

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), April-May 2015

B. Tech in Electronics & Communication Engineering, Semester IV



Roll No.....

ECE 406: Measurement & Instrumentation

Time: 3 hours

Max. Marks: 100

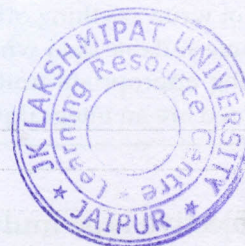
Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark) 10

- i. The measured value of a capacitor is $100\ \mu\text{F}$. The true value of the capacitor is $110\ \mu\text{F}$. The percentage relative error is
(a) 9.99% (b) 9.09% (c) 10.0% (d) 4.76%
- ii. A null type instrument as compared to a deflection type instrument has
(a) higher accuracy (c) a lower sensitivity
(b) a faster response (d) All of these
- iii. A recorder
(a) is an indicating device which displays a time varying signal
(b) records electrical and non-electrical quantities as a function of as a function of time or relates two signals to each other
(c) both A and B
(d) none of these
- iv. Which one of the following is a passive transducer?
(a) Piezoelectric (c) Thermocouple
(b) LVDT (d) Photovoltaic cell
- v. RTDs have
(a) Positive temperature coefficient (c) Negative temperature coefficient
(b) Either type of coefficient (d) high tolerance
- vi. A 0-300 V voltmeter has an error of $\pm 2\%$ of full scale deflection. What would be the range of readings if true voltage is 30 V?
(a) 24 V - 36 V (c) 29.4 V - 30.6 V
(b) 20 V - 40 V (d) none of the above
- vii. X-Y recorders
(a) Record one quantity with respect to another quantity
(b) Record one quantity on X-axis with respect to time on Y-axis
(c) Record one quantity on X-axis with respect to time on X-axis
(d) None of these
- viii. The advantage of Hay's bridge over Maxwell's bridge is because
(a) its equations for balance do not contain any frequency term
(b) it can be used for measurement of inductance of high Q coils
(c) it can be used for measurement of inductance of low Q coils

- ix. A modifying input to a measurement system can be defined as an input
- (a) which changes the input-output relationship for desired inputs only
 - (b) which changes the input-output relationship for desired as well as interfering inputs
 - (c) which changes the input-output relationship for interfering inputs only
 - (d) none of these
- x. The recording head in a magnetic tape responds to
- (a) Thermal signal and creates a magnetic signal
 - (b) Magnetic signal and creates an electrical signal
 - (c) Thermal signal and creates an electrical signal
 - (d) Electric signal and creates an magnetic signal



Q.2	Short answer type questions (4 questions @ 2.5 marks)	10
i.	Explain secondary instruments.	
ii.	Write down the advantages of Anderson's bridge.	
iii.	Describe Aperture time.	
iv.	Describe input characteristics for a transducer.	
Q.3A	Current was measured during a test as 30.4A, flowing in a resistor of 0.105Ω . It was discovered later that the ammeter reading was low by 1.2% and the marked resistance was high by 0.3%. Find the true power as percentage of the power that was originally calculated.	05
Q.3B	An analog transducer with a 0-10 V input is able to distinguish a change of 10mV in its input signal. Calculate its resolution. Calculate the number of bits of an A/D converter so that the digital output has almost the same resolution as the transducer. The A/D converter uses a binary code. Calculate also the quantization error and the number of decision levels.	05
Q.4A	Find the successive approximation A/D output for a 4 bit converter to 8.217 V input if the reference is 5V.	05
Q.4B	A piezo-electric crystal having dimensions of 5 mm x 5 mm x 1.5 mm and a voltage sensitivity of 0.055 V - m/N is used for force measurement. Calculate the force if voltage developed is 100 V.	05
Q.5A	What are the basic blocks of a Generalized Instrumentation System? Draw the various blocks and explain their functions.	05
Q.5B	Explain the instrumental errors with suitable examples.	05
Q.6A	Describe the voltage to time A/D converter (Ramp type) in detail with the help of block diagram.	05
Q.6B	A thermocouple circuit uses a chromel-alumel thermocouple which gives an emf of 33.3 V when measuring a temperature of 800°C with reference temperature 0°C . The resistance of meter coil, R_m is 50Ω and a current of 0.1mA gives full scale deflection. The resistance of junctions and leads, R_e , is 12Ω . Calculate: (a) The approximate error due to rise of 1Ω in R_e (b) The approximate error due to rise of 10°C in the copper coil of the meter. The resistance temperature co-efficient of coil is $0.00426/^{\circ}\text{C}$.	05

OR

- Q.6B A steel cantilever is 0.25 m long, 20 mm wide and 4 mm thick.
- (a) Calculate the value of deflection at the free end for the cantilever when a force of 25 N is applied at this end. The modulus of elasticity for steel is 200 GN/m^2 .
- (b) An LVDT with a sensitivity of 0.5 V/mm is used. The voltage is read on a 10V voltmeter having 100 divisions. Two tenth of a division can be read with certainty. Calculate the minimum and maximum value of force that can be measured with this arrangement.

05



- Q.7A Write down the advantages and disadvantages of capacitive transducers.
- Q.7B Consider a 6 bit D/A converter with a resistance of $320 \text{ k}\Omega$ in LSB position. The converter is designed with resistive network. The reference voltage is 10 V. The output of the resistive network connected to an OPAMP with a feedback resistance of $5 \text{ k}\Omega$. What is the output voltage for a binary input of 111.010?

05

05

OR

- Q.7B A thermistor has a resistance of 3980Ω at the ice point (0°C) and 794Ω at 50°C . The resistance-temperature relationship is given by $R_T = aR_0 \exp (b/T)$. Calculate the constants 'a' and 'b'.

05

- Q.8A The four arms of a Maxwell's capacitance bridge at balance are: arm 'ab' an unknown inductance L_1 , having an inherent resistance R_1 ; arm 'bc' a non-inductive resistance of 1000Ω ; arm 'cd' a capacitor of $0.5 \mu\text{F}$ in parallel with a resistance of 1000Ω ; arm 'da' a resistance of 1000Ω . Find the values of R_1 and L_1 . (Do not use direct formula for this numerical)

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- Q.9A Describe construction and working of strip chart recorder in detail with proper diagrams.
- Q.9B Describe the working of Hay's bridge for measurement of inductance. Derive the equations for balance and draw the phasor diagram under conditions of balance.

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OR

- Q.9B Describe the properties materials used for piezo-electric transducers. Derive expressions for voltage and charge sensitivities.

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