

UNIT-I
IC FABRICATION

1) Explain why buried layer is needed.

The buried layer is used in integrated transistor to decrease the collector series resistance. It provides the low resistivity current path. The buried n+ layer shunts the n- epitaxial collector layer effectively, decreasing the resistance.

2) What is Ion Implantation? Why it is preferred over diffusion process?

The conductivity of the semiconductor increases when small impurity is added to it. The process of adding impurity is called doping while the impurity to be added is called dopant. So ion implantation is a process of adding dopant to the silicon substrate. The ion implantation process is controllable, reproducible and also there are no unwanted side effects.

3) List the three different IC package configurations.

The following different IC package configurations are,

- (i) Metal can package
- (ii) Ceramic flat package
- (iii) Dual-in-line package.

4) What is parasitic capacitance?

In electrical circuits, parasitic capacitance is an unavoidable and usually unwanted capacitance that exists between the parts of an electronic component or circuit simply because of their proximity to each other.

5) Give the difference between monolithic and hybrid ICs.

Monolithic IC	Hybrid IC
1. In Monolithic circuits, all circuit components both active and passive elements and their interconnections are manufactured into or on top of a single chip of silicon.	1. Hybrid Integrated circuits separated component parts are attached to a ceramic substrate and interconnected by means of either metallization pattern or wire boards.
2. It is used for more applications in Linear and digital IC	2. It is used for adopt less applications
3. Cost wise is less.	3. Cost wise is slightly higher compared to monolithic ICs.

6) What is lithography?

Lithography is a process by which the pattern appearing on the mask is transferred to the wafer. It involves two steps: the first step requires applying a few drops of photo resist to the surface of the wafer & the second step is spinning the surface to get an even coating of the photo resist across the surface of the wafer.

7) What is photolithographic process?

Photolithography is a process used in micro fabrication to selectively remove parts of a thin film or the bulk of a substrate. It uses light to transfer a geometric pattern from a photo mask to a light-sensitive chemical "photoresist", or simply "resist," on the substrate.

8) Why aluminium is preferred in metallization process?

Aluminium is preferred in metallization process because,

- i. It is relatively a good conductor
- ii. It is easy to deposit aluminium films using vacuum deposition.
- iii. Aluminium makes good mechanical bonds with silicon.

iv. Aluminium forms low resistance, non – rectifying contact with p – type silicon and the heavily doped n – type silicon.

9) How are capacitors fabricated in ICs? Draw the cross sectional view of MOS capacitor?

It consists a implanted or diffused heavily doped within substrate while a polysilicon or metal plate on the top of a thin oxide layer .for MOS capacitors, generally gate oxide is used with no extra processing step.

10) What do you mean by monolithic process?

A monolithic IC is a type of "integrated circuit" electronic device that contains active and passive devices that are made in and on the surface of a single piece of a single crystal semiconductor, such as a Silicon (Si) wafer. A process called "planar technology" must be used in the single block (monolith), and be interconnected to the insulating layer over the same body of the semiconductor to produce a solid integral monolithic-IC.

11) What are the advantages of using dry etching process?

The major advantage of using the dry etching process over wet etching process is that it is possible to achieve smaller openings of thickness $\leq 1\mu\text{m}$.

UNIT II

CHARACTERISTICS OF OPAMP

1. Mention the applications of op-amp integrator.

The integrator circuit is mostly used in analog computers, analog-to-digital converters and wave-shaping circuits. A common wave-shaping use is as a charge amplifier and they are usually constructed using an operational amplifier though they can use high gain discrete transistor configurations.

2) What is the value of open loop gain and output impedance of an ideal op-amp?

The value of open loop gain and output impedance of an ideal op-amp is,

- i. Open loop gain is infinite. ($A=\infty$)
- ii. Output impedance is low. ($z_0=0$)

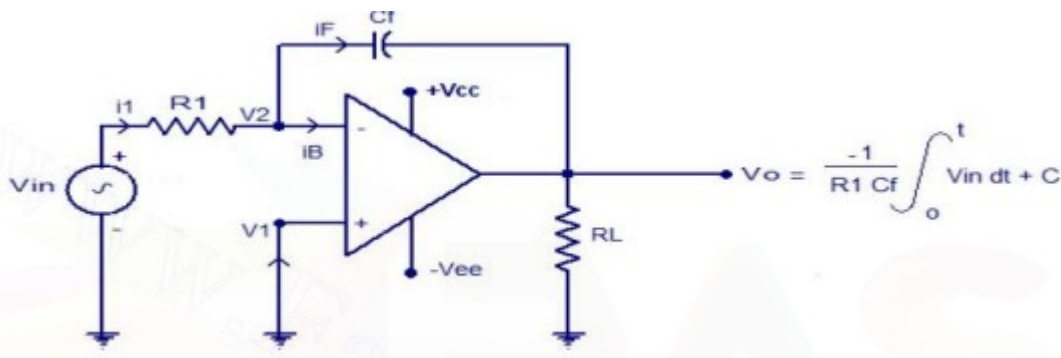
3) Define CMRR.

The expansion of CMRR is Common –Mode Rejection Ratio.

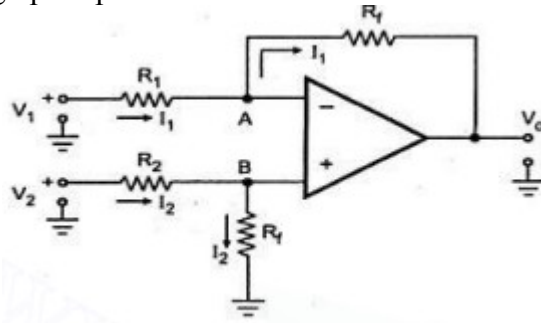
The relative sensitivity of an op-amp to a difference signal as compared to a common mode signal is called the common –mode rejection ratio. It is expressed in decibels.

$$\text{CMRR} = A_d/A_c$$

4) Draw the circuit diagram of an integrator and give its output equation.



5) Design a subtractor using op-amp.



6) Why operational amplifier configurations are not used in linear applications?

The operational amplifier configurations are not used in linear applications because

- i. The open loop gain of the op-amp is very high. Therefore only the smaller signals having low frequency may be amplified accurately without distortion.
- ii. Open loop Voltage gain of the op-amp is not a constant voltage gain varies with changes in temperature and power supply as well as mass production techniques.

This makes op-amp unsuitable for many linear applications

7. What is the input impedance of a non-inverting amplifier?

Input impedance of a non- inverting amplifier is extremely large ($= \infty$) as the op-amp draws negligible current from the signal source.

8) Give the ideal characteristics of operational amplifier .

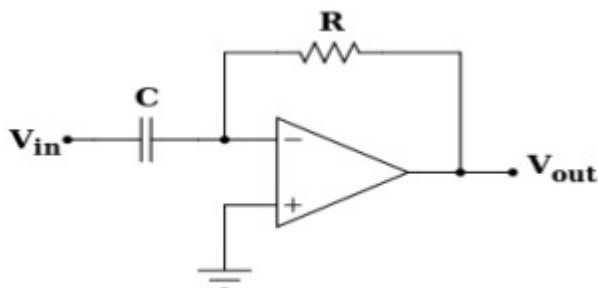
The ideal characteristics of operational amplifier are

- i. Open loop gain infinite ($A=\infty$)
- ii. Input impedance infinite ($z1=\infty$)
- iii. Output impedance low ($z0=0$)
- iv. Bandwidth infinite

9) Define slew rate and state its significance.

The slew rate is defined as the maximum rate of change of output voltage caused by a step input voltage. An ideal slew rate is infinite which means that op-amp's output voltage should change instantaneously in response to input step voltage.

10) Draw the circuit diagram of differentiator using op-amp.



UNIT III

APPLICATIONS OF OPAMP

1) Sketch the circuit of Anti log Op-Amp Amplifier .

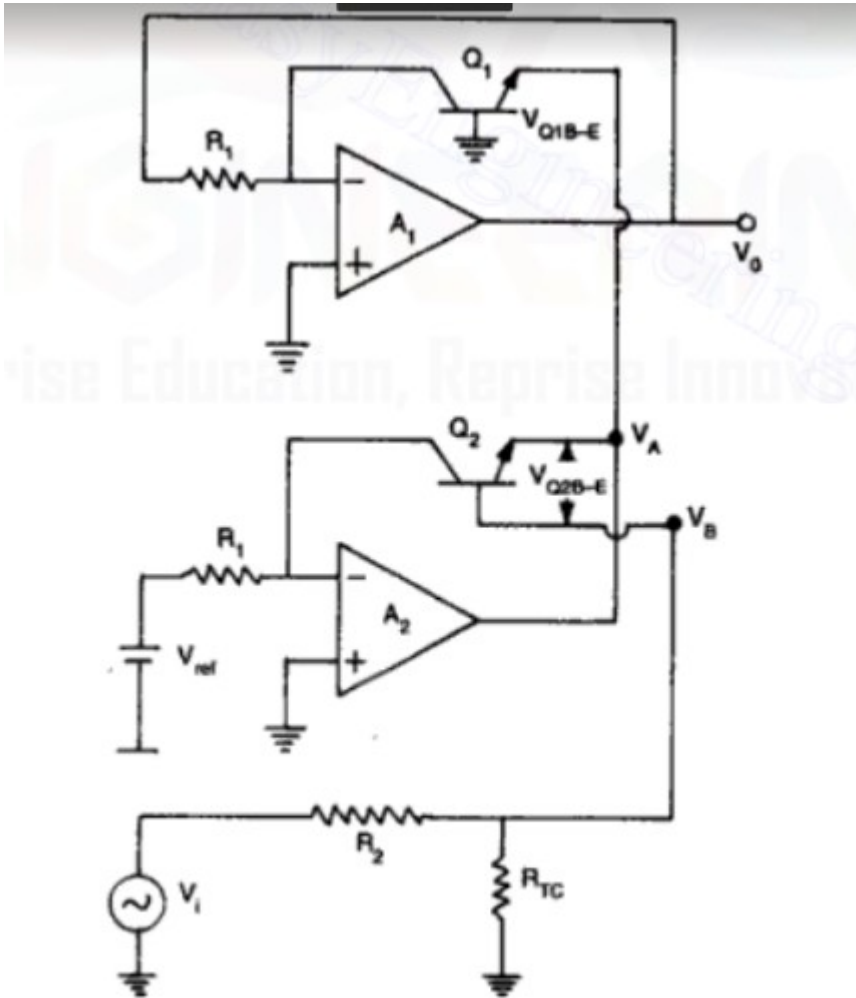


Fig. 4.19 Antilog amplifier

2) What is astable multivibrator?

Astable multivibrator is a free running oscillator having two quasi-stable states. Thus, there is oscillations between these two states and no external signal are required to produce the change in state.

3) What is an instrumentation amplifier?

Instrumentation amplifier is defined as the special amplifier which is used for such a low level amplification with high CMRR, high input impedance to avoid loading, low power consumption and some other features is called an instrumentation amplifier. It is also called data amplifier and is basically a difference amplifier.

4) List any four important applications of a comparator.

The applications of a comparator is

i. Zero crossing detector

- ii. Window detector
- iii. Time marker generator
- iv. Phase detector

5) What are the basic requirements of a good instrumentation amplifier?

The basic requirements of a good instrumentation amplifier are,

- i. Finite, accurate, and stable gain.
- ii. Easier gain adjustment.
- iii. High Input impedance.
- iv. Low output impedance.
- v. High CMRR.
- vi. Low power consumption.
- vii. Low thermal and time drifts.
- viii. High slew rate.

6. Define resolution and accuracy of a DAC.

Resolution is the number of different analog output values that can be provided by a DAC.

For an n-bit DAC Resolution = 2^n .

Resolution is also defined as the ratio of a change in output resulting from a change of 1 LSB at the digital inputs. For an n-bit DAC it can be given as Resolution (in volts) = $V_{FS}/2^n - 1$

Accuracy:

It is the maximum deviation between the actual converter output & the ideal converter output.

Relative accuracy:

It is the maximum deviation after gain & offset errors have been removed. The accuracy of a converter is also specified in form of LSB increments or % of full scale voltage.

7. What is a monostable multivibrator?

Monostable multivibrator is one which generates a single pulse of specified duration in response to each external trigger signal. It has only one stable state. Application of a trigger causes a change to the quasi-stable state. An external trigger signal generated due to charging and discharging of the capacitor produces the transition to the original stable state.

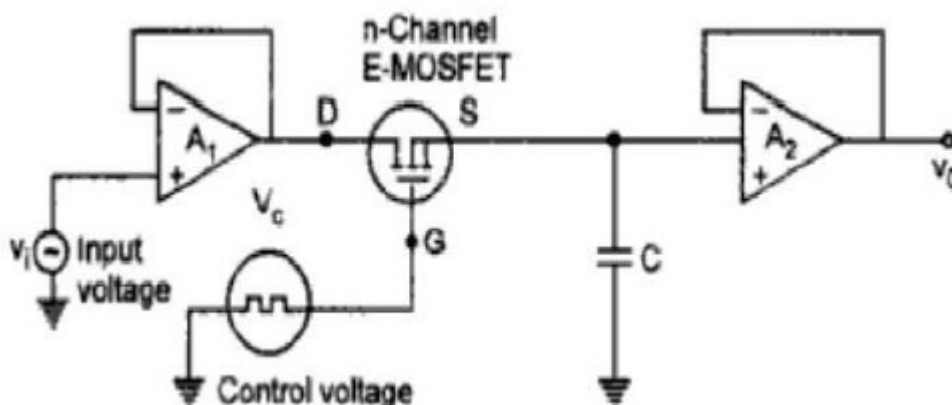
8) What is a Schmitt trigger?

Schmitt trigger is a regenerative comparator. converts sinusoidal input into a square wave output. The output of Schmitt trigger swings between upper and lower threshold voltages, which are the reference voltages of the input waveform.

9) What is a zero crossing detector?

Zero crossing detector is defined as the basic inverting and non-inverting comparator act as a zero crossing detector provided that V_{ref} is set to zero. This circuit is also called as sine wave to square wave generator.

10) Draw the circuit diagram of sample and hold circuit.



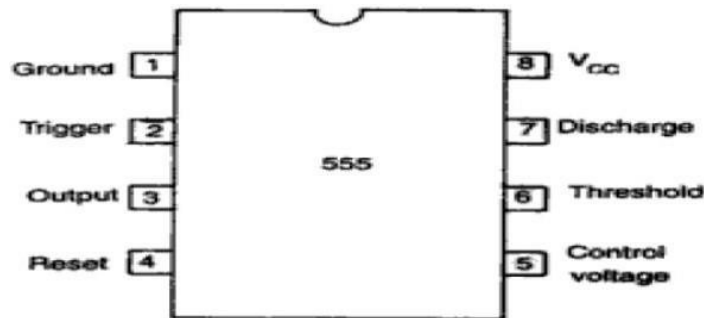
UNIT 4
SPECIAL ICs

- 1) List the applications of PLL.
 - i) Frequency multiplication/Division
 - ii) Frequency Translation
 - iii) FM Demodulation
 - iv) Frequency shift Keying Demodulator

2) What are the applications of IC 555 Timer?

- * Oscillator
- * Pulse generator
- * Ramp and square wave generator
- * Burglar alarm
- * Traffic light control

3) Sketch the pin diagram of IC 555 timer.



4) Why VCO is called voltage to frequency converter?

The VCO provides the linear relationship between the applied voltage and the oscillation frequency. Applied voltage is called control voltage. The control of frequency with the help of control voltage is also called voltage to frequency conversion. Hence VCO is also called voltage to frequency converter.

5) Mention any two applications of 555 Timer in Monostable mode.

- i. Frequency divider
- ii. Pulse width modulation
- iii. Missing pulse detector
- iv. Linear ramp generator

6) In a monostable multivibrator using 555 timer, the components values are $R_a = 5.6 \text{ ohm}$, $C = 0.068 \text{ Micro farad}$. Find the pulse width period T.

$$\begin{aligned} T &= 1.1 R * C \\ &= 1.1 * 5.6 * 0.068 * 10^{-6} \\ &= 0.41888 * 10^{-6} \text{ Seconds} \end{aligned}$$

7) What are the essential parts of PLL?

The essential parts of PLL is,

- i. Phase comparator
- ii. Low pass filter.
- iii. Error Amplifier
- iv. Voltage controlled oscillator

8) List the applications of analog multipliers.

The applications of analog multipliers are

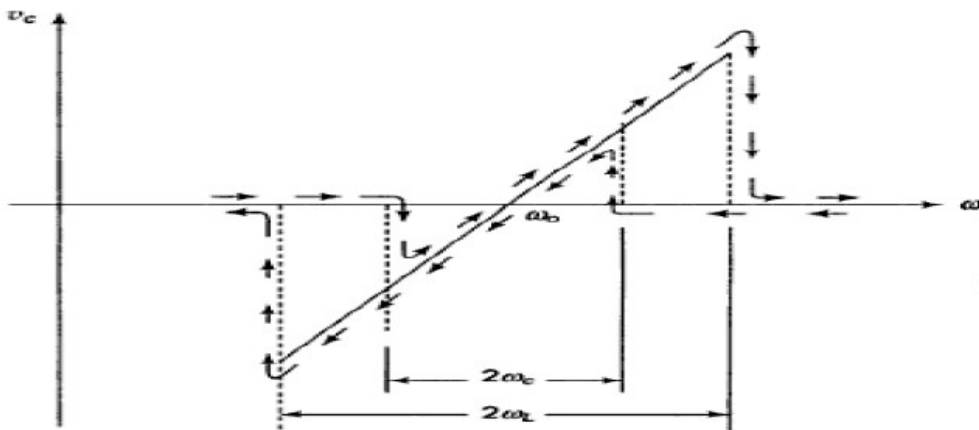
- i. Analog computer
- ii. Analog signal processing
- iii. Automatic gain control
- iv. True RMS converter
- v. Analog filter (especially voltage-controlled filters)
- vi) PAM (Pulse Amplitude Modulation)

9) Enlist the important features of 555 timer circuit .

The features of 555 timer circuit are,

- i. It has two basic operating modes: monostable and astable
- ii. It is available in three packages. 8 pin metals can, 8 pin dip, 14 pin dip.
- iii. It has very high temperature stability.

10) Draw the relation between the capture range and lock range relationship in a PLL.



UNIT V APPLICATION ICs

1. What is SMPS?

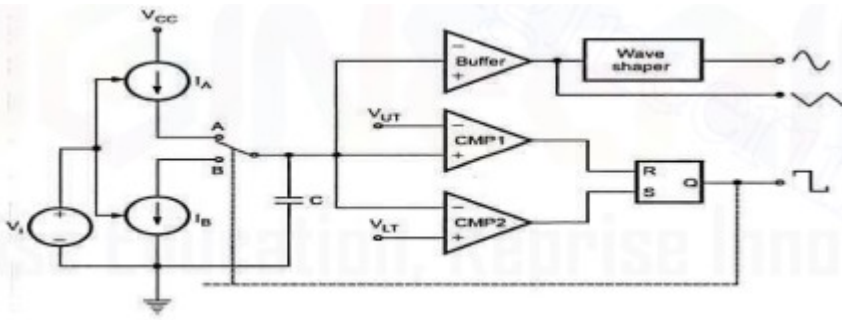
A Switched-Mode Power Supply (SMPS) is an electronic circuit that converts power using switching devices that are turned on and off at high frequencies, and storage components such as inductors or capacitors to supply power when the switching device is in its non-conduction state.

2. What are the applications of fixed voltage regulators?

The applications of fixed voltage regulators are

- i. Low current consumption
- ii. Overvoltage/ Short-circuit protection
- iii. Reverse polarity protection
- iv. Over temperature protection

3. Draw the internal block diagram of the functional generator IC



4. What is a switching regulator?

Switching regulators are those which operate the power transistor as a high frequency on/off switch, so that the power transistor does not conduct current continuously. This give improved efficiency over series regulators.

5) What is an isolation amplifier?

Isolation amplifiers provide electrical isolation and an electrical safety barrier. They protect data acquisition components from common mode voltages, which are potential differences between instrument ground and signal ground. Instruments that are applied in the presence of a common mode voltage without an isolation barrier allow ground currents to circulate, leading in the best case to a noisy representation of the signal under investigation.

6) Why do switching regulators have better efficiency then series regulators?

In switching regulators, the transistor is operated in cut off region or saturation region. In cut off region, there is no current and hence power dissipation is almost zero. In the saturation region there is negligible voltage drop across it hence the power dissipation is almost zero.

7)List the important parts of regulated power supply.

The parts of regulated power supply are

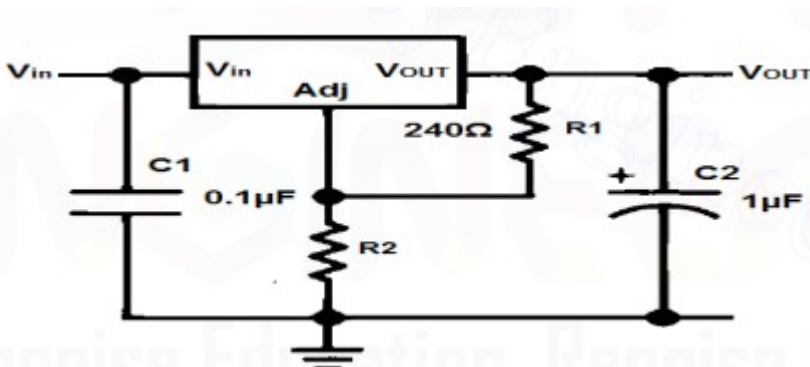
- *Reference voltage circuit
- *Error amplifier
- *Series pass transistor
- *Feedback network

8) What are the advantages of switch mode power supplies?

The advantages of switch mode power supplies are

- Smaller size
- Lighter weight (from the elimination of low frequency transformers which have a high weight)
- Lower heat generation due to higher efficiency.

9) Draw the circuit of LM 317 Voltage Regulator



10) Why current boosting is required in 723 regulators

The 723 regulator can give adjustable output voltage in a wide range. It provides short circuit protection and current feedback using external components. The basic regulator can be current boosted with an external pass transistor.

$I_{load} = \beta_{pass \text{ transistor}} \times I_o$