3 (Sem–6) ELE M 5

2020

ELECTRONICS

(Major)

Paper : 6·5

(Instrumentation)

Full Marks : 60

Time : Three hours

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

1. Fill in the blanks : 1×7=7

   (a) In measurements, random errors can be reduced by taking _____ of the measurement results obtained from multiple readings.

   (b) Typical value of the input impedance of a cathode ray oscilloscope is _____.

   (c) Piezoelectric crystal can act as _____ transducer.

   (d) An ideal ammeter has _____ internal impedance.

(e) Different harmonic component contents of a signal can be examined by using an instrument called _____.

(f) A square wave of 4 *V* peak-to-peak amplitude has RMS value of _____.

(g) Time period of 1 *MHz* sinusoidal signal is _____.

2. Answer the following questions : 2×4=8

(i) Resistance of a conductor has been measured and reported as $(10 \pm 0.5)\,\Omega$. What is the fractional uncertainty of the measurement ?

(ii) Why do you need instrumentation amplifiers in measurement systems ?

(iii) Design an inverting amplifier of voltage gain 40 *dB* with 741 Op-Amp.

(iv) A moving coil meter has internal resistance of $50\,\Omega$ and full-scale deflection current of $500\,\mu A$. Calculate the series resistance needed by the meter for measuring a DC current of 500 *mA*.

3. Answer ***any three*** questions : 5×3=15

(i) Draw a neat diagram of D'Arsonval movement meter and explain its constituent components in detail. 5

(ii) Design a circuit for measuring temperature of a climate chamber by

using NTC thermistors and appropriate amplifier circuits. Further, explain working of the circuits. 5

(iii) Demonstrate operation of a sweep generator with appropriate circuit and timing diagrams. 5

(iv) Illustrate working process of a digital transducer with an example. 5

(v) Design a square wave generator with operating frequency of 200 *Hz*. Further, use an appropriate digital circuit for converting 200 *Hz* signal into 50 *Hz* signal. 3+2=5

4. Answer ***any three*** questions : 10×3=30

(i) Describe the construction and working of true RMS responding meter. Why do you need this kind of meter ? 8+2=10

(ii) Illustrate the construction and working of digital storage oscilloscope (DSO). What are the advantages of DSO over analog oscilloscope ? 8+2=10

(iii) Draw a neat diagram of LVDT and explain its application in measuring displacement. How will you record the results of displacement measurements to personal computer in real time ? Explain in detail with additional functional blocks. 4+6=10

(iv) Design a multi-range analog voltmeter by using the moving coil meter mentioned in Q.2(iv). The ranges of measurement are (0–5) *V*, (0–10) *V* and (0–20) *V*. How will you convert the analog voltmeter into digital voltmeter? Explain with additional functional blocks. 6+4=10

(v) During measurement of power factor in AC power system, the following observations are obtained as shown in Table-1. Determine mean and standard deviation of the measurement. 10

Table - 1: Measured values of power factor

Trial no.	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Power Factor	0.5	0.6	0.7	0.8	0.8	0.8	0.8	0.5	0.7	0.6
Trial no.	11th	12th	13th	14th	15th	16th	17th	18th	19th	20th
Power Factor	0.6	0.6	0.7	0.8	0.8	0.8	0.8	0.5	0.7	0.5

(vi) Draw functional block diagram of a super-heterodyne wave analyzer and explain its working in brief. 10