Ketaki Mahajan
Mketaki

Somaiya TRUST

Batch: PI-2 Roll No.: 16014022050
Experiment / assignment / tutorial No.: 1A2
Grade: AA / AB / BB / BC / CC / CD / DD
Signature of the Faculty In-Charge with date

1A2 EEEE

1. Write short notes on various switchgear like fuses, MCBs, ELCBs, CFLs and LED lamp used for domestic purposes.

Fuses -

Fuses are electrical devices used to protect the circuits from over-current and short-circuit. They consist of a metal wire or strip that melts when the current exceeds a certain limit, thus, breaking the circuit and preventing damage. Fuses are commonly used in domestic electrical installations to protect appliances and circuits.

MCBs -

Full form of MCBs is miniature circuit breakers. They have a built-in mechanism that trips the switch when the current exceeds a certain threshold, thereby disconnecting the circuit.

They are automated switches designed to protect electrical circuits from overcurrents and short circuits. MCBs offers the advantage of easy resetting after a fault, which eliminates the need to replace a fuse. They are commonly used in residential building for circuit protection.

ELCBs -

Full form of ELCBs are Earth leakage Circuit Breakers. They are designed as specialized safety devices to protect against electrical shocks caused by earth leakage or current imbalance. They detect even small leakage currents and quickly trip the circuit to prevent electric shock hazards. They are commonly used in areas where electrical equipment is likely to come into contact with water, such as bathrooms and kitchens. They provide an additional layer of protection in domestic electrical installations.

CFLs -
Full form of CFL is compact fluorescent lamps. They are energy efficient light bulbs that are commonly used as a replacement for traditional incandescent bulbs.
They use the fluorescent technology to produce light and consume significantly less electricity, while providing similar levels of brightness. They have longer life-span compared to incandescent bulbs and help reduced energy consumption and electricity bills.
However, CFLs contain a small amount of mercury, which requires a proper disposal to prevent environmental contamination.

LEDs -
Full form of LED is Light Emitting Diode. They are highly energy-efficient light solutions that have gained popularity in recent years. They ~~are~~ use light-emitting diodes to produce light and consume even less electricity than CFLs. They have a much longer lifespan than both incandescent bulbs and CFLs, which reduces the frequency of replacement.
They are available in various colours, offer instant illumination, and are environmentally friendly as they do not contain mercury.

2. Draw the internal construction of a three-phase induction motor and explain its working.

The internal construction of a three-phase induction motor consists of several key components:

(1). Stator -
It is the stationary part of the motor and is made up of

Kitaki Mahajan
Kitaki

Somaiya TRUST

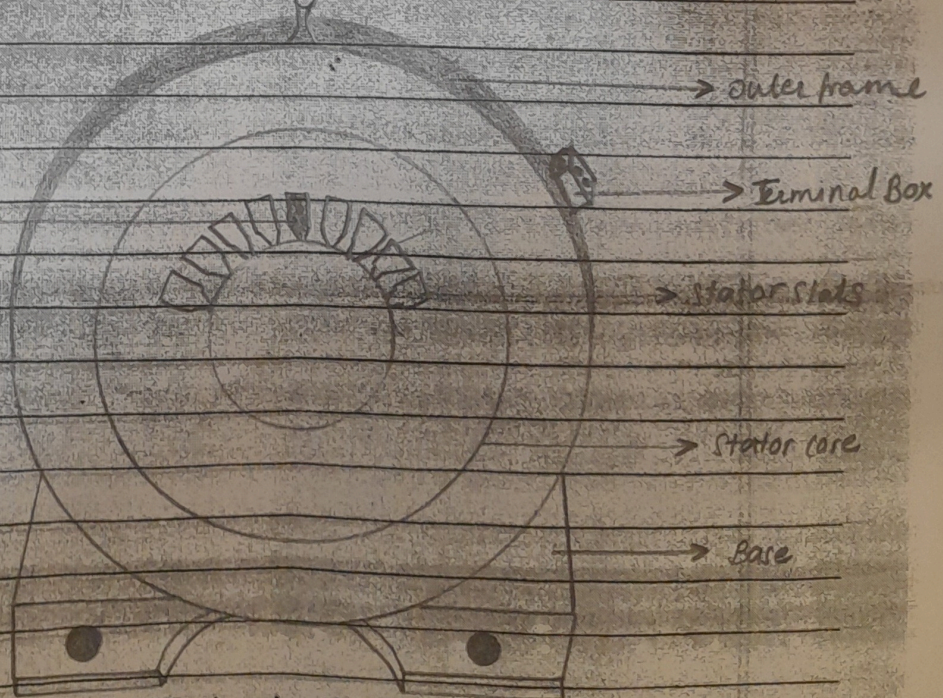
Batch: PI-2 Roll No.: 16014021050
Experiment / assignment / tutorial No. 1A2
Grade: AA / AB / BB / BC / CC / CD / DD
Signature of the Faculty In-Charge with date

a laminated iron core. It contains three sets of windings, usually spaced 120 degrees apart, known as the stator windings.

(ii). Rotor -
It is the rotating part of the motor and is also known made up of a laminated iron core. It can be of two types, squirrel cage rotor or wound rotor.

(iii). Stator windings -
It is connected to a three-phase AC power supply and generates a rotating magnetic field when energized. This rotating magnetic field induces currents in the rotor.

(iv). Rotor bars / coils -
They are shorted at both ends and are placed within the rotor slots. The rotor currents interact with the rotating magnetic field of the stator, producing torque and causing the rotor to rotate.



Working principle of a three-phase induction motor:

(i). When the three-phase power supply is connected to the stator winding, it creates a rotating magnetic field due to the phase displacement of the currents in the windings.

(ii). The rotating magnetic field induces currents, known as rotor currents, in the motor bars or coils. These currents flows in the rotor conductors and interact with the rotating magnetic field.

(iii). According to Lenz's law, the interaction between the rotor currents and the rotating magnetic field produces a torque that tries to bring the rotor into alignment with the stators magnetic field.

(iv). As a result, the rotor starts rotating and follows the rotating magnetic field at a slightly slower speed, known as the slip speed. The slip speed ensures that there is always a relative speed difference between the rotating magnetic field and the rotor allowing the production of torque.

(v). The torque produced by the interaction between the rotor currents and the rotating magnetic field drives the mechanical load connected to the motor shaft.

(vi). The speed at which the motor operates is determined by the frequency of the power supply and the number of poles in the motor. The synchronous speed (N_s) of a motor is given by the formula,

$$N_s = \frac{120 \times F}{P}$$

(where F = frequency of the power supply
P = no. of poles)

Ketaki Mahajan
11Ketaki

Somaiya TRUST

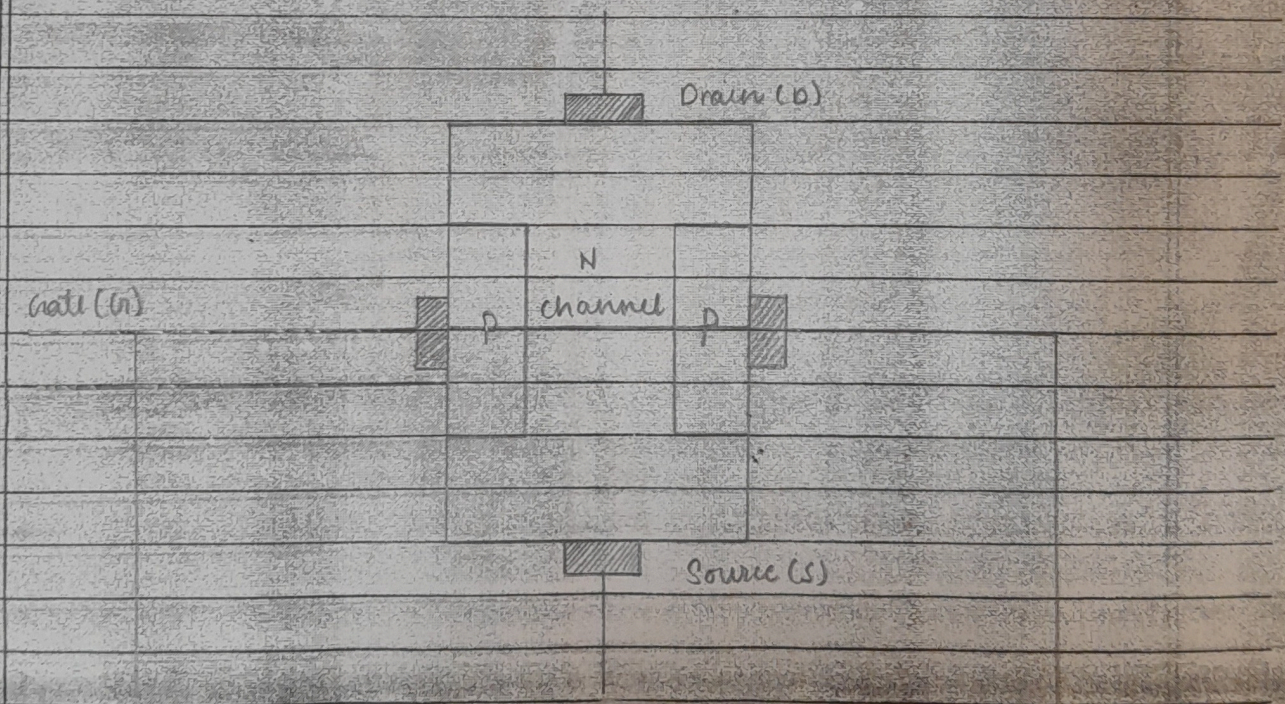
Batch: P1-2 Roll No.: 16014022050
Experiment / assignment / tutorial No.: 1A2
Grade: AA / AB / BB / BC / CC / CD / DD

Signature of the Faculty In-Charge with date

(viii) The difference between the synchronous speed and the actual rotor speed is known as slip. This slip is necessary for the motor to generate torque.

Overall, the three-phase induction motor operates on the principle of electromagnetic induction, where the rotating magnetic field created by the stator windings induces currents in the rotor, resulting in rotational motion and the generation of mechanical power.

3. With the help of a neat diagram, explain the principle, and working of N-channel JFET. Draw and explain its transfer and output characteristics.



An N-channel JFET is a three-terminal semiconductor device consisting of a doped N-type channel between two P-type regions. The two P-type regions are known as the "gate" and the N-type region is the "channel". The JFET operates based on the principle of controlling the current flow through the channel by varying the voltage applied to the gate terminal.

Working -

(i) When no external voltage is applied to the gate terminal ($V_{GS} = 0$), the JFET is in a "pinch off" state, and the channel is fully open, allowing current to flow freely from the source (S) to the drain (D) terminals.

(ii) As a negative voltage ($V_{GS} < 0$) is applied to the gate terminal with respect to the source terminal, it creates an electric field that repels the majority carriers (electrons) within the N-channel, narrowing the channels effective width.

(iii) As the gate voltage becomes more negative (V_{GS} decreases), ~~the electron~~ the depletion region widens, further restricting the flow of majority carriers through the channel. This reduces the current flowing from the source to the drain.

(iv) At a certain gate voltage (V_{GS} off), ~~,~~ is known as the "pinch off voltage", the channel is completely closed and no current flows between the source and the drain terminals.