Chettinad College of Engineering & Technology
Approved by AICTE-New Delhi and Affiliated to Anna University-Chennai

BE3251 – BEEE

QUESTION BANK

UNIT-I

Basic Circuit Analysis

Syllabus

Resistive elements - Ohm's Law Resistors in series and parallel circuits - Kirchoffs laws - Mesh current and node voltage - methods of analysis. A.C. circuits - Average and RMS value - Phasor Diagram - Power, Power Factor and Energy.

PART – A

Q1. *Define a loop of a network.*

Ans. : Loop is a set of branches forming a closed path in a network in such a way that if one branch is removed then remaining branches do not form a closed path. A loop also can be defined as a closed path which originates from a particular node, terminating at the same node, traveling through various other nodes, without traveling through any node twice.

Q2. *Define junction point and node of a network.*

Ans. : A point where three or more branches meet is called a **junction point.** A point at which two or more elements are joined together i.e. point at which two or more branches meet is called **node.** The junction points are also the nodes of the network.

Q3. *What is the difference between linear and nonlinear network ? Give their examples.*

Ans. : A circuit or network whose parameters i.e. elements like resistances, inductances and capacitances are always constant irrespective of the change in time, voltage, temperature etc. is known as **linear network**. A circuit whose parameters change their values with change in time, temperature, voltage etc. is known as **non linear network.** A circuit consisting linear elements like R, L and C is ana example of linear network while a circuit consisting of nonlinear elements such as diode is an example of nonlinear network.

Q4. *State the Ohm's law and its limitations.*

AU : May-13, Dec.-16

Ans. : The Ohm's law states that the current flowing through the electric circuit is directly proportional to the potential difference across the circuit and inversely proportional to the resistance of the circuit, provided the temperature remains constant. Mathematically, $I \propto \frac{V}{R}$.

The unit of potential difference is defined in such a way that the constant of proportionality is unity. Its limitations are,

1) It is not applicable to the nonlinear devices such as diodes, zener diodes, voltage regulators etc.
2) It does not hold good for non-metallic conductors such as silicon carbide.

Q5. *State the voltage-current relationship for the elements R, L and C.*

Ans. : For resistance R, $v(t) = i(t)\ R$

i.e. $i(t) = \frac{v(t)}{R}$.

For inductance L,

$$v(t) = L \frac{di(t)}{dt} \quad \text{i.e.} \quad i(t) = \frac{1}{L}\int v(t)\, dt.$$

For capacitance C,

$$v(t) = \frac{1}{C}\int i(t)\, dt \quad \text{i.e.} \quad i(t) = C \frac{dv(t)}{dt}$$

Q6. *State Kirchhoff's laws.* **AU : May-09, Dec.-15**

Ans. : Kirchhoff's current law states that the total current flowing towards a junction point is equal to the total current flowing away from that junction point.

Another way to state the law is, the algebraic sum of all the current meeting at a junction point is always zero. The word algebraic means considering the signs of various currents.

$$\sum I \text{ at junction point} = 0$$

Kirchhoff's voltage law states that in any network, the algebraic sum of the voltage drops across the circuit elements of any closed path (or loop or mesh) is equal to the algebraic sum of the e.m.fs in the path.

In other words, "the algebraic sum of all the branch voltages, around any closed path or closed loop is always zero."

Around a closed path $\sum V = 0$

Q7. *Define time period, frequency and amplitude of an alternating quantity.*

Ans. : The time taken by an alternating quantity to complete its one cycle is known as its **time period** denoted by **T** seconds.

The number of cycles completed by an alternating quantity per second is known as its **frequency.** It is denoted by **f** and it is measured in **cycles / second** which is known as **Hertz,** denoted as **Hz.**

The maximum value attained by an alternating quantity during positive or negative half cycle is called its **amplitude.**

Q8. *Define mesh analysis of a circuit.*

AU : May-11, Dec.-12

Ans. : Assuming mesh currents and then applying Kirchhoff's voltage law to various meshes to obtain the equations and solving them for the required current in the circuit is called mesh analysis of a circuit.

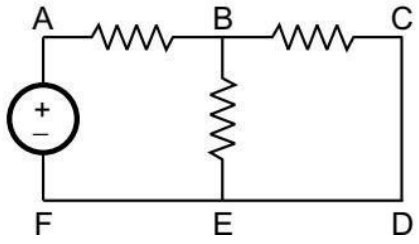
Q9. *Distinguish between a mesh and loop of a circuit.*

AU : Dec.-10, May-13, 16

Ans. : A mesh is a loop which do not have any loop inside it. A loop can have another loop inside it. Thus a mesh is always a loop but each loop can not be the mesh. A mesh is a smallest possible loop.

Loop : ABCDEFA

Mesh : ABEFA or BCDEB



Q10. *What is the difference between branch current and a loop current ?*

Ans. : A branch current is a current passing through a particular branch. Its value is unique associated with particular branch.

A loop current is a current which links simultaneously with all the branches forming a particular loop. Thus multiple loop currents may be associated with a particular branch which is ion to mutiple loops. , A branch current can

Q11. *Define 'Nodal analysis' of a circuit.*

AU : May-12

Ans. : Assuming branch currents, applying KCL at the prime nodes, expressing all the branch currents interms of node voltages, substituting in KCL equations and solving them simultaneously for the required variables is called node analysis.

Q12. What are the three types of power used in a a.c circuit?

Ans: Real power P = V I Cosϕ watts Reactive power Q = V I Sinϕ VAR Apparent power S = V I volt-ampe

Q13. Define average value.

Ans : The average value of an alternating current is that value of steady direct current which transfers the same charge as the alternating current flowing for the same time.

Q14. Define RMS value.

Ans : The effective value of an alternating current is that value of steady ,direct current which produces the same heat as that produced by the alternating current when passed which produces the same heat as that produced by the alternating current when passed through the same resistance for the same interval of time.

Q15. Define Form factor and Crest factor.

Ans: Form factor= RMS value / Average Value Crest(peak) factor=Maximum Value / RMS value

PART - B

Q1. *Determine the current delivered by the source in the circuit shown in figure below.*

AU : May-11, Marks 10

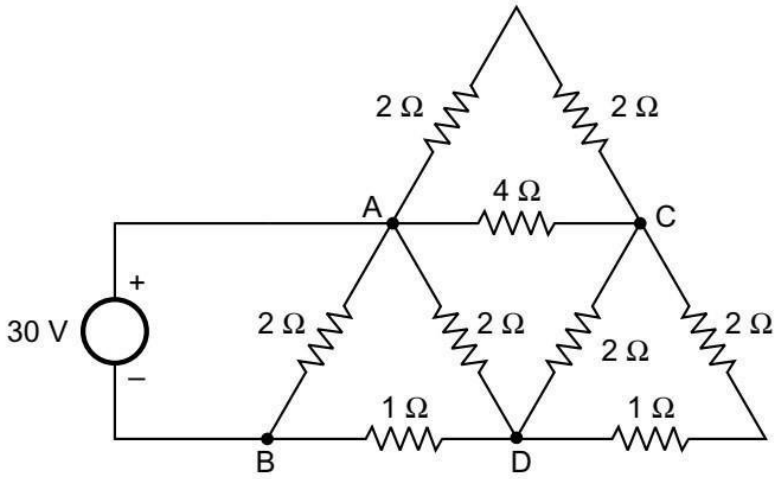


Fig. 1.8.5

Sol. :

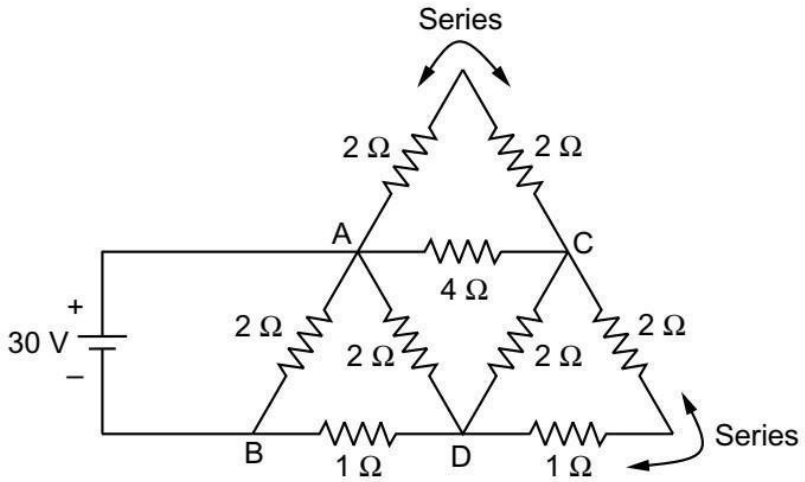
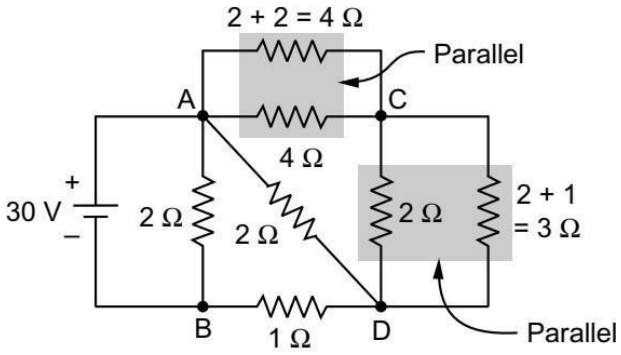


Fig. 1.8.5 (a)



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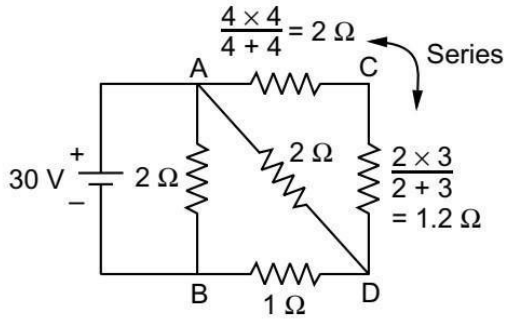

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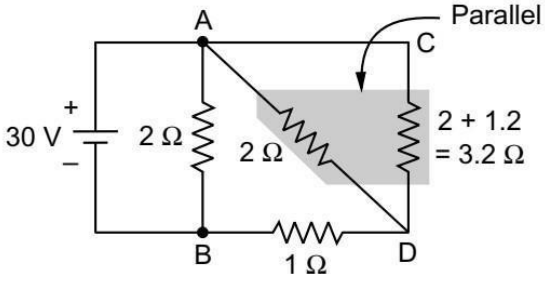

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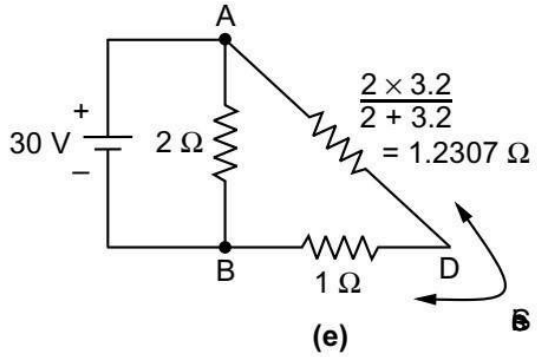

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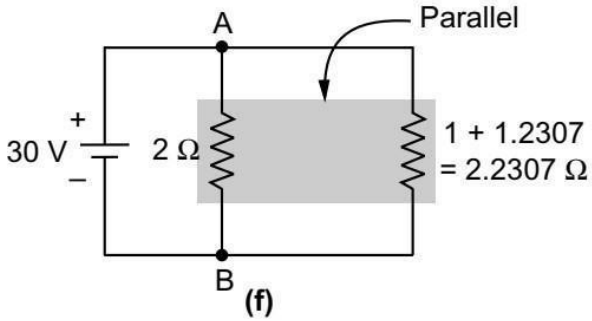

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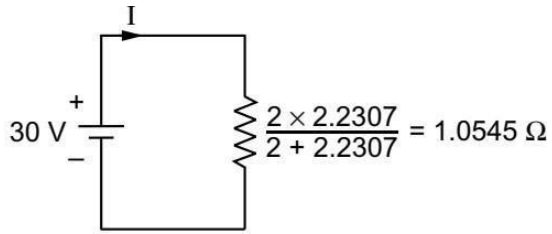
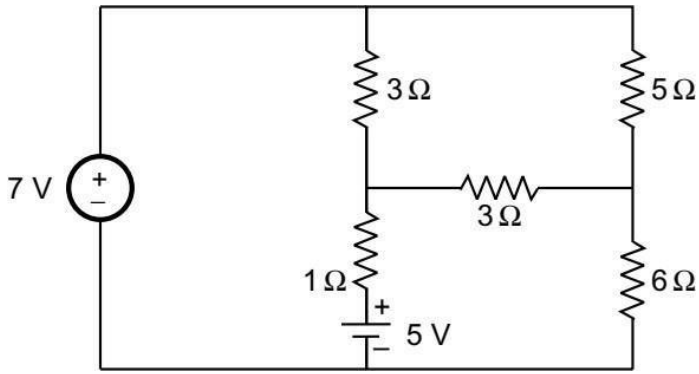


(g)

Fig. 1.8.5

$$\therefore \quad I = \frac{30}{1.0545} = \mathbf{28.448\ A}$$

Q2. *In the circuit shown in the Fig. 1.11.4, find the current supplied by 7 V source.*

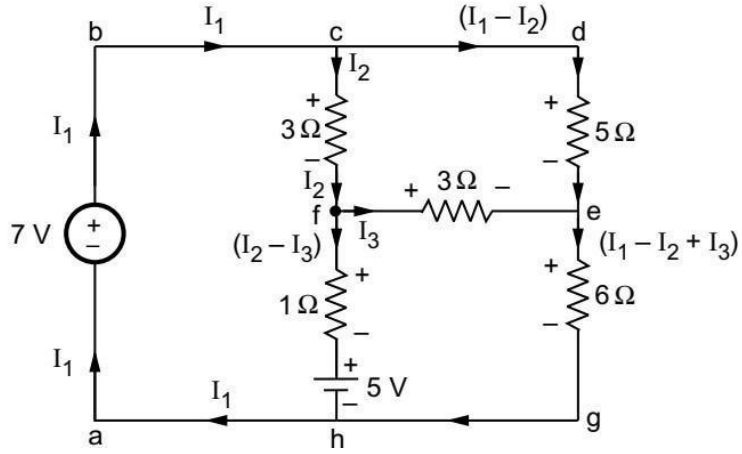


Sol. :

Step 1 : The circuit diagram is given.

Step 2 : Mark the various branch currents using KCL.

Step 3 : Mark the polarities for the drops due to branch currents as shown in the Fig. 1.11.4 (a).



Apply KVL to the various loops,

Loop abcfha, $-3\ I_2 - (I_2 - I_3) - 5 + 7 = 0$

i.e. $-4\ I_2 + I_3 = -2$ …(1)

Loop cdefc, $-5\ (I_1 - I_2) + 3\ I_3 + 3\ I_2 = 0$

i.e. $-5\ I_1 + 8\ I_2 + 3\ I_3 = 0$ …(2)

Loop feghf, $-3I_3 - 6\ (I_1 - I_2 + I_3) + 5 + (I_2 - I_3) = 0$

i.e. $-6I_1 + 7I_2 - 10I_3 = -5$ …(3)

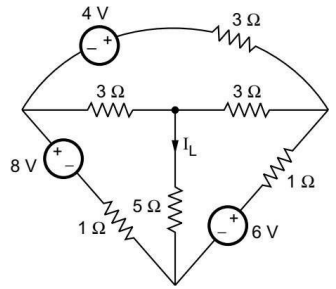
$$\therefore \quad D = \begin{vmatrix} 0 & -4 & 1 \\ -5 & 8 & 3 \\ -6 & 7 & -10 \end{vmatrix} = 285$$

and

$$D_1 = \begin{vmatrix} -2 & -4 & 1 \\ 0 & 8 & 3 \\ -5 & 7 & -10 \end{vmatrix} = 302$$

$$I_1 = \frac{D_1}{D} = \frac{302}{285} = \mathbf{1.0596\ A} \uparrow$$

Q3. *Determine the current I_L in the circuit shown in Fig. 1.11.9*



Solutions : Let us use KCL and KVL. Assume the branch currents as shown in the Fig. 1.11.9 (a).

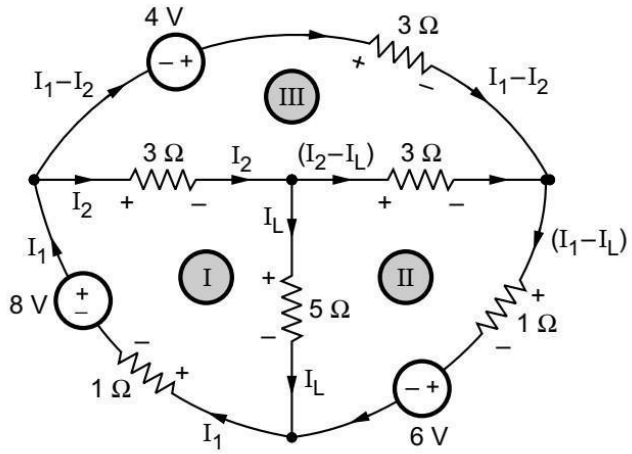


Fig. 1.11.9 (a)

Apply KVL to the three loops I, II and III.

$$-3\ I_2 - 5\ I_L - I_1 + 8 = 0$$

i.e. $I_1 + 3I_2 + 5I_L = 8$ ... (1)

$$-3(I_2 - I_L) - (I_1 - I_L) - 6 + 5I_L = 0$$

i.e. $-I_1 - 3I_2 + 9I_L = 6$ ... (2)

$$+ 4 - 3(I_1 - I_2) + 3(I_2 - I_L) + 3\ I_2 = 0$$

i.e. $-3I_1 + 9I_2 - 3I_L = -4$ ... (3)

Solving, $I_1 = 1.667$ A , $I_2 = 0.444$ A ,

$I_L = 1$ A $\quad \therefore I_L = \mathbf{1\ A}$

Q4. *A sinusoidally varying alternating current of frequency 50 Hz has a r.m.s value of* $10\sqrt{2}$ *A.*
i) Write down its equation.
ii) Find its value after (1/200) seconds.
iii) Find the time to reach 20 A for the first time.

Sol. : I = $10\sqrt{2}$ A, f = 50 Hz

$$I_m = \sqrt{2} \times I\,(RMS) = \sqrt{2} \times 10\sqrt{2} = 20\ A$$

$$\omega = 2\pi f = 2\pi \times 50 = 100\pi \ \text{rad/s}$$

i) $i(t) = I_m \sin \omega t = \mathbf{20 \sin 100\,\pi t\ A}$

ii) At $t = \frac{1}{200}$ sec, $i(t) = 20 \sin\left(100\pi \times \frac{1}{200}\right) = \mathbf{20\ A}$

Find sine in radian mode.

iii) $i(t) = 20$ A i.e. $20 = 20 \sin 100\pi t$

$\therefore \quad 100\pi t = \sin^{-1} 1$

i.e. $100\pi t = 1.5707$ radians

$\therefore \quad t = \mathbf{5\ ms}$

Q5. *The equation of an alternating current is given by i = 42.42 sin 628t. Calculate its*
i) Maximum value ii) Frequency
iii) RMS value iv) Average value v) Form factor

Sol. : Compare given equation with $i = I_m \sin(\omega t)$

i) $I_m = \mathbf{42.42\ A}$

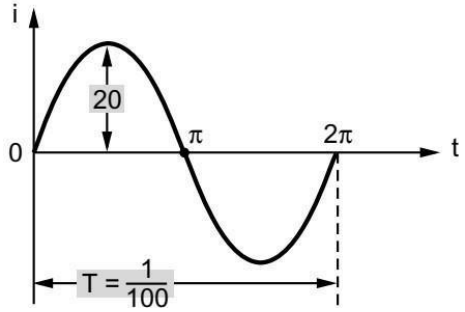
ii) $f = \frac{\omega}{2\pi} = \frac{628}{2\pi} = \mathbf{100\ Hz}$

iii) $I_{r.m.s.} = \frac{I_m}{\sqrt{2}} = \mathbf{30\ A}$

iv) $I_{av} = 0.637\ I_m = \mathbf{27.0215\ A}$

v) $K_f = \frac{r.m.s.}{Average} = \frac{30}{27.0215} = \mathbf{1.11}$

Q6. *For the current wave shown in Fig. 1.13.3. Find i) Peak current ii) Average value iii) Frequency iv) Periodic time v) Instantaneous value at t = 3 ms.*



Sol. : i) Amplitude or peak value of current waveform = 20 A.

i.e. $I_m = \mathbf{20\ A}$

ii) Average value

$$(I_{av}) = \frac{2I_m}{\pi} = \frac{2\times 20}{\pi} = \mathbf{12.732\ A}$$

iii) Frequency, $f = \dfrac{1}{\text{Time period}} = \dfrac{1}{T}$

$$f = \frac{1}{1/100} = \mathbf{100\ Hz}$$

iv) Periodic time,

$$T = \frac{1}{100} = \mathbf{0.01\ sec.}$$

v) Instantaneous value at

$$t = 3\ \text{msec} = 3\times 10^{-3}\ \text{sec}$$

$$i = I_m \sin \omega t = 20 \sin(2\pi f t)$$

$$= 20 \sin (628.3185\ t)$$

$$= 20 \sin(628.3185\times 3\times 10^{-3})$$

... Use radian mode

$$\mathbf{i = 19.0211\ A.}$$

Q7. *Write the polar form of the voltage given by, $V = 100 \sin (100\ \pi t + \pi/6)$ V*
Obtain its rectangular form.

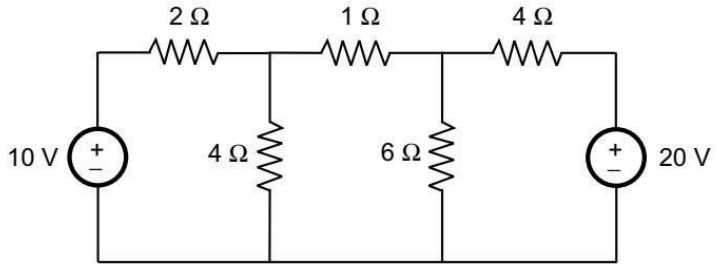
Sol. : $V_m = 100$ V and $\phi = +\dfrac{\pi}{6}$ rad $= +30°$,

$$V_{r.m.s.} = \frac{V_m}{\sqrt{2}} = 70.7106\ \text{V}$$

$\therefore$ In polar form = $\mathbf{70.7106 \angle +30°}$ V

$\therefore$ Rectangular form = $\mathbf{61.2371 + j\ 35.3553\ V}$

Q8. *Calculate current through 6 Ω resistance using loop analysis.*



Consider loop A-B-G-H-A, loop equation is,

$$-2I_1 - 4(I_1 - I_2) + 10 = 0$$

i.e. $6I_1 - 4I_2 = 10$ ... (1)

Consider loop B-C-F-G-B, loop equation is,

$$-1I_2 - 6(I_2 - I_3) - 4(I_2 - I_1) = 0$$

i.e. $4I_1 - 11I_2 + 6I_3 = 0$ ...(2)

Consider loop C-D-E-F-C, loop equation is,

$$-4I_3 - 20 - 6(I_3 - I_2) = 0$$

i.e. $$6I_2 - 10I_3 = 20 \quad \ldots(3)$$

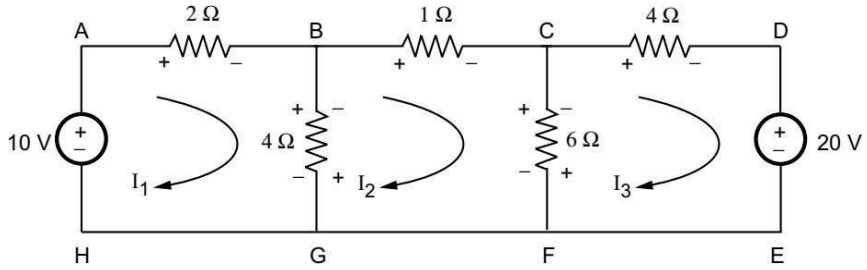
Solving, $$I_2 = -1.1267 \text{ A},$$

$$I_3 = -2.676 \text{ A}$$

Current through 6 Ω resistance = $I_2 - I_3$

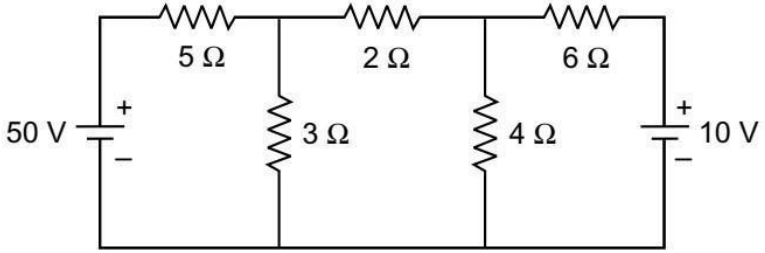
$$= -1.1267 - (-2.676)$$

$$= \mathbf{1.5493 \text{ A from C to F}}$$



PART - C

Q1. *Determine the power dissipation in the 4Ω resistor of the given circuit show in Fig. 1.24.11.*



Sol. : Use loop analysis. Show the loop currents and the polarities of the voltage drops.

Applying KVL to the three loops,

$$-5I_1 - 3I_1 + 3I_2 + 50 = 0$$

i.e. $$-8I_1 + 3I_2 = -50 \quad \ldots(1)$$

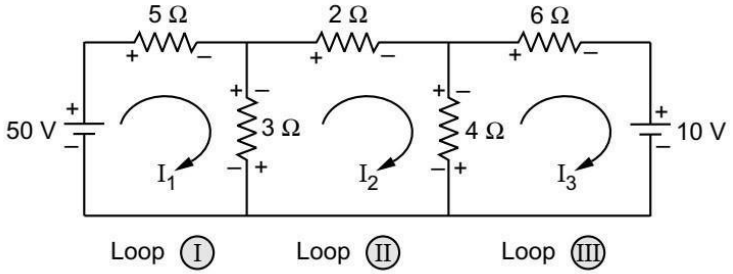


Fig. 1.24.11 (a)

$$-2I_2 - 4I_2 + 4I_3 - 3I_2 + 3I_1 = 0$$

i.e. $$3I_1 - 9I_2 + 4I_3 = 0 \quad \ldots(2)$$

$$-6I_3 - 10 - 4I_3 + 4I_2 = 0 \quad \text{i.e. } 4I_2 - 10I_3 = 10 \quad \ldots(3)$$

Solving, $I_1 = 7.1314$ A, $I_2 = 2.351$ A,

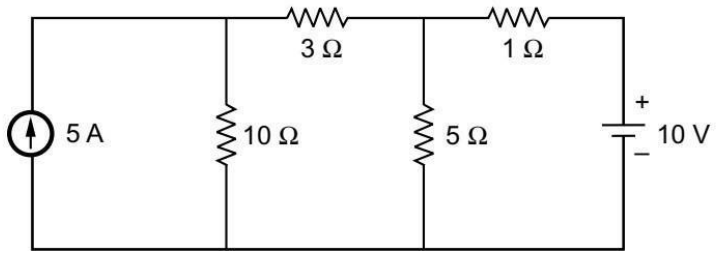
$$I_3 = -0.0597 \text{ A}$$

$$\therefore \quad I_{4\Omega} = I_2 - I_3 = 2.351 - (-0.0597)$$

$$= 2.4107 \text{ A}$$

$$\therefore \quad P_{4\Omega} = I_{4\Omega}^2 \times 4 = (2.4107)^2 \times 4 = \mathbf{23.2459 \text{ W}}$$

Q2. *Find out the current in each branch of the circuit shown in Fig. 1.25.9.*



Sol. : Use node analysis. The node voltages and branch currents are shown in the Fig. 1.25.9 (a).

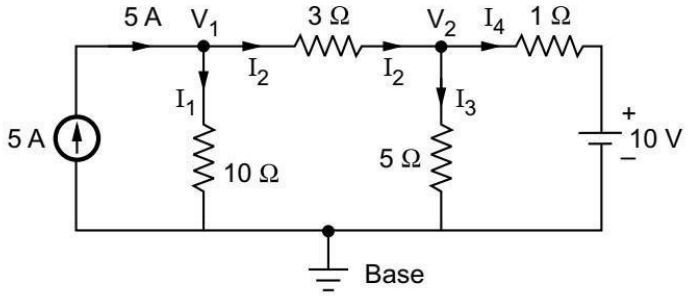


Fig. 1.25.9 (a)

Applying KCL at the two nodes,

$$5 - I_1 - I_2 = 0 \quad \text{i.e.} \quad I_1 + I_2 = 5 \qquad \ldots(1)$$

$$I_2 - I_3 - I_4 = 0 \qquad \ldots(2)$$

The expressions for the currents are,

Using in the equations (1) and (2),

$$\frac{V_1}{10} + \frac{V_1 - V_2}{3} = 5$$

i.e. $$0.4333V_1 - 0.333V_2 = 5 \qquad \ldots(3)$$

$$\frac{V_1 - V_2}{3} - \frac{V_2}{5} - \left[\frac{V_2 - 10}{1}\right] = 0 \quad \text{i.e.}$$

$$0.333V_1 - 1.5333V_2 = -10 \qquad \ldots(4)$$

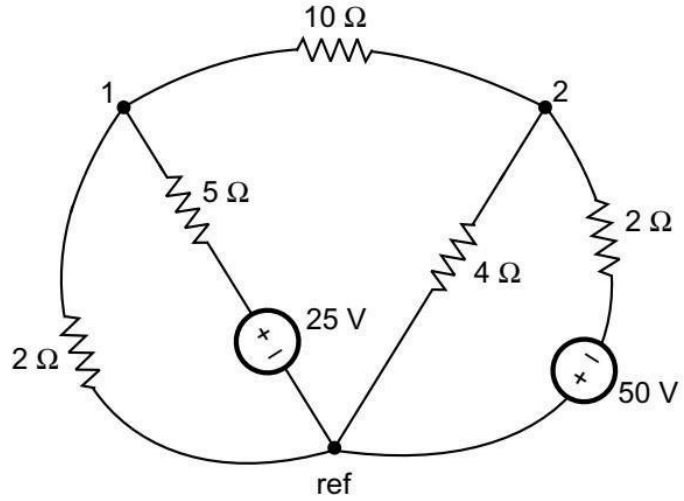
Solving equations (3) and (4),

$$V_1 = 19.8783 \text{ V}, \; V_2 = 10.8427 \text{ V}$$

$\therefore$ $$I_1 = \mathbf{1.9878\ A}, \; I_2 = \mathbf{3.0118\ A},$$

$$I_3 = \mathbf{2.1685\ A}, \; I_4 = \mathbf{0.8427\ A}$$

Q3. *Solve the network given below by the node voltage method.*



Applying KCL at two nodes,

$$I_1 + I_2 + I_3 = 0 \qquad \ldots(1)$$

$$I_3 - I_4 - I_5 = 0 \qquad \ldots(2)$$

$$I_1 = \frac{V_1}{2}, \quad I_2 = \frac{V_1 - 25}{5},$$

$$I_3 = \frac{V_1 - V_2}{10},$$

$$I_4 = \frac{V_2}{4},$$

$$I_5 = \frac{V_2 + 50}{2}$$

Note that 25 V source opposes V_1 to force I_2 while 50 V source helps V_2 to force I_5.

Using in equations (1) and (2),

$$\frac{V_1}{2} + \frac{V_1 - 25}{5} + \frac{V_1 - V_2}{10} = 0$$

i.e. $$0.8\,V_1 - 0.1\,V_2 = 5 \qquad \ldots(3)$$

$$\frac{V_1 - V_2}{10} - \frac{V_2}{4} - \left[\frac{V_2 + 50}{2}\right] = 0$$

i.e. $$0.1\,V_1 - 0.85\,V_2 = 25 \qquad \ldots(4)$$

Solving, $V_1 = \mathbf{2.6119\ V}$,

$V_2 = \mathbf{-29.1044\ V}$.

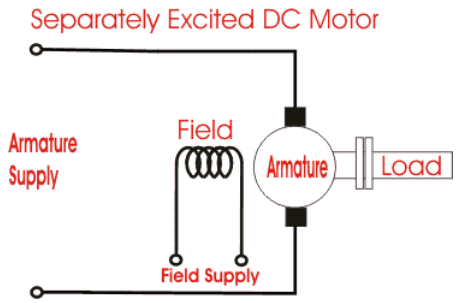
Thus all current values can be obtained, using V_1 and V_2.

UNIT II - ELECTRICAL MACHINES PART-

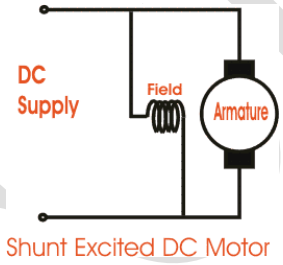
A

1. Draw the circuit for various types of d.c motor.(N/D-2020)

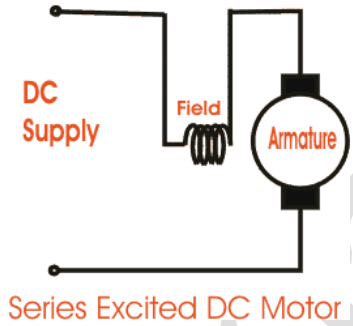
Separately Excited DC Motor



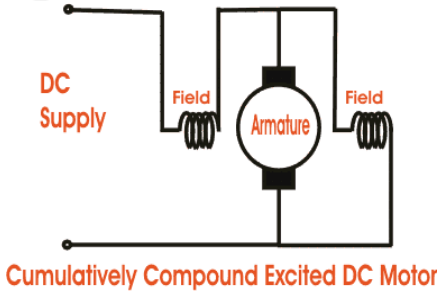
DC Shunt Motor



DC Series Motor



DC Compound Motor



2. Write down the EMF equation of a transformer..(N/D-2021)

. E1 = 4.44*N1* f* Bm*A and E2 = 4.44*N2*f*Bm*A

3. Give some application of D.C motor.(A/M-2015,N/D-2023)

Shunt :driving constant speed, lathes, centrifugal pumps, machine tools, blowers and fans, reciprocating pumps
Series :electric locomotives, rapid transit systems, trolley cars, cranes and hoists,conveyors
Compound :elevators, air compressors, rolling mills, heavy planners

4. Mention the application of DC generator?(A/M-2016)

- ☐ general lighting.
- ☐ Used to charge battery because they can be made to give constant output voltage.
- ☐ They are used for giving the excitation to the alternators.
- ☐ used for small power supply.

5. What is the significance of back EMF?(A/M-2017)

- When the motor is running on no load, small torque is required to overcome the friction and windage losses. Therefore, the armature current Ia is small and the back emf is nearly equal to the applied voltage.
- If the motor is suddenly loaded, the first effect is to cause the armature to slow down. Therefore,

the speed at which the armature conductors move through the field is reduced and hence the back emfEb falls. The decreased back emf allows a larger current to flow through the armature and larger current means increased driving torque. Thus, the driving torque increases as the motor slows down. The motor will stop slowing down when the armature current is just sufficient to produce the increased torque required by the load.

- If the load on the motor is decreased, the driving torque is momentarily in excess of the

requirement so that armature is accelerated. As the armature speed increases, the back emf Eb also increases and causes the armature current Ia to decrease. The motor will stop accelerating when the armature current is just sufficient to produce the reduced torque required by the load.

6. Write the principle of DC Motor? (N/D-2019)

Fleming's left hand rule to determine the direction of force acting on the armature conductors of DC motor. If a current carrying conductor is placed in a magnetic field perpendicularly, then the conductor experiences a force in the direction mutually perpendicular to both the direction of field and the current carrying conductor.

Fleming's left hand rule says that if we extend the index finger, middle finger and thumb of our left hand perpendicular to each other, in such a way that the middle finger is along the direction of current in the conductor, and index finger is along the direction of magnetic field i.e. north to south pole, then thumb indicatesthe direction of created.

7. What is the main purpose of commutator and brushes?Commutator:

The commutator converts the alternating emf into unidirectional or direct emf.

Brushes:

The brushes collect the current from the commutator

8. State the principle of operation of a transformer.

Transformer operates on the principle of mutual induction between inductively coupled coils. When A.C source is connected to one coil flux is produced in the core which links both the coils. As per the Faraday's laws of electromagnetic induction EMF is induced in the secondary coil also. if the external circuit is closed power is supplied.

9. Write down the EMF equation of a single phase transformer.

EMF induced in primary, E1= 4.44 Ø f N1 volts wheref = Frequency of supply main Ø = Flux linking both the primary and secondary winding

10. Write any two differences between single phase and three phase transformers.

i. Single phase transformer has two windings. Three phase transformer has six windings.

ii. Single phase supply is directly connected across the single primary winding where as the 3-phase transformer windings are connected in star or delta according to the design.

11. Write the EMF equation of an alternator? (N/D-2016)

$$\mathbf{E = 4.44 \times f \Phi T_{ph} \text{ volts}}$$

This is the basic e.m.f. equation for an induced e.m.f. per phase for full pitch, concentrated type of winding.

Where T_{ph} = Number of turns per phase T_{ph}

$= Z_{ph}/2$

Total flux cut in one revolution is $\Phi \times P$

Time taken for one revolution is $60/N_S$ seconds.

$\therefore$ e_{avg} per conductor $= \Phi P / (60/N_S)$

$= \Phi (PN_S/60)$.....(1)

But $f = PN_S/6120$

$\therefore$ $PN_S/60 = 2f$

12. Define voltage regulation of the alternator?

It is defined as the increase in terminal voltage when full load is thrown off, assuming field current and speed remaining the same.

% reg = [(E – V)/V] x100

Where E = no terminal voltage V = full load rated terminal voltage

13. What is meant by armature reaction in Alternators?

The interaction between flux set up by the current carrying armature and the mainis defined as the armature reaction.

14. Why a synchronous motor is a constant speed motor?

Synchronous motor work on the principle of force developed due to the magnetic attraction established between the rotating magnetic field and the main pole feed. Since the speed of rotating magnetic field is directly proportional to frequency the motor operates at constant speed.

PART-B

1. With a neat circuit diagram Explain the construction and principle of operation of DC Motor.(N/D-2016,N/D-2015,A/M-2022)

2. Explain the construction, working principle of single phase Induction motor.(N/D-2016)

3. Describe various types self excited of DC generator with their circuit layout.(A/M-2016)

4. Explain the characteristics of dc shunt motor.(N/D-2016)

5. Explain the tests on a single phase transformer and develop an equivalent from the above tests.(M/J- 2020)

6. Describe the construction details of single phase transformer.(A/M-2017,M/J-2017,N/D-2015,A/M- 2015)

that is connected to the load is called the secondary winding. The primary is wound in layers directly on a rectangular cardboard form.

7. Explain the different types of dc motor with neat sketch.(N/D-2016)

8. Explain the working principle of various types of single phase induction motor with neat circuit diagram.(M/J-2016)

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9. With a neat circuit diagram Explain the construction and principle of operation of DC Generator.(N/D-2015)

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10. Describe the construction of an induction motor with neat diagrams. (M/J 2016) Explain the construction of three phase induction motor with neat diagram? (A/M 2017)
Derive the EMF equation for the alternator? (A/M 2017)

UNIT III ELECTRONIC DEVICES & CIRCUITS

Syllabus: Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET,IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters

PART-A

1. **Differentiate between zener breakdown and avalanche breakdown. (AUC DEC '11)**

   Zener breakdown occurs in a reverse biased junction which gives a constant output voltage. Avalanche breakdown does not provide a constant output voltage. This constant voltage from a zener diode can be used as a reference voltage for many regulators.

2. **What is peak inverse voltage? (AUC NOV'10)**

   The maximum reverse-bias potential that can be applied before entering the Zener region is called the peak inverse voltage (referred to simply as the PIV rating) or the peak reverse voltage (denoted by PRV rating). Peak inverse voltage is defined as the maximum reverse voltage that a diode can be subjected to operate in a reverse region so that the diode does not get damaged due to this reverse voltage

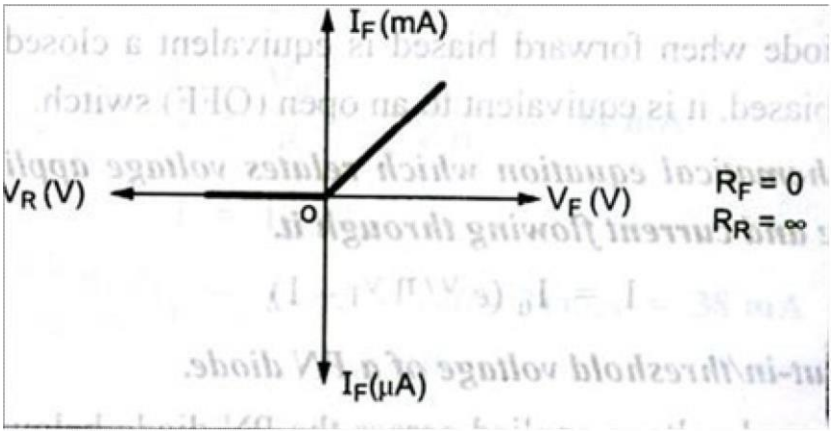
3. **How do the transition region width and contact potential across a PN junction vary with the applied bias voltage? (AUC DEC'07)**

   The width of the PN junction is widenened for a reverse biased junction and narrows for a forward biased junction.

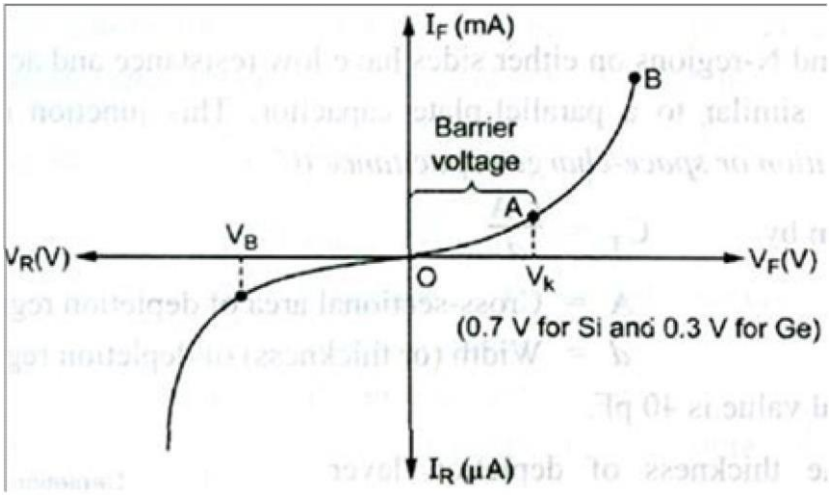
4. **What is an ideal diode?**

   An ideal diode is one which offers zero resistance when forward biased and infinite resistance when reverse biased.

5. **Draw the V-I characteristics of an ideal diode.**



6. **Draw the V-I characteristics of a practical PN diode**



7. **Define reverse recovery time.**

It is maximum time taken by the device to switch from ON to OFF stage. 15. List the PN diode switching times.

1. Recovery Time
2. Forward Recovery Time
3. Reverse Recovery Time
4. Reverse recovery time,
5. Storage and Transition Times

8. **List some applications of zener diode**

Zener diode find wide commercial and industrial applications. Some of their common applications are:

- As voltage regulators.
- As peak clippers or voltage limiters.
- For meter protection against damage from accidental application of excessive voltage.
- As a fixed reference voltage in a network for biasing and comparison purposes and for calibrating voltmeters.

9. **Define inverting amplifier.**

Inverting amplifier is one in which the output is exactly 180^0 out of phase with respect to input(i.e. if you apply a positive voltage, output will be negative). Output is an inverted(in terms of phase) amplified version of input.

10. **Define Non-inverting amplifier.**

Non Inverting amplifier is one in which the output is in phase with respect to input(i.e. if you apply a positive voltage, output will be positive). Output is an Non inverted(in terms of phase) amplified version of input.

PART-B & C

1. **How a PN junction diode is working? Draw and explain V-I characteristics of PN diode with neat**

2. Explain the construction and working of BJT.

3. Explain CB configuration with the help of input and output characteristics.

UNIT IV - DIGITAL ELECTRONICS

Syllabus: Review of number systems, binary codes, error detection and correction codes, Combinational logic – representation of logic functions-SOP and POS forms, K-map representations – minimization using K maps (Simple Problems only)

PART A

1. How many bits are required to represent the decimal numbers in the range 0 to 999 using straight binary code? Using BCD codes?

$(999)_{10} = (1111100111)_2 \rightarrow$ 10 bits are required using straight binary code

$(999)_{10} = (1001\ 1001\ 1001)_{BCD} \rightarrow$ 12 bits are required using BCD code

2. Show that the excess-3 code is self-complementing.

Self-complementing property: 1's complement of XS-3 code of a decimal digit is equal to XS-3 code of 9's complement of the corresponding decimal digit.

Example:

XS-3 code of the decimal digit 2 = 0101

1's complement of 0101 = 1010---------- (1)

9's complement of 2 = 9-2 = 7

XS-3 code of 7 = 1010---------- (2)

The self- complementing property of XS-3 code is proved from equations (1) & (2)

3. What is meant by weighted and non-weighted code?

- **Weighted codes** are those, which obey the positional weighting principles. In weighed code, each position of the number represents a specific weight. Example: 8421, 2421 & 84-2-1.
- **Non-Weighted Codes** are codes that are not positionally weighted. Each position of the number is not assigned a fixed value. Example: Excess-3 & Gray code

4. Add the decimals 67 and 78 using excess-3 code.

$67 = (0110\ 0111)_{BCD} = (1001\ 1010)_{XS-3}$

$78 = (0111\ 1000)_{BCD} = (1010\ 1011)_{XS-3}$

---

1 0100 0101 (+)

0011 0011 0011

$(0100\ 0111\ 1000)_{XS-3}$

---

5. Write the two properties of Gray code & mention the application of Gray code.

Properties:

(1) The gray code is non-weighted code, which means that there are no specific weights assigned to the bit positions.

(2) In gray code, only one bit changes from one number to the next.

Application: Shaft position encoder in which analog data are represented by continuous change of shaft position. The shaft is partitioned into segments, and each segment is assigned a number.

6. State & prove De-Morgan's theorem. (May/June 2013, Nov/Dec 2015)

De-Morgan's theorem 1: The complement of product of any number of variables is equivalent to sum of the individual complements.

De-Morgan's theorem 2: The complement of sum of any number of variables is equivalent to product of the individual complements.

Proof:

a) $(AB)' = A' + B'$

A	B	AB	**(AB)'**		A'	B'	**A'+B'**
0	0	0	**1**		1	1	**1**
0	1	0	**1**		1	0	**1**
1	0	0	**1**		0	1	**1**
1	1	1	**0**		0	0	**0**

b) $(A+B)' = A'B'$

A	B	A+B	**(A+B)'**		A'	B'	**A'B'**
0	0	0	**1**		1	1	**1**
0	1	1	**0**		1	0	**0**
1	0	1	**0**		0	1	**0**
1	1	1	**0**		0	0	**0**

7. Use De Morgan's theorem to convert the following expressions to one that has only single variable inversions?

Y = (RS'T+Q')'

Z = [(A+BC) (D+EF)]'

X = [(A'+C) (B+D')]'

Ans: Y = (RS'T+Q')' = (R'+S+T ') Q

Z = [(A+BC)(D+EF)]' = (A+BC)'+(D+EF)'

Z = A'(BC)' + D'(EF)' = A'(B'+C') + D'(E'+F') = A'B'+A'C'+D'E'+D'F'

X = [(A'+C) (B+D')]' = (A'+C)' + (B+D')' = AC'+B'D

8. Define distributive law.

X (Y + Z) = XY + XZ X + YZ = (X + Y) (X + Z)

9. Simplify the expression: X = (A'+B)(A+B+D)D'

X = (A'+B)(A+B+D)D' = (AA' + A'B + A'D + AB + BB + BD)D'

X = (0 + A'B + A'D + AB + B + BD)D' = (A'D + B(A' + A + 1 + D))D' = (A'D + B)D' X = A'DD' + BD' = 0 + BD' = BD'

10. Describe the importance of don't care conditions. (May/June 2013)

Functions that have unspecified outputs for some input combinations are called incompletely specified functions. We simply don't care what value is assumed by the function for the specified minterms. The unspecified minterms are called don't care conditions. These don't care conditions can be used on a map to provide further simplification of the Boolean expression.

11. State the advantages of CMOS logic.(April/May 2015)

CMOS logic has a few desirable advantages:

- High input impedance. The input signal is driving electrodes with a layer of insulation (the metal oxide) between them and what they are controlling. This gives them a small amount of capacitance, but virtually infinite resistance. The current into or out of CMOS input held at one level is just leakage, usually 1 nanoAmpere or less.
- The outputs actively drive both ways.The outputs are pretty much rail-to-rail.
- CMOS logic takes very little power when held in a fixed state. The current consumption comes from switching as those capacitors are charged and discharged. Even then, it has good speed to power ratio compared to other logic types.
- CMOS gates are very simple. The basic gate is an inverter, which is only two transistors. This together with the low power consumption means it lends itself well to dense integration.

12. Simplify Y = (A+B)(A'+C)

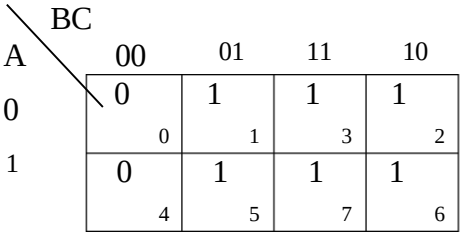
Y = (A+B)(A'+C) = AA' + AC + A'B + BC = 0 + AC + A'B + BC Y = AC + A'B + BC

Y = AC + A'B ---------- using consensus theorem XY+X'Z+YZ=XY+X'Z

13. Define the following: minterm and maxterm?

Minterm (standard product) is a combination of n variables using AND operation for the function of n variables. Possible minterms for a function of two variables A & B:, A'B', A'B, AB', AB. **Maxterm** (standard sum) is a combination of n variables using OR operation for the function of n variables. Possible maxterms for a function of two variables A & B: A+B, A+B', A'+B, A'+B'.

14. Minimize the function using K-map: F=∑m(1,2,3,5,6,7)



Quad (2,3,6,7) = B
Quad (1,3,5,7) = C F = B + C

15. Plot the expression on K-map: F(w,x,y) =∑m (0, 1, 3, 5, 6) + d (2, 4)

w \ xy	00	01	11	10
0	1 (0)	1 (1)	1 (3)	X (2)
1	X (4)	1 (5)	0 (7)	1 (6)

16. Simplify A+AB+A'+B

A+AB+A'+B = A+A' + AB + B

= 1+ AB + B ----------(X+X'=1)

= 1----------(X+1 = 1)

17. What are Universal Gates? Why are they called so?

A Universal gates are NAND and NOR, they are called so because using these codes any logical gate or logical expression can be derived.

18. Express f(a,b,c) = a+b'c as sum of minterms and canonical form. (OR) Express the function Y=A+B'C into canonical form. (Nov/Dec 2015)

A	B	C	B'	B'C	A+B'C
0	0	0	1	0	0
0	0	1	1	1	1
0	1	0	0	0	0
0	1	1	0	0	0
1	0	0	1	0	1
1	0	1	1	1	1
1	1	0	0	0	1
1	1	1	0	0	1

Non-Canonical Form: f(a,b,c) = ∑m(1, 4, 5, 6, 7)

Canonical Form

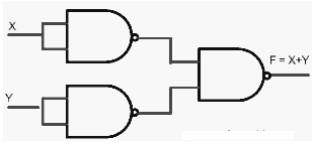
Y = A'B'C+AB'C'+AB'C+ABC'+ABC

19. What are Universal Gates? Why are they called so?

A Universal gates are NAND and NOR ,they are called so because using these codes any logical gate or logical expression can be derived .

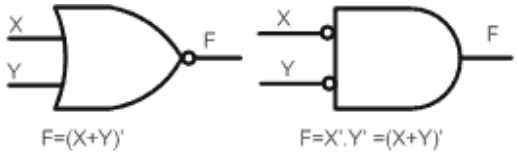
20. Implement OR using NAND only.

Input	Output	Rule
((XX)'(YY)')'	= (X'Y')'	Idempotent
	= X"+Y"	DeMorgan
	= X+Y	Involution



21. Implement NOR using NAND only.

Input	Output	Rule
((XX)'(YY)')'	=(X'Y')'	Idempotent
	=X"+Y"	DeMorgan
	=X+Y	Involution
	=(X+Y)'	Idempotent



22. State the advantages and disadvantages of a totem-pole output.

Advantage: Operating speed is high.

Disadvantage: Output of two gates cannot be tied together to form wired-logic connection for the purpose of forming a common-bus system.

23. Define Propagation delay and Fan out.

Propagation delay of a gate is the average transition delay time for the signal to propagate from input to output when input changes

The fan out of a gate specifies the number of standard loads that can be connected to the output of the gate without degrading its normal operation.

24. Apply De-Morgan's theorem to [(A+B)+C]' (MAY/JUNE 2014)

= (A+B)'.C' = (A'.B').C'

25. Give characteristics and specification of CMOS.

1 Power supply (VDD) = 3 — 15 Volts
2. Power dissipation (Pd) = 10 nW
3. Propagation delay (td) = 25 ns
4. Noise margin (NM) = 45% of VDD
5. Fan out (FO) = >50

26. Define noise margin. What is its importance? (MAY/JUNE 2016)

Noise margin is also known as noise immunity. It is defined as the ability of a logic circuit to tolerate noise without causing any unwanted changes in the output. Also, the quantitative measure of noise immunity is known as noise margin. It is important because it cause the voltage to drop into the invalid range so as to avoid the effects of noise voltage.

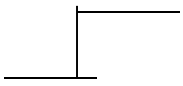
27. Simplify the following Boolean expression into one literal W'X(Z'+YZ')+X(W+YZ) (Nov/Dec 2014).

Solution: W'XZ'(1+Y)+X(W+YZ) => W'XZ'+WX+XYZ => X(W'Z'+W)+XYZ => (W+Z')X+XYZ
=> WX+XZ'+XYZ => WX+X(Z'+YZ) => WX+XZ'+YZ =>X(W+Z'+Y).

28. Define positive logic and negative logic system.

Positive logic: In positive logic system the high level H represents logic 1.

1 H



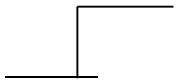
0 L

Eg.: positive logic AND gate

X	Y	Z
0	0	0
0	1	0
1	0	0
1	1	1

Negative logic: In negative logic system the low level L represents logic1.

0 H

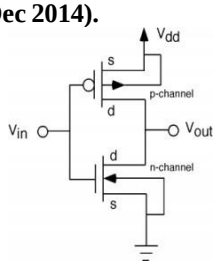


1 L

Eg: negative logic AND gate

X	Y	Z
1	1	1
1	0	1
0	1	1
0	0	0

29. Draw the CMOS inverter circuit (Nov/Dec 2014).



30. Convert Y = A+BC'+AB+A'BC into canonical form. (APRIL/MAY 2015)

Solution: Y = A+BC'+AB+A'BC = A(B+B')+BC'(A+A')+AB(C+C')+A'BC
=> AB+AB'+ABC'+A'BC'+ABC+ABC'+A'BC
=> AB(C+C')+AB'(C+C')+ABC'+A'BC'+ABC+ABC'+A'BC
=> ABC+ABC'+AB'C+AB'C'+ ABC'+A'BC'+ABC+ABC'+A'BC
=> ABC+ABC'+AB'C+AB'C'+A'BC'+A'BC.

31. Prove the Boolean theorems (a) x+x=x (b) x+xy=x (MAY/JUNE 2016)

Solution: (a) x+x =x
LHS : x+x = x(1+1) = x
(b) x+xy = x
LHS : x+xy = x (1+y) = x

32. Simplify the following expression X.Y+X(Y+Z)+Y(Y+Z). (NOV/DEC 2016)

Solution : XY + XY + XZ + Y + YZ
= XY + XZ + Y + YZ
= XY + XZ + Y
= Y + XZ

33. Why totem pole outputs cannot be connected together? (NOV/DEC 2016)

Two outputs cannot be tied together in totem – pole i.e. it does not support wired logic. If the gate of transistor A is high and the output of gate of transistor B is low , the low load resistance offered draws high current. This current might not damage the transistors immediately but over a period of

time can cause overheating and deterioration in performance and eventual device failure.

PART B

1. Draw the circuit of TTL NAND gate and explain its operation. Compare the TTL and ECL logic families.

2.(i) Simplify the following Boolean expressions using 3 variable maps **(Nov/Dec 2012)**

(a)F=XY+X'Y'Z'+X'YZ' (4), (b)F=X'Y'+YZ+X'YZ' (4),

(c) F=A'B+BC'+B'C' (4).

(ii)Obtain the minimal SOP and POS Expressions for F1 and F2. (4)

X	Y	Z	F1	F2
0	0	0	0	1
0	0	1	1	0
0	1	0	0	1
0	1	1	0	0
1	0	0	1	1
1	0	1	1	0
1	1	0	0	0
1	1	1	X	X

3.(i).Given Y(A,B,C,D)= ∏M(0,1,3,5,7,10,14,15) draw the K-map and obtain the simplified expression. Realize the minimum expression using basic gates. (8)

(ii) Implement the expression Y(A,B,C)= ∏M(0,2,4,5,6) using only NOR-NOR logic.(4)

(iii)Implement EXOR gate using only NAND gate. (4) **(MAY/JUNE 2014)**

2. Simplify the following function using Tabulation method Y(A,B,C,D) = □m(0,1,2,5,6,7,8,9,10,14) and implement using only NAND gates. **(MAY/JUNE 2014)**

5.(i) Draw the multiple- level two input NAND circuit for the following expression: **(Nov/Dec 2014)**

F=(AB'+CD')E+BC(A+B) (4)

(ii) Draw and explain Tri-state TTL inverter circuit diagram and explain its operation. (12) 6.(i)Convert the following function into product of Max-terms. F(A,B,C)=(A+B')(B+C)'(A+C') (4)

(ii)Using Quine McClusky method simplify the given function F(A,B,C,D)=∑m(0,2,3,5,7,9,11, 13,14) (12) **(Nov/Dec 2014).**

1. Simplify using Quine McClusky method and verify the result using K-map F=∑(0,1,2,5,7,8,9,10,13,15) **(April/May 2015)**

2. (i) Express the Boolean functions F=A+B'C in a sum of minterms. (10)

(ii) Simplify the following Boolean expression using Boolean algebra. (a) x'y'z+x'yz+xy' (3)

(b) xyz+x'z+yz (3) **(April/May 2015)**

3. (i) Minimize the following logic function using K-maps and realize using NAND and NOR gates. F(A,B,C,D) = ∑m(1,3,5,8,9,11,15)+d(2,13) (10)

(ii) Show that if all the gate in a two - level OR - AND gate network are replaced by NOR gate, the output function does not change. (6) **(Nov / Dec 2015)**

10.(i) Realize NOT, OR, AND gates using universal gates. (8)

(ii) Discuss about the basic operation of TTL NAND Gate. (8) **(Nov / Dec 2015)**

11 .Simplify the following Boolean function F, using Quine Mc Cluskey method and verify the results using K-map F(A,B,C,D)=∑(0,2,3,5,7,9,11,13,14). **(MAY/JUNE 2016)**

12.(i)Draw and explain Tri-state TTL inverter circuit diagram with its operation.(10) (ii)Implement the following functions using NAND and inverter gates.(6)

F=AB+A'B'+B'C **(MAY/JUNE 2016)**

13. (a)(i) Find the MSOP representation for F(A,B,C,D,E)= ∑(1,4,6,10,20,22,24,26)+d(0,11,16,27) using K-map method.Draw the circuit of minimal expression using only NAND gates. (7)

(ii)With neat circuit diagram , explain the function of 3-input TTL NAND gate.(6) **(NOV/DEC 2016)**

14. What are the advantages of using tabulation method? Determine the minimal sum of products using for the Boolean expression F=∑(1,2,3,7,8,9,10,11,14,15) using tabulation method. **(NOV/DEC 2016)**

UNIT V – Measurements of Parameters in Electrical Systems

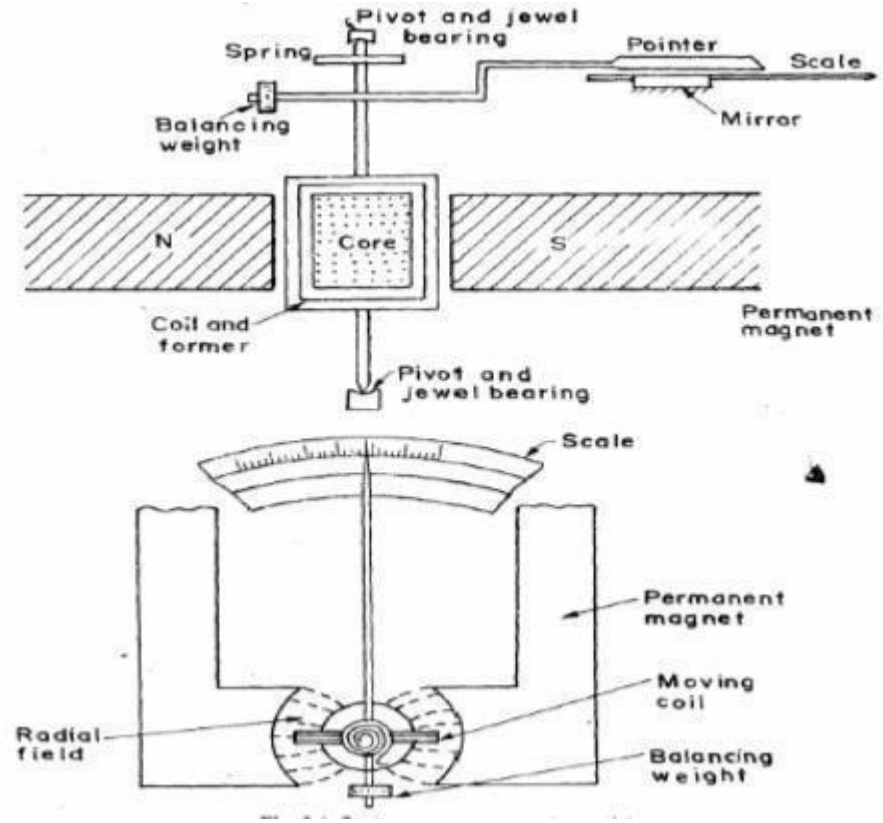
Syllabus: Analog instrument principle, operating force, Analog instrument controlling & damping system, moving coil and moving iron meters, Electrodynamometer type wattmeter, Induction type energy meter, Megger, Instrument transformer (C.T & P.T) Measurement of power & Energy using C.T, P.T.

1.	**State the essentials torque required for successful operation of instruments? (Nov/Dec 2018)** • Deflecting torque • Controlling torque • Damping torque
2.	**Why scale of gravity is non-uniform? (Apr/May 2021)** The quantity is to measure is proportional to sin rather than in gravity control which is not a uniform. Hence scale calibrated is not in uniform.
3.	**What is the basic principle of PMMC instruments?** A current carrying coil placed in the permanent magnet field experiences a force, proportional to the current it carries.
4.	**List the possible cause of errors in moving iron instruments? (Apr/May 2021)** • Hysteresis errors. • Temperature errors. • Stray magnetic field errors • Frequency & eddy current errors
6.	**What is loading effect? (Nov/Dec 2023)** The low sensitive instruments is used in high resistances circuit then its gives a lower reading than the true reading.
7.	**State the precautions to be taken while using d.c. voltmeter?** The voltmeter resistances are very high & it should always be connected across the circuit or component whose voltage is to be measure.
8.	**What are the requirements of a multiplier? (Nov/Dec 2018)** • Their resistances should not change with time. • They should not non-inductively wound for a.c.meters.
9.	**Which torque is absence in energy meter?** The controlling torque is absence in energy metering energy meter continues rotation of disc is required & it is not necessary to reset it to zero every time & hence controlling torque is absence.
10	**What are the constructional parts of dynamometer type wattmeter?** • Fixed coil • Moving Coil • Current limiting resister • Helical spring • Spindle attached with pointer • Graduated scale
11	**Name the errors caused in Dynamometer type wattmeter.(Nov/Dec 2013)** 2 • Error due to pressure coil inductance • Error due to pressure coil capacitance • Error due to methods of connection • Error due to stray magnetic fields • Error due to eddy current.
12	**Name the methods used for power measurement in three phase circuits.(Nov/Dec 2010)** • Single wattmeter method • Two wattmeter method • Three wattmeter method.

13	**What are the special features to be incorporated for LPF wattmeter? (Nov/Dec 2016)** BTL 2 • Pressure coil circuit • Compensation for Pressure coil current • Compensation for Pressure coil inductance.
14	**Define creeping. (May/June 2014)** Slow but continuous rotation of disc when pc is energized and cc is not energized.
15	**Name the types of instruments used for making voltmeter and ammeter**. **(Nov/Dec 2013)** • PMMC type • Moving iron type • Dynamometer type • Hot wire type • Electrostatic type • Induction type.
16	**State the applications of PMMC instruments. (May/June 2012)** • m/s of dc voltage and current • Used in dc galvanometer.
17	**How the range of instrument can be extended in PMMC instruments. (Nov/Dec 2011)** • In ammeter by connecting a shunt resister • In voltmeter by connecting a series resister.
18	**State the advantages of Hot wire type instruments. (Apr/May 2015)** • Can be used for both dc and ac • Unaffected by stray magnetic fields • Readings are independent of frequency and waveform.

Describe the construction and working of permanent magnet moving coil instrument. Also derive the expression for deflection. (Nov/Dec 2013)

1.



A moving-coil meter is a very commonly used form of analogue voltmeter because of its sensitivity, accuracy and linear scale, although it only responds to d.c. signals. As shown schematically in Figure 6.2, it consists of a rectangular coil wound round a soft iron core that is suspended in the field of a permanent magnet. The signal being measured is applied to the coil and this produces a radial magnetic field. Interaction between this induced field and the field produced by the permanent magnet causes a torque, which results in rotation of the coil.

Torque equation:

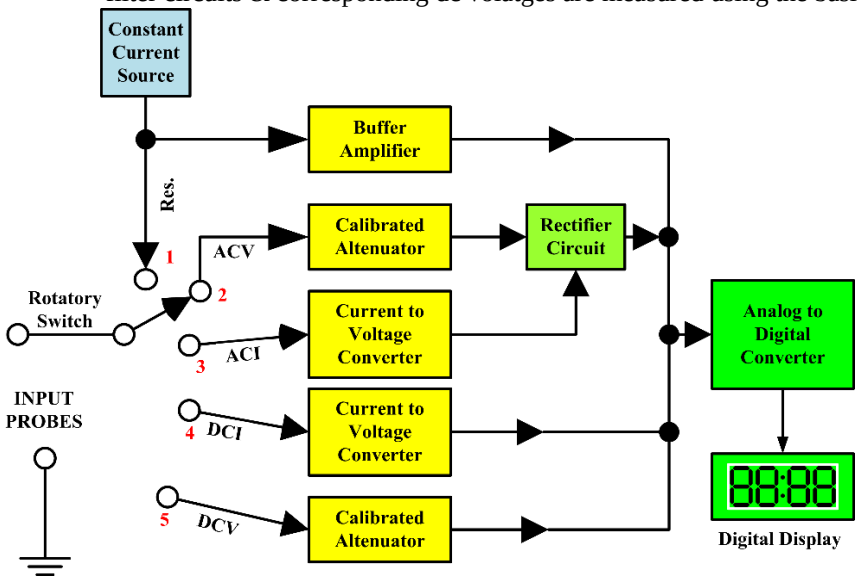
Deflecting torque Td= NBAI

N=number of turns of coil

B= Flux density in air gap A= coil area

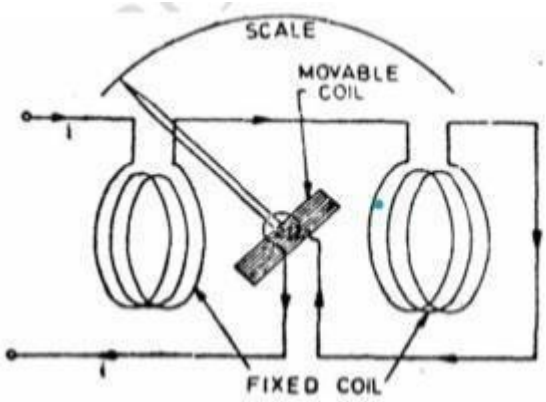
I= Current through moving coil Final steady deflection Tc=Td **Advantages & disadvantages:** Advantages:

- The sensitivity is high

	• Uniform scale • Operating current is small Disadvantages: • Not suitable for AC measurements • Ageing of PMMC introduces the errors • Cost is high
2.	**With a neat block diagram explain the working of a digital multimeter.** • Digital multimeter is an instrument which can be used for measuring d.c and a.c voltages, direct and alternating currents, and resistances over several ranges. • For measurement of a.c voltages and currents, the ac values are converted to dc value by using rectifier and filter circuits & corresponding dc volatges are measured using the basic circuit.  • Adv 1. Highly accurate and the accuracy is around 0.03 % 2. Loading effect is nil because of high input impedance 3. Measurement speed is more Dis- Adv: 1. Interruption of electric noise 2. Requirement of external power supply 3. Isolation problems occurs in DMM.

3. **With a neat diagram explain the construction and working of electrodynamometer type instruments. Also derive its torque equation. (Nov/Dec 2010)**

- Circuit diagram



This instrument can be used for the measurement of voltage current and with some modification it can be used for the measurement of power factor and frequency.

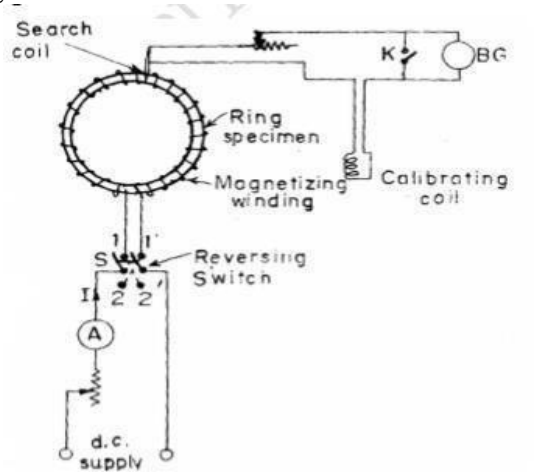
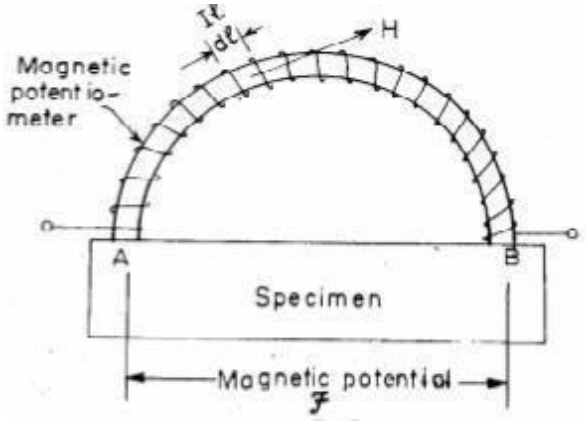
This instrument serves as a transfer instrument and provide same accuracy for both AC and DC.

Instrument is calibrated with a de source and then the same instrument is used without modification to measure AC. This type of instruments is called as transfer instruments.

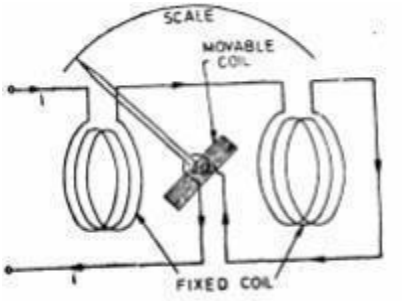
Principle:

Current through the fixed coil produces a magnetic field and the moving coil also produces a magnetic field when current flous through it moving coil is placed in between the two sections of fixed coil. These two fields creates a force between the two coils. This force causes the moving system to deflect.

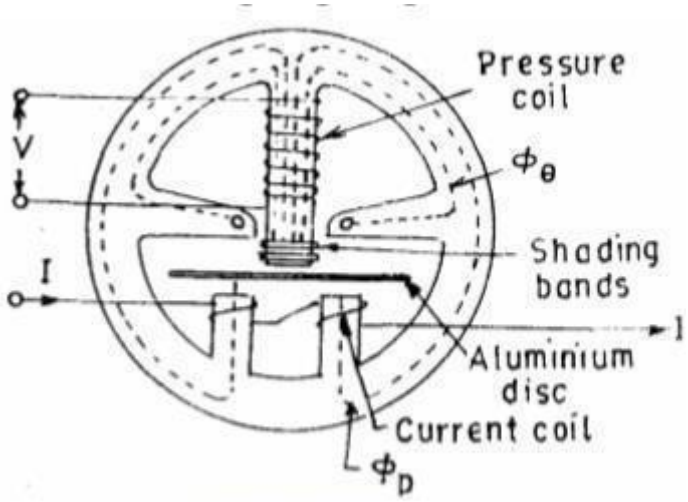
- <u>Adv</u>
  1. As the coils are air cored, these instruments are free from hysteresis and eddy current losses.
  2. They have a precision grade accuracy for frequencies from 40 HZ to 500 Hz. <u>Dis-Adv</u>
  1. They have a low torque/ weight ratio hence have a low sensitivity
  2. Increases frictional losses.

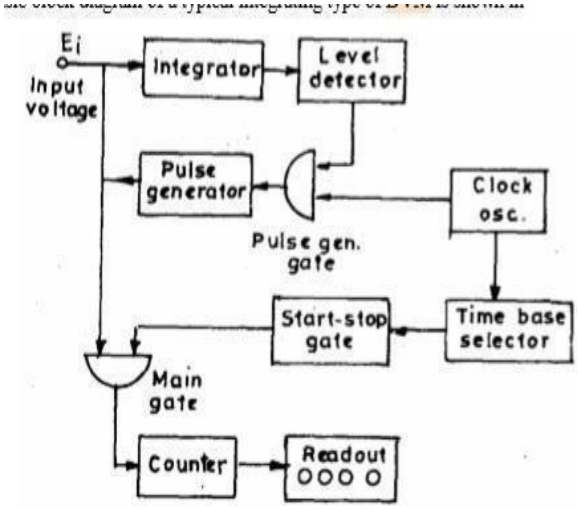
4.	**Explain the different methods of determination of B –H curve 13M (Nov/Dec 2011) (Nov/Dec 2010) (April/May 2011) (May /June2014)** By plotting values of flux density, (B) against the field strength, (H) we can produce a set of curves called Magnetisation Curves, Magnetic Hysteresis Curves or more commonly B-H Curves for each type of core material used as shown below • **Types of test** 1. Ballistic test 2. A.C Testing 3. Steady state test • **Determination of B-H curve methods** 1. Measurements of flux density  2. Magnetic potentiometer  (Fig) Magnetic potentiometer After reaching the point of maximum H i.e... when switch S is at tapping 10, the magnetizing current is next reduced, in steps to zero by moving switch 2 down through the tapping points 9, 8, 7 3, 2, 1. After reduction of magnetizing force to zero, negative values of H are obtained by reversing the supply to potential divider and then moving the switch S up again in order 1, 2, 3 7, 8. 9, 1O. This test is done by means of a number of steps, but the change in flux density measured at each step is the change from the maximum value + Bm down to some lower value. But before the next step is commenced the iron specimen is passed through the remainder of the cycle of magnetization back to the flux density + Bm. Thus the cyclic state of magnetization is preserved.
5.	**With a neat block diagram explain the working of digital frequency meter & digital phase meter. (Nov/Dec 2011) (Nov/Dec 2018)**

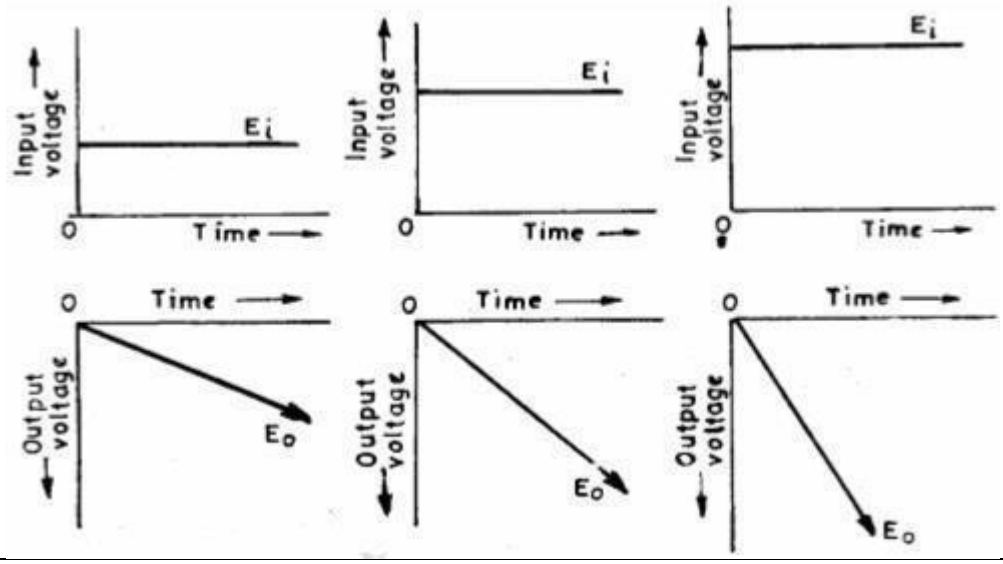
- Circuit diagram & explanation (9M)



- Electrodynamic instruments are capable of service as transfer instruments. Indeed, their principal use as ammeters and voltmeters in laboratory and measurement work is for the transfer calibration of working instruments and as standards for calibration of other instruments as their accuracy is very high.
- Electrodynamometer types of instruments are used as a.c. voltmeters and ammeters both in the range of power frequencies and lower part of the audio power frequency range. They are used as watt-meters, and with some modification as power factor meters and frequency meters.
- Advantages (2M)
  1. Simple in construction
  2. Simple operation
  3. Gives an accurate measurement.
- Dis-advantages of phase meter(2M)
  1. Poor accuracy
  2. The phase difference of 180 out of phase or inphase condition only can be detected. Other phase angles cannot be measured.

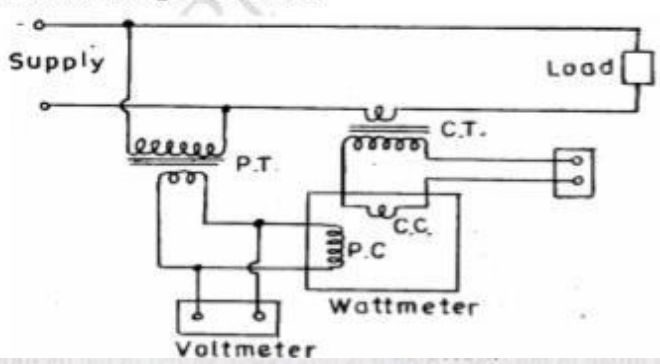
6.	**Give the construction and principle of operation of single phase induction type energy meter. Also derive its torque equation. (April/May 2011) Nov/Dec 2009) (May /June2018)** The supply voltage is applied across the pressure coil. The pressure coil winding is highly inductive as it has a very large number of turns and the reluctance of its magnetic circuit is very small owing to the presence of air gaps of very small length. Thus the current I, through the pressure coil is proportional to the supply voltage and lags it by a few degrees less than 90°. This is because the winding has a small resistance and there are iron losses in the magnetic circuit.  **(Fig) single phase energy meter** **Advantages of Energy Meter** The Energy Meter gives accurate readings. Energy meters require very little maintenance. The energy consumption of an energy meter is very low. **Disadvantages of Energy Meter** Installing a meter is very time-consuming. Electromagnetic interference changes the sensitivity of the energy meter. Installation cost of energy meters is very high.
7.	**Explain with neat diagram the working of linear ramp type & integrating type DVM. (April/May 2011)** • **Ramp type DVM** 1. The operating principle of a ramp type digital voltmeter is to measure the time that a linear ramp voltage takes to change from level of input voltage to zero voltage (or vice versa) 2. This time interval is measured with an electronic time interval counter and the count is displayed as a number of digits on electronic indicating tubes of the output readout of the voltmeter. • **Integrating type DVM**





8.	**Explain the operating principle of Instrument Transformer and what are errors affecting its charactersistics. (April/May 2011) (Nov/Dec 2018)** For measuring a large current in a d.c. circuit, we use low-range ammeter with a suitable shunt. The measurement of high d.c. voltage is made using a low-range voltmeter with a multiplier. **Current Transformer (C.T.)** A current transformer (C.T.) is used to measure high alternating current in a power system. The primary of this transformer has a few turns of thick wire whereas the secondary has many turns of very fine wire as shown in Fig. 4.15. It is clear from the figure that a current transformer is simply a well designed step-up transformer. Since voltage is stepped up, the current is stepped down which can be measured with a low-range a.c. ammeter. **Potential Transformer (P.T.)** A potential transformer (P.T.) is used to measure high alternating potential difference (voltage) in a power system. The primary of this transformer has many turns while the secondary has few turns as shown in Fig. It is clear from the figure that a potential transformer is simply a well-designed step- down transformer. The stepped down voltage is measured with a low-range a.c. voltmeter. The magnetic core of a potential transformer usually has a shell-type construction for better accuracy. In order to

provide adequate protection to the operator, one end of the secondary winding is usually grounded.



Sl.No.	Current Transformer (C.T.)	Potential Transformer (P.T.)
1	Connected in series with power circuit.	Connected in Parallel with Power circuit.
2	Secondary is connected to Ammeter.	Secondary is connected to Voltmeter.
3	Secondary works almost in short circuited condition.	Secondary works almost in open circuited condition.
4	Primary current depends on power circuit current.	Primary current depends on secondary burden.
5	Primary current and excitation vary over wide range with change of power circuit current	Primary current and excitation variation are restricted to a small range.
6	One terminal of secondary is earthed to avoid the insulation break down.	One terminal of secondary can be earthed for Safety.
7	Secondary is never be open circuited.	Secondary can be used in open circuit condition.