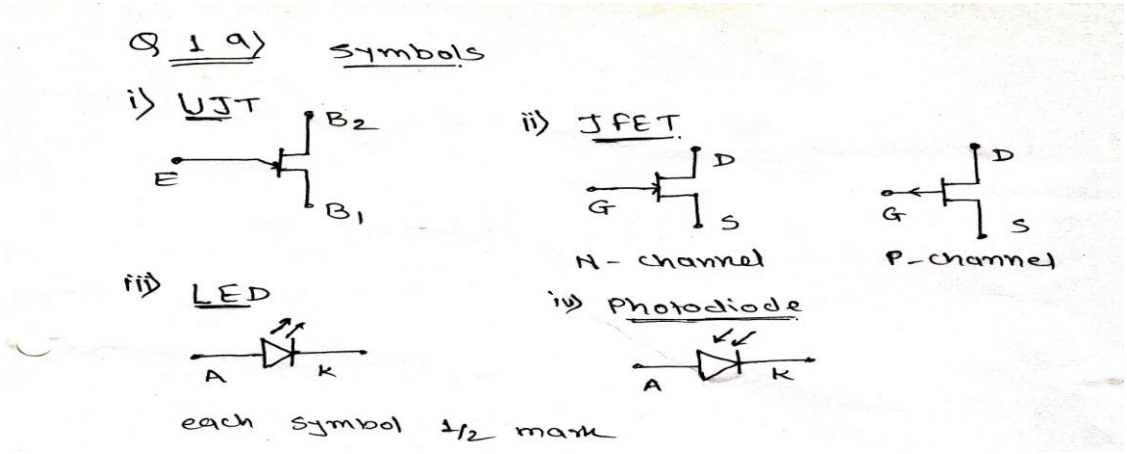
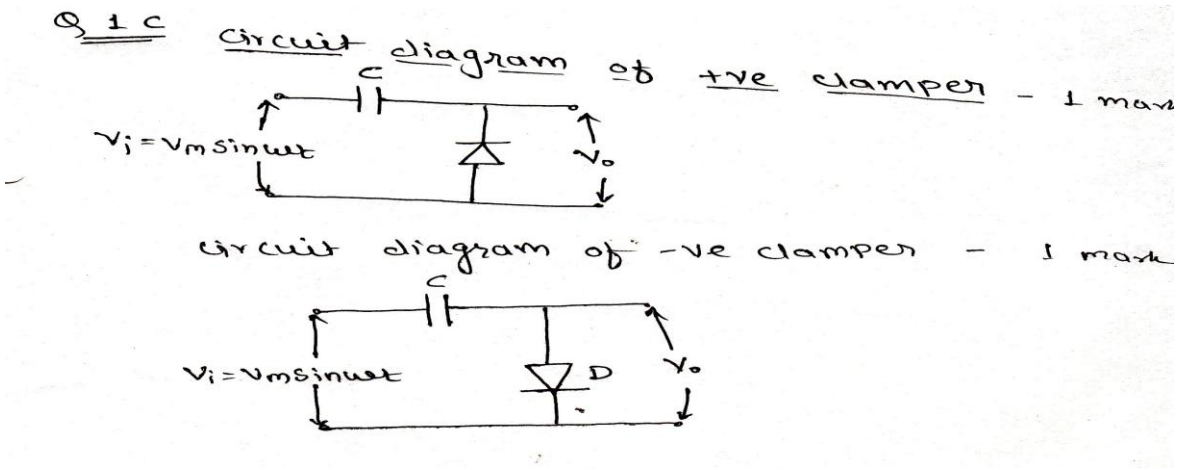
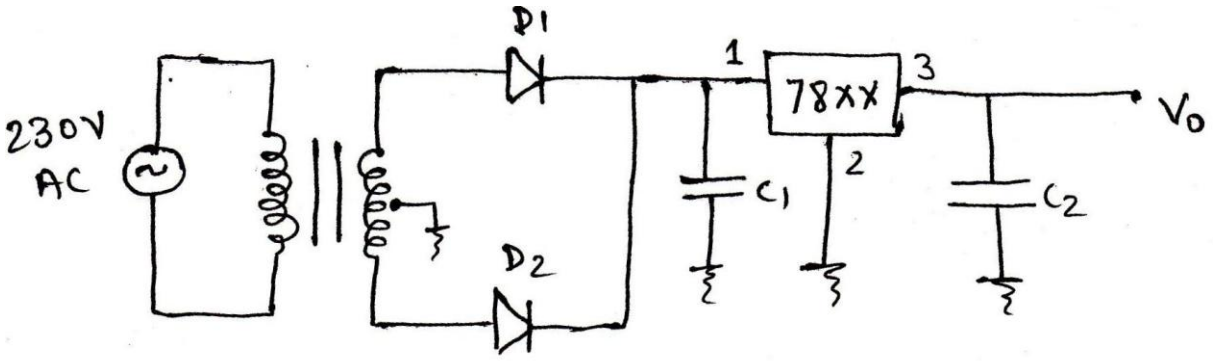
Important Instructions to examiners:

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.

		Marks
Q1	**Attempt any ten of the following:**	**20**
a)	Show the symbols of:	
Ans		½ mark s for each symbol
b) i	State the application of negative feedback and positive feedback (one in each case)	
Ans	Application of negative feedback 1. used in amplifiers	½

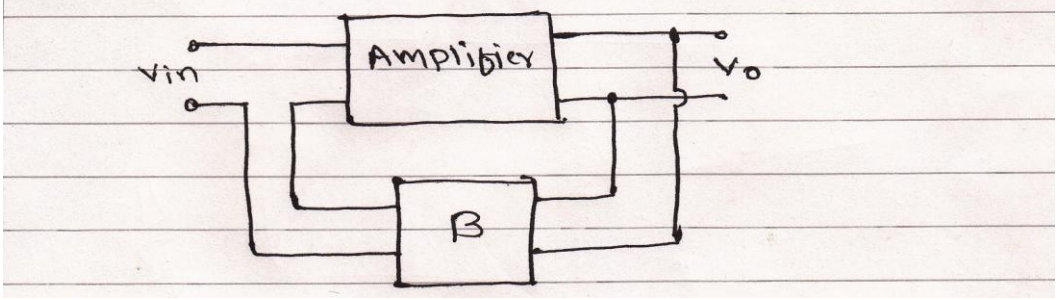
	Application of positive feedback 1. used in oscillators	½
ii	State the requirements of an oscillator.	
Ans	Requirements of an oscillator 1. Loop gain must be equal to 1 i.e. AB =1 2. The net phase shift ground the loop equal to 360^o or 0^o	**1**
c)	Draw circuit of Positive and Negative clampers**.**	
Ans		**1** **1**
d)	Draw the circuit diagram of voltage regulator using 78XXIC.	
Ans		**2**

e)	Define transistor as a switch.	
Ans	Transistor as a switch : Transistor as a switch operates between two states namely saturation and cut off. The saturation state occurs when both the junction (E-B junction and C-B junction) are forward biased on the other hand, the cut-off state occurs, when both the junctions are reverse biased. Open switch in cut off state Where, i_c=0 and $V_{CE} = V_{CE(sat)}$ Close switch in saturation state $i_c = V_{CC} / R_C$ and $V_{CE} = V_{CE(sat)}$	**2**
f)	What is the need for troubleshooting?	
Ans	Need of troubleshooting: i) Every product, ckt and instruments are designed to give desired o/p, but there are many problems associated with the design, tends to produce unexpected o/p. therefore, for satisfactory performance it needs to troubleshoot. So that the ckt can be made operational again ii) It is needed for identifying the symptoms and rectifying the problem so that it give desired o/p.	**2**
g)	State the application of:	
Ans	**Application (any one application of each)** **i) Photo transistor** 1. In fiber optic receiver	**½**

	2. Logic circuits 3. Optical switching 4. Optical communication 5. Photodetection	
	ii) LDR	½
	1. Automatic contrast and brightness in TV. 2. Used in camera light meters, street lights. 3. Used in alarm and outdoor clocks.	
	iii) UJT	½
	1. As a trigger device for SCR's and TRIAC 's 2. As Non-sinusoidal oscillator 3. In timing ckts.	
	iv) **Opto- coupler**	½
	1. Opto coupler can be used in applications where 9 low level input voltage is required to latch a high voltage relay for activating some king of electromechanical device.	
h)	Name the four types of negative feedback. Draw the block diagram of any one type**.**	
Ans	**Four types of negative feedback** 1. Voltage series feedback connection 2. Voltage shunt feedback connection 3. Current series feedback connection 4. Current shunt feedback connection	**1**

(Any one block diagram 1m.)

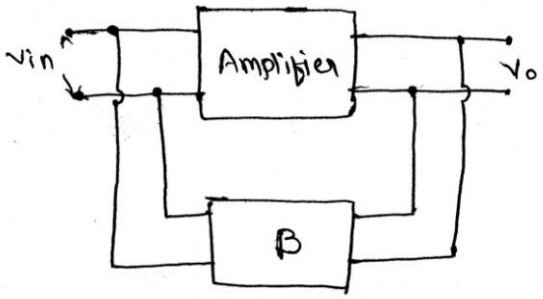
1) Block diagram of voltage series.



1

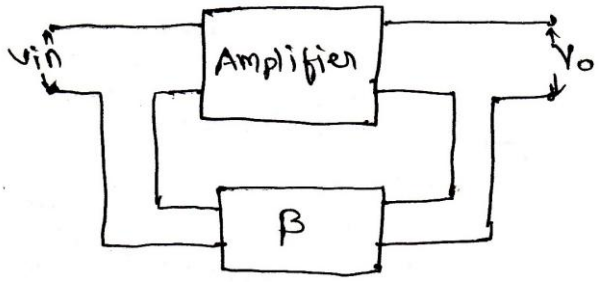
OR

2) Block diagram of Voltage Shunt



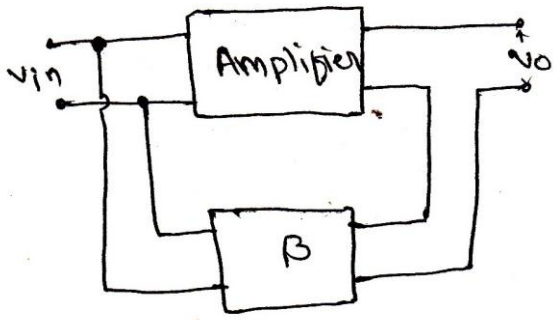
OR

3) Block diagram of current series



OR

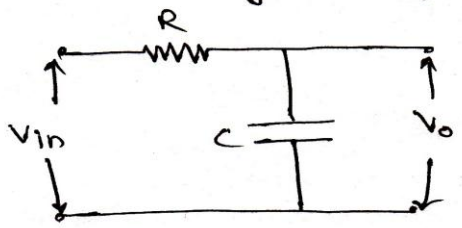
4) Block diagram of current shunt



i) Draw the basic circuit diagram of RC integrator and differentiator

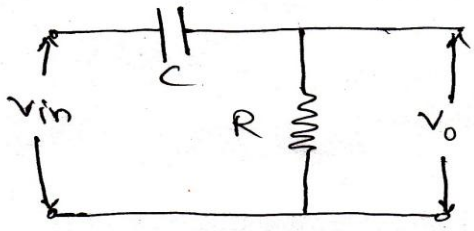
Ans

Q 1 i) circuit diagram of RC integrator 1m



1

circuit diagram of RC differentiator 1m



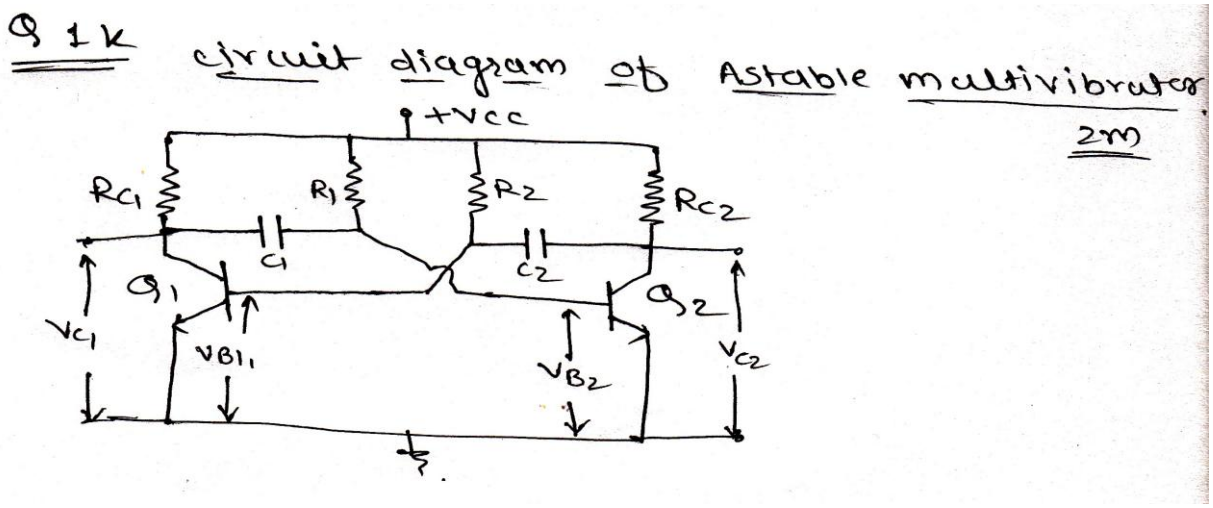
1

j) What is the need of voltage regulation?

Ans **Need of voltage regulator:** In many electronics applications it is desired that the o/p voltage should remain constant regardless of the variations in the i/p voltage or load

In order to ensure this, a voltage stabilizing device called voltage regulator is used

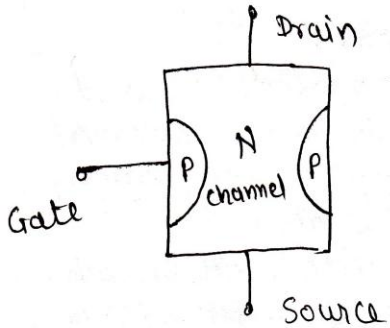
2

k)	Draw the basic circuit diagram of Astable Multivibrator (AMV)	
Ans		**2**
l)	Explain the procedure in brief for troubleshooting a phase shift oscillator.	
Ans	Procedure for troubleshooting a phase shift oscillator Step 1 Identify the symptoms 2 Perform a power check 3 Perform a sensory check 4 Apply signal tracking 5 Apply fault analysis 6 Replace or repair	**2**
Q2	**Answer any two**:	**16**
a)	Show the construction of JFET. Draw the volt-ampere characteristics and explain its working principle.	
Ans		

Q 2 g

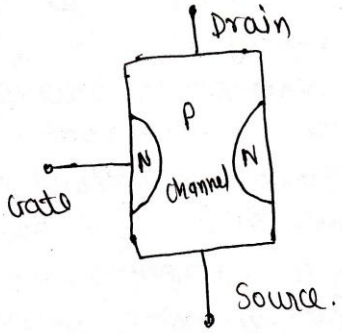
Construction of JFET — 2m

n - channel JFET

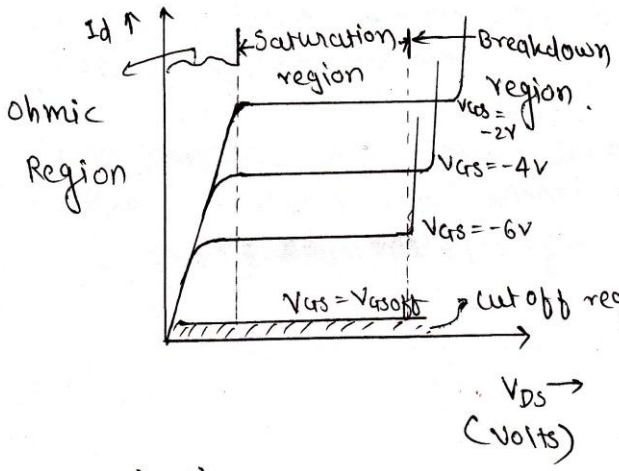


OR

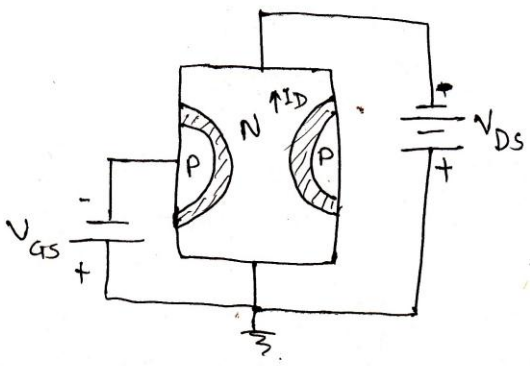
P- channel JFET

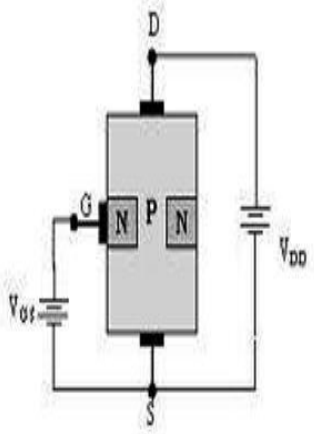


Volt - ampere characteristics — 2m



circuit diagram of n-channel JFET — 2m





Working of N-channel JFET **2**

The supply voltage V_{DS} is connected between Drain and source, which is forward bias another supply V_{GS} is connected in reverse biased

Due to $V_{GS,}$ P-N junction is reverse biased due to this depletion region is produced near the junction. If the negative voltage V_{GS} at gate is increases, then the depletion region further increases, therefore, channel width further decreases therefore drain current (I_D) further decreases ie. Drain current I_D is controlled by –ve voltage at the gate.

Note: Students can write p-type or N- type JFET, any one type give 8 marks

b) Explain Barkhausen criterion. Draw the circuit diagram of Colpitts oscillator and explain its working. State the frequency expression for oscillations of above oscillator

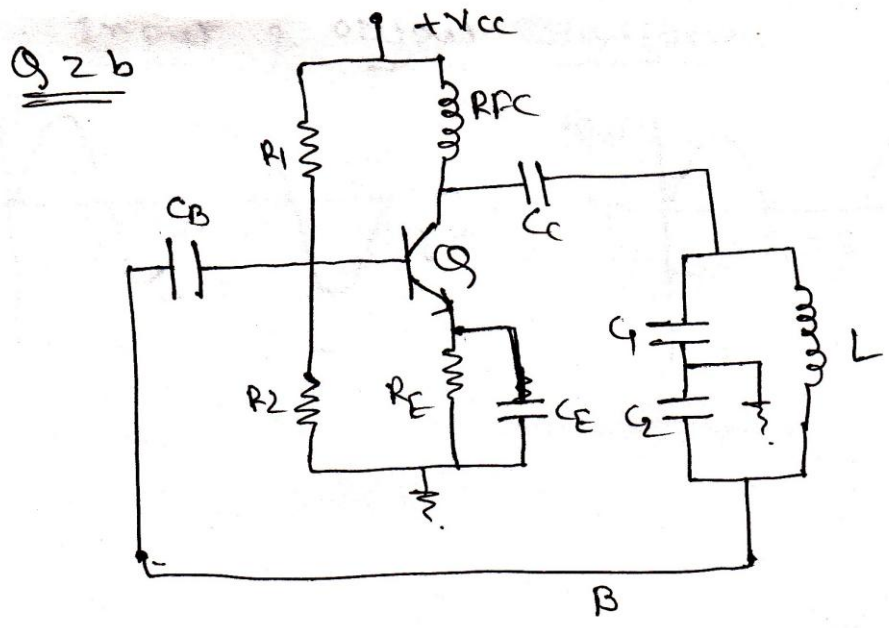
Ans **Barkhausen criterion** **2**

1. Loop gain must be equal to unity

   i.e. AB =1

2. The net phase shift around the loop equal to 360^o or 0^o

Circuits diagram of Colpitts oscillator **2**



Working : Above fig shows the circuit diagram of Clopitts oscillator the tank circuit is made up of **2**

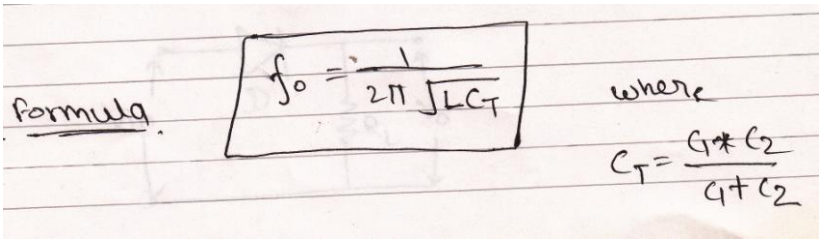
two capacitors C_1 and C_2 connected in series with each other across a fired inductor(L)

The feedback between the o/p and i/p is accomplished by the voltage developed across the capacitor C_2

The feedback fraction is given by $B=C_1/C_2$

180^o phase shift is provided by tank ckt and another 180^o is provided by the transistor. Thus total phase shift is of $360^{o.}$

When the ckt is energized by switching on the supply, the capacitors C_1 and C_2 are changed these capacitors discharge through the coil(L) which set up the oscillations of frequency f_o

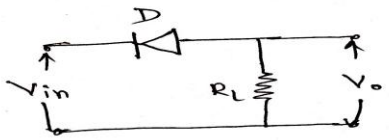


2

c) Draw the circuit of clipper with diode in series. Show the output waveform if the input is a sinusoidal waveform to the circuit.

Ans

Q 2 c circuit diagram of +ve clipper. – 2m



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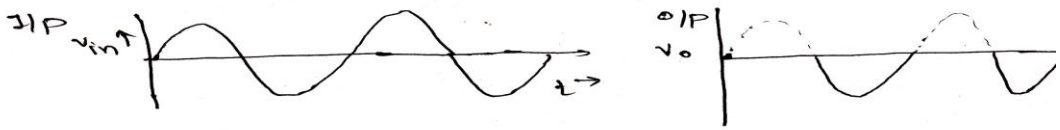
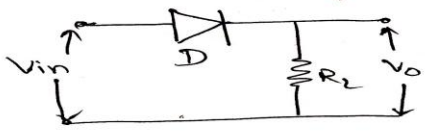
Input & output waveform. – 2m.



2

circuit diagram of –ve clipper. – 2m



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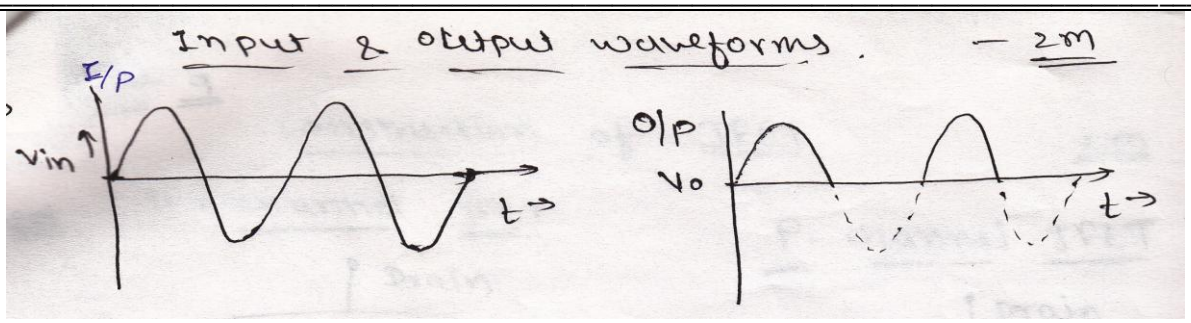


2

Q3 **Answer any two.** **16**

a) State the effect of negative feedback on:

Ans

- Voltage gain : Decreases **1**
- Bandwidth : Increases **1**
- Input impedance : Voltage shunt feedback – reduced, voltage series – increased Current series feedback – increased, current shunt – reduced, **1½**
- Output impedance :Voltage shunt feedback – reduced, Current series – increased, Voltage series feedback – reduced, Current shunt-increased **1½**
- Stability : Improved **1**
- Noise : Reduced **1**
- Distortion : Reduced (stable) **1**

b) State the application of RC integrator, RC differentiator, RC differentiator, Clippers, Clampers
Draw the circuit of negatively biased clipper with input and output waveforms

Ans **Application (any one application of each):-**

i) RC integrator **1**

- Generally acts as wave shaping circuit, convert sine wave to cosine wave.
- Square wave to triangular wave
- Spike to square wave

- Triangular to exponential wave
- Can act as low pass filter
- Mathematical integration in analog computer
- Triggering circuit

[Note : They can also show this using waveform]

ii) RC differentiator **1**

- Generally act as wave shaping circuit
- Convert sine wave cosine wave
- Square wave to spike or pulse
- Triangular to square wave
- Exponential to triangular
- Triggering circuit to convert square to spike

iii) Clippers **1**

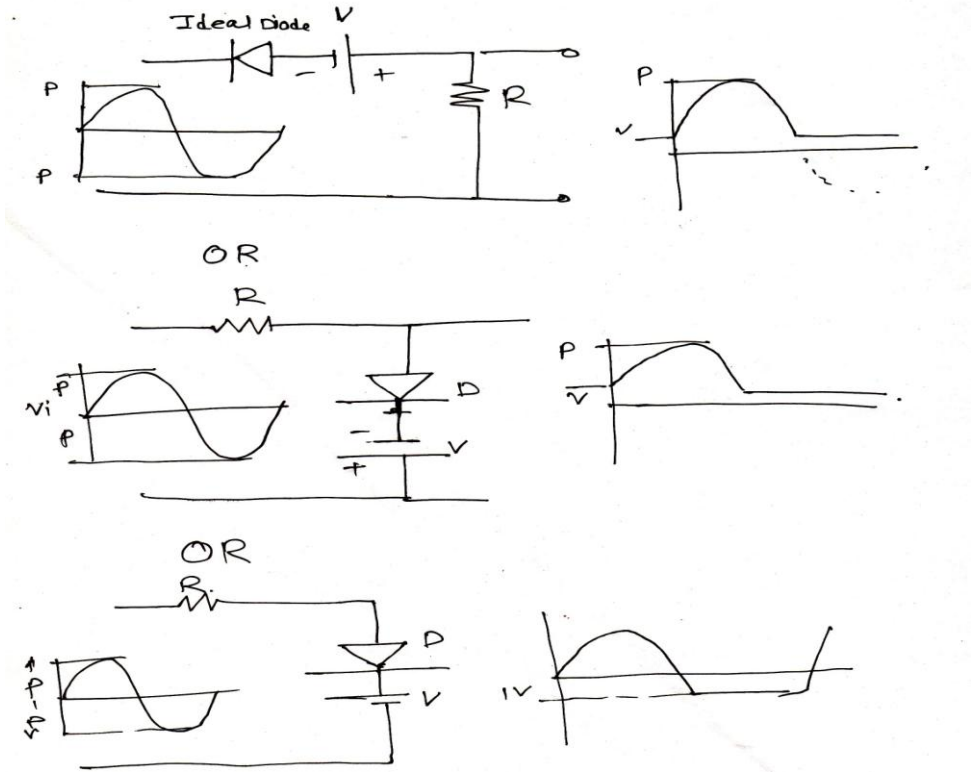
- Again it is wave shaping circuit used to remove unwanted portion from sine wave. i.e. positive or negative part of sine wave or triangular wave
- Can be used as level slicer
- It is used in digital computer, radar and radio and television circuit.
- Limiting amplitude.

iv) Clampers **1**

- Used to change level of DC of AC signal. Basically used to increase the level in voltage multiplier circuit such as doubler, tripler, multiplier.
- This can be used in T.V or CRO for EHT purpose

[Note : any other application from student mark can be given]

Circuit of negatively biased clipper with input and output waveform.

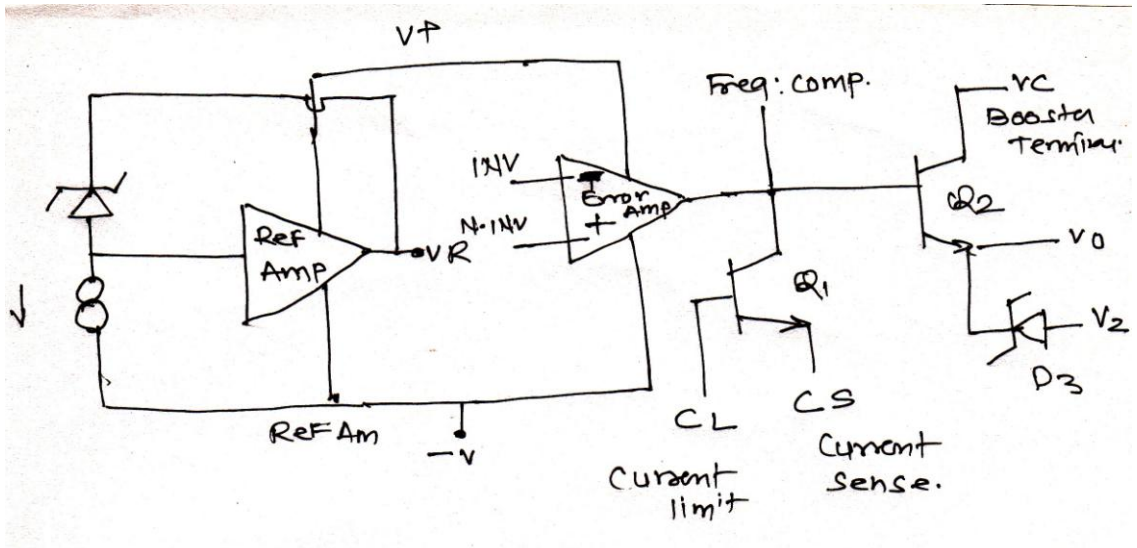


4

[Note : Any one of above circuit]

c) Draw the basic block diagram of723IC voltage regulator and explain the same.

Ans Block Diagram



4

Explanation :-

Block diagram of 723 is as shown in the figure. First block of 723 is ref amplifier which is provided with constant current source, V_R voltage can be between 6.8 volt to 7.5 volt typically 7.15 volt. Ref amplifier bias through input voltage. Output of reference amplifier can be connected to the error amplifier for low voltage application through potential divides circuit or high voltage application directly.

For over current and fold back application IC is provided with current limit and current sense circuit with transistor which can control the over current. For frequency compensation for switching purpose frequency compensation pin is provided. For frequency compensation capacitor can be connected. For unity gain 0.005µF capacitor can be connected. This IC is also with power amplifier circuit at output which provides extra current capacity. **4**

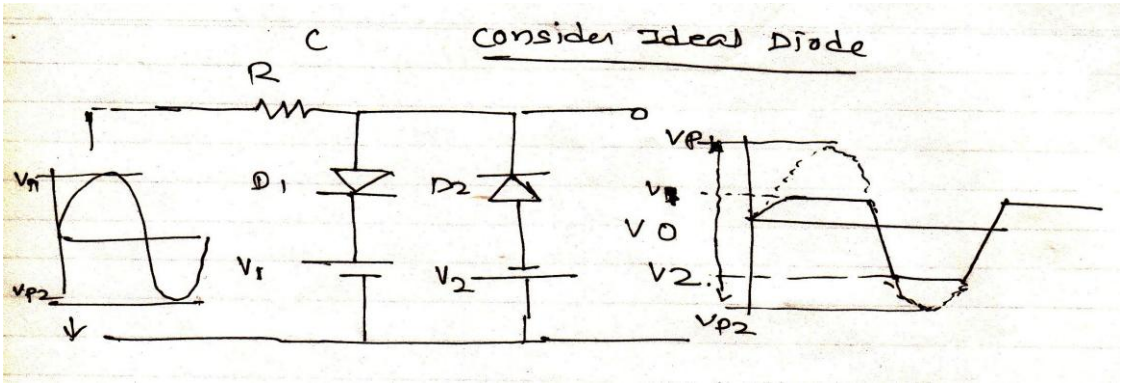
Diode D_3 is also do the important role with C_S & C_L in current controlling application.

[Note : explanation in any other also granted but explanation should be logical.]

Q4 **Answer any two:** **16**

a) Draw the circuit of combinational clipper and explain the same. State its application.

Ans Diagram:



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Explaination:

The combination of a biased positive clipper and biased negative clipper is called combination **2**

clipper. Such a clipper circuit can clip at two independent levels depending upon the bias voltage. Circuit is shown in fig.

In the given circuit AC voltage is applied to the input terminal and positive half cycle diode D_1 is forward biased and D_2 is reversed biased. D_1 is act as short circuit and D_2 is act as open circuit V_0 cannot exceed more than V_1. Similarly in negative half cycle D_1 will reversed biased and D_2 forward biased but output will not exceed more than V_2.

If V_1 and V_2 are equal then clipper is called symmetrical clipper.

Application :

Such circuit can be used as voltage slicer. This is also used limit the positive level of input. It can be used for wave shaping in TV and radio circuit.

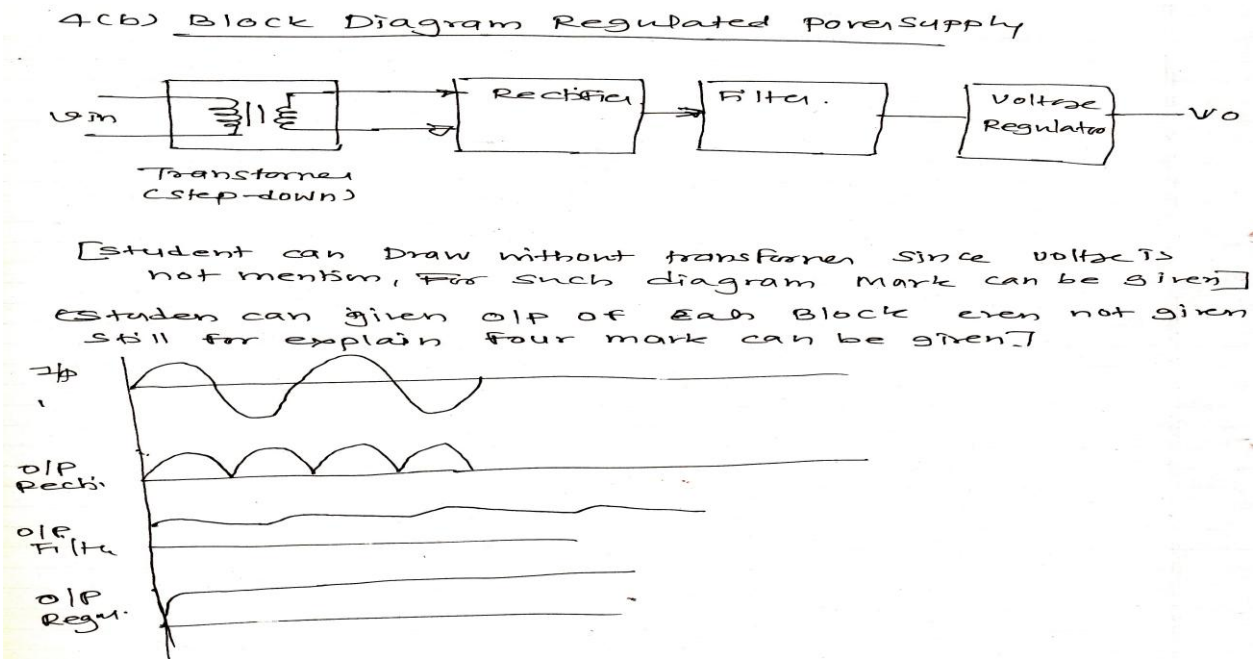
[Note: Student can give additional application of the circuit]

2

b) Draw the basic block diagram of DC regulated power supply and explain the working of each block.

Ans

Diagram:



4

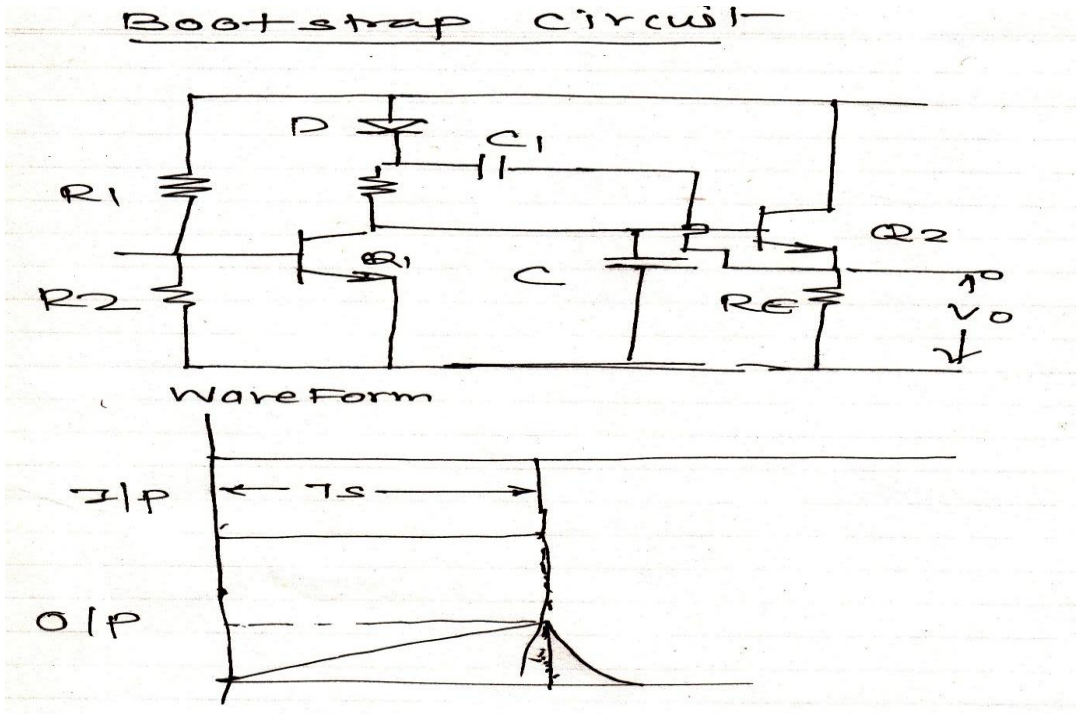
Explanation:

- For low voltage power supply step down transformer is first block of power supply. Transformer will step down the voltage with rating in required range.
- Output of transformer is connected to rectifier to convert AC into pulsating DC.
- Since same amount of AC i.e. ripple is contain in rectified o/p so its required filter. i.e. rectifier output is connected to the filter circuit for remove the AC component.
- O/p of filter i.e. almost pure DC is connected to regulated circuit to get constant specified output for change in input or load. Regulator circuit also control the fluctuation in input.

4

c) With neat diagram explain the working of bootstrap circuit. State its application.

Ans Circuit diagram:



4

Explanation:

Above fig. shows practical form of bootstrap circuit.

- Q_1 is acting as switch.
  Q_2 is act as emitter follower (unity gain amplifier)
- Initially Q_1 is ON and Q_2 is OFF.

2

	• C_1 will charge through Vcc and D1 and RE. • V0 is zero. • When negative pulse is applied Q_1 will turn OFF. Q_2 is emitter follower V0 will be same as base voltage. • Capacitor C charge through C_1 and R. output voltage start increasing as base voltage increase. • Diode D become reversed biased as output voltage coupled through C_1. • Which make voltage at capacitor C_1 remain constant. • Voltage drop across R remain constant voltage across capacitor C linearly increase with time. • Circuit act as own bootstrap. • Negative pulsed is removed output voltage again become zero. Application: 1. This circuit is used for linear sweep generation. In CRO, and other sweep operating circuit at deflection coil. 2. It can be used in TV circuit at deflection coil.	**2**
Q5	**Answer any two:**	**16**
a)	Briefly describe the working of miller sweep generator with a neat circuit diagram. State its application.	
Ans	**Working :** • The circuit consists of a transistor Q_1 as shown in the diagram which acts as a switch. • Transistor Q_2 is a common emitter amplifier. This is a high gain amplifier. • Let us assume initial condition Q_1 = ON & Q_2 = Off • Voltage across capacitor = output voltage – Vcc. • Suppose a negative pulse (as shown in the waveform) is applied to the base of Q_1 is reverse biased and it turn OFF. • B-E junction of transistor Q_1 is reverse biased ant it turn OFF.	**2**

- Q_2 turns ON.
- Output voltage starts decreasing towards zero
- Since capacitor C is connected to the base of decrease of output voltage is controlled by rate of discharge of capacitor C.
- Time constant for this discharge is

  $\tau = R_B.C$
- Value of time constant is very large

  Therefore discharge current practically remains constant.
- Therefore collector voltage decreases linearly
- When input pulse is removed, Q_1 turn ON, Q_2 turn OFF.

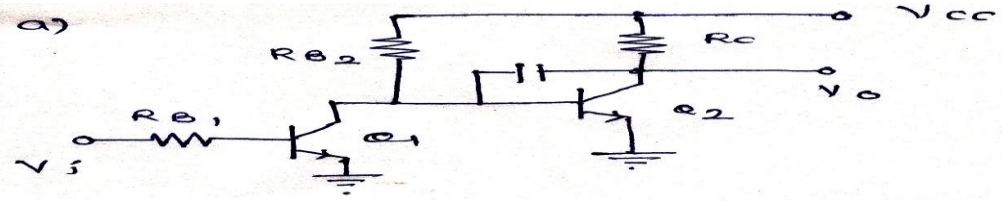
  Therefore capacitor c changes quickly through R_C & Vcc
- Time constant τ during charging is

  $\tau = R_c * C$
- The nature of input and output waveforms is as shown in the diagram.

Applications

- Used in CRT to deflect electron beam **2**
- Used in deflection coil of TV receiver

Q 5 a)



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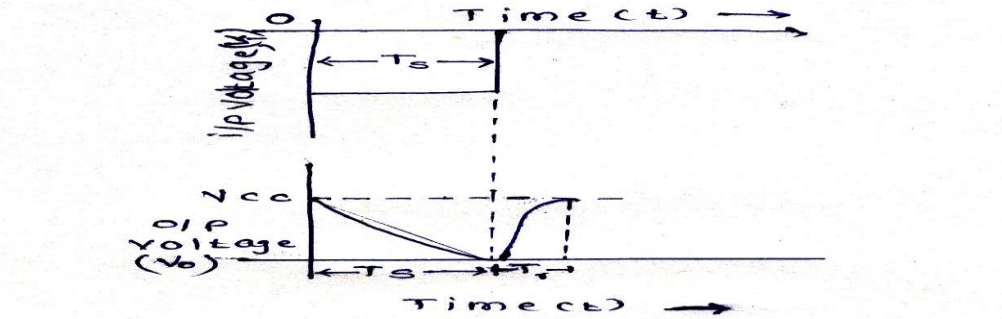
Miller sweep circuit



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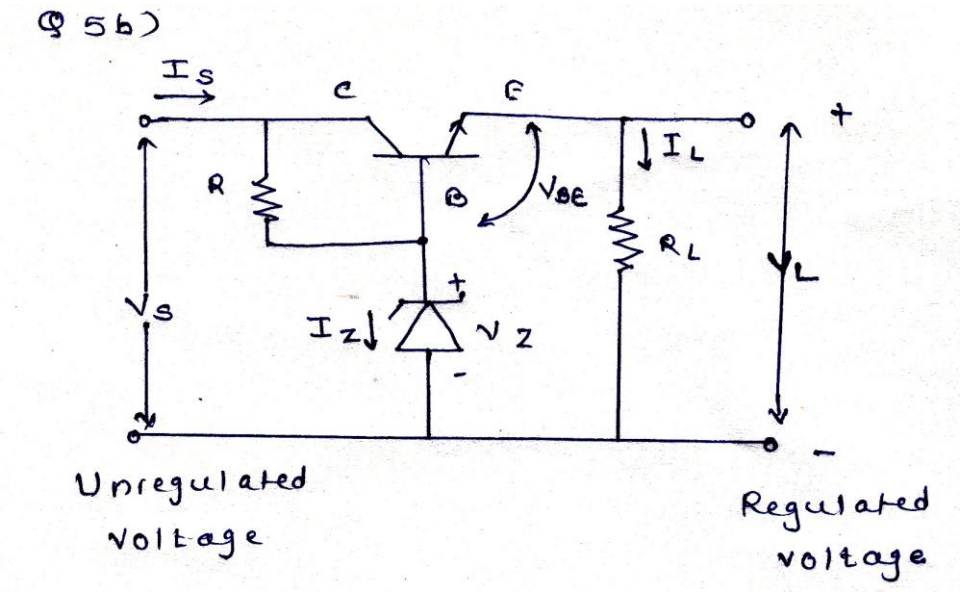
i/p & o/p waveforms of Miller sweep circuit.

b) Draw the circuit of transistorized series regulator and explain its operation.

Ans Circuit diagram



4

Working :-

- The circuit diagram of transistor series regulator is as shown.
- The transistor is connected in series with the load & therefore the circuit is called as series voltage regulator
- The circuit is also called as emitter follower because the transistor behaves as emitter follower. i.e. here, transistor behaves as variable resistance whose value is determined by the amount of base current.
- From the circuit we can write down equation as

$$V_L = V_Z - V_{BE}$$

Therefore $V_{BE} = V_Z - V_L$ ---------- 1

- Suppose value of load resistance is tends to increased
  Therefore load current decreases & load voltage tends to increase.
- From equation 1, as load voltage V_L increases , V_{BE} decreases because zener voltage V_Z = constant.

4

- Thus forward bias of transistor decreases which result in decreased in conduction level.
- Therefore collector to emitter voltage V_{CE} increases.
- Input current decreases to compensate for the increased in the value of load resistance, so that load voltage remains constant
- In brief we can write as

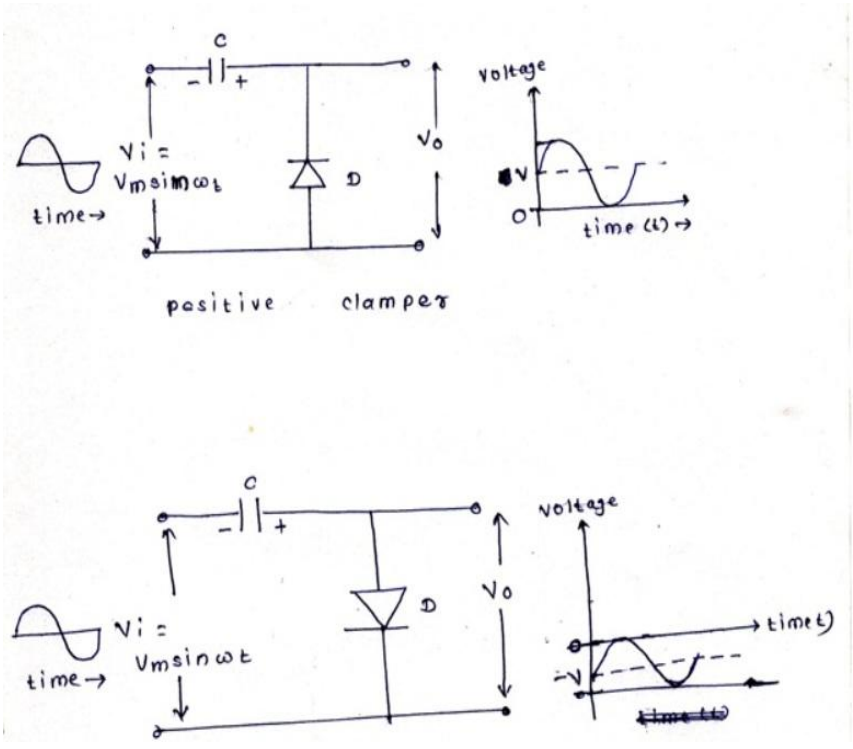
  $V_L \uparrow \rightarrow V_{BE} \downarrow \rightarrow V_{CE} \uparrow \rightarrow V_Z \downarrow$
- When load insistence R_L decreases

  $V_L \downarrow \rightarrow V_{BE} \uparrow \rightarrow V_{CE} \uparrow \rightarrow V_Z \uparrow$ and

Load voltage remains constant.

c) Explain the circuit operation of positive and negative clamper.

Ans **Circuit diagram and wave form:**



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2

Negative clamper

Positive clamper :

- It consists of a diode and capacitor.
- During negative half cycle of input voltage (V_i) the diode is forward biased current flows through the circuit.
- Therefore capacitor c is charged to a voltage $-V_m$ (negative peak value)
- The capacitor cannot discharge as the diode cannot conduct in reverse direction.
- In short, capacitor acts as a battery with e.m.f. = $-V_m$
- The polarity of this voltage is such that it get added in the input signal
- Therefore output voltage $V_0 = V_i + V_m$
- Thus a DC voltage V_m is added to input signal. This causes the waveform to clamp positively at V_m volt.

2

Negative clamper : The circuit diagram is as shown

- Here, diode is forward biased during positive half cycle of input voltage (V_i) & current flow through the circuit.
- Therefore capacitor cannot discharge to a voltage = V_m.
- The capacitor cannot discharge as the diode cannot conduct in reverse direction
- Capacitor acts as a battery with e.m.f. = $+V_m$
- The polarity of this voltage is such that it is subtracted from the input signal
- Therefore output voltage $V_0 = V_i - V_m$
  $= V_m \sin\omega t - V_m$.
- Thus a DC voltage V_m is subtracted from input signal. This causes the waveform to clamp negative at $-V_m$ volt.

2

Q6 **Answer any two:** **16**

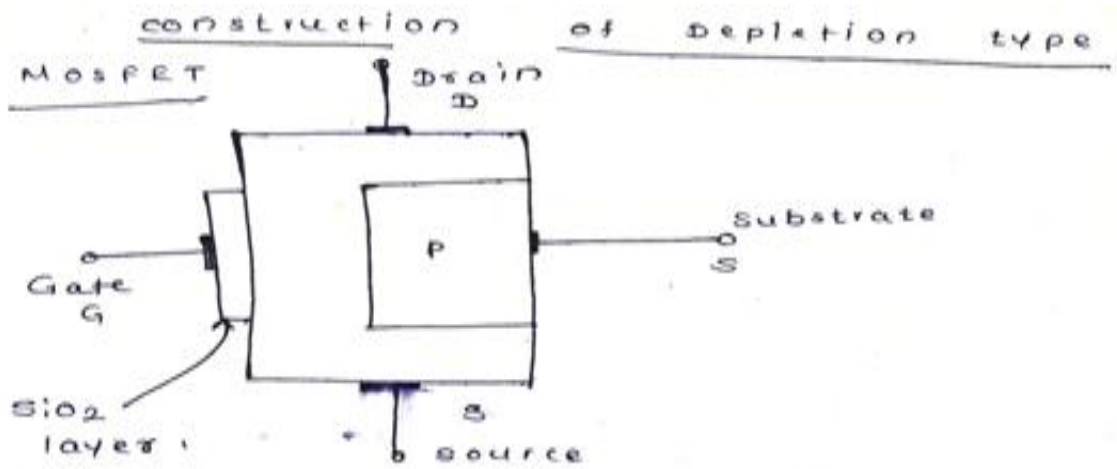
a) Draw the construction of any one type of MOSFET and explain its operation showing the characteristics of the same.

Ans ***Note: [Student can write any one i.e. either Depletion type MOSFET OR Enhancement type***

MOSFET]

Depletion type MOSFET :

- Construction of this MOSFET is as shown in diagram:

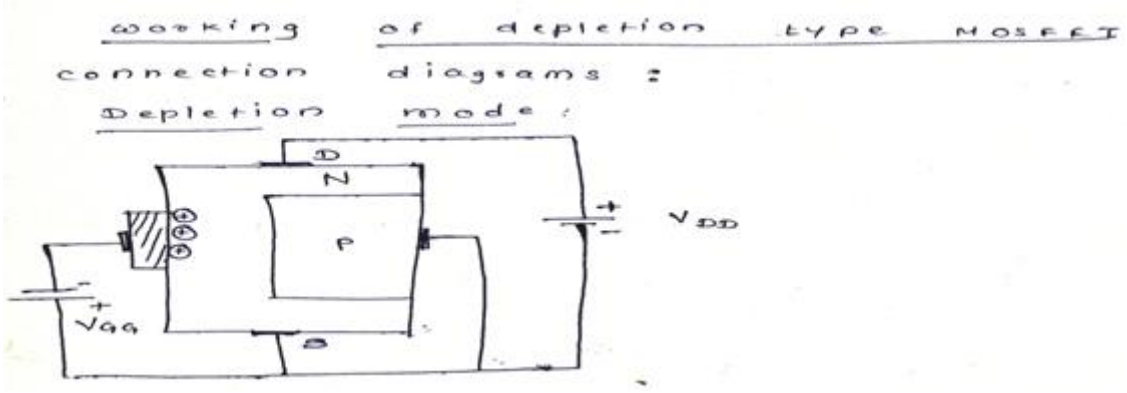


2

- This MOSFET can be operated in two different modes.
    1. Depletion mode
    2. Enhancement mode

1) Depletion mode: in this mode a MOSFET with negative gate to source voltage is used.

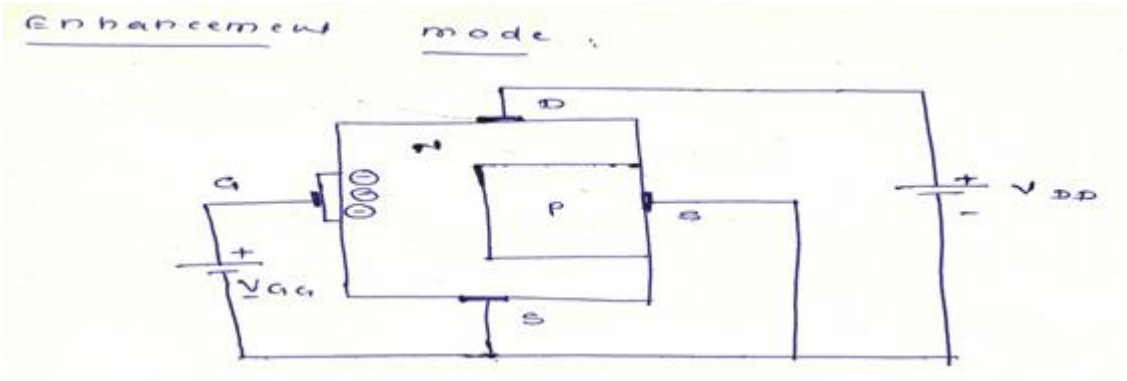
- Negative voltage applied to gate induces. A positive charge in the channel
- Therefore free electrons in the vicinity of positive charge are repelled away in the channel therefore channel is depleted away of free electrons.
- Therefore free electrons in the vicinity of positive charge are repelled away in the channel therefore channel is depleted away of free electrons. Therefore number of electrons passing through the channel decreases. Therefore drain current decreases.
- If we increase the value to this negative gate to source voltage, drain current reduces to zero.



2

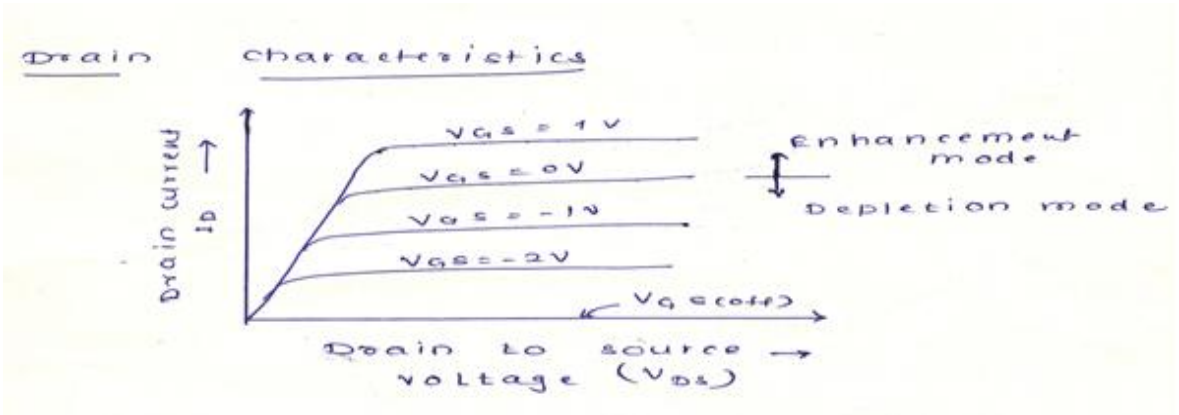
1. Enhancement mode: In this mode, a MOSFET with positive gate to source voltage is used.

- Positive gate voltage increases number of free electrons in the channel.
- The greater the gate voltage, the greater the number of free electrons.
- Therefore the conduction through channel is enhanced here.
- Therefore MOSFET is said to be operated in enhancement mode.



2

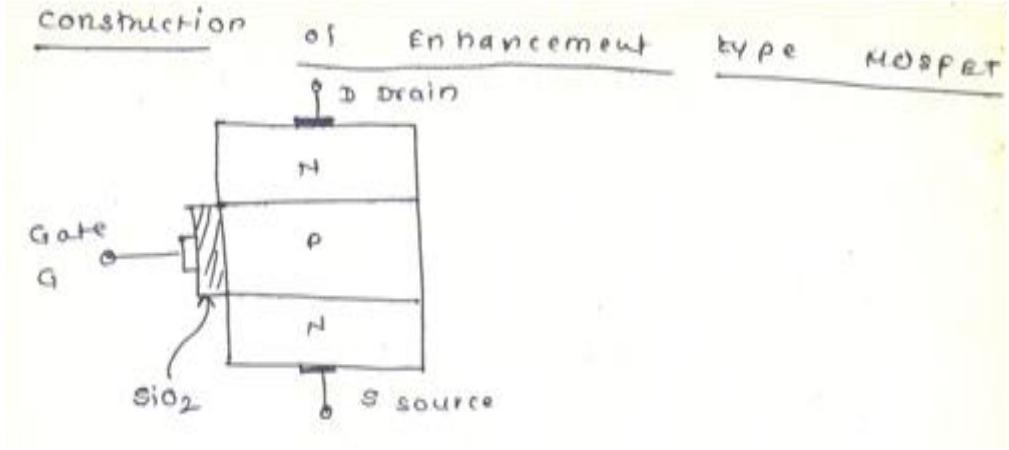
Characteristics of Depletion type MOSFET



2

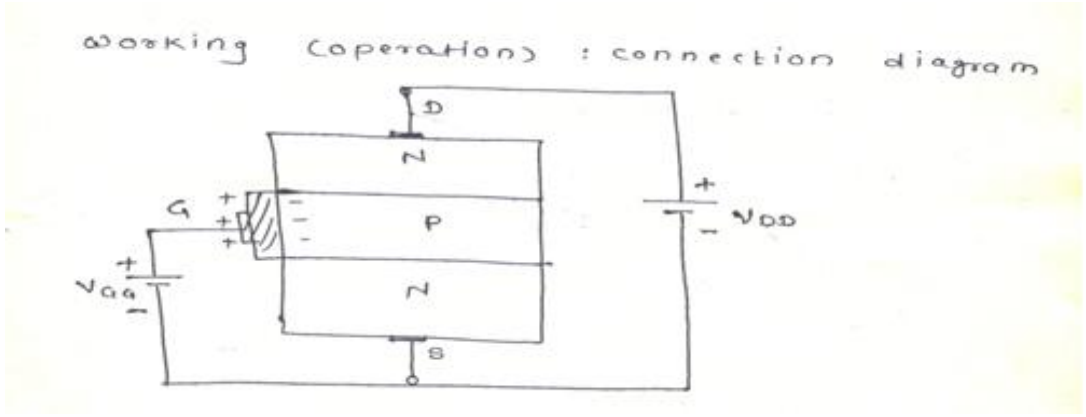
OR

Construction of Enhancement type MOSFET:



2

Working:

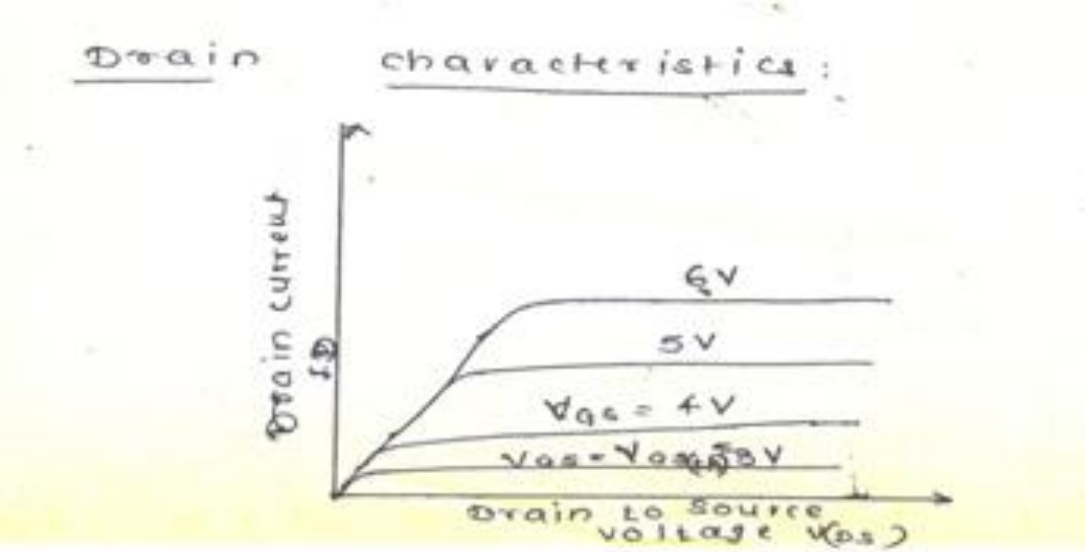


2

- MOSFET is always operated with $V_{GS} = 0$, V_{DD} tries to force free electrons from source to drain, but it do not become possible due to P-region. Therefore when $V_{GS} = 0$, drain current $I_D = 0$. Therefore this MOSFET is called as normally OFF MOSFET.
- When same positive voltage is applied at the gate, it induces negative charge in p-region. This induction occurs due to attraction of free electrons from source.
- When gate is positive enough, it can attract a number of free electrons
- Therefore a thin layer of electrons is formed which stretches from source to drain.
- Thus a thin layer of N-type channel is produced in p type substrate.
- This channel is called inversion layer.
- Minimum V_{GS} which produces inversion layer is called threshold voltage $V_{GS\,(th)}$.

2

Characteristics of Enhancement type MOSFET:



2

b) There is no output from an Astable multivibrator. Explain the step by step procedure to troubleshoot the fault in the above circuit.

Ans Troubleshooting of Astable multivibrator: **2**

Step 1 : Preliminary tests which includes

i) Power supply tests.

ii) Current drain test.

i) Power supply test:

Measure V_{NL} & V_{FL} values

V_{NL} = NO load voltage = this is the voltage across supply terminal when multivibrator circuit is not connected across it.

V_{FL} = is voltage across supply terminals when multivibrator circuit is connected.

There are three possibilities,

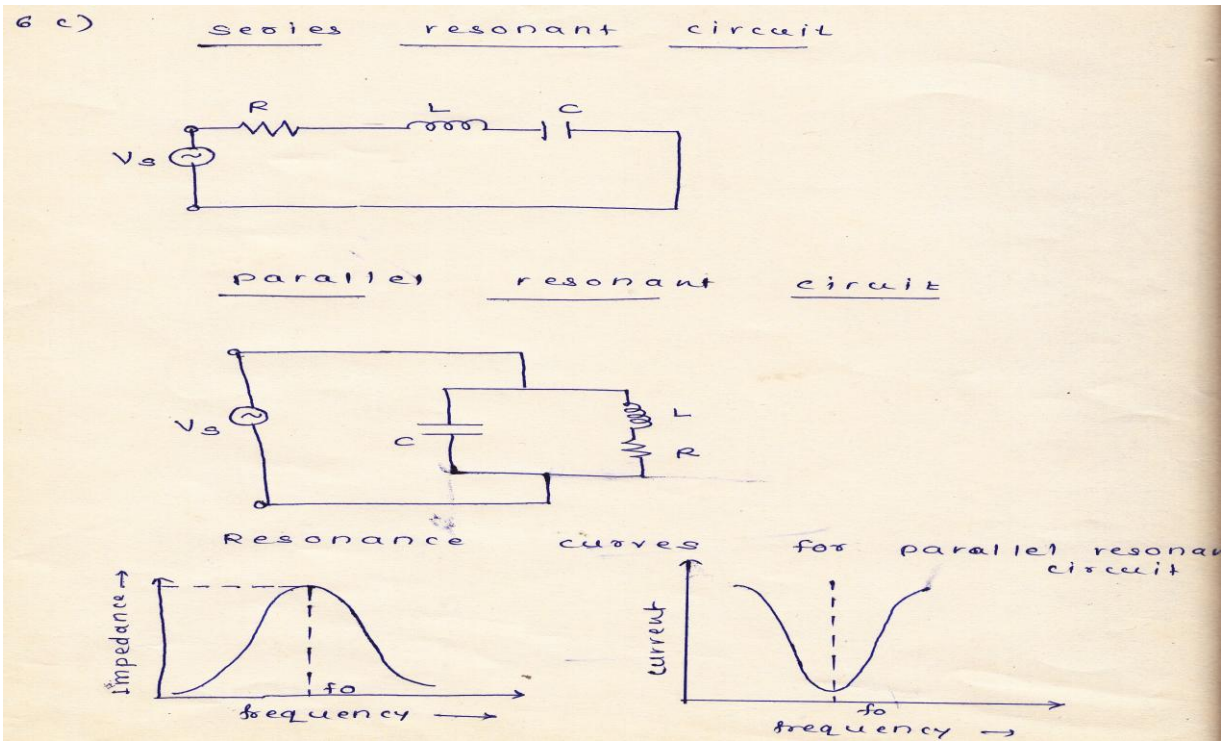
a) $V_{NL} = V_{FL}$ indicates open circuit condition

b) $V_{FL} < V_{NL}$ with small difference (about 0.3-0.4) indicates normal circuit

c) $V_{FL} << V_{NL}$ indicates short circuit.

	Condition (c) can be confirmed by carrying out current drain test ii) Current drain test For this connect current meter in series with the circuit a) High current : if short circuit b) No current: if open circuit.	
	Step 2 : After carrying out preliminary test following tests are carried out a) Voltage test: check voltage at Base, emitter , collector across base emitter junction of Q_1 and Q_2 . compare these voltages with normal voltages Draw conclusions from abnormal voltage points (List of all possible faults). b) Ohmic test: test transistors, resisters, capacitors according to your conclusion drawn during voltage test.	**3**
	Step 3: Draw final conclusion about the fault in the circuit.	**1**
c)	Explain with neat diagram the working principle of series and parallel resonance circuit. Also show the resonance curves. State there applications.	
Ans	Working Principle: • When AC supply source of variable frequency is applied to the circuit, then it will encounter different impedance at different frequencies. • As frequency increases, inductive reactance X_L also increases and capacitive reactance X_C decreases. • At a certain frequency X_L becomes equal to X_C. • This frequency is called as resonance frequency f_0. • Circuit is said to be at electrical resonance. • At this frequency impedance becomes maximum & current becomes minimum. $f_0 = 1/ 2\pi\sqrt{LC}$	**2**
	Application (any 2): • If is used in a tuned voltage amplifier to select a desired radio frequency. • Used in oscillators to generate desired frequency.	**2**

6 c)



1M for each dig.