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 NINE of the following: ----------18 Marks

a) Define Frequency and Phase. **(Each definition-1 Mark)**

1) Frequency:

The number of cycles completed by an alternating quantity in one second is called as frequency.

It Unit: Hertz (Hz)

2) Phase:-

It is the angle between any two quantities current and voltage or between two same voltages and same current.

b) Define current and voltage with their units. **(Each definition & Unit-1/2 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

$Units: - coulomb/\sec. or\ Amperes.$ ---------- **(1/2 marks)**

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

c) State the relation between line voltage and phase voltage in star and delta connected circuit

The relation between line voltage and phase voltage in star connected circuit (1 Mark)

$$V_L = \sqrt{3}\, V_{Ph}$$

The relation between line voltage and phase voltage in delta connected circuit (1 Mark)

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

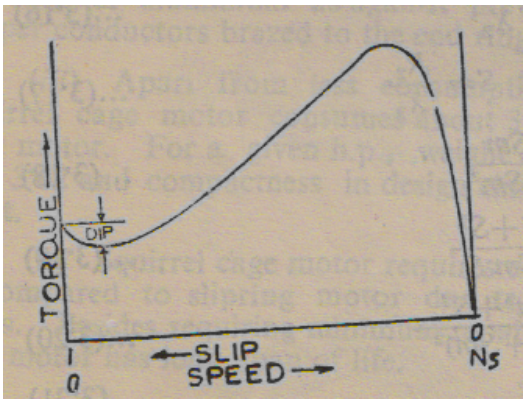
d) List any two application of transformer.

Application of Transformer:- (Any two application expected-1 Mark each)

i) Distribution Transformer (distribution or pole mounted substation)
ii) Furnace transformer (In the industry)
iii) Welding transformer (for welding purpose)
iv) Step up transformer (when we required more voltage)
v) Step down transformer (Rectifier)

e) Draw speed torque characteristics of 3-phase induction motor. **(2-Mark)**

Speed torque characteristics of 3-phase induction motor



f) State classification of drives. **(2 Mark)**

Classification of drive:

i) Individual Drive ii) Group drive iii) Multimotor Drive

g) State the necessity of earthing. **(2 Mark)**

Necessity Earthing:

- 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.

h) State the relation between line current and phase current in star and delta connected circuit.

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* $I_{ph} = I_L / \sqrt{3}$ *where* I_L *is line Current and* I_{ph} *is phase Currnts*

i) Define transformation ratio of single phase transformer.

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.

$$Transformation\ \ ratio\ (k) = \frac{N_2}{N_1}\ or = \frac{E_2}{E_1}\ or = \frac{V_2}{V_1}\ or = \frac{I_1}{I_2}$$

j) List two application of each motor. i) Capacitor start and run ii) Universal motor

i) Applications of Capacitor start and run: **(Any one expected-1 Mark)**

i) Compressors of air conditioner
ii) Big water cooler

ii) Applications of Universal Motor: **(Any one expected-1 Mark)**

i) Washing machine
ii) Mixers and grinders
iii) Food processors
iv) Small drilling machines

k) State the function of fuse? Name the material used for fuse wire.

(Function of fuse-1 Mark & Name of material used-1 Mark)

Function of Fuse:

- Fuse is a wire of short length or thin strip of material having low melting point
- It is protective device against over current, occurs due over load or short circuit.
- When some faults, such as short circuit occurs or when load more than circuit capacity is connected in it, the current exceeds the limiting value, the fuse wire gets heated, melts and breaks the circuit.

Name the material used for fuse wire:

S.No	Material used for fuse wire	Melting point in ^{0}C
1	Tin	230
2	Lead	328
3	Zinc	419
4	Silver	960
5	Copper	1090
6	Aluminium	-

Q.2 Attempt any FOUR of the following: ----------16 Marks

a) Suggest various safety precautions which should taken while working electricity.

(Any four points expected Each Precautions -1 Mark)

The Following are the precautions should be taken while working electricity:- (Any Four point expected)

i) Avoid working on live parts.
ii) Switch off the supply before starting the work.
iii) Never touch a wire till you are sure that no currents are flowing.
iv) Do not guess, whether electric current is flowing through a circuit by touching.
v) Insulate yourself on the insulating material like wood, plastic etc. before starting the work on live main.
vi) Your hand & feet must be dry (not wet) while working on live main.
vii) Rubber mats must be placed in front of electrical switch board/ panel.
viii) Use hand gloves, Safety devices & proper insulated tools.
ix) Ground all machine tools, body, and structure of equipments.
x) Earthing should be checked frequently.
xi) Do not use aluminum ladders but use wooden ladders.
xii) Do not operate the switches without knowledge.
xiii) Use proper insulated tools & safety devices.
xiv) When working on live equipment obey proper instruction.
xv) Do not work on defective equipment.
xvi) Use safe clothing.
xvii) Use shoes with rubber soles to avoid shock.
xviii) Do not wear suspected Necklace, arm bands, finger ring, key chain, and watch with metal parts while working.
xix) Do not use defective material. Do not work if there is improper illumination such as in sufficient light or unsuitable location producing glare or shadows.
xx) Do not work if there is an unfavorable condition such as rain fall, fog or high wind.
xxi) Do not sacrifice safety rules for speed.
xxii) Do not allotted work to untrained person (worker) to handle electrical equipment.
xxiii) Make habit to look out for danger notice, caution board, flags, and tags.
xxiv) Warn others when they seen to be in danger near live conductors or apparatus.
xxv) Inspect all electrical equipment & devices to ensure there is no damage or exposed wires that may causes a fire or shock.
xxvi) Avoid using electrical equipment near wet, damp areas.
xxvii) Use approved discharge earth rod for before working.
xxviii) Never speak to any person working upon live mains.

xxix) Do not Do the work if you are not sure or knowledge of the condition of equipment/ machine.

xxx) Safety book/ Training should be given to all persons working in plants.

b) State the meaning of the term MCCB and ELCB and give their applications.

i) Meaning of MCCB: Molded case circuit Breaker **(1 Mark)**

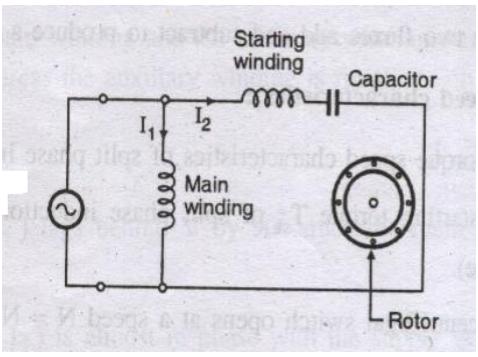
Application of MCCB: It protects circuit/ equipment against overload and short circuit conditions **(1 Mark)**

ii) Meaning of ELCB: Earth Leakage circuit breaker **(1 Mark)**

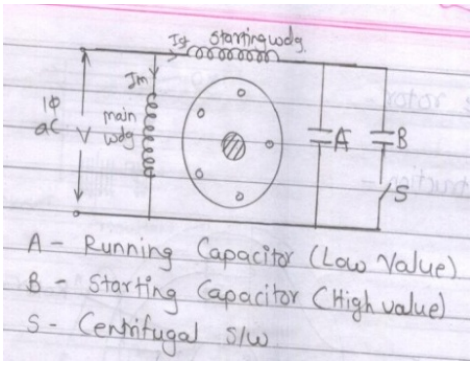
Application of ELCB: It protects person against shock due to leakage current also it protects circuit/ equipment against overload and short circuit conditions **(1 Mark)**

c) Draw and explain capacitor start and run motor. (Diagram-2 Marks & Explain-2 Marks)

Capacitor-start capacitor run 1-Ph Induction Motor:-



OR



or Equivalent fig

Working Principle:

In these motors one capacitor is connected in series with the auxiliary winding. There is no centrifugal switch. Thus this winding along with the capacitor remains energized for both starting and running conditions. Capacitor used serves the purpose of obtaining necessary phase displacement at the time of starting and also improves the power factor of the motor.

d) Define efficiency and voltage regulation. **(Each-Definition- 2 Mark)**

i) Efficiency:-

$$Transmission\ \ Efficency\ = \frac{Output\ \ power\ \ \ at\ receiving\ \ \ end}{Input\ \ power\ \ \ at\ sending\ \ \ end} \times 100$$

$$\eta_{T}\ \% = \frac{Output\ (P_R)\ (Load\ (power)\ at\ reciving\ end)}{Output\ (P_R) + Total\ losses} \times 100$$

Where, P_R is o/p power at receiving end

OR

% Efficiency = $\frac{P_R}{P_R + I^2 R_T} \times 100 \quad ------ for -1- Phase \qquad Where,\ R_T\ is\ total\ resis\tan ce$

OR

% Efficiency =

$$\frac{P_R}{P_R + 3\,I^2 R_{ph}} \times 100 \quad ------ for -3- Phase \qquad Where,\ R\ \ is\ \ resis\tan ce\ of\ \ per\ \ phase$$

OR

% Efficiency = $\frac{output\ \ power}{output\ \ power + total\ copper\ losses} \times 100$

ii) Voltage Regulation:

Voltage regulation is nothing but voltage drop in transmission line expressed in % of receiving end voltage

% Regulation = $\frac{Sending\ \ End\ Voltage - \mathrm{Re}ceiving\ \ End\ Voltage}{\mathrm{Re}ceiving\ \ End\ Voltage} \times 100$

% 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

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

Where, R_T = Total resistance & X_T = Total reactance

% Voltage Regulation = $\frac{V_S\,ph - V_R\,ph}{V_R\,ph} \times 100$ ---------- **For 3-phase**

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

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

e) State the sequence of three phase supply. Draw the phasor diagram of three phase supply. Write the equation of total power consumed in star connected load.

- **The sequence of three phase supply:** **(2 Mark)**

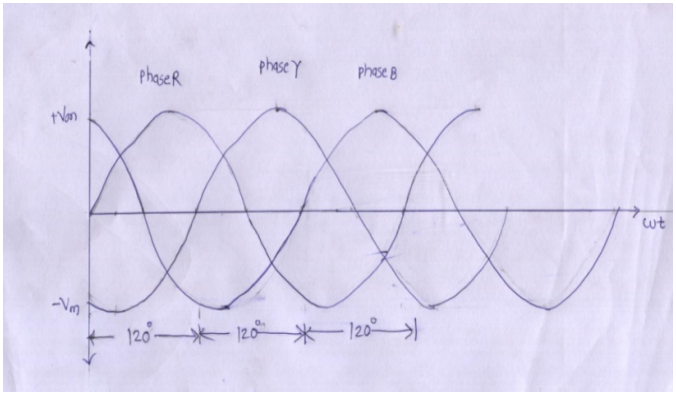
The phase sequence is defined as the sequence in which the three phases reaches their maximum positive values. There are two types of phase sequences.

Positive Phase sequence and Negative Phase sequence.

Normally the phase sequence is positive R-Y-B **OR**

Phase sequence is the sequence is which the currents or voltage in the 3-phase attain their peak position with particular reference of time e.g R,Y,B or R,B,Y

- **The phasor diagram of three phase supply:** **(1 Mark)**



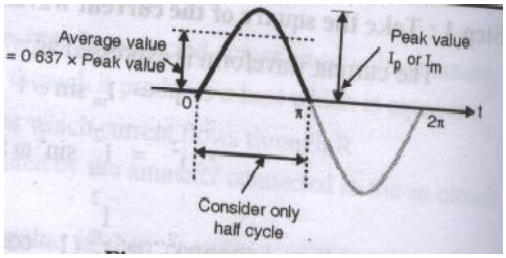
or Equivalent fig.

Equation of total power consumed in star connected load: **(1 Mark)**

$$P = \sqrt{3}\ V_L\ I_L\ Cos\phi$$

f) Define average value and RMS value.

i) Average Value :----------(2 Mark)



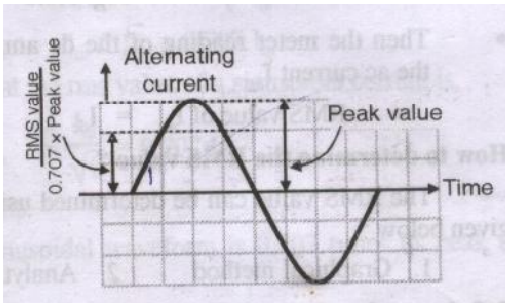
or Equivalent fig.

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× maximum value

ii) R.M.S Value: ---------- (2 Mark)



or Equivalent fig.

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**

∴ RMS Value = Form Factor × Average Value **OR**

RMS Value = 0.707× maximum value

Q.3 Attempt any FOUR of the following: ----------16 Marks

a) State first aid measures. **(Any four first aid measure expected-1 Mark each)**

First aid measures to be carried out for the person who received electrical shocks:-

i) 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.
ii) 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.
iii) 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.
iv) Call to doctor immediately.
v) Before coming doctor, if any burns or wound occurs on the body of the person use proper oil/ medicine (first aid)
vi) If the person is not breathing, immediately start artificial respiration until the medical aid arrives.
vii) Do not touch the person with bare hands.
viii) Do not give liquid unit the patient is conscious.
ix) 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.

b) State factor for selection of motor for different drives.

(Any four point expected- 1 Mark each point)

- **Factors to be considered for selection of Electrical Drives: (Any 4 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 M/c

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.

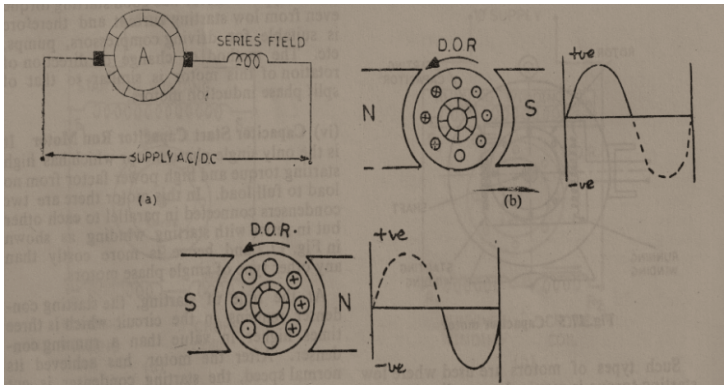
5) Size and rating of motor: - Whether motor is continuously running, intermittently running or used for variable load cycle.

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

c) Draw and explain Universal motor. **(Diagram-2 Mark & Explanation-2 Mark)**

Diagram of Universal Motor:

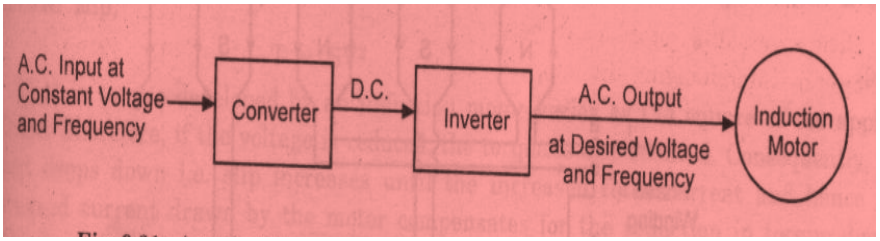


Explanation of Universal Motor:

- The motor which operates on both AC and DC supply is called universal motor.
- If through a DC series motor alternating current is passed, it will develop a torque which is always unidirectional because the current in both the armature and filed windings changes simultaneously.
- Consider the case of two pole motor and let the alternating current be in its positive half, then the polarity of the filed poles and the current flowing through the armature conductors be as indicated in above figure.
- By applying Fleming left hand rule it will be seen that the torque developed in the armature will try to rotate in anticlockwise direction.
- During the next instant, the alternating current goes through the negative half cycle. Now current through the field winding and armature will also change as direction in above figure.
- It will again see that the armature will tend to rotate in the anticlockwise direction.

d) Describe speed control of induction motor by variable frequency drive.

(Diagram-2 Mark & Working-2 Mark)

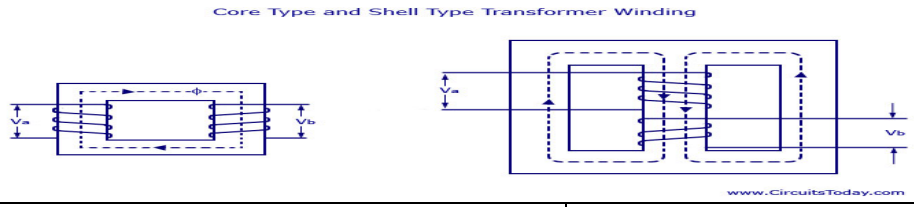


or equivalent fig

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

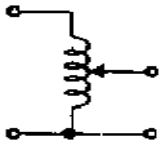
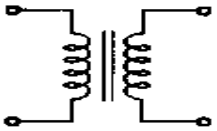
- The synchronous speed of the induction motor can be varied smoothly over a wide range by changing the supply frequency.
- In order to maintain the air gap flux at its normal value under varying frequency conditions, it is necessary to keep V/f ratio constant.
- Therefore if speed controls to be achieved 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.

e) Differentiate between shell type and core type transformer. (Any Four Point -1 Mark each)

S.No	Core Type Transformer	Shell Type Transformer
1.		
2.	The Winding surround the core	The core surround the windings
3.	Average length of the core is more	Average length of the core is less
4.	Magnetic Flux has only one continuous path	Magnetic Flux is distributed into 2 paths
5.	Suitable for high voltage & less output	Suitable for less voltage & high output
6.	Easy for repairs	Difficult for repairs
7.	Less in Weight	More in Weight
8.	Leakage flux are more	Leakage flux are less

f) Differentiate between auto transformer and two winding transformer.

(Any four points expected: Each point 1 Mark)

Sr no.	Points	Autotransformer	Two winding transformer
1.	**Symbol**		
2.	**Number of windings**	It has one winding	It has two windings
3.	**Copper saving**	Copper saving takes more as compared to two winding	Copper saving is less
4.	**Size**	Size is small	Size is large
5	**cost**	Cost is low	Cost is high
6	**Losses in winding**	Less losses takes place	More losses takes place
7.	**Efficiency**	Efficiency is high	Efficiency is low
8.	**Regulation**	Regulation is better	Regulation is poor
9.	**Electrical isolation**	There is no electrical isolation	Electrical isolation is present in between primary and secondary winding
10.	**Movable contact**	Movable contact is present	Movable contact is not present
11.	**Application**	Variac, starting of ac motors, dimmerstat.	Mains transformer, power supply, welding, isolation transformer

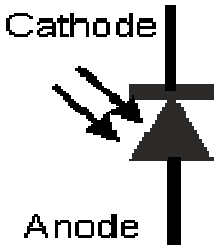
---------- **END OF SECTION-I**----------

SECTION-II

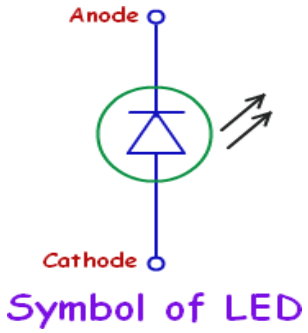
Q.4 Attempt any NINE of the following: ----------18 Marks

a) Draw a symbol of photodiode and LED. **(Each symbol – 1 Mark)**

Symbol of photodiode:



Symbol of LED:



b) State any four specifications of photo transistor. **(Any four point expected-1/2 each)**

Following are the specification of photo transistor: - (Any four point expected):

1. Dark Current (Vce = 15 V):	100 nA
2. Light Current (Vce = 5 V, H = 20 mW/cm):	20 nA
3. Collector to Emitter Saturation Voltage:	0.4 V
4. Rise Time (10 to 90%):	5 microS
5. Fall Time (90 to 10%):	5 microS
6. Collector to Emitter Sustaining Voltage (Vce):	30 V
7. Emitter to Collector Breakdown Voltage:	5 V
8. Collector Current:	25 mA
9. Operating Temperature Range:	-40 to +85 Degrees C
10. Lead Soldering Temperature:	240 Degrees C

c) Define α and β of the transistor. **(Each Definition – 1 Mark)**

i) The common-base current gain, (α):

The common-base current gain is approximately the gain of current from emitter to collector in the forward-active region OR. α = Ic/Ie

ii) The common-emitter current gain is represented by (β) or h_{FE}:-

It is approximately the ratio of the DC collector current to the DC base current in forward-active region OR β = Ic/Ib

d) A full wave rectifier with capacitor filter employ RL = 50 ohm, C= 1000 μ F. Calculate ripple factor.

$$Ripple\ \ factor\ \gamma = \frac{1}{4\sqrt{3} \times f\ C R_L}$$ ---------- **(1/2 Mark)**

Assuming Frequency f = 50 Hz

$$Ripple\ \ factor\ \gamma = \frac{1}{4\sqrt{3} \times 50 \times 1000 \times 10^{-6} \times 50}$$ ---------- **(1/2 Mark)**

$$Ripple\ \ factor\ \gamma = \frac{1}{17.32}$$

$$Ripple\ \ factor\ \gamma = 0.057$$ ---------- **(1 Mark)**

e) Define the term gain and bandwidth of an amplifier. **(Each Definition – 1 Mark)**

i) Gain - Gain is a measure of the ability of a circuit (often an amplifier) to increase the power or amplitude of a signal from the input to the output, by adding energy to the signal converted from some power supply.

$$\text{Gain} = 10 \log \left(\frac{P_{out}}{P_{in}} \right) \text{ dB}$$ **OR** $$\text{Gain} = 20 \log \left(\frac{V_{out}}{V_{in}} \right) \text{ dB}$$

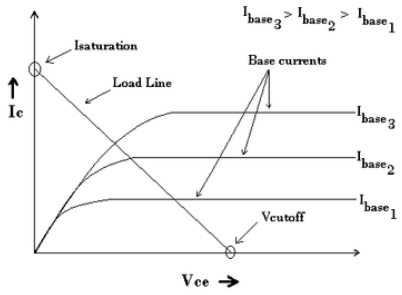
ii) Bandwidth –

The bandwidth represents the amount or "width" of frequencies, or the "band of frequencies," that the amplifier is MOST effective in amplifying. However, the bandwidth is

NOT the same as the band of frequencies that is amplified. The bandwidth (BW) of an amplifier is the difference between the frequency limits (3 dB points) of the amplifier. Mathematically - $BW = f_h - f_l$

f) Draw DC load line of CE amplifier and define Q-point.

- **DC loads line for CE amplifier –** **(1 Mark)**



- **Q – Point**:- **(1 Mark)**

The operating point of a device, also known as bias point, quiescent point, or Q-point, is the steady-state voltage or current at a specified terminal of an active device (a transistor or vacuum tube) with no input signal applied.

g) List the types of oscillator. **(Any two type expected- 1 Mark each)**

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

h) State the Barkhausen criteria for oscillator. **(Explanation-1 Mark & Condition-1 Mark)**

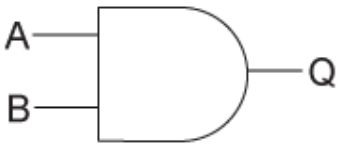
Barkhausen's criterion is a necessary condition for oscillation:

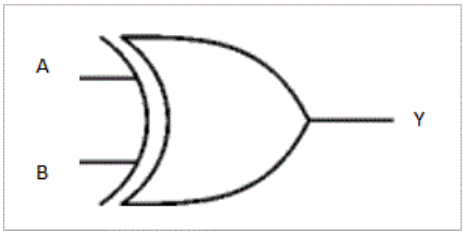
It states that if *A* is the gain of the amplifying element in the circuit and β (*j*ω) is the transfer function of the feedback path, so β*A* is the loop gain around the feedback loop of the circuit, the circuit will sustain steady-state oscillations only at frequencies for which:

1. The loop gain is equal to unity in absolute magnitude, that is, $|\beta A| = 1$ and
2. The phase shift around the loop is zero or an integer multiple of 2π.

i) Draw logic symbol and expression of AND and EX-OR gates. **(Each Symbol – 1 Mark)**

Logic symbol and expression of AND Gate: **Logic symbol and expression of EX-OR Gate:**





j) Perform the following conversion. i) $(212)_{10} = (?)_2$ ii) $(436)_8 = (?)_2$

(Each conversion – 1 Mark)

i) $(212)_{10} = 11010100$

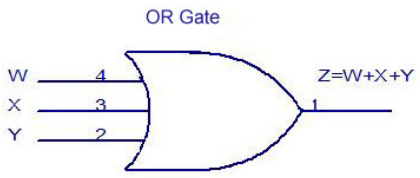
ii) $(436)_8 = 100011110$

k) Draw the symbol, logical expression and truth table of 3-input OR gate.

(Symbol: 1 Mark, Expression-1/2 Mark & Truth table: 1/2 Mark)

Symbol, Expression, Truth table:-

3 Input OR Gate



TRUTH TABLE

INPUTS			OUTPUT
W	X	Y	Z
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

l) Define : i) NTC ii) PTC **(Each Definition- 1 Mark)**

A **thermistor** is a type of resistor whose resistance varies significantly with temperature,

There are two types -- NTC and PTC.

i) NTC – (Negative Temperature Coefficient):-

This is a thermistor in which resistance of it decreases as temperature increases.

ii) PTC – (Positive Temperature Coefficient) –

This is a thermistor in which resistance of it increases as temperature increases.

m) What is line regulation and load regulation? **(Each Meaning- 1 Mark)**

i) Line regulation:

It is the capability to maintain a constant output voltage level on the output channel of a power supply despite changes in the input voltage level, keeping load resistance constant.

ii) Load regulation:

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

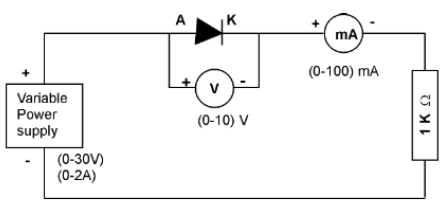
Q.5 Attempt any FOUR of the following: ----------16 Marks

a) Draw the experimental set-up to obtain V-I characteristics of PN Junction diode in forward bias. Draw V-I characteristics for the same.

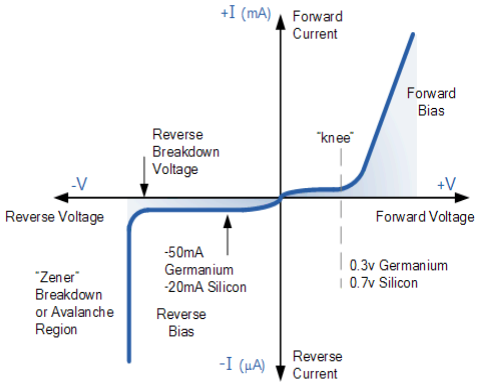
(Experimental setup-2 Mark & V-I Characteristics-2 Mark)

CIRCUIT DIAGRAM:

a) Forward biasing



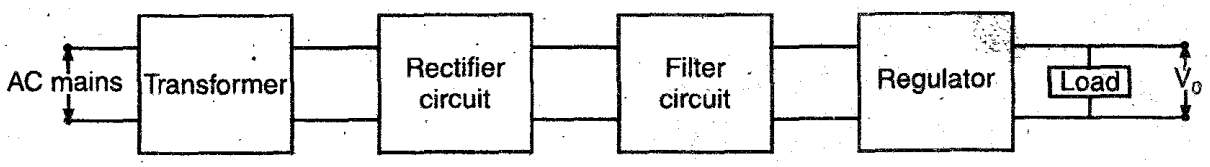
V-I characteristics PN Junction diode in forward bias:-



b) Draw the basic block diagram of a regulated power supply. State function of each block.

(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 .

c) Compare half wave rectifier and full wave rectifier.(Any four points expected-1 Mark each)

Sr no	parameter	half wave rectifier	full wave rectifier
1	Ckt dig.	Ref fig.1	Ref fig.2
2	No of diodes	1	2 or 4
3	Avg load voltage	Vm/π	2Vm/π
4	Avg load current	Im/π	2Im/π
5	PIV	Vm	2Vm for center tap Vm for bridge
6	Efficiency	40.6 %	81.2%
7	Ripple frequency	50Hz	100Hz
8	Ripple factor	1.21	0.48
9	Waveform	Ref fig.1	Ref fig.2

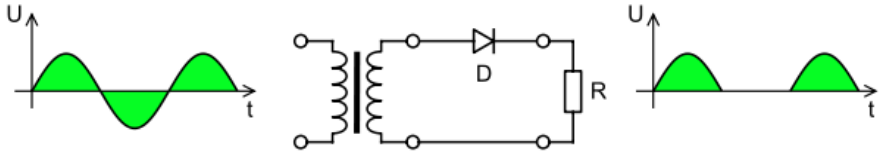


Figure 1

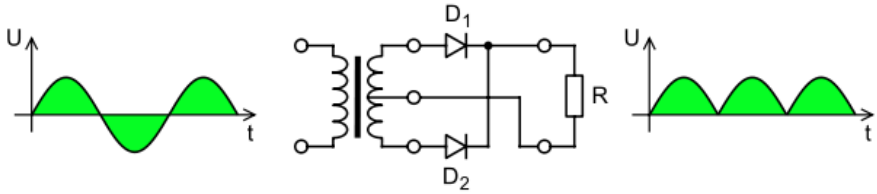


Figure 2

d) For Hartley oscillator C=1nF, L1=4.7mH, L2=47uH. Calculate frequency of Oscillation.

$$f = \frac{1}{2\pi\sqrt{L_T C}}$$

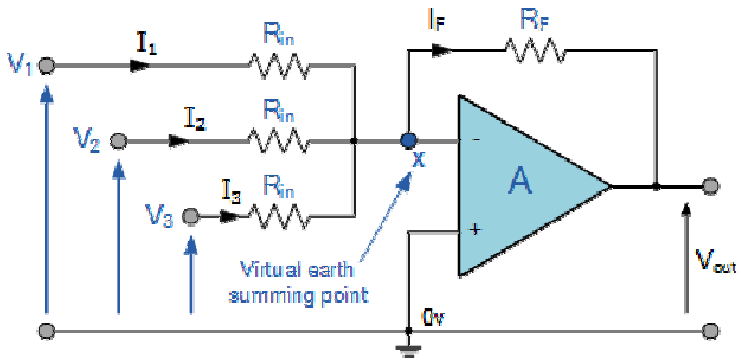
where: $L_T = L_1 + L_2$ ---------- **(2 Mark)**

LT= 4.7 mH + 47 uH = 4.747 mH

Frequency of Oscillation f =73.38 KHz ---------- **(2 Mark)**

e) Draw the circuit diagram of an adder using op-amp. Give its mathematical formula.

Circuit diagram of an adder using op-amp: **(2 Mark)**



Mathematical formula: **(2 Mark)**

$$I_F = I_1 + I_2 + I_3 = -\left[\frac{V1}{Rin} + \frac{V2}{Rin} + \frac{V3}{Rin}\right]$$

$$\text{Inverting Equation: } Vout = -\frac{Rf}{Rin} \times Vin$$

$$\text{then, } -Vout = \left[\frac{R_F}{Rin}V1 + \frac{R_F}{Rin}V2 + \frac{R_F}{Rin}V3\right]$$

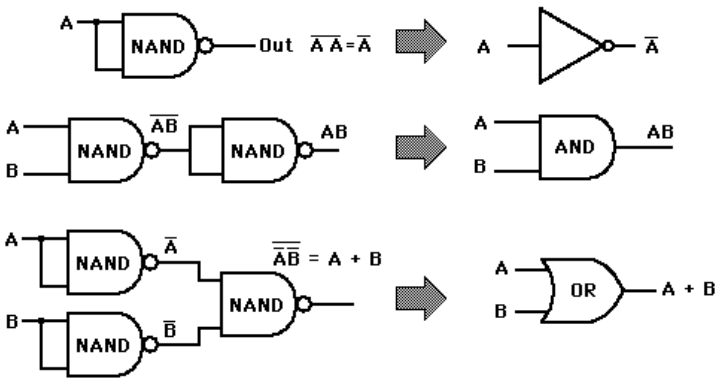
$$-Vout = \frac{R_F}{R_{IN}}\left(V1 + V2 + V3 \ldots etc\right)$$

f) Why NAND gate is called universal gate? Implement AND, OR & NOT gates using NAND gates.

Reason:- **(2 Mark)**

The NAND gate is called as universal gate since any other gate can be formed using number of NAND gate combination.

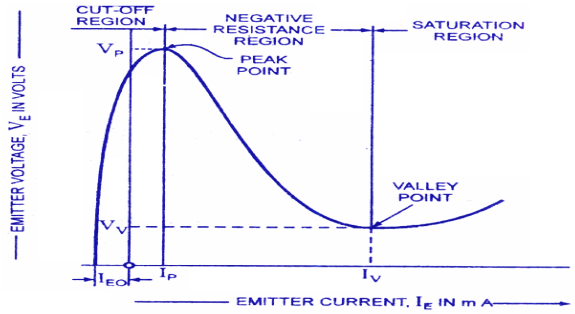
Implement NOT , AND , OR gates using NAND gates : **(2 Mark)**



Q.6 Attempt any FOUR of the following: ----------16 Marks

a) Draw characteristics of UJT. Explain regions on characteristics.

Characteristics of UJT: **(2 Mark)**



Static Emitter-Characteristic For a UJT

- **Regions on characteristics:** **(2 Mark)**

Cutoff-

This is the region where the UJT doesn't yet receive enough voltage to turn on. The voltage han't yet reached the triggering voltage, so the transistor will not turn on.

Negative Resistance Region-

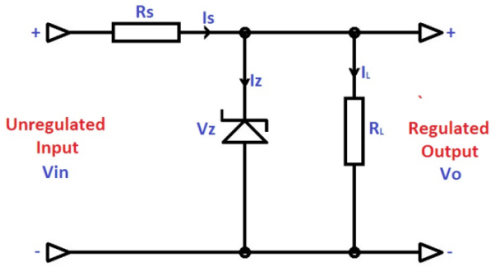
After the transistor has reached the triggering voltage, it now will turn on. After a while if the applied voltage still increases to the emitter lead, it will peak out. From Peak point voltage to the Valley Point, the applied voltage drops while the current, though, increases. The current increases but the voltage decreases i.e. resistance RB2 of total resistance RB1+RB2 of UJT decreases that is why it's called negative resistance.

Saturation-

After negative resistance region, UJT enters into saturation region. This is the region where if the applied voltage to the emitter still increases, the current and voltage will rise.

b) Draw the circuit diagram of zener diode as voltage regulator and explain its working.

Diagram of zener diode as voltage regulator: **(2 Mark)**

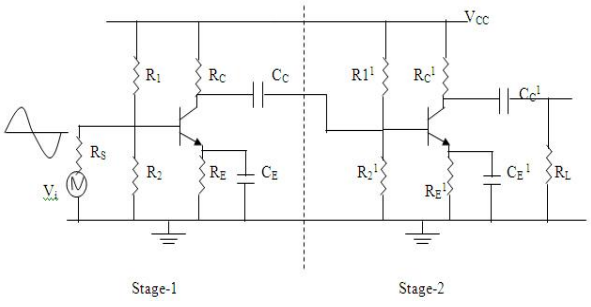


Working: **(2 Mark)**

Zener Diodes are widely used as Shunt Voltage Regulators to regulate voltage across small loads. Zener Diodes have a sharp reverse breakdown voltage and breakdown voltage will be constant for a wide range of currents. Thus we will connect the zener diode parallel to the load such that the applied voltage will reverse bias it. Thus if the reverse bias voltage across the zener diode exceeds the knee voltage, the voltage across the load will be constant.

c) Draw the circuit diagram of RC coupled amplifier and state the need of cascading.

Circuit diagram of RC coupled amplifier: **(2 Mark)**

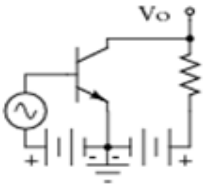
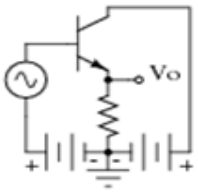
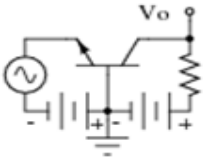


The need of cascading: **(2 Mark)**

When the amplification provided by a single stage amplifier is not sufficient for a particular purpose or when the input and output impedance is not of the correct magnitude for the required application, then two or more amplifiers are connected in cascade.

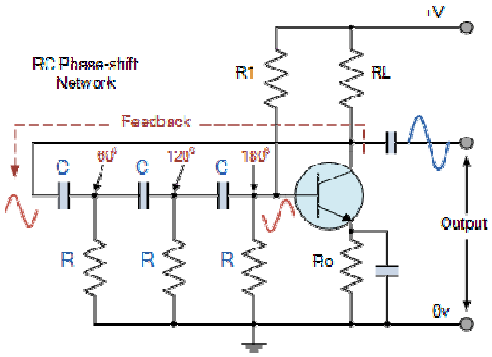
d) Compare common emitter, common base and common collector transistor configuration.

(4 Mark)

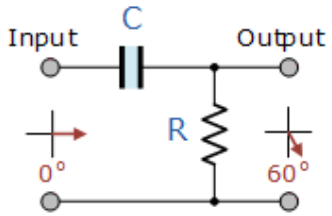
Basic circuit	Common emitter	Common collector	Common base
			
Voltage gain	high	less than unity	high, same as CE
Current gain	high	high	less than unity
Power gain	high	moderate	moderate
Phase inversion	yes	no	no
Input impedance	moderate ≃ 1 k	highest ≃ 300 k	low ≃ 50 Ω
Output impedance	moderate ≃ 50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

e) Draw RC Phase shift oscillator. State the roll of phase shift network.

RC Phase shift oscillator: **(2 Mark)**



The roll of phase shift network: **(2 Mark)**



The **circuit, a single Resistor-Capacitor Network** whose output voltage "leads" the input voltage by some angle less than 90^o. An ideal single-pole RC circuit would produce a phase shift of exactly 90^o. 180^o of phase shift is required for oscillation. The amount of actual phase shift in the circuit depends upon the values of the resistor and the capacitor, and the chosen frequency of oscillations. The values of R and C have been chosen so that at the required frequency the output voltage leads the input voltage by an angle of about 60^o. Then the phase angle between each successive RC section increases by another 60^o giving a phase difference between the input and output of 180^o (3×60^o).

f) Convert the following:

i) $(1101011)_2 = (?)_H$ ii) $(11010)_2 = (?)_{10}$ iii) $(206)_8 = (?)$ iv) $(3000.45)_8 = (?)_8$

i) $(1101011)_2 = (6B)_H$

ii) $(11010)_2 = (26)_{10}$

iii) $(206)_8 = (86)_H$

iv) $(3000.45)_8 = (3000.45)_8$