

**ELECTRONIC INSTRUMENTATION  
(ELEC 4241)**

**Time Allotted : 2½ hrs**

**Full Marks : 60**

*Figures out of the right margin indicate full marks.*

*Candidates are required to answer Group A and  
any 4 (four) from Group B to E, taking one from each group.*

*Candidates are required to give answer in their own words as far as practicable.*

**Group – A**

1. Answer any twelve:

**12 × 1 = 12**

*Choose the correct alternative for the following*

- (i) At which state the phase-locked loop tracks any change in input frequency?  
(a) Free running state (b) capture state  
(c) phase locked state (d) all of the above
- (ii) In a Voltage-Controlled Oscillator (VCO), how does the frequency change with the input voltage?  
(a) frequency remains constant regardless of input voltage  
(b) frequency increases as input voltage increases  
(c) frequency decreases as input voltage increases  
(d) frequency randomly fluctuates
- (iii) What is the primary advantage of a programmable gain amplifier?  
(a) fixed gain  
(b) adjustable gain through digital or analog control  
(c) low bandwidth  
(d) high output impedance
- (iv) In an LVDT the core is made up of a  
(a) Non magnetic material  
(b) a solid ferro-electric material  
(c) high permeability, nickel iron hydrogen annealed material  
(d) none of the above
- (v) Which function makes a stable waveform displayed on the DSO screen?  
(a) Auto set function (b) Triggering function  
(c) Saving a setup function (d) Recalling a setup function
- (vi) In a Q meter, the value of shunt resistance connected across the oscillator is  
(a) 2Ω (b) 0.02Ω (c) 0.002Ω (d) 0.2Ω

- (vii) LCD's operating frequency range is  
 (a) 30Hz to 60 Hz (b) 50Hz to 70Hz  
 (c) 10Hz to 60 Hz (d) 100Hz to 1Khz
- (viii) In a DSO, the function of the trigger circuit is to  
 (a) Adjust the display brightness (b) Synchronize the waveform display  
 (c) Increase the amplitude of the signal (d) Control the probe attenuation
- (ix) What is the purpose of a multiplexer in a DAS?  
 (a) To amplify signals  
 (b) To filter signals  
 (c) To select one input signal from multiple sources  
 (d) To convert digital data to analog form
- (x) In Virtual Instrumentation, which component is responsible for acquiring real-world signals?  
 (a) Graphical User Interface (b) Data Acquisition System  
 (c) Microprocessor (d) RAM

*Fill in the blanks with the correct word*

- (xi) VFCs are commonly used in \_\_\_\_\_ systems to convert analog signals into frequency-based signals.
- (xii) \_\_\_\_\_ is displayed on the x-axis of a spectrum analyzer.
- (xiii) The quality factor, or Q-factor, is defined as the ratio of \_\_\_\_\_ energy to dissipated energy in a reactive component.
- (xiv) A low-pass filter is used in DAS to remove \_\_\_\_\_ from the acquired signals.
- (xv) The operational amplifier used in a current-to-voltage converter must have a low \_\_\_\_\_ offset to ensure accurate measurements.

### **Group - B**

2. (a) What is the necessity of a true rms voltmeter? Why are two thermocouples used in a true rms voltmeter? [[CO1] (Evaluate/HOCQ)]  
 (b) Explain the function of dual slope integrating type voltmeter. [[CO1] (Analyze/IOCQ)]  
**(3 + 3) + 6 = 12**
3. (a) List the advantages and applications of frequency counters. [[CO1] (Remember/LOCQ)]  
 (b) What is a current mirror? Explain with a diagram the working principle of a current mirror. [[CO1] (Analyze/IOCQ)]  
**4 + (2 + 6) = 12**

### **Group - C**

4. (a) How liquid level change can be sensed by a capacitive sensor? Derive the expression of sensitivity. [[CO2](Analyze/IOCQ)]

- (b) What is the disadvantage if a solid dielectric medium is used in a variable distance capacitive sensor? [[CO2] (Understand/LOCQ)]
- (c) Describe the function of a resistive potentiometer as a sensor. [[CO2] (Evaluate/HOCQ)]
- 5 + 5 + 2 = 12**
5. (a) Describe the different modes of operation of piezoelectric transducers. What are the properties of materials used for piezoelectric transducers? Mention the applications of piezoelectric transducer. [[CO2] (Remember/LOCQ)]
- (b) Explain with figure how very low voltage measurement is done with chopper stabilized amplifier. [[CO2] (Understand/LOCQ)]
- (3 + 2 + 2) + 5 = 12**

### Group - D

6. (a) A circuit consists of a coil, a resistance and a variable capacitor connected in series is tuned to resonance using a Q meter. If the frequency is 500kHz, the resistance is  $0.5\Omega$  and the variable capacitor is 350pF, calculate the effective inductance and resistance of the coil, if the Q-meter indicates 90. [[CO3] (Analyze/HOCQ)]
- (b) Discuss about the applications of Q-meter. [[CO3] (Understand/LOCQ)]
- 6 + 6 = 12**
7. (a) Explain the working principle of Heterodyne Wave Analyzer. [[CO3] (Analyze/IOCQ)]
- (b) List the different applications of Wave Analyzer. [[CO3] (Analyze/IOCQ)]
- (c) Explain with the help of a block diagram, the working principle of a 'Spectrum Analyzer'. [[CO3] (Understand/LOCQ)]
- 3 + 3 + 6 = 12**

### Group - E

8. (a) What are the goals of the data acquisition system? Describe various types of data acquisition systems with proper diagrams. [[CO4] (Analyze/IOCQ)]
- (b) What is a 'virtual instrument'? [[CO4] (Remember/LOCQ)]
- (2 + 8) + 2 = 12**
9. (a) A 4-bit DAC has a reference voltage of 10V. Determine the output voltage for a digital input of  $1011_2$  using the weighted resistor method. What is the resolution of this DAC? [[CO4] (Evaluate/HOCQ)]
- (b) Define multiplexing and describe the working principles of Digital-to-Analog Multiplexing and Analog-to-Digital Multiplexing with suitable block diagrams. [[CO4] (Remember/LOCQ)]
- 4 + (2 + 6) = 12**

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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	42.71	36.46	20.83

