2182

October 2024

ELECTRICAL DRIVES AND CONTROL

PART-A

1. Define Voltage. **[3 marks]**

Voltage, also known as electric potential difference, is the measure of the electromotive force (EMF) that drives electric current through a circuits. Voltage is measured in volts (v). Symbol v.

2. Define Permeability. **[3 marks]**

It is defined as measure of the ability of a material to alter the magneticfield in the area that it occupies.

3. Define power factor in AC circuit. **[3 marks]**

The ratio of active power (P) in watts to the apparent power (S) in volt amperes in an Ac circuit is defined as the power factor of the circuit.

$$\text{Power factor} = \frac{\text{Active power}(VI\cos\emptyset)}{\text{Volt amperes}(VI)}$$

$$\text{Power factor} = \frac{P}{S}$$

$$P.F = \cos\emptyset$$

4. List the types of speed control in three phase induction motor. **[3 marks]**

I. Control from stator side:

1. By changing the applied voltage:
2. By changing the applied frequency
3. By changing the number of stator poles
4. Constant V/F control of induction motor
5. Speed control from rotor side:

II. Rotor resistance control:

1. Cascade operation
2. By injecting EMF in rotor circuit

5. What is meant by industrial drives? Mention its types. **[3 marks]**
(Types 1 marks, Explanation 2 marks)

Systems employed for motion control are called drives and may employ any of the prime movers such as, diesel or petrol engines, gas or steam turbines, steam engines, hydraulic motors and electric motors, for supplying mechanical energy for motion control. If a drive used for industrial process it is called as industrial drive.

Types of Electric Drives:

The electric drives are classified into three types. They are

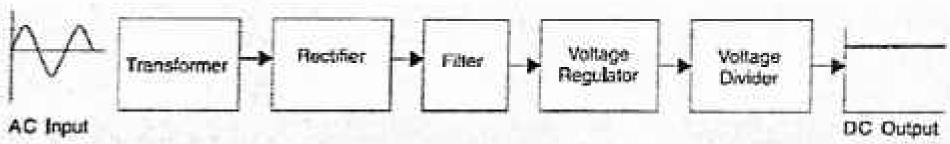
A.Group Drive B. Individual Drive C. Multi-motor Drive

6. State any three application of brushless servo motor. **[3 marks]**

1. Aerospace and defense
2. Industrial automation
3. Medical imaging equipment

7. What is meant by Regulated Power Supply (RPS)? **[3 marks]**

A D.C power supply which maintains the output voltage constant irrespective of the changes in input voltage and load variation is called as regulated D.C power supply.



8. Define Photo Electric Sensor. **[3 marks]**

A photoelectric sensor emits a light beam (visible or infrared) from its light-emitting element. A reflective-type photoelectric sensor is used to detect the light beam reflected from the target. A through-beam type sensor is used to measure the change in light quantity caused by the targetcrossing the optical axis.

9. Write about universal gates. **[3 marks]**

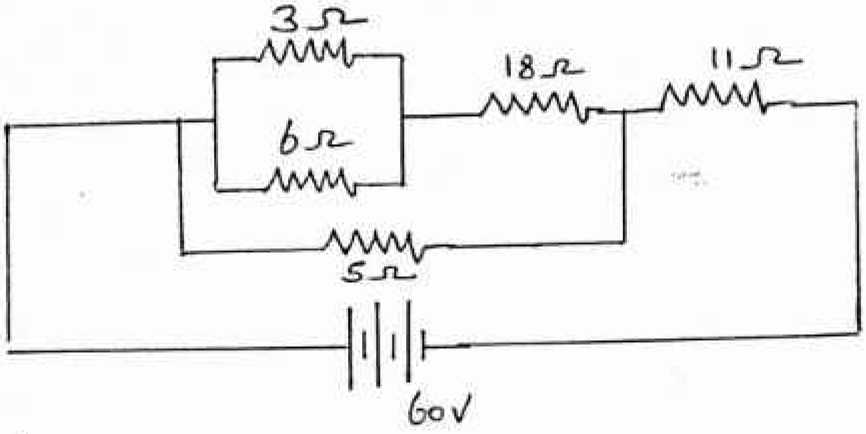
A universal logic gate is a logic gate that can be used to construct all other logic gates. Byusing universal gate any Boolean function can be implemented without using other gates. NAND gate and NOR gate are used as universal gates.

10. State any three application of LCD. **[3 marks]**
(Any Three point)

1. Used in watches, packet calculators.
2. Used in laptop, computers.
3. Used in television displays.
4. Used in video games.
5. Used in instrument displays.

PART –B

11.(a) find the current in each branch of the circuits given below, if the total applied voltage is 60 v.



Given Data:

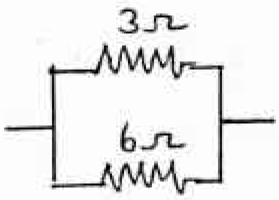
$V = 60\ v$

To Find:

(i) the current in each Branch

Solution:

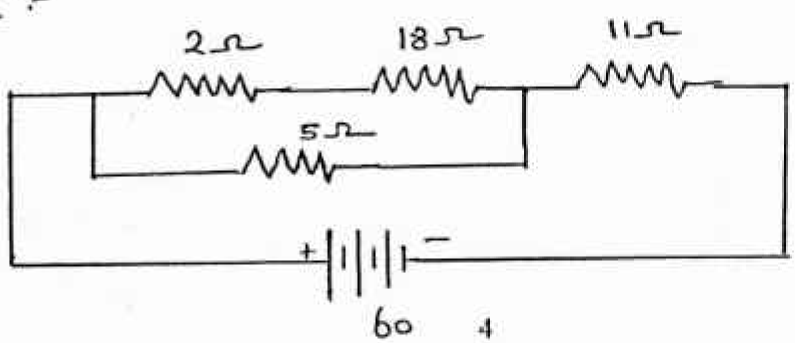
Step-I :-



$$R = \frac{(R_1 \times R_2)}{(R_1 + R_2)} = \frac{(3\times 6)}{(3+6)} = \frac{18}{9} = 2\ \Omega$$

$$\boxed{R = 2\ \Omega}$$

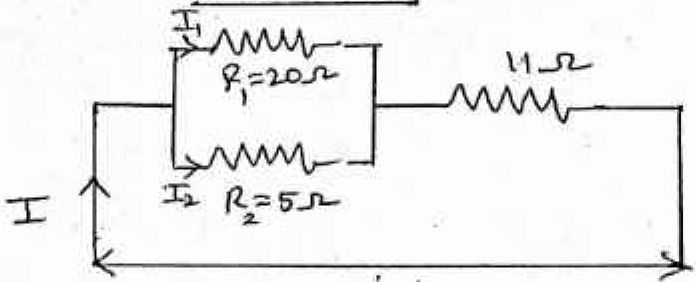
Step-II :-



To Series: $R = (R_1 + R_2)$

$= (2 + 18)$

$\boxed{R = 20\,\Omega}$



$V = 60$

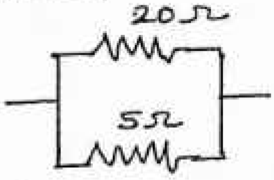
Step - III :

To Find Branch current:

$$I_1 = \frac{V}{R_1} = \frac{60}{20} = 3 \text{ Amps.}$$

$$I_2 = \frac{V}{R_2} = \frac{60}{5} = 12 \text{ Amps.}$$

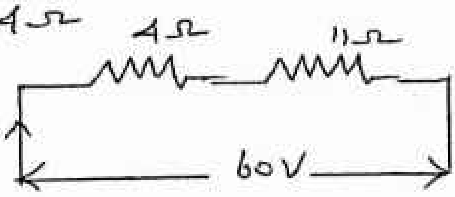
To find total current :-



To parallel:

$$R = \frac{(R_1 \times R_2)}{(R_1 + R_2)} = \frac{(20 \times 5)}{(20 + 5)} = \frac{100}{25}$$

$R = 4\,\Omega$



To Series $R = R_1 + R_2 = 4 + 11 = 15\,\Omega$

$$I = \frac{V}{R} = \frac{60}{15} = 4 \text{ Amps}$$

Result:

$I_1 = 3$ Amps

$I_2 = 12$ Amps

$I = 4$ Amps

// (Ans)

(Or)

(b). Explain the working principal of DC motor with neat sketches. Also mention its applications.

(Diagram 7 marks, Explanation 7 marks)

Principle of DC Motor and its Operation:

Even though the construction of a DC motor is same as that of a DC generator, the basic principle of operation differs from that of a DC generator. When a current carrying conductor is placed in a magnetic field (two magnetic flux lines do interact with each other), a force is experienced on the conductor.

The amount of force developed, F = BIL Newton Where

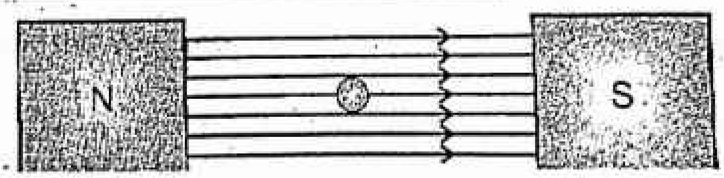
F Force in Newton

B = Magnetic flux density in Wb/m2

L= Length of the conductor in meter

I = Current in the conductor in ampere

<u>Case I: When no current flows through the conductor</u>



Fleming's left hand rule is used to find the direction of force developed. For example, let us consider a bipolar motor. The figure shows a uniform magnetic field in which a straight conductor that carries no current is placed, the conductor being perpendicular to the direction of the magnetic field, no force acts on the conductor.

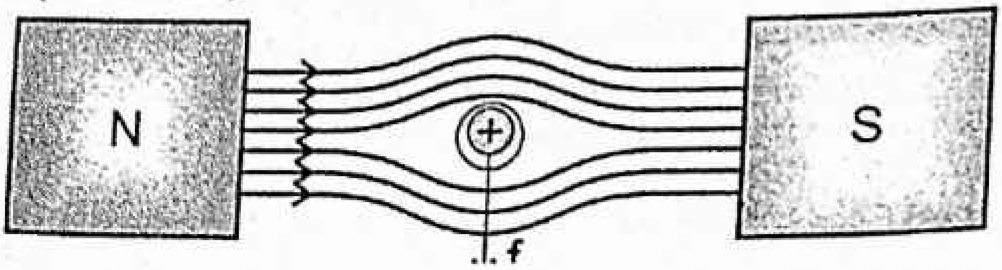
<u>Case II: When Current Flows through the conductor (Pole without Magnetic Lines)</u>

The magnetic flux produced by a current carrying conductor placed between the poles. The direction of the magnetic flux is identified by the Maxwells cork screw rule. When the current in a conductor is flowing inwards; the produced magnetic flux is in clockwise direction.

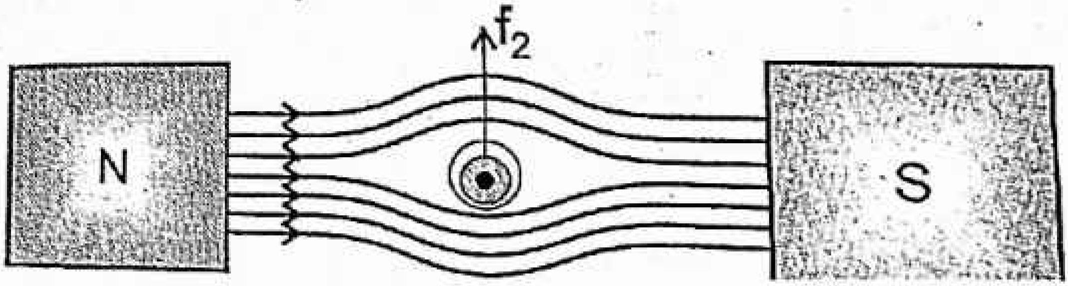
When the current is flowing outwards the produced magnetic flux lines is in anti-clockwise direction. The magnetic flux pro- duced by the poles are not shown.

Case III: When Current flows through the conductors and main pole flux lines

we can observe that the magnetic flux lines above the conductor is increased (due to adding of conductor flux lines with main poles flux lines) and the magnetic flux lines below the conductor is decreased (due to opposition of conductor flux lines with main poles flux lines).



So the conductor is forced from top to bottom, (From high density flux to low density flux). The resultant magnetic field obtained by combining the main field and due to the current in the conductor (outwards) is shown in Fig 1.46. Here the flux lines in the bottom of the conductor is increased and in the top of the conductor is decreased, so a force is developed on the conductor from bottom to top.



Interaction between the Main Flux and the Flux produced by the Current carrying Conductor The resultant magnetic field is obtained by combining the main field and the field due to the current in the conductor .The coil is wound on the armature core which is supported between the bearings and these forces act on the coil sides to rotate the armature of the machine.

Applications of Dc Motor:

I. Shunt motor:

Dc shunt motors are used where the speed has to remain nearly constant with load andwhere a high starting torque is not required. Thus shunt motors may be used for driving centrifugal pumps and light machine tools, wood working machines, lathe etc.,

II. Series motor:

Series motors are used where the load is directly attached to the shaft or through a gear arrangement and where there is no danger of the load being "thrown off". Series motors are idealfor use in electric trains, where the self-weight of the train acts as load and for cranes, hoists, fans, blowers, conveyers, lifts etc. where the starting torque requirement is high.

III. Compound motor:

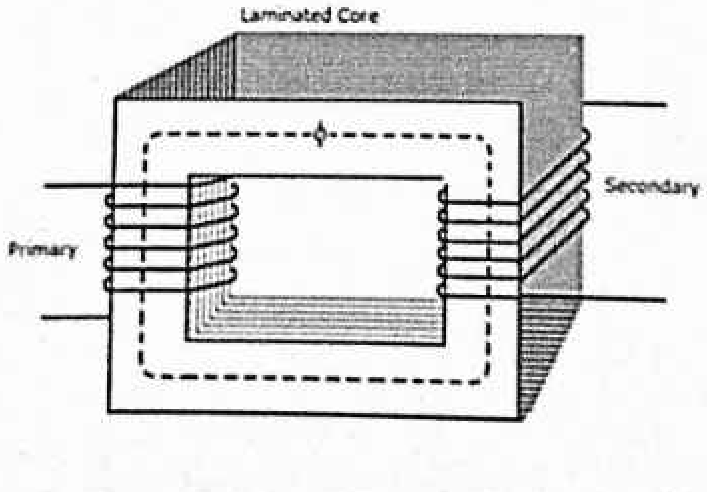
Compound motors are used for driving heavy machine tools for intermittent loads shears,punching machines etc.

12. (a) Explain the construction and working of transformer with neat diagram.
(Diagram 7 marks, Explanation 7 marks)

Construction:

For the simple construction of a transformer, transformer has two coils and a laminated steelcore. The two coils are insulated from each other and from the steel core

- The device will also need some suitable container for the assembled core and windings, amedium with which the core and its windings from its container can be insulated.
- In all transformers that are used commercially, the core is made out of transformer sheet steel laminations assembled to provide a continuous magnetic path with minimum of air-gap included.
- The steel should have high permeability and low hysteresis loss. So, the steel should be made ofhigh silicon content and must also be heat treated.
- By effectively **laminating the core**, the eddy-current losses can be reduced. The lamination canbe done with the help of a light coat of core plate varnish on the surface.
- For a frequency of 50 Hertz, the thickness of the lamination varies from 0.35 mm to 0.5mm.



Working of transformer:

- The voltage can be raised or lowered in a circuit, but with a proportional increase or decrease in the current ratings. The main principle of operation of a transformer is mutual inductance between two circuits which is linked by a common magnetic flux. The principle of mutual inductance states that when two coils are inductively coupled and if current in one coil is charged uniformly then an e.m.f. gets induced in the other coil. This e.m.f. can drive a current, when a closed path is provided to it.

- The transformer has primary and secondary windings. The alternating current supply is given to the first coil and hence it can be called as the primary winding.
- The energy is drawn out from the second coil and thus can be called as the secondary winding.
- When primary winding is excited by an alternating voltage, it circulates an alternating current. This current produce an alternating flux (ϕ) which completes its path through common magnetic core as shown dotted in the fig 2.4.
- Thus an alternating, flux links with the secondary winding. As the flux is alternating, according to Faraday's law of an electromagnetic induction, mutually induced e.m.f. gets developed in the secondary winding.

According to Faraday's laws of Electromagnetic Induction as

$$Emf = M\frac{\mathrm{dI}}{\mathrm{dt}}$$

In short, a transformer carries the operations shown below:

- Transfer of electric power from one circuit to another.
- Transfer of electric power without any change in frequency.
- Transfer with the principle of electromagnetic induction.
- The two electrical circuits are linked by mutual induction.

(Or)

(b) **Explain the construction and working of three phase induction motor with neat diagram.** **(Diagram 7 marks, Explanation 7 marks)**

Construction of 3 phase induction motor:

The three phase induction motor consists essentially of two main parts:

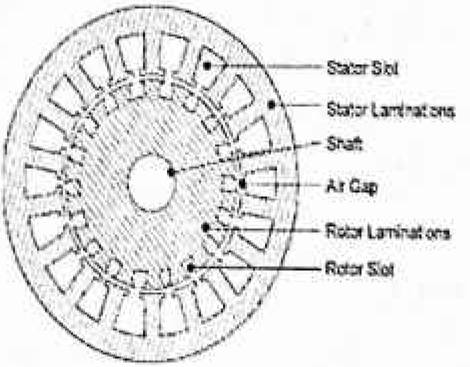
a. Stator and
b. Rotor

1. <u>Stator construction:</u>

The stator of an induction motor is, in principle, the same as that of alternator. The various parts of 3 phase induction motor is shown in Fig,

a. Stator frame:

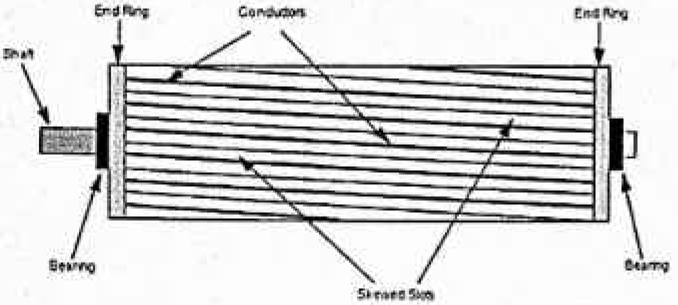
It is in the form of cylinder. It is made of cast iron and used for supporting the stator core.Terminal box is fixed in the outer surface. At both ends of the stator frame, provision is made to fit the end bells. Eye bolt is fitted at the top of frame. Eye bolts are used for lifting the motor. Cooling fan is used for cooling the motor through air ventilation.



It is made up of number of silicon steel stampings. The core is laminated to reduce eddycurrent loss. The laminated core is punched and bolted together with the frame. The core is slotted along its inner periphery. The three phase winding fed from a three phase supply is placedin the slots. The winding is wounded for a defined number of poles. The exact number of poles isdetermined the by the requirement of speed.

2. Rotor

Three phase induction motors are classified in to two types according to the construction of rotor.



i. Squirrel-cage rotor: motors employing this type of rotor are known as squirrel-cage induction motors

ii. Phase-wound or wound rotor: motors employing this type rotor are variously known as 'phase-wound' motors or 'wound 'motors or as 'slip-ring' motors.

Working principle:

When the three phase stator windings are fed by a three phase supply, a magnetic flux ofconstant magnitude, but rotating at synchronous speed, is set up.

Synchronous speed $Ns = 120 * F / P$

Where, F = Frequency of applied 3 phase voltage

P = No. of stator poles

This flux pass through the air gap, sweeps past the rotor surface and so cuts the rotor conductors which, as yet are stationary. Due to relative speed between the rotating flux and stationary conductors an e.m.f. is induced in the rotor conductors, according to faraday's law of electro-magnetic induction. The frequency of the induced e.m.f is the same as the supply frequency. Its magnitude is proportional to the relative velocity between the flux and conductor and its direction is given by Fleming's right-hand rule. Since the rotor bars or conductors form a closed circuit, rotor current is produced whose direction, as given as Lenz's law, in such as to oppose the very cause producing it. In this case, the cause which produce the rotor current is the relative velocity between rotating flux of the stator and stationary rotor conductor. Hence to reduce the relative speed, the rotor starts running in the same direction as that of the flux and tries to catch up with the rotating flux of all ac motors, the poly phase induction motor is the one which is extensively used for various kind of industrial drives.

Advantages:

- It has very simple and extremely rugged, almost unbreakable Construction (especiallysquirrel cage type)
- Its cost is low and its very reliable
- It has sufficiently high efficiency. In normal running condition, no brushes are needed, hence frictional losses are reduced. It has a reasonably good power factor.
- It requires minimum of maintenance
- It starts up from rest and need no extra starting motors.

Disadvantages:

- It speed cannot be varied without sacrificing some of its efficiency.
- Just like dc shunt motor, it speeds decrease with increase in load.
- Its starting torque is somewhat inferior to that of a shunt motor

13. (a) Explain the working principal of stepper motor with suitable sketches.

(Any one type)

(Diagram 7 marks, Explanation 7 marks)

Stepper motor is an electromagnetic energy conversion device that converts electrical pulse to discrete mechanical movements. These motors are also called step motor or stepping motor or stepper.

- Due to its nature of its working, it is primarily used for position control systems. A step in a Stepper motor is defined as the angular rotation produced by the shaft of the motor each time it receives a pulse
- Each step causes the shaft to rotate a definite number of degrees. The angle through which themotor shaft rotates for each command pulse is called the *step-*angle (β).

Step angle = 360^{o} / (No. of stator phases x No. of rotor teeth)

Based on the construction of the magnetic circuit there are three main types of motors:

- Permanent magnet (PM) stepper motor - High torque low angular resolution
- Variable reluctance (VR) stepper motor – Excellent angular resolution, low torque
- Hybrid (HY) stepper motor - combines structure of PM and VR steppers, provides good torqueand angular resolution

I. **<u>Permanent magnet (PM) stepper motor :</u>**

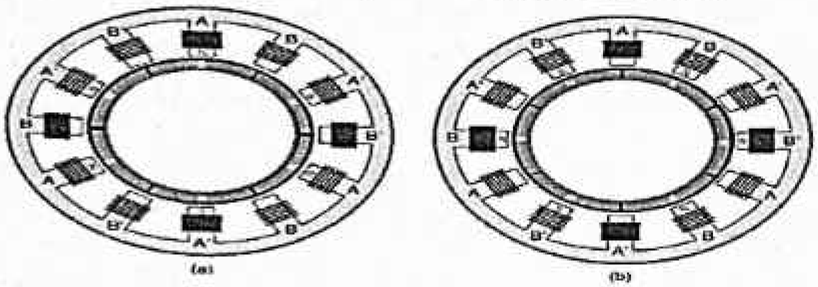
Construction

- It has wound stator poles and permanently magnetized rotor which is constructed in cylindrical Shape. Its direction of rotation depends on the polarity of stator current.

- The rotor is on the inside, with permanent magnets mounted on its perimeter. The stator is on theoutside, with electromagnets (called windings) inside slots. The controller energizes the windings with pulses of DC current.
- Many of the windings are connected together. Each group of connected windings forms a phase.

Working :

- The stator has 12 windings and its rotor has six magnets mounted on its perimeter. PM steppersare generally two-phase motors. In the figure, the different phases are denoted A and B.



- The windings labeled A' and B' receive the same current as those labeled A and B, but in theopposite direction.
- That is, if A behaves as a north pole, A' behaves as South Pole. Each winding has one of threestates: Positive current, negative current, and zero current.
- Here, positive current implies a north pole and negative current implies a south pole. Illustrates a single turn (30° rotation) of a PM stepper motor.
- In the windings, a small "N" implies that the winding behaves like a north pole due to positivecurrent. A small "S" implies that the winding behaves like a south pole due to negative current.
- If a winding doesn't have an N or S, it isn't receiving current. A is positive (North Pole), A' is negative (South Pole), and Phase B isn't energized.
- The rotor aligns itself so that its south poles are attracted to the A windings and its north polesare attracted to the A' windings.
- B is positive (North Pole), B' is negative (South Pole), and Phase A isn'tenergized.

II. Variable reluctance (VR) stepper motor

In a variable reluctance (VR) stepper motor, the rotor turns at a specific angle to minimize the reluctance between opposite windings in the stator.

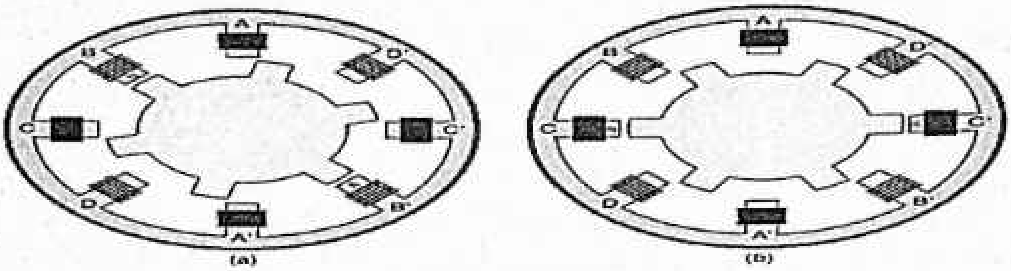
Construction:

- It has the wound stator same as that of permanent magnet type, but the rotor is non-magnetic.

- The rotor is made up of ferromagnetic material. When the stator pole is magnetized, the rotorteeth will align with the magnetized stator pole.
- It is called variable reluctance motor because the reluctance of the magnetic circuit formed by therotor and the stator teeth varies with the angular position of the rotor.

Working:

- When the controller energizes a second pair of windings, the rotor turns so that a different pair of teeth will be aligned. Because the teeth aren't magnetized, it doesn't matter whether a winding behaves as a north pole or as a south pole



- The controller has delivered current to the B and B' windings, and the rotor hasaligned itself accordingly.
- The C and C' windings are energized. The C and C' windings attract the nearestpair of teeth, which moves the rotor 15° in the clockwise direction.
- If we know the number of windings in the stator (N_W) and the number of teeth on the rotor (N_t),the step angle of a VR stepper can be computed with the following equation:

$$\text{Step angle} = 360^o \text{ X } [(N_W - N_t) / N_W N_t]$$

- The step angle can be computed as 360(2/48) =15°. The angular resolution can be improved by increasing the number of windings and teeth.
- With the right structure, the step angle can be made much less than that of a PM stepper. But the torque of a VR stepper is so low that it can't turn a significant load. For this reason, VR steppers are not commonly found in practical systems.

III. Hybrid (HY) stepper motor:

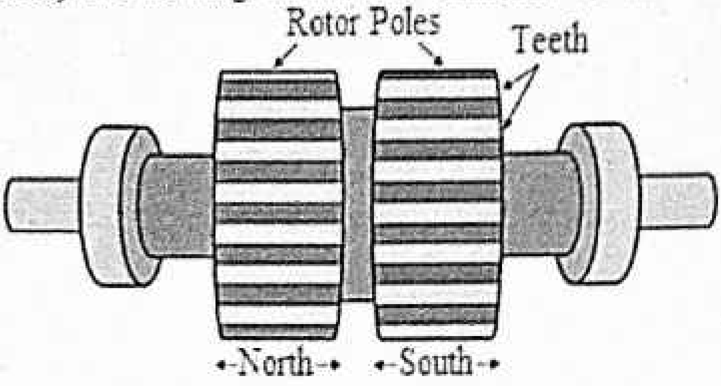
- Hybrid stepper motor combines features of both permanent magnet type as well as variablereluctance type motor.
- The rotor is of permanent magnet type and axially magnetized with radial soft iron teeth. It isbest suited when small step angles of 1.8°, 2.5° etc. are required.

Construction

Its rotors and stators are different from those of PM and VR steppers but the principle oftheir operation is similar.

Rotor

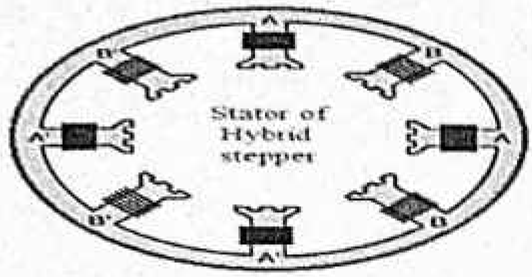
- If we compare the HY stepper to the PM stepper, the HY stepper is longer. The reason for this is that the HY stepper rotor has (at least) two rotating mechanisms connected to one another.



- The rotor poles are magnetized so that one behaves like a north pole and one behaves like a southpole.
- Each pole has its own teeth, and the teeth of one rotor pole are oriented between those of theother.
- The angular difference between the two sets of teeth determines the step angle of the motor.
- The more teeth the stepper has, the better the angular resolution. The rotor has onepair of rotor poles, but other HY steppers may have two, three, or more pairs.
- Adding rotor poles increases the stepper's rotational torque and holding torque, but alsoincreases its size and weight.

Stator

- The stator windings of a PM stepper or VR stepper are too large to attract/repel the teeth of onerotor pole without repelling or attracting the teeth of the other rotor pole.
- For this reason, the stator of an HY stepper has teeth that are approximately the same size as theteeth on the rotor.
- If a winding is energized to produce a north pole, its teeth will attract the teeth of the rotor'sSouth Pole.
- If a winding behaves as a south pole, its teeth will attract the teeth of the rotor's North Pole.



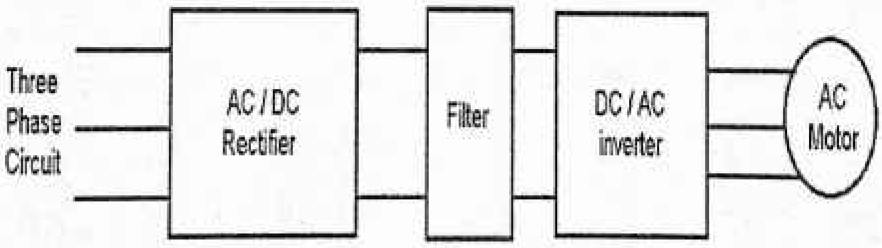
Working:

- Like a VR stepper, an HY stepper can have multiple phases, one for each pair of windings. Thewindings are divided into two phases: A/A' and B/B'. These are the phases labeled in Figure.
- Each phase receives positive current, negative current, and zero current. When one phase isenergized, its windings attract the teeth of one rotor pole.
- When the next phase is energized, its windings attract the teeth of the other rotor pole.
- Hybrid steppers commonly have 50–60 teeth on a rotor pole, which increases the angularresolution. It's common to see hybrid steppers with step angles as low as 1.8° and 0.9°.

(Or)

(b) Explain about the Variable Frequency Drive (VFD) with block diagram.
(Diagram 7 marks, Explanation 7 marks)

- VFD is power electronics based device which converts a basic fixed frequency, fixed voltagesine wave power (line power) to a variable frequency, variable output voltage used to control speed of induction motor(s).



- It regulates the speed of a three phase induction motor by controlling the frequency and voltageof the power supplied to the motor.

$$N_s = \frac{120f}{p}$$

- Since the number of pole is constant the speed Ns can be varied by continuously changingfrequency.
- A variable frequency drive (VFD) is an electronic device that controls the speed of an AC motor by adjusting the frequency and voltage of its power supply. VFDs are used to control the speed of motors that have varying loads, such as induction motors.
- **Adjustable speeds**

  VFDs can control the speed of the motor.
- **Soft start/stop**

  VFDs can control the ramp-up and ramp-down of the motor when it starts or stops.
- **Power conversion**

  VFDs convert incoming alternating current (AC) power to direct current (DC) using a rectifier.
- **DC bus**

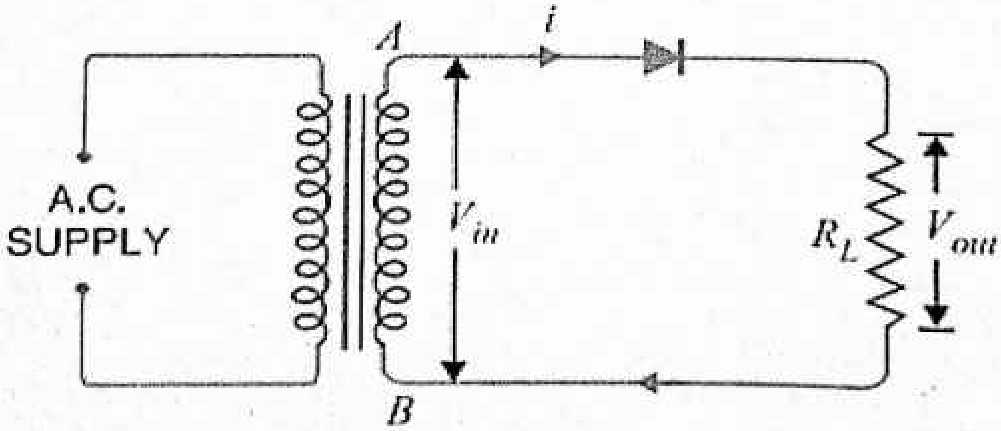
  The DC power is stored in a DC bus, where capacitors smooth out the energy flow.
- **Inverter**

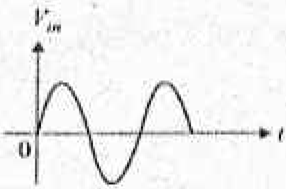
  The inverter converts the DC power back into AC, but with an adjustable frequency.
- **Pulse width modulated output**

  The inverter produces a pulse width modulated output that controls the motor's speed. VFDs have evolved into sophisticated microprocessor controllers that allow for efficient, Durable, and predictable operation.

14. (a) Explain the construction and working principle of half wave rectifier with neat diagram. (Diagram 7 marks, Explain 7 marks)

A half wave rectifier is an electronic circuit that rectifies only half cycle of the input A.Cwaveform. It is a simple circuit and cost effective.





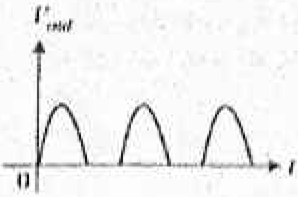


Figure shows the basic circuit of a half wave rectifier. It consists of a step down transformer, a diode D and a load resistance R_L which are connected in series. The A.C voltageto be rectified is applied to the input of the transformer primary winding. The transformer steps down the voltage. The step down voltage (Vin) which is available across secondary winding is applied to the diode and Load resistance R_L.

Operation:

When an A.C voltage is applied to the input circuit, the A.C voltage across the secondary winding AB changes its polarity after every half cycle.

During positive half cycle:

Terminal A is positive with respect to terminal B. This makes, anode of the diode positivewith respect to cathode. Hence the diode is forward biased and it conducts current. A current flows through terminal A, diode and Load resistance R_L and terminal B. Now there is a voltagedrop across load resistance R_L.

During negative half cycle:

Terminal A is negative with respect to terminal B. This makes, anode of the diode negative with respect to cathode. Hence the diode is reverse biased and it does not conduct current. Hence no voltage drop is available across load resistance R_L. Hence, when an AC voltage is applied to the input of the rectifier, only for the positive half cycle current flows through the diode and load resistance. Hence the output voltage (V_{out}) across Load resistance R_L contains only positive half cycle. It is called as a pulsating DC voltage. The pulsations in the output voltages are smoothened by the filter circuits. The input voltage, Output voltage and Load current wave forms are shown in the figure. Since only one half cycle of the input wave is used, it is called as a Half wave rectifier.

Advantages

1. Circuit is simple
2. Less cost

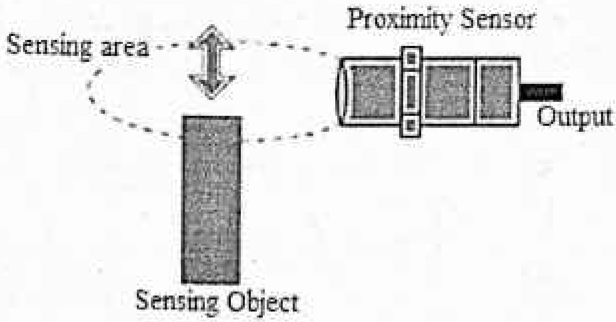
Disadvantages

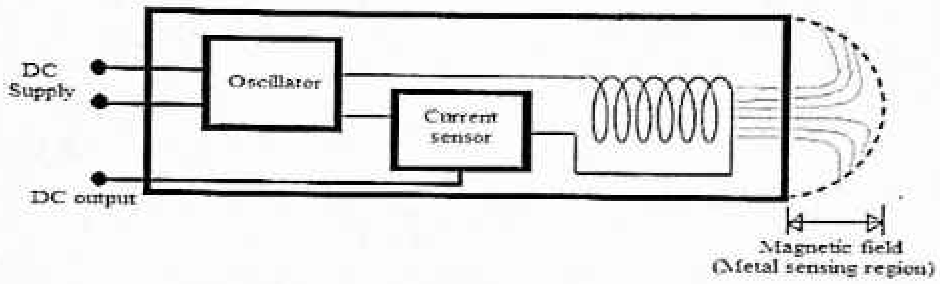
1. To produce pure D.C voltage, it requires complicated filter circuit
2. The AC supply delivers power only half cycle. Therefore, the output power is low.
3. Rectification Efficiency is Low. (40.6% only)

(Or)

(b) Explain the construction and working principle of Inductive proximity sensor with neat diagram. **(Diagram 7 marks, Explanation 7 marks)**

Inductive Proximity sensors basically convert movement of person or thing into electricalform without having any physical contact



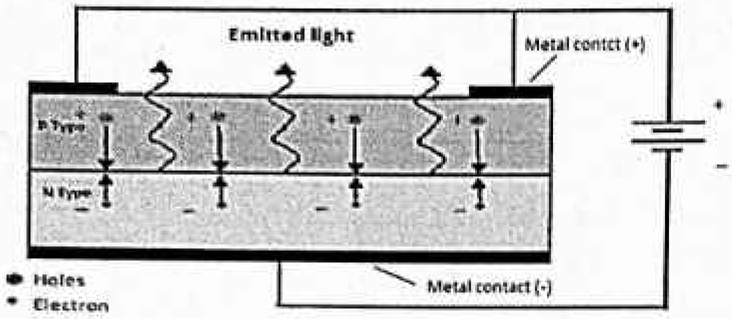


- Inductive type detects metallic objects such as aluminum, iron, copper and brass etc. Herecoupling condition of transformer is basically replaced by impedance change.
- This impedance change occurs due to eddy current losses. This impedance change is similar to inserting resistance in series with the object being sensed.
- Inductive type of proximity sensor which works on inductance principle. It is simple to make this type of sensor.
- There are four basic components needed viz. coil, oscillator, detection circuitry and output circuitry.
- Oscillator will produce fluctuating magnetic field around the coil. This coil is positioned near the device to be detected. Eddy current produced on the metal object reduce the sensor's ownoscillating fields.
- Detection circuit will monitor this strength of oscillator and will trigger the output when it goes below threshold.

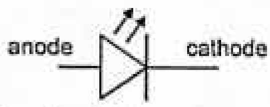
15. (a) Explain the construction and working principle of LED with neat diagram.
(Diagram 7 marks, Explanation 7 marks)

Construction:

The construction and symbol of LED is shown in Fig. In this diode, an N type layer is grown on a substrate. P type layer is deposited on N type layer by diffusion process. The metalanode connections are made at the outer edge of P layer. A metal film is applied to the bottom of the substrate for reflecting more visible light. Cathode connection is made to the metal film. LEDis always encased, in order to protect the wires.



Working:



It is a forward biased PN junction diode which emits visible light when energized. During forward biasing of PN junction, recombination of charge carrier takes place. During recombination, the electrons lying in the conduction band of N region move towards the holes lying in the valance band of P region. Due to this movement, the energy difference between conduction band electrons and valance band holes is dissipated in the form of light and heat. For semiconductor material of Si and Ge, more heat is dissipated than light. For semiconductor material like gallium arsenide, gallium phosphide, and gallium arsenic phosphide, more light is dissipated than heat. If the semiconductor material is transparent, light is emitted at the junction. The colour of the emitted light depends on the type of material as given below.

1. Ga As – infra red (invisible)
2. Ga P- red or green light
3. Ga As P – red or yellow light.

LED emits no light, when it is reverse biased.

Applications

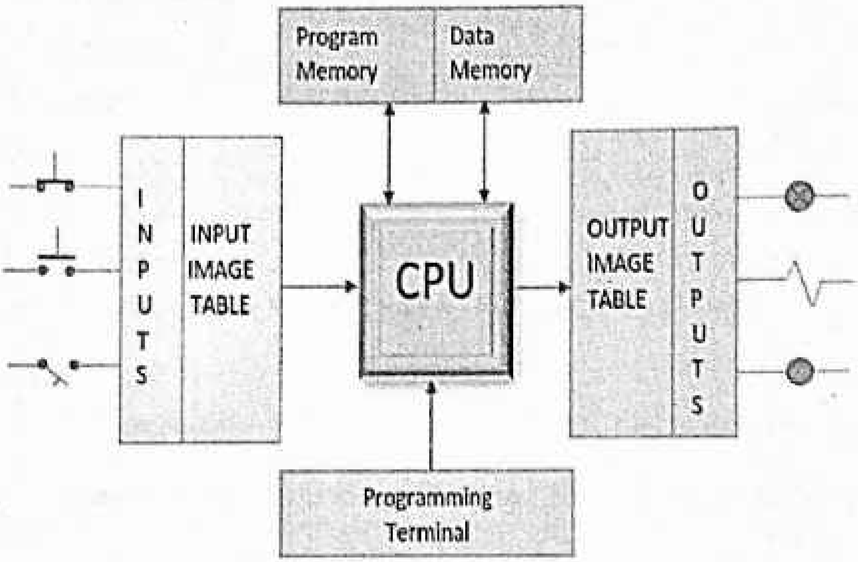
1. Used in burglar alarms
2. Used in televisions
3. Used in advertisement boards
4. Used in pocket calculators
5. Used in optical communication

(Or)

(b) Draw the block diagram of PLC and explain.

(Diagram 7 marks, Explanation 7 marks)

<u>Block diagram of PLC:</u>



A simplified block diagram of a PLC. It has three major units/sections.

1. I/O (Input / Output) Modules.
2. CPU (Central Processing Units).
3. Programmer/Monitor.

<u>I/O Section:</u>

➢ The I/O section establishes the interfacing between physical devices in the real world outside the PLC and the digital arena inside the PLC. The input module has bank of terminals for physically connecting input devices, like push buttons, limit switches etc. to a PLC.

- The role of an input module is to translate signals from input devices into a form that the PLC's CPU can understand.
- The Output module also has bank of terminals that physically connect output devices likesolenoids, motor starters, indicating lamps etc. to a PLC. The role of an output module is to translate signals from the PLC's CPU into a form that the output device can use.
- The tasks of the I/O section can be classified as:
    - Conditioning
    - Isolation
    - Termination
    - Indication

CPU Section:

The Central Processing Unit, the brain of the system is the control portion of the PLC. Ithas three Subparts.

- Memory System
- Processor
- Power Supply

Memory System:

The memory is the area of the CPU in which data and information is stored and retrieved.

The total memory area can be subdivided into the following four Sections.

I/O Image Memory

- The input image memory consists of memory locations used to hold the ON or OFF states ofeach input field devices, in the input status file.
- The output status file consists of memory locations that stores the ON or OFF states of hardware

  output devices in the field. Data is stored in the output status file as a result of solving userprogram and is waiting to be transferred to the output module's switching device.

Data Memory

It is used to store numerical data required in math calculation, bar code data etc.

- User Memory

  It contains user's application program.

- Executive Memory

It is used to store an executive program or system software. An operating system of the PLC is a special program that controls the action of CPU and consequently the execution of the user's program.

Processor:

The processor, the heart of CPU is the computerized part of the CPU in the form ofMicroprocessor / Micro controller chip.

- It reads the information. It stores this information in memory for later use.
- It carries out mathematical and logic operations as specified in application program. It sends data out to external devices like output module, so as to actuate field hardware.
- It performs peripheral and external device communication. It performs self-diagnostics.

Power Supply:

- The power supply provides power to memory system, processor and I/O Modules.
- It converts the higher level AC line Voltage to various operational DC values. for electronic circuitry.
- It filters and regulates the DC voltages to ensure proper computer operations.

Programmer/Monitor:

- The Programmer/Monitor (PM) is a device used to communicate with the circuits of the PLC.The programming unit allows the engineer/technicians to enter the edit the program to be executed.
- In its simplest form it can be hand-held device with membrane keypad for program entry and a display device (LED or LCD) for viewing program steps of functions.

K VEERAPATHIRAN. M.E
LECT/EEE
CSI POLYTECHNIC COLLEGE
SALEM-7