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**BTECH**
**(SEM III) THEORY EXAMINATION 2021-22**
**ELECTRICAL MEASUREMENTS & INSTRUMENTATION**

*Time: 3 Hours*                                                                                   *Total Marks: 100*

**Note: 1.** Attempt all Sections. If require any missing data; then choose suitably.

## SECTION A

**1.**          **Attempt *all* questions in brief.**                                                   **2 x 10 = 20**

| Q no. | Question | Marks | CO |
|---|---|---|---|
| a. | Differentiate between null type and deflection type of measuring instruments along with suitable example. | 2 | 1 |
| b. | A voltage has true value of 1.50 V. An analog indicating instrument with scale range of 0-2.50 V show a voltage of 1.46 V. What are the value of absolute error and correction? Express the error as fraction of true value. | 2 | 1 |
| c. | Enlist the errors found in Wheatstone bridge. | 2 | 2 |
| d. | Justify the need of modified Schottky bridge. | 2 | 2 |
| e. | Define Nominal ratio and Transformation ratio for CT and PT. | 2 | 3 |
| f. | Explain the term "Burden of Instrument Transformers" | 2 | 3 |
| g. | Draw the Lissajous pattern for frequency ratio 3:2 | 2 | 4 |
| h. | Write principal of operation of digital frequency meter. | 2 | 4 |
| i. | Differentiate active and passive type of transducers with suitable example. | 2 | 5 |
| j. | Write principle of operation of Thermocouple. | 2 | 5 |

## SECTION B

**2.**          **Attempt any *three* of the following:**                                           **3 x 10 = 30**

| Q no. | Question | Marks | CO |
|---|---|---|---|
| a. | Define the limiting Error. The resistance value for three registers are specified as $R_1 = 100\ \Omega \pm 5\ \%$, $R_2 = 75\ \Omega \pm 5\ \%$ and $R_3 = 50\ \Omega \pm 5\ \%$. Determine the value of limiting error in ohms and in percentage for the total equivalent resistance, if they are connected in (i) Series and (ii) parallel, connection respectively. | 10 | 1 |
| b. | Describe the working of Hay's bridge for measurement of inductance. Derive the equations for balance and draw the phasor diagram. A Hay's bridge is configured as follows, Arm *AB*: A choke coil having a resistance $R_1$ and inductance $L_1$, Arm *BC*: a non inductive resistance $R_3$, Arm *CD*: a mica condenser $C_4$ in series with a non-inductive resistance $R_4$, Arm D*A*: a non inductive resistance $R_2$. A supply of 300 V and 500 Hz is given between terminals *A* and *C* and detector is connected between nodes *B* and *D*. The balance is obtain under the following condition. $R_2 = 2410\ \Omega$, $R_3 = 750\ \Omega$, $R_4 = 64.5\ \Omega$ and $C_4 = 0.35\ \mu F$ and a series resistance of capacitor=0.4 $\Omega$. Determine the inductance $L_1$ and resistance $R_1$ of unknown choke coil. | 10 | 2 |
| c. | The current transformer with 5 primary turns has a secondary burden consisting of a resistance of 0.16 $\Omega$ and an inductive reactance of 0.12 $\Omega$. When the primary current is 200 A, the magnetising current is 1.5 A and the iron loss current is 0.4 A. Find the number of secondary turns needed to make the current ratio 100.1 and also find the phase angle. | 10 | 3 |
| d. | Classify different types of digital voltmeters. Explain Integrated type of digital voltmeters with the help of suitable diagrams. | 10 | 4 |
| e. | Describe the principle of operation, construction, working of piezoelectric transducers. Derive the expression for output voltage. A piezoelectric crystal has a thickness of 2.5 mm and voltage sensitivity 0.05 Vm/N. Determine the output voltage when it is subjected to a pressure of $1.6 \times 10^6$ N/m$^2$. | 10 | 5 |

PAPER ID-411680

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### SECTION C

**3.**  **Attempt any *one* part of the following:**                           **1 x 10 = 10**

| Q no. | Question | Marks | CO |
|---|---|---|---|
| a. | Illustrate the construction and operation of moving iron type of instruments. Also derive the expression of deflecting torque. Enlist the advantages, disadvantages of these instruments. | 10 | 1 |
| b. | Derive and illustrate the condition for balance with suitable circuit diagram for Kelvin's Double bridge. | 10 | 1 |

**4.**  **Attempt any *one* part of the following:**                           **1 x 10 = 10**

| Q no. | Question | Marks | CO |
|---|---|---|---|
| a. | Derive balance equation of Maxwell's Inductance-Capacitance Bridge along with its phasor diagram. Also find the storage factor for this bridge. Mention advantages and disadvantages of this bridge. | 10 | 2 |
| b. | Derive the equation of balance for Schering bridge. Also draw its phasor diagram. Discuss how dissipation factor of a capacitor can be measured by it. | 10 | 2 |

**5.**  **Attempt any *one* part of the following:**                           **1 x 10 = 10**

| Q no. | Question | Marks | CO |
|---|---|---|---|
| a. | Draw the equivalent circuit and phasor diagram of a current transformer. Derive the expression for ratio and phase angle. | 10 | 3 |
| b. | A current transformer of turns ratio 1:199 is rated as 1000/5 A, 25 VA. The core loss and magnetizing component of the primary current are 4A and 7A under rated conditions. Determine the phase angle and ratio errors for the rated burden and rated secondary current of 0.8 p.f. lagging and 0.8 p.f. leading. Neglect the resistance and leakage resistance of secondary winding. | 10 | 3 |

**6.**  **Attempt any *one* part of the following:**                           **1 x 10 = 10**

| Q no. | Question | Marks | CO |
|---|---|---|---|
| a. | Define spectrum analyzer. Classify different types of spectrum analyzers and explain basic spectrum analyzer with neat block diagram. Also give the applications of wave analyzers. | 10 | 4 |
| b. | Describe the construction and working of general purpose CRO using block diagram and explain its components in detail. | 10 | 4 |

**7.**  **Attempt any *one* part of the following:**                           **1 x 10 = 10**

| Q no. | Question | Marks | CO |
|---|---|---|---|
| a. | Discuss factors for selecting a transducer. Explain pressure capacitance transducer with a neat diagram. State advantages and disadvantages of a capacitive transducer. | 10 | 5 |
| b. | Explain the principle, construction and working of strain gauge transducer and formulate the expression for gauge factor in terms of Poisson's ratio. A resistance strain gauge with a gauge factor 3 is fastened to a steel member subjected to a stress of 100 N/mm$^2$. The modulus of elasticity of steel is approximately 2 x 10$^5$ N/mm$^2$. Estimate the value of percentage change in the resistance. | 10 | 5 |