DIGITAL ASSIGNMENT – 1

Course: Basic Electrical and Electronics Engineering

Course Code: EEE1001

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Slot: C2

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1. **Discuss the following:**

(i) Residential wiring

(ii) Earthing and Fuses

Ans. (i) Residential wiring:

CONNECTION USED:

The delta source connection is used when three single-phase circuits are to be obtained from a three-phase source. This conversion from three-phase to single-phase is required in residential wiring, because household lighting and appliances use single-phase power.

Electrical systems can seem like a confusing mess of wires, connections, and hidden boxes. If you use common sense and take the necessary precautions, you can easily and safely handle most home wiring projects. Working with electrical wiring can be intimidating because of the potential for serious injury.

PROCESS:

AC (Alternating Current) changes constantly from zero to120 volts and then back down to zero to minus 120 volts. This cycle repeats itself 60 times every second. In terms of your electric service, this is referred to as 120VAC 60Hz. The flow of electricity through a wire is comparable to the flow of water through a pipe. However, in order for electrical current to flow, a return path must be provided. Just as un-pressurized water is drained away from a house, current must flow back through a neutral wire, which carries no voltage. Just as pipe with a large diameter can carry a greater volume of water than a narrow pipe, a large wire can carry more current than a small wire. The amount of current flowing in a circuit is called amperage. Most household circuits have a capacity of either 15 or 20 amps.

Electricity travels at a rate that is close to the speed of light. No one has ever seen a volt or an amp, but when these forces interact, you can see their effect in a lit bulb.

The service head is used to anchor the three service wires to the home. From there, the wires are directed down to the electric meter. The wires from the service head are connected to an electric meter, which is usually mounted to the side of the house. It is used to register the consumption of electricity in kilowatt-hours. A kilowatt-hour equals 1,000 watts of electricity used per hour. The meter is owned by your local power company and is protected by law. Tampering with the meter is prohibited and punishable by law.

SERVICE HEAD

ELECTRIC METER

RESIDENTIAL WIRING VOLTAGE VARIATIONS:

Residential wiring uses a 120/240V, single phase, three-wire system.

Most homes in the United States have two hot wires and one neutral coming into them supplying a stated 240/120 volts. The actual voltage received is normally slightly less 230/115 volts. This type of power is commonly called single phased power. Most residential homes have this type of basic house wiring.

The power coming into our home is also called alternating current. Alternating current is used to allow electricity to be transported over long distances.

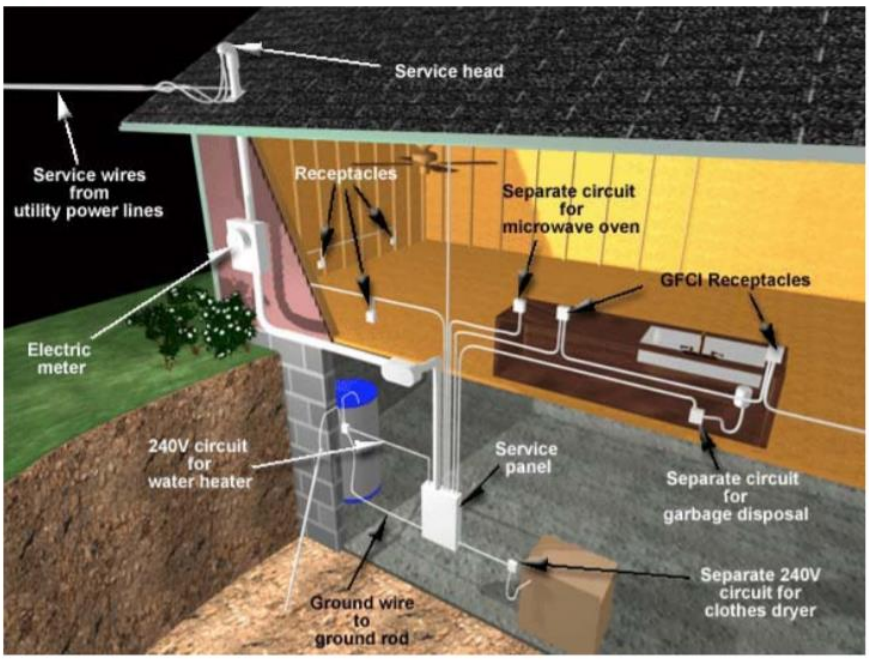
Most household lighting and appliances operate on 120-V, 60-Hz, single-phase alternating current in the United States.

Usually a line voltage of 12000V is stepped down to 120/240V with the help of a step-down transformer. The three wires coming from the transformer are typically coloured red (hot), black (hot), and white (neutral).

Since most appliances are designed to operate with 120 V, the lighting and appliances are connected to the 120V lines for a room. All appliances are connected in parallel. Heavy appliances that consume large currents, such as air conditioners, dishwashers, ovens, and laundry machines, are connected to the 240-V power line.

When you use one hot wire and the neutral you get 115 volt power. Most small electrical devices and lights run on this current. Heavy duty items like ranges, hot water tanks and dryers use both hot wires and the neutral to achieve 230 volts.

The ground wire does not carry power like the neutral wire but enables appliances to have a separate ground connection.



Residential Electrical System

PRECAUTIONS:

Because of the dangers of electricity, house wiring is carefully regulated by a code drawn by local ordinances and by the National Electrical Code (NEC).

NEC (National Electrical Code):

The NEC is designed to protect property and people from electrical hazards and it covers the installation of electrical wiring and equipment in residential and commercial properties. Where any state or local government adopts the NEC, it becomes the law. The NEC is adopted and enforced in each of the 50 states. In Canada, the Canadian Electrical Code sets the guidelines for electrical wiring, but there are only very small differences between the two. Local electrical codes conform to the national guidelines. Local codes govern the size and type of electrical equipment as well as the methods used for installation. Before you begin a project, you should check with the local building authority to see if a permit is necessary. All codes are enforced to protect you from injury and property loss.

To avoid electric shock, the best way is to follow safety guidelines concerning electrical systems and appliances. Some of them are given below:

- Use safety devices when necessary, and wear suitable clothing like gloves, insulated shoes, etc.
- Never use two hands when testing high-voltage circuits, since the current through one hand to the other hand has a direct path through your chest and heart.
- Never assume that an electrical circuit is dead. Always check to be sure.

- Do not touch an electrical appliance when you are wet. Recall that water is a good conductor of electricity.
- Always have another person present Mwhen working on a wiring system, just in case of an accident.
- Be extremely careful while working with electronic appliances such as TV and radio as they have large capacitors in them. After the power is disconnected, the capacitors take time to discharge.

Ans. (ii) Earthing and Fuses:

SERVICE PANEL:

The service panel, also known as a fuse box or breaker box, is where power is distributed to individual circuits throughout the house. A circuit breaker or fuse is used to protect each circuit by opening it in the event of a short circuit or an overload. Each breaker or fuse should be identified so you can tell which circuit it protects. This makes it easier to shut off an individual circuit while repairs or modifications take place.

SERVICE PANEL

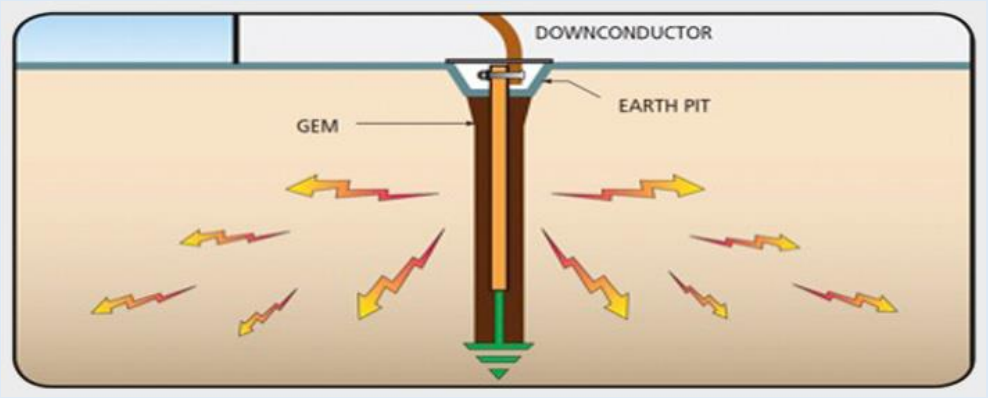
FUSE V/S EARTHING:

A fuse interrupts an excessive current so that further damage by overheating or fire is prevented. Wiring regulations often define a maximum fuse current rating for particular circuits. Overcurrent protection devices are essential in electrical systems to limit threats to human life and property damage.

However, one could easily be electrocuted *without* tripping a breaker or blowing a fuse. Thus, earthing a metal appliance, enclosure, plumbing, etc. prevents potentially lethal voltages from developing on these conductors.

WHY EARTHING IS NECESSARY?

The necessity for earthing is to ensure that the metalwork of electrical equipment, other than current carrying parts, cannot have a potential above earth in the event of a fault which might otherwise cause danger of an electric shock. If a fault is developed, causing unearthed metalwork of a piece of electrical equipment; it is charged to a level of dangerous potential. Any person touching the metal & at the same time comes in contact with earth will receive a severe electric shock. Had the metal been effectively earthed, the very low resistance of the circuit would result in a flow of current sufficient to blow the Fuse or to operate the protective device. In an earth, metalwork of a piece of electrical equipment becomes a zero potential and due to this a person does not get a shock.



PROCESS:

- A pit is dug in the ground.
- A copper plate or G.I. plate is buried vertically in the pit.
- An earth wire is bolted to the earth wire the help of nut, bolt & washer.
- The earth wire & the nut, bolts & washer should be of the same metal that of the plate used.
- A thick layer of salt & charcoal is placed around the earth plate, so as to reduce the earth resistance & to maintain dampness. A G.I.
- Pipe is fitted over the plate.
- A funnel with a wire mesh cover is placed at the top of the pipe, & the whole arrangement is covered with a cast iron cover.
- In order to maintain the moistness around the earth plate, 3 or 4 buckets of water are poured in the pipe through the funnel.

FUSE:

A Fuse is a safety device. It is connected in series with the circuit & protects the electrical apparatus & equipment's from damage, when excess current flows. There are several types of fuses used in electrical field, but the KitKat type fuse is commonly used in domestic installation. The fuse-base consist of a porcelain or polycarbonate material plastics. Base having silvered heavy brass terminals. The incoming & outgoing positive wire is connected to these terminals. Inside the fuse, carrier two contact terminals are provided. Fuse camera is made up of porcelain or polycarbonate material. It has two brass fuse carrier terminals, having a screw for connecting a fuse element. In modern type fuse, Base contact terminals are made of silver coated brass & fuse carrier also made

of tined copper & having a silver fuse. While specifying fuses in general, their type, current capacity & working voltage also should be specified.

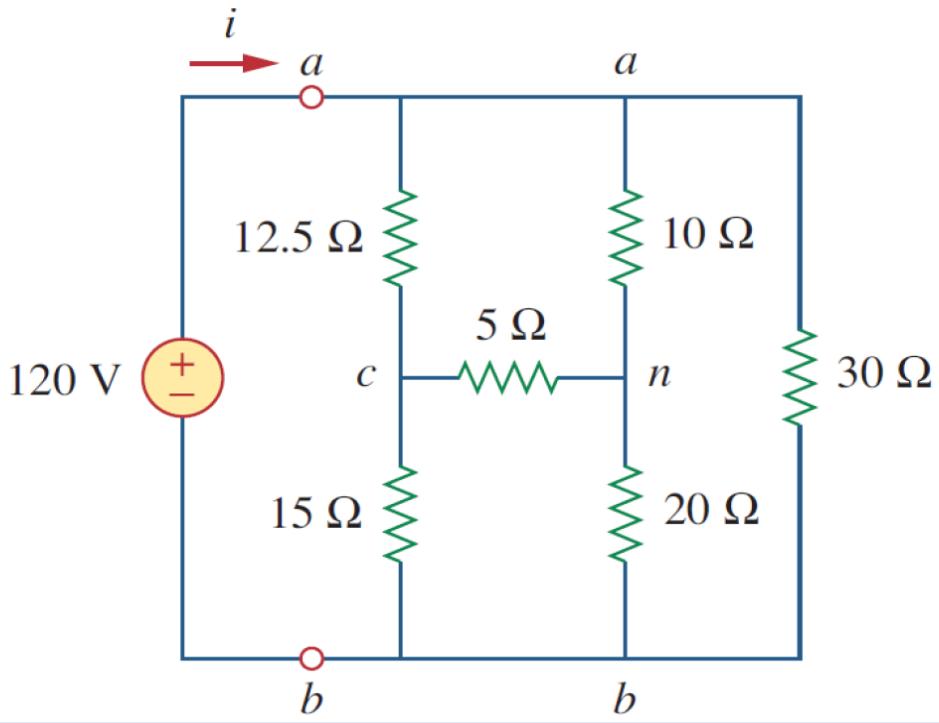
FUSE

A fuse is a safety device used for the purpose of protecting a circuit against excess current. In the event of excessive current, the fuse element melts & open up the circuit there by protecting it from damage.

The fuses can interrupt automatically a circuit with an over current in it for a fixed time. They are mainly used to against the short-circuits. They limit the peak value of the fault current.

During normal operations fuse element acts as a conductor and it provides complete path of current. When a short circuit occurs the current flowing through fuse increases sharply. This causes the heating of the fuse element. Fuse element has a low melting point so that it melts at a lower temperature than that of ordinary conductor, when the heat caused by the short circuit current reaches the melting point of the fuse element the element melts & opens the circuit.

2. Find the resistance between the terminals a and b using wye-delta conversion technique and find the current "*i*".



Applying Wye to Delta conversion at 'n' :-

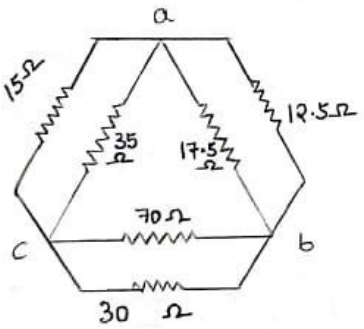
$$R_{ab} = \frac{R_{an}R_{bn} + R_{bn}R_{cn} + R_{cn}R_{an}}{R_{bn}}$$

$$R_{bc} = \frac{R_{an}R_{bn} + R_{bn}R_{cn} + R_{cn}R_{an}}{R_{cn}}$$

$$R_{ca} = \frac{R_{an}R_{bn} + R_{bn}R_{cn} + R_{cn}R_{an}}{R_{an}}$$

$R_{an}R_{bn} + R_{bn}R_{cn} + R_{cn}R_{an} = 10\times20 + 20\times5 + 5\times10 = 350\,\Omega$

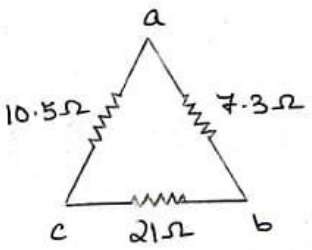
$R_a = 17.5\,\Omega$; $R_b = 70\,\Omega$; $R_c = 35\,\Omega$



$$R_{ab} = \frac{17.5\times12.5}{17.5+12.5} = 7.29 \approx 7.3\,\Omega$$

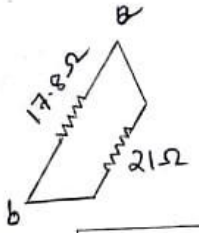
$$R_{bc} = \frac{70\times30}{70+30} = 21\,\Omega$$

$$R_{ca} = \frac{35\times15}{35+15} = 10.5\,\Omega$$



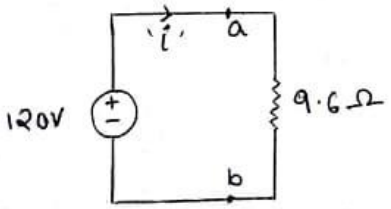
(R_{ab} & R_{ca} are in series)

$\Longrightarrow$ $(10.5 + 7.3 = 17.8\,\Omega)$



$$R_{eq} = \frac{21\times17.8}{21+17.8}$$

$R_{eq} = 9.63\,\Omega$



$$i = \frac{V}{R_{eq}} = \frac{120}{9.63}$$

$\boxed{i = 12.46\,A}$