National Institute of Technology, Delhi

Name of the Examination: B. Tech. End Sem

Branch : ECE   Semester :4TH

Title of the Course :ELECTRONIC MEASUREMENT   Course Code :ECB-254
AND INSTRUMENTATION

Time: 3 Hours   Maximum Marks: 50

SECTION-A (Attempt all, Each question carry 1 mark)   10×1=10marks

Q1. (a) A Piezoelectric force transducer has a charge sensitivity of 20 pC/N. It is connected to a charge amplifier and overall gain of transducer and amplifier is 50 mV/N. The gain of amplifier is....

(b) A moving coil meter has 10Ω resistance and requires 40mA for full scale deflection. The shunt resistance required to convert it into 0-2A ammeter is ?

(c) An LVDT is used to measure displacement. The LVDT feeds a voltmeter of 0-5V range through a 250 gain amplifier. For a displacement 0.5mm the output of LVDT is 2mV. The sensitivity of instrument is ?

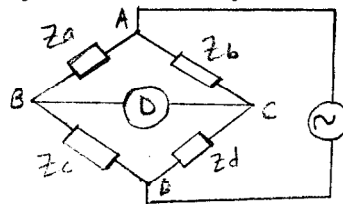(d) In figure 1. Z_a=100 ∠ 50°, Z_b=300 ∠ -90° and Z_c=200 ∠ 0°. For balanced condition Z_d will be ?

(e) The resistance of a 125Ω strain gauge changes by 1Ω for 400 micro strain. The gauge factor is ?

(f) A resistance is measured by voltmeter-ammeter method. The voltmeter is 0-250V, ± 1% accuracy and ammeter is 0-5 A, ± 1 % accuracy. The readings of voltmeter and ammeter are 100 V and 2 A respectively. The error in the measured resistance can be....

(g) A Lissajous pattern on an oscilloscope is stationary and has 5 horizontal tangencies and 2 vertical tangencies. The frequency of horizontal input is 1000Hz. Determine the frequency of vertical input.

(h) How does a spectrum analyzer functionally differ a wave analyzer?

(i) If the time/div control is set to 2μs/div, when the waveform displayed on the CRT screen covers 4 divisions, determine the frequency of the signal ?

(j) Differentiate between photovolatic, photoconductive and photoemissive effects.

SECTION-B (Attempt any four, Each Question carry 5 marks)   4×5=20marks

Q2. A PMMC voltmeter with a resistance of 20 Ω gives a full scale deflection of 120° when a potential difference of 100mV is applied across it. The moving coil has a dimensions of 30mm × 25mm and wound with 100 turns. The control spring constant is 0.375 × 10^{-6} N-m/degree. Find the flux density in the air gap. Find also the dimension of copper wire of coil winding if 30% of the instrument resistance is due to coil winding. The specific resistance of copper 1.7 × 10^{-8} Ωm.

Q3. A voltmeter of 600 Ω resistance and a milliammeter of 0.8 Ω resistance are used to measure two unknown resistances by voltmeter-ammeter method.

If the voltmeter reads 40V and milliammeter reads 120mA in both the cases, calculate the percentage error in the values of measured resistances if (a) in the first case, the voltmeter is put across the resistance and milliammeter connected in series with the supply, and (b) in the second case, the voltmeter is connected in the supply side and milliammeter connected directly in series with the resistance.

Q4. A platinum resistance thermometer has a resistance of 150 Ω at 0°C. What is the resistance when temperature is 200°C ? When the thermometer has a resistance of 400 Ω, what is the value of temperature ? The resistance temperature coefficient of platinum is 0.0039/°C.

Q5. (a) Find the dynamic range of spectrum analyzer with a 30KHz, 3dB Bandwidth, a noise figure of 15dB and third order intercept of +25dBm. [3]

(b) Calculate the total harmonic distortion for the following observations 1) D_2=5% 2) D_3=3% 3)D_4=2% [2]

Q6. A sheet of 4.5mm thick Bakelite is tested at 50Hz between 12cm in diameter. The Schering bridge uses a standard air capacitor C_2 of 105pf capacitor, a non-reactive R_4 of 1000/π in parallel with a variable capacitor and is obtained with C_4=0.5µF and R_3=260Ω. Calculate the capacitance, power factor and relative permittivity of the sheet.
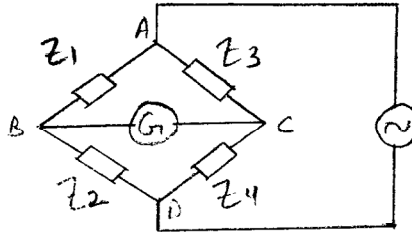
Schering Bridge

SECTION-C (Attempt any two, Each Question carry 10 marks)   2×10=20marks

Q7. (a) Explain with the help of Block diagram the operation of a Dual trace CRO. State the functions of each block. Also explain its operation in alternate mode, chop mode and X-Y mode along with waveforms. [8]
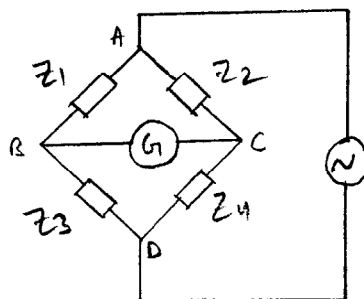
(b) Estimate the Bandwidth of CRO, if signal of 12µs rise time is observed as the signal with 15µs rise time.[2]

Q8. (a) Explain the principle of Q meter. What are the various factors that may cause error in its measurement and how can these errors be eliminated. [6]

(b) The self capacitance of a coil is measured by using the Q meter. The first measurement is at f_1=1MHz and C_1=500pf. The second measurement is at f_2=2MHz and C_2=110pf. Find the distributed capacitance. Also calculate the value of L. [4]

Q9. (a) Explain the operation of a Maxwell's Bridge along with its phasor diagram. Also derive the expression for measurement of unknown inductance and resistance using this bridge. [6]

(b) Find the equivalent parallel resistance and Capacitance that causes Wien Bridge to null with the following components values: R_1=3.1KΩ, C_1=5.2µF, R_2=25KΩ, f=2.5KHz and R_4=100KΩ. [4]

Wien Bridge