MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC-27001-2013 Certified)

Summer – 2019 Examinations
Model Answers
Subject & Code: Electrical & Electronic Measurements (22325)

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.

3) The language errors such as grammatical, spelling errors should not be given more importance (Not applicable for subject English and Communication Skills).

4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.

5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.

6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.

7) For programming language papers, credit may be given to any other program based on equivalent concept.

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<u>**Model Answers**</u>
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1		**Attempt any <u>FIVE</u> of the following:**	**10**

1 a) Define the term 'calibration' and state its need for measuring instruments.
Ans:
Calibration: Calibration means comparing measuring instrument with Standard instrument to find out the error in the instrument under test.
Need of Calibration for Measuring Instruments:
- To ensure that the readings of an instrument are consistent in comparison with the standard instruments.
- For determining the accuracy of the instrument.
- For evaluating / adjusting the precision and accuracy of instruments.
- To eliminate or reduce error in the instrument.
- To verify whether the data obtained is reliable or correct.
- If instrument is kept idle for a long time, the instrument's conditions will change, thus calibration is needed in such cases.
- Every instrument will need to be calibrated periodically to make sure of its proper function and safety.

1 Mark for Definition and 1 Mark for any one need

1 b) What is the difference between conventional ammeter and clip-on ammeter?
Ans:
Difference Between Conventional Ammeter and Clip-on Ammeter:

Sr. No.	Conventional Ammeter	Clip-On Ammeter
1	Conventional ammeter measures the current flowing through it at the time of measurement.	Clip-on ammeter measures the current flowing through cable, bus bar, wire etc without connected with them.
2	Conventional ammeter is electrically connected with circuit.	Clip-on ammeter is magnetically coupleded with circuit.
3	Particular conventional ammeters measures AC as well as DC current.	Clip-on ammeters are generally used for measurement of AC current.
4	Measures only value of current.	Measures value of current and also has facility to measure voltage.
6	Here circuit should be made off first and then ammeter is connected in circuit for current measurement.(Circuit is disturbed)	Circuit is not disturbed while measurement of current.
7	Locking of current reading at the time of measurement is not available.	Locking of current reading at the time of measurement is available

1 Mark for each of any two points = 2 Marks

OR Equivalent Answer

1 c) Calculate the resistance of shunt required to make a milliammeter which gives

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maximum deflection for a current of 15 mA and which has a resistance of 5 Ω, read upto 10 Amp.

Ans:

Given: Full scale deflection current I_G = 15 mA .

Resistance of moving coil instrument R_G = 5 Ω.

Shunt resistance R_{sh} :

For full scale deflection when the arrangement carries current of I = 10 A, using the principle of equal voltage across parallel resistances of R_G and R_{sh},   1 Mark

$I_G . R_G = (I – I_G) R_{sh}$

$R_{sh} = I_G . R_G / (I – I_G) = 15 \times 10^{-3} \times 5 / (10 – 15 \times 10^{-3})$

R_{sh} = 7.51 x 10⁻³ ohms   1 Mark

1 d) State the difference between unity P.F wattmeter and low P.F wattmeter.

Ans:

Difference Between Unity P.F. Wattmeter and Low P.F. Wattmeter:

Sr. No.	Unity P.F Wattmeter	Low P.F Wattmeter	
1	UPF Wattmeter is used in short circuit test of machines / device.	LPF Wattmeter is used in open circuit test of machines / device.	
2	UPF wattmeter is used for measure power in resistive circuit.	LPF wattmeter is used for measurement power in highly inductive circuits.	1 Mark for each of any two points = 2 Marks
3	UPF Wattmeter is the instrument that measures power for higher values of power factor accurately.	LPF Wattmeter is the instrument that measures power for lower values of power factor accurately.	
4	The value of deflecting torque is very low for low P.F.	The value of deflecting torque is moderate for low P.F.	
5	Errors are caused due to pressure coil inductance for low P.F.	Errors due pressure coil inductance are eliminated here.	

OR Equivalent Answer

1 e) A single phase wattmeter rated for 500 V; 5A is having full scale deflection of 1000 watt. What is multiplying factor of the wattmeter?

Ans:

$$\text{Multiplying factor} = \frac{Voltage\ Range \times Current\ Range \times PF}{FSD}$$ 1 Mark

$$\text{Multiplying factor} = \frac{500 \times 5 \times 1}{1000} = 2.5 \text{ (P.F is assumed as 1)}$$ 1 Mark

1 f) State the various error in single phase electronic energy meter.

Ans:

Errors in Single Phase Electronic Energy Meter:

1)Error due to wrong sensor opeartion.

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2) Error due to temperature.
3) Error due to wrong CT opeartion.   1 Mark for
4) Error due to wrong PT opeartion.   each of any
5) Error due to wrong opeartion of scaling network.   two errors
6) Error due to wrong ADC opeartion.   = 2 Marks
7) Error due to wrong Display.
OR Equivalent Answer

1 g) State any two advantages of electronic energy meter?
      Ans:
      Advantages of Electronic Energy Meter:
      1) Low cost.
      2) High accuracy.
      3) More flexibility.
      4) High sensitivity   1 Mark for
      5) No frictional losses.   each of any
      6) Less loading effect.   two
      7) High frequency range.   advantages
      8) Power consumption is less.   = 2 Marks
      9) High resolution.
      10) No requirement for external adjustment.
      11) Low load, full load, power factor and creeping adjustments are not required.

2   **Attempt any THREE of the following:**   **12**

2 a) State the types of errors in measuring instruments and reasons of occurrence of errors.
      Ans:
      Types of Errors With Reasons of Occurrence in Measuring Instruments:
      A) Gross error: These are due to mistakes on the part of person using the instrument.   1 Mark
      B) Systematic Error:
       i) Instrumental Error: These errors are caused due to the mechanical structure of   2 Marks
          measuring instrument such as:
           a) Inherent shortcomings of instruments: Instrument may read too low or too
           high.
           b) Improper use of instruments: Improper handling e.g. overloading, overheating,
           failure to adjust zero, use of high resistance leads.
           c) Loading effect: Cause distortion in original signal.
       ii) Environmental Error: These are because of surrounding conditions such as
          temperature, pressure, humidity, dust, vibrations, or external magnetic fields or
          electrostatic fields.
       iii) Observational Error: Parallax errors, incorrect multiplying factor.
      C) Random error: These persist even after gross and systematic errors are removed.   1 Mark

2 b) Define the following terms.
          (i)   Precision
          (ii) Drift
          (iii) Resolution

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(iv) Back lash

Ans:

(i) Precision: It is a measure of consistency or repeatability of measurements. It is also known as the degree of exactness for which an instrument is designed or intended to perform. Precision refers to the closeness of two or more measurements to each other.

(ii) Drift: Drift is gradual variation in output over period of time that is independent to change in output operating conditions etc.

(iii) Resolution: The smallest increment in input (the quantity being measured) which can be detected with certainty by an intrument is called its resolution or discrimination.

OR

It is the smallest change in the measured variable to which an instrument will responds.

(iv) Back lash: It is also known as mechanical hysteresis and it is a loss of motion in mechanical elements such as gears, linkages etc. which are used for transmission of motion.

1 Mark for each definition = 4 Marks

2 c) Distinguish between:
    (i) Absolute and secondary instruments
    (ii) Analog and digital instruments.

Ans:

(i) Distinction between Absolute and Secondary Instruments:

Sr. No.	Absolute Instrument	Secondary Instrument
1	It gives magnitude of quantity in terms physical constants of instrument.	It gives reading of the quantity directly on the scale at the time of measurement.
2	Calibration is not required.	Calibration with absolute instrument is required time to time as per requirements.
3	Measurement is time consuming because of tedious calculations.	Measurement is quick because of direct indication.
4	Very rarely used in practical applications.	Very widely used in practical applications.
5	Absolute instruments are used in laboratories as standardizing instruments.	Secondary instruments are used in everyday measurement work.
6	Examples: Tangent Galvanometer, Absolute electrometer, and Raleigh current balance.	Examples: Ammeter, Voltmeter, Ampere-hour meter, Wattmeter etc.

1 Mark for each of any two points = 2 Marks

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(ii) Distinction between Analog and Digital Instruments:

Sr. No.	Analog Instruments	Digital Instruments	
1	The instrument which gives output that varies continuously as quantity to be measured is known as analog instrument.	The instrument which gives output that varies in discrete steps and only has finite number of values is known as digital instrument.	1 Mark for each of any two points = 2 Marks
2	The accuracy of analog instrument is less.	The accuracy of digital instrument is more.	
3	The analog instruments are not affected by temperature.	The digital instruments are generally affected by temperature.	
4	Sensitivity of analog instrument is more.	Sensitivity of digital instrument is less.	
5	The analog instruments are economical.	The digital instruments are expensive.	
6	The resolution of analog instruments is less.	The resolution of digital instruments is more.	

OR Equivalent Answer

2 d) Which meter has a greater sensitivity and why? Meter A having a range of 0-10 V and a multiplier resistance of 18 kΩ and meter B with a range of 0-300 V and multiplier resistance of 298 kΩ? Both meter movements have a resistance of 2 kΩ.

Ans:

For meter A: $R_S = 18\,k\Omega$ $R_m = 2\,k\Omega$ $V = 10\,V$

    $R_S = (S_A\,V) - (R_m)$ ……………..(Where S_A is sensitivity of meter A)   1 Mark

    $18 \times 10^3 = (S_A \times 10) - (2 \times 10^3)$

    $(18 + 2) \times 10^3 = S_A \times 10$

    $20 \times 10^3 = S_A \times 10$

      $\mathbf{S_A = 2000\,\Omega\,/\,V}$ ……………..(1)   1 Mark

For meter B: $R_S = 298\,k\Omega$ $R_m = 2k\Omega$ $V = 300\,V$

    $R_S = (S_B\,V) - (R_m)$ ……………..(Where S_B is sensitivity of meter B)

    $298 \times 10^3 = (S_B \times 300) - (2 \times 10^3)$

    $(298 + 2) \times 10^3 = S_B \times 300$

    $300 \times 10^3 = S_B \times 300$

      $\mathbf{S_B = 1000\,\Omega\,/\,V}$ …………….(2)   1 Mark

According to definition of Sensitivity and from equation (1) and (2), meter A is more sensitive than meter B.   1 Mark

3   **Attempt any THREE of the following:**   **12**

3 a) Describe with circuit diagram, the working of full wave rectifier type A.C Voltmeter.
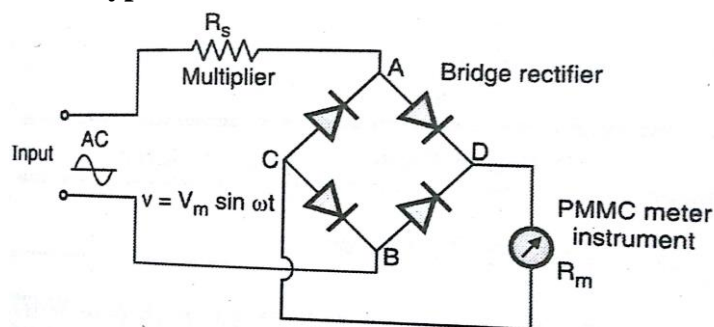
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Ans:
Full Wave Rectifier Type A.C Voltmeter:

2 Marks for Diagram

Circuit diagram of full wave rectifier type A. C. Voltmeter
Working of full wave rectifier type A. C. Voltmeter:
Consider the circuit diagram; here for rectification the full wave bridge circuit (ABCD) is used. Input is given across A and B in series with R_S (multiplier) ultimately d.c. is available as output voltage from points C and D to which PMMC meter is connected. Now the current passing through meter is given as, $I_M = \frac{Vdc}{Rm+Rs}$ which causes full scale deflection of the meter.

2 Marks for Working

3 b) A 3-phase, 500 volt motor load has a power factor of 0.4. Two wattmeter connected to measure the input. They show the input to be 30 KW. Find the reading of each wattmeter?
Ans:
Given: $V_L = 500V$, $\cos \phi = 0.4$ & $(W_1 + W_2) = 30kW = 30000W$

$$As, \quad W_1 + W_2 = \sqrt{3}\ V_L\ I_L \cos \phi$$
$$30000 = \sqrt{3} \times 500 \times I_L \times 0.4$$
$$I_L = \frac{30000}{\sqrt{3} \times 500 \times 0.4} = 86.602\ A$$
$$W_1 = V_L\ I_L \cos(30° + \phi)$$

1 Mark

1 Mark

Now, $\cos \phi = 0.4$, $\phi = 66.42°$
$$\therefore W_1 = 500 \times 86.602 \times \cos(30° + 66.42°)$$
$$\mathbf{W_1 = (\ -\ 4842\ W)}$$
$$W_2 = V_L\ I_L \cos(30° - \phi)$$
$$\therefore W_2 = 500 \times 86.602 \times \cos(30° - 66.42°)$$
$$\mathbf{W_2 = (\ 34842\ W)}$$

1 Mark

1 Mark

3 c) List the various errors occurred in dynamometer type wattmeter and describe the way of compensating any one type of error.
Ans:
Various Errors Occurred in Dynamometer Type Wattmeter:
   1) Error due to connection method.
   2) Error due to pressure coil inductance.
   3) Error due to pressure coil capacitance.

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4) Error due to mutual inductance effect.

5) Error due to stray magnetic fields.

6) Error due to eddy currents.

7) Temperature error.

8) Error due to vibration of moving system.

9) Error due to friction.

2 Marks for any two errors

The way of Compensating the Errors:

Sr. No.	Errors in Wattmeter	Compensation method
1	Error due to connection method	To overcome this error, wattmeter are provided with additional compensating winding which is connected in series with pressure coil but positioned in such a manner that it produces a field in opposition to that produced by current in current coil.
2	Error due to pressure coil inductance	A suitable value capacitor connected in parallel with pressure coil.
3	Error due to pressure coil capacitance	This error can be reduced by designing pressure coil circuit such that inductive reactance of the circuit matches exactly with the capacitance reactance of the circuit i.e. $X_L = X_C$.
4	Error due to mutual inductance effect	This error can be reduced by proper design of pressure coil and current coil system so that they always remain in a zero position of mutual inductance.
5	Error due to stray magnetic fields	To avoid this error, magnetic shield is placed over CC & PC.
6	Error due to eddy currents	These are minimized by avoiding solid metal parts and using laminated core.
7	Temperature error	Using zero temperature coefficient materials for coils and components, this can be minimized.
8	Error due to vibration of moving system	It is avoided by designing the moving system such that its natural frequency is greater than 2 times the frequency of deflecting torque of the wattmeter.
9	Error due to friction	It is reduced by reducing the weight of moving system to minimum possible.

2 Marks for any compensation of one error

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3 d) Describe with circuit diagram, the calibration of single phase electronic energy meter using direct loading?
**Ans:**
Calibration of Electronic Energy Meter by Direct Loading Method:
The following figure shows the arrangement of calibration for single phase electronic energy meter. A phase shifter is connected for changing power factor of circuit.

2 Marks for Description

The energy readings are taken for different values of current at different power factors.
Let D = Registration of meter under calibration in kWh &
    Ds = Registration of standard meter in kWh
Then % error = $[(D - D_S)/D_S] \times 100$
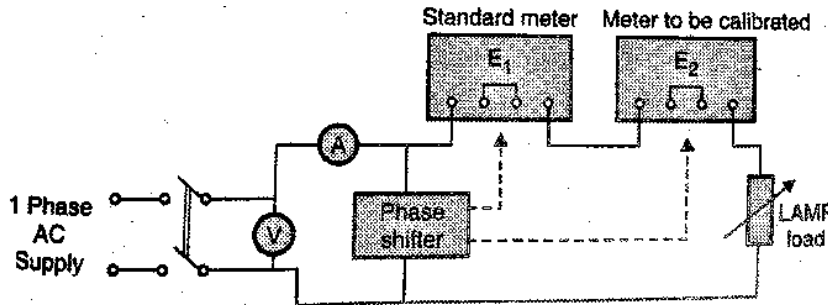
2 Marks for Diagram

OR Equivalent Answer

4 Attempt any THREE of the following: **12**

4 a) Describe with block diagram working of single phase electronic energy meter.
Ans:
Working of Single Phase Electronic Energy Meter:
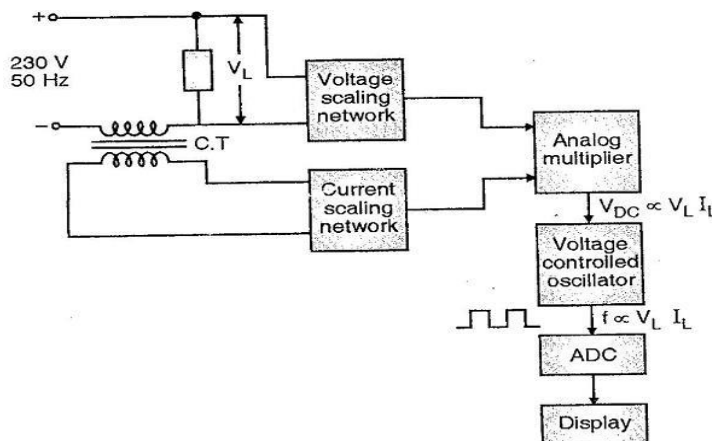
2 Marks for Diagram

OR Any other equivalent layout diagram
Working of Electronic Energy Meter:-
1. CT reduces current to reasonable value for current scaling network.
2. Voltage & current scaling networks reduce proportionally the voltage & current to values suitable for the analog multiplier.
3. Analog multiplier gives a dc voltage proportional to the product of the voltage and

2 Marks for Description

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current drawn from supply that is the power drawn.
4. The voltage controlled oscillator gives a frequency proportional to its input (which is proportional to the power).
5. The ADC converts the square wave frequency analog output to display the energy in Watt-hour.

4 b) Describe with block diagram; working of signal generator and state at least two applications of signal generator.

Ans:

Block Diagram of Signal Generator:
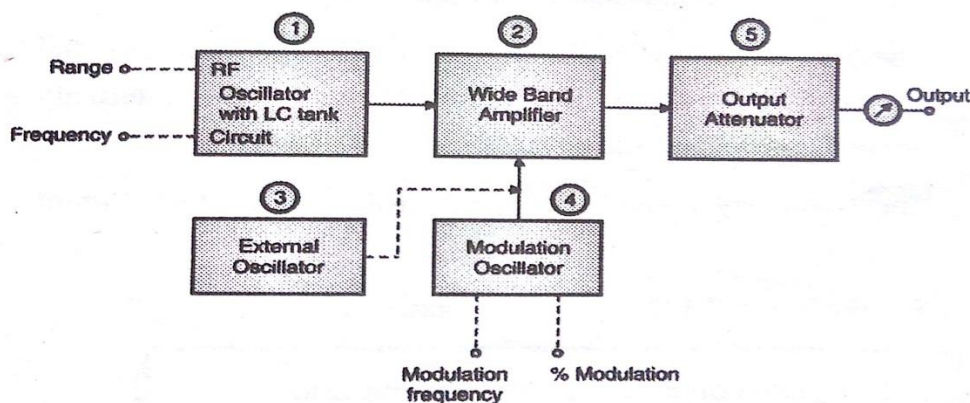
2 Marks for Diagram

Working:

As shown in above diagram, the RF oscillator having LC tank circuit produces carrier frequency. The sine wave voltages are with an appreciable range of frequency and amplitudes.

The frequency of oscillation is selected from the frequency range control and the vernier dial setting on the front panel. The modulation is indicated by meter.

The output signal can be AM (Amplitude Modulated) or FM (Frequency Modulated). Modulation can be done by sine wave, square wave or triangular wave or by pulse.

AM is provided by external source or by internal sine wave generator. Modulation is done in output amplifier circuit which delivers its output to an attenuator.

The attenuator facilitates selection of proper range of attenuation and the output level is controlled. The output voltage is observed on output meter.

1 Mark for working

Other Provisions-

1. Buffer amplifiers are used for isolating the oscillator circuit from the output in high frequency oscillator.
2. Regulated power supplies are used for frequency stability of all the ranges.
3. Temperature compensation is also provided.

Applications of Signal Generator:

(i) It is used for Bandwidth measurement.
(ii) It is used for Gain measurement.
(iii) It is used for Signal to noise ratio measurement.
(iv) It is used for standing wave ratio and other properties measurement.
(v) It is used for testing of transmitters
(vi) It is used for testing of radio receivers.

1 Mark for any two applications

4 c) What is Trivector meter? Describe the constructional details of Trivector meter?

Ans:

Trivector Meter:

Trivector meter is a measuring instrument which measures the active, reactive power and total Energy consumed. They are normally used in substations to measure the power flowing through the feeders and for billing the industrial consumers.

1 Mark
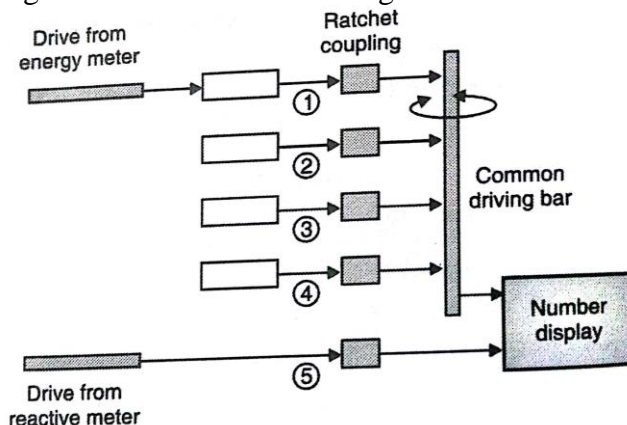
2 Mark for Diagram

It is an electromechanical meter with gears and ratchet coupling mechanism.

It consists of five gearing systems as:

Gearing system 1 : For watt hour meter

Gearing system 2 : For watt hour meter with p.f. 0.924 and driven at reduced speed

Gearing system 3 : For watt hour meter with p.f. 0.707 and driven at reduced speed

Gearing system 4 : For watt hour meter with p.f. 0.383 and driven at reduced speed

Gearing system 5 : For reactive meter driven at normal speed.

1 Mark

Whenever power factor of the load changes, the driving mechanism shifts to respective ratchet couplings and system drives the mechanism.

The display unit is connected to common driving bar and the respective numbers of KVAh are displayed on it.

4 d) Describe how the following measurement can be made with the use of CRO:

   (i) Voltage measurement
   (ii) Time period measurement

Ans:

Procedure of Voltage Measurement with use of CRO:

• Through vertical amplifier apply a voltage to be measured to Y deflection plate

• The X deflection plates are excited by the time base generator.

• A set of squares is marked on the transparent screen cover which aids measurements.

• Using these markings and the gain of vertical amplifier, the peak to peak (p-p) value (and hence r.m.s. value) of the voltage can be measured.

• After noting down the selection in volts / division from the front panel (which is selected for measurements) the peak to peak value(p-p), amplitude and r.m.s. value of sinusoidal signal can be obtained as :

2 Marks

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$$\text{Peak to peak } (V_{p\text{-}p}) \ = \left(\frac{\text{Volts}}{\text{division}}\right) \times \text{No. of divisions}$$

$$\text{Amplitude} = V_{max} = \frac{Vp-p}{2}$$

$$\text{RMS Value } (V_{r.m.s.}) = \frac{Vp-p}{2\sqrt{2}} \quad \text{for sinusoidal signals}$$

Procedure of Time Period Measurement using CRO:
- The waveform is displayed on the screen such that one complete cycle is visible on the screen.
- If single cycle occupies full or major horizontal distance then the accuracy in measurement is much more.
- Select time / division on the front panel and note it.
- The time period (T) can be calculated as:

$$\text{Time period (T)} = \left(\frac{time}{division}\right) \times \text{No. of divisions occupied by one cycle.}$$

2 Marks

OR Equivalent Answer

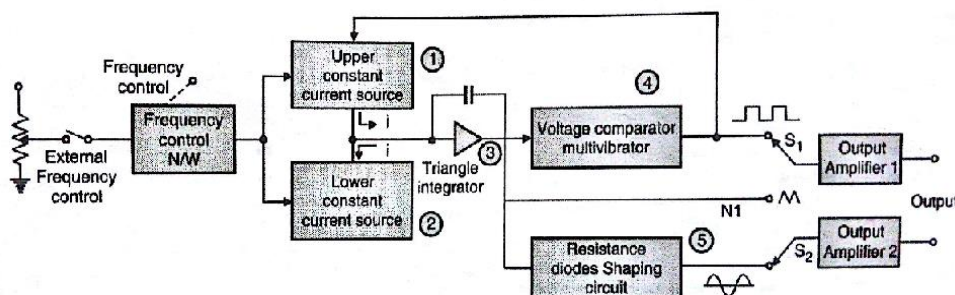4 e) Describe with block diagram, the working of function generator.
Ans:
Block Diagram of Function Generator:
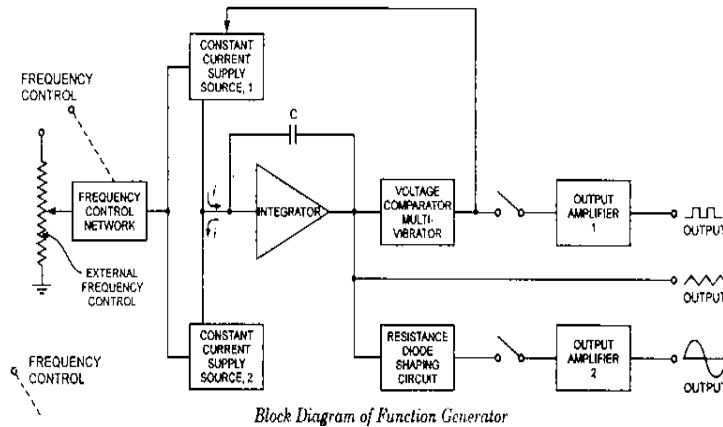
Block Diagram of Function Generator

2 Marks for Diagram

OR

Working of Function Generator :
• This instrument can deliver sine, triangular & square waves with frequency range of 0.01 Hz to 100 kHz.
• The frequency control network is governed by a frequency dial on the front panel of the instrument
• The frequency control voltage regulates two current sources.
• The upper current source supplies a constant current to the integrator whose output voltage increases with time.
• The voltage comparator multi-vibrator changes state at a predetermined level on the positive slope of the integrator's output voltage.
• The lower current source supplies a reverse current to the integrator so that its output voltage reaches a predetermined level on the negative slope of the integrator's output voltage.
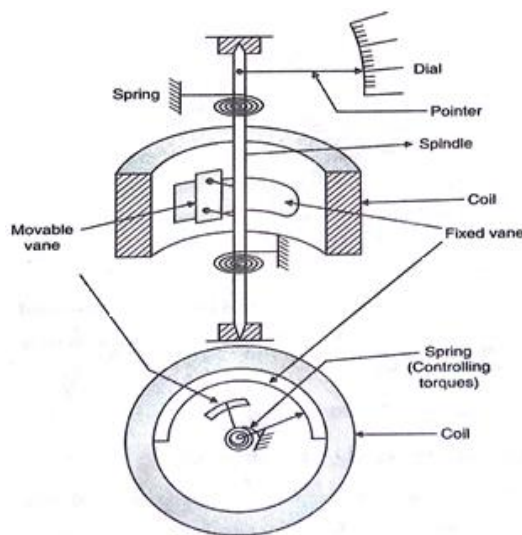
| | | 2 Marks for Working |

5   **Attempt any <u>TWO</u> of the following:**   **12**

5 a) Explain with sketch, the construction and working principle of repulsion type moving iron instrument? Compare repulsion type MI instrument with attraction type MI instrument?
Ans:
Repulsion Type Moving Iron Instrument:

2 Marks for Diagram

Construction:
It consist of fixed cylindrical hollow coil which carries operating current. Inside the coil, there are two soft iron pieces. One of which is fixed other is movable. The fixed iron piece is attached to the coil whereas the movable iron piece is attached to the spindle. Under the action of deflecting torque, the pointer attached to the moving system moves over the scale. The controlling torque is provided by spring control and damping torque is provided by air friction.

1 Mark for construction

Working Principle:
When the coil carries current (AC or DC), the two iron pieces are magnetized with

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same polarity and a repulsive force act on them. Due to this force, the moving iron piece gets deflected and becomes steady when the deflecting force becomes equal to the controlling force.

1 Mark for Principle

Comparison of Repulsion type Instrument with Attraction type Instrument:

Sr. No	Parameter	Attraction type MI instrument	Repulsion type MI instrument	
1	Working Principle	The coil when carries current, it produces magnetic field, strong inside the coil and weaker outside the coil. The soft iron piece placed near to the coil gets attracted to the stronger magnetic field inside the coil. This attractive force acts as deflecting force.	The coil when carries current, it produces magnetic field inside the coil. Due to this magnetic field, the two iron pieces are magnetized with same polarity. Therefore, a repulsive force act on the iron pieces and moving iron piece gets deflected	1 Mark for each of any two points = 2 Marks
2	Deflecting torque	Iron piece gets attracted towards strong magnetic field inside the coil and deflection torque is produced.	Repulsive force between two similarly magnetized iron pieces produces the deflection torque.	
3	Controlling torque	By the springs but gravity control may also be used for vertically mounted panel type instruments.	By spring control method.	
4	Iron pieces	One iron piece is used	Two iron pieces are used.	

5 b) Explain with suitable diagram, the constructional detail and working of ~~Dynometer~~ Dynamometer type wattmeter.

Ans:

Dynamometer Type Wattmeter

Construction:

It essentially consists of the two fixed coils and one moving coil. The fixed coils are placed close together and parallel to each other. Moving coil is pivoted in between the two fixed coils.The fixed and moving coils are excited / connected as shown in figure. The moving coil is attached to the moving system so that under the action of deflecting torque, the pointer moves over the scale. Controlling torque is provided by springs and damping torque is provided by air friction damping.
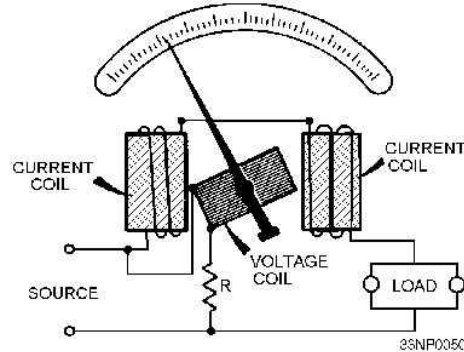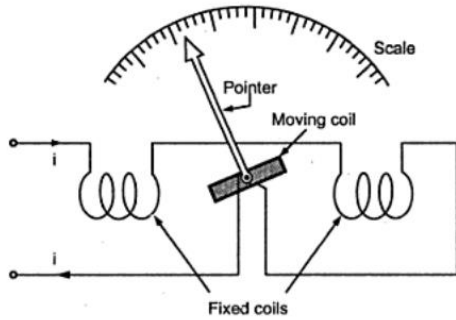
2 Marks for construction

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OR

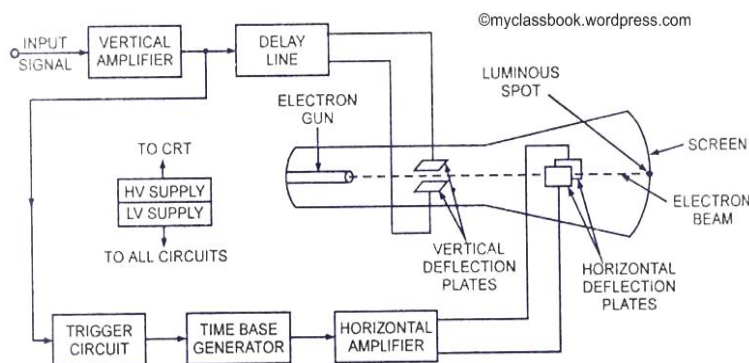2 Marks for
Diagram

Working:

When the instrument is connected in the circuit, operating current flow through the coils. The interaction between the magnetic fields produced by the coils produces mechanical force on the movig coil. The result is that moving coil moves the pointer over the scale to give reading. Since fixed coil current is proportional to the load current and the moving coil current is proportional to the voltage, the deflecting torque is proportional to the product of voltage and current i.e power. When direction of current reverses, then it reverses the direction of current of fixed as well as moving coil so that the direction of deflecting torque remains unchanged. Hence these instruments can be used for measurement of A.C. & D.C. power.

2 Marks for
working

5 c) Draw a block diagram of CRO and state the function of each block.
Ans:
Block Diagram of CRO With Function of Each Block:

3 Marks for
Diagram

1. Vertical amplifier strengthens the input signal applied to vertical depleting plates
2. Trigger circuit gives input to time base circuit.
3. The output of time base generator is amplified by horizontal amplifier and then applied to horizontal deflecting plates of CRT.
4. CRT consists of electron gun assembly which include thermally heated cathode, accelerating anode, focusing anode.
5. The electron beam coming out from electron gun assembly enters to deflecting plates.
6. The screen of CRT internally coated with Phosphors material on which we observe

3 Marks

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Summer – 2019 Examinations
Model Answers
Subject & Code: Electrical & Electronic Measurements (22325)
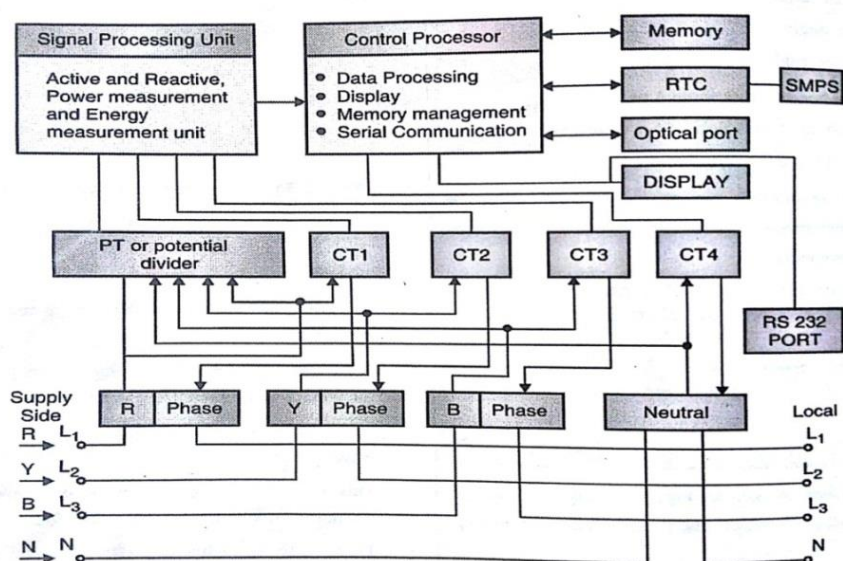
waveform of the input signal.

6		**Attempt any <u>TWO </u>of the following:**	**12**

6 a) Explain with block diagram the construction and working principle of three phases electronic energy meter?
Ans:
Three Phases Electronic Energy Meter:

2 Marks for Diagram

Construction:
As shown in above diagram, the three phase supply terminals with neutral point (R, Y, B & N) are connected from supply side. CT_1, CT_2, CT_3, are connected in R, Y, B phase respectively. They steps down the current to a suitable value and give it to a signal processing unit. PT or potential divider unit is used to step down the line voltage to a suitable value and give it to a signal processing unit. CT_4 is connected in neutral to check balance load condition.

2 Marks for Construction

Working:
- The signal processing unit computes the active, reactive power & energy in kWh.
- The control processor does the necessary data processing work and memory management to monitor and evaluate different parameters.
- Real time clock (RTC) is provided for synchronization of all data processing works. The display unit is interfaced with control processor.
- Different electric parameters can be displayed on LCD display and SMPS is provided to give constant DC supply.
- The Data in energy meter can be transferred to an external device like AMR through RS232 port.

2 Marks for Working

6 b) What is the necessity of synchroscope in power system? Explain with neat sketch the working of synchroscope.
Ans:
Necessity of Synchroscope:

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In a power system, three phase alternators , transformers are connected in parallel with each other and with bus bars. When three phase alternators are to be connected to an infinite bus, the correct instant of synchronising is important to connect that incomming alternator safely to existing system. So to detect the correct instant of synchronizing, Synchroscope is used.

2 Mark for necessity

Weston type Synchroscope:
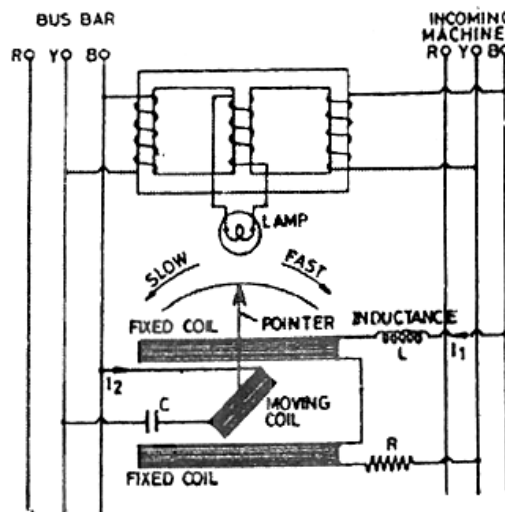
2 Mark for Diagram

Working:
It consists of three limbed transformer. The winding on one of the outer limbs is excited from bus- bars and that on other limb by incoming machine. The two fluxes produced by outer limbs are forced through the central limb. The resultant flux through central limb is equal to the phasor sum of these fluxes.

When bus-bar and incoming machine voltages are in phase, the emf induced in central limb winding is maximum hence lamp glows with maximum brightness. When bus-bar and incoming machine voltages are 180^0 out of phase, the emf induced in central limb is almost zero and lamp does not glow. When frequency of incoming machine is different than that of bus-bar, the lamp will flicker. The correct instant of synchronizing is when the lamp is flickering at a very much slow rate and it is at its maximum brightness.

2 Mark for Working

6   c)   Explain with neat sketch:
(i)   Earth resistance measurement using earth tester
(ii)   High resistance measurement using megger.

Ans:

Earth Resistance Measurement Using Earth Tester:
It is connected to earth electrode whose resistance is to be measured, and the other spike P and R, as shown in the figure.

When handle is rotated the D.C. flows from the generator through the current coil of the movement to the current reverser, and alternating current from the reverser through the soil between the electrode E and R . This voltage drop between electrode P and E is rectified by the rectifier and fed to the potential coil of the meter. As the indication of the meter depends upon the ratio of the potential across its potential coil, and current passing through its current coil, the deflection of the pointer will indicate directly earth
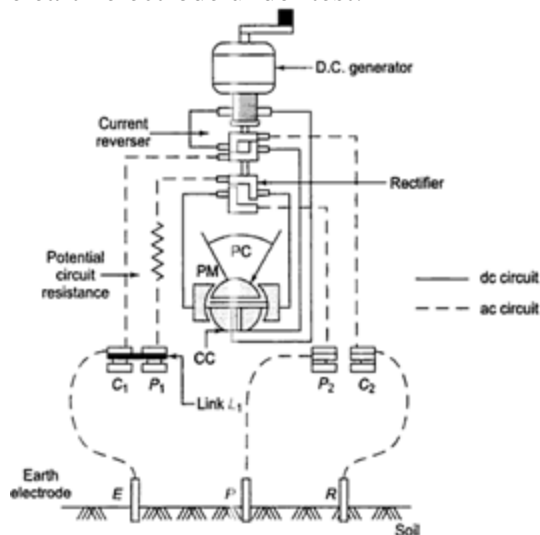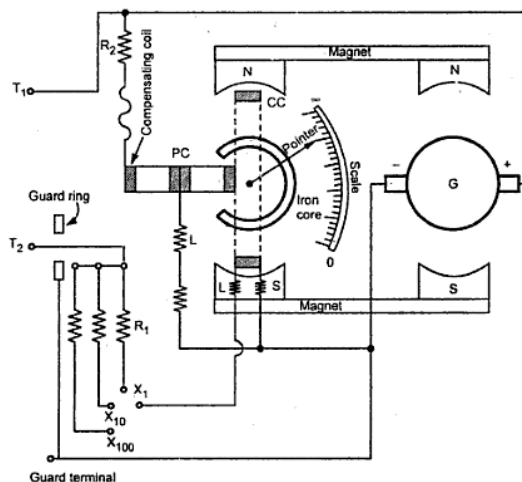
3 Marks for Earth tester

resistance in ohm of the earth electrode under test.

High Resistance Measurement Using Megger:
Working of Megger:

Two coils i.e. the current coil and pressure coil are mounted at an angle on the same spindle and form the part of the moving system. These coils are connected to a small hand driven generator, with polarities such that torque produced by them will act in opposition to each other. The potential coil is connected in series with a fixed control resistance and the current coil is in series with a resistance to control the current flowing through it and the resistance under test. When the resistance under test is infinity no current flows through the current coil.

3 Marks for Megger

The pressure coil will therefore set itself perpendicular to the magnetic axis, and the pointer indicates infinity on dial. If the resistance under test is very low, the high current will flow through the current coil and it sets the pressure coil to lie in the direction of axis of permanent magnet. As the effect of pressure coil is negligible, the position of the pointer is towards zero. For resistance values in between zero and infinity, the pointer will indicate in between zero and infinity accordingly. The dial is marked with values of resistances in mega ohms by calibration. When the instrument is not working the pointer may rest at any position on the dial.