ELECTRONIC INSTRUMENTATION
(ELEC 4241)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> 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) 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 (a), (b) & (c).

   (ii) What is the output voltage in a dual slope integrating type DVM?
   (a) Differential of the input (b) Multiple of the input
   (c) Integral of the input (d) Zero.

   (iii) The main disadvantage of true r.m.s reading voltmeter is
   (a) Presence of transducer (b) Presence of thermocouple
   (c) Presence of transformer (d) Presence of oscillator.

   (iv) The order in which the temperature transducers typically exhibit nonlinearity (highest to lowest) is
   (a) Thermocouple, RTDs, Thermistor (b) Thermistor, Thermocouple, RTDs
   (c) RTDs, Thermocouple, Thermistor (d) Thermistor, RTDs, Thermocouple.

   (v) An LCD's operating frequency range is
   (a) 30 Hz to 60 Hz (b) 50 Hz to 70 Hz
   (c) 10 Hz to 60 Hz (d) 100 Hz to 1 khz.

   (vi) 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).

   (vii) What is the purpose of sampling in DSO operation?
   (a) To control time base signal (b) To convert analog signal to digital
   (c) To convert digital signal to analog (d) To visualize the signal on screen.

   (viii) The operating frequency range of frequency selective wave analyzer is
   (a) 20 Hz to 20 kHz (b) 2 kHz to 20 MHz
   (c) 10 kHz to 18 MHz (d) 0 to 1 GHz.

(ix) How many bits are required in a binary ladder type DAC to achieve a resolution of 10 mV if full-scale is +5 V?
(a) 10 bits   (b) 13 bits   (c) 9 bits   (d) 4 bits.

(x) Q-meter works on the principle of
(a) mutual inductance   (b) self inductance
(c) series Resonance   (d) parallel resonance.

Group - B

2. (a) Explain the working of a digital voltmeter where voltage to frequency is converted. *[(CO1)(Analyze/IOCQ)]*
(b) Compare the maximum conversion time of an 8-bit digital ramp ADC with that of a Successive approximation type ADC, both are using a clock of 100 kHz.
[(CO1)(Evaluate/HOCQ)]
6 + 6 = 12

3. (a) What is the necessity of a true rms voltmeter? Why are two thermocouples used in a true rms voltmeter? *[(CO1)(Evaluate/HOCQ)]*
(b) What is current mirror? Justify why a current mirror consists of low impedance input stage connected to a high impedance output current stage.
[(CO1)(Evaluate/HOCQ)]
(3 + 3) + (3 + 3) = 12

Group - C

4. Write short notes on any two of the followings: **(2 × 6) = 12**
(i) Resistance Temperature Detector (RTD)
(ii) Inductive sensor
(iii) Power factor meter. *[(CO2)(Understand/LOCQ)]*

5. (a) What is the disadvantage if a solid dielectric medium is used in a variable distance capacitive sensor? *[(CO2)(Understand/LOCQ)]*
(b) Explain the circuit diagram and operation of a Chopper Amplifier type voltmeter using photo-diodes. *[(CO2)(Analyze/IOCQ)]*
5 + 7 = 12

Group - D

6. (a) What is a Wave Analyzer? Explain with the help of block diagram the working principle of a Frequency Selective Wave Analyzer. *[(CO3)(Evaluate/HOCQ)]*
(b) Explain with the help of a block diagram, the working principle of a 'Spectrum Analyzer'. *[(CO3)(Understand/LOCQ)]*
6 + 6 = 12

7. (a) How series resonance is obtained in Q-meter? *[(CO3)(Understand/LOCQ)]*

(b)   Analyze different methods of connecting an unknown coil with Q-meter.
[(CO3)(Analyze/IOCQ)]

(c)   Explain how shunt resistance affects the Q- measurement of an unknown coil?
[(CO3)(Evaluate/HOCQ)]

4 + 4 + 4 = 12

Group - E

8. (a)   Obtain the 4 bit binary representation of an analog signal of 10.6 Volt using successive approximation techniques. Assume the reference voltage is 16 Volt.
[(CO4)(Evaluate/HOCQ)]

(b)   What is a Data Acquisition System? State the objectives of a Data Acquisition System. Explain in detail the functioning of a Digital Data Acquisition System.
[(CO4)(Analyze/IOCQ)]

4 + (2 + 2 + 4) = 12

9. (a)   Develop analog divider and square root extractor circuits using 'Analog Multiplier'.
[(CO4)(Create/HOCQ)]

(b)   What is 'Multiplexing'? Explain 'Analog to Digital' and 'Digital to Analog' Multiplexing with block diagrams.
[(CO4)(Analyze/IOCQ)]

6 + (2 + 4) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	28	32	40

Course Outcome (CO):

After the completion of the course students will be able to
●   Infer about low current and voltage measurement using electronic instruments.
●   Explain the applications of DSO and sensors
●   Understand wave analyzing circuits and function generator.
●   Acquire the concepts of data acquisition and virtual instrumentation.

LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.