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INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

IV SEMESTER B.S. DEGREE EXAMINATION – APRIL/MAY 2017

SUBJECT: MEASUREMENTS AND INSTRUMENTATION (MET 242)

(BRANCH: MECHATRONICS ENGINEERING)

Saturday, 29 April 2017

Time: 3 Hours **Max. Marks: 100**

- ✓ **Answer ANY FIVE full Questions.**
- ✓ **Missing data, if any, may be suitably assumed.**

1A. Prove that in a Permanent Magnet Moving Coil Mechanism (PMMC), the angular deflection is linearly proportional to the current flowing through it.

1B. What is the working principle of Cathode Ray Oscilloscope (CRO)? Draw and explain the block diagram of a CRO.

1C. Define Seebeck Effect. Describe the three laws of thermocouple with diagram. **(6+8+6)**

2A. Differentiate between static and dynamic characteristics. Define accuracy and precision.

Draw suitable diagrams for the following:

- High Precision and High Accuracy
- High Precision and Low Accuracy
- Low Precision and High Accuracy
- Low Precision and Low Accuracy.

2B. Determine the value of:

i. Shunt Resistance in a DC Ammeter (Shunt Resistor), and

ii. Multiplier Resistance in a DC Voltmeter (Multiplier Resistor).

Draw the circuit diagram for both.

2C. Explain the system of Bourdon Tube Pressure Gauge. **(5+10+5)**

3A. The following measurements were taken with an analogue meter of the current flowing in a circuit (the circuit was in steady state and therefore, although the measurements varied due to random errors, the current flowing was actually constant):

21.5mA, 22.1mA, 21.3mA, 21.7mA, 22.0mA, 22.2mA, 21.8mA, 21.4mA, 21.9mA, 22.1mA

Calculate:

i. The Mean Value

ii. The Median Value, and

iii. The Standard Deviation.

3B. A Kelvin double bridge each of the ratio arms P = Q = p = q = 1000 Ω. The emf of the battery
is 100 V and a resistance of 5 Ω is included in the battery circuit. The galvanometer has a resistance of 500 Ω and the resistance of the link connecting the unknown resistance to the standard resistance may be neglected. The bridge is balanced when the standard resistance S = 0.001 Ω. *(Refer Figure 1 given below)*

i. Determine the value of unknown resistance
ii. Determine the current (approximate value) through the unknown resistance R, at balance.
iii. Determine the deflection of galvanometer when the unknow resistance R is changed by 0.1 percent from its value at balance. The galvanometer has a sensitivity of 200 mm/μA. **(10+10)**

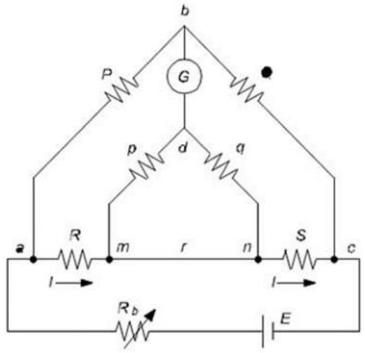

Figure 1

4A. Differentiate between systematic and random error. What are the different sources of static errors? Explain them.

4B. I. Define sensitivity drift and zero drift. What factors can cause sensitivity drift and zero drift in instrument characteristics?

II. An instrument is calibrated in an environment at a temperature of 20°C and the following output readings y are obtained for various input values x:

y	13.1	26.2	39.3	52.4	65.5	78.6
x	5	10	15	20	25	30

Determine the measurement of sensitivity of instrument in terms of y/x.

4C. Define metrology. List the objectives of metrology. **(8+8+4)**

5A. What is the working principle of Potentiometer? List the parameters that are considered while selecting a potentiometer.

5B. Explain the construction and working principle of Resistance Temperature Detector (RTD).

5C. The arms of an AC Maxwell's Bridge are as follows: AB is a non-inductive resistance of 1000Ω in parallel with a capacitor of capacitance 0.5μF, BC is a non-inductive resistance of 600Ω. CD is an inductive impedance (unknown) and DA is a non-inductive resistance of 400Ω. If a balance is obtained under these conditions, find the value of resistance and inductance of branch CD. *(Refer Figure 2 below)* **(8+8+4)**

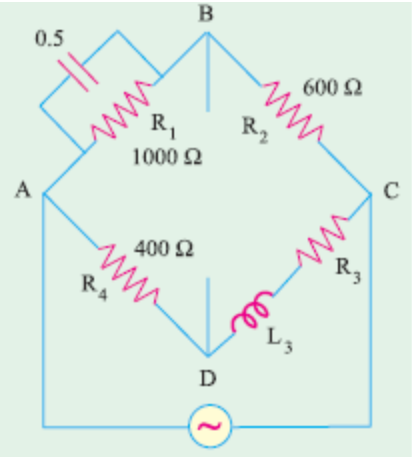

Figure 2

6A. Explain various controls in a Cathode Ray Oscilloscope (CRO).

6B. Explain in brief the elements of a measurement system. Draw the block diagram also.

6C. Discuss how the sensing capacity of an ultrasonic sensor varies with respect to:

a. Target Size
b. Target to sensor distance
c. Temperature of the surroundings
d. Type of target to be sensed

(8+8+4)

7A. With the help of a diagram, explain the working principle of Autocollimator.

7B. Explain Limit Gauges and Taylor's Theory of Gauging.

7C. Define the term blind zone with respect to ultrasonic sensor. With the help of a diagram, explain the different sensing distances of ultrasonic sensor. **(8+6+6)**

8A. Explain the construction and working of inductive sensor, with a neat sketch.

8B. Explain the desirable features of sensors.

8C. Write a short note on Incremental Encoder. Also, list the applications of encoders. **(8+6+6)**