



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) Define intrinsic and extrinsic semiconductor with examples

Ans: [Each definition for 1M]

Intrinsic Semiconductor: A semiconductor which is extremely pure form is known as Intrinsic semiconductor

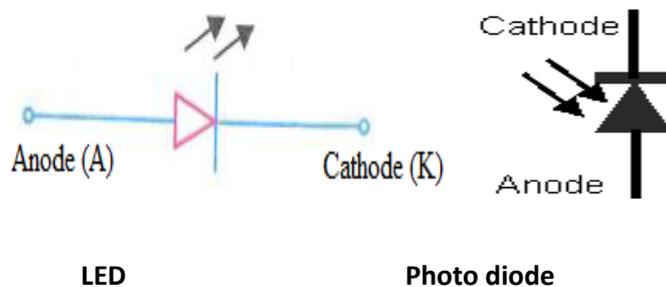
Example of intrinsic semiconductor are Germanium and silicon

Extrinsic Semiconductor :A semiconductor which is impure semiconductor in which a small amount of suitable impurity added to increase its conductivity.

Example of extrinsic semiconductor are gallium, Indium, Boron, Arsenic and Phosphorous .

b) Draw the symbol of LED and photodiode.

Ans: [Each symbol for 1M]



c) List the four specifications of zener diode.

Ans: [For each specification ½ M]

1. Zener voltage (V_z)
2. Zener current (I_z)
3. Zener resistance (R_z)
4. Power rating

d) State the need of biasing of BJT.

Ans: [Any relevant answer can be consider for 2M]

Need:

- The basic need of transistor biasing is to keep the base-emitter (B-E) junction properly forward biased and the collector-emitter (C-E) junction properly reverse biased during the application of A.C. signal.
- To fixed operating point at the center of load line.



- To ensure that operating point does not shift from its place during its process
 - This type of transistor biasing is necessary for normal and proper operation of transistor to be used for amplification or for getting faithful amplification.
- e) **Define gain and bandwidth of an amplifier.**

Ans: [Each definition for 1M]

Bandwidth

The range of frequency over which the voltage gain of an amplifier remains constant is known as bandwidth of an amplifier.

OR

The range of frequency over which the voltage gain is equal to or greater than 70.7% of its maximum value

Gain:

The ratio of output parameter (voltage/ current /power) to the input parameter (voltage/ current /power) of an amplifier is known as gain. It is denoted by a letter A

- f) **What is oscillator ? Give its classification.**

Ans.[Oscillator explanation 1M , classification 1M]

An oscillator is an electronic circuit that produces a periodic wave form of desired frequency with only dc supply voltage as an input i.e. without any ac input signal .

Classification of Oscillator :

- 1) RC oscillator
- 2) LC oscillator
- 3) Crystal Oscillator

- g) **Why BJT is called bipolar junction transistor.**

Ans. [2M for correct answer]

Ans: BJT is called bipolar junction transistor because in BJT current conduction takes place due to majority as well as minority charge carriers.

- h) **Give the different types of amplifier coupling .**

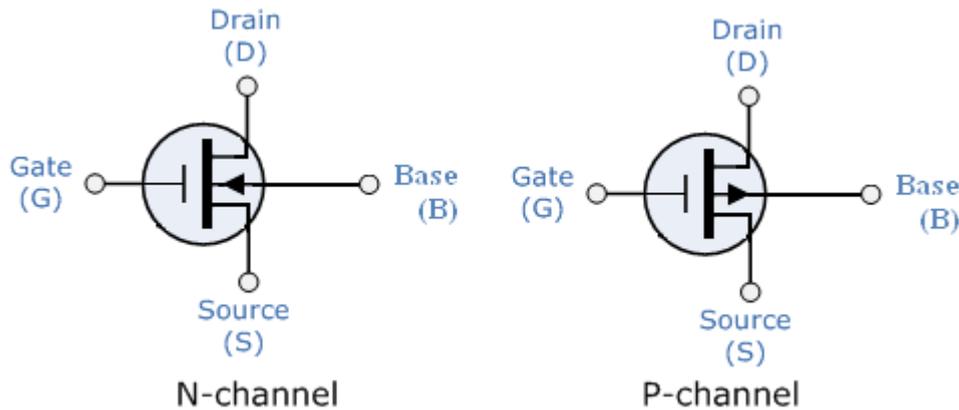
Ans :[2m for all three types]

1. Resistance – capacitance(RC) coupling.
2. Transformer coupling
3. Direct coupling

- i) **Draw symbol of D-MOSFET. (n-channel and P-channel)**



Ans: [Each symbol for 1M]



j) Write down output voltage for 7805 IC and IC 7912.

Ans:[1 M for each IC output voltage]

The output voltage of 7805 is +5 Volts and 7912 is -12 Volts

k) State Barkhausen's Criterion for sustained oscillations.

Ans:[1M for one condition]

Barkhausen's Criterion for Oscillations

The necessary condition for sustained oscillations are

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



l) What do you mean by universal gate ? Give its type

Ans : [Brief explanation 1M, types/example 1M]

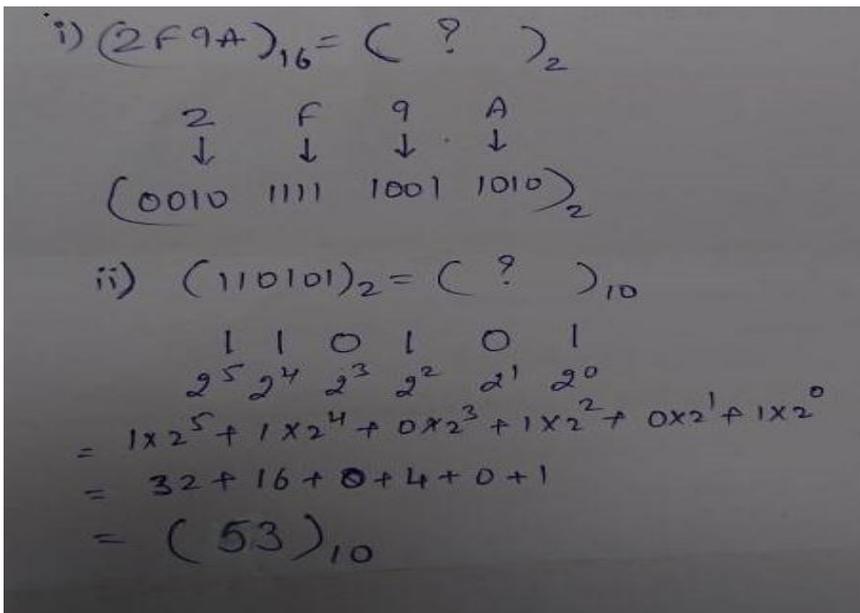
A universal gate is a gate which can implement any Boolean function or equation and any logic gate without need to use any other gate type.

The NAND and NOR gates are universal gates.

m) Convert : (i) $(2F9A)_{16} = (?)_2$

(ii) $(110101)_2 = (?)_{10}$

Ans: [for each sum 2M]



n) Give the difference between RC and LC oscillator

Ans: [Any two points 2M]

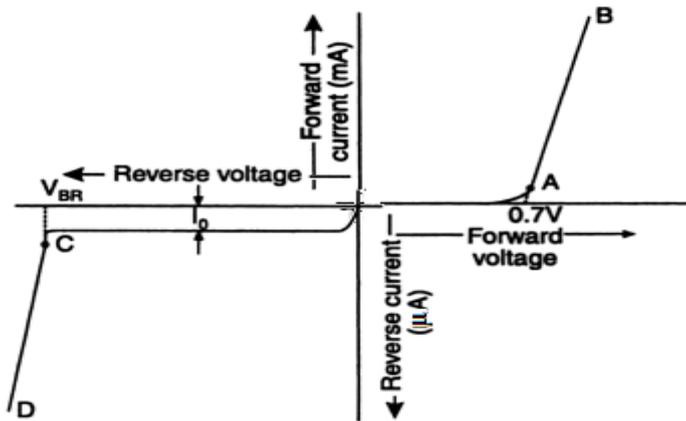
Parameter	RC Oscillator	LC Oscillator
Type of oscillator according to frequency range	Low frequency Oscillator	High frequency Oscillator
Components used in feedback network	Resistors and Capacitors used in feedback network	Inductors and Capacitors used in feedback network
Examples	RC phase shift oscillator ,Wein bridge oscillator	Hartely Oscillator , Colpitts Oscillator

Q. 2: Attempt any four of the following

16 M

a) Draw and label VI characteristics of p-n junction diode in forward bias and reverse bias.

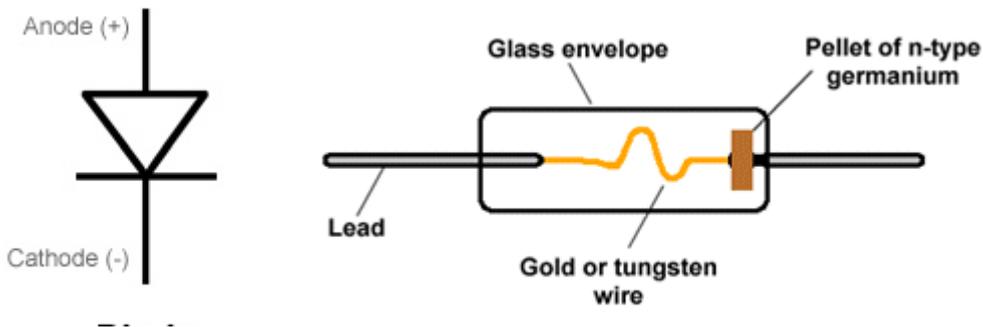
Ans: [Forward characteristics 2M , Reverse characteristics 2M]



b) Draw symbol of point contact diode . State its working principle give any two applications.

Ans: [Symbol 1M, working principle 1M, applications 2M]

Symbol



Working Principle : In point contact diode a gold or tungsten wire is used to act as the point contact to produce a PN junction region. In forward direction its operation is quite similar but in reverse bias condition the wire acts like an insulator. Since this insulator is between the plates the diode acts as a capacitor. I

Applications : 1. It is used to detect the high frequency signals .

2. Used in radio receiver as a detector specialized in analog electronics

c) Give the classification of rectifier and filter.

Ans: [Each classification for 2M]

Classifications of rectifier: 1) Halfwave rectifier

2) Fullwave rectifier

i) Centertappedfullwave rectifier

ii) Bridge fullwave rectifier

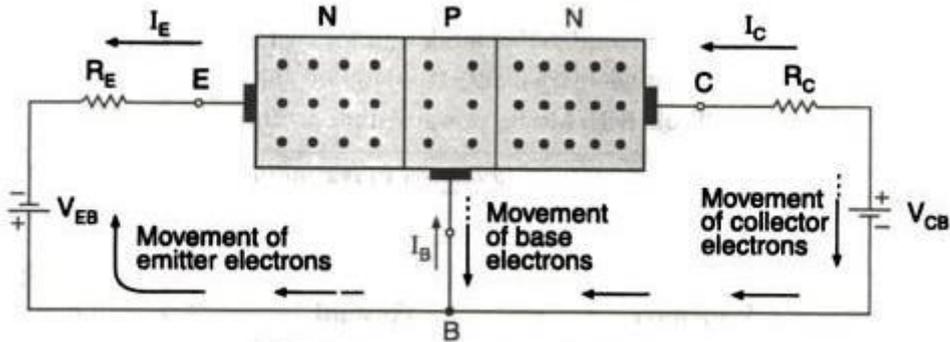
Classifications of filter : 1) Inductor (L) series filter



- 2) Capacitor (c) shunt filter
- 3) LC filter
- 4) Π (CLC) filter

d) Draw and explain working principle of NPN transistor.

Ans:[Diagram 2M, working 2M]



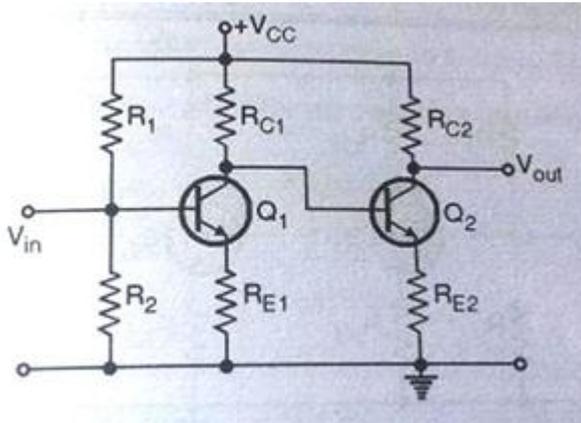
Above fig shows NPN transistor with forward biased emitter-base junction and reverse biased collector-base junction.

- The forward bias causes the electrons in the N-type emitter to flow toward the base. This constitutes the emitter current I_E .
- As these electrons flow through the P-type they tend to combine with holes. As the base is likely doped and very thin therefore only a few electrons (2%) combine with holes to constitute base current I_B .
- The remaining electrons (98%) crossover into the collector region to constitute collector current I_C .
- In this way almost the entire emitter current flows in the collector circuit. It is clear that emitter current is sum of collector and base current.

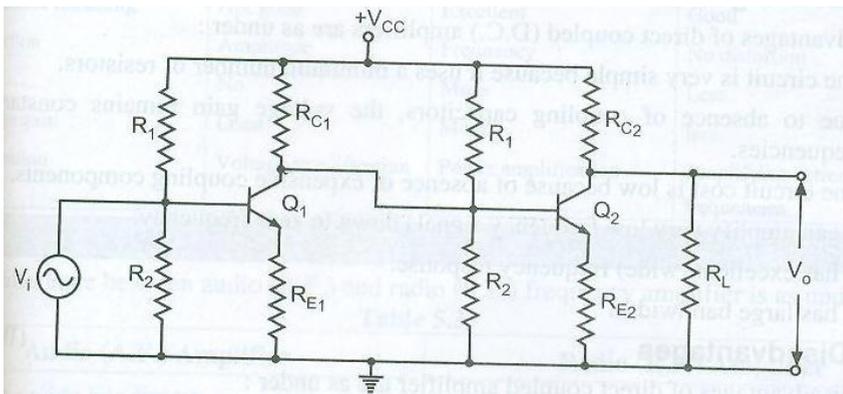
$$I_E = I_B + I_C$$

e) Explain direct coupling amplifier with circuit diagram and frequency response .

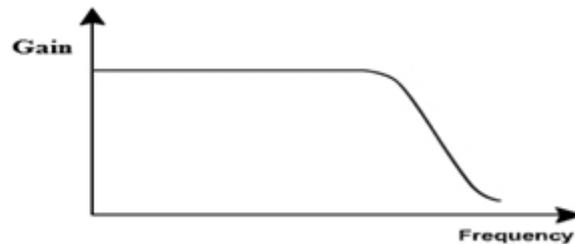
Ans:[Circuit diagram 3M, frequency response 1M]



OR



Frequency response:



f) What is need of regulated power supply ? Define load regulation and line regulation .

Ans: [Need 2M,Each definition for 1 M]

Need of regulated powersupply.

- The unregulated D.C. power supply suffers from the disadvantages of poor voltage regulation and high ripple factor.
- This may result in the erratic operation of most of the electronic devices and circuits and also electronic gadgetssuch as pocket radios, electronic calculators, digital watches/clocks, tape recorder etc.
- In order to avoid erratic operations of electronic circuits and also to improve voltage regulation and ripple factor, there is necessity of regulated D.C. power supply.

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

$$\% \text{ Load regulation} = \frac{(V_{NL} - V_{FL})}{V_{FL}} \times 100$$

Where V_{NL} = load voltage with no load current

V_{FL} = 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.

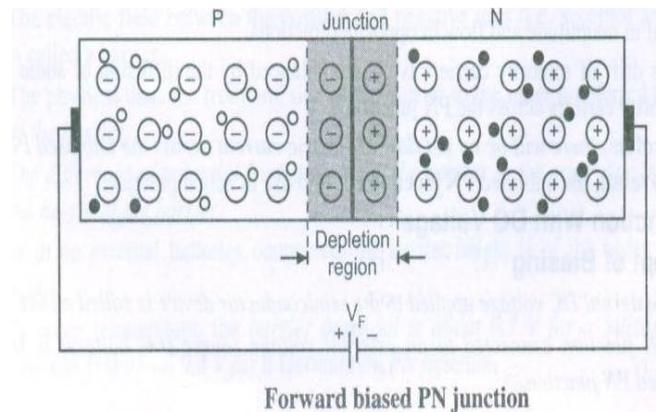
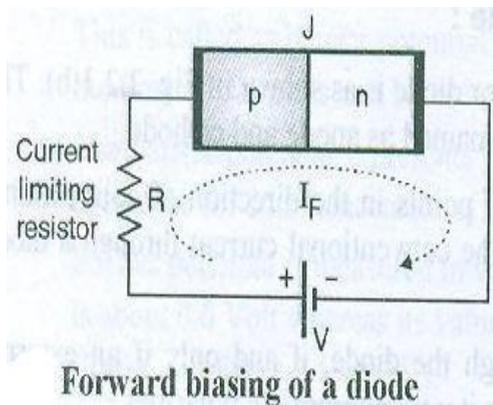
The smaller the line regulation, the better the power supply. A well-regulated power supply can have a line regulation of less than 0.1%.

Q. 3 Attempt any FOUR from following

16M

a) Draw and explain forward biasing of p-n junction diode

Ans: [Diagram 2M, Explanation 2M]



1. If the p-region (anode) is connected to the positive terminal of the external DC source and n-

side (cathode) is connected to the negative terminal of the DC source then the biasing is said to be “forward biasing”.

2. Due to the negative terminal of external source connected to the n-region, free electrons from n-side are pushed towards the p-side. Similarly the positive end of the supply will push holes from p-side towards the n-side.

3. With increase in the external supply voltage V , more and more number of holes (p-side) and electrons (n-side) start travelling towards the junction as shown in figure.



4. The holes will start converting the negative ions into neutral atoms and the electrons will convert the positive ions into neutral atoms. As a result of this, the width of depletion region will reduce.

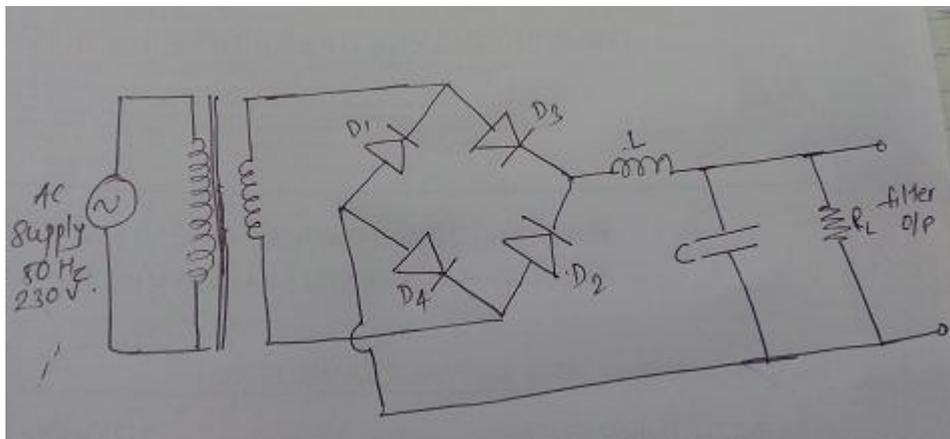
5. Due to reduction in the depletion region width, the barrier potential will also reduce.

Eventually at a particular value of V the depletion region will collapse. Now there is absolutely no opposition to the flow of electrons and holes.

Hence a large number of electrons and holes (majority carriers) can cross the junction under the influence of externally connected DC voltage.

b) Draw the circuit diagram of bridge rectifier with LC filter

Ans:[Circuit diagram 4M]



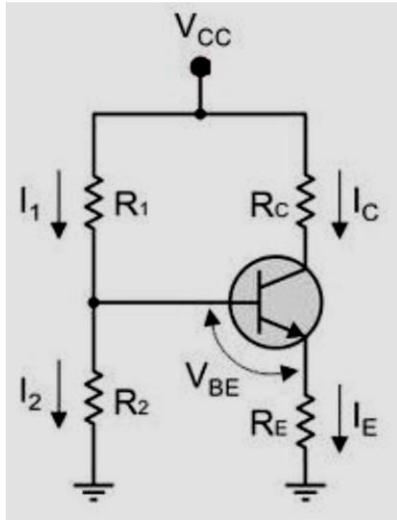
c) List various biasing circuit of BJT . Draw voltage divider bias type .

Ans:[List of biasing 2M, circuit diagram 2M]

Types of biasing

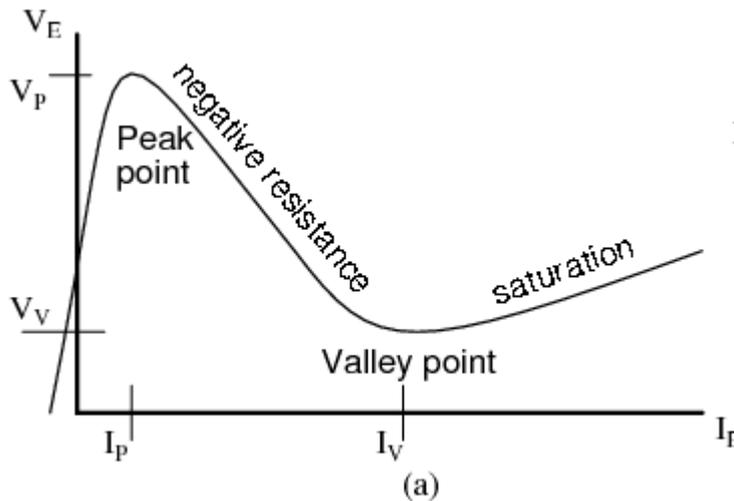
- i. Base bias (or fixed bias)
- ii. Base bias with emitter feedback.
- iii. Base bias with collector feedback
- iv. Voltage divider bias (or self bias)
- v. Emitter bias.

Circuit diagram of voltage divider biasing



d) Draw and explain VI characteristics of UJT.

Ans: [Characteristics 2M, Explanation 2 M]

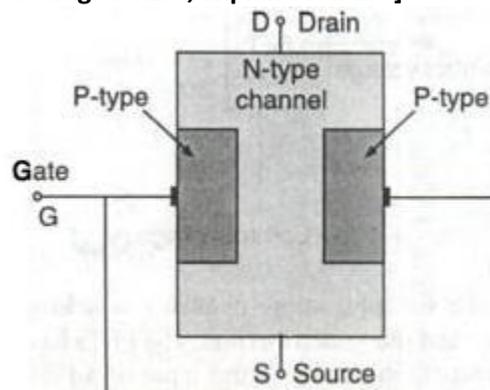


The VI characteristic of UJT is curve showing the relation between emitter voltage V_E and emitter current I_E of a UJT at a given inter base voltage V_{BB} .

1. From above graph it is noted that when emitter voltage less than peak point voltage a very small current flows through UJT I_{E0} and in this region UJT is in the cut-off region.
2. Once conduction is established at $V_E = V_P$ the emitter potential V_E starts decreasing with the increase in emitter current I_E . This corresponds exactly with the decrease in resistance R_B for increasing current I_E . Emitter voltage decreases upto valley point.
3. After valley point any further increase in emitter current I_E places the device in the saturation region.

e) Explain with diagram constructional details of n-channel JFET.

Ans:[Constructional diagram 2M, Explanation 2M]

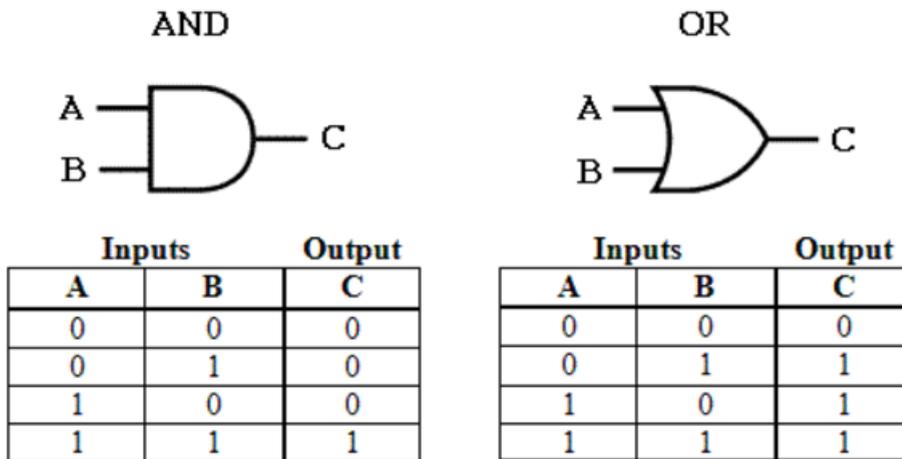




N-channel JFET consist of an N-type semiconductor bar with two P-type heavily doped regions diffused on opposite sides of its middle part . The P-type region forms two PN junctions . The space between these two junctions is called channel . Both P-type regions are internally connected and a single terminal is taken out is called Gate. Two terminals from opposite ends of N-type channel called drain and source. The drain is the terminal through which electrons leave the bar and source is the terminal through which electron enter the bar .

f) Give symbol and truth table of AND and OR gate .

Ans: [2M for each gate]



Q.4 Attempt any FOUR of the following

16M

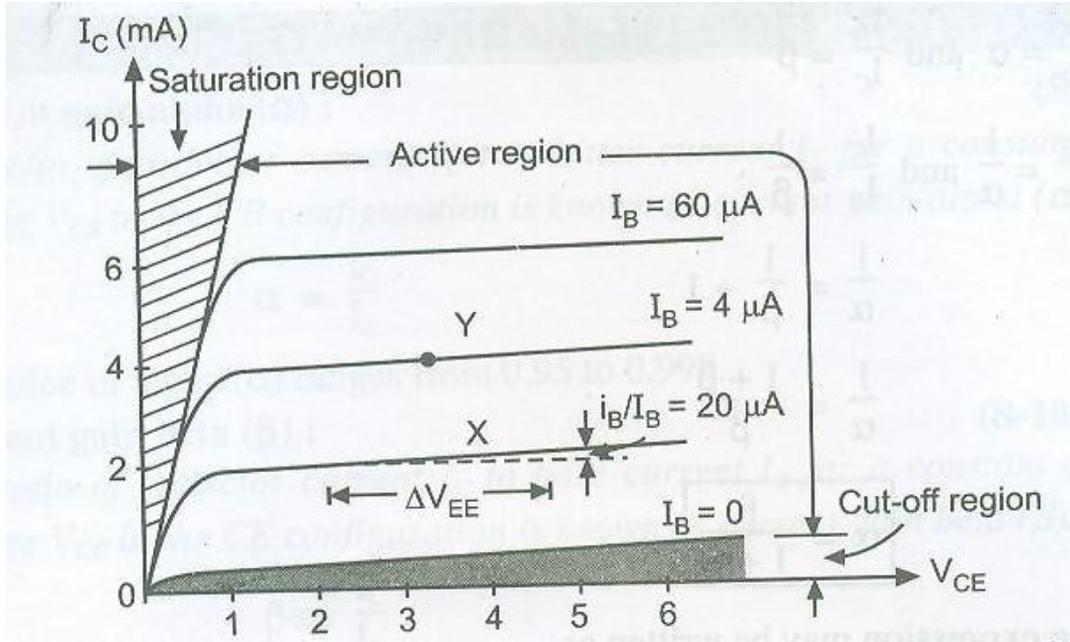
a) Compare halfwave ,centre tap and bridge type fullwave rectifier on the basis of (i) Ripple factor (ii) Rectification efficiency (iii) TUF and (iv) PIV

Ans .[Anyfourpoints:4 M]

Sr.No	Parameters	HalfWave	Centre tap	Bridge Full
i	Ripple Factor	1.21	0.482	0.482
ii	Rectification efficiency	40.6%	81.2%	81.2%
iii	Transformer utilization factor(TUF)	0.324	0.671	0.813
iv	Peak inverse voltage(PIV)	V_m	$2V_m$	V_m

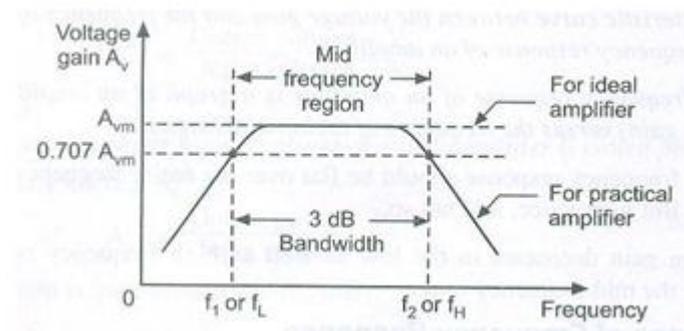
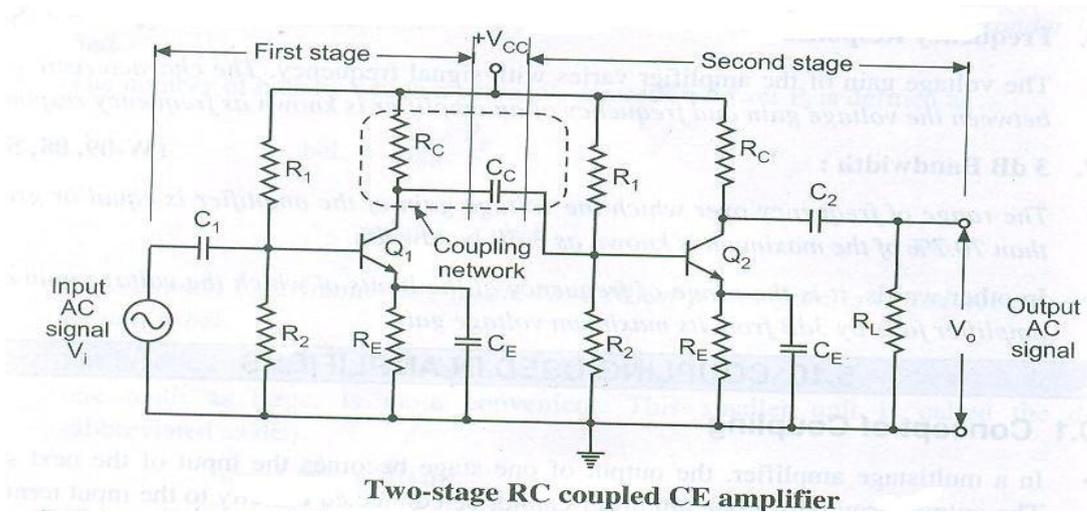
b) Draw output characteristics of CE configuration and show various regions of BJT.

Ans: [Neat and labelled characteristics 4M]



c) Draw two stage RC coupled amplifier and draw its frequency response .

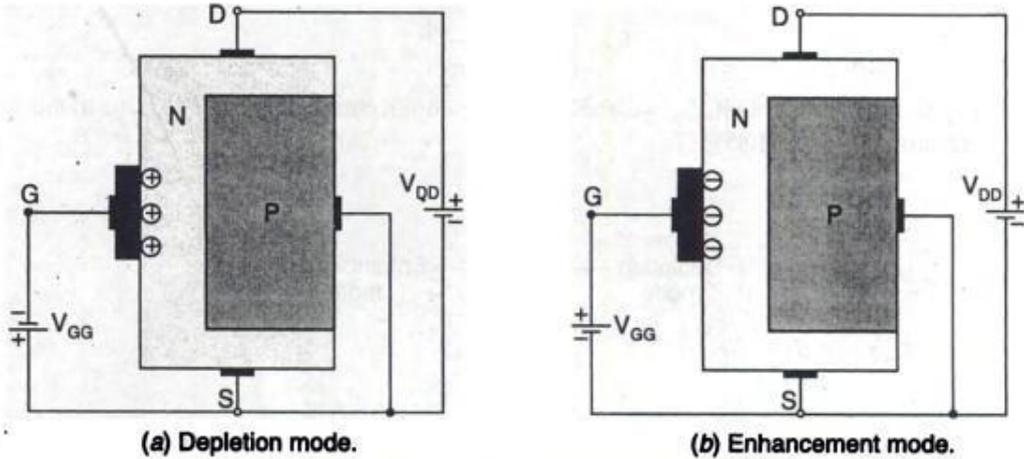
Ans:



Frequency response of RC coupled two stage amplifier

d) Explain working principle of N-channel depletion type MOSFET with construction diagram.

Ans: [Diagram: 2M; Explanation: 2M]



Basic Operation

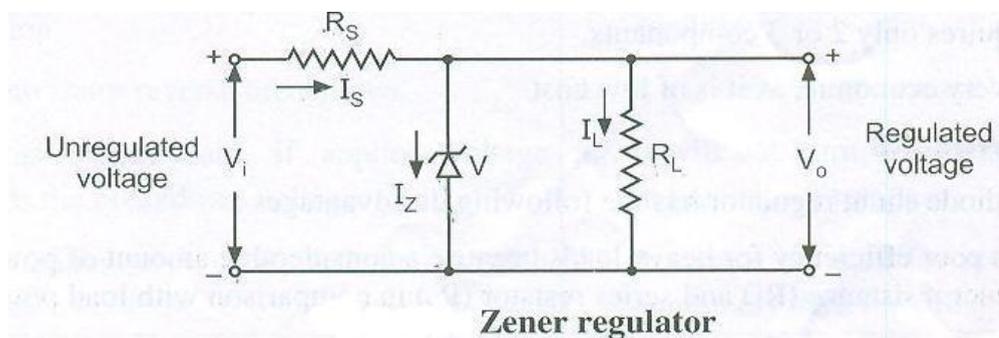
This MOSFET can be operated in two different modes, namely, Depletion Mode and Enhancement Mode.

In depletion Mode, MOSFET is with negative gate to source voltage. The negative voltage on the gate induces a positive charge in the channel. Due to this, free electrons in the vicinity of positive charge are repelled away in the channel. Thus, the channel is depleted of free electrons, reducing the number of free electrons that are passing through the channel. Thus, negative gate to source voltage is increased and the value of drain voltage V_{GS} is totally depleted of free electrons and hence drain current reduces to zero.

In Enhancement mode, a positive gate to source voltage is applied. The positive gate voltage increases the number of free electrons passing through the channel. The greater the gate voltage, greater is the number of free electrons passing through the channel. This enhances the conducting of the channel.

e) Explain how zener diode can be used as voltage regulator.

Ans: [Circuit diagram 2M, Explanation 2M]





Working

- For proper operation, the input voltage V_i must be greater than the Zener voltage V_z . This ensures that the Zener diode operates in the reverse breakdown condition. The unregulated input voltage V_i is applied to the Zener diode.
- Suppose this input voltage exceeds the Zener voltage. This voltage operates the Zener diode in reverse breakdown region and maintains a constant voltage, i.e. $V_z = V_o$ across the load inspite of input AC voltage fluctuations or load current variations. The input current is given by, $I_S = V_i - V_z / R_s = V_i - V_o / R_s$
- We know that the input current I_S is the sum of Zener current I_z and load current I_L .

Therefore, $I_S = I_z + I_L$

or $I_z = I_S - I_L$

- As the load current increase, the Zener current decreases so that the input current remains

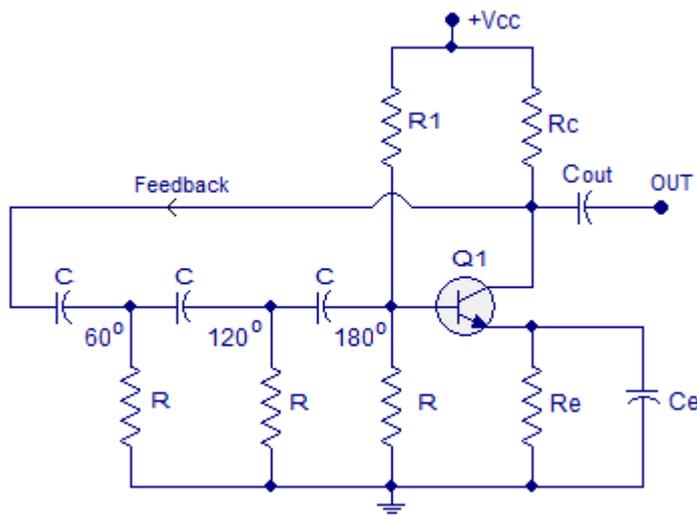
constant. According to Kirchhoff's voltage law, the output voltage is given by,

$V_o = V_i - I_S \cdot R_s$

- As the input current is constant, the output voltage remains constant (i.e. unaltered or unchanged). The reverse would be true, if the load current decreases. This circuit is also correct for the changes in input voltage.
- As the input voltage increases, more Zener current will flow through the Zener diode. This increases the input voltage I_S , and also the voltage drop across the resistor R_s , but the load voltage V_o would remain constant. The reverse would be true, if the decrease in input voltage is not below Zener voltage
- Thus, a Zener diode acts as a voltage regulator and the fixed voltage is maintained across the load resistor R_L .

f) Draw neat circuit diagram of RC phase shift oscillator . State its equation for output frequency.

Ans: [Circuit diagram 3M, Equation 1M]



Circuit diagram of RC phase shift Oscillator

$$\text{Equation of output frequency} = \frac{1}{2\pi\sqrt{6} RC}$$

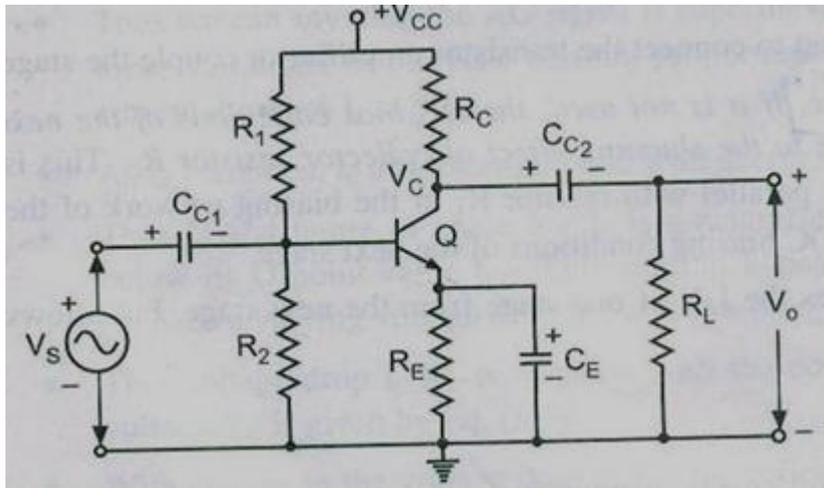
Q .5 Attempt any FOUR of the following .

16M

a) Explain single stage CE amplifier with the help of circuit diagram.

Ans: [Circuit diagram 2M, Explanation 2M]

Circuit diagram:



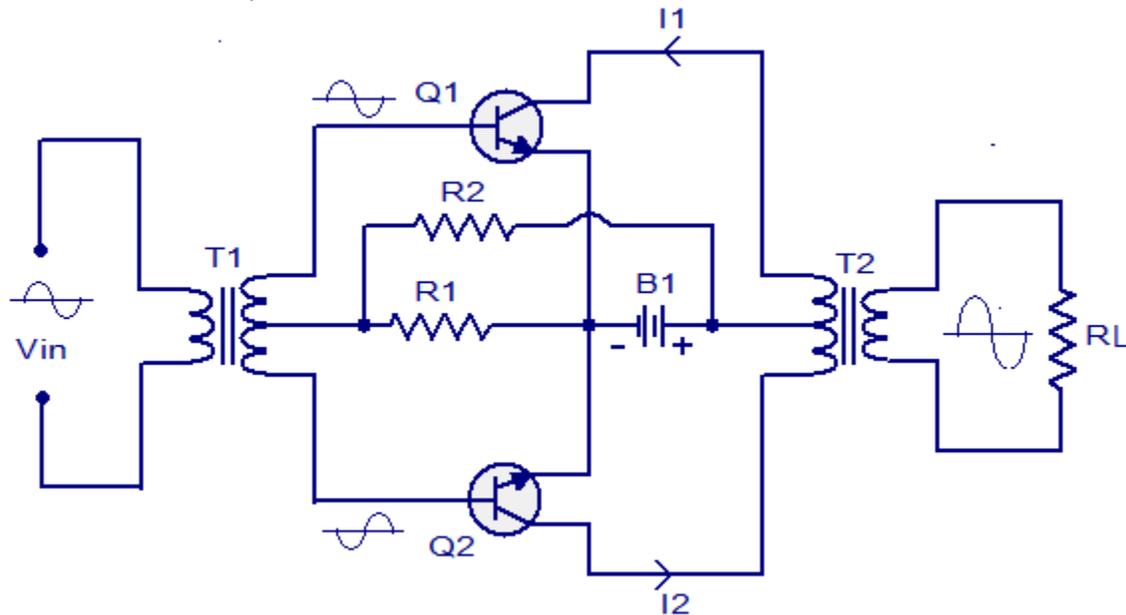
- The circuit diagram of a voltage amplifier using a single transistor in CE configuration is shown in figure. It is also known as a small-signal single-stage CE amplifier or RC coupled CE amplifier. It is also known as a voltage amplifier.
- The potential divider biasing is provided by resistors R1, R2 and RE.
- It provides good stabilization of the operating point. The capacitors CC1 and CC2 are called the coupling capacitors used to block the AC voltage signals at the input and the output sides.
- The capacitor CE works as a bypass capacitor. It bypasses all the AC currents from the emitter to the ground and avoids the negative current feedback. It increases the output AC voltage.
- The resistance RL represents the resistance of whatever is connected at the output. It may be a load resistance or input resistance of the next stage.



b) Explain the operation of Class A push pull amplifier with circuit diagram.

Ans: [Circuit diagram 2M, Explanation 2M]

Circuit diagram:



Operation: The transformer T1 is used to split the input signal into two phases. When Q1 is driven positive, its collector current increases, while Q2's collector current decreases. The collector currents of Q1 and Q2 flow through the primary of transformer T2 in the same direction. As a result, an amplified version of the original input signal is induced in the T2 secondary. The current through the T2 secondary is the difference between the two collector currents.

c) Compare between BJT and FET (Four points)

Ans:[Any four points ,each for 1M]

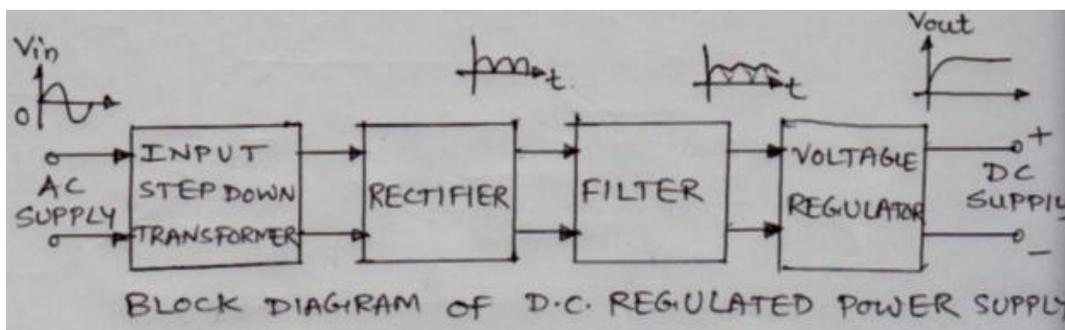


Sr. no.	BJT	JFET
1.	It is bipolar device i.e. current in the device is carried by electrons and	It is unipolar device i.e. current in the device is carried by either electrons
2.	It is current controlled device i.e. base current controls the collector current.	It is voltage controlled device i.e. voltage at the gate terminal controls the amount of current flowing
3.	Input resistance is low, of the order	Input resistance is very high, of the
4.	It has positive temperature coefficient of resistance at high current levels i.e. current increases as	It has negative temperature coefficient of resistance at high current levels i.e.
5.	It suffers from minority carrier	It does not suffer from minority

d. Draw the block diagram of Dc regulated power supply and explain the function of each block.

Ans: [Block diagram 2 M, Function of each block 2 M]

Block diagram of regulated power supply:



- 1) **Transformer** : It is used to convert ac voltage either ac high value or ac low value as per requirement
- 2) **Rectifier** : Rectifier converts the transformer secondary a.c. voltage into pulsating voltage .

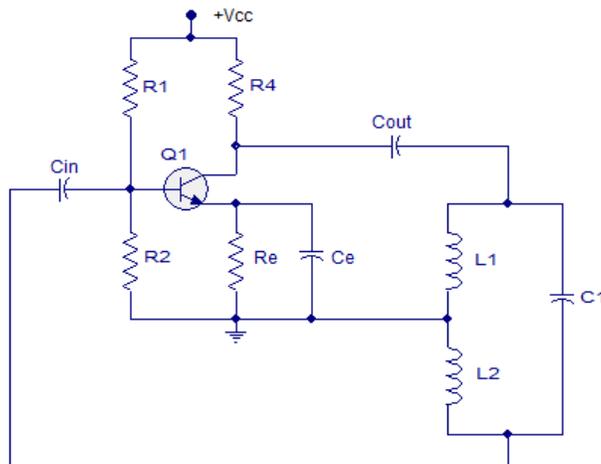


- 3) **Filter** :The pulsating d.c. voltage is applied to the filter it reduces the pulsations in the rectifier d.c. output voltage . Basically filter is used to remove ac components which are present in the rectifier output.
- 4) **Voltage regulator** : Finally, the voltage regulator performs two functions. Firstly, it reduces the variations in the filtered output voltage. Secondly, it keeps the output voltage (V_{out}) nearly constant whether the load current changes or there is change in input a.c. voltage.

e) Draw circuit diagram of Hartley oscillator give its two applications.

Ans: [Circuit diagram 2M, Any 2 applications 2M]

Circuit diagram:



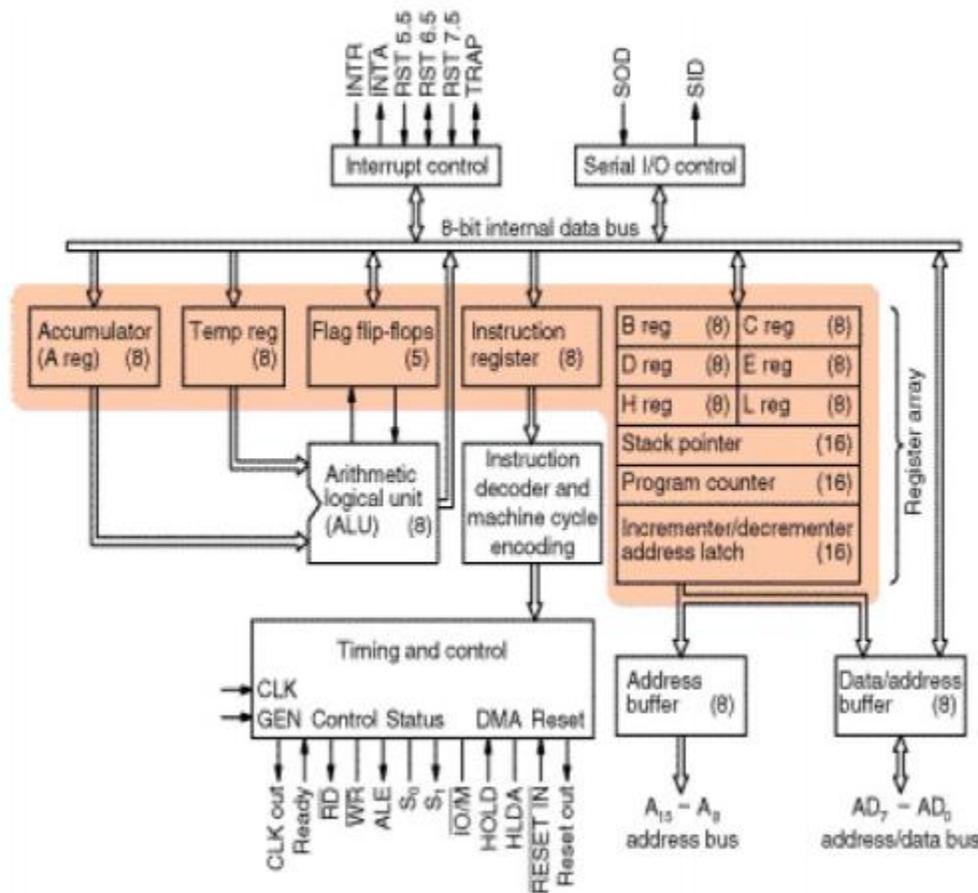
Applications

- The Hartley oscillator is to produce a sine wave with the desired frequency
- Hartley oscillators are mainly used as radio receivers TV transmitter.
- The Hartley oscillator is Suitable for oscillations for providing carrier frequency to modulator

f) Draw block diagram of microprocessor and state the function of each block.

Ans:[Block diagram 2M, Function of blocks 2M]

Any relevant block diagram can be consider.



Registers:The 8085 includes six registers, one accumulator, and one flag register, as shown in Figure. In addition, it has two 16-bit registers: the stack pointer and the program counter. The 8085 has six general-purpose registers to store 8-bit data; these are identified as B, C, D, E, H, and L.

Program Counter (PC): This 16-bit register deals with sequencing the execution of instructions. This register is a memory pointer. The microprocessor uses this register to sequence the execution of the instructions. The function of the program counter is to point to the memory address from which the next byte is to be fetched. When a byte is being fetched, the program counter is automatically incremented by one to point to the next memory location.

Stack Pointer (SP): The stack pointer is also a 16-bit register, used as a memory pointer. It points to a memory location in R/W memory, called stack. The beginning of the stack is defined by loading 16-bit address in the stack pointer.

Arithmetic & Logic Unit (ALU) :It performs various arithmetic and logic operations. The data is available in accumulator and temporary/general purpose registers.

Arithmetic Operations: Addition, Subtraction, Increment, Decrement etc.



Logic Operations: AND, OR, X-OR, Complement etc.

Q.6 Attempt any FOUR of the following

16M

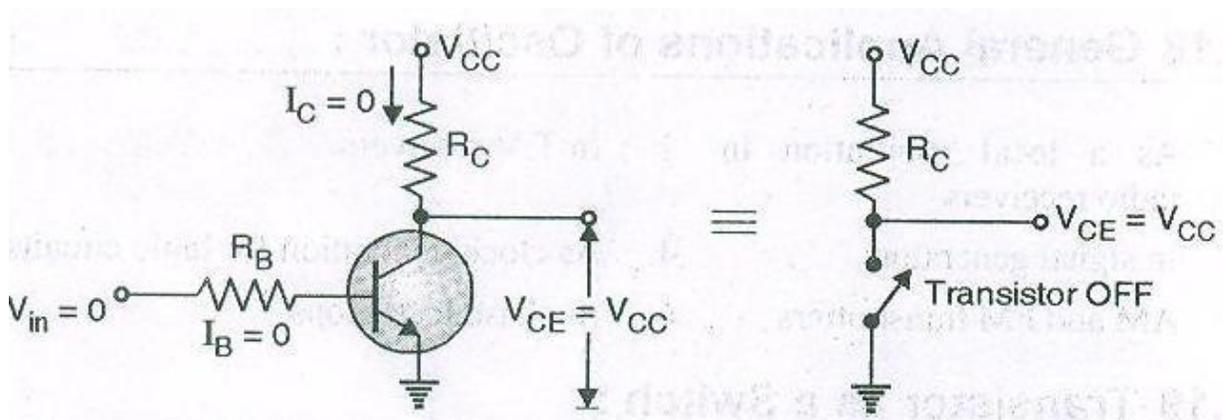
a) Describe transistor as a switch with neat diagram .

Ans.[Circuit Diagram: 2M; Explanation: 2M]

1. Transistor in cutoff region (open switch)

In the cutoff region both the junctions of a transistor are reverse biased and a very small reverse current flows through the transistor.

The voltage drop across the transistor (V_{CE}) is high. Thus in the cutoff region the transistor is equivalent to an open switch as shown in figure.

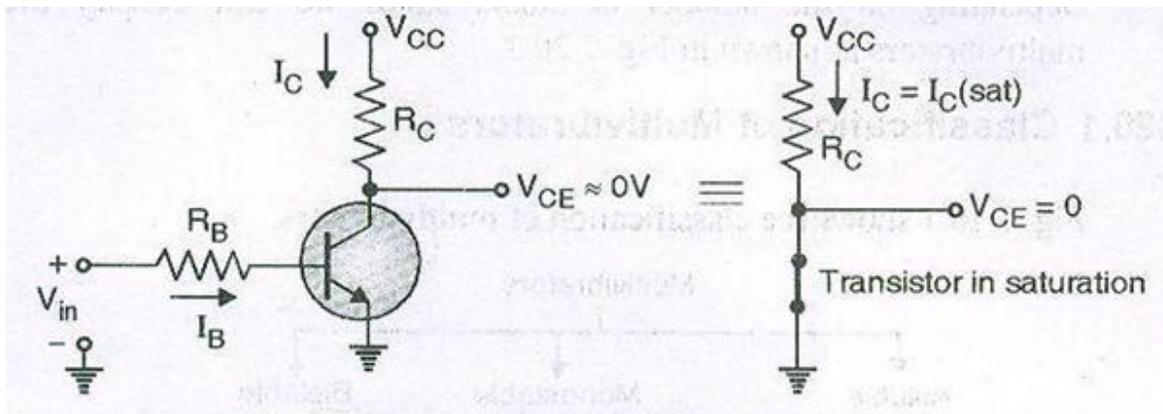


2. Transistor in saturation region (close switch)

When V_{in} is positive, a large base current flows and the transistor saturates.

In the saturation region both the junctions of a transistor are forward biased. The voltage drop across the transistor (V_{CE}) is very small of the order of 0.2V to 1V depending on the type of transistor and collector current is very large.

In saturation the transistor is equivalent to a closed switch as shown in figure.



b) Define α & β and derive the relation between α & β w. r. t. BJT.

Ans : [Each definition 1M, Derivation 2M]

α : The ratio of output collector current I_C to input emitter current I_E in the CB configuration is called current gain alpha (α).

β : The ratio of output collector current I_C to the input base current I_B in the CE configuration is called current gain beta (β).

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 $I_B/I_C = \beta$

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

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

$$\text{hence } 1/\alpha = (1 + \beta)/\beta$$



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

c) Classify different types of power amplifier w.r.t. period of conduction of input signal.

Ans: [for each type 1M]

Power amplifier are classified w.r.t period of conduction of input signal as:

- 1) **Class A** :In class A power amplifier transistor biased in a such way that output current (I_c) flows for full cycle (360°)of input signal .
- 2) **Class B** :In class B power amplifier transistor biased in a such way that output current (I_c) flows for half cycle (180°)of input signal .
- 3) **Class C** :In class C power amplifier transistor biased in a such way that output current (I_c) flows for less than half cycle ($<180^\circ$)of input signal .
- 4) **Class AB** : In class AB power amplifier transistor biased in a such way that output current (I_c) flows for more than half cycle and less than full cycle of input signal .($180^\circ < \phi < 360^\circ$) where ϕ = conduction angle

d) Define : (i) Drain resistance

(ii) Mutual capacitance

(iii) Amplification factor

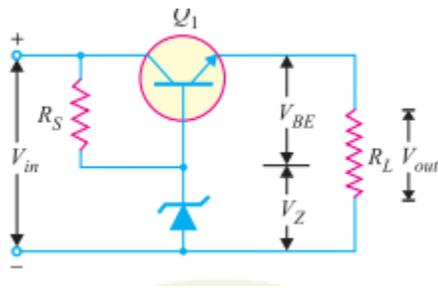
(iv) Pinch of voltage of FET

Ans: [Each definition 1M]

- i) **Drain resistance** :It is ratio of change in drain to source voltage(ΔV_{DS}) to the corresponding change in drain current (ΔI_D) for constant gate to source voltage V_{GS} .
- ii) **Transconductance/ mutual conductance** :It is ratio of change in Drain current (ΔI_D) to change in Gate to Source Voltage (ΔV_{GS}) at a constant V_{DS} .
- iii) **Amplification Factor** : It is ratio of change in Drain to Source Voltage (ΔV_{DS}) to change in Gate to Source Voltage (ΔV_{GS}) at a constant I_D .
- iv) **Pinch off voltage** :It is minimum value of drain to source voltage at which drain current becomes constant

e) Draw transistorized series voltage regulator and explain its working .

Ans: [Circuit diagram 2M, working 2M]



Operation. The base voltage of transistor Q1 is held to a relatively constant voltage across the zener diode. For example, if 8V zener (i.e., $V_Z = 8V$) is used, the base voltage of Q1 will remain approximately 8V.

Equation of output voltage $V_{out} = V_Z - V_{BE}$

- (i) If the output voltage decreases, the increased base-emitter voltage causes transistor Q1 to conduct more, thereby raising the output voltage. As a result, the output voltage is maintained at a constant level.
- (ii) (ii) If the output voltage increases, the decreased base-emitter voltage causes transistor Q1 to conduct less, thereby reducing the output voltage. Consequently, the output voltage is maintained at a constant level.

The advantage of this circuit is that the changes in zener current are reduced by a factor β . Therefore, the effect of zener impedance is greatly reduced and much more stabilised output is obtained

f) Write advantages and disadvantages of positive and negative feedback.

Ans: [For each feedback 2M]

	Positive feedback	Negative feedback
Advantages	Voltage gain increases -1 mks	(any 1 – 1 mks) Bandwidth increases Noise decreases Distortion decreases voltage stability is high
Disadvantages	(any 1 – 1 mks) Noise increases Distortion increases voltage stability decreases Bandwidth decreases	Voltage gain decreases- 1 mks