the reason for the fact that a voltmeter employing a $50\mu$A basic meter is rated at 20kΩ/V on D.C. measurements and only 5kΩ/V on A.C. measurements. **(02 )**