

Calculate the values of R_1 and L_1 . Calculate also the value of the storage(Q) factor of the coil if the frequency is 1000Hz.

$$(3 + 1 + 1 + 2) + 5 = 12$$

7. (a) Describe with the help of suitable diagrams how can a dc potentiometer be used for (i) calibration of voltmeters, (ii) calibration of ammeters and (iii) calibration of wattmeters.
- (b) In a test by Murray loop method for a fault to earth on a 520 metre length of cable having a resistance of 1.1Ω per 1000 metre, the faulty cable is looped with a sound cable of the same length but having a resistance 2.29Ω per 1000 metre. The resistances of the other two arms of the testing network, at balance, are in the ratio of 2.7:1. Calculate the distance of the fault from the testing end of the test cable.

$$6 + 6 = 12$$

Group - E

8. (a) Explain, with the help of a block diagram, the various parts of an electronic multimeter.
- (b) A sawtooth voltage has a peak value of 50V and a time period of 3.0 seconds. Calculate the error when measuring this voltage with an average reading voltmeter, calibrated in terms of rms value of a sinusoidal wave.
9. (a) Draw and describe the block diagram of an integrating type digital voltmeter.
- (b) What are the functions of delay line and time base generator in a cathode ray oscilloscope (CRO)? If no delay line is provided, what problem may arise?

$$6 + (2 + 2 + 2) = 12$$

ELECTRICAL & ELECTRONIC MEASUREMENT (ELEC 2202)

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one 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) A 0-300V voltmeter has an error of $\pm 2\%$ of full scale deflection. What would be the range of readings if true voltage is 30V?
 (a) 24V-36V (b) 29.4V-30.6V
 (c) 20V-40V (d) none of the above.
- (ii) Horizontally mounted moving iron instruments use
 (a) eddy current damping (b) fluid friction damping
 (c) electromagnetic damping (d) air friction damping.
- (iii) A 1mA ammeter has a resistance of 100Ω . It is to be converted to a 1A ammeter. The value of the shunt resistance required is
 (a) 0.001Ω (b) 0.1001Ω
 (c) 100000Ω (d) 100Ω .
- (iv) The ratio of transformation in case of potential transformer
 (a) increases with increase in power factor of secondary burden
 (b) remains constant irrespective of the power factor of secondary burden
 (c) decreases with increase in power factor of secondary burden
 (d) none of the above.
- (v) 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° .
- (vi) Hay's bridge is used to measure inductance of
 (a) low Q coils (b) medium Q coils
 (c) low and medium Q coils (d) high Q coils.

- (vii) 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.
- (viii) Megger is a
 (a) PMMC type instrument and measures low resistance
 (b) PMMC type instrument and measures high resistance
 (c) moving iron type instrument and measures low resistance
 (d) moving iron type instrument and measures high resistance.
- (ix) Input impedance of an electronic voltmeter is
 (a) low (b) high (c) medium (d) zero.
- (x) In an A.C. co-ordinate potentiometer, the currents in the phase and quadrature potentiometer are adjusted to be
 (a) out of phase by 90° (b) out of phase by 60°
 (c) out of phase by 30° (d) out of phase by 180° .

Group - B

2. (a) Compare a permanent magnet moving coil (PMMC) instrument with a dynamometer type instrument on the basis of their operation and application.
- (b) In an electrodynamometer instrument the total resistance of the voltage coil circuit is 8.0Ω and the mutual inductance changes uniformly from $-173\mu\text{H}$ at zero deflection to $+175\mu\text{H}$ 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 current coil, what will be the deflection? The spring control constant is $4.63 \times 10^{-6} \text{N-m/rad}$.
- (c) Why controlling torque is necessary in an analog indicating instrument? What would happen in the absence of a controlling torque?
3. (a) Define the following terms in the context of normal frequency distribution of data. (i) mean value (ii) deviation (iii) standard deviation (iv) variance.

5 + 5 + 2 = 12

- (b) The expected value of the voltage across a resistor is 80V. However, the measurement gives the value as 79V. Calculate (i) absolute error (ii) % error (iii) relative accuracy (iv) % of accuracy.

(4 × 2) + 4 = 12**Group - C**

4. (a) Explain the operating principle of a dynamometer type wattmeter for power measurement.
- (b) A correctly adjusted single phase 240V induction watthour meter has a meter constant of 600 revolutions per kWh. Determine the speed of the disc for a current of 10A at a power factor of 0.8 lagging. If the lag adjustment is altered so that the phase angle between voltage coil flux and applied voltage is 86° . Calculate the error introduced at (i) unity power factor and (ii) 0.5 power factor lagging. Comment on the results.
5. (a) 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.
- (b) Explain the disadvantages of using shunts and multipliers when used for extension of instruments' range.
- (c) How does the phase angle change with change in secondary winding current for a current transformer?

5 + 7 = 12**6 + 4 + 2 = 12****Group - D**

6. (a) Describe how an unknown capacitance can be measured with the help of De'Sauty's bridge. What are the limitations of this bridge and how can those be overcome by using a modified form of De'Sauty's Bridge? Draw phasor Diagram to illustrate your answer.
- (b) A Maxwell's inductance capacitance bridge is used to measure an unknown inductance in comparison with capacitance. The various values at balance are: $R_2=400\Omega$, $R_3=600\Omega$, $R_4=1000\Omega$, and $C_4=0.5\mu\text{f}$.