ELECTRICAL & ELECTRONIC MEASUREMENT
(ELEC 2103)

Time Allotted : 3 hrs   **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

    (i)   Maxwell's inductance-capacitance bridge is used to measure inductance of
            (a) low Q coils   (b) medium Q coils
            (c) high Q coils   (d) low and medium Q coils

    (ii)   A set of readings has a wide range and therefore it has
            (a) high precision   (b) low precision
            (c) low accuracy   (d) high accuracy

    (iii)   Which of the following is an example of integrating instrument
            (a) voltmeter   (b) watt-hour meter
            (c) ammeter   (d) wattmeter

    (iv)   In an electrodynamometer type wattmeter
            (a) the current coil is made fixed
            (b) the pressure coil is made fixed
            (c) any of the two coils can be made fixed
            (d) both the coils should be movable

    (v)   Capacitance can be measured by using
            (a) Maxwell's bridge   (b) Schering bridge
            (c) Hey's bridge   (d) Wien bridge

    (vi)   A true RMS reading voltmeter uses two thermocouples in order to
            (a) increase sensitivity
            (b) cancel out the nonlinear effect of first thermocouple
            (c) prevent drift in dc amplifier
            (d) all of these

(vii)   Which of the following may be used for extending the range of an instrument?
(a) Shunt   (b) Multiplier
(c) Instrument transformer   (d) All of the above

(viii) A potentiometer may be used for
(a) Measurement of resistance   (b) Measurement of current
(c) Calibration of resistance and current   (d) All of the above

(ix)   In an induction type energy meter, maximum torque is produced when the phase angle between the two fluxes is
(a) 0°   (b) 45°
(c) 60°   (d) 90°.

(x)   For measurement of high voltage which type of instrument is suitable
(a) PMMC instrument   (b) Electrostatic instrument
(c) Induction type instrument   (d) Moving iron type instrument

Group - B

2. (a)   Explain the working principle of an induction type instrument.
           [(CO1) (Understand/LOCQ)]
    (b)   Develop the expression of deflection of a moving iron instrument
           [(CO1) (Apply/IOCQ)]
    (c)   Justify that an electrodynamometer type instrument is a transfer instrument.
           [(CO1) (Evaluate/HOCQ)]
                                                                        4 + 5 + 3 = 12

3. (a)   In an electrodynamometer instrument the total resistance of the voltage coil circuit is 8.0Ω and the mutual inductance changes uniformly from -173µH at zero deflection to +175µH at full scale, the angle of full scale being 95°. If a potential difference of 100V is applied across the voltage circuit and a current of 3A at a power factor of 0.75 is passed through the current coil The spring control constant is 4.63×10^{-6}N-m/rad. Solve the value of deflection.
           [(CO1) (Apply/IOCQ)]
    (b)   The expected value of the voltage across a resistor is 80V. However, the measurement gives the value as 79V. Determine (i) absolute error (ii) % error (iii) relative accuracy.   [(CO2) (Evaluate/HOCQ)]
    (c)   Why pole shading method is used in an induction type instrument.
           [(CO1) (Remembering/LOCQ)]
                                                                        5 + 3 + 4 = 12

Group – C

4. (a)   Explain the operating principle of a dynamometer type wattmeter for power measurement.   [(CO3) (Understand/LOCQ)]
    (b)   A wattmeter has a current coil of 0.03 Ω resistance and a pressure coil of 6000Ω resistance. Examine the percentage error if the wattmeter is so connected that:
           (i) the current coil is on the load side

    (ii) the pressure coil is on the load side.
    [(CO3) (Analyse/IOCQ)]
(c)   Recommend a method by which creeping can be minimized in a single phase induction type energy meter. [(CO3) (Evaluate/HOCQ)]

                                                                        4 + 5 + 3 = 12

5. (a)   What is transformation ratio, nominal ratio and turns ratio of current transformer (CT) and potential transformer (PT). [(CO4) (Remember/LOCQ)]
    (b)   A 1000/5 A, 50Hz current transformer has a secondary burden comprising a non-inductive impedance of 1.6Ω. The primary winding has one turn. Calculate the flux in the core and ratio error at full load. Neglect leakage reactance and assume the iron loss in the core to be 1.5W at full load. The magnetizing mmf is 100A. [(CO4) (Apply/IOCQ)]

                                                                            6 + 6 = 12

Group - D

6. (a)   How Wien Bridge is used to measure unknown frequency? Deduct the condition for balance of the bridge and find frequency in terms of bridge parameters.
    [(CO5) (Evaluate/HOCQ)]
    (b)   Show the phasor diagram for Wien bridge. [(CO5) (Understand/LOCQ)]
    (c)   A Maxwell's capacitance bridge is used to measure an unknown inductance in comparison with capacitance .The various values at balance are R_2=400Ω R_3=600Ω R_4=1000 Ω C_4=0.5uF. Calculate the values of unknown inductance and storage factor (Q) of coil if frequency is 1000 Hz. [(CO5) (Apply/IOCQ)]
                                                                        4 + 2 + 6 = 12

7. (a)   Write short notes on any one of the following:
    (i)   Crompton's DC Potentiometer
    (ii)   Drysdale Polar Potentiometer. [(CO5) (Remember/LOCQ)]
    (b)   A basic potentiometer has 200 cm slide wire with a resistance of 200 ohm. A 10 v battery in series with a variable resistance R1 provides current through the slide wire. The standard cell potential is 1.018V and the potentiometer is calibrated when the sliding contact is set to 101.8cm from the zero voltage end of the slide wire.
    (i) Calculate R1 and the current through R1,
    (ii) Determine the measured voltage when zero galvanometer deflection is obtained with the slide rule at 94.3 cm from the zero voltage end.
    [(CO5) (Apply/IOCQ)]

                                                                            6 + 6 = 12

Group - E

8. (a)   Explain with a diagram how to localise the cable fault using Murray Loop Test.
    [(CO5)(Analyse/IOCQ)]

(b)   A saw tooth voltage has a peak value of 160 V and a time period of 3.6 seconds. Evaluate the error when measuring this voltage with an average reading voltmeter calibrated in terms of rms value of a sinusoidal wave.
(CO6) (Evaluate/HOCQ)]

7 + 5 = 12

9. (a)   Build the block diagram of successive approximation type digital voltmeter and explain it.   [(CO6) (Apply/IOCQ)]
    (b)   Explain the necessity of two thermocouples used in true RMS reading voltmeter.
    [(CO6) (Evaluate/HOCQ)]

8 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	29.16%	45.83%	25%

Course Outcome (CO):
After the completion of the course students will be able to
1. Understand the mechanism of various deflecting type measuring instruments and extension of their ranges
2. Define and classify various errors in measurement
3. Acquire knowledge of various power and energy measuring devices
4. Understand the operating principles and applications of instrument transformers and potentiometers
5. Acquire knowledge about and analyze various ac and dc bridges for measuring different electrical parameters and their applications.
6. Acquire knowledge about various electronic and digital instruments like average reading AC voltmeters, peak reading AC voltmeters, true RMS voltmeter, electronic multi-meter, digital voltmeters.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question

Department & Section	Submission Link
EE	Joining Code: rntwrgs Submission Link: https://classroom.google.com/c/NDA0OTI4NTYzMTEx/a/NDczMzQ2NTM1OTcz/details