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.

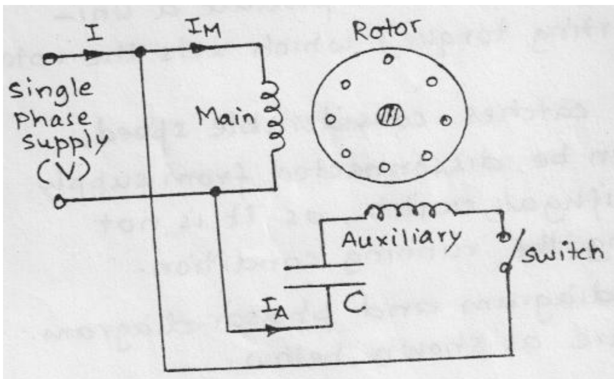
SECTION — I

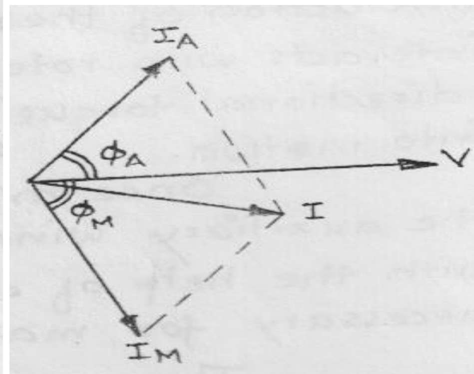
Q.1	**Attempt any FIVE of the following:** **20 Marks**
a)	**Define the following. (i) Frequency (ii) Phase (iii) Average value (iv) Maximum value**
Ans:	**i) Frequency:** **(1 Mark)** The number of cycles completed by an alternating quantity in one second is called as frequency. It Unit: Hertz (Hz) **ii) Phase:-** **(1 Mark)** It is the angle between any two quantities current and voltage or between two same voltages and same current. **iii) Average value :** **(1 Mark)** Average value of A.C current is equal to the D.C current that is required to produce the same amount of charge. **OR** $Average\, value = \frac{RMS\ Value}{Form\ \ factor}$ Average Value = 0.637 $\times$ maximum value **iv) Maximum Value:** **(1 Mark)** The peak value of an alternating quantity is called its maximum value.

b)	**State relation between phase and line current and voltage in balanced star and delta connections.**
Ans:	**1. The relation between line voltage and phase voltage in star connected circuit** **(1 Mark)** $$V_L = \sqrt{3}\,V_{Ph}$$ **2. The relation between line voltage and phase voltage in delta connected circuit** **(1 Mark)** $$V_{ph} = V_L \quad \therefore V_L = line\ voltage\ \&\ Vph = Phase\ volatge$$ **1. The relation between line current and phase current in star connected circuit.** **(1 Mark)** $I_L = I_{ph}$ **2. The relation between line current and phase current in delta connected circuit.** **(1 Mark)** $$I_L = \sqrt{3}\ I_{ph}\ \ OR\ \ I_{ph} = I_L/\sqrt{3} \quad where\ I_L\ is\ line\ Current\ and\ I_{ph}\ is\ phase\ Currnts$$
c)	**Give expression for e.m.f. equation, and transformation ratio of transformer.**
Ans:	**Expression for e.m.f. equation of transformer:** **Emf equation of transformer:** N_1 = No. of turns on primary winding N_2 = No. of turns on secondary winding Φ_m = maximum value of flux linking both the winding in Wb f = Frequency of supply in Hz R.M.S. emf induced in primary winding = (RMS emf / turn) x N_1 $E_1 = 4.44\ \Phi_m f\ N_1$ volts---------------------- **(1 Mark)** Similarly, $E_2 = 4.44\ \Phi_m f\ N_2$ volts ------------------------ **(1 Mark)** **Transformation Ratio (k):-** --- **(2 Marks)** It is the ratio of secondary number of turns to primary number of turns. OR It is the ratio of secondary voltage to primary voltage. **OR** It is the ratio of primary current to secondary current. $$Transformation\ \ ratio\ (k) = \frac{N_2}{N_1}\ or = \frac{E_2}{E_1}\ or = \frac{V_2}{V_1}\ or = \frac{I_1}{I_2}$$

d) Explain with suitable diagram working of capacitor start split phase induction motor.

Ans: **(Figure: 2 Mark & Explanation: 2 Marks, Total: 4 Marks)**





Explanation:

- In this motor a capacitor is connected in series with the auxiliary winding but only during stating, later on it is disconnected with the help of centrifugal switch.
- Due to capacitor the current I_A leads the applied where as I_M lags behind the applied voltage.
- The phase difference between these current is very much closer to 90^0.
- Therefore the flux produced by these current are also displaced in phase by about 90^0 , thereby creating effect of a two phase supply.
- Rotating magnetic field is produced and the starting torque is produced which sets the rotor in motion.
- When the rotor attains a speed of about 70% to 80% , the centrifugal switch is opened, thereby disconnecting the auxiliary winding from supply.

e) Differentiate between Fuse and MCCB. (Any four points)

Ans: **(Any Four points expected: 1 Mark each point, Total: 4 Marks)**

S. No.	Particulars	Fuse	MCCB
1	Function	Fuse is used for the detection of fault as well as the interruption of circuit.	Circuit breakers perform switching operations (make and break operations) alone. Fault detection is made by protective relays
2	Principle of operation	The operation of electric fuses is based on the heating property of electric	Overload by bimetallic strip. SC by Solenoid using electromagnetic

		current.	attraction force
3	Mode of operation	Completely automatic	Manual operation. To make circuit breakers automatic, additional relay arrangements should be made.
4	Additional equipments required	No additional equipments are needed.	For automated operations additional relay arrangements should be needed.
5	Operating time	Operating time of fuses is very small, close to 0.002 seconds.	Operating time of circuit breakers are more than that of the fuses. (0.02 -0.05 seconds)
6	Breaking capacity	Breaking capacity of fuses is small.	Breaking capacity of circuit breaker is large.
7	Operating current	Few mA to A Small to medium	0.5A to 63A
8	Size	Smallest	Medium
9	Running cost	Highest	Nil
10	type of connection	Only in phase	Only in phase

f) **Describe the safety tools in order to avoid shocks.**

Ans: **Minimum required of safety devices & special tools to be provided to individual are.**

(Any Four Tolls Expected: 1 Mark each, Total 4 Marks)

1. Rubber hand gloves of proper voltage rating.
2. Safety shoes
3. Safety Belt
4. Ladder
5. Earthing devices
6. Helmet
7. Line tester
8. Rope
9. Hand tools insulated
10. Dress code 100 % cotton etc.

g) **What is earthing? Why is it necessary?**

Ans: **Meaning of earthing:** **(2 Marks)**

Connecting the metallic frame of the electrical machines /any electrical equipment body etc to ground is known as earthing. Earthing protected against the electric shock.

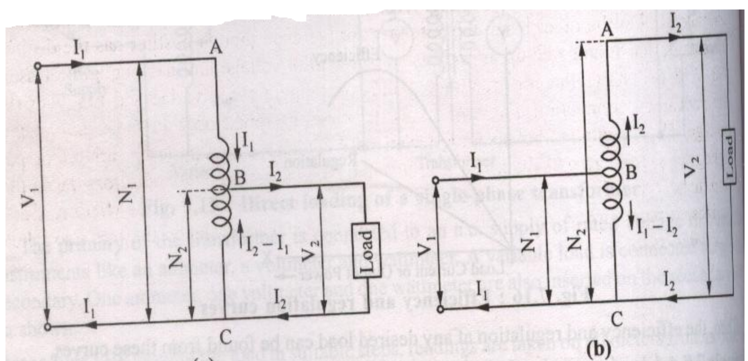
Necessity Earthing: **(2 Marks)**

- Earthing provides protection to the electrical machinery due to leakage current.
- Earthing provides protection to Tall Building & structure against lightening stroke
- Earthing is protects human from shocks.

Q.2 **Attempt any THREE of the following:** **18 Marks**

a) **With neat sketches, explain working of Auto transformer. List four specifications.**

Ans: **(Figure: 2 Mark & Working: 3 Mark, Specification: 1 Mark, Total: 6 Marks)**



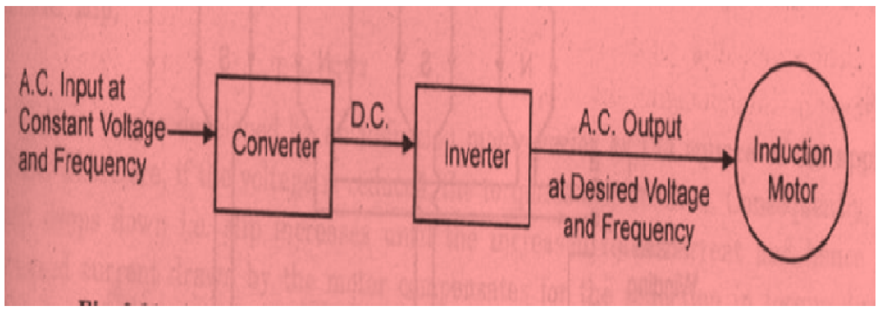
(a) Step-down auto-transformer, (b) Step-up auto-transformer

Auto Transformer:-

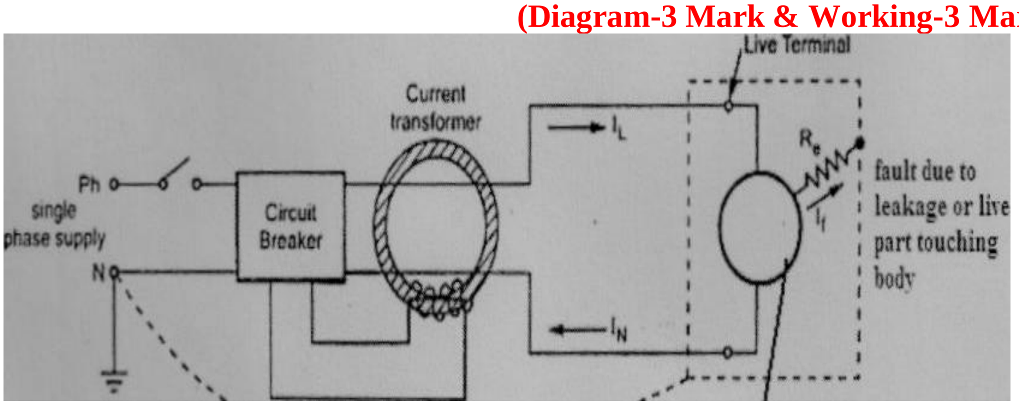
An Auto Transformer is a transformer having only one winding wound on a laminated magnetic core, the part of this winding being common to both the primary & secondary circuits auto transformer is also called as dimmer stat **OR**

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.

	Auto Transformer specifications. ➢ Single phase Auto Transformer ➢ Three phase Auto Transformer
b)	**Explain with block diagram speed control of induction motor by variable frequency drive method.**
Ans:	**(Diagram-3 Mark & Working-3 Mark)**  **or equivalent fig** **Explanation of speed control of 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.
c)	**(i) State classification of drives.**
Ans:	**Classification of drive:** **(Each Classification: 1 Mark, Total: 3 Mark)** i) Individual Drive ii) Group drive iii) Multimotor Drive
c)	**(ii) List factors for selection of Motor for different drives.**
Ans:	**(Any three Factors expected- 3 Mark each point)** ➢ **Factors to be considered for selection of Electrical Drives: (Any 3 Point 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)	**Draw neat sketch and explain working of ELCB.**
Ans:	**(Diagram-3 Mark & Working-3 Mark)**



Earth leakage circuit breaker is a safety device used in electrical installations with high earth impedance to prevent shocks and disconnect power under earth fault conditions. Works on principle of relaying when the current in the earth path exceeds a set value. ELCB is used for protection against electric leakage in the circuit of 50 Hz or 60 Hz , rated voltage single phase 240 V, 3 ph. 4 kv. Rated current up to 60 Amp. When the earth fault occurs, the ELCB cuts off the power within the time of 0.1 sec. automatically to protect the personnel.

Under normal conditions (IL — IN) = If is very low or nearly zero. The CT surrounding the phase and neutral senses the differential current under earth fault and actuates the CB to operate (open). The difference current If through fault path resistance R_e is the leakage to earth. If this value exceeds a preset value then the CB opens. Normally it is around 35 mA for tripping in domestic installations with tripping time being as low as 25msec.

Q.3	Attempt any THREE of the following: 12 Marks
a)	**Define voltage and current with their units.**

Ans: **(Each definition & Unit-2 Mark: Total: 4 Mark)**

1) Current:

It is defined as the movement of free electrons or flow of electrons inside a conducting material. It is denoted by I and measured in ampere.

OR $I = Q/t$

Where,

I = Average current in amperes

Q = Total charge flowing

T = Time in seconds required for the flow of charge

$$Units:-coulomb/\sec.\ or\ Amperes.$$

2) Voltage:-

Work done per unit charge is called voltage.

OR

The electrical potential or voltage at a point is the work done in moving unit charge form infinity to that point.

OR

$$V = W/Q$$

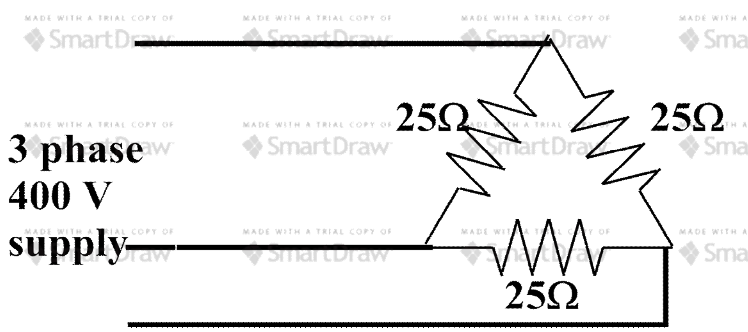
Unit for voltage = Volt

b) Three resistance of 25ohm each are connected in delta across a 3-Ph, 400 V a.c. supply. Draw the circuit; find phase current, line current, line voltage, phase voltage.

Ans: Given Data:

V_L = 400V, R_{ph}= 25 ohm, 3-Ph

Draw the Circuit: --- (1 Mark)



In Delta connection:

$$V_{ph} = V_L \quad \therefore V_L = line\ voltage \ \&\ Vph = Phase\ volatge$$

	$I_L = \sqrt{3}\ I_{ph}$ 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)**
c)	**Define efficiency and voltage regulation of transformer.**
Ans:	**i) Efficiency:-** $Transmission\ \ Efficency = \frac{Output\ power\ \ at\ receiving\ \ end}{Input\ power\ \ at\ sending\ \ end} \times 100$ ---- **(1 Mark)** $\eta_T \% = \frac{Output\ (P_R)\ (Load(power)\ at\ reciving\ end)}{Output\ (P_R) + Total\ losses} \times 100$ **Where, P_R is o/p power at receiving end** **OR** **% Efficiency =** $\frac{P_R}{P_R + I^2 R_T} \times 100 \ \ ------ for - 1 - Phase \quad Where,\ R_T\ is\ total\ resistance$ **OR** **% Efficiency =** $\frac{P_R}{P_R + 3 I^2 R_{ph}} \times 100 \ \ ------ for - 3 - Phase \quad Where, R\ is\ resistance\ of\ per\ phase$ **OR** **% Efficiency =** $\frac{output\ \ power}{output\ \ power\ + total\ copper\ losses} \times 100$ ------------- **(1 Mark)** **ii) Voltage Regulation:** Voltage regulation is nothing but voltage drop in transmission line expressed in % of receiving end voltage

$$\% \textbf{ Regulation} = \frac{Sending\ End\ Voltage - Receiving\ End\ Voltage}{Receiving\ End\ Voltage} \times 100$$ **(1 Mark)**

$$\% \text{ Voltage Regulation} = \frac{V_S - V_R}{V_R} \times 100$$ **------------------ for 1-phase**

Where, V_R = receiving end voltage V_S = Sending end voltage

$$\% \text{ Regulation} = \frac{I_R(R_T\ Cos\phi_R \pm X_T\ Sin\phi_R}{V_R} \times 100$$ **------------ For 1-phase**

Where, R_T = Total resistance & X_T = Total reactance

$$\% \text{ Voltage Regulation} = \frac{V_S ph - V_R ph}{V_R ph} \times 100$$ **--- For 3-phase** -------- **(1 Mark)**

$$\% \text{ Regulation} = \frac{I_R(R_{ph}\ Cos\phi_R \pm X_{ph}\ Sin\phi_R}{V_R ph} \times 100$$ **----------------- For 3-phase**

Where, **"+ ve"** sign is used when Power factor is lagging.
"- ve" sign is used when Power factor is Leading.

d) **Compare squirrel cage motor with slip ring rotor of 3-phase induction motor. (Any four points)**

Ans: **(Any four points each 01 Marks)**

S.No	3-phase squirrel cage I.M	Slip ring 3-Ph I.M
1	Rotor is in the form of bars	Rotor is in the form of 3-ph winding
2	No slip-ring and brushes	Slip-ring and brushes are present
3	External resistance cannot be connected	External resistance can be connected
4	Small or moderate starting torque	High Starting torque
5	Starting torque is of fixed	Starting torque can be adjust
6	Simple construction	Completed construction
7	High efficiency	Low efficiency
8	Less cost	More cost
9	Less maintenance	Frequent maintenance due to slip-ring and brushes.
10	Starting power factor is poor	Starting power factor is adjustable & large
11	Size is compact for same HP	Relatively size is larger
12	Speed control by stator control method only	Speed can be control by stator & rotor control method

e)	**What is Tariff? State the types of tariff**
Ans:	**Tariff:** **(1 Mark)** Tariff is the way of billing energy consumed by consumer. **OR** The rate at which electrical energy is supplied to a consumer is known as tariff. **Types of Tariff:-** **(Any Three types are expected: 1 Mark each: Total 3 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

-- (END PART-I) ---

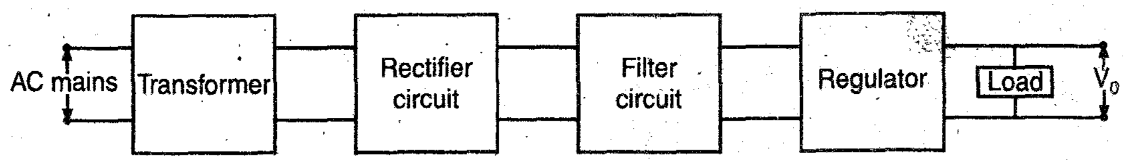
SECTION — II

Q.4	**Attempt. any FIVE of the following:**	**20 Marks**
a)	**Define conductor and insulator with example. (any two)**	
Ans:	**Conductor:** **(1 Mark for definition and 1 Mark for 2 examples)** In some materials, the outermost electrons of the atoms are loosely bound and free to move through the material. Any substance that has free electrons and allows charge to move relatively freely through it is called a conductor. OR In energy band diagram , where there is overlapping of conduction band and valency band ,it is called as conductor. e.g. Silver, copper, gold, aluminum, etc. **Insulator:** **(1 Mark for definition and 1 Mark for 2 examples)** In most solid materials the outermost electrons are so tightly bound that there are no free electrons that can freely move throughout the material. These materials are known as insulators. . OR In energy band diagram , where there is large gap(band gap) present between conduction band and valency band ,it is called as conductor. e.g. glass, paper, air, etc.	
b)	**Define intrinsic and extrinsic semiconductor with suitable example.**	
Ans:	**Intrinsic semiconductor-** **(1 Mark for definition and 1 Mark for example)** The semiconductor which is in purest form like Si, Ge (without trivalent or pentavalent impurities/ doping) is called "Intrinsic semiconductor." **Extrinsic semiconductor-** **(1 Mark for definition and 1 Mark for example)** The semiconductor which is having doping of trivalent materials (Boron , Aluminium) or pentavalent materials (Phosphorus , Arsenic) is called "Extrinsic semiconductor."	

c) **Draw block diagram of regulated power supply. State the function of each block.**

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 converts alternating 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 components 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) **What is rectifier? State the need of rectifier.**

Ans: **Rectifier:** **(2 Marks)**

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

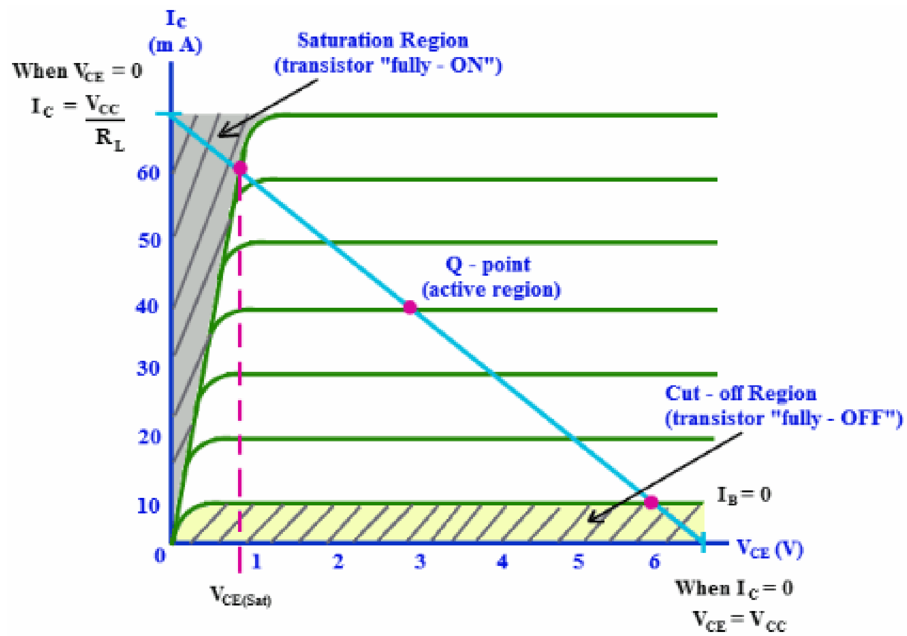
Need of rectifier: **(2 Marks)**

Almost all the electronic circuits require a dc power. For the portable low power circuits, we can use the batteries but most of the time we need to use the supply(mains) to supply power then we have to use an equipment which can convert ac voltage into the dc voltage such a circuit is called a rectifier.

e)	**Explain the working of transistor as a switch.**

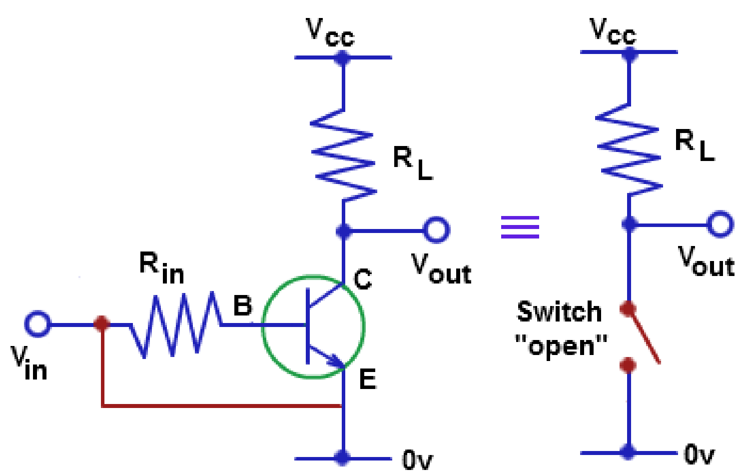
Ans: **Transistor as a Switch:** **(Characteristics 2 Marks and working 2 Marks)**

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.



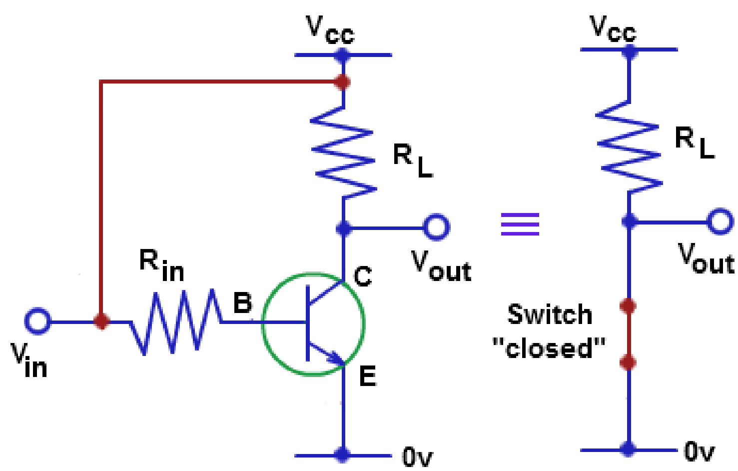
Switch Off

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.



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.



f)	**Define oscillator. State the criterial conditions for sustained oscillations.**
Ans:	**Oscillator:** **(1 Mark)**

An **electronic oscillator** is an electronic circuit that produces a repetitive, oscillating electronic signal, often a sine wave or a square wave. Oscillators convert direct current (DC) from a power supply to an alternating current signal.

The criterial conditions for sustained oscillations— (Barkhausen criterion) **(3 Marks)**

1. There should be proper positive feedback in the oscillator circuit.
2. The following condition must be satisfied

   $m_v A_v \geq 1$

   where m_v = Feedback fraction

   A_v = Voltage gain of amplifier without feedback

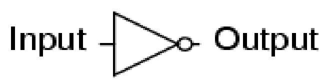
   The relation is called Barkhausen criterion.

g) **Draw symbol of NOT and XNOR gate with their truth table.**

Ans: **Logic symbol and truth table of NOT Gate:**

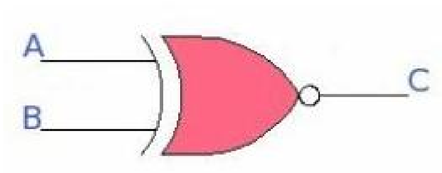
(1 Mark for symbol and 1 Mark for truth table)

NOT gate truth table



Input	Output
0	1
1	0

Logic symbol and truth table of EX-NOR Gate: **(1 Mark for symbol and 1 Mark for truth table)**

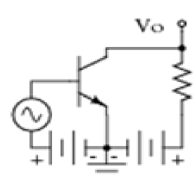
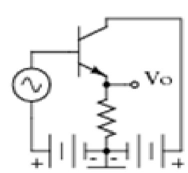
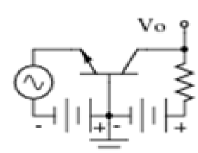


A	B	C (Out)
0	0	1
0	1	0
1	0	0
1	1	1

Q.5 **Attempt any THREE of the following:** **18 Marks**

a) **Give comparison between CB, Cl and CC configuration. (six points)**

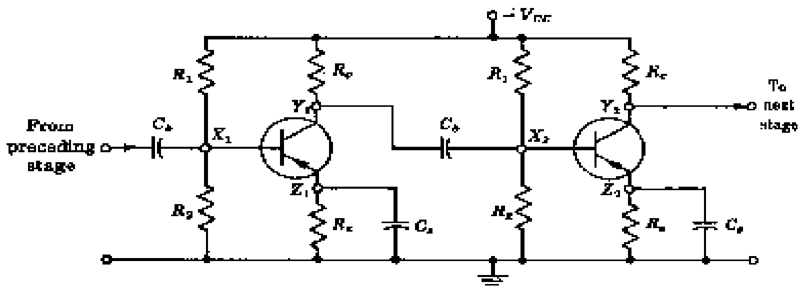
Ans:

Basic circuit	Common emitter	Common collector	Common base
			
Voltage gain	high	less than unity	high, same as CE
Current gain	high	high	less than unity
Power gain	high	moderate	moderate
Phase inversion	yes	no	no
Input impedance	moderate ≈ 1 k	highest ≈ 300 k	low ≈ 50 Ω
Output impedance	moderate ≈ 50 k	low ≈ 300 Ω	highest ≈ 1 Meg

(Each point 1 Mark)

b) Draw and explain two stages RC coupled amplifier. List two applications.

Ans: **Two stage RC coupled amplifier- Circuit diagram** **(4 Marks)**



Working:-

Vin is the small a.c. signal which is to be amplified.

- Q1 and Q2 are NPN transistors, therefore + Vcc is applied.
- C1 = input coupling capacitor C2 couples stage1 output with stage2

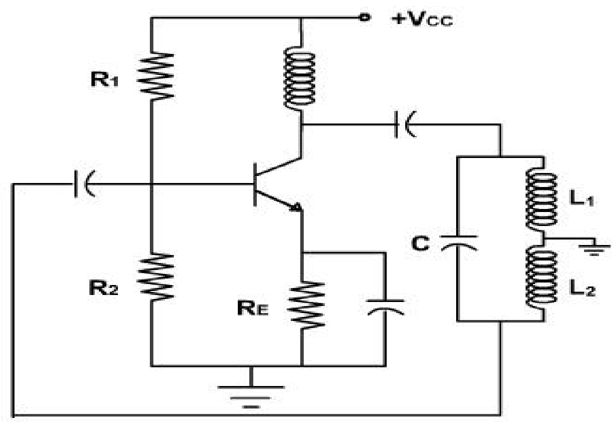
  C3 = output coupling capacitor
- R1 and R2 form voltage divider bias
- R1, R2 and Re provide steady Q-point and the transistor is operated in active region.
- Total gain of the amplifier = A_1 X A_2,(A1= gain of first stage,A2= gain of second stage)

180 degree phase shift is provided by each transistor, hence total phase shift = 360 degree. Thus the output is in phase with the input.

Applications: **(2 Marks)**

They are widely used as voltage amplifiers (ie. In the initial stages of public address systems) because of their excellent audio-fidelity over a wide range of frequency. They are also used in communications, controllers, audio and video instruments etc

c)	Draw and explain Hartley Oscillator. State its two applications.
Ans:	**Hartley Oscillator: (Diagram 2 Marks, Explanation 2 Marks, applications 2 Mark)**



Explanation :

Figure shows Hartley oscillator when LC tank is resonant, the circulating current flows through L_1 in series with L_2. Thus, equivalent inductance is $L = L_1 + L_2$.

In the oscillator, the feedback voltage can be developed by the inductive voltage divider, L_1 & L_2. Since output voltage appears across L_1 and feedback voltage across L_2, the feedback fraction can be given by

$$\beta = V / V_{out} = XL_2 / XL_1 = L_2 / L_1$$

As usual, loading effect of the base is ignored. For the oscillations to begin, the voltage gain should be greater than 1/ β. The frequency of oscillation can be given by

$$f_r = \frac{1}{2\pi\sqrt{2LC}}$$

Applications:

1. It is used as local oscillator in radio and TV receivers.
2. In the function generators.
3. In RF sources.

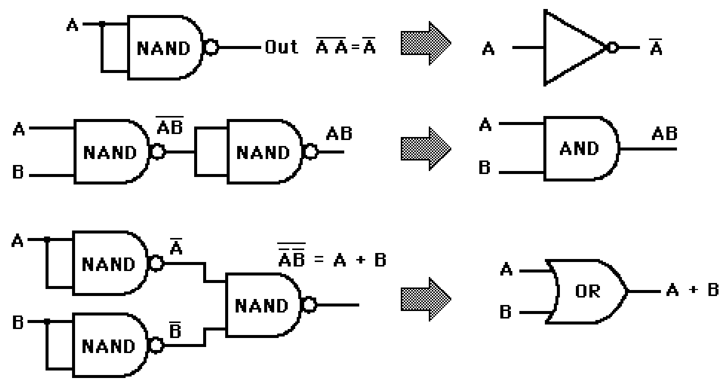
d) What is universal gate? Design basic gates using any one of the universal gate.

Ans: **(Universal gates : 2 marks, AND, OR, INVERTER using NAND or NOR gates: 4 marks)**

Meaning of Universal Gate:

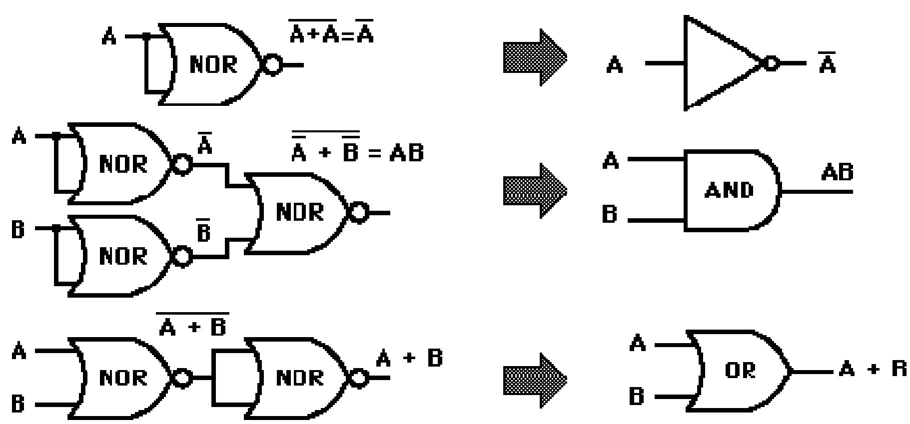
The NAND gate and NOR gate are called as universal gates since any other gate can be formed using number of NAND gates or NOR gates combination.

Basic gates using NAND gates -



OR

Basic gates using NOR gates:–

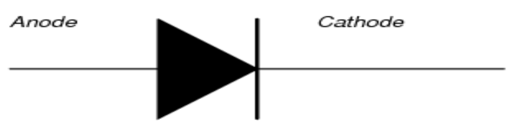


OR equivalent figure

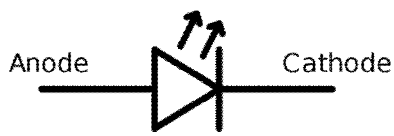
Q.6 Attempt any THREE of the following: : 12 Marks

a) Draw symbol of the following: (i) PN junction diode (ii) Zener diode (iii) LED (iv) UT

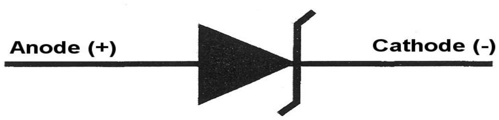
Ans: **(i)Symbol of PN junction diode :-** **(1 Mark)**



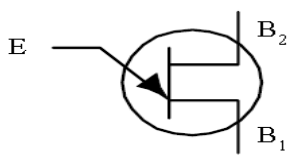
(ii)Symbol of LED :- **(1 Mark)**



(iii)Symbol of Zener diode **(1 Mark)**



(iv)Symbol of UJT **(1 Mark)**



b) Give comparison between BJT and .FET. (Any four points)

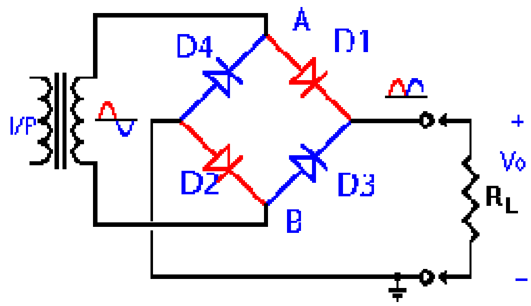
Ans:

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

(1 Mark for any 1 point)

c)	**Draw circuit diagram of Bridge rectifier. Explain with their waveform.**
Ans:	**(Circuit Diagram – 1 mark, Working – 2 marks, waveform – 1 mark)**

Circuit of bridge rectifier:

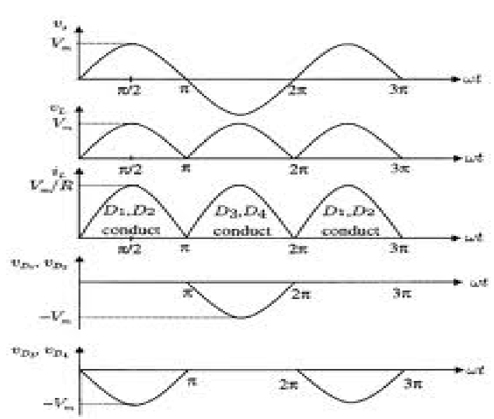


Working:-

The Bridge rectifier consists of a step down transformer, a rectifier circuit with four diodes and a load resistance RL .

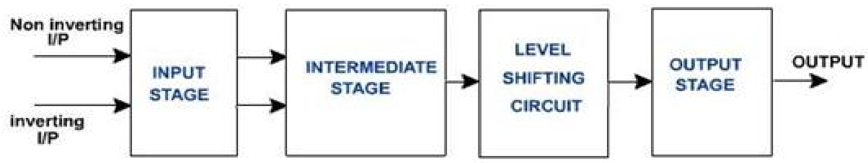
- The 230 V ac input from mains is stepped down (reduced) using the step transformer.
- The reduced ac i.e. output of the secondary of the transformer is applied to the bridge circuit.
- The bridge consists of four diodes D1,D2,D3&D4, which offers full wave rectification. The diodes conduct in pair.
- During +ve half cycle of the ac input, point A is +ve& point B is –ve. Therefore diode D1 & D2 are forward biased and D3 & D4 are reverse biased. Therefore only D1 and D2 conduct and the current flows along the path " A-D1-RL-D2-B".
- During -ve half cycle of the ac input, point B is +ve& point A is –ve. D3 and D4 conduct while D1 & D2 remain reverse biased(off). Therefore the current follows following path" B-D3-RL-D4-A".
- In both the cases load resistance conducts in the same direction as shown in the above figure. Thus the ac signal gets converted into dc pulses.

The waveforms are as follows:-



d) **Draw block diagram of OP-AMP. State function of each block.**

Ans: **(2Marks for diagram and 2 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

e) **Convert following binary number to decimal, Hexadecimal and octal form. $(101101.1101)_2$**

Ans: **(Decimal conversion:2 Mark, Hex & Octal conversion: 1 Mark each, Total:4 Marks)**

Solution :

i) $(101101.1101)_2$

Decimal Conversion

$$= 2^5 \times 1 + 0 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1$$

$$+ 1 \times 2^0 + 1 \times 2^{-1} + 1 \times 2^{-2} + 0 \times 2^{-3} + 1 \times 2^{-4}$$

$$= 32 + 8 + 4 + 1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{16} = 45 + 0.5 + 0.25 + 0.0625$$

$$= 45 + 0.8125 = 45.8125$$

$\therefore$ $(101101.1101)_2 = (45.8125)_{10}$

Hex Conversion :

10 1101 . 1101
2 D . D = $(2D.D)_H$

Octal Conversion :

101 101 . 110 100
5 5 . 6 4 = $(55.64)_8$