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Roll No. of candidate

2019

B.Tech. (ECE) 3rd Semester End-Term Examination

ELECTRONIC MEASUREMENT AND INSTRUMENTATION

(New Regulation)

(w.e.f. 2017–2018)

Full Marks – 70   Time – Three hours

The figures in the margin indicate full marks
for the questions.

Answer Q.No. 1 and any *four* from the rest.

1. Choose the correct answer for the following multiple choice question: $(10 \times 1 = 10)$

    (i) Schering bridge is used to measure:
         (a) Capacitance   (b) Resistance
         (c) Inductance   (d) None of these

    (ii) When the feedback resistor connecting the inverting and output terminal is set to zero, then the output will be the ———— version of the input in the non inverting end of the op-amp.

         (a) same   (b) amplified
         (c) attenuated   (d) none of the above

[Turn over

(iii) A moving iron instrument is used as an ammeter, its range can be extended by using:

   (a) Suitable shunt across its terminal

   (b) A high inductive resistance

   (c) Either (a) or (b)

   (d) Neither (a) nor (b)

(iv) A moving system in the indicating instrument is subjected to:

   (a) Deflecting torque   (b) Controlling torque

   (c) Damping torque   (d) All the above

(v) A null type of bridge with DC excitation is commonly known as:

   (a) Wheatstone bridge

   (b) Anderson bridge

   (c) Hay's bridge

   (d) Schering bridge

(vi) Under balanced condition, the current flowing through the detector is equal to:

   (a) 1A

   (b) 0A

   (c) Sum of the current flowing in the adjacent arm

   (d) Difference between the current flowing in the adjacent arm

(vii) Which part is called the heart of the CRO?

    (a) CRT   (b) Sweep generator

    (c) Trigger circuit   (d) Amplifier

(viii) Which of the following are integrating instrument?

    (a) Ammeters

    (b) Voltmeter

    (c) Wattmeter

    (d) Ampere hour and watt hour meter

(ix) Dead beat instruments are:

    (a) Over damped

    (b) Under damped

    (c) Critically damped

    (d) None of the above

(x) In an ideal op amp, CMRR is:

    (a) 0   (b) ∞

    (c) 1   (d) 0.5

2. (a) Distinguish between direct and indirect methods of measurement. Give example.

    (b) Why controlling torque is necessary in an analog indicating instrument?

    (c) Explain the working of Q-meter with suitable diagram.

d) A basic D'Arsonval galvanometer movement with $R_m = 100\,\Omega$ and full scale deflection current $I_{fsd} = 1\,mA$ is to be converted into a multi range DC voltmeter with voltage ranges:

(i)   0-10 V

(ii) 0-250 V

(iii) 0-500 V.

Draw the necessary circuit arrangement and find the value of the suitable multipliers. $(2 + 3 + 5 + 5 = 15)$

3. (a) Compare Hay's bridge and Maxwell's bridge.

(b) Derive the expression for bridge sensitivity for a Wheatstone bridge with equal arm.

(c) An ac bridge has the following constants: arm ab: a capacitor C_1 in series with a resistance r_1, arm bc: $R_3 = 2000\,\Omega$, arm cd: $R_4 = 2850\,\Omega$, arm da : $C_2 = 0.5\ \mu F$ in series with $r_2 = 0.4\,\Omega$ and $R_2 = 4.8\,\Omega$. A supply of 450 Hz is given between 'a' and 'c' and the detector is connected between 'b' and 'd'. Calculate the value of the constants of arm ab and also find the dissipation factor for the capacitor. $(3 + 4 + 8 = 15)$

4. (a) What are ideal op-amp characteristics?

   (b) Derive the relation of output voltage of an op-amp in terms of CMRR as given

   $$V_{out} = A_d V_d [1 + (1/CMRR)(V_{cm}/V_d)]$$
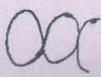
   where, V_{out} = output voltage

   A_d = differential gain

   V_d = differential voltage

   V_{cm} = common mode voltage.

   (c) Sketch the circuit of a summing amplifier to get an output voltage $V_0 = -V_1 + 2V_2 - 3V_3$.

   (d) The 741 C is used as an inverting amplifier with a gain of 50. The sinusoidal input has a variable frequency and the maximum amplitude of 20 mV peak. What is the maximum frequency of the input at which the output is undistorted? $(3 + 3 + 4 + 5 = 15)$

5. (a) Quantization is done before sampling in A/D conversion process. (True/False). Justify your answer.

   (b) Explain the operation of sample and hold circuit with a neat diagram.

   (c) For a 5 bit R-2R ladder DAC, calculate the analog output voltage when the input is:

   (i) 00001 (ii) 10000 (iii) 11111

   Given, $R_F = 5\,k\Omega$, $R = 5\,k\Omega$, $V_{ref} = 10\,V$.

   (d) Describe the operation of ramp type ADC with a suitable diagram. $(3 + 3 + 4 + 5 = 15)$

6. (a) What are rise time, fall time and delay time in CRO?

    (b) For the given Lissajous pattern, find the frequency of the vertical signal if the frequency of the horizontal signal is 3 kHz.

    (c) How oscilloscope can be used to measure voltage, current, frequency and phase?

    (d) Explain the deflection mechanism used in CRO.

    (3 + 3 + 4 + 5 = 15)

7. Write short note on any *three* of the following :

    (3 × 5 = 15)

    (a) Digital voltmeter.

    (b) Comparison between analog and digital multimeter.

    (c) Frequency meter.

    (d) Ohm meter.

    (e) Owen's bridge.