SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)
Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai
Accredited by NAAC-UGC with 'A++' Grade (Cycle III) &
Accredited by NBA (B.E - CSE, EEE, ECE, Mech & B.Tech.IT)
COIMBATORE-641 035, TAMIL NADU

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B

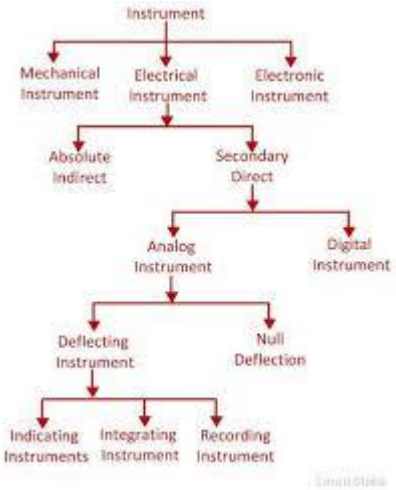
Reg. No: | | | | | | | | | | | | |

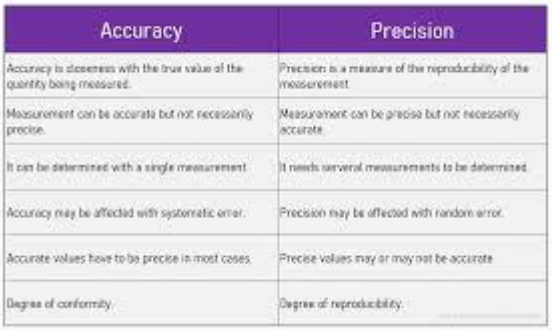
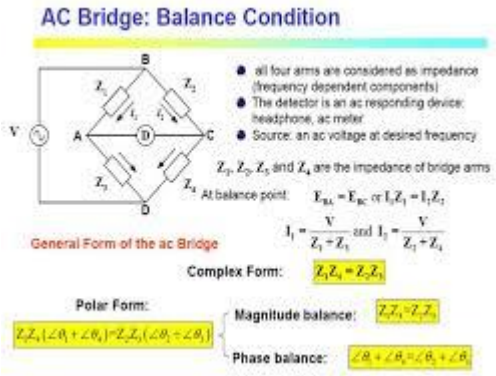
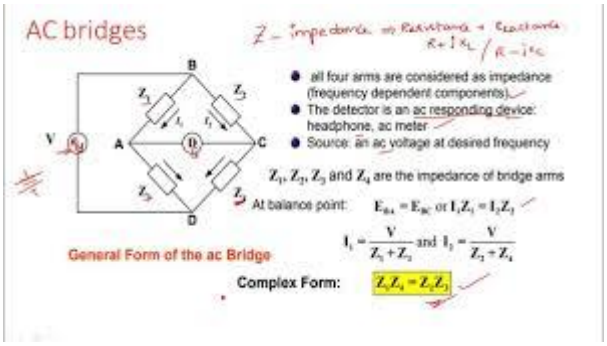
B.E/B.Tech- Internal Assessment – I
Academic Year 2024-2025 (Even)
Fourth Semester
Electrical and Electronics Engineering
23EET206/ Measurements and Instrumentation

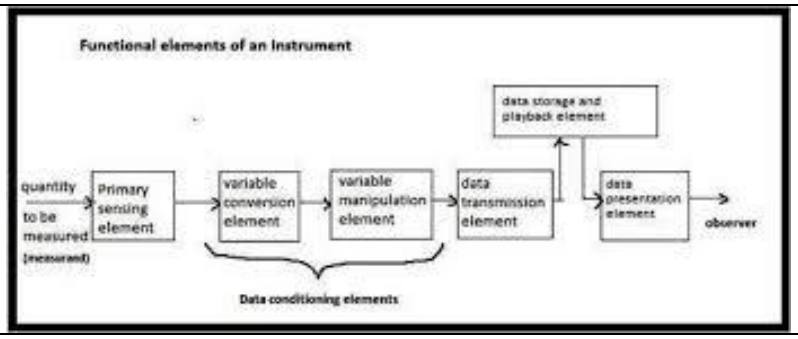
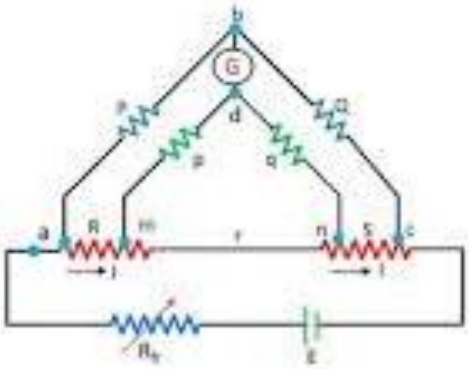
KEY ANSWER

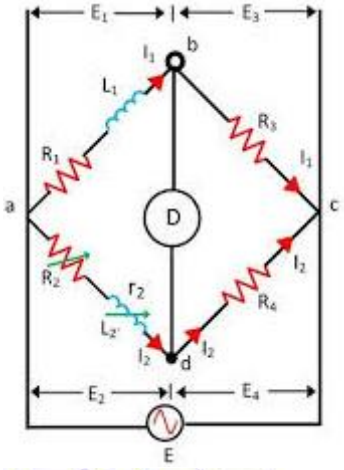
Time: 1 1/2 Hours **Maximum Marks: 50**

Answer All Questions

1.	Classify the analog Instruments based on operating principle. 
2.	Illustrate the term Accuracy and Precision?

			
3.	Write the two conditions to be satisfied for balancing AC bridges. 		
4.	What type of AC bridge is used for measurement of capacitance? And write its formula. 		
5.	List any two limitations of wheat stone bridge. Limitation of Wheatstone bridge: "It is not susceptible to high dc current." ... "The Wheatstone bridge measures resistance from few "ohms" to "megohms." "The upper range of the bridge can be increased with the help of the applied "emf", and the lower range is limited by connecting the lead at the binding post."		
6.	(a)	With aid of block diagram showing the basic functional elements of an general instrument and explain the functions of each block with example	13

			
		(OR)	
	(b)	Discuss in detail various types of errors associated in measurement and how these errors can be minimized? 	13
7.	(a)	Explain the operation of Kelvin bridge with neat circuit diagram and also derive the expression for determining unknown resistance.  $C + i_1 = \frac{A}{B}(D + i_2)$ Also we have $\frac{i_1}{i_2} = \frac{A}{B}$ ..... (1) $i_1 = \frac{A}{A+B} \times i$ As $i_1 + i_2 = i$ and $i_2 = \frac{B}{A+B} \times i$ We can write equation (1) as $C + \frac{A}{A+B} \times i = \frac{A}{B} \times \left(D + \frac{B}{A+B} \times i\right)$ It implies that $C = \frac{A}{B} \times D$	13
		(OR)	
	(b)	Explain how inductance is measured in terms of known capacitance using Maxwell's bridge and also derive the equation for balanced condition.	13



Writing the equation for balance

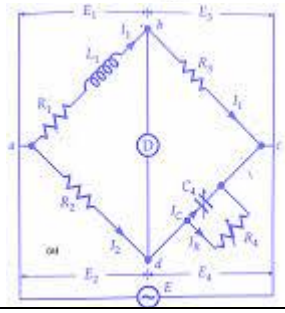
$$(R_1 + j\omega L_1)\left(\frac{R_4}{1+j\omega C_4 R_4}\right) = R_2 R_3$$

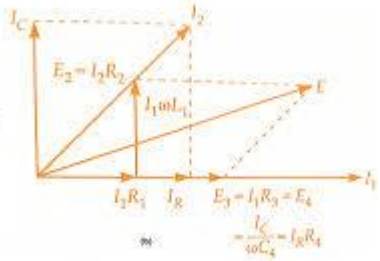
or $$R_1 R_4 + j\omega L_1 R_4 = R_2 R_3 + j\omega R_2 R_3 C_4 R_4$$

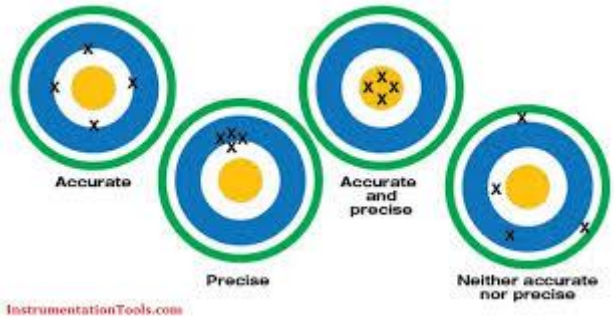
Separating the real and imaginary terms, we have

$$R_1 = \frac{R_2 R_3}{R_4} \quad \text{...(16.18)}$$

and $$L_1 = R_2 R_3 C_4 \quad \text{...(16.19)}$$

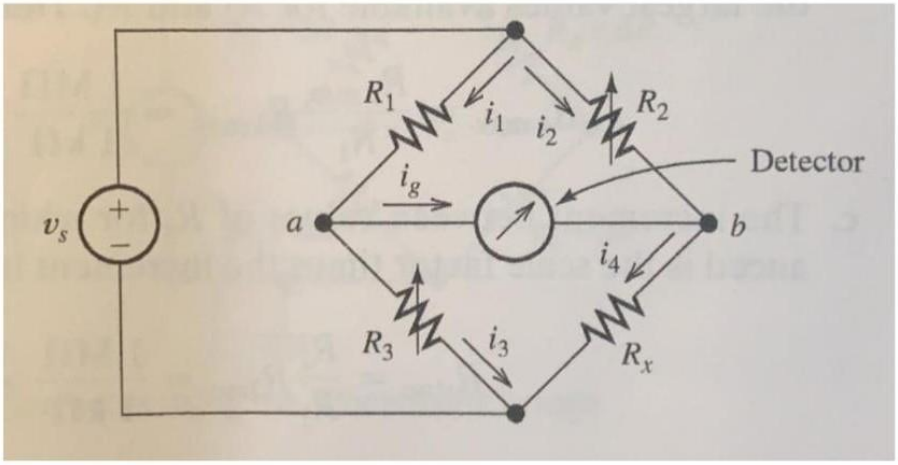




8.	(a)	Define and explain the following static characteristics of an instrument with real time example. Also explain the types of static errors possible in an instrument. a) Accuracy, b) Resolution, c) Sensitivity and d) Linearity.  	14
		(OR)	
	(b)	Explain how unknown resistance is measured in terms of known resistance using wheat stone bridge and also derive the equation for balanced condition with numerical calculations.	14

The Wheatstone bridge is a circuit used to measure unknown resistances. For example, it is used by mechanical and civil engineers to measure the resistances of strain gauges in experimental stress studies of machines and buildings. The circuit is shown below. The circuit consists of a DC voltage source v_s, a detector, the unknown resistance to be measured R_x, and three precision resistors R_1, R_2 and R_3. Usually, R_2 and R_3 are adjustable resistances, which is indicated in the figure by the arrow drawn through the resistance symbols.

The detector is capable of responding to very small currents (less than one microampere). However, it is not necessary for the detector to be calibrated. It is only necessary for the detector to indicate whether or not current is flowing through it. Often, the detector has a pointer that deflects one way or the other, depending on the direction of the current through it. In operation, the resistors R_2 and R_3 are adjusted in value until the detector indicates zero current. In this condition, we say that the bridge is balanced. Then, the current i_g and the voltage V_{ab} across the detector are zero.



(1). Please derive the unknown R_x in terms of R_1, R_2 and R_3.
(2). Model the Wheatstone Bridge circuit in MATLAB/Simulink and verify the result you found in Part (1).
(3). Find a real-world application of Wheatstone Bridge and explain how it works. Model your application of Wheatstone Bridge in MATLAB/Simulink.