K.S.R. COLLEGE OF ENGINEERING (Autonomous) **R 2018**

SEMESTER - II

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18EE041	**BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING** (Common to AU,CE,CS,IT & ME)	3	0	0	3

Prerequisite: *Engineering Mathematics, Engineering Physics*

Objective(s):

- To study the basic concepts of electric circuits and various measuring instruments.
- To familiarize the constructional details and operation of the electrical machines.
- To study the special electrical machines.
- To study the characteristics of semiconductor devices and its applications.

UNIT - I ELECTRICAL CIRCUITS [9]

Structural of Electrical Power System - Ohm's Law – Kirchhoff's Laws –circuit Analysis – Introduction to AC Circuits: R, RL & RLC series circuits, Average and RMS Value – Power and Power factor for single phase Circuits – Three Phase Star and Delta Connections-electrical safety.

UNIT - II DC MOTOR AND TRANSFORMERS [9]

Faraday's Law – Lenz's Law-Fleming's left hand and right hand rule, DC Motor : Construction –Operation-series and shunt motor Characteristics Applications, Applications. Single Phase Transformer: Construction – Operation – EMF Equation – Types - Applications.

UNIT - III AC MOTORS & SPECIAL MACHINES [9]

Single Phase Induction Motor: Construction – Operation – Split Phase Induction Motor and Capacitor Start Induction Run Motor – Applications, Three Phase Induction Motor: Construction – Operation – Types – Applications. Special Machines: Stepper Motor.

UNIT - IV MEASURING INSTRUMENTS [9]

Basic Methods of Measurements: Direct and Indirect , Functional elements of an instrument – Errors in measurements – Analog and Digital Instruments – Basic Principle of Indicating Instruments – Moving Coil and Moving Iron Ammeter and Voltmeter. Dynamometer type Wattmeter – Induction type Energy Meter – Cathode Ray Oscilloscope.

UNIT - V ANALOG AND DIGITAL ELECTRONICS [9]

Semiconductor devices: PN Junction Diode, Zener diode: classification, operation and Characteristics- Bipolar Junction Transistor – CE Configurations and its Characteristics. Review of number systems – digital logic gates – Introduction to Microprocessors.

Total = 45 Periods

Course Outcomes:

CO1. Solve the electric circuits by applying basic circuital laws using various combinations of circuit elements.
CO2. Illustrate the function of various measuring instruments.
CO3. Explain the construction, operating principle and application of DC generator, DC motor, transformers.
CO4. Enlighten the construction, operating principle and application of AC motors.
CO5. Discuss the characteristics of Diodes, Zener diode, BJT using CE configurations.

Text Books :

1 Smarajit Ghosh, Fundamentals of Electrical and Electronics Engineering, PHI Learning Private Limited, Second Edition, 2007.

2 V.Jegathesan, K.VinothKumar and R.Saravanakumar, Basic Electrical and Electronics Engineering, Wiley India, First Edition, 2012.

Reference Books :

1 Muthusubramanian,R, Salivahanan S and Muraleedharan K .A, Basic Electrical, Electronics and Computer Engineering,Tata McGraw Hill, Second Edition, 2006.

2 Nagsarkar T K and Sukhija M S,Basics of Electrical Engineering, Oxford University press , Ninth Edition, 2005.

3 Mehta, V.K and Rohit Mehta, Principle of Electrical Engineering, S Chand & Company, Second Edition 2008.

4 Mahmood Nahvi and Joseph A. Edminister, Electric Circuits, Schaum' Outline Series, McGraw Hill, Fifth Edition 2002.

UNIT-I

ELECTRICAL CIRCUITS (CO1)

1. **Define electric potential. (Remembering, CO1)**
   The potential or absolute potential is defined as the measure of potential difference with respect to specific reference points. Electric potential (V) at a point is defined as the work done in bringing a unit positive charge from infinity to the point in electric field.

2. **Define potential difference. (Remembering, CO1)**

   Potential difference is defined as the work done in moving a unit positive charge from one point to another point in an electric field.

3. **Define Voltage. (Remembering, CO1)**

   Voltage (E) is the difference in electrical potential between two points in a circuit. It's the push or pressure behind current flow through a circuit, and is measured in (V) volts.

4. **Define Electric Current. (Remembering, CO1)**

   Current (I) is what flows on a wire or conductor like water flowing down a river. Current flows from negative to positive on the surface of a conductor. Current is measured in (A) amperes or amps.

5. **Define Resistance. (Remembering, CO1)**

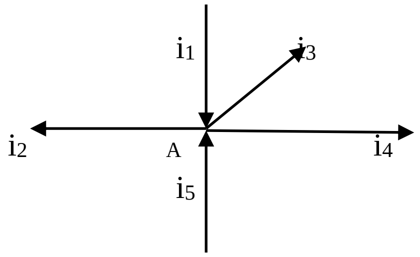
   Resistance (R) determines how much current will flow through a component. Resistors are used to control voltage and current levels. A very high resistance allows a small amount of current to flow. A very low resistance allows a large amount of current to flow. Resistance is measured in Ω ohms.

6. **Define Power. (Remembering, CO1)**

   Power (P) is the amount of current times the voltage level at a given point measured in wattage or watts.

7. **State Ohm's law. (Remembering, CO1)**
   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.
   $E \alpha I$ (Temperature remains constant)
   $E = IR$
   R is constant of proportionally, becomes the resistance when E is volts and I is in amperes.

8. **State Kirchhoff's law. (Remembering, CO1)**
   Kirchhoff's formulated two fundamental laws of electricity. These laws important for network simplification
   (a) Kirchhoff's current law: The total current flowing towards a junction point is equal to the current flowing away from that junction point.



According to Kirchhoff’s current law

$$i_1 + i_5 = i_2 + i_3 + i_4$$

(flowing towards A) = (flowing away from A)

(b) Kirchhoff’s voltage law: The algebraic sum of the voltage drops across the circuit elements of any closed path is equal to the algebraic sum of the voltage rise.

9. Faradays Law of Electromagnetic Induction. (Remembering, CO1)

First law: whenever magnetic flux linking with the coil changes an emf is induced in the coil.

Second law: The magnitude of the induced emf is equal to the product of number of turns of the coil and the rate of change of the flux.

10. State Lenz law. (Remembering, CO1)

Lenz’s law states that the induced emf in a circuit produces a current which opposes the change in magnetic flux producing it.

11. Define RMS value of an alternating current. (Remembering, CO1)

The Root Mean Square value of an alternating current is that steady current (DC) which when flowing through a given resistance for a given time produces the same amount of heat as produced by the alternating current when flowing through the same resistances for the same time.

12. Define average value of an alternating current. (Remembering, CO1)

The average value of an alternating quantity is defined as that value which is obtained by averaging all the instantaneous values over a period of half cycle.

Average value = Total area of curve under the curve for time T / time T

13. Express power factor in terms of load parameters. (Understanding, CO1)

Power factor is the ratio of active power (VI COSΦ) to apparent power (VI) or the power factor is the cosine angle between the applied voltage and the resultant current flowing through the circuit. Power factor is normally called when the current lags the applied voltage and the applied voltage and leading when the current leads the voltage.

14. Define form and crest factor. (Remembering, CO1)

The form factor is the alternating current wave shape is defined as the ratio of its rms value to the average value of current over a half cycle. (1.11)

The peak factor of an alternating current wave shape is defined as the ratio of its maximum value to the rms value. (1.414)

15. **A current of 3A flows through a 10 ohms resistor. Find the power developed by the resistor and the energy dissipated in 5 minutes. (Analyze, CO1)**

Given: I=3A, R=10Ω,

Solution: power developed $P=I^2R$

$P=3^2X10=90W$

Energy dissipated in 5 minute E=P X Time in seconds

E=90X (5/60) = 7.5 Joules

16. **If one of the resistors in parallel circuit is removed, what happens to the total resistance? (Understanding, CO1)**

Total resistance value to be increased if one of the resistors in parallel circuit is removed.

17. **If a 10V battery is connected across the parallel resistors of 3, 5, 10 and 20 ohms. How much voltage is there across 5 ohms resistor? (Understanding, CO1)**

In the parallel resistor connection voltage across each element is same so

Across 5Ω resistor 10V voltage appears.

18. **Write the equivalent resistance when two resistors are connected in parallel. (Remembering, CO1)**

$R_T = (R_1 + R_2)/R_1R_2$

19. **Define active and reactive power in AC circuits. (Remembering, CO1)**

Active power - Power drawn by an AC circuit is equal to the product of instantaneous values of voltage and current power = v x i

Reactive power – power drawn by the circuit due to reactive components of current reactive power. The reactive components of current is equal to I sinΦ

UNIT-II

DC MOTOR AND TRANSFORMERS (CO2)

1. **Define Electrical Machine. (Remembering, CO2)**

A device which is used to convert one form of energy into another form of energy is called machine.

In electrical machine either the input or output of the machine is in the form of electrical energy.
Example : Cycle Dynamo

2. **Type of DC machines: (Remembering, CO2)**

1. Generator
2. Motor

1. **Generator**
   1. Separately excited.
   2. Self excited.

   Self excited
   1. Series.
   2. Shunt.
   3. Compound.

2. Motor - Self Excited
1. Shunt.
2. Series.
3. Compound.

3. **What is meant by commutation? (Remembering, CO2)**
The process of reversal of current in a coil is termed as commutation. The device which is used to convert the reversal (alternating) current into direct current is known as commutator.

4. **List out the characteristics of motor. (Remembering, CO2)**
Mainly three basic characteristics of DC motor is,
   1. Toque Vs armature current characteristics
   2. Speed Vs armature current characteristics
   3. Speed Vs torque characteristics

5. **Give the principle of DC motor. (Remembering, CO2)**
The principle of operation of a DC motor can be stated "when the current carrying conductor is placed in a magnetic field, it experiences a mechanical force"

6. **Mention the two different types of armature winding in DC machines. (Remembering, CO2)**
Two types of armature windings used in DC machines are
   1. Lap winding and
   2. Wave winding

7. **Why the starter is necessary for a DC motor? (Remembering, CO2)**
In case of DC motors, the back emf developed in the armature winding is directly proportional to the speed of rotation. At the time of starting back emf of the machine is zero. Hence the applied voltages directly appear across the armature winding, causing an extremely large current through the armature winding.
A DC motor starter consists of properly graded starting resistances. Its also provided with protective devices to safeguard the motor from overload and from the failure of supply

8. **How the direction of the DC motor reversed. (Remembering, CO2)**
The direction of DC motor reversed by changing either the direction of armature polarity or field polarity

9. **Why series motor is never started on a load? (Understanding, CO2)**
The motor armature current is decided by the load, on light load or no load the armature current drawn by the motor is very small. In case DC series motor flux is directly proportional to the armature current, on no load as armature current is very small hence the flux is also very small
According to N α i/Φ
so on very light load or no load as flux is very small, the motor tries to run at dangerous high speed which may damage the motor mechanically, this is the reason why series motor should never started on no loads conditions.

10. **How can the speed of the DC motor be controlled? (Understanding, CO2)**
The speed of the DC motor can be controlled by two methods,
   1. Armature (voltage) control method and 2. Field (flux) control method

11. **What is the significance of back EMF in DC motor? (Remembering, CO2)**
There is an induced emf in the rotating armature conductors according to faradays law of electromagnetic induction, the induced emf is always acts in the opposite direction of the supply voltage (This is according to Len's law) this emf tries to set up a current through the armature which is in the opposite direction to that which supply voltage is forcing through the conductor. So as this always opposes the supply voltage it is called back emf.

12. **Which characteristic is called the mechanical characteristics of a DC motor? (Remembering, CO2)**
Mainly three mechanical characteristics of DC motor is,
   1. Toque Vs armature current characteristics

2. Speed Vs armature current characteristics
2. Speed Vs torque characteristics

13. How will you change the direction of rotation of a d.c motor? (Remembering, CO2)
Either the direction of the main field or the direction of current through the armature conductors is to be reserved.

14. What is back emf in D.C motors? (Remembering, CO2)
As the motor armature rotates, the system of conductor come across alternate North and South Pole magnetic fields causing an emf induced in the conductors. The direction of the emf induced in the conductors is in the direction opposite to the current. As this emf always opposes the flow of current in motor operation it is called back emf.

15. List application of the DC shunt and series motor. (Remembering, CO2)
DC shunt motor – blowers, fans, lathe machines, milling machines and drilling machines
DC series motor – cranes, hoists, elevators, trolleys, conveyers and locomotive engines

16. What is the principle of transformer? (Remembering, CO2)
Transformer is the static device its works on the principle of mutual induction. It transfers an electric energy from one circuit to other without change in frequency when there is no electrical connection between the two circuits.

17. How are the transformers classified? (Remembering, CO2)
The transformers are classified
1. Core type
2. Shell type and
3. Berry type

18. Mention the two different components of core less in a transformer. (Remembering, CO2)
The two different core losses in transformers are
1. Hysteresis loss
2. Eddy current losses

19. Give any two applications of DC generators. (Remembering, CO2)
1. Shunt generator is used as a constant voltage generator for battery charging and ordinary lighting purpose.
2. Series generator is used as a constant current generator for welding and arc lamps.

20. List out the different variable and constant losses in an electrical machine. (Remembering, CO2)
1. Variable losses- Copper losses
2. Constant losses-Iron losses (Hysteresis loss + Eddy current loss)

21. Mention the difference between core and shell type transformers. (Remembering, CO2)
In core type, the windings surround the core considerably and in shell type the core surround the winding.

22. What is the purpose of laminating the core in transformers? (Remembering, CO2)
To reduce eddy current loss.

23. Give the emf equation of a transformer and define each term (Understanding, CO2)
Emf induced in primary coil $E1 = 4.44\ f\ \phi_m N_1$ volt
Emf induced in secondary coil $E2 = 4.44f\ \phi_m\ N_2$ volt
Where f is the frequency of AC input
ϕ_m is the maximum value of flux in the core
N1, N2 are the number of primary and secondary turns.

24. Does the transformer draw any current when secondary is open? Why? (Understanding, CO2)

Yes, it (primary) will draw the current from the main supply in order to magnetize the core and to supply iron and copper losses on no load . There will not be any current in the secondary since secondary is open.

25. Define voltage regulation of a transformer. (Remembering, CO2)

When a transformer is loaded with a constant primary voltage, the secondary voltage decreases for lagging power factor load, and increases for leading Power factor load because of its internal resistance and leakage reactance. The change in secondary terminal voltage from no load to full load expressed as a percentage of no loads or full load voltage is termed as regulation.

% regulation down = $(V_{02}-V_2)$ x 100 /V_{02}

% regulation up = $(V_{02}-V_2)$ x 100/ V_{02}

26. Full load copper loss in a transformer is 1600 watts. What will be the loss at half load? (Remembering, CO2)

If x is the ratio of actual load to full load then copper loss = x2(full load copper loss) Here Wc = (0.5)2 x 1600 = 400 watts

27. Define all day efficiency of a transformer. (Remembering, CO2)

It is the computed on the basis of energy consumed during a certain period, usually a day of 24 hrs. % all day = output power in kWh /input power in kWh for 24 hrs.

28. Why transformers are rated in kVA? (Remembering, CO2)

Copper loss of a transformer depends on current and iron loss on voltage. Hence total losses depend on Volt- Ampere and not on the power factor. That is why the rating of transformers are in kVA and not in kW.

29. What are the typical uses of auto transformer? (Remembering, CO2)

(i) To give small boost to a distribution cable to correct for the voltage drop.
(ii) As induction motor starters.
(iii) As furnace transformers
(iv) As interconnecting transformers
(iv) In control equipment for single phase and 3 phase elective locomotives.

30. What are the applications of step-up and step-down transformers? (Remembering, CO2)

Step-up transformers are used in generating stations. Normally the generated voltage will be either 11 kV or 22 kV. This voltage is stepped up to 110 kV or 220 kV or 400 kV and transmitted through transmission lines. (In short it may Be called as sending end).

Step-down transformers are used in receiving stations. The voltage are again stepped down to 11 kV or 22 kV and transmitted through feeders.(In short it may be called as receiving end).Further these 11 kV or 22kV are stepped down to 3 phase 400 V by means of a distribution transformer and made available at consumer premises.

31. A 1100/400 V, 50 Hz single phase transformer has 100 turns on the secondary winding. Calculate the number of turns on its primary. (Remembering, CO2)

We know V1 / V2 = k = N2 / N1
Substituting 400/1100 = 100/N1
N1 = 100/400 x 1100 = 275 turns.

32. What are the factors on which hysteresis loss depends? (Remembering, CO2)

The hysteresis loss depends on the magnetic flux density, frequency f and the volume of the material V.

33. What is core loss? What is its significance in electric machines? (Remembering, CO2)

When a magnetic material undergoes cyclic magnetization, two kinds of power losses occur on it – hysteresis and eddy current loss which together are known as core loss. It is important in determining heating, temperature rise , rating and efficiency of transformers, machines and other a.c run magnetic devices.

34. What is eddy current loss? (Remembering, CO2)

When a magnetic core carries a time varying flux voltages are induced in all possible paths enclosing flux. Result is the production of circulating current in core. These induced currents do no useful work are known as eddy current and have power loss known as eddy current loss.

35. How is hysteresis and eddy current losses minimized? (Remembering, CO2)

Hysteresis loss can be minimized by selecting materials for core such as silicon steel & steel alloys with low hysteresis coefficient and electrical resistivity. Eddy current losses are minimized by laminating the core.

36. Define the term "slip" in an induction motor. (Remembering, CO2)

Slip of the induction motor defined different between synchronous speed and actual speed of rotor $S= N_S-N_R/N_S$

UNIT-III

AC MOTORS & SPECIAL MACHINES (CO3)

1. What is the importance of slip in the induction motor? (Remembering, CO3)

When the rotor starts rotating, it tries to catch the speed of rotating magnetic field. If its catches the speed of the RMF, the relative motion between rotor and the RMF will vanish ($N_S-N_r = 0$).

2. What are the different parts of the induction machine? (Remembering, CO3)

The different parts of the induction motors are

1. Stator
2. Rotor
3. End rings
4. Copper aluminum bars

3. Types of induction motor. (Remembering, CO3)

Single Phase Induction Motor	**Three Phase Induction Motor**
1. Split Phase Induction Motor	**Asynchronous Motor**
2. Capacitor Start Induction Motor	1. Squirrel cage induction motor
3. Capacitor Start Induction Run Motor	2. Slip ring induction motor
4. Shaded Pole Induction Motor	**Synchronous Motor**

4. **Application of Induction Motor. (Remembering, CO3)**

Single Phase Induction Motor	Three Phase Induction Motor
1.Home Appliances (Mixer, Grinder, Fan etc.)	**Asynchronous Motor**
2.Industrial applications	1. Conveyors
3.Elevators	2. Cement factories
4.Pumping applications	3. Paper mills
Synchronous Motor	4. Rice mills and rolling mills
1. Constant Speed applications	
Synchronous Condensers	

5 **Define: Stepper motor? (Remembering, CO3)**
Stepper motor is a motor which rotates step by step and not continuous rotation. When the stator is excited using a DC supply the rotor poles align with the stator poles in opposition such that reluctance is less.

6 **What are the advantages of Stepper motor? (Remembering, CO3)**
No feedback is normally required for either position control or speed control, Positional control is non – cumulative, Stepping motor are compatible with modern digital equipment

7 **Mention the different types of stepper motor? (Remembering, CO3)**
Variable Reluctance stepper motor (Single stack, Multi stack), Permanent magnet stepper motor, Hybrid stepper motor, Outer rotor stepper motor

8 **What are the different modes of excitation? (Remembering, CO3)**
Single phase excitation, two phase excitation, Half step mode, Mini-step drive

9 **Mention the features of stepper motor? (Remembering, CO3)**
Small step angle, High positioning accuracy, High torque inertia ratio, Stepping rate, Pulse frequency

10 **Define: Step Angle of stepper motor? (Remembering, CO3)**
A stepping motor rotates through a fixed angle for every pulse. The rated value of this angle is called the step angle and expressed in degrees.

11 **What are types of 3- phase induction motor? (Remembering, CO3)**
Squirrel cage induction motor ii. Slip ring induction motor

12 **Why the rotor slots of a 3-phase induction motor are skewed? (Remembering, CO3)**
The rotor slots of a three -phase induction motor are skewed to make the motor run quietly by reducing the magnetic hum ii. to reduce the locking tendency of the rotor

13 **What are slip rings? (Remembering, CO3)**
The slip rings are made of copper alloys and are fixed around the shaft insulating it. Through these slip rings and brushes the rotor winding can be connected to external circuits.

14 **State the difference between slip ring rotor and cage rotor of an induction motor. (Remembering, CO3)**
Slip ring rotor has 3-phase windings. Three ends of which are stared and the other three ends are brought up and connected to 3 slip rings mounted in the shaft. Extra resistance can be added in the rotor circuit. Squirrel cage rotor has short-circuited copper bars.Extra resistance can't be added as slip ring rotor.

15 **Write an expression for the slip of an induction motor. (Remembering, CO3)**
Percentage slip = (Ns -Nr) / Ns * 100

16 **What is cogging of an induction motor? (Remembering, CO3)**
When the number of stator and rotor teeth's is equal or integral multiple of rotor teeth ,they have a tendency to align themselves exactly to minimum reluctance position. Thus the rotor may refuse to accelerate. This phenomenon is known as cogging.

17 **State the effect of rotor resistance on starting torque? (Remembering, CO3)**
Starting torque increases with increase in value of rotor resistance.

18 **Give the conditions for maximum torque for 3-phase induction motor. (Remembering, CO3)**
The rotor resistance and rotor reactance should be equal for developing maximum torque i.e. R2 = s X2 where s is the slip –under running conditions. R2 = X2 under starting conditions

19 **What is reason for inserting additional resistance in rotor circuit of a slip ring induction motor? (Remembering, CO3)**

Introduction of additional resistance in the rotor circuit will increase the starting torque as well as running torque. Also it limits the starting current, improves the power factor.

20 **List out the methods of speed control of cage type 3-phase induction motor. (Remembering, CO3)**

a) By changing supply frequency
b) By changing the number of poles
c) By operating two motors in cascade

21 **Mention different types of speed control of slip ring induction motor. (Understanding, CO3)**

a) By changing supply frequency
b) By changing the number of stator poles c) By rotor rheostat control
d) By operating two motors in cascade

22 **What are the advantages of 3-phase induction motor? (Understanding, CO3)**

a) It was very simple and extremely rugged, almost unbreakable construction b) Its cost is very low and it is very reliable
c) It has been sufficently high efficiency .No brushes are needed and hence frictional losses are reduced
d) It requires minimum of maintenance.

23 **What does crawling of induction motor mean? (Understanding, CO3)**

Squirrel cage type, sometimes exhibit a tendency to run stably at speeds as low as 1/7 the of their synchronous speed, because of the harmonics this phenomenon is known as crawling

24 **State the application of an induction generator? (Remembering, CO3)**

a) Used in windmill for generating electric power.
b) Used in regenerative breaking places like traction.

25 **What are the various methods available for making a single-phase motor self-starting? (Remembering, CO3)**

I. By splitting the single phase into 2 phase ii. By providing shading coil in the poles.

26 **What is the function of capacitor in a single-phase induction motor? (Remembering, CO3)**

I. To make more phase difference between the starting and running winding. ii. To improve the power factor and to get more torque

27 **Give the names of three different types of single-phase motor. (Remembering, CO3)**

I. Split phase motor
ii. Shaded pole motor.
iii. Single phase series motor. iv. Repulsion motor.

28 **What is the use of shading ring in a pole motor? (Remembering, CO3)**

The shading coil causes the flux in the shaded portion to lag behind the flux in unshaded portion of pole. This gives in effect a rotation of flux across the pole face and under the influence of this moving flux a stating torque is developed.

29 **State any four use of single-phase induction motor. (Remembering, CO3)**

Fans, Wet grinders, Vacuum cleaners, small pumps, compressors, drills

30 **Why is the efficiency of a 3-phase induction motor less than of a transformer? (Remembering, CO3)**

In induction motor, there is a mechanical loss due to the rotation of the rotor. Hence the efficiency of an induction motor is less than that of the transformer

31 **What are the types of starters? (Understanding, CO3)**

Stator rheostat, Autotransformer and Star to Delta switch
Rotor resistance starter

UNIT - IV
MEASURING INSTRUMENTS (CO4)

1. **What is meant by measurement? (Remembering, CO4)**
   Measurement is an act or the result of comparison between the quantity and a predefined standard.
2. **Mention the basic requirements of measurement. (Remembering, CO4)**
   - The standard used for comparison purpose must be accurately defined and should be commonly accepted.
   - The apparatus used and the method adopted must be provable.
3. **What are the 2 methods for measurement? (Remembering, CO4)**
   Direct method
   In these methods, the unknown quantity (also called the measurand) is directly compared against a standard. The result is expressed as a numerical and a unit. The standard, in fact, is a physical embodiment of a unit. Eg., Physical quantities like length, mass and time.
   Indirect method
   Measurement by direct methods is not always possible, feasible and practicable. These methods in most of the cases, are inaccurate because they involve human factors. They are also less sensitive. Hence direct methods are not preferred and are rarely used.
4. **Explain the function of measurement system. (Remembering, CO4)**
   The measurement system consists of a transducing element which converts the quantity to be measured in an analogous form. the analogous signal is then processed by some intermediate means and is then fed to the end device which presents the results of the measurement.
5. **Define Instrument. (Remembering, CO4)**
   Instrument is defined as a device for determining the value or magnitude of a quantity or variable.
6. **List the types of instruments. (Remembering, CO4)**
   The 3 types of instruments are
   a. Mechanical Instruments
   b. Electrical Instruments and
   c. ElectronicInstruments.
7. **Classify instruments based on their functions. (Remembering, CO4)**
   - Indicating instruments
   - Integrating instruments
   - Recording instruments
8. **Give the applications of measurement systems. (Remembering, CO4)**
   The instruments and measurement systems are used for
   - Monitoring of processes and operations.
   - Control of processes and operations.
   - Experimental engineering analysis.
9. **Why calibration of instrument is important? (Remembering, CO4)**
   The calibration of all instruments is important since it affords the opportunity to check the instrument against a known standard and subsequently to errors in accuracy.

10. **Explain the calibration procedure. (Remembering, CO4)**

Calibration procedure involves a comparison of the particular instrument with either.

- A primary standard
- A secondary standard with a higher accuracy than the instrument to be calibrated or an instrument of known accuracy.

11. **Define Calibration. (Remembering, CO4)**

It is the process by which comparing the instrument with a standard to correct the accuracy.

12. **Name the different essential torques in indicating instruments. (Remembering, CO4)**

- Deflecting torque
- Controlling torque
- Damping torque

13. **Name the types of instruments used for making voltmeter and ammeter. (Remembering, CO4)**

- PMMC type
- Moving iron type
- Dynamometer type
- Hot wire type
- Electrostatic type
- Induction type.

14. **State the advantages of PMMC instruments. (Remembering, CO4)**

- Uniform scale.
- No hysteresis loss
- Very accurate
- High efficiency.
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15. **State the disadvantages of PMMC instruments. (Remembering, CO4)**

- Cannot be used for ac m/s
- Some errors are caused by temperature variations.

16. **State the applications of PMMC instruments. (Remembering, CO4)**

- Measurements of dc voltage and current
- Used in dc galvanometer.

17. **How the range of instrument can be extended in PMMC instruments. (Understanding, CO3)**

- In ammeter by connecting a shunt resister
- In voltmeter by connecting a series resister.

18. **State the advantages of Dynamometer type instruments. (Remembering, CO4)**

- Can be used for both dc and ac m/s.
- Free from hysteresis and eddy current errors.

19. **State the advantages of Moving iron type instruments. (Remembering, CO4)**

- Less expensive
- Can be used for both dc and ac
- Reasonably accurate.

20. **State the advantages of Hot wire type instruments. (Remembering, CO4)**

- Can be used for both dc and ac
- Unaffected by stray magnetic fields
- Readings are independent of frequency and waveform.

21. Define Measurement. (Remembering, CO4)

Measurement is the process of assigning a number to an attribute (or phenomenon) according to a rule or set of rules. The term can also be used to refer to the result obtained after performing the process.

22. SI (*International System of Units*) (Remembering, CO4)

The SI units for the four basic physical quantities: length, time, mass, and temperature are:

1. **metre (m)** :SI unit of length
2. **second (s)** :SI unit of time
3. **kilogram (kg)** :SI unit of mass
4. **kelvin (K)** :SI unit of temperature

There are two types of SI units, base and derived units. Base units are the simple measurements for time, length, mass, temperature, amount of substance, electric current and light intensity. Derived units are made up of base units, for example, density is kg/m^3.

23. What are the constructional parts of dynamometer type wattmeter?(Remembering, CO4)

- Fixed coil
- Moving Coil
- Current limiting resister
- Helical spring
- Spindle attached with pointer
- Graduated scale

24. Write down the deflecting torque equation in dynamometer type wattmeter. (Remembering, CO4)

$T_d \propto VI \cos\phi$

25. State the disadvantages of Dynamometer type wattmeter. (Remembering, CO4)

- Readings may be affected by stray magnetic fields.
- At low power factor it causes error.

26. Name the errors caused in Dynamometer type wattmeter.(Remembering, CO4)

- 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.

27. What are the types of energy meters? (Remembering, CO4)

- Electrolytic meters
- Motor meters.
- Clock meters

28. Name the constructional parts of induction type energy meter.(Remembering, CO4)

- Current coil with series magnet
- Voltage coil with shunt magnet
- Al disc
- Braking magnet
- Registering mechanism.

29. How voltage coil is connected in induction type energy meter. (Remembering, CO4)

It is connected in parallel to supply and load.

30. How current coil is connected in induction type energy meter. (Remembering, CO4)

It is connected in series to the load.

31. Why Al disc is used in induction type energy meter. (Remembering, CO4)

Aluminum is a nonmagnetic metal.

UNIT – V

ANALOG AND DIGITAL ELECTRONICS (CO5)

1. **Define semiconductors? (Remembering, CO5)**

A semiconductor is an element with electrical properties between those of a conductor and those of an insulator. The best semiconductor has four valance electrons.

2. **Write the two types of Extrinsic Semiconductors. (Remembering, CO5)**
    1. N – Type semiconductor.
    2. P – Type Semiconductor.

3. **Define N – Type Semiconductor. (Remembering, CO5)**

Silicon that has been doped with a pentavalent impurity is called an n type semiconductor, where n stands for negative.

4. **Define P – Type Semiconductor. (Remembering, CO5)**

Silicon that has been doped with a trivalent impurity is called a P type semiconductor, where n stands for Positive.

5. **Give the value of Charge, Mass of an electron. (Remembering, CO5)**
    1. Charge of an electron – 1.6 x 10 -19 coloumbs.
    2. Mass of an electron - 9.11 x 10 -31 Kgs.

6. **What is doping? (Remembering, CO5)**

Process of adding impurity to a intrinsic semiconductor atom is doping. The impurity is called dopant

7. **Which charge carriers is majority and minority carrier in N-type Semiconductor? (Remembering, CO5)**

Majority carrier: Electron and **Minority carrier:** Holes.

8. **Which charge carriers is majority and minority carrier in P-type Semiconductor? (Remembering, CO5)**

Majority carrier: Holes and **Minority carrier:** Electron.

9. **What is PIV? (Remembering, CO5)**

When the diode is not conducting, the reverse voltage gets applied across the diode. The peak value of such voltage decides the peak inverse voltage.

10. **What are the disadvantages of bridge rectifier? (Remembering, CO5)**

The only disadvantage of bridge rectifier is the use of four diodes as compared to two diodes in normal full wave rectifier. This causes an additional voltage drop as indicated by the term $2R_f$ present in the expression of I_m instead of R_f. This reduces the output voltage.

11. **Define P-N junction. (Remembering, CO5)**

When P-type and N-type are suitably joined together by the conducting surfaces of these two semiconductors is called P-N junction

12. **Define forward biasing. (Remembering, CO5)**

When a diode is forward biased the current is produced because the holes in the P-region and electron from N-region moves towards the junction. The depletion region formed will be very small hence recombination occurs and current will be produced.

13. **Define reverse biasing. (Remembering, CO5)**

When a reverse biased voltage is given an electron from N-region and holes from P-region moves away from the junction, hence the depletion region formed is very high and hence a small current will be produced due to minority carriers.

14. **Define reverse resistance. (Remembering, CO5)**

The resistance offered by the diode in its reversed biased condition is called reverse resistance.

15. **Define forward resistance. (Remembering, CO5)**

The resistance offered by the diode in its forward biased condition when a voltage is given is called forward resistance.

16. **Define transition capacitance. (Remembering, CO5)**

The P-N region on either of the dielectric media act as the plates hence we have components for making a plate capacitor the junction capacitance is called transition capacitance.

17. **Define power rating. (Remembering, CO5)**

The power rating of a diode is defined as the maximum value of power that can be dissipated without failure if V_f is the forward biased voltage and I_f is the forward biased current.

$$P_d = V_f \times I_f$$

18. **Define diffusion capacitance. (Remembering, CO5)**

This capacitance effect is present when the junction is forward biased it is called diffusion capacitance.

19. **Define drift velocity and drift current. (Remembering, CO5)**

When an electric field is applied the charge carriers moves in the opposite direction and produce current this result is drift current and net average velocity is called drift velocity.

20. **Define transition time. (Remembering, CO5)**

Only after the minority carriers are swept of the junction the diode voltage begins to reverse and the diode current decreases exponentially the time which elapses between and when the diode normally recovered is the called transition time

21. **Define storage time. (Remembering, CO5)**

When the conduction diode is reverse biased the voltage doesn't become zero. Immediately up to time t1 the diode is conducting in the forward direction. The time interval $t = t_2 - t_1$ during which the stored minority carriers reduces to zero is called storage time (T_s).

22. **What are valence electrons? (Remembering, CO5)**

Electron in the outermost shell of an atom is called valence electron.

23. **What is forbidden energy gap? (Remembering, CO5)**

The space between the valence and conduction band is said to be forbidden energy gap.

24. **What are conductors? Give examples? (Remembering, CO5)**

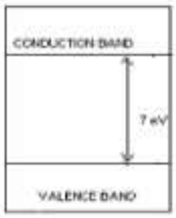
Conductors are materials in which the valence and conduction band overlap each other so there is a swift movement of electrons which leads to conduction. Ex.: Copper, silver.

25. **What are insulators? Give examples? (Remembering, CO5)**

Insulators are materials in which the valence and conduction band are far away from each other. So no movement of free electrons and thus no conduction. Ex glass, plastic.

26. **Give the energy band structure of Insulator. (Understanding, CO5)**

In Insulators there is a wide forbidden energy gap. So movement of valence electron from valence to conduction band is not possible.



27. **What is Intrinsic Semiconductor? (Remembering, CO5)**

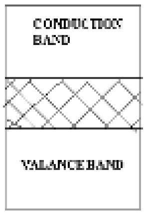
Pure form of semiconductors are said to be intrinsic semiconductor.
Ex: silicon, germanium.

28. **Give the energy band structure of Semi conductor. (Understanding, CO5)**

In Semiconductors there is a small forbidden energy gap. So movement of valence electron from valence to conduction band is possible if the valence electrons are supplied with some energy.

29. **Give the energy band structure of conductor. (Understanding, CO5)**

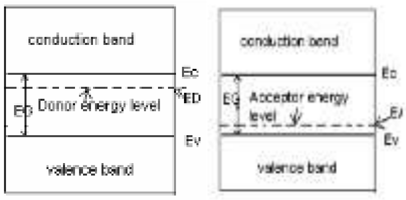
In conductors there is no forbidden energy gap, valence band and conduction and overlap each other. So there is a heavy movement of valence electrons.



30. **What is Extrinsic Semiconductor? (Remembering, CO5)**

If certain amount of impurity atom is added to intrinsic semiconductor the resulting semiconductor is Extrinsic or impure Semiconductor

31. **Give the energy band structure of n- type and P- type semiconductor. (Remembering, CO5)**



N – Type **P - Type**

32. **What is Reverse saturation current? (Remembering, CO5)**

The current due to the minority carriers in reverse bias is said to be reverse saturation current. This current is independent of the value of the reverse bias voltage

33. **What is meant by biasing a PN junction? (Remembering, CO5)**

Connecting a PN junction to an external voltage source is biasing a PN junction.

34. **What is barrier potential? (Remembering, CO5)**

Because of the oppositely charged ions present on both sides of PN junction an electric potential is established across the junction even without any external voltage source which is termed as barrier potential

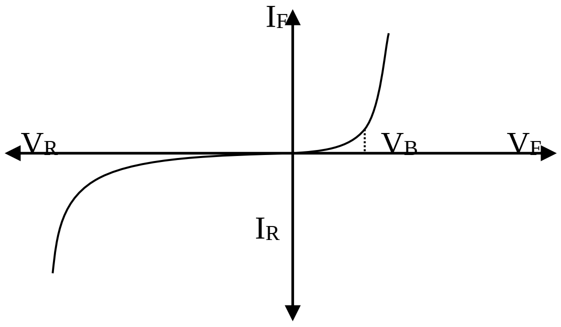
35. **What is depletion region in PN junction? (Remembering, CO5)**

The region around the junction from which the mobile charge carriers (electrons and holes) are depleted is called as depletion region. Since this region has immobile ions, which are electrically charged, the depletion region is also known as space charge region.

36. **Define Zener break down. (Remembering, CO5)**

The break down occurs in junctions, which are heavily doped. The heavily doped junctions have a narrow depletion layer. When the reverse voltage is increased, the electric field at the junction also increases. A strong electric field causes a covalent bond to break from the crystal structure. As a result of this, a large number of minority carries are generated and a large current flows through the junction.

37. **Draw V-I Characteristics of a PN junction Diode. (Remembering, CO5)**



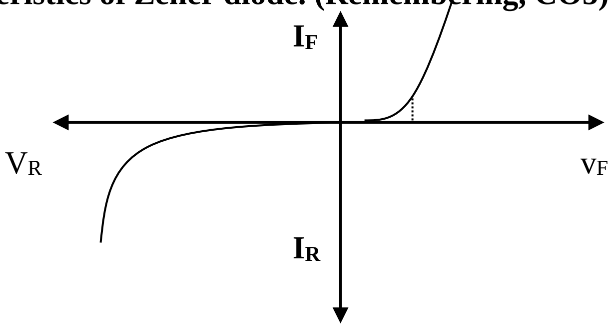
38. **Write the application of diode. (Remembering, CO5)**

1. As rectifiers or power diode in DC power supplies.
2. As signal diodes in commutation circuits.
3. As zener diodes in voltage stabilizing circuits.
4. As a switch in logic circuits

39. **Write the application of zener diode. (Remembering, CO5)**

1. As a voltage regulator.
2. As a fixed reference voltage in transistor biasing circuits.
3. As peak clippers or limited in wave shaping circuits.

40. **Draw the VI Characteristics of Zener diode. (Remembering, CO5)**



41. **What is Biasing? (Remembering, CO5)**

Biasing → In order to operate transistor in the desired region we have to apply external dc voltages of correct polarity and magnitude at the two junctions of the transistor.

42. **What are transistors? (Remembering, CO5)**

Transistors → Three terminal devices that can function as electronic switches or as signal amplifiers. They are current operated devices with high input impedance and low output impedance. → Since it transfers current from a high to a low resistance region, it was named bipolar.

43. **What is BJT? (Remembering, CO5)**

BJT → Bipolar Junction Transistor.

→ Since the operation of a BJT depends on the interaction of both the majority and minority carriers it is named bipolar.

→ The transistor is used as an amplifier and for an amplifier to operate properly, a steady level of current and voltage should be established.

→ The steady state voltage and current in which the amplifier is operated is called operating point or quiescent point.

→ The method of establishing the operating point is called biasing.

44. How Transistor Amplifier is biased? (Remembering, CO5)

The biasing of a transistor is defined as supplying the transistor with proper input and output DC voltage such that the currents and voltages of the transistor are within the desired region.

45. What are the conditions for biasing? (Remembering, CO5)

Conditions for Biasing:The values to be maintained for perfect operation are :

1. Proper dc value of the collector current.
2. Proper value of V_{BE} (0.7V for Si and 0.3V for Ge)
3. Proper value of V_{CE} (1V for Si and 0.5V for Ge) at any instant.

46. What are the methods for biasing? (Remembering, CO5)

The transistor needs two bias voltages V_{BB} and V_{CC}. The V_{BB} supply is used for biasing of the emitter junction and V_{CC} supply for biasing the collector base junction. Also it is possible to bias both the junctions using a single supply.

Common Methods:

1. Fixed Bias or Base Bias.
2. Emitter feedback bias.
3. Collector feedback bias
4. Voltage divider bias and
5. Emitter bias.

47. List out the different types of logic gates. (Remembering, CO5)

The types of gates available are the NOT, AND, OR, NAND, NOR, Exclusive-OR, and Exclusive-NOR

48. State Boolean Algebra. (Remembering, CO5)

Boolean algebra is a system of mathematical logic. Its differs from both ordinary algebra and binary numbers. It donates various laws with respect to universal gates

49. Which gates are called universal? (Remembering, CO5)

The NAND and NOR gates are known as universal gates, since any logic function can be implemented using NAND or NOR