

B.TECH/EE/5TH SEM/ELEC 3131/2016

**ELECTRONIC INSTRUMENTATION
(ELEC 3131)**

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) The resistance of a thermometer is 5Ω at 30°C and 6.5Ω at 60°C. Using linear approximation the value of resistance temperature coefficient at 45°C is
(a) 0.009/°C (b) 0.0087/°C
(c) 0.0085/°C (d) 0.01/°C.
- (ii) What is the most suitable material used for thermistor?
(a) Germanium (b) copper
(c) platinum (d) silver.
- (iii) In an LVDT, the two secondary windings are connected in differential form
(a) to obtain higher output voltage
(b) to obtain an output voltage which is phase sensitive
(c) in order to establish the null point for the displacement of the core
(d) both (b) and (c).
- (iv) Capacitive transducers are normally used for
(a) static measurement
(b) dynamic measurement
(c) both static and dynamic measurements
(d) none of this.
- (v) Radiation pyrometers are used in the temperature range of
(a) 0-500°C (b) 500-1000°C
(c) -250-500°C (d) 1200-2500°C.

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- (vi) Piezoelectric transducers are
(a) passive transducer (b) active transducer
(c) secondary transducer (d) none of these.
- (vii) The operating frequency range of frequency selective wave analyzer is
(a) 20Hz to 20KHz (b) 20KHz to 20MHz
(c) 10KHz to 18MHz (d) 0 to 1GHz.
- (viii) How many bits are required in a binary ladder type DAC to achieve a resolution of 10mV if full-scale is +5 V?
(a) 10 bits (b) 13bits (c) 9bits (d) 4 bits.
- (ix) To measure liquid level by a capacitive transducer the principle of operation used is
(a) change of distance between plates
(b) change of area of plates
(c) change of dielectric constant
(d) both (a) and (c).
- (x) The true value of Q of a coil is 245 and the measured value is 244.5. The ratio of distributed capacitance to self capacitance of the coil is
(a) 2.04×10^{-3} (b) 1.002 (c) 0.997 (d) 1.

Group - B

2. Define the gauge factor of a resistance strain gauge and derive the expression for the same in terms of other constants. For bonded type strain gauges, what are the materials used for base, leads and adhesive? Why adhesive is used in strain gauges?
(2 + 6 + 4) = 12
3. (a) Explain the working principle of a linear variable differential transformer with suitable diagram.
(b) Draw and describe the following for thermistors
(i) Resistance vs. Temperature characteristics
(ii) Voltage vs. Current characteristics
What are the applications of thermistors?
6 + (4 + 2) = 12

Group - C

4. (a) Explain how a parallel-plate capacitor serves as the most suitable transducer for measurement of linear and angular displacements.

- (b) A capacitive transducer is made up of two concentric cylindrical electrodes. The outer diameter of the inner cylindrical electrode is 3mm. and the inner diameter of the outer electrode is 3.1mm. The dielectric medium is air. Calculate the dielectric stress when a voltage of 100 V is applied across the electrodes. Is it within safe limit? The length of each electrode is 20mm. Calculate the change in capacitance if the inner electrode is moved through a distance of 2mm. Breakdown strength of air is 3kV/mm.

$$(3 + 3) + 6 = 12$$

5. (a) Describe the different modes of operation of piezoelectric transducers. What are the properties of materials used for piezoelectric transducers?
- (b) Describe the working principle of an electromagnetic type flow meter.
- (c) Draw and explain the frequency response of a charge amplifier.

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

Group - D

6. (a) Explain the working principle of a Heterodyne Wave Analyzer. State the different applications of Wave Analyzer.
- (b) Explain with the help of block diagram, the working principle of a Spectrum Analyzer.

$$5 + 2 + 5 = 12$$

7. (a) What is a Q-meter? State the different ways to connect an unknown coil with the Q-meter. Explain how Q-value of small coils and large capacitors can be measured with the Q-meter. Discuss the different errors associated with Q-meter.
- (b) A coil with a resistance of 10Ω is connected with a Q-meter in direct connection mode. At resonance, oscillator frequency is 10MHz and resonating capacitor is set at 65pF. Calculate the % error introduced by 0.02Ω shunt resistance.

$$(1 + 1 + 4 + 2) + 4 = 12$$

Group - E

8. (a) What is a Data Acquisition System? State the different types of Data Acquisition Systems used in practice. Draw the typical block diagram

of a Digital Data Acquisition System and discuss about its elements.

- (b) Obtain the 4 bit binary representation of an analog signal of 10.6 Volt using successive approximation technique. Assume that the reference voltage is 16 Volt.

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

9. (a) What is an Analog Multiplier? State the different applications of an Analog Multiplier. How can you develop analog divider and square root extractor circuits using Analog Multiplier?

- (b) What is 'virtual Instrumentation'? State the advantages of virtual instrumentation system.

$$(1 + 1 + 6) + (1 + 3) = 12$$