Important suggestions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and communication skills)
4) While assessing figures, examiner may give credit for principle components indicated in a figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case some questions credit may be given by judgment on part of examiner of relevant answer based on candidate understands.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

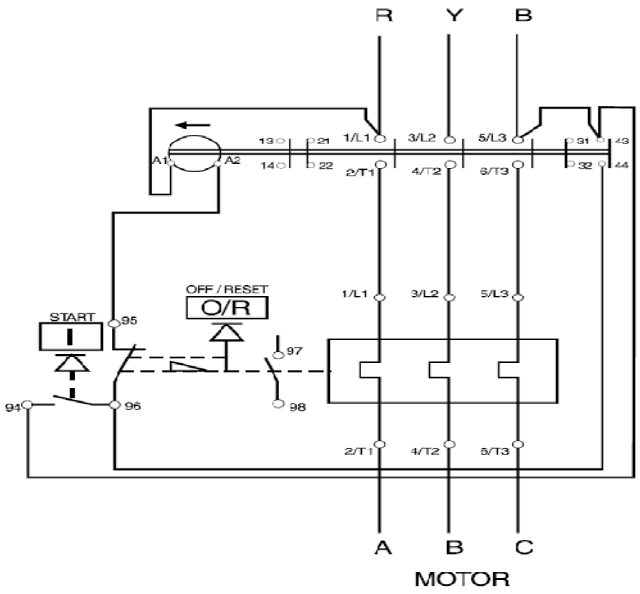
SECTION — I

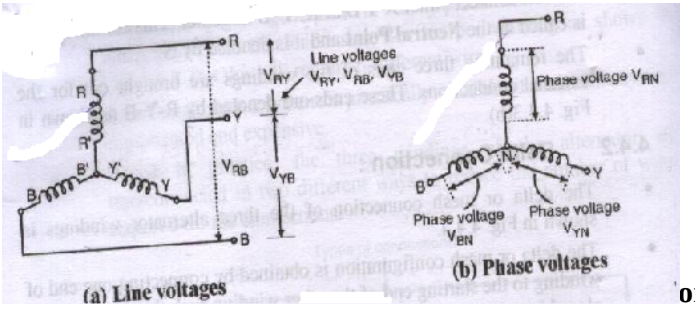
Q.1	**Solve any Seven:** **14 Marks**
a)	**Classify transformers on the basis of i) Construction ii) Voltage**
Ans:	**Classify transformers on the basis of: i) Construction: (Any Two expected) : (1 Mark)** 1. Core-type transformer 2. Shell-type transformer 3. Berry type **Classify transformers on the basis of: ii) Voltage: (1 Mark)** 1. Step-up Transformer 2. Step-down transformer
b)	**b) Define : i) Voltage ratio ii) Current ratio**
Ans:	**Voltage Ratio:-** ----------**(1 Marks)** It is the ratio of secondary voltage to primary voltage. $Voltage\ ratio = \frac{V_2}{V_1}$ **Current Ratio (I):-** ----------**(1 Marks)** It is the ratio of secondary number of turns to primary number of turns.

	$Current\ Ratio\ (I) = \frac{I_1}{I_2}$ **OR** $\frac{E_2}{E_1}\ or = \frac{V_2}{V_1}\ or = \frac{I_1}{I_2}$
c)	**Define voltage regulation of a transformer. State its ideal value.**
Ans:	**ii) Voltage Regulation:** ----------**(1 Marks)** Voltage regulation is nothing but voltage drop expressed in % of secondary voltage at no load **% Regulation** = $\frac{No\ \ load\ \ Voltage - Full\ load\ Voltage}{No\ \ load\ Voltage} \times 100$ % Voltage Regulation = $\frac{V_{NL} - V_{FL}}{V_{NL}} \times 100$ **It,s ideal valu is Zero**
d)	**Define synchronous speed of a three phase induction motor. State its unit.**
Ans:	**Synchronous Speed:-** **(Meaning: 1 Mark & Unit : 1 Mark)** It is speed at which rotating magnetic field rotates in induction motor. **OR** $N_S = \frac{120\ f}{P}$ Where, $N_S = Syncronous\ \ speed \qquad f = Supply\ of\ \ frequency \quad and \quad P = Number\ of\ \ Pole$ **Synchronous Speed unit:** **Unit : RPM or RPS**
e)	**Define slip of an induction motor. Write the formula to determine percentage slip.**
Ans:	**Meaning of Slip:-** **(Meaning: 1 Mark & Formula : 1 Mark)** It is the ratio the difference between the synchronous speed and actual speed of the rotor to synchronous speed. **The formula to determine percentage slip** It is expression in percentage = % Slip = $\frac{N_S - N}{N_S} \times 100$

	Ns= Synchronous speed Where, N= Rotor speed
f)	**How can the direction of rotation of 3 phase induction motor be reversed?**
Ans:	Direction 3-Phase induction can be changed by : **(Allotted 2 Marks)** 1) Interchanging connection of any of the two phases. i.e. by changing phase sequence.
g)	**State the function of fuse.**
Ans:	**Function of Fuse:** **(Allotted 2 Marks)** ➢ It is protective device against over current, occurs due over load or short circuit.
h)	**State two advantages of MCCB.**
Ans:	**Advantages of MCCB:** **(Any Two advantages are expected: 1 Mark each)** 1. MCCBs are Compact. They save considerable panel space 2. MCCBs minimize downtime. Unlike in a fuse-based system, there's no searching for a replacement fuse. MCCBs can be Reset & Switched On immediately after clearing the fault that caused the tripping. 3. MCCBs minimize inventory. Unlike fuses, they are not "consumables" and hence there is no need to stock MCCBs the way fuses have been stocked. An MCCB can clear several faults before it is due for replacement. 4. MCCBs are "Maintenance free" and hence the recurring costs are minimal. 5. There is no possibility of single phasing due to fault in only one phase when MCCBs are used. 6. Multi-purpose accessories can be fitted with MCCBs
i)	**State two types of earthing systems.**
Ans:	**Types of Earthing Systems:** **(Any Two Types are expected: 1 Mark each)** 1. Plate Earthing **2.** Pipe Earthing **3.** Rod Earthing
j)	**State two types of tariffs.**
Ans:	**Types of Tariff:-** **(Any Two types are expected: 1 Mark each: Total 2 Marks)** i) Flat-demand Tariff ii) Simple-demand Tariff or Uniform Tariff iii) Flat-rate Tariff iv) Step-rate Tariff v) Block-rate Tariff

	vi) Two-part Tariff: vii) Maximum demand Tariff viii) Three-part Tariff ix) Power factor Tariff :- a) KVA maximum demand Tariff b) Sliding Scale Tariff or Average P.F. Tariff c) KW and KVAR Tariff x) TOD (Time of Day) Tariff
Q.2 a)	**Attempt the following: 04 Marks**
a)	**Define : i) Frequency ii) Phase iii) Maximum value of an alternating quantity**
Ans:	**i) Frequency: (1.5 Mark)** The number of cycles completed by an alternating quantity in one second is called as frequency. **ii) Phase:- (1.5 Mark)** It is the angle between any two quantities current and voltage or between two same voltages and same current. **iv) Maximum value of an alternating quantity: (1 Mark)** The peak value of an alternating quantity is called its maximum value.
Q.2 b)	**Attempt any Four of the following: 16 Marks**
a)	**Explain why a transformer is always rated in KVA.**
Ans:	**Reason for transformer is always rated in KVA: (4 Mark)** As copper loss of a transformer depends on current and iron loss on voltage, Hence total transformer loss depends on volt-ampere and not on phase angle between voltage and current i.e. It is independent of load power factor. That is why rating of transformer is in KVA. **OR** Output power of transformer is given by P= VICosØ, for different types of load i.e (resistive, capacitive, inductive) cosØ changes so, for same voltage and current output power will different, so transformer is designed to operate at particular voltage and

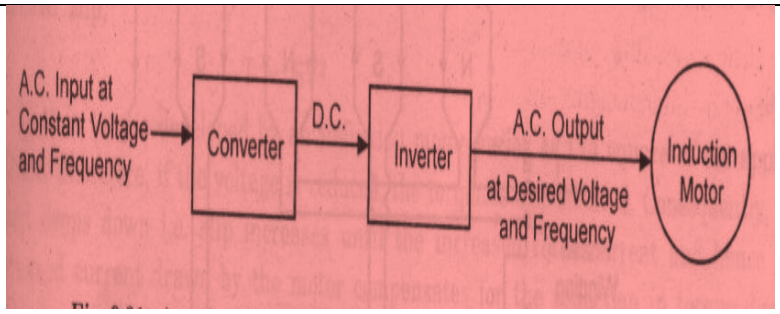
	current levels and it not designed to deliver particular output power that is why rating of transformer is in KVA.
b)	**Draw circuit diagram of direct on line starter.**
Ans:	**Circuit diagram of direct on line starter:** **(4 Mark)**  **or equivalent figure**
c)	**State the factors governing selection of an electric drive for particular service.**
Ans:	**(Any Four Factors expected- 1 Mark each point)** ➢ **Factors to be considered for selection of Electrical Drives: (Any 4 Points expected)** **1) Nature of Supply:-** Whether supply available is AC, pure DC or rectified DC **2) Nature of Drive :-**Whether motor is used to drive individual machines or group of machine **3) Nature of Load: -** Whether load required light or heavy starting torque or load having high inertia require high starting torque for long duration. **4) Electric Characteristics of drive: -** Starting, Running, Speed control and braking characteristics of electric drive should be studied and it should be match with load. **5) Size and rating of motor: -** Whether motor is continuously running, intermittently running or used for variable load cycle. **6) Mechanical Consideration: -** Types of enclosure, Types of bearings, Transmission of power, Noise level, load equalization **7) Cost: -** Capital, Running and maintenance cost should be less.

d)	**State three different safety tools used in electrical circuit. Explain the function of each.**
Ans:	**Following are the safety tools used in electrical circuit:** **(First any Two Tools expected: 1.5 Mark each & another any One Tools: 1 Mark)** 1. **Rubber Mats:** are placed in front of electrical panels and switch boards. 2. **Hand Gloves:** from protect shock in the working period. 3. **Tester:** To test the supply before working. **4. Earthing:** Earth rod
e)	**Define RMS value of an alternating quantity. Explain its practical significance.**
Ans:	**Meaning of R.M.S Value: ---------- (Figure: 1 Mark & Meaning: 2 Mark)** The r.m.s value of an alternating current is that steady current (d.c) which when flowing through a given resistance for a given time produces the same amount of heat as produced by the alternating current when flowing through the same resistance for the same time. **OR** $\therefore$ RMS Value = Form Factor $\times$ Average Value **OR** RMS Value = $0.707 \times$ maximum value ➢ **Practical significance of RMS values: ---------- (1 Mark)** It indicates capacity to do work
f)	**Draw star connected circuit. State the relation between line and phase values of voltages and currents in it.**
Ans:	**Diagram of star connected circuit: (2 Mark)**  **or equivalent figure** **1. The relation between line voltage and phase voltage in star connected circuit** $V_L = \sqrt{3}\, V_{Ph}$ **(1 Mark)** **2. The relation between line current and phase current in star connected circuit.**

	$I_L = I_{ph}$ **(1 Mark)**
g)	**Define autotransformer. State the different types of autotransformer on the basis of voltage level.**
Ans:	**Auto Transformer:-** **(2 Mark)** An Auto Transformer is a transformer having only one winding wound on a laminated magnetic core, the part of this winding being common to both the primary & secondary circuits auto transformer is also called as dimmer stat **OR** **Autotransformer explanation:-** ➢ It is a transformer with one winding only. ➢ Autotransformer is a special transformer in which a part of winding is common for the primary and secondary windings. ➢ It consists of only one winding wound on a laminated magnetic core, with a rotary movable contact. ➢ Autotransformer can operate as a step down or a step up transformer. **Types of autotransformer on the basis of voltage level:** **(2 Mark)** 1. Single phase Auto Transformer 2. Three phase Auto Transformer
Q.3	**Attempt any Four of the following:** **16 Marks**
a)	**State applications of sodium vapour lamps.**
Ans:	**Applications of Sodium vapour lamps:** **(Any Four Expected: 1 Mark each)** **1.** These lamps are used for the illumination of Roads Street light. **2.** for the illumination of Goods Yards, **3.** for the illumination of Airport **4.** for the illumination of Advertisement purpose. **5.** for the illumination of Open theater **6.** for the illumination of Grounds **7.** for the illumination of Workshop **8.** for the illumination of Parking area
b)	**State the first aid measures to be given to a person who has received electric shock.**
Ans:	**First aid measures to be carried out for the person who received electrical shocks:-** **(Any Four Point Expected: 1 Mark each point)** 1. Switching OFF the supply: when a person comes in contact with live conductor, switch off the main supply immediately if it is nearby or cut the wires with

	insulated pliers from the wiring circuit. 2. Removing the person from the contact of current:- Push a person with a dry sticks of wood or pull him by using hands wear by insulated hand gloves, or use cotton thick cloths or use dry news paper folded of sufficient thickness. 3. Removing the person from fire: If a person's cloth catches fire, then wrap him in the blanket or coat & roll him on the ground to extinguish. 4. Call to doctor immediately. 5. Before coming doctor, if any burns or wound occurs on the body of the person use proper oil/ medicine (first aid) 6. If the person is not breathing, immediately start artificial respiration until the medical aid arrives. 7. Do not touch the person with bare hands. 8. Do not give liquid unit the patient is conscious. 9. Give artificial respiration to the person who received electrical shocks by any one method **OR** **First aid measures to be carried out for the person who received electrical shocks:-** i) Mouth to mouth method ii) Schafer's prone pressure method iii) Silvestre's method (Arm-lift-pressure method) iv) Nielson's arm lift Back-pressure method.
c)	**Define electric power and electric energy. State their units.**
Ans:	**1. Meaning of Electric power:** **(Meaning : 1 Mark & Unit: 1 Mark)** Power is defined as the rate of doing work **OR** The rate of doing the work of moving electrons from point to point is called Electric Power. **O**R $Electrical\ Power = V.I$ **The Unit of Electric Power**: Watts **2. Meaning of Electric Energy:** **(Meaning : 1 Mark & Unit: 1 Mark)** Capacity to de work is called energy **OR** Power multiplied by time is called power The amount of work done is taken as measure to energy expended. **OR**

	The amount of work done is exactly equal to the amount of energy expended. **OR** $Electrical\ Energy = V.I.t$ **OR** $Electrical\ Energy = Electrical\ Power \times Time$ **The Unit of Electric Energy**: KWh
d)	**Three resistances of 25 ohms each are connected in delta across a three phase. 400 V a.c. supply. Find phase current. line current and power consumed.**
Ans:	Given Data: V_L = 400V, R_{ph}= 25 ohm, 3-Ph **In Delta connection:** $V_{ph} = V_L \ \therefore V_L = line\ voltage\ \&\ Vph = Phase\ volatge$ $I_L = \sqrt{3}\ I_{ph}$ OR $I_{ph} = I_L/\sqrt{3}$ where I_L is line Current and I_{ph} is phase Currnts **i) Line voltage & Phase voltage:** $\therefore Vph = V_L = 400$ Volt ---------- **(1 Mark)** **ii) Phase Current:** $\therefore Iph = \frac{Vph}{Rph} = \frac{400}{25}$ $\therefore Iph = 16$ Amp ---------- **(1 Mark)** **iii) Line Current:** $I_L = \sqrt{3}\ I_{ph} = \sqrt{3} \times 16$ $\therefore I_L = 27.71$ Amp ---------- **(1 Mark)** **iii) Power Consumed:** ---------- **(1 Mark)** $P = V_L \times I_L$ $P = 400 \times 27.71$ $P = 11084\ Watts$
e)	**Briefly explain the speed control of 3 phase I.M. by variable frequency drive with the help of block diagram.**
Ans:	**Diagram of variable frequency drive: (Diagram-2 Mark & Explanation:2 Mark)**



or equivalent figure

Explanation of speed control of 3 phase induction motor by VFD (Variable frequency Drive):

- The synchronous speed of the induction motor can be varied smoothly over a wide range by changing the supply frequency.
- In order to maintain the air gap flux at its normal value under varying frequency conditions, it is necessary to keep V/f ratio constant.
- Therefore if speed controls to be achieved by changing frequency, the supply voltage is also to be changed simultaneously.
- Since the commercial power systems operate at constant frequency, variation of frequency for speed control purpose is necessarily achieved by using rotary (e.g. motor-generator sets) or solid state frequency conversion equipments.

f) Briefly explain three different types of enclosures for electric machines.

Ans: **Types of enclosures for electric machines: -**

(First any Two Types expected: 1.5 Mark each & another any One Tools: 1 Mark)

Enclosures of motors are selected to suit the requirement of particular environment conditions. Following are some types of enclosures,

i) Open type enclosure:-

It is used where motor is installed in clean atmosphere and in closed room.

ii) Screen Protected enclosure:-

Here screen is provided for rotating parts for better protection. It is also used where motor is installed in clean atmosphere and in closed room.

iii) Drip proof (moisture) enclosure:-

This type of enclosure is used in very damp atmospheric condition such as water pumping station motor on ship sub-merssible motors, etc.

iv) Flame (Fire) proof enclosure:-

It is used where motors are installed in explosive atmosphere like chemical plants, mines etc.

	v) Totally enclosed type enclosure:- It is used where there is dusty atmosphere such as saw mill, stone crushing plant, coal handling plant, cement manufacturing plant, cotton industry etc. As it is totally enclosed it requires special cooling arrangement. **vi) Pipe ventilated totally enclosed type enclosure:-** It is used where there is dusty atmosphere such as saw mill, stone crushing plant, coal handling plant, cement manufacturing plant, cotton industry etc. As it is totally enclosed it requires pipe ventilation, clean and cold air is circulated through pipe forcefully for cooling of motors and hot air is taken out through pipe.
g)	**State the necessity of earthing of electrical motors and appliances.**
Ans:	**Necessity Earthing of electrical motors and appliances:** **(4 Marks)** ➢ The purpose of earthing is to minimize risk of receiving an electric shock if touching metal parts when a leakage current is present. ➢ Earthing is to ensure safety or Protection of electrical equipment and Human by discharging the electrical **leakage current** to the earth. **OR** ➢ Earthing is provided to protect human from shocks due to leakage current. ➢ Earthing provides protection to the electrical **motors and appliances.** due to leakage current. ➢ Earthing provides protection to the electrical **motors to protect against over voltage (Neutral earthing)**

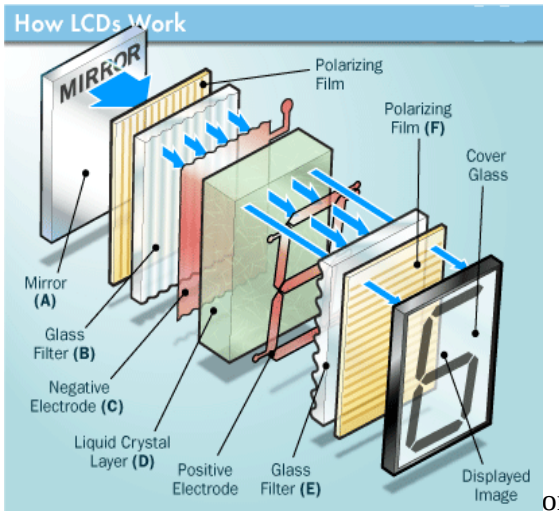
---------- **(END PART-I)** ----------

SECTION — II

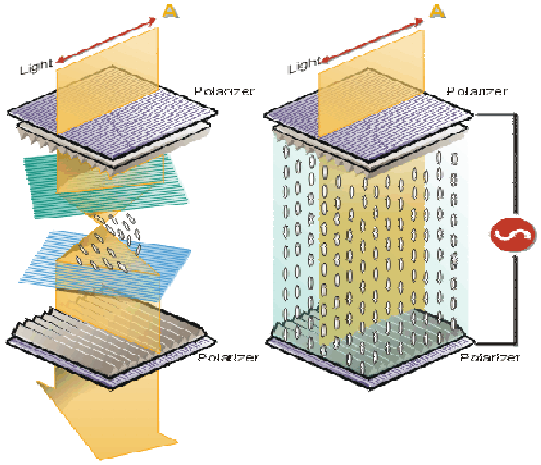
Q.1	Attempt. any Four:16 Marks
a)	Explain the working principle of LCD.

Ans: **Working of LCD: (Marks Allotted – 2 Marks for diagram and 2 – Marks for operation)**

Basics of LCD Displays:-The liquid-crystal display has the distinct advantage of having a low power consumption than the LED**.**



or



or equivalent figure

Working:-

For making an LCD screen, a reflective mirror has to be setup in the back. An electrode plane made of indium-tin oxide is kept on top and a glass with a polarizing film is also added on the bottom side. The entire area of the LCD has to be covered by a common electrode and above it should be the liquid crystal substance. Next comes another piece of glass with an electrode in the shape of the rectangle on the bottom and, on top, another polarizing film. It must be noted that both of them are kept at right angles. When there is no current, the light passes through the front of the LCD it will be reflected by the mirror and bounced back. As the electrode is connected to a temporary battery the current from it will cause the liquid crystals between the common-plane electrode and the electrode shaped like a rectangle to untwist. Thus the light is blocked from passing through. Thus that particular rectangular area appears blank.

OR

Working:

- The source of light produces a light.
- The light passes through a liquid crystal , its intensity is influenced by other layers , especially by liquid crystal.
- The flow of light is controlled by the voltage applied to the liquid crystal.
- According to the voltage applied , the structure of the liquid crystal rotates (different angle for different pixels).
- Thus for each pixel , different amount of light passes through the liquid crystal.
- The electrode on the side of screen is common for all pixels.

b) Define: Line regulation and Load regulation.

Ans: **(2 – Marks for each)**

i) Line regulation:

Itis the capability to maintain a constant output voltage level ofa power supply despite changes in the input voltage level, keeping load resistance constant.

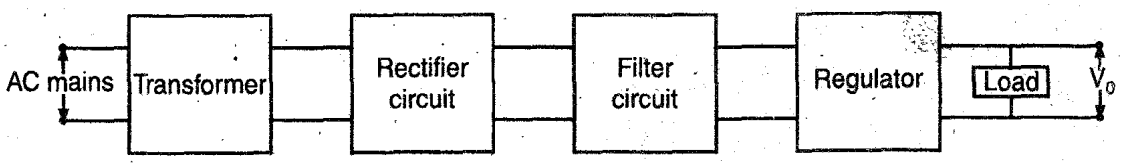
ii) Load regulation:

It is the capability to maintain a constant output voltage level of a power supply despite changes in the load condition i.e. change in the load resistance value , keeping input voltage of regulator constant.

c) Draw the block diagram of regulated power supply and explain it.

Ans: **(Block diagram-2 Mark &Function of each part-1/2 Mark)**

Basic block diagram of a regulated power supply :



OR any other equivalent diagram

Function of each block:

1) Transformer:

A Step down transformer is used to convert 230 V AC supply to required amount of AC supply (e.g. 5V,9V,12V,24V).

2) Rectifier:

A rectifier is an electrical device that convertsalternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction.

3) Filter:

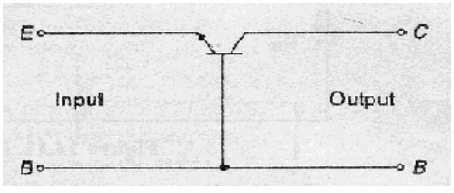
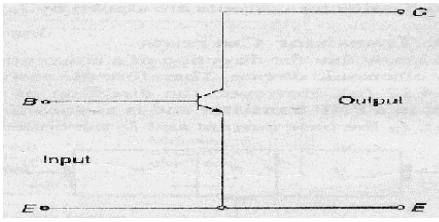
A filter is used to remove unwanted AC componentsor ripple present on the output of rectifier.

4) Regulator:

It is used to maintain constant dc output voltage irrespective of change in input voltage or load resistance.

d) Compare: CE configuration with CB configuration (4 pts.)

Ans: **(Any four points expected: 1 Mark each)**

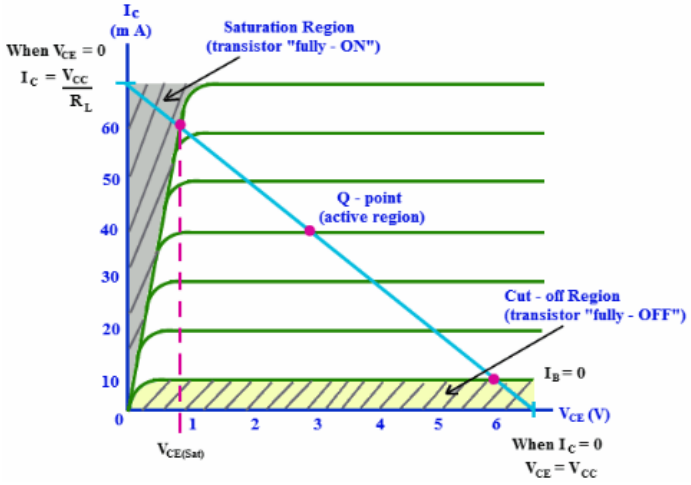
Points	CB configuration	CE configuration
Configuration	In this configuration, base terminal is connected as a common terminal. OR Circuit Diagram	In this configuration, emitter terminal is connected as a common terminal. OR Circuit Diagram
Input and output	The input is applied between the emitter and base terminals. The output is taken between the collector and base terminals. 	The input is applied between the base and emitter terminals. The output is taken between the collector and base terminals. 

Input characteristics	$I_E$is then plotted versus V_{EB} to give the common-base input characteristics keeping the output(CB) voltage constant. OR Characteristics Diagram / plot	$I_B$is then plotted versus V_{BE} to give the common-base input characteristics keeping the output voltageV_{CE} constant. OR Characteristics Diagram / plot
output characteristics	For each fixed value of I_E, $I_C$is plotted versus V_{CB} . OR Characteristics Diagram / plot	For each fixed value of I_B ,$I_C$is plotted versus V_{CE} . OR Characteristics Diagram / plot
Input resistance	Very low (20 ohm)	Low (1 kilo-ohm)
Output resistance	Very high (1 Mega-ohm)	High (10 Kilo-ohm)
Current gain	Less than unity	Large (50-100)
Voltage gain	Very large (150)	Large (100-125)

e) Explain the circuit of transistor as a switch.

Ans: **Transistor as a Switch:** **(Characteristics 2 Marks and working 2 Marks)**

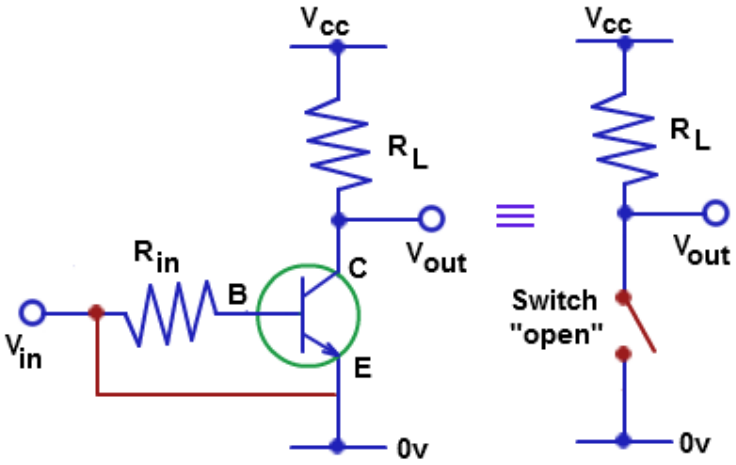
There are basically three regions namely active region, saturation region and cut off region. Transistor used in amplifier as switch so that it operates more in active region. This range is between saturation and cutoff region. When it is set to the maximum level, it is saturation region and when it is completely off the condition is Cutoff.



or equivalent figure

Switch Off

When transistor is switched off it acts in cutoff region where base emitter junction voltage VBE < 0.7 V. Here base-emitter junction and base-collector junction is reverse biased. Hence no collector current flows.



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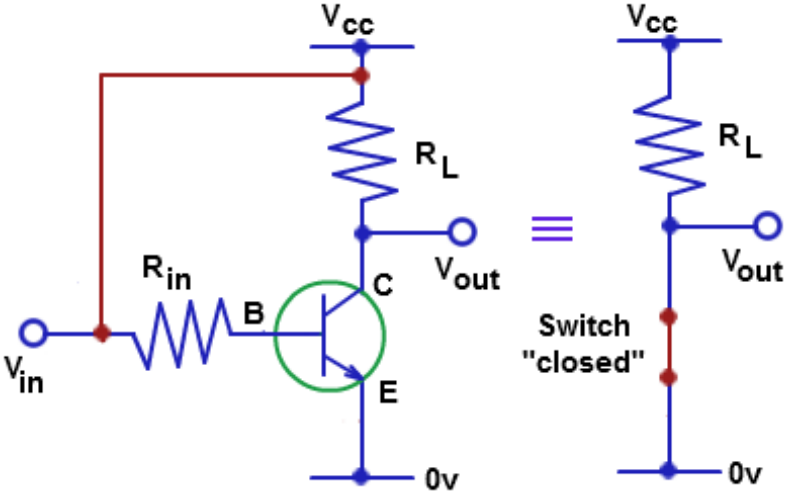
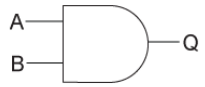
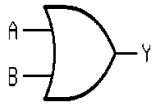
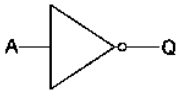
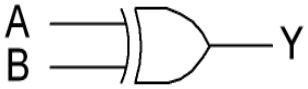
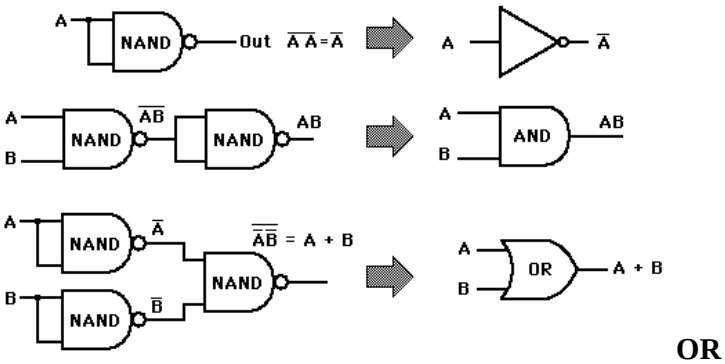
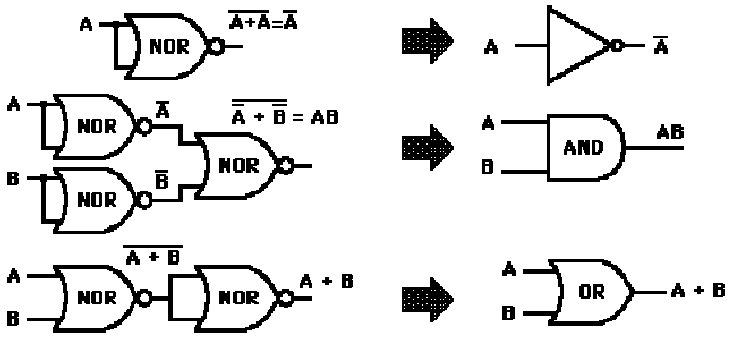
Switch On

When transistor is switched on it acts in saturation region where base emitter junction voltage VBE > 0.7 V. Here base-emitter junction and base-collector junction is forward biased. Hence maximum collector current flows.

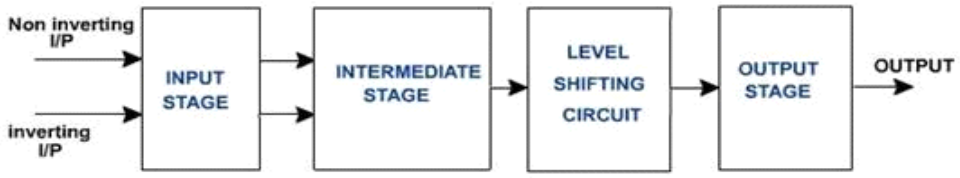


or equivalent figure

f)	**Draw the symbols of following gates : i) AND ii) OR iii) NOT iv) XOR**
Ans:	**i) AND:** **ii) OR :** **(Each Symbol : 1 Mark)**   **iii) NOT :** **iv) Ex-or :**  
Q.2	**Attempt any THREE of the following:18 Marks**
a)	**Design basic gates using NAND and NOR gate**
Ans:	**Basic gates using NAND gates - (3 marks for NAND gates and 3 marks for NOR gates)**  **OR** **Basic gates using NOR gates:**  **OR equivalent figure**

b) Draw the block diagram of OP-AMP and explain each block of it.

Ans: **Block diagram of OP-AMP:** **(3 Marks for diagram and 3 Marks for Explanation)**



1. Input Stage:
- Dual i/p, Balanced o/p Diff Amplifier
- Provides → most voltage gain of Op-Amp
  → i/p resistance of Op-Amp

2.Intermediate Stage:
- Dual i/p, Unbalanced o/p Diff Amplifier
- Drives the o/p of 1st stage
- Direct coupling→ dc voltage well above gnd level

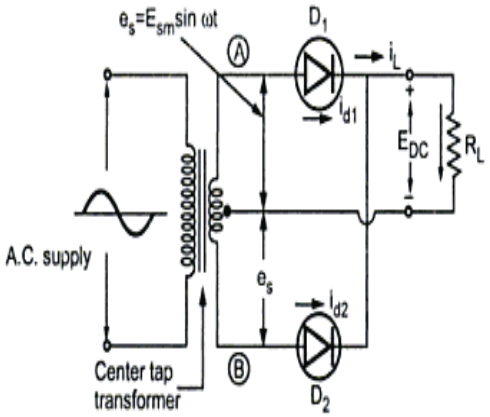
3. Level Translator (or) Shifting Stage:
- Dc voltage level to zero w.r.t gnd

4.Output Stage:
- Increases o/p voltage swing
- Raises current supply capability of Op-Amp
- Low Resistance

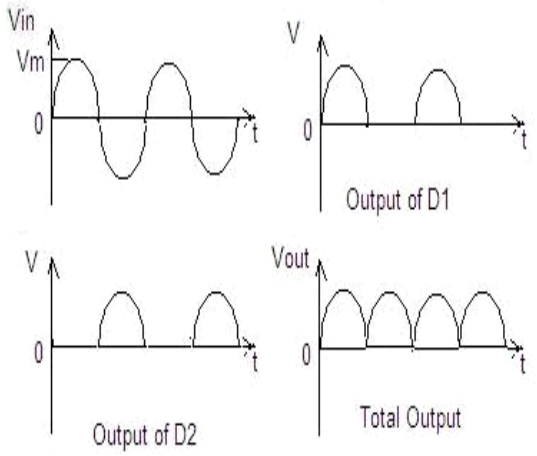
c) Draw and explain the ckt. of full wave rectifier with its I / P and O / P waveforms.

Ans: **Full wave rectifier with its I / P and O / P waveforms**

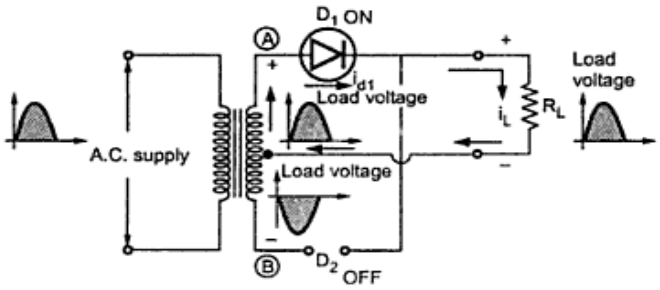
(3 Marks each for circuit diagram , waveform and explanation: 3 Mark)



Full wave rectifier



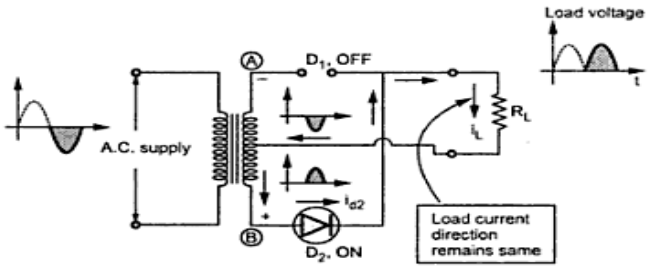
Operation of the Circuit



Current flow during positive half cycle

Consider the positive half cycle of ac input voltage in which terminal (A) is positive and terminal (B) negative. The diode D_1 will be forward biased and hence will conduct; while diode D_2 will be reverse biased and will act as an open circuit and will not conduct. This is illustrated in the Fig.

The diode D_1 supplies the load current, i.e. $i_L = i_{d1}$. This current is flowing through upper half of secondary winding while the lower half of secondary winding of the transformer carries no current since diode D_2 is reverse biased and acts as an open circuit.



Current flow during negative half cycle

In the next half cycle of a.c. voltage, polarity reverses and terminal (A) becomes negative and (B) positive. The diode D_2 conducts, being forward biased, while D_1 does not, being reverse biased. This is shown in the Fig.

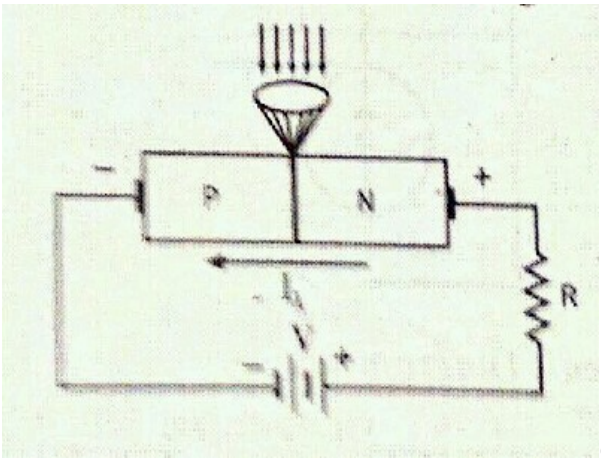
The diode D_2 supplies the load current, i.e. $i_L = i_{d2}$. Now the lower half of the secondary winding carries the current but the upper half does not.

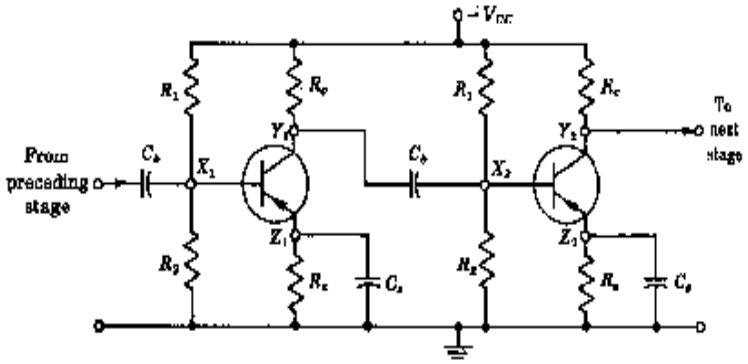
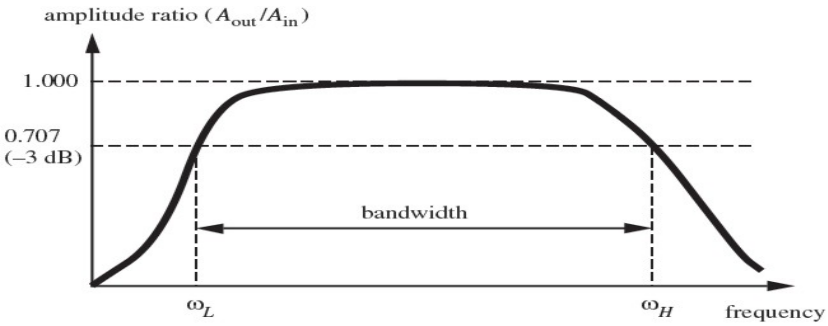
It is noted that the **load current flows in both the half cycles of a.c. voltage and in the same direction through the load resistance.** Hence we get rectified output across the load. The load current is sum of individual diode currents flowing in corresponding half cycles. It is also noted that the two diodes do not conduct simultaneously but in alternate half cycles. The individual diode currents and the load current are shown in the Fig.

d) i) Compare : BJT with FET. (3 pts.)

Ans: **(Any Three points expected: 1 Mark each)**

BJT	FET
The BJT is a current-controlled device	FET is considered as a voltage-controlled device
It is bipolar device	It is unipolar device
Low input impedance	Very high input impedance
Low output impedance	High output impedance
Medium switching time	Fast switching time
High voltage gain	Low voltage gain

d)	**ii) Define Intrinsic and Extrinsic semiconductors.**
Ans:	**Intrinsic semiconductor-** **(1.5 Mark)** The semiconductor which is in purest form like Si, Ge (without trivalent or pentavalent impurities/ doping) is called "Intrinsic semiconductor." **Extrinsic semiconductor-** **(1.5 Mark)** The semiconductor which is having doping of trivalent materials (Boron , Aluminium) or pentavalent materials (Phosphorus , Arsenic) is called "Extrinsic semiconductor."
Q.3	**Attempt any Four: :** **16 Marks**
a)	**Explain the working principle of photo diode.**
Ans:	**i) Photodiode Schematic diagram:** **(2 Marks for diagram, 2 Marks for Working)**  **or equivalent dia.** **Working-** Photodiode is a two terminal semiconductor P-N junction device and is designed to operate with reverse bias.A photodiode is a p-n junction or PIN structure. When a photonof sufficient energy strikes the diode, it excites an electron, thereby creating a free electron(and a positively charged electron hole). When a reverse biased P-N junction is illuminated, the current flowing through it varies almost linearly with light flux. The output voltage is taken from across a series-connected load resistor R as shown in above figure.

b)	**Draw the ckt. diagram of RC coupled amplifier and show its frequency response with proper notations.**
Ans:	**(2 Marks for diagram, 2 Marks for frequency response)** **Two stage RC coupled amplifier- Circuit diagram**  **or equivalent figure** **Frequency response : Gain VS Frequency plot**  **or equivalent figure**
c)	**State Barkhausen's criteria of oscillations. List different types of oscillators.**
Ans:	**(2 Marks two conditions &2 marks for types of oscillators)** **Barkhausen's criterion is a necessary condition for oscillation:** It states that if A is the gain of the amplifying element in the circuit and $\beta(j\omega)$ is the transfer functionof the feedback path, so βA is the loop gain around the feedback loop of the circuit, the circuit will sustain steady-state oscillations only at frequencies for which: 1. The loop gain is equal to unity in absolute magnitude, that is, $\lvert\beta A\rvert = 1$ and 2. The phase shift around the loop is zero or an integer multiple of 2π.

Following are the types of oscillator:-

1) AF Oscillator and RF Oscillator

2) LC Oscillator and RC Oscillator

3) Hartley oscillator , Colpitts oscillator , Phase-shift oscillator , Wien bridge oscillator

d) Convert the following: i) (32)10 = (?)$_2$ ii) (99)$_{BCD}$ = (?)$_2$

Ans: **(2 Marks for each conversion)**

i) Any proper method & answer is $(32)_{10} = (00100000)_2$.

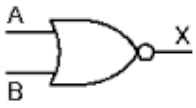
ii) Assuming 99 as decimal number and conversion of $(99)_{10}$ to binary number.

So, answer is $(99)_{10} = (01100011)_2$.

e) Draw the symbols and truth table of : i) NOR gate ii) NAND gate

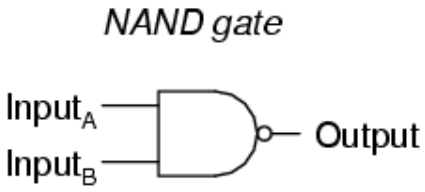
Ans: **(1 Mark for symbol and 1 Mark for truth table)**

i) NOR gate :



A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

ii) NAND gate :

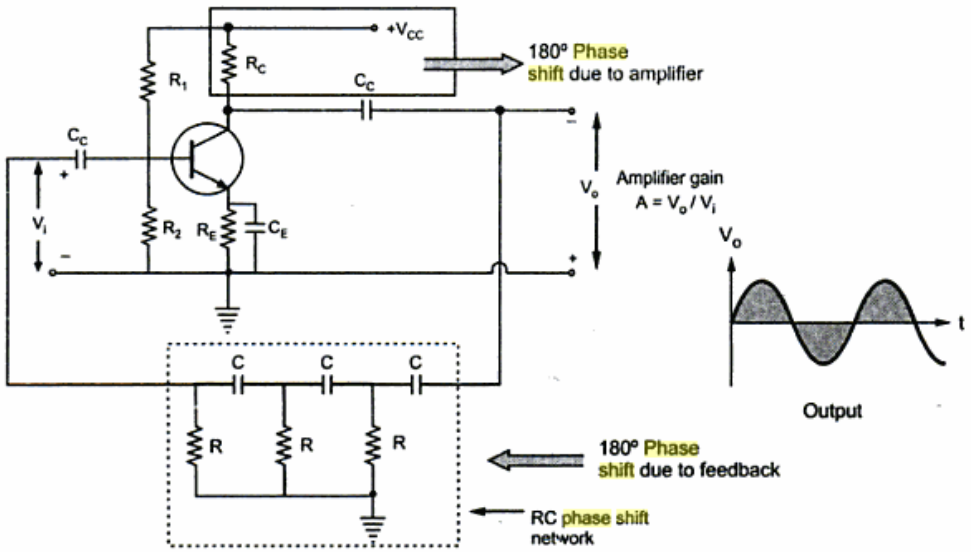


A	B	Output
0	0	1
0	1	1
1	0	1
1	1	0

f)	**Draw and explain the working of phase shift oscillator.**
Ans:	**(2 Marks for circuit , 2 Marks for explaination)**

Phase Shift Oscillator using Transistor

In a practical RC phase shift oscillator, a common emitter (CE) single stage amplifier is used as a basic amplifier. This produces 180° phase shift. The feedback network consists of 3 RC sections each producing 60° phase shift. Such a RC phase shift oscillator using BJT amplifier is shown in the Fig.



Transistorised RC phase shift oscillator

The output of amplifier is given to feedback network. The output of feedback network drives the amplifier. The total phase shift around a loop is 180° of amplifier and 180° due to 3 RC section, thus 360°. This satisfies the required condition for positive feedback and circuit works as an oscillator.

The frequency of sustained oscillations generated depends on the values of R and C and is given by,

$$f = \frac{1}{2\pi\sqrt{6}\,R\,C}$$

The frequency is measured in Hz.

----------END SECTION-II----------