MODEL ANSWER

SUMMER– 18 EXAMINATION

Subject Title: Basic Electronics Subject Code: 17321

Important Instructions 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 principal components indicated in the 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 of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q.1 Attempt any TEN from following **20 Marks**

a)Why is an intrinsic semiconductor doped?

Ans: (Any relevant answer-2M**)**

Intrinsic semiconductor is doped in order to increase conductivity of semiconductor. Doping increases majority charge carries either electrons or holes and majority charge carriers responsible for electric current.

b) Define line and load regulation.

Ans: (Each definition-1M)

1. **Load regulation :** The load regulation indicates how much the load voltage changes when the load current changes. The load regulation is defined as:

% Load regulation = (VNL-VFL) / VFL *100

Where VNL = load voltage with no load current

VFL = load voltage with full load current.

The smaller the load regulation, the better the power supply. A well-regulated power supply can have a load regulation of less than 1%

2. **Line regulation :** Any change in the line voltage out of the nominal value (i.e., 120V ac) will affect the performance of the power supply.

OR

Line regulation is a measure of how well a power supply is able to maintain the dc output voltage for a change in the ac input line voltage.

The smaller the line regulation, the better the power supply. A well-regulated power supply can have a line regulation of less than 0.1%.

c) List four applications of LED.

Ans: (Any four applications -2M)

Applications of LED

1. As a power supply status indicator in electronics instruments
2. In traffic light Indicators.
3. In data displaying boards.
4. In medical applications and toys
5. In optical fiber communications
6. Remote controls

d) What is need of regulated power supply?

Ans: (Any relevant answer -2M)

A regulated voltage very important for the smooth functioning of many electronic circuits it deliver a constant voltage at its output regardless of changes in ac supply voltage and load current. Without voltage regulator in power supply, it may give unexpected result or damage one of the components in the circuit, hence voltage regulator is needed.

e) Why transistor is called as bipolar device.

Ans: (Correct answer-2M)

BJT is called bipolar device because in BJT current conduction takes place due to majority as well as minority charge carriers that is because of electrons as well as holes.

f) List different types of FET.

Ans: (Proper/correct classification-2M)

Types of FETs:

1. Junction FET (JFET)
   i. N-Channel JFET
   ii. P-Channel JFET

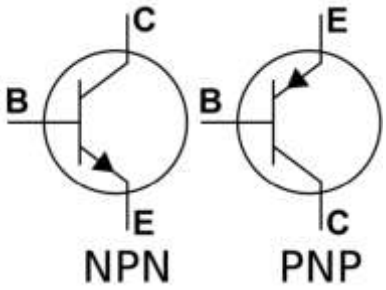
2. MOSFET

   i. E-MOSFET
   ii. D-MOSFET

g) Draw the symbol of NPN andPNP transistor.

Ans: (Each symbol-1M)

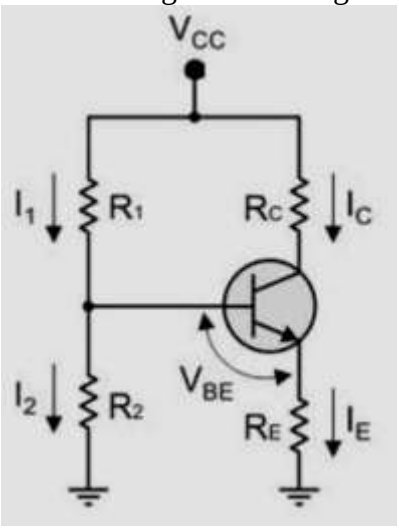
Symbol of NPN and PNP transistor



h) Draw the circuit diagram of voltage dividing biasing

Ans: (Correct diagram -2M)

Circuit diagram of voltage dividing biasing:



i) What is Barkhausens Criterion?

Ans: (Each condition-1M)

Barkhausen's Criterion for Oscillations

The necessary condition for sustained oscillations is

1. Product of voltage gain and feedback factor should be equal to and greater than Loop gain ($\beta.Av) \geq 1$
2. Phase shift between the input and output signal or around the loop must be equal to 360^0or 0^0.

j) Draw truth table & Boolean expression of EX-OR gate

Ans: (Truth table-1M, Boolean expression-1M)

Truth table of EX-OR gate

A	B	F
0	0	0
0	1	1
1	0	1
1	1	0

Boolean expression of EX-OR gate

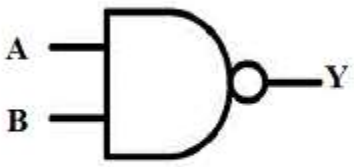
F= (**A** ⊕ **B**)

F=$\overline{\mathbf{A}}$.**B** + **A**.$\overline{\mathbf{B}}$

k) Draw symbol of NAND gate. State its truth table and write its Boolean expression.

Ans : (Symbol- ½, Truth table-1M, Boolean expression-½M)

Symbol and Truth table



Inputs		output
A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

Boolean Expression: Y= $\overline{AB}$

l) State the need of cascade amplifier.

Ans: (Any relevant answer -2M)

Most systems a single transistor amplifier does not provide sufficient gain or bandwidth or will not have the correct input or output impedance matching. Hence cascade amplifier is use which consist more than one stages of amplification.

m) List the advantages of RC coupled amplifier.

Ans: (Any two points -2M)

Advantages:

1. The frequency response is excellent
2. The circuit is very compact and extremely light
3. Cost is low because it employ resistors and capacitors which are cheap

n) Why common emitter configuration is commonly used?

Ans : (Relevant answer -2M any two points)

Common emitter configuration is commonly used for amplifications because-

1. The common emitter configuration (CE) provides maximum voltage and current gain and hence provides maximum power gain. The other configurations provide either high current gain or voltage gain but not both for a BJT.
2. It has suitable bandwidth and gain while other configurations only have bandwidth or gain, but common emitter has both of them.

3. The CE configuration has moderate input& output resistance. Therefore many such stages can be coupled to each other without using any additional impedance matching circuits. Due to this automatic impedance matching maximum power transfer will take place from one stage to other.

Q. 2: Attempt any FOUR of the following: **16 M**

a) Derive the relation between α and β of a transistor.

Ans: (Complete derivation-4M)

Relationship between α and β:

- We know, $I_E=I_B+I_C$
- Dividing the above equation on both sides by I_C,
- $I_E/I_C = I_B / I_C+1$
- Since $I_C/I_E=\alpha$ and $I_B/I_C=\beta$

So, $I_E/I_C=1/\alpha$ and $I_C/I_B=1/\beta$

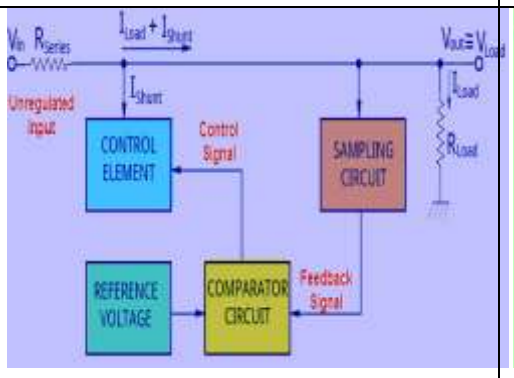
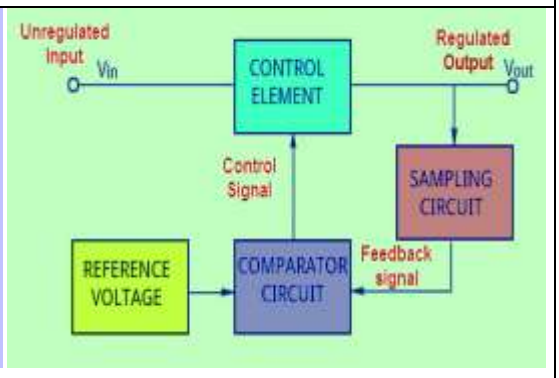
Therefore, $1/\alpha =(1/\beta) +1$

hence $1/\alpha = (1+\beta)/\beta$

Therefore, $\alpha = \beta/(1+\beta)$

b) Compare Shunt and Series Regulator.(4 points)

Ans: (Any 4 points- 4M)

Parameter	Shunt Regulator	Series Regulator
Position of Control element	In parallel with load	In series with load
Block Diagram		

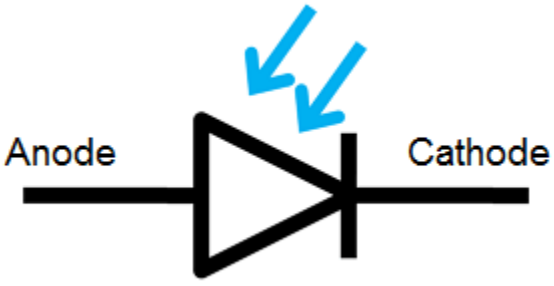
Efficiency	Low	High
Voltage regulation at high load current	Shunt voltage regulator give good voltage regulation at high load currents.	At high load currents, series voltage regulator does not give good voltage regulation
Use	Shunt regulators are appropriate for light loads.	Series voltage regulator is appropriate for heavy loads

c) What is photodiode? Draw the symbol and explain operation of photodiode.

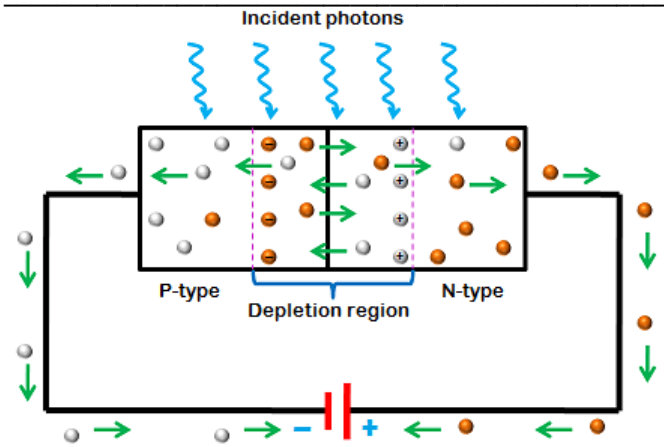
Ans:(Explanation of Photodiode-1M, Symbol- 1M, operation- 2M)

A photodiode is a light detector that converts light into an electrical current. A photodiode is a semi-conductor device, with a p-n junction and an intrinsic layer between p and n layers. It produces photocurrent by generating electron-hole pairs, due to the absorption of light in the depletion region. The photocurrent thus generated is proportional to the absorbed light intensity.

Symbol of Photodiode



Operation:

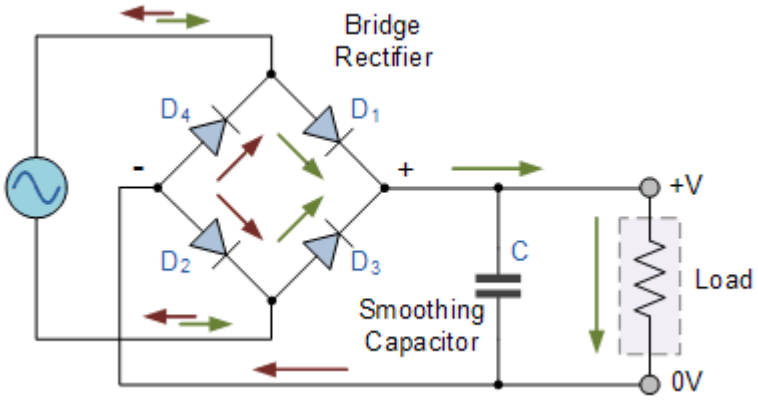


1. When external light energy is supplied to the p-n junction photodiode, the valence electrons in the depletion region gains energy.
2. If the light energy applied to the photodiode is greater the band-gap of semiconductor material, the valence electrons gain enough energy and break bonding with the parent atom. The valence electron which breaks bonding with the parent atom will become free electron. Free electrons moves freely from one place to another place by carrying the electric current.
3. When the valence electron leave the valence shell an empty space is created in the valence shell at which valence electron left. This empty space in the valence shell is called a hole. Thus, both free electrons and holes are generated as pairs. The mechanism of generating electron-hole pair by using light energy is known as the inner photoelectric effect.
4. Mostly free electrons move towards the n region. When the free electrons reaches n region, they are attracted towards the positive terminals of the battery. In the similar way, holes move in opposite direction.
5. The strong depletion region electric field and the external electric field increase the drift velocity of the free electrons. Because of this high drift velocity, the minority carriers (free electrons and holes) generated in the depletion region will cross the p-n junction before they recombine with atoms. As a result, the minority carrier current increases.
6. When no light is applied to the reverse bias photodiode, it carries a small reverse current due to external voltage. This small electric current under the absence of light is called dark current. It is denoted by I_λ.
7. In a photodiode, reverse current is independent of reverse bias voltage. Reverse current is mostly depends on the light intensity.

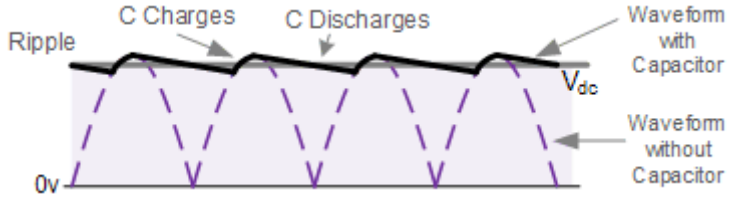
d) Draw the circuit diagram Bridge Rectifier with Shunt capacitor filter along its Input /Output waveforms.

Ans:(Circuit diagram -2M, Waveforms- 2M)

Circuit diagram:



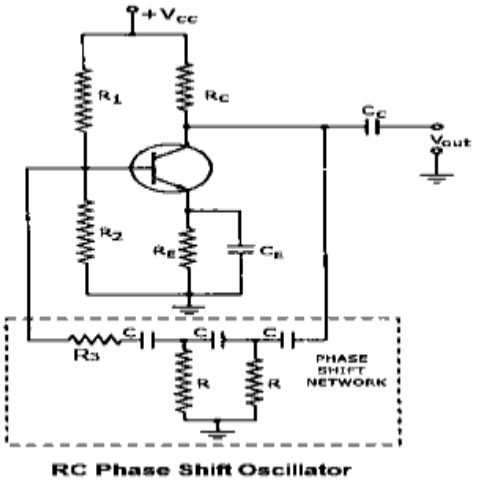
Input/Output waveforms:



e) Draw and explain RC phase shift Oscillator.

Ans:(Circuit diagram -2M, Explanation- 2M)

Circuit Diagram:



RC Phase Shift Oscillator

Explanation: Here the collector resistor RC limits the collector current of the transistor, resistors R1 and R2 form the voltage divider network while the emitter resistor RE improves the stability. Next, the capacitors CE and Co are the emitter by-pass capacitor and the output DC decoupling capacitor, respectively. Further, the circuit also shows three RC networks employed in the feedback path. This RC networks causes the output waveform to shift by 180° during its course of travel from output terminal to the base of the transistor. Next, this signal will be shifted again by 180° by the transistor in the circuit due to the fact that the phase-difference between the input and the output will be 180° in the case of common emitter configuration. This makes the net phase-difference to be 360°, satisfying the phase-difference condition.

f) Compare between CB , CE & CC transistor configuration.(4 points)

Ans : (Any four points-4M)

Parameter	CB	CE	CC
I/P impedance	Low Or 50Ω	Medium Or 600Ωto 4kΩ	High Or 1 MΩ
Current Gain	Less than or equal to 1	High	Highest

Voltage Gain	Medium	Medium	Less than or equal to 1
Output Impedance	High Or 50 k Ω	Medium Or 10 k Ω to 50 k Ω	Low Or 50 Ω
Phase shift between input and output	0°	360°	0°

3. Attempt any FOUR of the following : 16

(a) Classify power amplifier on basis of operating point with appropriate sketch.

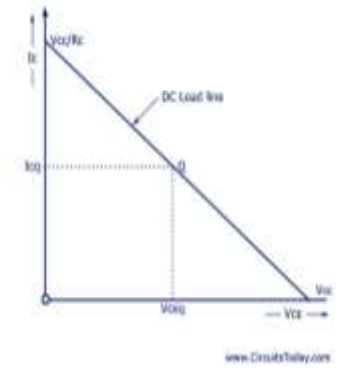
Ans:- Classification- 2 mks, sketch- 2 mks

Classification of power amplifier -

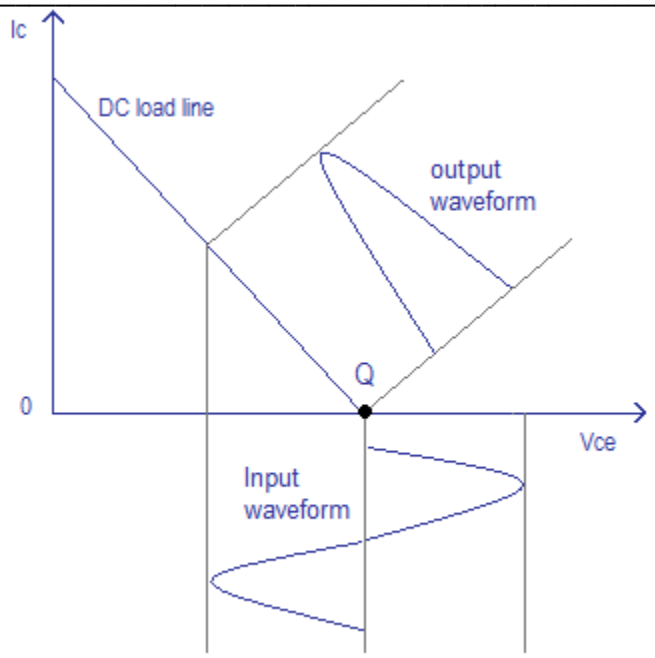
1. Class A Power amplifier
2. Class B Power amplifier
3. Class AB Power amplifier
4. Class C Power amplifier

Sketch

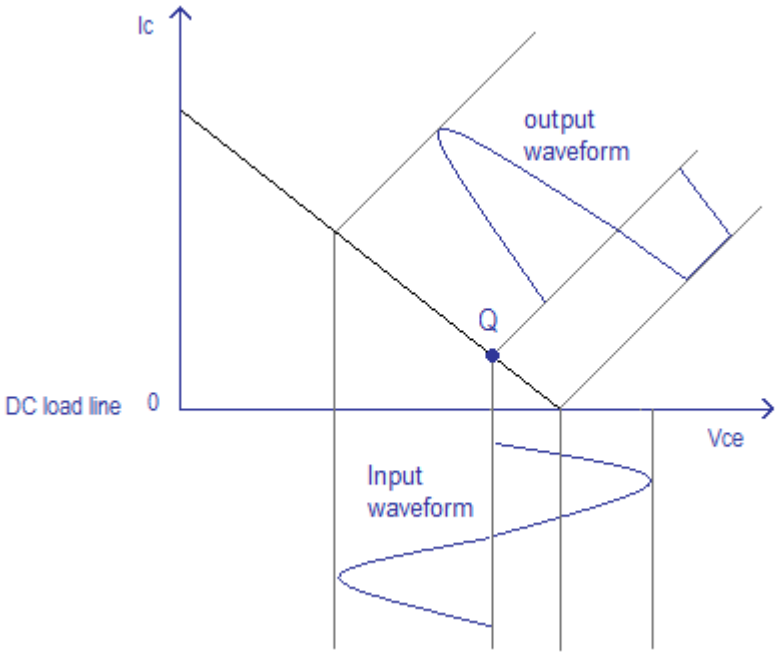
1. Class A Power amplifier



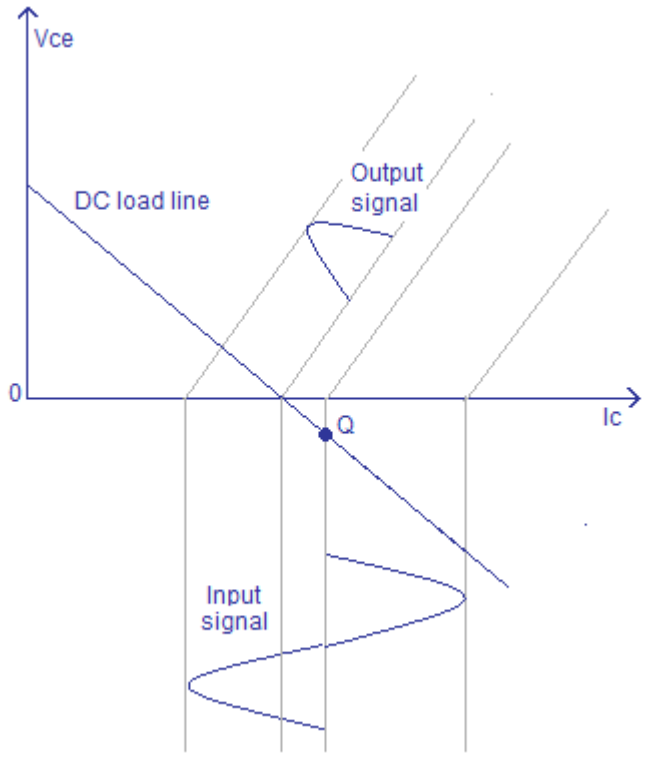
2. Class B Power amplifier



3. Class AB Power amplifier



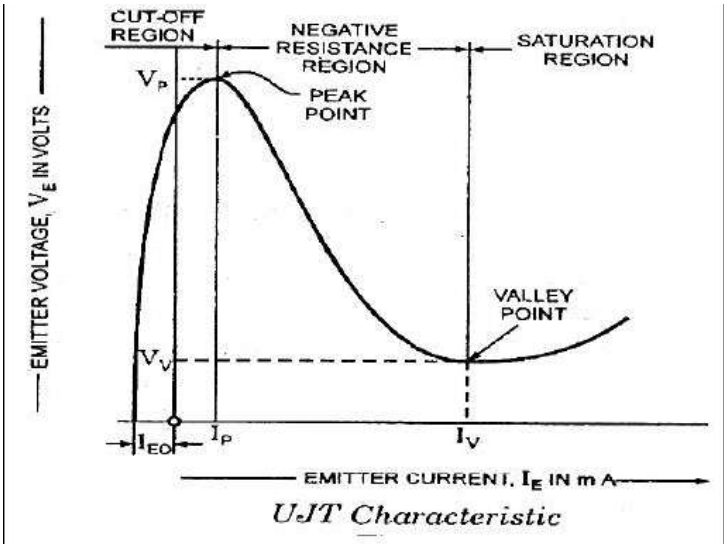
4. Class C Power amplifier



(b) Draw characteristics of UJT and label each region and all important points.

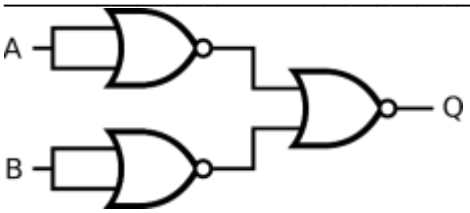
Ans: characteristics- 2 mks, label – 2 mks

UJT Characteristics:



(c) Design AND gate using NOR gates only.

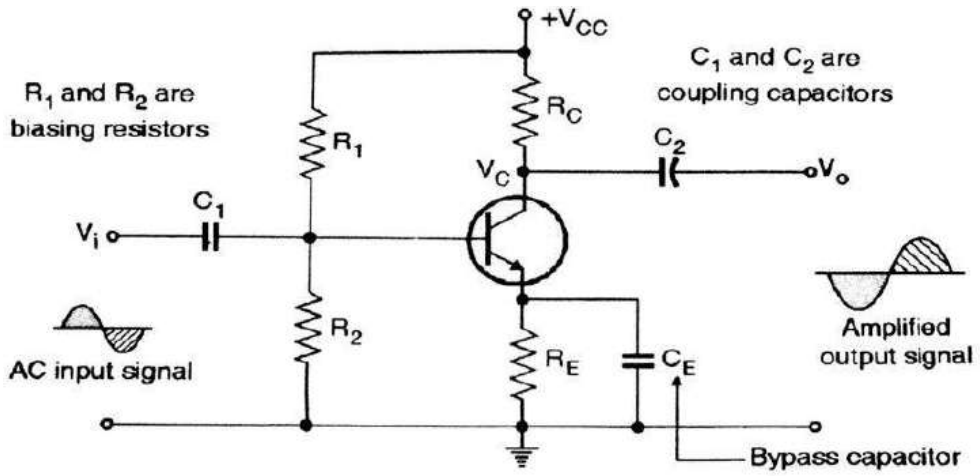
Ans :- proper diagram- 4 mks



(d) Draw the single stage RC coupled amplifier circuit and explain its's operation.

Ans:- Diagram—2 mks, explanation- 2 mks

Diagram



Single stage RC coupled CE amplifier

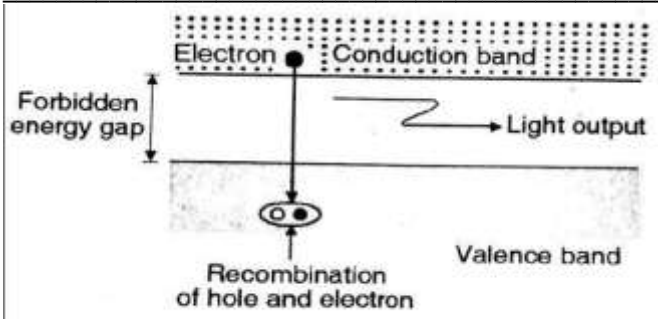
Operation:-

The capacitors C1 and C2 are called as the coupling capacitors. As the load resistor RL (not shown in the diagram) is coupled to the amplifier through the coupling capacitor, this amplifier is called as RC coupled amplifier. The transistor is connected in the common emitter (CE) configuration. Therefore, this amplifier is called CE amplifier.

(e) Draw symbol of LED and explain it's working principle.

Ans:-Symbol- 1 mks , working principle diagram- 1 mks, principle – 2 mks

Working Principle of LED:



When the LED is forward biased, the electrons in the n-region will cross the junction and re-combine with the holes in the p-type material. These free electrons reside in the conduction band and hence at a higher energy level than the holes in the valance band. When t h e recombination takes place, these electrons return back to the valance band which is at lower energy level than the conduction band. While returning back, the recombining electrons give away the excess energy in the form of light. This process is called as "electroluminescence". In this way an LED emits light.

(f) Compare RC and LC filiter. (four points)

Ans:- Relevant four points comparison- 4 mks

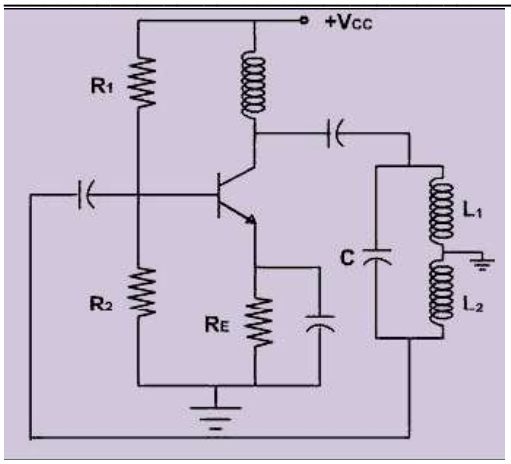
RC filters	LC filters
The RC filter is only useful for small load currents.	The LC filters are useful for heavy load currents.
More power dissipated in RC filter.	Less power dissipated in LC filter.
It has poor voltage regulation.	It has good voltage regulation.
It is cheaper.	It is costlier.
It has high ripple factor.	It has low ripple factor.
RC is fine for filtering low power signals.	LC is fine for filtering high power signals.

4. Attempt any FOUR of the following : 16

(a) Draw and explain Hartley Oscillator circuit diagram.

Ans: Circuit diagram 2mks, Explanation- 2mks

Circuit diagram:



Function of each component:

1. An NPN transistor connected in a common emitter configuration works as the active device in amplifier stage and CE configuration provides 180°phase shift.

2. R1 and R2 are biasing resistors and RE is used for stabilization of operating point against β variations.
3. RFC is the radio frequency choke, which provides the isolation between AC and DC operation.
4. CE is the emitter bypass capacitor andCC1 and CC2 are the coupling capacitors.
5. L1 and L2 forms tank circuit . The mutual inductance between L1 and L2 provides the feedback of energy from collector-emitter circuit to the base-emitter circuit.

The frequency of oscillation is given as-

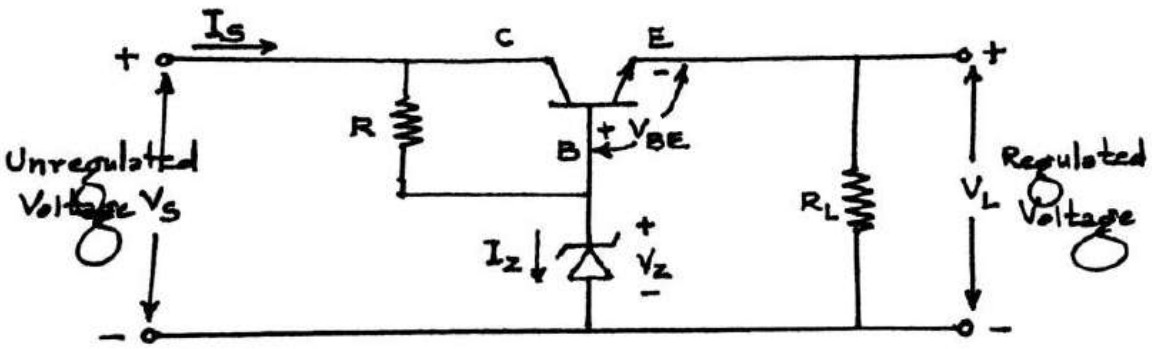
$$f = \frac{1}{2\pi\sqrt{L_T C}}$$

where: $L_T = L_1 + L_2 + 2M$

(b) Draw the circuit diagram of transistorized series voltage regulator and explain it's operation.

Ans: Circuit diagram-2mks, Operation-2mks

Circuit Diagram:



Operation:-

Transistorized Series Regulator: The figure shows a circuit of a transistor series regulator. Since the transistor is connected in series with the load, the circuit is known as a series regulator.

Operation:

i) The unregulated DC supply is fed to the input terminal as shown in the figure.

ii) The output voltage is given by VL = VZ - VBE

iii) VZ being a zener voltage, can assumed constant. Therefore, if the output voltage varies, the VBE changes.

iv) If the output voltage increases due to some reason, then VBE decreases and due to this base current decreases. Therefore the collector current decreases.

v) This will increase the collector to emitter voltage (VCE) across the transistor and VL will be regulated, as VL = VS - VCE

vi) If the output voltage decreases, then exactly opposite action will take place and the output voltage is regulated.

vii) The circuit action may be summarized in the form of following equation.

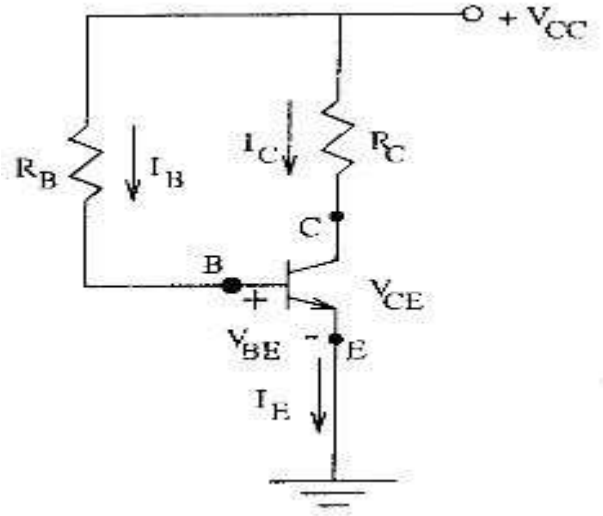
$$VL \downarrow \rightarrow VBE \downarrow \rightarrow IB \downarrow \rightarrow IC \downarrow \rightarrow VCE \uparrow \rightarrow VL \downarrow$$

(c) Draw and explain self-basing of a transistor.

Ans:- Diagram- 2 mks, explanation- 2 mks

Diagram:-

Transistor Biasing is the process of setting a transistors DC operating voltage or current conditions to the correct level so that any AC input signal can be amplified correctly by the transistor.



Explanation-

It is required to find the value of RB so that required collector current flows in the zero signal conditions.

Let IC be the required zero signal collector current.

$\therefore IB = IC * \beta$

Considering the input closed circuit and applying Kirchhoff 's voltage law,

$VCC = IB\ RB + VBE$

$IB * RB = VCC - VBE$

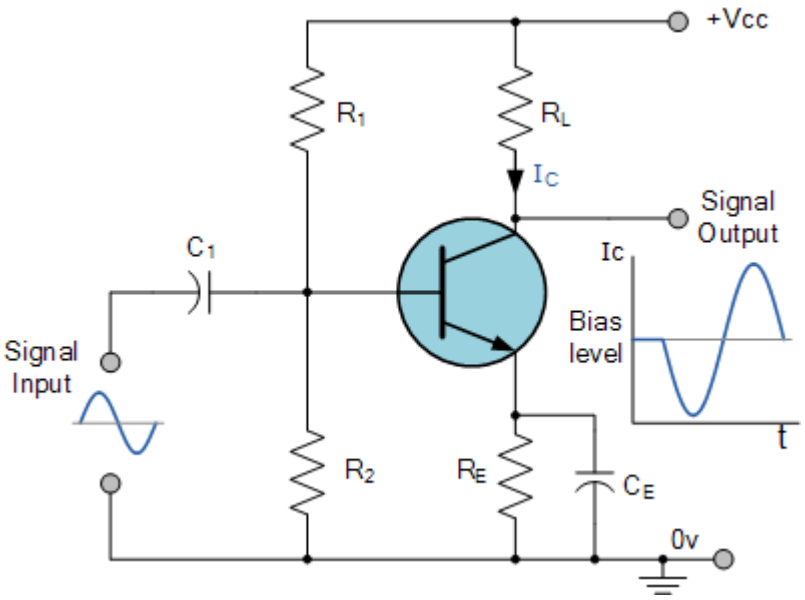
$\therefore IB = (VCC - VBE) / RB$

As VCC and IB are known and VBE can be seen from the transistor manual, therefore, value of RB can be readily found VBE is generally quite small as compared to VCC, the former can be neglected

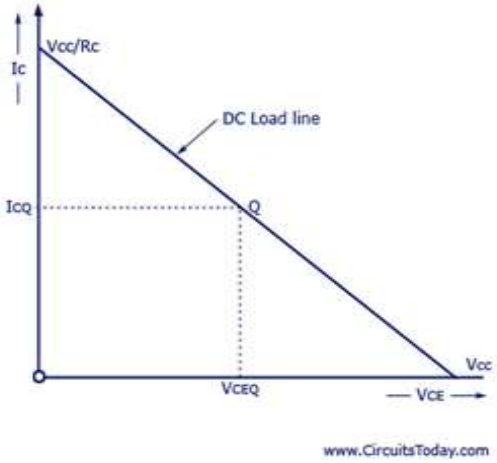
Applying KVL to o/p loop ,
Collector-emitter voltage, VCE = VCC − IC RC

d) Draw and explain class A power amplifier circuit diagram.

Ans:- Diagram – 2 mks, explanation 2 mks



The Class A amplifier is the simplest form of power amplifier that uses a switching transistor in the common emitter circuit configuration to produce an inverted output. The transistor is always biased "ON" so that it conducts during one complete cycle of the input signal waveform producing minimum distortion and maximum amplitude of the output signal. The Q point is located at the centre of active region as shown



(e) Compare JFET and BJT. (4 points)

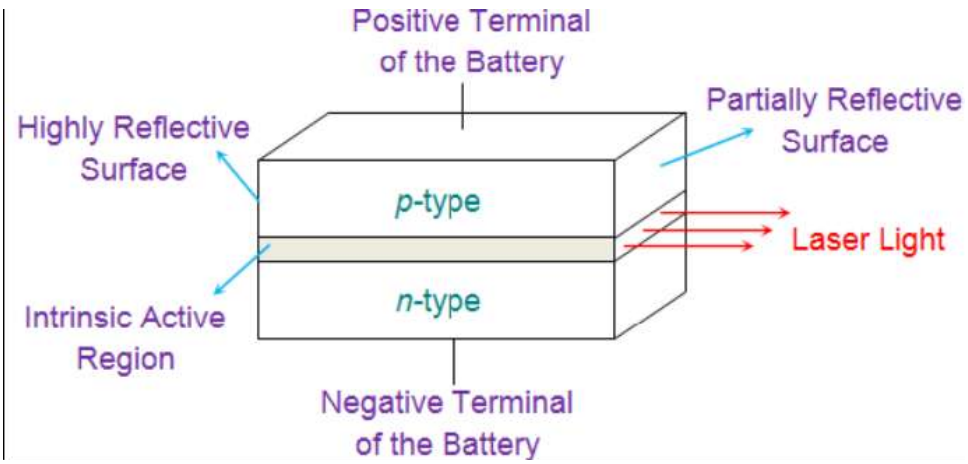
Ans:- Relevant 4 points- 4 mks

SR. NO.	FET	BJT
1	It is unipolar device i.e. current in the device is carried either by electrons or holes	It is bipolar device i.e. current in the device is carried either by both electrons & holes
2	It is a voltage controlled device i.e. voltage at the gate (or drain) terminal controls amount of current flowing through the device.	It is a current controlled device i.e. the base current controls the amount of collector current.
3	Its input resistance is very high & is of order of several megaohms.	Its input resistance is very low compared to FET.
4	It has a negative temperature co-efficient at high current levels. It means that current decreases as temperature increases.	It has a positive temperature co-efficient at high current levels. It means that current increases as temperature increases.
5	It is less noisy.	It is comparatively noisier.
6	It has relatively lower gain bandwidth product as compared to BJT.	It has relatively higher gain bandwidth product as compared to FET.

(f) Explain the operating principle of LASER and list applications of LASER diode.

Ans: -Diagram -2mks, operation- 1mks , any 2 applications- 1 mks

Diagram :



A basic construction of Laser diode is as shown . A PN junction is formed by two layers of doped gallium arsenide. There is highly reflective surface at one end of PN junction and partially reflective surface at the other end, forming resonant cavity for the photon .

Operating Principle:

The Laser diode is biased by external voltage source. As electron move through the junction, recombination occurs just like a ordinary diode. As electrons fall into holes to recombine, photons are released. A released photon can strike atom, causing another photon to released. As forward current is increased, more electrons enter the depletion region and cause more photons to be emitted. Eventually some of the photons that are randomly drifting within the depletion region strike the reflected surfaces perpendicularly. These reflected photons move along the depletion region, striking atoms and releasing additional photons due to avalanche effect.

Applications:-

1. fiber optic communications
2. barcode readers
3. laser pointers
4. CD/DVD/Blu-ray disc reading/recording
5. laser printing
6. laser scanning and light beam illumination.
7. Military applications
8. Medical surgery
9.Diamond cutting

5. Attempt any FOUR of the following : 16

(a) Define following :

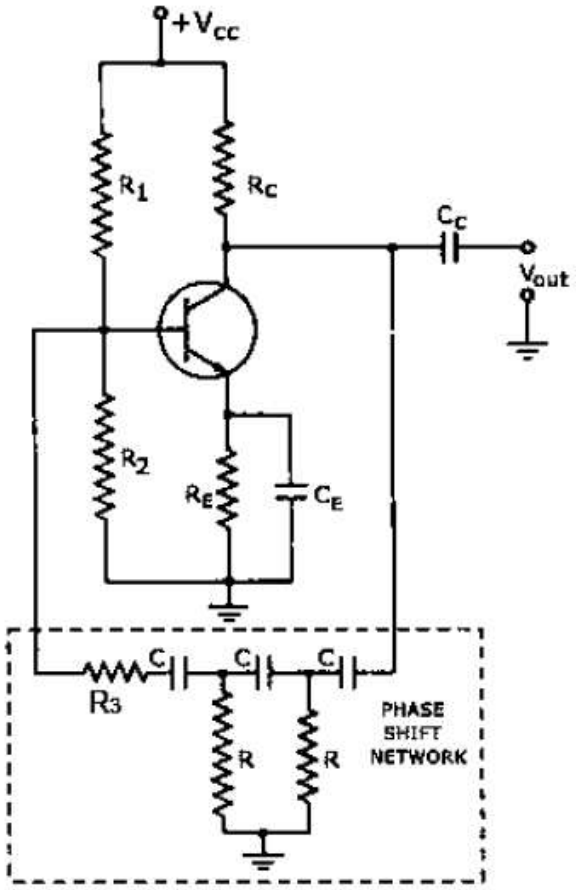
i. Radix
ii. Bit
iii. Nibble
iv. Byte

Ans:- Each definition- 1 mks

i. Radix- the base to a given number system is called as radix.
ii. Bit- Single ‘1’ or ‘0’ is called as a bit.
iii. Nibble- a group of 4 bits is called as nibble
iv. Byte- a group of 8 bits is called as a byte.

(b) Draw the circuit of any one type of phase shift oscillator and explain it’s operation.

Ans:- Diagram – 2 mks, explanation- 2 mks



RC Phase Shift Oscillator

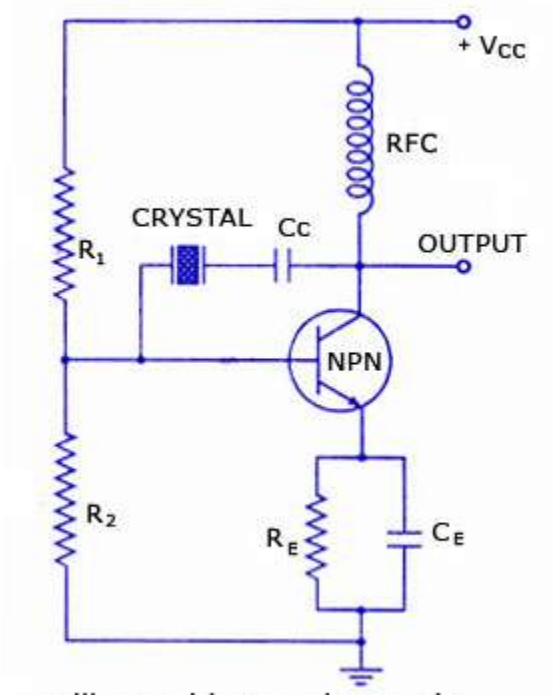
Operation:- Circuit consists of a single stage amplifier in common emitter configuration & RC phase shifting network. R1, R2, RE provides biasing• & CE is bypass capacitor. Common emitter amplifier introduces 180° phase shift between input &output & remaining 180° phase shift is produced by three identical basic RC phase shifting networks. Each RC network is designed to introduce a phase shift of 60° . The phase shift around the loop is 360° only at one precise frequency. So the circuit gives positive feedback and works as oscillator.

Frequency of Oscillations:

$$f_c = \frac{1}{2\pi RC\sqrt{6}}$$

(c) Draw the circuit diagram of crystal oscillator and explain its working.

Ans:- Circuit diagram – 2 mks, explanation- 2 mks

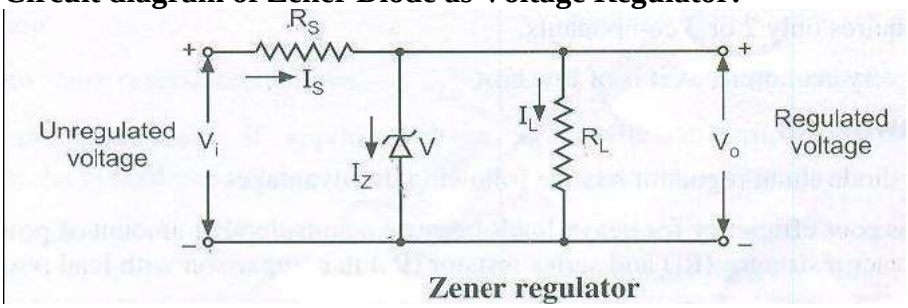


To excite a crystal for operation in the series-resonant mode it may be connected as a series element in a feedback path, the crystal impedance is the smallest and the amount of positive feedback is the largest. Resistor R1, R2 and RE provide a voltage-divider stabilized dc bias circuit, the capacitor CE provides ac bypass of the emitter resistor RE and the radio-frequency coil (RFC) provides for dc bias -while decoupling any ac signal on the power lines from affecting the output signal. The voltage feedback signal from the collector to the base is maximum when the crystal impedance is minimum . The coupling capacitor Cc has negligible impedance at the circuit operating frequency but blocks any dc between collector and base. The circuit shown in figure is generally called the Pierce crystal. The resulting circuit frequency of oscillations is set by the series resonant frequency of the crystal. Variations in supply voltage, transistor parameters, etc. have no effect on the circuit operating frequency which is held stabilized by the crystal. The circuit frequency stability is set by the crystal frequency stability, which is good.
The resonant frequency is given as-

$Fo = 1/(2 \pi \sqrt{LC})$

(d) Explain how zener diode can be used as a voltage regulator.
Ans: -Circuit diagram 2mks, Explanation 2mks

Circuit diagram of Zener Diode as Voltage Regulator:



A Voltage Regulator circuit provides constant O/P voltage inspite of changes in its i/p voltage or load current.
The Series Resistance Rs is connected to limit the total current drawn from the unregulated power supply.

Zener diode is a shunt type voltage regulator because the zener diode is connected in parallel with the load resistance and is connected in reverse biased condition.

If Vin is higher than Vz and if the Iz is between Izmin & Izmax then the voltage across zener will remain constant equal to Vz irrespective of any changes in Vin & IL. As output voltage is constant and equal to Vz, a regulated o/p voltage is obtained.

When Vin varies

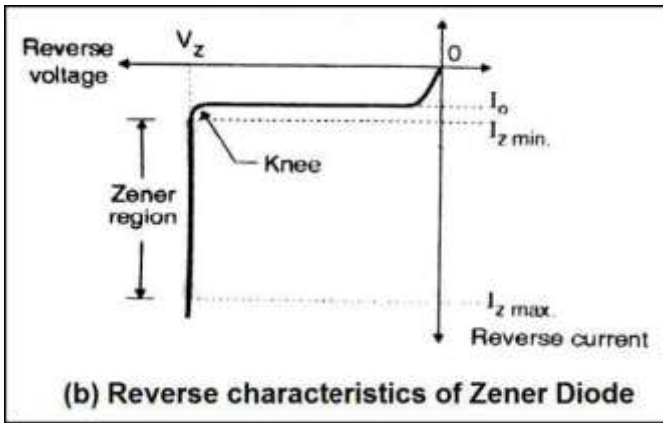
Assume R_L constant, Vin is varying

So, I_L is also constant as $I_L = V_Z/R_L$

But Vin changes & supply current also changes

$$I = \frac{Vin - Vz}{R_S} \qquad \text{Also } I = Iz + I_L$$

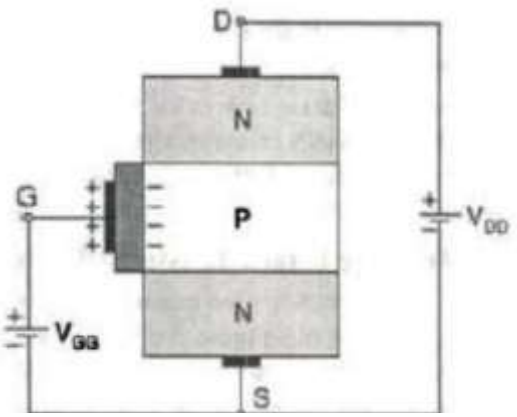
If Vin is increased, then current I will increase. But as Vz is constant & R_L is also constant, the I_L will remain constant.



(b) Reverse characteristics of Zener Diode

(e) Explain the working principle of depletion and enhancement type MOSFET.
Ans: (Each Diagram-1M, each Operation -1 M)

Enhancement type MOSFET



As its name indicates, this MOSFET operates only in the enhancement mode and has no depletion mode. It operates with large positive gate voltage only. It does not conduct when the gate-source voltage VGS = 0. This is the reason that it is called normally-off MOSFET.

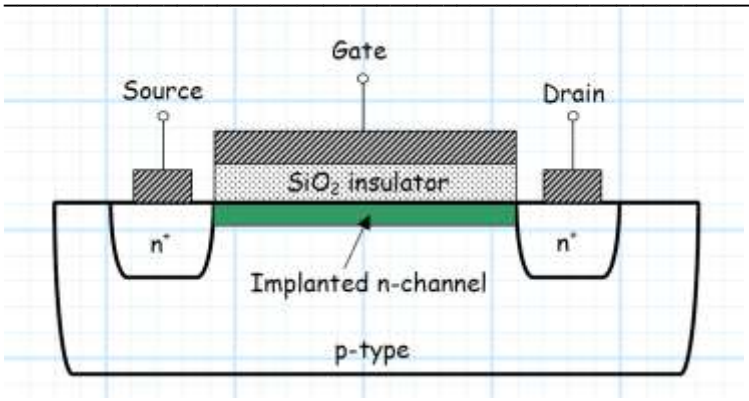
Working:

When V_{GS} is set at 0V and a voltage is applied between the drain and source, no current flows due to the absence of an N-channel. By keeping V_{DS} at some positive voltage and when V_{GS} is increased, the positive potential at the gate will push the holes (since like charges repel) in the P-substrate along the edge of the SiO_2 layer. The result is a depletion region near the SiO_2 insulating layer void of holes.

However, the electrons in the P-substrate (the minority carriers of the material) will be attracted to the positive gate and accumulate in the region near the surface of the SiO_2 layer. This is called Inversion layer.

As V_{GS} increases in magnitude, the concentration of electrons near the SiO_2 surface increases, until eventually, the induced N-type region can support a measurable flow between drain and source.

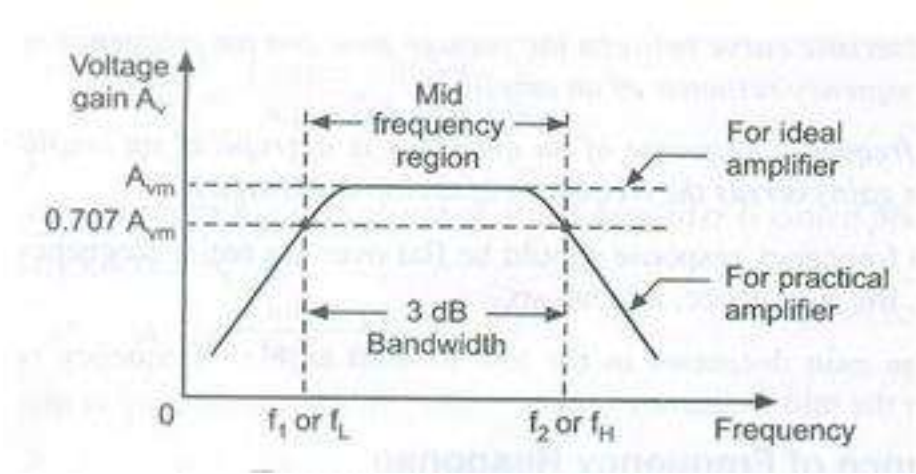
DEPLETION MOSFET



The conduction channel is physically implanted (rather than induced)! Thus, for a depletion NMOS transistor, the channel conducts even if VGS=0. If the value of VGS is positive, the channel is further enhanced. That is, more free electrons are attracted to the channel, and its conductivity increases. If the value of VGS is negative, free electrons are repelled from the channel! The conductivity of the channel is thus decreased. We call this phenomenon channel depletion.

(f) Draw the frequency response curve of single stage RC coupled amplifier. Why gain falls in low frequency and high frequency region ?

Ans:-Frequency response -2mks, explanation- 2 mks



Frequency response of RC coupled two stage amplifier

Explanation-

1. Due to coupling capacitors in amplifier voltage gain of amplifier reduces at low frequency because reactance of capacitor ($X_c = 1/2\pi RC$). As voltage gain of amplifier decreases, bandwidth increases in amplifier because in amplifier gain bandwidth product is always constant.

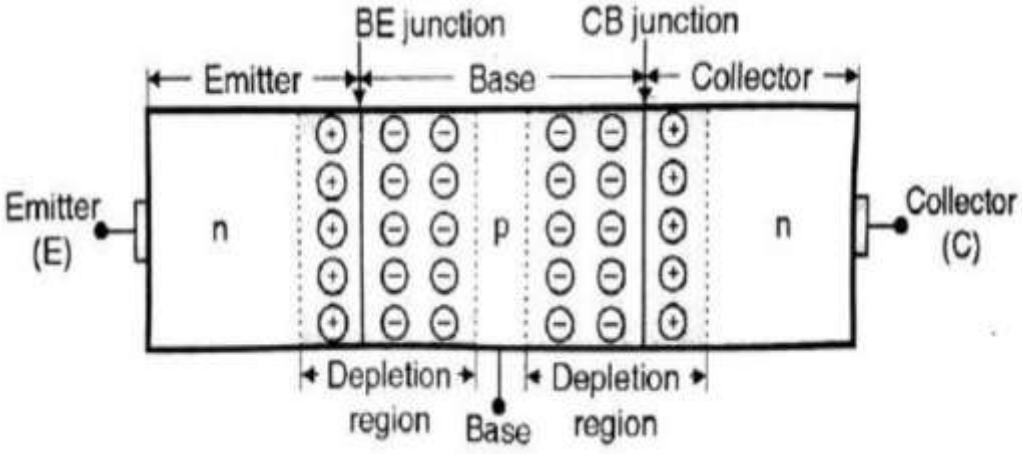
2.. While at higher frequency gain of amplifier reduces due to internal capacitances /parasitic capacitors transistor Due to bypass capacitor CE connected in amplifier allows an easy path for AC i.e. it bypasses the as current and hence it avoid any voltage drop across RE resistance and hence avoid drop in voltage gain . If bypass capacitor is not used , Ac current will flow through RE ,which will cause voltage drop across RE producing negative feedback and hence amplifier gain will reduce. So due to bypass capacitor bandwidth increases as voltage gain reduces.

6. Attempt any FOUR of the following : 16

(a) With neat diagram explain working of NPN transistor.

Ans:-Diagram- 2 mks, working – 2 mks

A transistor is formed of two p-n junctions. For unbiased p-n junctions, the depletion regions are formed. The depletion regions formed at the B-E and C-B junctions of n-p-n transistor.



Working Principle: When the n-p-n transistor is biased, as shown in fig.(b), such that the emitter-base junction is forward biased and collector-base junction is reverse biased, the minority and majority carriers are set into the motion. The majority carriers electrons from n-region enters into p-region and holes from p-region enters into n region. Since the base is lightly doped than the emitter, almost all the current flowing across the B-E junction consists of electrons entering the base from the emitter. Hence the electrons are the majority carriers in n-p-n transistor.

Some of the electrons entering into the base region do not reach the collector region. Instead they flow out of the base terminal via the base connection as shown in fig.(c) due to recombination. As the base region is very thin and lightly doped, there are very few holes available in the base region for recombination. Hence about 2% electrons will flow out of base due to recombination. The remaining 98% electrons cross the reverse biased collector-base junction to constitute the collector current. They cross the collector region and collected by the supply Vcc. The emitter current is thus equal to the sum of the base current and collector current. $IE = IB + I$c

(b) Define μ, g_m and r_d and state relation between μ, g_m and r_d.

Ans:- Each definition- 1 mks, relation-1 mks

i) Drain resistance, rd, also known as dynamic resistance of channel, is defined as resistance between drain to source when JFET is operating in pinch-off or saturation region and expressed as,

$rd = \Delta VDS / \Delta ID$,keeping VGS constant

ii) Transconductance (gm). It is the ratio of small change in drain current to corresponding change in gate to source voltage.

$gm = \Delta ID / \Delta V$, keeping VDS constant.

iii) Amplification Factor: It is defined as the ratio of small change in drain voltage to small change in gate voltage at constant drain current.

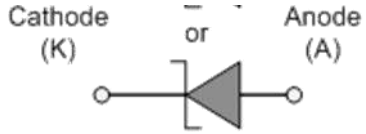
Amplification factor $\mu = \Delta VDS / \Delta V$, keeping ID constant

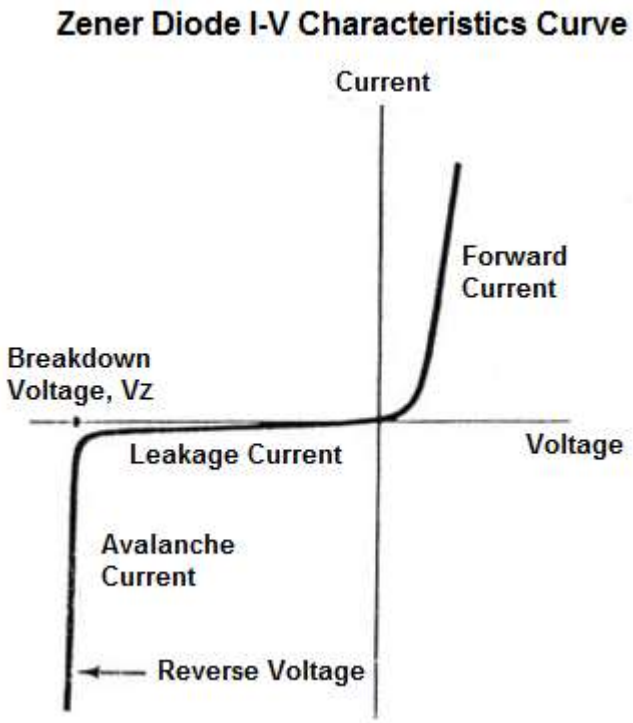
Relation between them- $\mu = gm * rd$

(c) Draw symbol and VI characteristics of zener diode and lable all regions in it.

Ans:- Symbol – 1 mks, characteristics with all lable- 3 mks

Symbol –

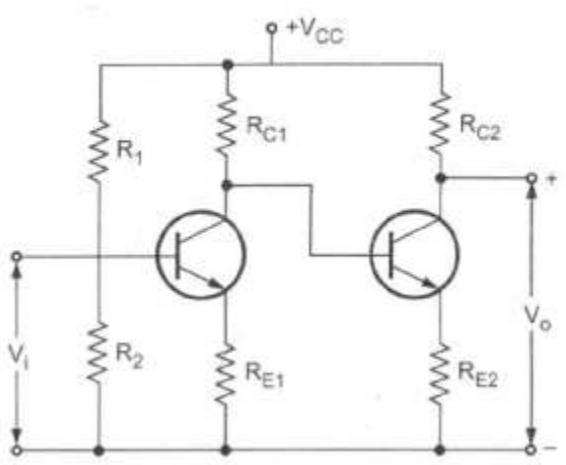




(d) State the need of cascade amplifier and draw circuit diagram of 2-stage direct coupled amplifier.

Ans:- Need- 2mks, circuit diagram--2mks

Need:- The voltage (or power) gain, obtained from a single stage small signal amplifier, is limited. Therefore, it is not sufficient for all practical applications. Therefore, in order to obtain greater voltage and power gain, cascade amplifiers are used.



(e) Compare RC coupled, transformer coupled and direct coupled amplifier based on four points.

Ans:-Relevant four points-4mks

Parameter	**RC coupled**	**Transformer coupled**	**Direct coupled**
Coupling element	**Resistor and capacitor**	**Transformer**	**No element**
Impedance matching	**Poor**	**Excellent**	**good**
Frequency response	**Excellent at audio frequency**	**Poor**	**good**
Amplify	**AC only**	**AC only**	**AC as well DC**
Application	**Voltage/Audio amplifier**	**Power amplifier**	**Low frequency amplifier,opamp**
Size and cost	**small**	**Large and bulky**	**least**

(f) Compare half wave full wave rectifier on basis of PIV , ripple factor, efficiency & TUF.

Ans:- Relevant comparison-4mks ,note-comparison can be between Half wave and centre tap/bridge rectifier.

Parameters	HWR	FWCTR	FWBR
PIV	Vm	2Vm	Vm
Ripple factor	1.21	0.482	0.482
Efficiency	40.6 %	81.2 %	81.2 %
TUF	0.282	0.693	0.812