Set(2) QID: 2103230119 Apr-25

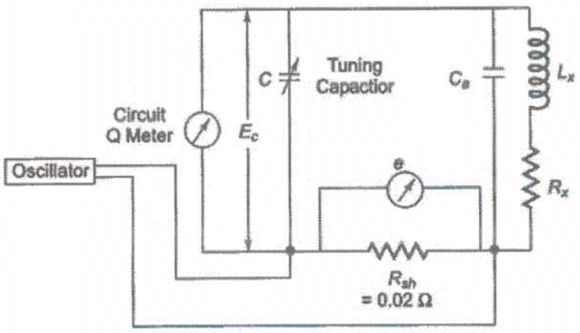
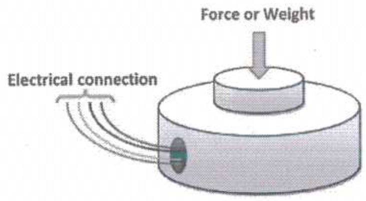
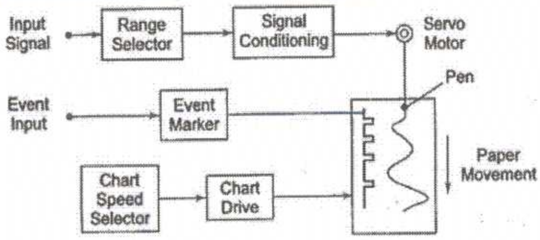
T2 TED (21) – 4042 REVISION 2021 P-10

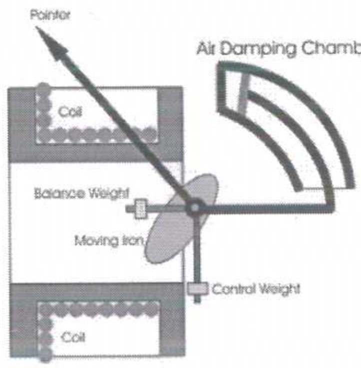
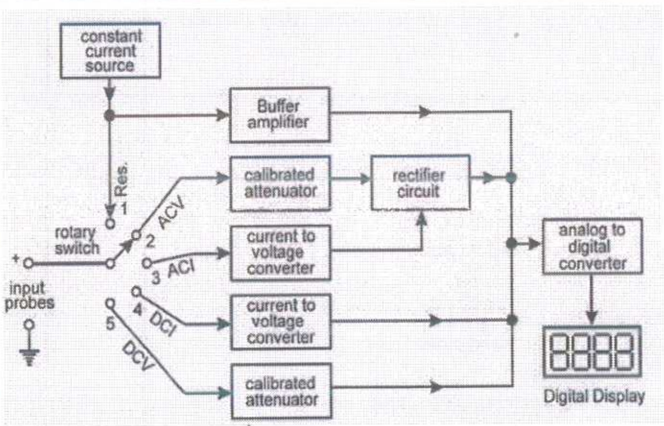
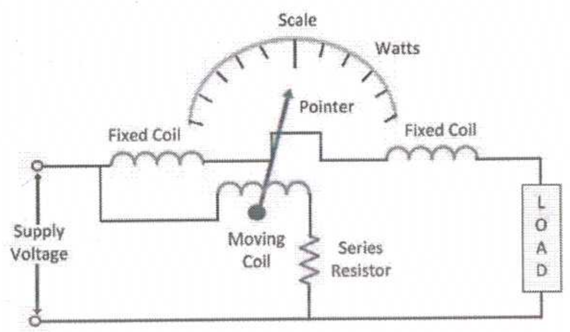
## Scoring Indicators

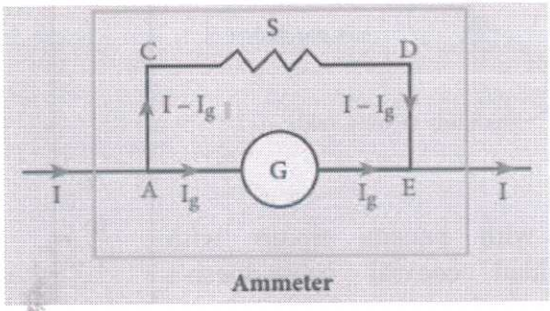
## ELECTRONICS MEASUREMENTS & INSTRUMENTATION

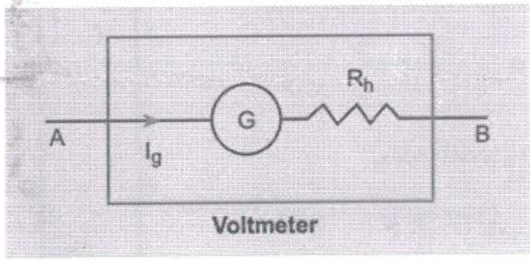
| Q No | Scoring Indicators | Split score | Sub Total | Total Score |
|---|---|---|---|---|
| | **PART A** | | | 9 |
| I.1. | Gross error is human error ie error caused by misreading or improper adjustment of the instrument etc | | 1 | |
| I. 2. | Moving iron instrument | | 1 | |
| I. 3. | 1:1 probe<br>10:1 probe | 2*0.5 | 1 | |
| I. 4. | To prevent early arrival of signal to vertical deflection plates | | 1 | |
| I. 5. | Measurement of resistance,inductance etc | 2*0.5 | 1 | |
| I. 6. | DC/AC potentiometer,Slidewrie potentiometer,Cromptons potentiometer | 2*0.5 | 1 | |
| I. 7. | Q Meter | | 1 | |
| I. 8. | Linear Variable Differential Transformer | | 1 | |
| I. 9. | Sensitivity,Linearity,Resolution,precision ,span & range | 2*0.5 | 1 | |
| | **PART B** | | | 24 |
| II.1. | Digital Voltmeter / Analog Voltmeter<br>1. o/p signal in digital form / 1.Analog form<br>2. Has overload indication / 2. No overload indn<br>3. Better resolution / 3. less resolution<br>4. More sensitivity / 4.Less sensitivity<br>5. More speed / 5.less speed | 3*1 | 3 | |
| II. 2. | ***Applns of CRO*** | 0.5*6 | 3 | |

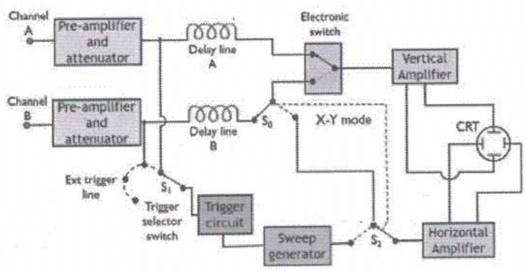
| | | | | |
|---|---|---|---|---|
| – | 1. Used in Radio stations<br>2. To control analog signals<br>3. Used for research purposes<br>4. Used with resonance ckt to observe bandwidth,waveshape etc<br>5. Observe Characteristics of AM,FM etc<br>6. Used for current,voltage,frequncy Measurement | | | |
| **II. 3.** | ***Electrostatic focussing in CRT*** | | **3** | |
| | Electrostatic focussing is a method of aligning the path of charged particles by applying electric filed between deflecting plates.The word electrostatic means,the strength and direction of field changes wrt to time so that particles will move only in one direction,The beam passes through horizontal and vertical deflection plates and strikes the screen | | | |
| **II.4** | ***Procedure of measurement of phase angle*** | | **3** | |
| | When two signals are applied simultaneously to an oscilloscope without internal sweep,one to the horizontal channel and the other to the vertical channel,the resulting pattern is a Lissajous figure that shows the phase difference between the two signals.such patterns results fro, sweeping of one signal by the other.correct phase angle can be measured by introducing a small phase shift to one of the inputs,the proper angle may be deduced by noting the direction in which the pattern changes | | | |
| **II.5.** | ***Features of DSO*** | **3*1** | **3** | |
| | 1. Storage capability<br>2. Signal processing possible<br>3. Quantitative analysis<br>4. 2 dimensional memory<br>5. Built in interfaces like RS 232 available | | | |
| **II.6.** | ***Multiple trace CRO,defn-1,advantages-2*** | **1+1+1** | **3** | |
| | Definition<br>A single electron beam generates more than 1 trace, that undergoes deflection by two independent sources.<br>Advantages<br>1. can display multiple traces on the screen<br>2. Input and o/p waveforms of a ckt can be compared easily | | | |

| | | | | |
|---|---|---|---|---|
| II.7. | ***Practical ckt diag of Q meter*** | | 3 | |
| |  | | | |
| II.8. | ***Working principle of piezoelectric transducer*** | | 3 | |
| | When a mechanical force is applied on a piezo electric crystal,a voltage is produced across its faces.Thus mechanical phenomena is converted into electrical signal.No external supply is required to work and hence it is an active transducer | | | |
| II.9. | ***Load cell*** | | 3 | |
| |  | | | |
| II.10. | ***Strip chart recorder*** | | 3 | |
| | <br>**Fig. 12.1(a)** Basic Strip Chart Recorder | | | |
| | **PART C** | | | 42 |
| III | ***Moving iron attraction type instrument*** | 4+3 | 7 | |

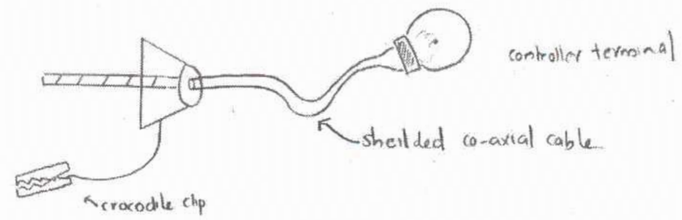
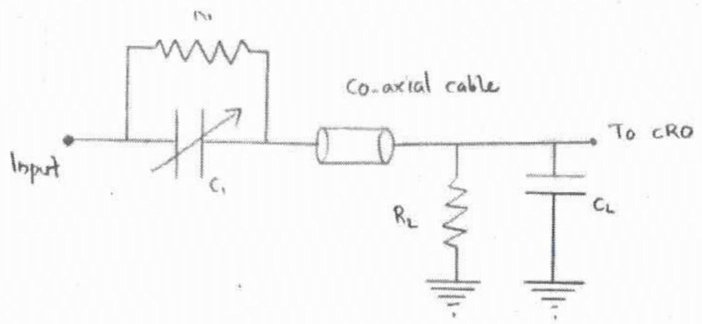
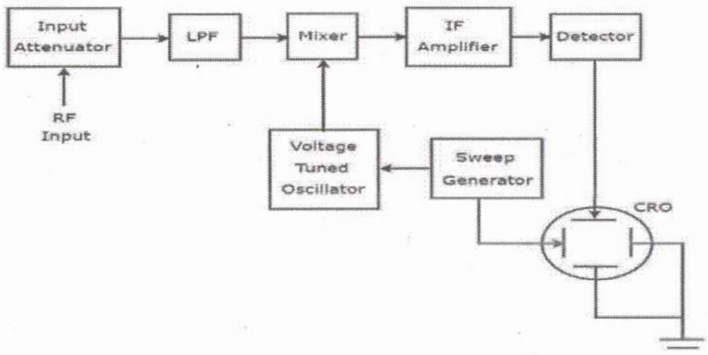
| | | | | |
|---|---|---|---|---|
| | Attraction type<br><br><br>Coils fixed,moving iron disc,current passed through coils-magnetic filed- disc is atrracted -disc moves ,pointer attached to disc moves,movement propotional to current.Air damping ,balance and control weight to control the movement of the spring | | | |
| ~~IV~~ 2 | ***Digital multimeter*** | **4+3** | **7** | |
| | <br><br>DMM capable of measuring AC/DC voltage,AC/DC current,Resistance etc,calibrated attenuator to suppress high volatge,rectifier to covert ac to dc,ADC to convert analog siganls to digital signals | | | |
| ~~X~~ 3 | ***Electrodynamometer watt meter*** | **4+3** | **7** | |
| | <br> | | | |

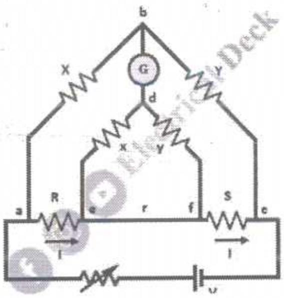
<table>
<tr><td></td><td>The fixed coils,as separate elements,are connected in series and carries the total line current.The movable coils located in the magnetic field of fixed coils is connected in series with the current limiting resistor across the powerline,and carries small current.The deflection of the movable coil is propotional to the product of the instantaneous value of current in the movable coil and total line current</td><td></td><td></td><td></td></tr>
<tr><td>~~VI~~ 4</td><td>Galvanometer to ammeter(3.5(fig2+expln 1.5)) Voltmeter(3.5)</td><td>2*3.5</td><td>7</td><td></td></tr>
<tr><td></td><td>




Ammeter by connecting low Resistance in shunt<br>
Voltmeter by connectig high R in series</td><td></td><td></td><td></td></tr>
<tr><td>~~VII~~ 5</td><td>Dual trace Oscilloscope</td><td>4+3</td><td>7</td><td></td></tr>
<tr><td></td><td>


Both the inputs are separately fed to the preamplifier and attenuator stage. The outputs of the two separate preamplifiers and attenuator stage are then provided to the electronic switch. This switch only passes a single channel input particularly at a time to the vertical amplifier.The circuit also has a trigger selector switch that permits the circuit triggering with either A or B</td><td></td><td></td><td></td></tr>
</table>

| | | | | |
|---|---|---|---|---|
| | channel input or with the externally applied signal.The signal from the horizontal amplifier is fed to the electronic switch by either sweep generator or channel B by switch S0 and S2.In this way, the vertical signal from channel A and horizontal signal from channel B is provided to the CRT for the operation of the oscilloscope.This is the **X-Y mode of the oscilloscope** and permits accurate X-Y measurements. | | | |
| **VIII** 6 | ***1:1 probe(3.5(fig 2+expln 1.5)) 10:1 probe(3.5)*** | **2*3.5** | 7 | |
| | 1:1 probe<br><br><br>Simplest probe,terminal with banana tip,tip with crocodile clip,uses shielded coaxial cable,doesn't provide any improvement in the input impedance<br>10:1 probe<br><br><br>Used for connecting fast rising and high frequency signals | | | |
| **IX** 7 | <br> | **4+3** | 7 | |

| | | | | |
|---|---|---|---|---|
| | The RF signal, which is to be analyzed is applied to input attenuator. If the signal amplitude is too large, then it can be attenuated by an input attenuator.<br>Low Pass Filter (LPF) allows only the frequency components that are less than the cut-off frequency.<br>Mixer gets the inputs from Low pass filter and voltage tuned oscillator. It produces an output, which is the difference offrequencies of the two signals that are applied to it.IF amplifier amplifies the Intermediate Frequency (IF) signal, i.e. the output of mixer. The amplified IF signal is applied to<br>detector.The output of detector is given to vertical deflection plate of CRO. So, CRO displays the frequency spectrum of RF signal on its CRT screen. | | | |
| ~~X~~ 8 | ***Kelvin's double bridge for resistance measurement***<br>***Fig-3***<br>***Expln-2***<br>***Eqn-2*** | 3+2+2 | 7 | |
| | <br>Here, R is the unknown resistance to be measured, S is the standard resistance and 'r' is the resistance of the connecting lead. G is the galvanometer and is connected in such a way that the effect of r is eliminated. The circuit incorporates two sets of ratio arms i.e., X, Y, and x, y.Under balanced condition, $V_{ab} = V_{acd}$<br>$V_{ab} = \frac{XV_{ac}}{X+Y}$ [using voltage division rule] ... (1)<br>$V_{ac} = I\left[R + S + \frac{(x+y)r}{x+y+r}\right]$ ... (2)<br>$\therefore V_{aed} = I\left[R + \frac{x}{x+y}\left\{\frac{(x+y)r}{x+y+r}\right\}\right]$<br>$V_{aed} = I\left[R + \frac{xr}{x+y+r}\right]$ ... (3) | | | |

$$V_{ab} = \frac{X}{X+Y} I \left[ R + S + \frac{(x+y)r}{x+y+r} \right] \dots (4)$$

$$V_{ab} = V_{aed} \quad i.e., equating\ eqn\ 3\ \&\ 4$$

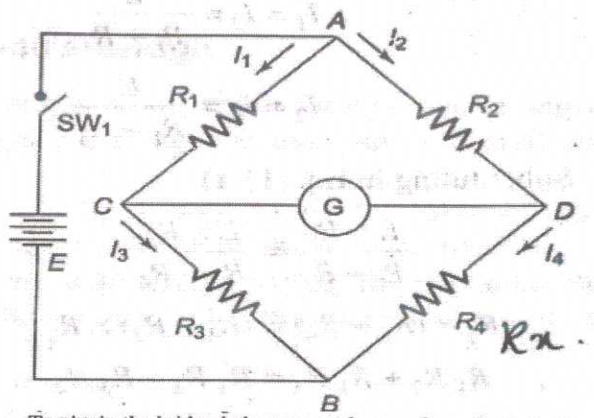
$$\frac{X}{X+Y} I \left[ R + S + \frac{(x+y)r}{x+y+r} \right] = I \left[ R + \frac{xr}{x+y+r} \right]$$

$$R = \frac{X}{Y}.S + \frac{yr}{x+y+r} \left[ \frac{X}{Y} - \frac{x}{y} \right]$$

$$\frac{X}{Y} = \frac{x}{y}$$

$$\therefore R = \frac{X}{Y} S$$

| | | | | |
|---|---|---|---|---|
| ~~XI~~ 9 | ***Wheatstone bridge*** ***Fig-3*** <br> ***Expln-2*** <br> ***Eqn-2*** | 3+2 <br> +2 | 7 | |




To obtain the bridge balance equation, we have from the Fig. 11.1.

$$I_1 R_1 = I_2 R_2 \quad (11.1)$$

For the galvanometer current to be zero, the following conditions should be satisfied.

$$I_1 = I_3 = \frac{E}{R_1 + R_3} \quad (11.2)$$

$$I_2 = I_4 = \frac{E}{R_2 + R_4} \quad (11.3)$$

Substituting in Eq. (11.1)

$$\frac{E \times R_1}{R_1 + R_3} = \frac{E \times R_2}{R_2 + R_4}$$

$$R_1 \times (R_2 + R_4) = (R_1 + R_3) \times R_2$$

$$R_1 R_2 + R_1 R_4 = R_1 R_2 + R_3 R_2$$

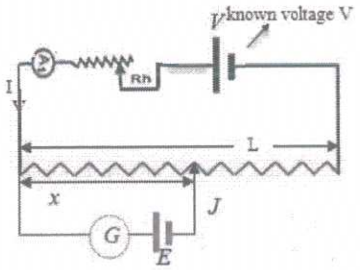
$$R_4 = \frac{R_2 R_3}{R_1}$$

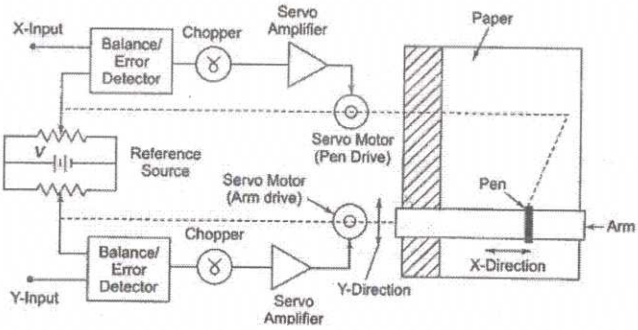
This is the equation for the bridge to be balanced.

In a practical Wheatstone's bridge, at least one of the resistance is made adjustable, to permit balancing. When the bridge is balanced, the unknown resistance (normally connected at $R_4$) may be determined from the setting of the adjustable resistor, which is called a standard resistor because it is a precision device having very small tolerance.

Hence $$R_x = \frac{R_2 R_3}{R_1} \quad (11.4)$$

| | | | | |
|---|---|---|---|---|
| ~~XII~~ 10 | ***Basic slide wire potentiometer(fig 2 Expln 2) Applns 3*** | 4+3 | | |

| | | | | |
|---|---|---|---|---|
| | <br><br>The basic working principle of this is based on the fact that the fall of the potential across any portion of the wire is directly proportional to the length of the wire, provided wire has a uniform cross-sectional area and the constant current flowing through it."When there is no potential difference between any two nodes there is electric current will flow"<br><br>Applns: 1.Voltage divider 2.Audio control 3.television 4.Transducers | | | |
| ~~XIII~~ 4 | ***Thermistor-3.5 Strain gauge 3.5*** | **2*3.5** | **7** | |
| | Thermistor<br>A **thermistor** (or **thermal resistor**) is defined as a type of resistor whose electrical resistance varies with changes in temperature. Although all resistors' resistance will fluctuate slightly with temperature, a thermistor is particularly sensitive to temperature changes.<br>The working principle of a thermistor is that its resistance is dependent on its temperature. We can measure the resistance of a thermistor using an ohmmeter<br>Strain gauge: A strain gauge is a resistor used to measure strain on an object. When an external force is applied on an object, due to which there is a deformation occurs in the shape of the object. This deformation in the shape is both compressive or tensile is called strain, and it is measured by the strain gauge. When an object deforms within the limit of elasticity, either it becomes narrower and longer or it become shorter and broadens. As a result of it, there is a change in resistance end-to-end.The strain gauge is sensitive to that small changes occur in the geometry of an object. By measuring the change in resistance of an object, the amount of induced stress can be calculated.The change in resistance normally has very small value, and to sense that small change, strain gauge has a long thin metallic strip arrange in a zigzag pattern on a non-conducting material called the carrier, as shown below, so that it can enlarge the small amount of stress in | | | |

| | | | | |
|---|---|---|---|---|
| | the group of parallel lines and could be measured with high accuracy. The gauge is literally glued onto the device by an adhesive. | | | |
| ~~XIV~~ 12 | ***X-Y Recorder*** | **4+3** | **7** | |
| |   The balancing circuit then compares the attenuated signal to a fixed internal reference voltage. The output of the balancing circuit is a dc error signal produced by the difference between the attenuated signal and the reference voltage. This dc error signal is then converted into an ac signal with the help of a chopper circuit. This ac signal is not sufficient to drive the pen/arm drive motor, hence, it is amplified by an ac amplifier. This amplified signal (error signal) is then applied to actuate the servo motor so that the pen/arm mechanism moves in an appropriate direction in order to reduce the error, thereby bringing the system to balance. Hence as he input signal being recorded varies, the pen/arm tries to hold the system in balance, producing a record on the paper | | | |