



Registration No.....

School of Electrical Skills
First Semester, End Term Semester Examination
Summer Semester, B. Voc. Program, Session: 2017-18

Course Code: ELE1001

Time: 3 Hours

Course Name: Construction Electrician

Max. Marks: 100

Instructions: Answer all questions from section A, each question carries two marks. Answer any six questions from section B, each question carries five marks. Answer all questions from section C, each question carries ten marks.

Section – A

10x2=20 Marks

Q.1. (A) Two lamps (Bulbs) each rated at 100 W, 230 V are connected in series across 230 V, a.c. main. Each of the lamp will glow at:

- | | |
|---------------|---------------|
| (a) 50 Watts | (b) 100 Watts |
| (c) 200 Watts | (d) 25 Watts |

(B) Phase relationship between the applied voltage and the current flowing through the inductive circuit is:

- | | |
|-------------------------------|------------------------------------|
| (a) Current leads the voltage | (b) Voltage lags the current |
| (c) Current lags the voltage | (d) Current phase with the voltage |

Q.2. (A) Which of the following formulae is generally to calculate the impedance involving resistance and reactance?

- | | |
|----------------------------|------------------------------------|
| (a) $Z = \sqrt{R^2 + X^2}$ | (b) $Z = R^2 + X^2$ |
| (c) $Z = R + X$ | (d) $Z = \sqrt{(R^2 + X^2)^{1/2}}$ |

(B) A series R-L circuit has a resistance of 30 ohms and an inductive reactance of 40 ohms. The impedance is:

- | | |
|-------------|-------------|
| (a) 50 ohms | (b) 70 ohms |
| (c) 10 ohms | (d) 35 ohms |

Q.3. (A) If the supply frequency changes from 50Hz. to 100 Hz. keeping the voltage constant, the current flowing through the coil, having negligible resistance and high inductive reactance:

- | | |
|--------------------|--------------------|
| (a) Remains same | (b) become half |
| (c) Become doubled | (d) Become 4 times |

(B) The power consumed by the pure inductor is:

- | | |
|-------------|----------------|
| (a) 0 watt | (b) 1 watt |
| (c) 2 watts | (d) 4 watts tg |

Q.4. (A) A staircase point is operated with:

- | | |
|--------------------------------|--------------------------|
| (a) Two one-way switches | (b) Two two-way switched |
| (c) Two intermediated switches | (d) None of the above |

(B) What is the number of phases in a normal industrial supply system?

- (a) One
- (b) Three
- (c) Four
- (d) Two

Q.5. (A) The power consumed for a balanced load connected either in star or delta is:

- (a) $2 V_L I_L \cos \theta$
- (b) $\sqrt{3 V_P I_P} \cos \theta$
- (c) $3 V_P I_P \cos \theta$
- (d) $\sqrt{3} V_L I_L \cos \theta$

(B) AC volt meters and ammeters are normally calibrated in:

- (a) Average value
- (b) Instantaneous value
- (c) Peak value
- (d) r.m.s. value

Q.6. (A) A heater was short circuited heating element is tested with a series test lamp. The test lamp will:

- (a) Glow bright
- (b) Glow dim
- (c) Glow normally
- (d) not glow

(B) Which one of the following materials is not a conductor?

- (a) Aluminium
- (b) Copper
- (c) Porcelain
- (d) Silver

Q.7. (A) For a circuit rated for 5 amps, the correct tinned copper wire size will be:

- (a) 35 SWG
- (b) 36 SWG
- (c) 37 SWG
- (d) 38 SWG

(B) In the case of 3-pin sockets, the phase wire should be controlled through a switch and should be connected to terminal of the socket assuming earth point is at the top:

- (a) Right
- (b) Left
- (c) In any one side
- (d) None of these

Q.8. (A) Cells are connected in series to:

- (a) Increase the output voltage
- (b) Decrease the output voltage
- (c) Decrease the internal resistance
- (d) Increase the current capacity

(B) The initial function of choke in a tube light circuit is to....

- (a) Limit the starting current
- (b) Induce high voltage
- (c) Heat up the filament
- (d) Limit the current after starting

Q.9. (A) Because of the choke, the power factor of the tube lamp circuit is:

- (a) Unity
- (b) Leading
- (c) Lagging
- (d) Zero

(B) Which letters are used for the supply lines of a three-phase system? The individual lines are designated by:

- (a) A, B, C
- (b) Lower case letters a,b,c
- (c) Lower case letters d,e,f,
- (d) R, Y, B

Q.10. (A) If the power factor of a circuit is unity, its reactive power is:

- (a) Zero (b) Unity
(c) Maximum (d) Minimum

(B) Switch board is fixed at a height of:

- (a) 1.5 metres (b) 2 metres
(c) 4 metres (d) 3 metres

Section – B

6x5=30 Marks

Answer any six questions.

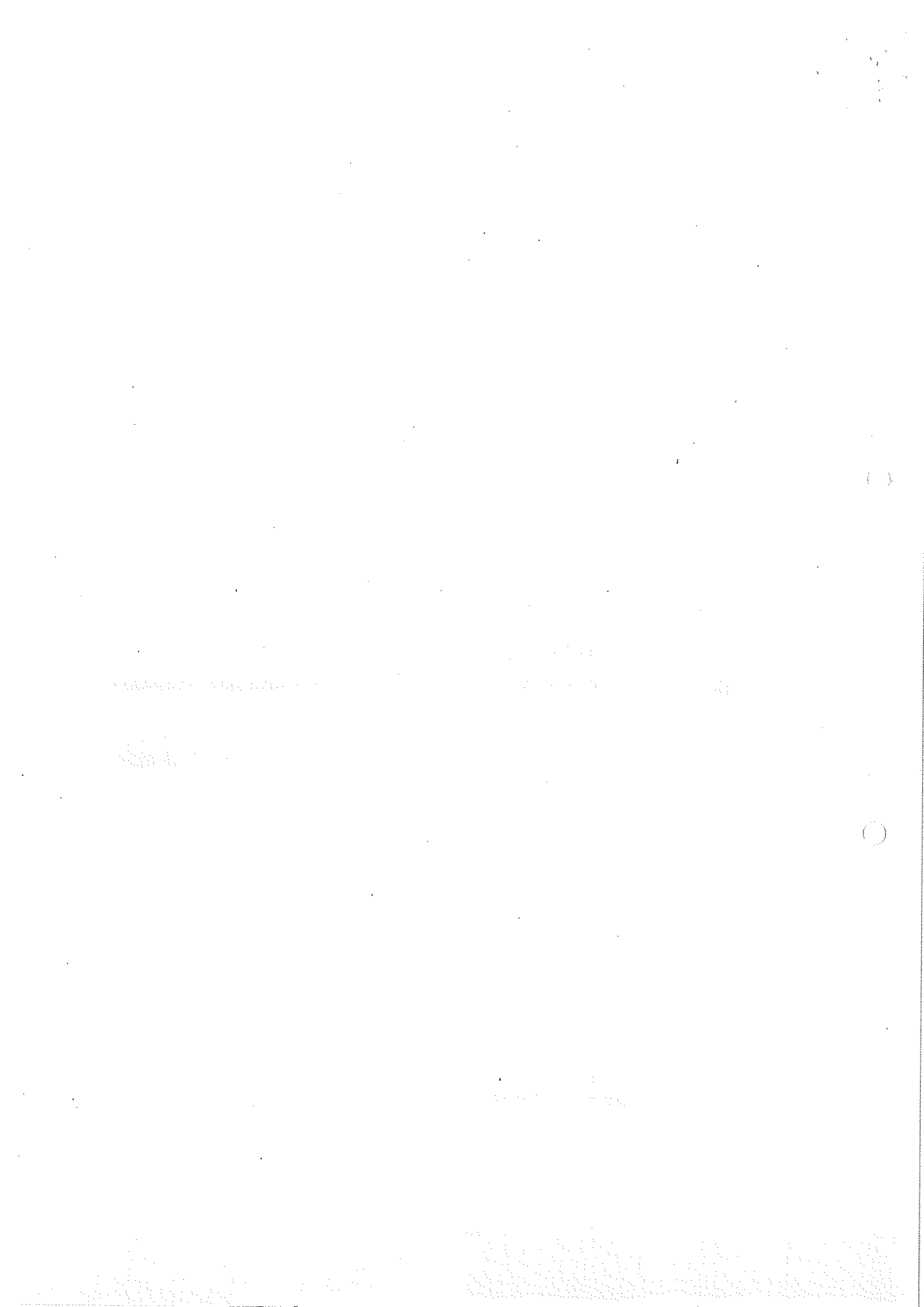
- Q.1. What are the advantages of earthing?
- Q.2. What do you understand by electrician's hand tools? Write the name of minimum ten electrician's hand tools.
- Q.3. What are the methods of extinguishing electrical fire? Which method is more suitable?
- Q.4. What safety precautions to be observed by an electrician during electrical work?
- Q.5. What do you mean by house wiring? Mention the types of house wiring?
- Q.6. What are the causes of (a) open circuit and (b) short circuit in the wiring installation?
- Q.7. What are low, medium, high and extra high voltage according to IE rules?
- Q.8. What are the tests that should be performed for new wiring installation before energizing the circuit?

Section – C

10x5=50 Marks

Answer all the questions.

- Q.1. What are the advantages and disadvantages of conduit wiring?
- Q.2. What is megger? What precautions must be taken before using a megger for installation test?
- Q.3. What damage can be caused if earthing is not done? Describe the method of measuring earthing resistance.
- Q.4. Draw the electrical circuit diagram of tube light circuit. Explain its working principle and function of all the components used in the circuit.
- Q.5. In the classroom, there are four lights of 25 watts and four ceiling fans of 75 watts are in operation for eight hours every day. Calculate (a) current drawn by these fixtures and (b) total energy consumption of one month.



Course code: ELE1001.

Course Name: Construction Electrician

Solution of question paper

Section - A

1. (A) → Ans. (a) → 1M
(B) → Ans. (c) → 1M
2. (A) → Ans. (a) → 1M
(B) → Ans. (a) → 1M
3. (A) → Ans. (c) → 1M
(B) → Ans. (a) → 1M
4. (A) → Ans. (b) → 1M
(B) → Ans. (b) → 1M
5. (A) → Ans. (d) → 1M
(B) → Ans. (d) → 1M
6. (A) → Ans. (a) → 1M
(B) → Ans. (c) → 1M
7. (A) → Ans. (a) → 1M
(B) → Ans. (a) → 1M
8. (A) → Ans. (a) → 1M
(B) → Ans. (b) → 1M
9. (A) → Ans. (c) → 1M
10. (A) → Ans. (d) → 1M
(B) → Ans. (a) → 1M

Section-B

Q1. Ans:

Earthing system makes the equipment electrically shock free and gives you a safe place to stay. Here are some advantages of earthing system.

(1). safety for human life, electrical device and buildings. —

(2M)
It saves the human life from the danger of electrical shock which can cause death, by blowing a fuse. It protects your electric equipment or devices.

(2) voltage stabilization: — In an electrical distribution system, earth is the omnipresent conductive surface, which makes it a universal standard for all electric system.

(3) over voltage protection: —

(2.5M)
Earthing system provides an alternative path in the electrical system to minimize the dangerous effect in the electrical system which happen at the time of lightning and unintentional contact with high voltage lines.

Electrician's hand tools are required to accomplish the electrical work.

Some of the electrician's hand tools are as follows: —

Hammer, wire strippers, pliers, Allen wrench set, knife, screwdrivers, wire cutters, Tester, Tape measure, Voltmeter, Flashlight, Torpedo level, Try square, Electric soldering iron,

ms: —

Different methods of extinguishing fire are as follows: —

- > Cooling the fuel by removing heat (e.g. by applying water)
- > ~~Some~~ smothering by cutting off oxygen supply (e.g. by applying foam, CO₂).
- > Starving the fire by removing the fuel. (e.g., stopping gas flow during a pipeline fire).
- > Inhibition by stopping the chain reaction (by applying dry chemical powder).

Types of extinguishers and the class of fire for which they can be used.

water	class A fire
Dry chemical powder	class B & class C fire
foam	class A & B fire
CO ₂	class B & C fire
Special dry powder	class D fire

the class

(1M) class 'C' method is most suitable method in fire extinguishing.

Q. 4 Aug:

Some safety precautions during electrical work are as follows: -

(i) Avoid contact with energized electrical ckt.

(ii) Disconnect the power source before servicing or repairing electrical equipment.

(iii) Use tools and equipment with

non-conducting handles when working³ on electrical devices.

(4) Never handle electrical equipment when hands, feet, or body are wet or perspiring, or when standing on a wet floor.

(3M) (5) Don't store highly flammable liquids near electrical equipment.

(6) Don't wear loose clothing or ties near electrical equipment.

(7) De-energize open experimental ckt's and equipment to be left unattended.

Q.5 Ans:

(2M) House wiring is defined as any wiring or electrical system used in a home or its surrounding areas. The wiring process is fairly time consuming and requires planning for the varying power needs of electronic and appliances.

The various types of house wiring are

1. cleat wiring.

2. C.T.S (T.R.S wiring)

3. Lead-sheathed wiring.

4. wooden casing and capping wiring

5. conduit wiring,

- (a) Surface conduit,
(b) Underground or concealed or recessed
Conduit.

(MS) Wooden casing and capping wiring is most commonly used for indoor and domestic installation.

Now a days P.V.C conduit pipes are used in workshops and public buildings.

B.G. Ans: -

(a) Ans:

An open circuit exists when there is a break or gap in the ckt.

open ckt's can be caused by one or more of the following.

- (MS) (2.5.8)
- (I) Broken wire
 - (II) Poor connection
 - (III) Loose terminal
 - (IV) Blown fuse
 - (V) Tripped circuit breaker
 - (VI) Faulty switch
 - (VII) ~~Blown globe~~

(b) Ans: A short ckt exists when the original path of current flow is ~~also~~ altered and a shorter than normal path for current flow exists.

4.
Causes of short circuits include the following

- (i) worn or damaged wiring insulation.
- (ii) wire squashed or jammed between components.
- (iii) Tools dropped across or accidental contact between positive and negative.
- (iv) Incorrectly connected ammeter.
- (v) Active wire incorrectly connected or joined to neutral position.

B.7. Ans:

○ According to I.E. rules: -

Low voltage: - where voltage doesn't exceed 240 volts under normal conditions, subject, however, to the percentage variation allowed by these rules.

Medium voltage: - where the voltage doesn't exceed 650 volts under normal conditions, subject, however, to the percentage variation allowed by these rules.

High voltage: - when the voltage doesn't exceed 22,000 volts under normal conditions, subject, however, to the percentage variation allowed by these rules.

Extra high: - when the voltage doesn't exceed 22 kV.

B.8. Ans:

'Megger' insulation tester is used for testing the installation of wiring.

Following tests are recommended for the installation as per Indian Electricity rule, 1956.

m T (1) Insulation or leakage test :- In this test the resistance between each conductor and earth is measured for determining the value of leakage current.

m T (2) Continuity or open test :- The test is for testing the continuity of the ckt/sub-ckt and load points.

~~(3) Short ckt test~~

m T (3) Polarity test :- This test is carried out to check whether live wire is in switch or not.

m T (4) Earthing system test :- Earth continuity test in outlets is also carried out with test lamp.

(m T) (5) Short ckt test :-

1. Ans:

Advantages: —

1. ~~It~~ conduits offer a high resistance against corrosion.
2. It is a durable and very popular system.
3. It is a water proof wiring system.
4. There are no chance of fire.
5. No risk of electrical shock.
6. It has a long life and it is durable.

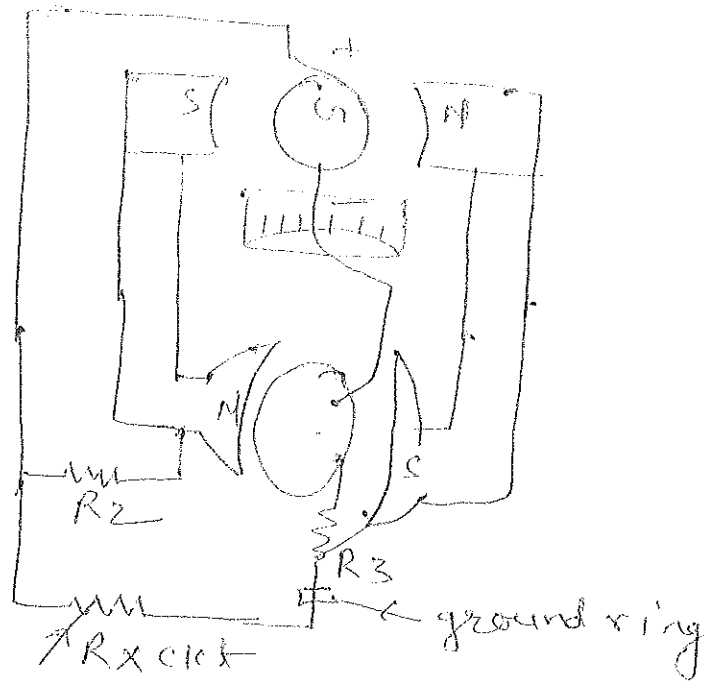
Disadvantages:

1. In case of ~~steel~~ conduit, it is expensive system compare to other wiring system.
2. In case of P.V.C. plastic conduit risk of mechanical injury is possible.
3. Time required is more ~~is~~ to install the wiring system.
4. Fault finding process is very difficult.
5. Wiring installation is difficult.

B.2 Ans:

Megger is an instrument used for measuring the resistance of electrical insulation. The megger is a portable instrument consisting of two primary elements:
(1) A hand-driven DC generator, which supply the high voltage for making the

(2) the instrument position, which indicates the value of resistance being measured.



(fig - A - megger internal circuit)

when megger used, the generator voltage is present on test leads. This voltage - could be hazardous to the equipment you are checking.

To use a megger to check wiring insulation connect one test lead to the insulation and other test lead to conductor, after isolating the wiring from equipment.

(4M) Megger safety precautions: —

when you use a megger, you could be injured or damage equipment you are working on if the following minimum safety precautions are not observed.

(1) use meggers on high-resistance measurement only (such as insulation measurement)

or to check two separate conductors on a cable.

- (ii) Never touch the test leads while the handle is being cranked.
- (iii) Deenergize and discharge the circuit completely before connecting a megger.
- (iv) Disconnect the item being checked from other circuitry, if possible, before using a megger.

Q.3 Ans: -

Earthing system makes the equipment shock free and gives you a safe place to stay. If proper earthing or earthing is not present in the system, it causes electrical shock & result in death of human life. It protects the electrical equipment or devices. If earthing is not done short circuit current damage of building occurs.

Method of earthing:

Method of earthing: -

- (1) Plate type earthing: - It consists a cast iron plate or a copper plate or galvanized iron plate. The plate is buried 8 feet into the ground with

bolt in a vertical position. These pits generally filled with layers of salt and charcoal up to 4 feet starting from bottom.

(2) Pipe type Earthing: -

(2M) Earthing pipes are also known as earthing electrode pipes, these can be used in homes, offices as well as power stations. Copper pipe is generally used in this type of earthing system; the pipe size depends upon the current to be carried and on soil type. Generally pipe used for this purpose is of 38mm diameter and 2.5m in length, buried in the earthing pit at that depth.

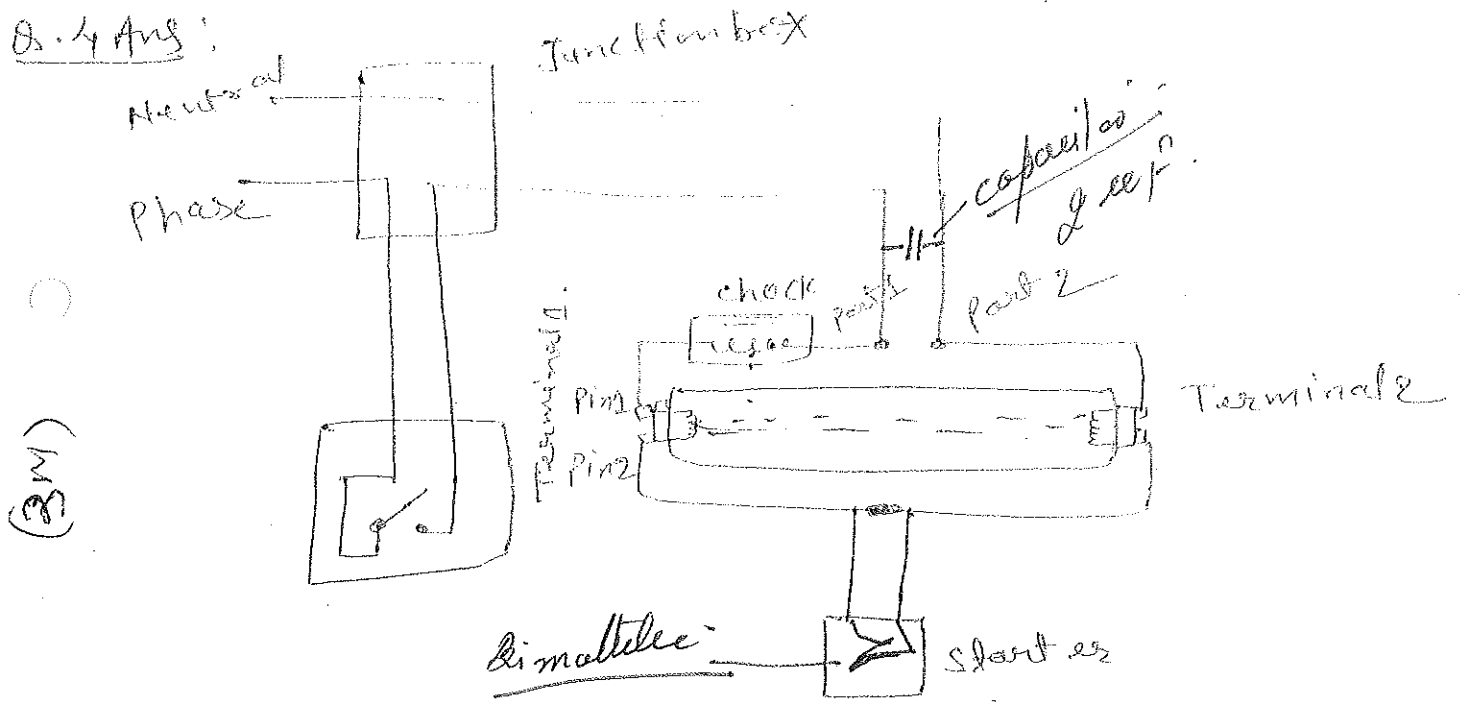
(3) Rod earthing: - It is same as pipe earthing. Rods can be of copper or galvanized iron. If you are using a copper rod, make sure the diameter of rod is 12.5mm and if you want to use a galvanized iron rod then diameter should be of 25mm.

(4) wire earthing: -

(1M) This type of earthing has strip electrodes of cross-section not less than 9.5mm x 1.6mm in case of copper and

25mm x 4mm of galvanized iron buried 7.5m into a horizontal pit of a minimum depth of 0.5m. this type of earthing is best in rocky soil as in these places it is difficult to do plate type earthing.

Q.4 Ans:



(fig: - wiring diagram of tube light)

The tube light or a fluorescent tube is a low pressure mercury-vapor gas-discharge lamp that uses fluorescence to produce visible light. An electrical current in the gas excites mercury vapor, which produces short-wave ultraviolet light that then causes a phosphor coating on the inside of the lamp to glow. A fluorescent lamp convert electrical energy in to useful light much more

efficiently than incandescent lamps.

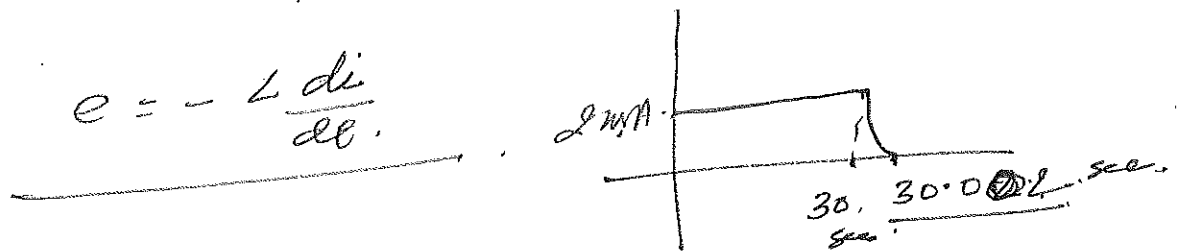
The tube light is not connected in the supply main directly. Although it operates at 230V, 50Hz, some auxiliary electrical components are used to insert in this installation to support the tube light operational principle. The component used in tube light are.

1. chock or ballast
2. starter
3. switch
4. wires.
- ⑤ capacitor

(4M)

Ballast electronic ballast converts power frequency to very high frequency to initialize gas discharge process in fluorescent lamp by controlling voltage across the lamp and current through the lamp.

The starter is a small neon glow up lamp that contains a fixed contact, a bimetallic strip and a small capacitor.



$$= -L \frac{(0 - 2 \text{ mA})}{30.002 - 30.} = +L \frac{2}{.002} = L \times 1000$$

- ① inductance of chock is 6 inductance high voltage
 ② secondary to limit the current in case of fault

B.S. Ans:

(a) Ans: Let assume that supply vol. is 230V, 50Hz
 Since four light bulbs of 25 watt = 100 watt

|| or four ceiling fan of 75 watt = 300 watt

So, Total power consumed = (100 + 300) watt
 = 400 watt.

(4m)

So, current drawn by fixtures :-

$$I = \frac{P}{V \cos \phi} = \frac{400}{230 \times 0.9} = 1.93 \text{ amp}$$

So, $I = 1.93 \text{ amp}$

} Let $\cos \phi = 0.9$

(b) Ans:

Energy consumed by four bulb = 100×8
 = 800 watt hr
 = 0.8 kWh

|| or energy consumed by
 four ceiling fan of 75 watt

$$= 300 \times 8 = 2400 \text{ watt hr}$$

$$= 2.4 \text{ kWh}$$

Total energy consumed = (0.8 + 2.4) kWh

$$= 3.2 \text{ kWh.}$$

So, Energy consumed in one month

$$= 3.2 \times 30 = 96 \text{ kWh}$$

So, Total energy consumption = 96 kWh.

(6m)

100

100

100

100

100

100

100



Registration No.....

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Course Name: Electrical Technician

Max. Marks: 100

Instructions: Answer all questions from section A, each question carries two marks. Answer any six questions from section B, each question carries five marks. Answer all questions from section C, each question carries ten marks.

Section – A

10x2=20 Marks

Q.1. (A) The path of a magnetic flux in a transformer should have:

- (a) High resistance
- (b) High reluctance
- (c) Low resistance
- (d) Low reluctance

(B) If P is the power of a star connected system then what will be power of an equivalent delta connected system?

- (a) P
- (b) 3P
- (c) P/3
- (d) None of the above

Q.2. (A) Brushes are provided in a dc machine for:

- (a) Providing a path for the flow of current
- (b) Preventing sparking
- (c) Reducing the losses
- (d) None of these

(B) In a transformer, electrical power from the primary is transferred to the secondary:

- (a) Magnetically
- (b) Electrically
- (c) Electromagnetically
- (d) None of these

Q.3. (A) The transformers are rated in:

- (a) kVA
- (b) kW
- (c) kV
- (d) none of these

(B) Oil in a transformer is used for:

- (a) Insulation
- (b) Insulation and cooling
- (c) Lubrication
- (d) Both B and C

Q.4. (A) The most common method of cooling used in distributed transformers is:

- (a) Natural cooling
- (b) Air-blast cooling
- (c) Forced oil cooling
- (d) Forced water cooling

(B) The speed at which the rotating magnetic field produced by stator currents rotates is:

- (a) Synchronous speed
- (b) Rotor Speed
- (c) Greater than synchronous speed
- (d) None of these

Q.5. (A) The thickness of stator laminations is of the order of:

- (a) 0.5 mm
- (b) 1 mm
- (c) 5 mm
- (d) None of these

(B) How many cycles does a sine wave go through in 10 s when its frequency is 60 Hz?

- (a) 10 cycles
- (b) 60 cycles
- (c) 600 cycles
- (d) 6 cycles

Q.6. (A) If the peak value of a certain sine wave voltage is 5 V, what is the rms value?

- (a) 0.707 V
- (b) 3.535 V
- (c) 5 V
- (d) 1.17 V

(B) The expression for total power output of a delta connected system in terms of phase voltage and current is given by _____.

- (a) $3V_p I_p \cos \phi$
- (b) $\sqrt{3} V_p I_p \cos \phi$
- (c) $1/\sqrt{3} V_p I_p \cos \phi$
- (d) $1/3 \times V_p I_p \cos \phi$

Q.7. (A) In a star connected system, the current flowing through the line is _____.

- (a) Greater than the phase current
- (b) Equal to phase current
- (c) Less than the phase current.
- (d) None of above

(B) The core flux in transformer mainly depend on _____.

- (a) Supply voltage
- (b) Supply voltage and frequency
- (c) Supply voltage, frequency and load
- (d) Supply voltage and load

Q.8. (A) The basic function of a transformer is to change _____.

- (a) The power level
- (b) The power factor
- (c) The level of the voltage
- (d) The frequency

(B) The transformer laminations are insulated from each other by

- (a) Mica strip
- (b) Thin coat of varnish
- (c) Paper
- (d) Any one of the above

Q.9. (A) Thin laminations are used in a machine in order to reduce _____.

- (a) Eddy current losses
- (b) Hysteresis losses
- (c) Both ~~a~~ and ~~b~~
- (d) Copper losses

(B) The resistance of voltmeter is:

- (a) Very low
- (b) Very high
- (c) Variable
- (d) None of above

Q.10. (A) The Primary winding of a transformer:

- (a) Is always a low voltage winding
- (b) Is always a high voltage winding
- (c) Could either be a low voltage or high voltage winding
- (d) None of the above

(B) Material used for construction of transformer core is usually:

- (a) Wood
- (b) Copper
- (c) Aluminium
- (d) Silicon steel

Section – B

6x5=30 Marks

Answer any six questions.

Q. 1. Define the following terms:

(A) Resistivity (B) Magnetic Flux Density (C) Magnetic Reluctance

(D) Form Factor (e) Peak Factor

Q. 2. Compare core type and shell type transformers.

Q. 3. Describe Faraday's Laws of electromagnetic induction.

Q. 4. Explain relationship between line current, line voltage, phase current, and phase voltage for (a) star connection (b) Delta connection.

Q. 5. Derive e.m.f. equation of transformer.

Q. 6. A 4-pole, 3-phase, 50 Hz, star connected induction motor has a slip of 4%. Calculate full load speed of motor.

Q. 7. Explain Fleming's left hand & right hand rule.

Q. 8. The primary winding of a 50 Hz single phase transformer has 480 turns and is fed from 5400 V supply. The secondary winding has 20 turns. Find the peak value of the flux in the core and the secondary voltage.

Section – C

5x10=50 Marks

Q. 1. What do you understand by the Junction Transistor? Describe the principle and working of a PNP and NPN transistors.

Q. 2. What is the function of diode? How Zener diode is different from a diode?

Q. 3. On what principle induction motor works? What are the main parts of the motor? Explain briefly slip in the induction motor.

Q. 4. With diagram explain the working principle of a single phase transformer. State the relationship between voltages and currents on primary side and secondary side of a transformer.

Q. 5. Three inductive coils, each with a resistance of 15Ω and inductance of 0.03 H are connected in star to 3-phase, 400 V, 50 Hz, supply. Calculate the (i) Phase current and (ii) Total power consumed.

()

()

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Course code: ELE1002

Course Name: Electrical Technician

END SEMESTER — SOLUTION OF QUESTION PAPER

Section — A

1. (A) → Ans (cb) → 1M
(B) → Ans (a) → 1M

2. (A) → Ans (a) → 1M
(B) → Ans (c) → 1M

3. (A) → Ans (a) → 1M
(B) → Ans (b) → 1M

4. (A) → Ans (a) → 1M
(B) → Ans (a) → 1M

5. (A) → Ans (a) → 1M
(B) → Ans (c) → 1M

(6) (A) → Ans (b) → 1M
(B) → Ans (a) → 1M

(7) (A) → Ans (b) → 1M
(B) → Ans (b) → 1M

(8) (A) → Ans (c) → 1M
(B) → Ans (b) → 1M

(9) (A) → Ans (c) → 1M
(B) → Ans (b) → 1M

(10) (A) → Ans (c) → 1M
(B) → Ans (d) → 1M

Section-B

Q.1 Ans:

(A) Ans: — The resistivity of a material is the resistance offered by unit length of material of unit cross-section. If the length is in meters and cross-section in square meters, then resistivity expressed in $\Omega\text{-m}$.

$$\rho = \frac{RA}{l} \quad \Omega\text{-m.} \quad \rightarrow (1M)$$

(B) Ans: — magnetic flux density is the number of lines of magnetic flux per unit area, represented by letter B.

$$B = \frac{\Phi}{A} \quad \text{weber/m}^2. \quad \rightarrow (1M)$$

(C) Ans: magnetic reluctance is the opposition offered by a magnetic path to the establishment of magnetic flux, just like resistance in electrical ckt. ~~it is~~

(d) Ans: It is defined as rms value of wave and average value of the wave.

ie, Form factor = $\frac{\text{rms value of the wave}}{\text{Average value of the wave}}$
For sinusoidal wave

$$\text{Form factor} = \frac{V_m}{\frac{V_m}{\sqrt{2}}} = \frac{\pi}{2} \cdot \frac{1}{\sqrt{2}} = 1.11 \quad \rightarrow (1M)$$

(e) Ans:

Peak factor is the ratio of the peak value of the wave to its rms value

for sinusoidal wave

(11)

Peak factor = $\frac{V_m}{V_m/\sqrt{2}} = \sqrt{2} = 1.414$

→ (11)

Q.2. Ans: -

Core Type

Shell Type

(1) the winding encircles the core.

(1) the core encircles most part of the winding.

(2) It has single magnetic circuit

(2) It has double magnetic ckt.

(3) the core has two limbs

(3) The core has three limbs.

(4) the cylindrical coils are used

(4) the multi layer disc or sandwich type coil are used.

(5) the windings are uniformly distributed on two limbs hence natural cooling is effective

(5) the natural cooling doesn't exist as the windings are surrounded by the core.

(6) the coil can easily removed from maintenance point of view

(6) the coil can't remove easily.

Q.3. Ans: -

Faraday's laws state that an emf is induced in a circuit which is

(1.5M) (i) Directly proportional to the time rate of change of flux enclosed by the circuit.

(1.5M) (ii) Directly proportional to N , the no. of turns of the circuit.

(2M) Combining the two laws, Faraday's laws of induction can be expressed mathematically as

$$e = -N \cdot \frac{d\phi}{dt} \text{ volts.}$$

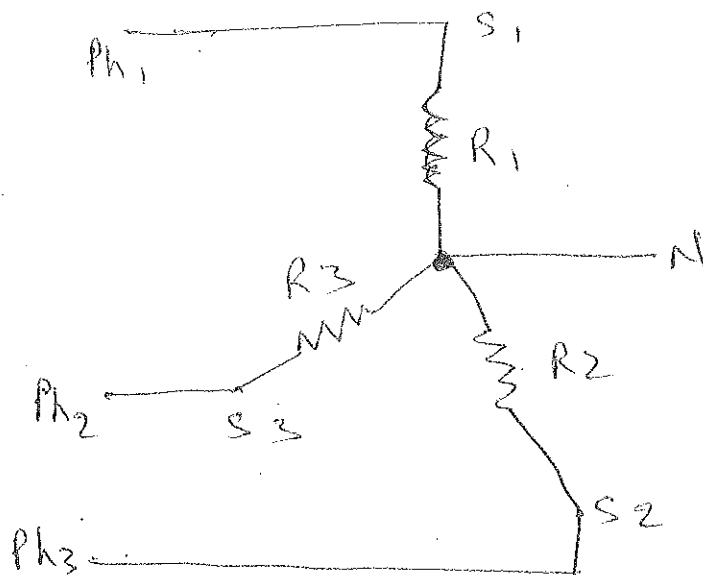
here -ve sign indicate the direction of the induced current is always oppose the action that produced it.

Q.4 Ans: -

(5M) (a) For star connection: -

$$\text{Line voltage} = \sqrt{3} \text{ Phase voltage}$$

$$\text{Line current} = \text{Phase current}$$



(fig-a: star connection)

The voltage between one of the phases and neutral terminal is known as phase voltage (V_{ph}).

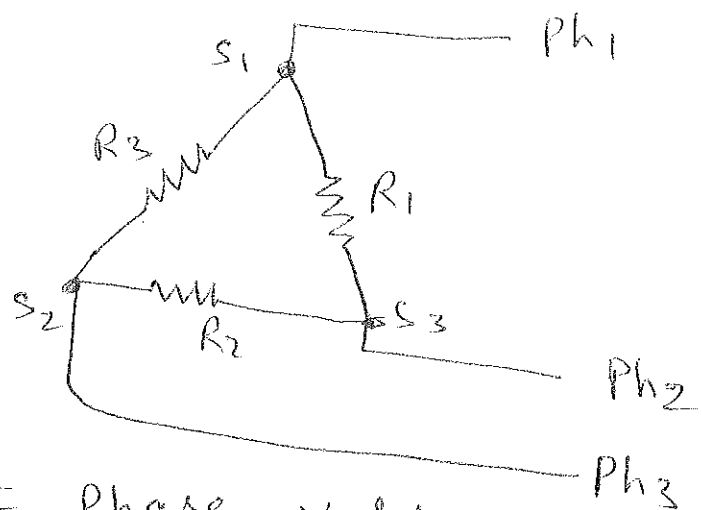
The current flowing through any of the phase winding is called phase current (I_{ph}).

The voltage between any two phases of the supply is called line voltage (V_L).

The current flowing between any two phases of the windings is termed as line current (I_L).

(b) Ans:

In Delta connection: -



Line voltage = Phase voltage

Line current = $\sqrt{3}$ phase current

Power in both star & delta connection is same i.e., $\sqrt{3} V_L I_L \cos \phi$.

Q.5. Ans:

Let N_1 and N_2 be the primary and secondary no. of turns in the transformer.

Suppose flux at any instant is given by

$$\phi = \phi_m \sin \omega t \quad \text{--- (1) } \rightarrow \text{ (Ans)}$$

where ϕ_m is the maximum value of flux in ~~atb~~ in webers (wb), if

follows that instantaneous value of ϕ
the induced emf. in N_1 turns of the
primary is $\omega = 2\pi f$

$$e_1 = -N_1 \cdot \frac{d\phi}{dt} = -\frac{N_1 d(\phi_m \sin \omega t)}{dt}$$

$$= -N_1 \cdot \omega \cdot \phi_m \cos \omega t$$

$$= 2\pi f N_1 \phi_m \sin(\omega t - \pi/2)$$

— (2)

The max^m value of induced voltage
from equⁿ (2) is

$$E_{\max} = 2\pi f \phi_m N_1$$

and hence its effective value is

$$E_1 = \sqrt{2} \pi f N_1 \phi_m = 4.44 f N_1 \phi_m$$

— (3)

Similarly emf. induced in secondary
winding is

$$e_2 = -N_2 \cdot \frac{d\phi}{dt} = 2\pi f N_2 \phi_m \sin(\omega t)$$

$$E_2 = 4.44 f N_2 \phi_m$$

Q.6. Ans

Given values are

$$P = 4, f = 50 \text{ Hz}, \% S_{fl} = 4\%$$

$$S_{fl} = \text{full load absolute slip} = 0.04 \quad \rightarrow \text{(1M)}$$

$$N_s = \frac{120f}{P} = \frac{120 \times 50}{4} = 1500 \text{ r.p.m.} \rightarrow \text{(1M)}$$

$$S_{fl} = \frac{N_s - N_{fl}}{N_s}$$

where N_{fl} = full load speed of motor.

$$\text{i.e., } 0.04 = \frac{1500 - N_{fl}}{1500} \quad \rightarrow \text{(2M)}$$

$$\boxed{N_{fl} = 1440 \text{ r.p.m.}} \quad \rightarrow \text{1M}$$

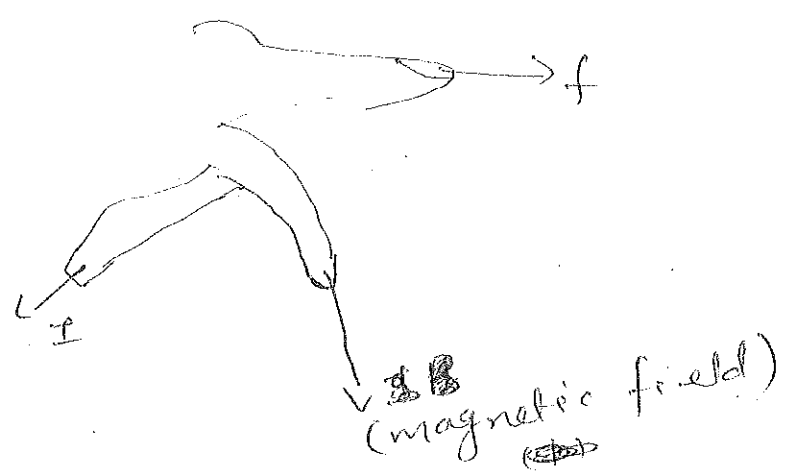
this is full load speed of motor. (1)

Q.7. Ans -

Fleming's Left hand rule: —

(2.5M)
Hold the thumb, the fore finger and the central figure at right angle to each other of the left hand as shown in (fig-a). If the fore-finger points in

the direction of magnetic field and the central finger to the direction of current, the thumb will point to the direction of force or motion.



(fig(a) the left hand rule)

$$F = B I l \sin \theta$$

this eqn. is actually cross product of two vectors

$$F = I \vec{l} \times \vec{B}$$

⇒ Fleming Right hand rule: —

Hold the thumb, fore-finger and the central finger of the right hand at right angles to each other. If the thumb points to the direction of motion and forefinger to the direction

(2.5M)

of field, the central finger will point in the direction of induced e.m.f. i.e., the central finger will point to the positive terminal of emf or will indicate the direction of current flow if the ends of the conductor are connected to external ckt i.e., the load.

Q.8. Ans. —

given, $f = 50 \text{ Hz}$, $N_1 = 480$, $N_2 = 20$, $E_1 = 5400 \text{ V}$

since $E_1 = 4.44 f \phi_m N_1 \rightarrow (1 \text{ m})$

i.e., $5400 = 4.44 \times 50 \times \phi_m \times 480$

i.e., $\phi_m = 0.0506 \text{ wb} \rightarrow (1.5 \text{ m})$

since

$$\frac{E_1}{E_2} = \frac{N_1}{N_2} \rightarrow (1 \text{ m})$$

i.e., $E_2 = \frac{N_2 \times E_1}{N_1} = \frac{20}{480} \times 5400$

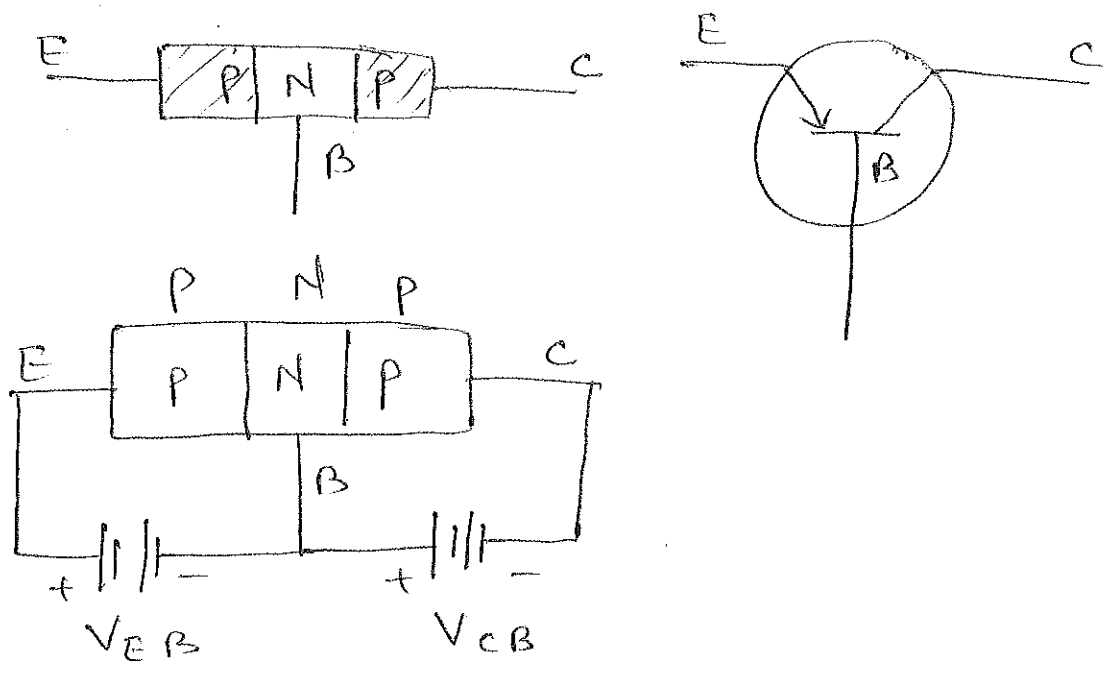
i.e., $E_2 = 225 \text{ V}$

$\rightarrow (1.5 \text{ m})$

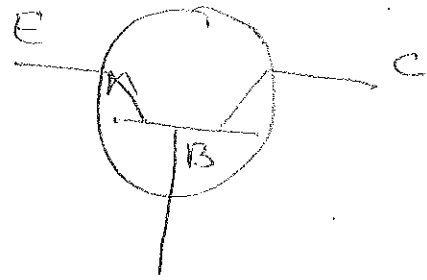
1 Ans:

A junction transistor in which a layer of n-type semiconductor is sandwiched between two layers of p-type semiconductors is known as p.n.p transistor, as shown in fig-a.

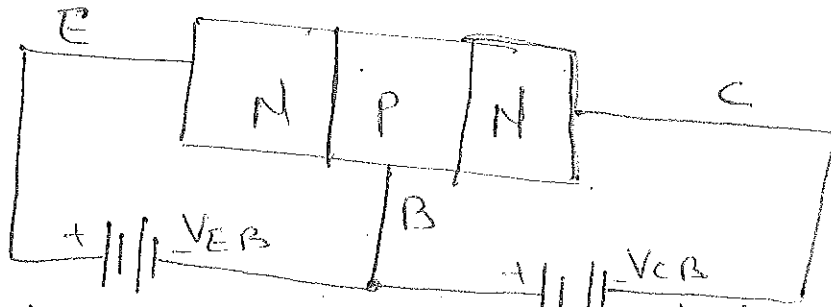
Similarly, when a p-type semiconductor is sandwiched between two layers of n-type semiconductors, then arrangement is termed as n.p.n transistor shown in fig-(b).



(fig-a) - p.n.p transistor



(2 M)



(fig-6 n-p-n Transistor)

The sandwiched section is called base; the left hand side section is called emitter and that on the right hand side is called collector.

(1 M)

Biasing a transistor: - The behaviour of the transistor can be understood by biasing the emitter in the forward bias direction with the help of battery and biasing the collector in the reverse direction with the help of battery.

(1 M)

(a) P.n.p. Transistor: - In a P.n.p transistor, when the emitter is forward biased as shown in fig. 9, the holes in the emitter and electrons in the base start moving towards the junction because the holes are

7
attached by the cathode and electrons
by the anode of the battery.

As soon as these - charged particles (electrons and holes) reach the junction, a small fraction (say about 5.5%) of the total number of holes combine with electrons and get neutralised.

Now since base layer is very thin and collector is kept at high negative potential by battery thus almost all the holes (94.5%) are attracted by the - collector. Because of the recombination of about 5.5% of holes with the electrons at the junction, the collector current is slightly smaller than the emitter - current. The emitter - current depend upon emitter base voltage.

(b) n-p-n Transistor: -

In - case of n-p-n transistor when the emitter is forward biased and - collector is reversed biased, the - electron in the emitter and holes in the base starts moving towards the junction due to influence of the external forward

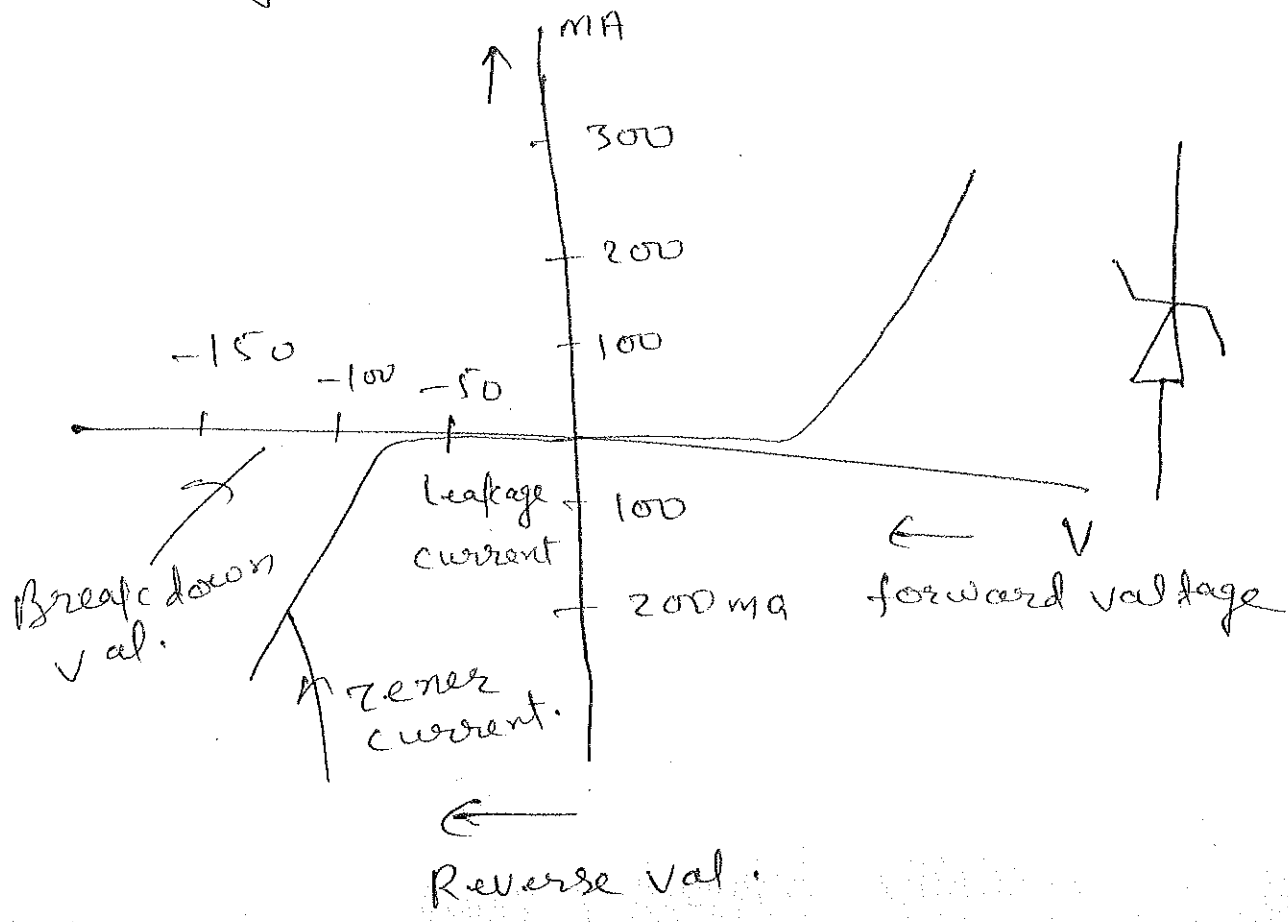
(15.1)

biased voltage. On reaching the junction, a small fraction of total electrons (5.5% approx.) combined with holes to get neutralised. Since base is very thin and collector is maintained at a large positive potential, thus almost all the electrons (94.5%) are attached by the collector to constitute the collector current. Here also the collector current is slightly smaller than the emitter current because of the recombination of approx. 5.5% electrons with the holes at the junction.

Q.2. Ans: —

The semiconductor PN junction diodes, usually made of Ge or Si, are capable of rectifying relatively large currents. It is seen from the characteristics that a substantial current flows through the diode when a forward voltage of about 1V is applied. When reverse voltage is applied, making the

anode negative, conduction stops and diode blocks the reverse current. If reverse voltage is increased, a small leakage current being to flow. If the reverse potential continues to be increased however beyond the safe inverse voltage, a critical voltage, called break-down voltage, the reverse current will increase sharply to a high value. The break down region is the knee of characteristics curve and sudden increase in current is called zener current as shown in fig.

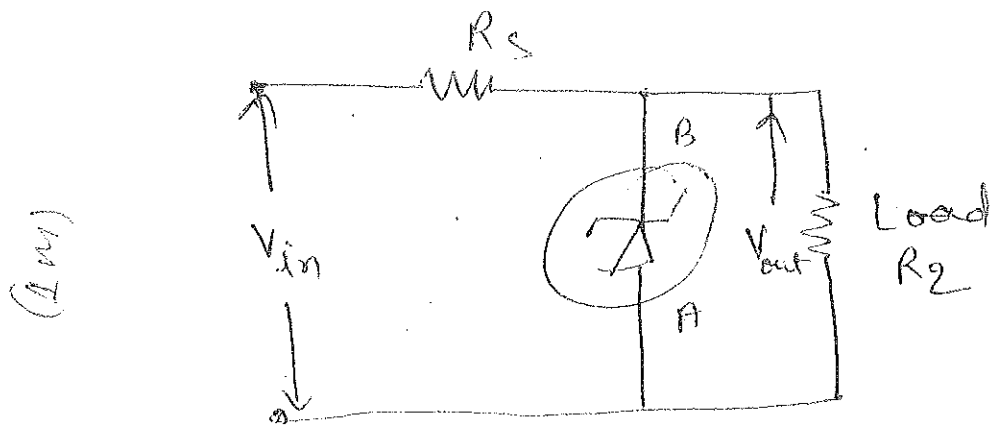


(8)

(3M)

(Reverse diode)

Zener diode constitutes a high class regulator at the O/P of power supply.



If I/P V_{in} increases, the current through both the Zener diode and the load, R_L will increase. At the same time Zener diode resistance decreases and the current through the diode increases more than proportionately. As a result more vol. drop occurs across the series resistor R and the O/P voltage (V_{out}) across the diode will be closed to original value. In this way a Zener diode regulator can maintain the O/P voltage.

(20/11)

→ The main function of a diode is to allow an electric current to pass in one direction (called diode's forward direction), while blocking in the opposite direction (the reverse direction).

(1M)

As the function of Zener diode is to conduct a large reverse current, but the device will not be damaged as we see in case of normal diode. This is achieved by changing the way of doping the PN junction and this reverse voltage is called the 'Zener voltage'. Therefore Zener diode can conduct in both ways.

Ques 3. Ans: —

(1M)

Principle of S-PIM: whenever a short circuited conductor is placed in a rotating magnetic field conductor tends to move.

0

main parts:

(2M)

1. stator: - stator is a static part, and is wound for two, four, six poles depending on the speed required. The core is laminated and is provided with slots, usually semi-enclosed.

2. Rotor: - this is built up of laminated iron strips. The winding is placed

2.11

in slots which are either semi enclosed or completely closed.

slip in IM:

Let N_s be the synchronous speed

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

N be the actual speed of rotor

Then difference between the N_s and N of the motor is called

the slip speed of the motor.

(5M)

$$\text{and slip} = \frac{N_s - N}{N_s}$$

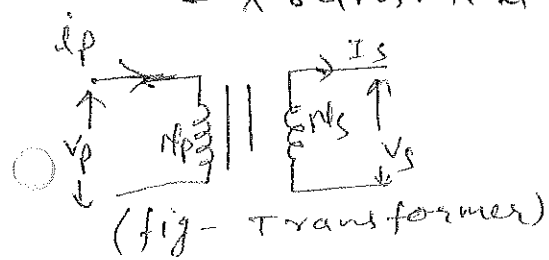
it is usually taken in %

$$\boxed{\% \text{ slip} = \frac{N_s - N}{N_s} \times 100}$$

It is usually 2 to 4% when motor is at start still and supply is given to stator slip is unity i.e., 100%. In IM slip can't be zero.

Q. 4. Ans: -

The transformer works on the principle of mutual induction action; i.e., if the coils be placed near to each other and if one is connected to A.C. supply, the e.m.f. will be induced to other coil. The e.m.f. induced will be according to turns in the second coil. The transformer mostly used in AC supply to increase the voltage and thus decrease the current and keep the power same for transmitting the high voltage,



When A.C. vol. is given

to the primary an e.m.f. is induced in the primary which is back e.m.f. and it opposes applied vol.

If V_p is the applied vol, E_p vol. will be induced and if N_p are primary turns then

$$\text{Per turn induced vol.} = \frac{E_p}{N_p} \text{ volts.}$$

the same primary flux will also circulate in the secondary.

If N_s are total secondary turns, the e.m.f. induced in the secondary will be:

$$E_s = N_s \times \text{Per turn induced vol.}$$

$$= N_s \times \frac{E_p}{N_p}$$

The e.m.f. induced due to mutual induction, this vol. also opposes the primary vol.

$$\text{So, } E_s = \frac{N_s \times E_p}{N_p}$$

$$\text{or, } \boxed{\frac{E_s}{E_p} = \frac{N_s}{N_p}}$$

Since I/P power = O/P power.

$$E_p I_p = E_s I_s$$

$$\text{So, } \frac{E_p}{E_s} = \frac{I_s}{I_p}$$

$$\text{So, } \boxed{\frac{E_s}{E_p} = \frac{N_s}{N_p} = \frac{I_p}{I_s}}$$

Qa. 5 Ans: —

(1) Since three coils are connected in star
Line val. applied to star connected

ckt $V_L = 400V.$

Phase val. = $\frac{V_L}{\sqrt{3}} = \frac{400}{\sqrt{3}} = 231V \rightarrow (1.5)$

Inductive reactance of each coil,

$X_L = 2\pi \times 50 \times 0.03 = 9.42 \Omega \rightarrow (1M)$

Impedance per phase = $15 + j9.42$

= $\sqrt{(15)^2 + (9.42)^2} = 17.7 \Omega.$

Current per phase = $\frac{231}{17.7} = 13A. \rightarrow (2M)$

○ In star connected ckt,

(1) Line current = phase current = 13A.

Thus, $\rightarrow (2M)$

(11) Line current = 13.0A

Power factor $\cos \phi = \frac{R_{ph}}{Z_{ph}}$

$\cos \phi = \frac{15}{17.7} = 0.847$

Power absorbed consumed = $\sqrt{3} V_L I_L \cos \phi$
= $\sqrt{3} \times 400 \times 13.0 \times 0.847$
= 2888 kW

(1.5M)
(3.5M)





Registration No.....

School of Electrical Skills
First Semester, End Term Semester Examination
Summer Semester, B.Voc. Program, Session: 2017-18

Course Code: ELE1003

Time: 3 Hour

Course Name: Maintenance Technician Electrical

Max. Marks: 100

Instructions: Answer all questions from section A, each question carries two marks. Answer any six questions from section B, each question carries five marks. Answer all questions from section C, each question carries ten marks.

Section – A

10x2=20 Marks

- Q. 1. (A) Four bulbs of 40 W each are connected in series with a battery across them, which of the following statement is true?
- (a) The current through each bulb is same
 - (b) The voltage across each bulb is not same
 - (c) The power dissipation in each bulb is not same
 - (d) None of the above
- (B) The resistivity of the conductor depends on:
- (a) Area of the conductor
 - (b) Length of the conductor
 - (c) Type of material
 - (d) None of these
- Q. 2. (A) How many coulombs of charge flow through a circuit carrying a current of 10 A in 1 minute?
- (a) 10
 - (b) 60
 - (c) 600
 - (d) 1200
- (B) The unit of resistivity is:
- (a) Ω
 - (b) $\Omega - \text{metre}$
 - (c) Ω / metre
 - (d) Ω / m^2
- Q. 3. (A) Which of the following instruments should be connected in series connection?
- (a) Voltmeter
 - (b) Ammeter
 - (c) Wattmeter
 - (d) Energy meter
- (B) Which of the following are the passive elements?
- (a) Resistor
 - (b) Bulb
 - (c) Both
 - (d) None of these.
- Q. 4. (A) Which of the followings are active element?
- (a) Voltage source
 - (b) Current source
 - (c) Both
 - (d) None of these
- (B) Power dissipation in ideal inductor is:
- (a) Maximum
 - (b) Minimum
 - (c) Zero
 - (d) A finite value

- Q. 5. (A) Inductor does not allow the sudden change of:
 (a) Current (b) Voltage
 (c) Power (d) None of the above
- (B) Capacitor does not allow the sudden change of:
 (a) Current (b) Voltage
 (c) Power (d) None of the above
- Q. 6. (A) Internal resistance of ideal voltage source is:
 (a) Zero (b) Infinite
 (c) Finite (d) 100 ohms
- (B) Which quantity consists of a unit 1KWh?
 (a) Energy (b) Time
 (c) Power (d) Charge
- Q. 7. (A) the resistance offered by a diode, when it is reverse-biased, is:
 (a) Zero (b) Low
 (c) High (d) Infinite
- (B) Ratio of active power to power factor is:
 (a) Apparent power (b) Power factor angle
 (c) Power factor (d) None of these
- Q. 8. (A) What is form factor?
 (a) Average value / R.M.S. value (b) Average value / Peak value
 (c) Instantaneous value / Average value (d) R.M.S. value / Average value
- (B) What is the frequency of domestic power in India?
 (a) 50 Hz. (b) 60 Hz.
 (c) 220 Hz. (d) 70 Hz.
- Q. 9. (A) What is apparent power in AC operation?
 (a) Product of voltage and current.
 (b) Product of rms voltage and rms current.
 (c) Product of voltage and current at no load.
 (d) Product of voltage and current at full load.
- (B) What is the real power in AC operation?
 (a) $V \cos \phi$ (b) Apparent power $\times \cos \phi$
 (c) Both option A & B (d) None of these
- Q. 10. (A) Capacitors for P.f correction are rated in:
 (a) KW (b) KVA
 (c) KV (d) KVAR
- (B) In pure capacitive circuit, the real power is _____.
 (a) Infinite (b) Maximum
 (c) Normal (d) Minimum (e) Zero

Section – B

6x5=30 Marks

Answer any six questions.

- Q. 1. On what factors does the resistance of a substance depend? Give formula for it.
- Q. 2. List out some safety measures against electric shocks.
- Q. 3. State and explain Kirchhoff's Laws.
- Q. 4. Compare a 3-phase 4-wire system with single phase system.
- Q. 5. What is power factor? What are the main causes of low power factor and how to improve it?
- Q. 6. Compare between magnetic circuit and electric circuit.
- Q. 7. Define the terms:
(A) Time period (B) Apparent power (C) Form factor (D) Real Power (E) Peak factor
- Q. 8. Write down the test done by electrician after wiring installation.

Section – C

5x10=50 Marks

1. (a) Define conductor, semiconductor and insulator with example.
(b) State an instrument used to measure:
a. Current
b. Potential difference
c. Resistance
2. What do you mean by impedance in an A.C. circuit? Calculate the current and phase angle difference of the circuit having 10Ω resistance, 0.04 H inductance and $200 \mu\text{f}$ capacitor connected in series and connected to a supply of 200 volts 50 c/s.
3. (a) What is the effect of the current carried by a conductor upon its surroundings? Explain the term reluctance for magnetic circuit. Is Ohm's Law applicable for magnetic circuit?
(b) Under what conditions will resonance takes place? What is the nature of the circuit during resonance?
4. Given four 1Ω resistors, state how they must be connected to give an overall resistance of
(a) $\frac{1}{4} \Omega$ (b) 1Ω (c) $1\frac{1}{3} \Omega$ (d) $2\frac{1}{2} \Omega$, all four resistors being connected in each case.
5. The R – L circuit is connected across a 230 V, 50 Hz, single phase A.C. supply having 15-ohm resistance and 0.14 H inductance find the:
a. Current flowing in the circuit
b. Power factor of the circuit
c. Voltage across the resistor
d. Voltage across the inductance

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Course code: ELE1003

Course Name: Maintenance Technician Electrical

SOLUTION OF QUESTION PAPER

- | | <u>Section-A</u> |
|-------------------------|------------------|
| 1. (A) → Ans (a), (b) | → 1M |
| (B) → Ans (a), (b), (c) | → 1M |
| 2. (A) → Ans (c) | → 1M |
| (B) → Ans (b) | → 1M |
| 3. (A) → Ans (b) | → 1M |
| (B) → Ans (c) | → 1M |
| 4. (A) → Ans (c) | → 1M |
| (B) → Ans (c) | → 1M |
| 5. (A) → Ans (a) | → 1M |
| (B) → Ans (b) | → 1M |
| 6. (A) → Ans (a) | → 1M |
| (B) → Ans (a) | → 1M |
| 7. (A) → Ans (d) | → 1M |
| (B) → Ans (a) | → 1M |
| 8. (A) → Ans (a) | → 1M |
| (B) → Ans (a) | → 1M |
| 9. (A) → Ans (b) | → 1M |
| (B) → Ans (a) | → 1M |
| 10. (A) → Ans (d) | → 1M |
| (B) → Ans (e) | → 1M |

Section - B

Q. 1. Ans: -

Resistance depends upon following factors:

(1) (M.T) The resistance of conductor varies directly as its length i.e. as conductor length increases resistance increases.

$$\text{So, } R \propto L$$

(2) (M.T) The resistance of the conductor varies inversely as its cross-section i.e. cross-section increases resistance decreases.

$$\text{So, } R \propto \frac{1}{A}$$

(3) (M.T) The resistance of conductor depend upon nature of the material.

(4) The resistance of conductor depends on its temperature.

Hence resistance depends on length, area of cross-section, material and its temperature.

(2M) formula for calculating Resistance,

Since, $R \propto L$ and $R \propto \frac{1}{A}$

$$\text{So, } R \propto \frac{L}{A}$$

Hence, $R = \rho \frac{L}{A}$ where ρ (rho) is a constant for material - called its specific resistance or resistivity.

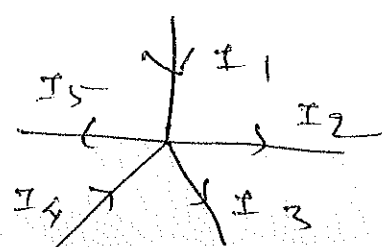
Q.2. Ans:

- 1. Care in handling all electrical apparatus and equipments is the only effective safeguard against injury and death.
- 2. Never use appliances, that has damaged or frayed leads.
- 3. Replace immediately broken switches and plugs, etc.
- 4. Check that all metallic parts of electrical equipment are effectively earthed.
- 5. Never place bare wires or leads in plug, fit a plug top.
- 6. Check for proper working of safety devices.
- 7. Never tamper unnecessarily with any live apparatus.

Q.3. Ans:

Kirchhoff's laws are used in determining the equivalent resistance of a complex network and the current flowing in the various conductors. The two laws are:

(1) Current Law: - The algebraic sum of the currents at any junction of a network is zero.

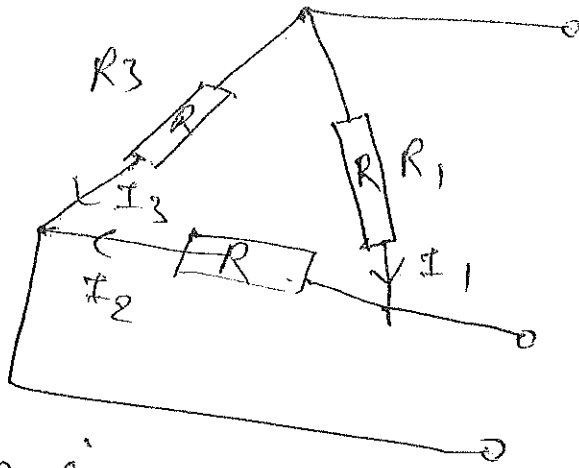


here $I_1 + I_4 = I_2 + I_3 + I_5$

or, $I_1 + I_4 - I_2 - I_3 - I_5 = 0$

(2) Voltage law: - In any closed electric circuit, the algebraic sum of potential drops ($I.R$) is equal to the sum of the impressed e.m.f.s.

(2M)



$$R_1 I_1 + R_2 I_2 - R_3 I_3 = 0$$

Q4 Ans: -

(2M)

1. In single phase circuits, there is a chance of power becoming zero which is undesirable in the power ckt.

(2M)

2. In single phase motors the torque is pulsating but in 3-phase the motor torque is rotating and uniform.

(2M)

3. 3-~~ph~~ transmission line is more efficient and requires less copper for transmission of same amount of power over the same distance.

4. 3- ϕ motors are self-starting while single phase motors are not.
5. 3- ϕ motors, for the same O/P, occupy less space, take less current, are light in weight and are cheaper.

Q.5 Ans.

Power factor (P.F.) of a ckt. defined as

$$= \frac{\text{True power}}{\text{Apparent power}}$$

$$\text{or, } \boxed{\text{P.F.} = \frac{VI \cos \phi}{V \times I}}$$

Low P.f. is due to running many inductive motors below full load, lighting of fluorescent tubes and using transformers.

P.f. improvement is necessary in an installation because low P.f. has following adverse effects:

(1) For given power to be supplied, the current is increased due to low P.f., it causes increase in copper losses and decrease the efficiency of both apparatus and the supply system.

(2) With low P.f. makes the voltage regulation of generators transformers

(Q.6) Loss and transmission lines greater.
 Capacitors are used to improve P.F. means reducing the phase difference between voltage and current.
 Q.6 Ans: -

In electric ckt as per Ohm's Law:

$$I = \frac{E}{R}$$

Similarly, in magnetic ckt when Ohm's law is applied

$$\text{magnetic flux} = \frac{\text{M.M.F}}{\text{Reluctance}}$$

Electric ckt

magnetic ckt

1. E.M.F. in volts
2. current in Amperes
3. Resistance in Ohms, $R = \frac{\rho l}{a}$
4. Conductivity = $\frac{1}{\text{Resistivity}}$
5. conductance = $\frac{1}{\text{Resistance}}$
6. Current = $\frac{\text{e.m.f}}{\text{resistance}}$
7. Resistivity

1. M.M.F in Ampere turn
2. Flux in webers.
3. Reluctance in AT/wb, $S = \frac{l}{\mu a}$
4. permeability = $\frac{1}{\text{reluctivity}}$
5. permeance = $\frac{1}{\text{reluctance}}$
6. Flux = $\frac{\text{M.M.F}}{\text{reluctance}}$
7. Reluctivity

7. Ans:

(A) Ans: - A time period (denoted by 'T') is the time needed for one complete cycle of vibration to pass a given point.

$$T = \frac{1}{f}$$

(B) In an AC ckt, the product of r.m.s voltage and r.m.s current is called apparent power.

~~snar~~

(C) Form factor is defined as the ratio of r.m.s value of a wave and average value of the wave.

$$\text{Form factor} = \frac{\text{r.m.s. value of wave}}{\text{Average value of wave}}$$

(d) The actual amount of power being used, or dissipated, in a ckt is called real power.

(e) Peak factor is the ratio of Peak value of wave to its r.m.s value.

$$\text{Peak factor} = \frac{V_m}{V_m/\sqrt{2}} = \sqrt{2} = 1.414$$

Q.8 Ans:

while carrying out inspection and testing of internal wiring installations, following point should be checked:

1. **Insulation Resistance Test:-** In this test the insulation resistance of a wire is tested to ensure that there is no leakage current flowing through it. The test is performed using "megger" instrument. In this, main switch is put in OFF condition and all lighting connections on the ckt are short ckted. The megger is then connected between line and earth. Megger is then rotated to generate voltage and then the reading on the dial of megger is noted. The insulation resistance between wiring and earth should not exceed $1/5000$ of the current flowing through it.

2. **Earth Continuity Test:**

This is second most important test for safety of installation.

All metal clad switches, metal parts, covers, conduits, must be solidly connected to earth. In absence of this, there could be a severe damage to the whole electrical installation, appliances connected to it. In adverse events, the leakage current flowing through it may cause severe electrical shock to the person coming in physical

contact with it.

In order to test this, the main switch should be in open position. All other ckt contacts like bulbs, switches should be ON position. The earth continuity tester is then connected between the switch/conduit and an independent earth. The tester will indicate the value of resistance. In all cases the value should not exceed more than 1Ω . If the value appears higher than 1Ω it indicates that switch/conduit is not properly earthed.

Section - c

1 (a) Ans:

A material having large number of free electrons is called conductor.

(m/g) for example, copper (Cu) has 8.5×10^{28} free electrons per cubic meter which is a very large no. hence Cu is good conductor.

The resistance of conductor is very low.

(m/g) Semiconductors are those materials whose electrical conductivity is between conductors and insulators.

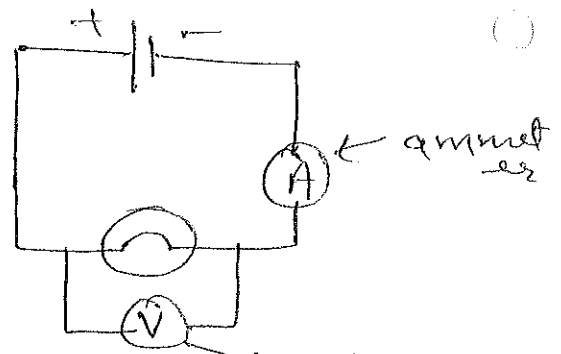
for example Si, Ge.

(1.5M)
In insulator, the energy gap between conduction band and valence band is very high. Hence in insulators it is very difficult to pass the electricity.

for example plastic, glass, wood etc.

(b) Ans:

(2M)
(a) current: - An ammeter is an instrument used to measure current and must be connected in series with the circuit. fig. shows an ammeter connected in series with the lamps to measure the current flowing through it. Since all the current in the ckt passes through the ~~ckt~~ ammeter, it must have a very low resistance.



(2.5M)
(b) A voltmeter is an instrument used to measure potential difference and must be connected in parallel with the part of the ckt whose p.d. is required.

(c) An ohmmeter is an instrument for measuring resistance.

(1M)

Q. Ans:

(2M) Total opposition offered by a series circuit in AC is called impedance. It is denoted by Z , it is measured in ohms and equal to

$$Z = \sqrt{R^2 + (X_C - X_L)^2} \text{ ohms.} \rightarrow (1M)$$

Here in question $R = 10 \Omega$

$$L = 0.04 \text{ H,}$$

$$C = 200 \mu\text{F}$$

$$X_L = \frac{2\pi \times 50 \times 0.04}{7}$$

$$= \frac{88}{7} = 12.57 \Omega.$$

$\rightarrow (2M)$

$$X_C = \frac{10^6}{2\pi \times 50 \times 200}$$

$$= \frac{175}{11} = 15.9 \Omega$$

$$Z = \sqrt{10^2 + (15.9 - 12.57)^2}$$

$$= \sqrt{100 + 11} = 10.53 \Omega$$

$\rightarrow (3M)$

(4M) Now, $I = \frac{V}{Z} = \frac{200}{10.53} = 19 \text{ Amps. ms.}$

$$\cos \phi = \text{P.F.} = R/Z \Rightarrow \frac{10}{10.53} = 0.95 \text{ leading}$$

So, angle of phase difference from cosine table = 18.2°

(1m)

3. (a) Ans: -

(1m) when current is passed through a conductor, a magnetic field is set up along its length.

The reluctance of a magnetic ckt is the property of the magnetic material, which opposes the flow of magnetic flux through it.

Yes, ~~ohm's~~ ohm's law is applicable for magnetic ckt.

(1m)

Ohm's law for magnetic ckt's relates the mmf applied to a ckt to the flux flowing through magnetic ckt and the reluctance offered by the ckt i.e., as per this law,

$$\boxed{\text{mmf} = \text{flux} \times \text{reluctance}}$$

(b) Ans:

(1m) In an A.C. ckt resonance takes place when the inductive reactance of the ckt is equal to its capacitive reactance.

At resonance ckt becomes a resistive one, because at the time of resonance, inductive

reactance is equal to capacitive reactance 7.

$$X_L = X_C$$

$$\text{ie, } 2\pi fL = \frac{1}{2\pi fC}$$

$$\text{or, } f = \frac{1}{2\pi\sqrt{LC}}$$

here f is called resonance freq.

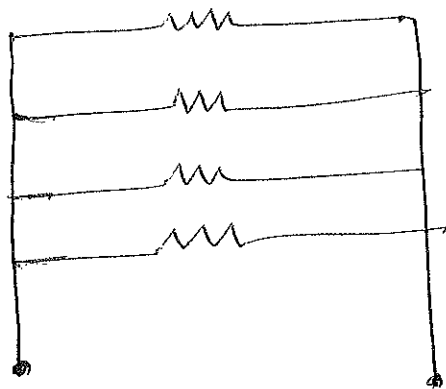
P.F. of resonant circuit is unity.

Nature of circuit during resonance is resistive.

Q. Ans:

(a) since All four in parallel.

$$\frac{1}{R} = \frac{1}{1} + \frac{1}{1} + \frac{1}{1} + \frac{1}{1} \Rightarrow R = \frac{1}{4} \Omega.$$

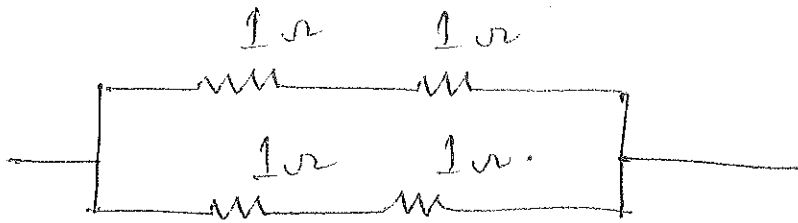


(b) Two in series, in parallel with another two in series, since 1Ω and 1Ω in series gives 2Ω , and 2Ω in parallel with 2Ω gives

ie,

$$\frac{2 \times 2}{2+2} = \frac{4}{4} = 1 \Omega$$

(2.5m)



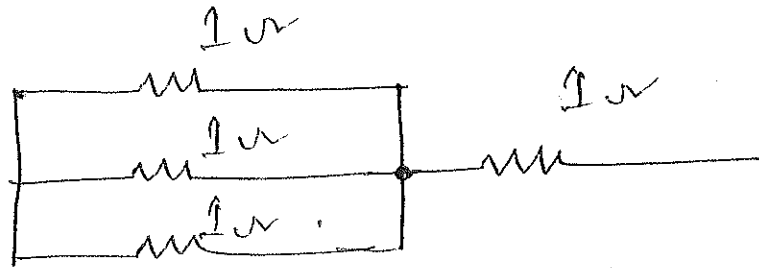
(c) Ans: -

three in parallel, in series with one
since for the three in parallel

$$\frac{1}{R} = \frac{1}{1} + \frac{1}{1} + \frac{1}{1} = \frac{3}{1}$$

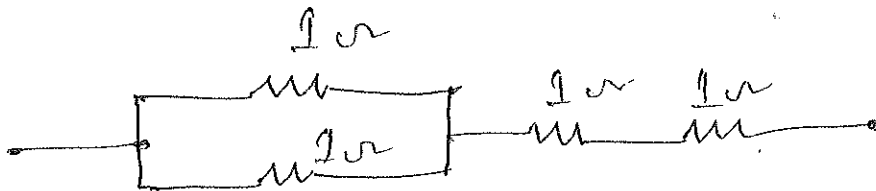
ie, $R = \frac{1}{3} \Omega$ and $\frac{1}{3} \Omega$ in series with
 1Ω gives 1Ω

(2.5m)



(d) Ans:

Two in parallel, in series with two
in series, since for the two in
parallel.



$$R = \frac{1 \times 1}{1+1} = \frac{1}{2} \Omega$$

(2.5m)

and, $\frac{1}{2} \Omega$, 1Ω and 1Ω in series giving $2 \frac{1}{2} \Omega$.

5. Ans: —

(1) Since $L = 0.1 \text{ H}$

freq. of supply, $f = 50 \text{ Hz}$

Inductive reactance of coil

$$X_L = 2\pi fL$$

$$= 2 \times \pi \times 50 \times 0.1$$

$$= 31.43 \Omega$$

Total resistance in the coil $R = 15 \Omega$.
Impedance of the coil,

$$Z = \sqrt{R^2 + (X_L)^2}$$

$$= \sqrt{15^2 + (31.43)^2} = 34.83 \Omega$$

Vol. applied to series coil,

$$V = 230 \text{ V}$$

Current flowing in the coil,

$$I = \frac{230}{34.83} = 6.6 \text{ A}$$

(ii) p.f. of the coil,

$$\cos \phi = R/Z = \frac{15}{34.83}$$

$$= 0.43 \text{ (lagging)}$$

(iii) Vol. across inductance $= I X_L$

$$= 6.6 \times 31.43 = 207.4 \text{ V}$$

IV) Voltage across the resistor = IR
 $= 6.6 \times 15$
 $= 99V$

(1M)