

B.Tech First Year: Regular Course Lecture Plan Session 2022-23

Subject Name		Electrical Engineering	
Unit No.	Unit Name	Syllabus Topics	Lecture No
4	Electrical Machines	DC machines:Principle & Construction	27
		DC Generator-e.m.f equation,types ,applications	28
		DC Motor- Working,torque equation,back e.m.f	29
		DC Motor- Types, characteristics of series and shunt motors ,applications.	30
		Three Phase Induction Motor:Construction and working	31
		Slip, Slip-torque characteristics of three phase induction motor	32,33
		Single Phase Induction motor - Working & starting	34,35
5	Electrical Installation	Synchronous motor - starting and working	36
		LT Switchgears : Switch Fuse Unit (SFU), MCB	37
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Signature	
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UNIVERSITY OF MACHILIPATNAM
COLLEGE OF ENGINEERING
TECHNICAL DRAWING

ELECTRICAL INSTALLER

LISWICH FUSE UNIT (SFU) AKTU (20-21, 19-20, 18-19)

Ques.: What is SFU (switched fuse unit)? State its advantage.

Ans: A fuse is a protective device which disconnects the circuit quickly. In abnormal condition, it blows and disconnects the circuit from the supply. Thus, it provides circuit protection by destroying itself. It is used to isolate the circuit from the main supply. Generally, fuses are made of tin, lead, zinc, copper, silver, etc.

* A Switch is used for repair and maintenance. It is manually operated. It consists of the combination of Fuse Unit which consists of the Switch and Fuse. The unit which connects the two is called Switch Fuse Unit.

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Explains the Working of Fuses & BREAKER (MCB) (19-20, 20-21)

2. **MINIATURE** Breaker is an electromechanical circuit breaker which breaks the circuit

A switch which makes when it opens the circuit and device operation and it is when current exceeds

"normal" or "normal load" were ...
under the value of fault capacity "current limiting".

* MCB is a high voltage circuit breaker device which provides protection against overcurrent and short circuit.

B.Tech I Year prerequisites [Subject Name: Electrical Engineering]

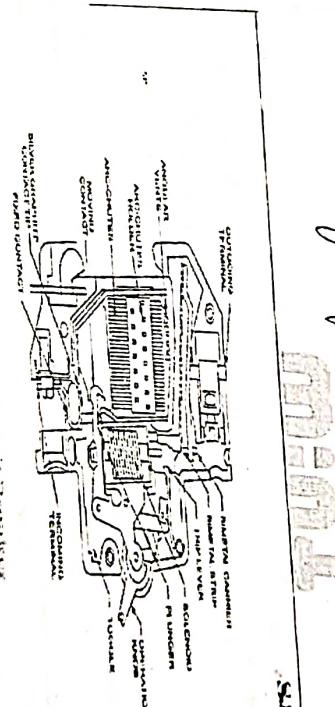
It is necessary to use MCB because of its following features:

- (i) Its operation is very fast and opens in less than one millisecond.
- (ii) One trippping circuit is necessary and the operation is automatic.
- (iii) It provides protection against overload & short ckt without noise, smoke or flame.
- (iv) It can reset very quickly after correcting the fault, just by sustailing a fault persists.
- (v) No rewiring is required if fault occurs more than one at same time.
- (vi) The mechanical life is upto 1000 operating cycle.
- (vii) The current Rating of MCB is from 0.5 A to 63 A.

MCB

ques: Compare MCB with Fuse

Ans: MCB disconnects instantly whereas Fuse disconnects slowly.



QUESTION: COMPARE MCB with FUSE.
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MCB

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* If the fuse wire after short circuit is replaced with a newer one but go loose then it may be dangerous. Also to replace a blown fuse in low current carrying points is dangerous especially in dark.

* During replacement of fuse wire, the exact type of fuse wire may not be available. Also for replacement, a kit of hand tools has to be kept ready.

* Restoring the power supply after tripping due to overload or short circuit is easy.

* NO maintenance & repairs are req. for MCB.

3. MOULDED CASE CIRCUIT BREAKER (MCCB)

Ques: Explain the construction and working of Mcc B.

Ans MCC B is similar to MCB but used when the load currents exceeds the capabilities of MCB.

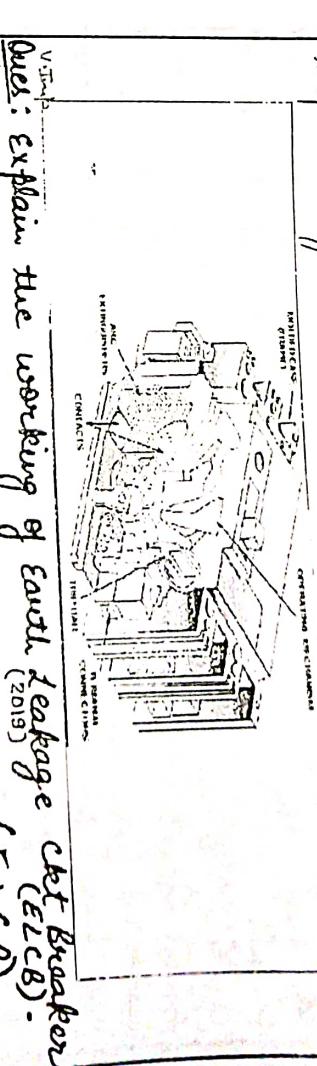
It is used for circuit having current ranges from 63 A to 3000A.

* Its working is based on thermal mechanism. It has a bimetallic contacts which expands & contracts when these are changed in temperature. Under normal condition, the contacts are closed allowing the current to pass. If conditions current exceeds the safe values are opened to interrupt generated and contacts are closed.

* Due to interruption of high current, arc extinguisher are formed. To suppress this arc, arc extinguisher are used.

B.Tech I Year Prerequisites [Subject Name: Electrical Engineering]
With the help of

* There is a disconnect switch which can be operated manually. Hence practically, it has adjustable trip settings & hence it can be used for high current fault after it is overcurrent. All the operating parts of MCCB are two halves & they are joined to form a stable structure. Practically, MCCB can be operated manually & hence it has adjustable trip settings & hence it can be used for main feeder protection, generator protection, motor protection, capacitor bank protection, welding applications & applications requiring adjustable trip setting.

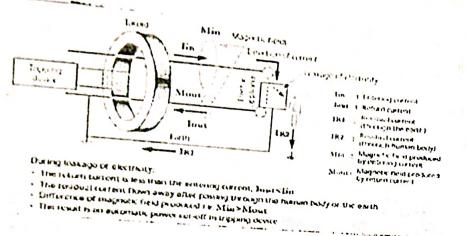


4. EARTH LEAKAGE CIRCUIT BREAKER (ELCB)

Ques: Explain the working of Earth Leakage Ckt Breaker (ELCB).

ELCB is used to protect the circuit from the electrical leakage. When someone gets an electric shock, then this circuit breaker cuts off the power at the same time of 0.1 sec for protecting the personal safety & avoiding the gear from the shock against short ckt and overload.

Prerequisites [Subject Name: Electrical Engineering]



ELCB consists of a small current transformer surrounding live and neutral wire. The secondary winding of CT is connected to relay circuit which can trip the ckt breaker which is connected in the circuit.

Under normal conditions, the current in the line and neutral conductor is same so that net current ($I_L - I_N$) through the core is zero. So, no flux production in core & no induced E.M.F. \therefore ckt breaker does not trip.

If there is a fault due to leakage from live wire to earth or a person by mistake touching to the live terminal, then net current flowing to the core will not be zero but equal to ($I = I_L - I_N$) which sets up the flux & E.M.F in CT.

As per the preset value, the unbalance in the current is detected by C.T. and relay coil is energized which will give up tripping signal for the ckt breaker to break the circuit to reduce the risk of electrocution.

B. Tech I Year [Subject Name: Fund. Of Electrical Engineering]

AIR CIRCUIT BREAKER

In air circuit breaker (ACB) is an automatically operated electrical switch that uses air to protect an electrical circuit from damage caused by excess current from an overload or short circuit.

Its primary function is to interrupt current flow after a fault is detected. When this happens, an arc will appear between the contacts that have broken the circuit. Air circuit breakers use compressed air to blow out the arc or alternatively, the contacts are rapidly being into a small sealed chamber, the escaping of the displacing air thus blowing out the arc.

Types of Air circuit breakers

1. Plain Air circuit breaker

2. Air blast circuit breaker

TYPES OF WIRES :

Ques: Explain various types of wires used in electrical installation.

Ans: Vulcanised India Rubber wire (V.R.R.)

- * It consists of turned conductor coated with protective cotton and is further covered with bitumen compound & finally finished with wax.
- * It makes it resistive and heat resistant.
- * It is available in single core only.
- * These wires are covered with cotton as it has tendency to absorb moisture & hence are rarely used, now a days.

Cat Type Sheathed Wire (C.T.S)

In this type, ordinary rubber insulated conductors are provided with an additional tough rubber sheath. It is also called Tough Rubber Sheathed (T.R.S) wire.

Provides additional insulation and along with that a protection against moisture, chemical fumes & wear and tear. Available in single core, double core & three core varieties.

B.Tech I Year Prerequisites [Subject Name: Electrical Engineering]
 B.Tech I Year Prerequisites [Subject Name: Electrical Engineering] (P.V.C.)

Polyvinyl Chloride Wires (P.V.C.)

3. Polyvinyl Chloride Wires with PVC insulation:

- * Last commonly used wires with moisture proof.
- * It is non-hygrosopic and durable.
- * It is tough and hence durable.
- * Resistant to corrosion.
- * It is chemically inert.
- * As it is tough, its additional covering is not required.

DISADVANTAGE:

- * It softens at high temperature & hence it is avoided where extremes of temp. may occur.
- * For eg. in heating appliances.

4. Flexible Wires

- * Used very commonly in domestic wiring.
- * It consists of two separately insulated conductors of insulation is usually rubber & more commonly available in parallel or twisted form.
- * Due to its flexible nature, the handling of these wires become very easy.

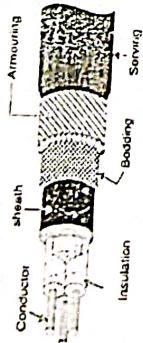
TYPES OF CABLES:

Ques: Explain the construction of single core underground cable. Ans: A.K.T.U (20-18-14), (20-21)

Ans: A.K.T.U (20-18-14), (20-21)

Ques: Underground cable is defined as the cable which are insulated and finely powdered

with number of layers of insulators to give proper mechanical support. Its various parts are :-



Conductors of Core: This section consists of single conductor or more than one conductor. The conductors are also called cores. Cables with three conductors used are aluminum or annealed copper. The conductors are stranded conductors in order to provide flexibility to the cable.

Insulation: Each conductor or core is covered by insulation of proper thickness. Commonly used insulating materials are varnished cambric or vulcanized bitumen and impregnated paper.

Metallic Sheath: The insulated conductors are covered by lead sheath or aluminum sheath. This provides mechanical protection and mainly sustains moisture and other gases to reach the insulation.

Bedding: Metallic sheath is covered by another layer called bedding. Bedding consists of paper tape compounded with a fibrous material like Jute. It is provided for the purpose of building is to strands or braids on metallic sheath from friction. This protects the mechanical injury resulting due to surrounding environment.

Bronze: Layer consists of the layer of aluminum and steel wires which provide protection to the cable from mechanical injury.

Screwing: The last layer of fibrous material like cotton is a layer which protects the entire cloth bunched the air and phenolic conductors. **Ans:** Based on Voltage level, the various types of cables are :-

1. **Low Tension Cable:** Used for 11 KV level & levels upto 6.6 KV.
2. **Medium Tension Cable:** Used for 22 KV and 33 KV are called Botted Cable.
3. **High Tension Cable:** Used for 22 KV and 33 KV levels. These are screened type cables & are further classified as -

H-Type Cables: i.e. separate lead screened cables -

4. Extra High Tension Cable: Used for voltage levels more than 33 KV. These are pressure cables which are further classified as -

1. Single Core Cable.
2. Two Core Cable.
3. Three Core Cable.

IMPORTANCE Of EARTHING

18-19)

Ques: What is earthing? Explain its importance.

Ans:

* The connection of electrical machinery to the general mass of earth, with a conducting material of very low resistance is called Earthing or Grounding.



IMPORTANCE OF EARTHING:

* Consider a machine which is not earthed. It is operated at supply voltage 'V'. If the outer part of the machine gets a person touches to the outer part of the machine insulation becomes zero. If a person touches to such a machine of perfect insulation he will not get a shock.

* But if there is some fault and insulation becomes weak or if one of the winding is touching to the cover of the machine, then insulation resistance becomes zero. If a person touches to such a machine current flows through the body of the person towards the earth. As body resistance is small, current through the body is high so that the person receives a shock.

* To avoid such a situation, the body of the m/c is connected to the earth with a very low resistance. This is called Earthing.

19-20

Ques: What is earthing? Explain its importance.

Ans:

- * If a machine is earthed and the person touches to a faulty machine then body resistance and earthing resistance appears to be in parallel.
- * Earthing resistance \ll Body resistance
- almost entire current flows through earth.
- connector and the person does not receive any shock.
- * Earthing is necessary for all domestic appliances, machines, tall buildings and structures, equipments, power stations etc.

TYPES OF EARTHING

PLATE EARTHING: A copper plate or galvanised plate is buried in an earth pit below ground level. The plate electrode connects the electrical conductors to the earth.

PIPE EARTHING: A galvanised steel perforated pipe inside the ground connects the electrical conductors to the earth.

ROD EARTHING: Similar to the pipe earthing. A Copper rod replaces the pipe electrode.

CHEMICAL EARTHING: Similar to the pipe earthing. A chemical compound material replaces the charcoal and salt layers.

Ques: Explain the plate earthing in detail.

Ans:

- * Earth connection is provided with the help of copper plate or Galvanised Iron (G.I) plate. The copper plate size is 60 cm * 60 cm * 3.18 mm while G.I. plate size is not less than 60 cm * 60 cm * 6.3 mm. The plate is embedded 3m (10 feet) into the ground & is kept with a vertical.

Lightning & Earthy Protection

For the protection of electrical substation or equipment of distribution from lightning surge, a properly installed Lightning Protection System is required.

Question-1 What are the components of Lightning Protection System?

↳ A properly installed lightning protection system will provide an enhanced grounding network for lightning's destruction, electricity as it is directed safely into the ground, leaving the building, occupant's & contents unharmed.

It consist of 4 key components:

* The terminals

* Conductors/ Banking

* Grounding

* Transient / Surge Protection.

"Lightning rods"; "Lightning rods"

↳ Air terminals, also known as lightning rods, are the top portion of the protection system. They make initial contact with the lightning.

↳ Conductors, conduct the lightning strike safely from the air terminals to the ground. Bonding reduces the potential difference between the lightning and the earth.

↳ Grounding, the most vital part of a lightning protection system. It is achieved when all equipment in a facility are connected to a common bus bar.

This rail itself is bonded to the external grounding system at one point only. This approach to bonding is utilized because it reduces AC impedance and DC resistance.

↳ Transient / Surge Protection, the final component of lightning protection system. This consists of lightning protection devices in all incorporating surge protection services.

Ques-2 What are the components of Lightning Protection System?

↳ A properly installed lightning protection system will provide an enhanced grounding network for lightning's destruction, electricity as it is directed safely into the ground, leaving the building, occupant's & contents unharmed.

Ques-3 What is the function of lightning protection system?

↳ A properly installed lightning protection system will provide an enhanced grounding network for lightning's destruction, electricity as it is directed safely into the ground, leaving the building, occupant's & contents unharmed.

Ques-4 What are the components of lightning protection system?

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Ques-5 What is the function of lightning protection system?

↳ A properly installed lightning protection system will provide an enhanced grounding network for lightning's destruction, electricity as it is directed safely into the ground, leaving the building, occupant's & contents unharmed.

Ques-6 What are the components of lightning protection system?

↳ A properly installed lightning protection system will provide an enhanced grounding network for lightning's destruction, electricity as it is directed safely into the ground, leaving the building, occupant's & contents unharmed.

Ques-7 What is the function of lightning protection system?

↳ A properly installed lightning protection system will provide an enhanced grounding network for lightning's destruction, electricity as it is directed safely into the ground, leaving the building, occupant's & contents unharmed.

Ques-8 What are the components of lightning protection system?

↳ A properly installed lightning protection system will provide an enhanced grounding network for lightning's destruction, electricity as it is directed safely into the ground, leaving the building, occupant's & contents unharmed.

Ques-9 What is the function of lightning protection system?

↳ A properly installed lightning protection system will provide an enhanced grounding network for lightning's destruction, electricity as it is directed safely into the ground, leaving the building, occupant's & contents unharmed.

Ques-10 What are the components of lightning protection system?

↳ A properly installed lightning protection system will provide an enhanced grounding network for lightning's destruction, electricity as it is directed safely into the ground, leaving the building, occupant's & contents unharmed.

- * Not suitable for heavy load applications since the discharge rate is very low in 9000.
 - * In general, these batteries are limited to specific applications.
 - Ex - Alkaline batteries, Mercury batteries, Silver-Oxide Batteries, Zinc Carbon batteries etc.
- An places where rocky soil earth lead exists.
In ordinary soil condition, the range of the earth resistance should be 2 to 5 ohms.
In rocky soil, earth resistance is from 5 to 8 ohms.

BATTERY

A device that converts the stored chemical energy into electrical energy using chemical action is called battery.

CLASSIFICATION OF BATTERIES : [V.T.M.P.]

COMPARISON B/w PRIMARY & SECONDARY BATTERIES

SECONDARY BATTERIES

- * Initial cost is high.
- * Cost per kWh is less.
- * As these batteries are rechargeable, regular maintenance is required.
- * Less suited for portable applications.
- * Most suitable for portable applications since it is smaller & light weight in nature.
- * Has poor charge maintenance - concave.

B.Tech I Year Prerequisites [Subject Name: Electrical Engineering]

- * Not suitable for heavy load applications due to its inferior discharge rate.
- * Due to inherent versatility, these batteries are used in most of the applications.
- Ex - Nickel Cadmium, Nickel batteries, Lead-acid batteries etc.

Mercury batteries, Silver-Oxide Batteries, Zinc Carbon batteries etc.

TYPES OF BATTERIES :

- Types of Battery
- Lead Acid Battery

APPLICATIONS

In automobile for starting and lighting, battery electric vehicles, back up operations like rail road signals, air traffic controls and critical system in submarines etc.

In railways for lighting & air conditioning systems, for starting engines and power supply in emergency power supply in military aeroplanes, helicots, in mobile cameras and photoflash & in electric shavers etc.

Cellular phones, portable computers and laptops, digital cameras, electronic toys etc.

3) NiMH Battery (Nickel Metal Hydride)

4) Lithium ion Battery

* Consumer products such as calculators, calculators, electronic scales, medical equipments, portable radios, in traction applications etc.

* UPS systems, telecommunications equipment, fire alarm and security system, solar batteries, emergency lights, office automated equipment etc.

5) SMF Battery (Sealed Maintenance Free)

<u>COMPARISON B/W THESE BATTERIES :</u>	
<u>Lead Acid</u>	<u>Nickel Cadmium</u>
Low internal resistance	Very low internal resistance
Nominal Battery voltage is 12 V.	Nominal Battery voltage is 3.2 - 37V.
charge & discharge cut off voltage are 1.2 V & 1.4V.	charge & discharge cut off voltage are 4.2 V & 2.5 V.
less maintenance required.	Moderate maintenance required.
efficiency is approx. 90%.	efficiency is approx. 90 - 95%.
Very high toxicity level.	low toxicity level.
thermally stable.	thermally stable
charging time of battery is 8-16 hrs.	charging time is 1-2 hrs

B.Tech I Year Prerequisites [Subject Name: Electrical Engineering]

IMPORTANT CHARACTERISTICS OF BATTERIES

Ques: Explain the important characteristics for batteries.

Ans: The various important characteristics of batteries are:

- 1) Nominal Voltage: It is indicated on a battery depending on the amount of cells connected in series. It is open circuit voltage of the battery.
- 2) Battery capacity or battery life: It is specified in ampere hours (AH). amount of electricity which a battery can deliver the specified discharge rate till its voltage falls to a specified value.

(Mathematically), the product of discharge current (I_D) in amperes and the time for discharge (T_D) in hours till voltage falls to a specified value is the capacity of a battery.

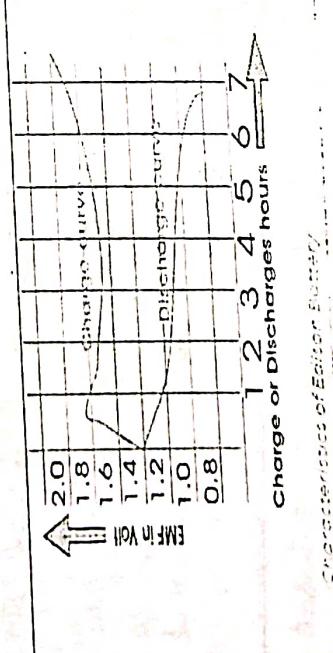
$$\text{Battery Capacity} = I_D \times T_D (\text{AH})$$

3) Specific gravity of electrolyte: more the specific gravity of electrolyte, more is the battery capacity.

4) Specific energy: The battery capacity expressed in weight per kg weight is called specific energy. It is also called gravimetric energy density of a battery.

5) Electrical characteristics: These characteristics include the charging and discharging curves for a battery. It is the graph of terminal voltage against charging and discharging time in hours at Normal rate.

- Ques: Draw the characteristics of battery.
- Ans: The emf of a fully charged Nickel-Iron Battery (2018-19) is 1.4 V. The average discharge voltage is about 1.2 V and the average charging voltage is about 1.7 V per cell.
- The voltage characteristics of the Nickel Iron battery are similar to that of the lead-acid cell. As the fully charged cell if 1.4 V and it slowly decreases to 1.3 V & then very slowly to 1.1 or 1.0 V during discharge.



- * The average time of charging of a battery is 7 hours and discharging time is 5 hours.
- * Another characteristic of Edison battery is that during operation at higher temperature, decreases the life of a battery. The same thing happens if the battery is charged for more than the average time of charging.
- The Ampere-Hour and Watt-Hour efficiency of nickel-iron battery is 85% and 60% respectively. At 4°C temperature, the capacity of Edison battery should be halved up before operation, though during operation heated up to 20°C keeps the battery hot and running the I^2R loss.
- 6) Battery Efficiency:** It is defined as the ratio of the output during discharging to the input required during charging, to regain the original state of battery.
- It is commonly called Ampere-Hours efficiency or Quantity efficiency & denoted as η_{AH} .
- 7. $\eta_{AH} = \frac{\text{Current} * \text{Time On Discharge}}{\text{Current} * \text{Time On Charge}} \times 100$**
- * For lead acid battery, it is about 80% to 90%.

Ques: Calculate the Backup of battery of 100 Ah connected to load of 100 Watts and supply voltage is 24V.

Soln:

$$\text{Battery Backup} = \frac{100 \text{ Ah} \times 12 \text{ V}}{100 \text{ Watt}} = 12 \text{ Hours}$$

Ques: An alkaline cell is discharged at a steady current of 4 Amperes for 12 hours, the average terminal voltage being 1.2 V. To restore it to original state of required, the average terminal voltage being 1.44V. Calculate Ampere hours and Watt-hour efficiencies.

$$\text{Soln: } I_D = 4 \text{ A}, T_D = 12 \text{ Hours}, V_d = 1.2 \text{ V} \quad \text{AKTU (2018-19)}$$

$$\eta_{A.H} = \frac{I_D \times T_D \times 100}{I_c \times T_c} = \frac{4 \times 12 \times 100}{3 \times 20} = 80\%$$

$$1. \eta_{W.H} = \frac{I_D \times T_D \times V_d}{I_c \times T_c \times V_c} = \frac{4 \times 12 \times 1.2}{3 \times 20 \times 1.44} = 66.66\%$$

Ques: Calculate the energy consumption per day in a house using 5 CFLs of 20W each, 3 fans of 60W each for 3 hrs a day. AKTU (2018-19)

$$\text{Soln: } \text{KWh} = \frac{(5 \times 20 \times 3) + (3 \times 60 \times 3)}{1000} = 0.84 \text{ KWh (Unit)}$$

B.Tech I Year Prerequisites [Subject Name: Electrical Engineering]

B.Tech I Year [Subject Name: Electrical Engineering]

Ques: What is Battery Backup? Explain its uses. AKTU (2018-19)

Ans: A Battery backup device is an electric device that supplies secondary power in the absence of main power. It can also protect electronic hardware from power spikes and fluctuations. The main battery backup device which is commonly used is called Uninterruptible Power Supply.

NEED OF UPS :

* Most of the systems operate on a.c supply. Thus a.c supply failure causes periodical stoppage of the various systems.

* Most of the modern systems are computers and microprocessors. Any interruption in the power supply may results into the loss of the work and may make system ineffective.

Many important places like hospitals, temples, playing grounds, banks etc. require continuous supply for their efficient operation.

To avoid all these adverse and serious situations, battery backup is necessary and is provided by using UPS.

BUSBAR

- ↳ Bushbars also referred as bus bar the fascinating feeds of engineering making complex power distribution simpler, more affordable and flexible.
- ↳ The main function of bushbars is to conduct a substantial current and are typically housed inside switchgear, panel boards.
- ↳ Rather than branching the main supply at one location, bushbars allow new circuits to branch off anywhere along the route of the busbar.
- ↳ It connects high voltage equipment at electrical switchboards, and low voltage equipment in battery bank.

Question :- How do Bushbars work ?

- ↳ Electrical Bushbars are conductors or a group of conductors used for collecting electric power from incoming feeders. From there, they distribute the power to the outgoing feeders. In layman's terms, it is type of electrical junction where all incoming and outgoing electrical currents meet.

Question :- What are the applications of bushbars ?

- ↳ Bushbar are produced in a variety of shapes, such as flat strips, solid bars, or rods. They are typically composed of copper, brass or aluminium. As solid or hollow tubes.
- ↳ We consider two types of bushbars - laminated and flexible.
 - * Laminated bushbars are widely used in following application :-
(i) Base station (ii) Power switch station systems (iii) Telephone exchange systems (iv) Cellular communication Systems.
 - * Flexible bushbars are used in :-
(i) Transformer and charging stations (ii) Electrical connection in switching cabinets (iii) Electric, Hybrid and Fuel cell Vehicles.

B. Tech I Year [Subject Name: F. of Electrical Engineering]

5 Years AKTU University Examination Questions		Unit-5	
S. No.	Questions	Session	Lecture No
1	Explain a) MCB b) ELCB c) MCCB.	2020-21 (odd)	37-40
2	Write full form of (i) MCB (ii) MCCB (iii) ELCB (iv) SFU.	2019-20 (odd)	37-40
3	Write short notes on the following: (a) MCB (b) MCCB (c) Fuse (d) Types of wires.	2018-19 (odd)	37-40
4	Explain different types of wires and cables.	2020-21 (odd)	37-40
5	Explain the requirement of earthing for electrical equipment. What is the difference between neutral and earthing?	2019-20 (odd)	37-40
6	Name the various cables used in electrical system based on insulation. Explain any two. What are the features of good conductor in electrical circuit?	2019-20 (odd)	37-40
7	Explain the construction, rating and specific applications of at least two types of wires and cables used in electrical engineering.	2018-19 (even)	37-40
8	Why Earth pin is made thicker and bigger than line and neutral?	2018-19 (odd)	37-40
9	Explain following: (i) Need of Earthing (ii) Battery backup	2018-19 (odd)	37-40
10	What is the difference between primary and secondary batteries?	2018-19 (even)	37-40
11	Describe electrical characteristics of Lead-Acid battery.	2018-19 (even)	37-40
12	What are the factors that affect the battery capacity?	2019-20 (odd)	37-40
13	Calculate the energy consumption per day in a house using 5 CFLs of 20 W each, 3 fans of 60 W each for 3 Hrs a day.	2018-19 (odd)	37-40
14	An alkaline cell is discharged at a steady current of 4 A for 12 hours, the average terminal voltage being 1.2 V. To restore it to original state of voltage, a steady current of 3 A for 20 hours is required, the average terminal voltage being 1.44 V. Calculate the ampere hour and watt-hour efficiencies in this particular case.	2019-20 (odd)	37-40
15	Draw the characteristics of battery. Calculate the backup of battery of 100AH connected to load of 100 watts and supply voltage is 12V.	2018-19 (odd)	37-40