SYED AMMAL ENGINEERING COLLEGE
Approved by the AICTE, New Delhi, and Affiliated to Anna University, Chennai, Govt. of Tamilnadu
Dr. E.M.Abdullah Campus, Ramanathapuram – 623 502.

Department of Electrical and Electronics Engineering

EE6303 LINEAR INTEGRATED CIRCUITS
UNIT-I
PART-A (Each 2 Marks)

1.Give the difference between monolithic and hybrid Ics.(Nov/Dec 2010)

Ans:

| Monolithic Integrated Circuits	Hybrid Integrated Circuits
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. 2.It is used for more applications in Linear and digital IC 3. Cost wise is less.	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 adopt less applications 3. Cost wise is slightly higher compared to monolithic ICs.

2.What is lithography? (Nov/Dec 2010)

Ans:

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

3.What is the purpose of oxidation process in IC fabrication?(Apr/May 2010)

Ans:

The silicon wafers are stacked up in a quartz boat & then inserted into quartz furnace tube. The Si wafers are raised to a high temperature in the range of 950 to 1150oC & at the same time, exposed to a gas containing O_2 or H_2O or both. The chemical action is
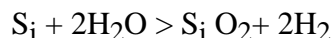
$S_i + 2H_2O > S_i O_2 + 2H_2$

4.What is parasitic capacitance? (Apr/May 2010)

Ans:

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

5.List the basic processes usedin IC fabrication.(Nov/Dec 2011)

Ans:

1. Silicon wafer (substrate) preparation

2. Epitaxial growth

3. Oxidation

4. Photolithography

5. Diffusion

6. Ion implantation

7. Isolation technique

8. Metallization

9. Assembly processing & packaging

6. What is meant by ion implantation?(Nov/Dec 2011) (Nov/Dec 2012)

Ans:

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 de 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.

7.What is the significance of using buried layer?(May/June 2012)

Ans:

In general bipolar integrated circuits use epitaxial layer process in which high resistivity epitaxial is formed over a low resistivity substrate. To provide isolation between the epitaxial growth and the substrate, the doping used in both layers is of opposite type. Due to this a heavily doped buried layer is formed. The buried layer is also called diffusion layer.

8.What are the advantages of polysillicon gate MOSFET over aluminium gate?

Ans:

The silicon film is of high quality and suitable for IC manufacturing. SOI provides a speed advantage because the source/drain to body junction capacitance is practically eliminated because the junctions extend vertically to the buried oxide. The cost of a SOI wafer is many times higher than an ordinary silicon wafer and can increase the total Fabrication cost of IC chips by ~30%.

9. Why inductors are difficult to fabricate in integrated circuits.(Nov/Dec 2012)(May/June 2013)

Ans:

No satisfactory integrated inductors exist. If high Q inductors with inductance of values

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larger than 5μH are required, they are usually supplied by a wound inductor which is connected externally to the chip. Therefore, the use of inductors is normally avoided when integrated circuits are used.

10. List the advantages of integrated circuit over discrete component circuit.(May/june 2013)
**Ans:**

1. Miniaturization and hence increased equipment density.
2. Cost reduction due to batch processing.
3. Increased system reliability due to the elimination of soldered joints.
4. Improved functional performance.
5. Matched devices.
6. Increased operating speed

UNIT-II
PART-A (Each 2 MARKS)

1. Give the ideal characteristics of operational amplifier and give its equivalent circuit (Nov/Dec 2010) (Apr/May 2010)

Ans:

(i) Open loop gain infinite

(ii) Input impedance infinite

(iii) Output impedance low

(iv) Bandwidth infinite

(v) Zero offset, ie, $V_o=0$ when $V_1=V_2=0$
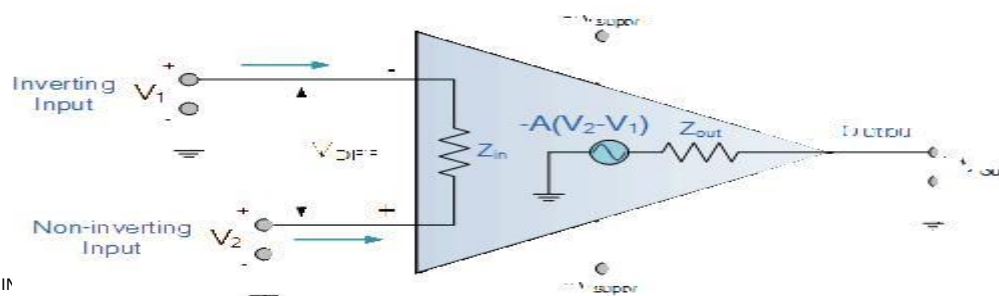
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2.Draw the circuit diagram of an intrgrator and give its output equation. (Nov/Dec 2010)

Ans:

$$V_o = \frac{-1}{R_1 C_f} \int_{0}^{t} V_{in}\, dt + C$$
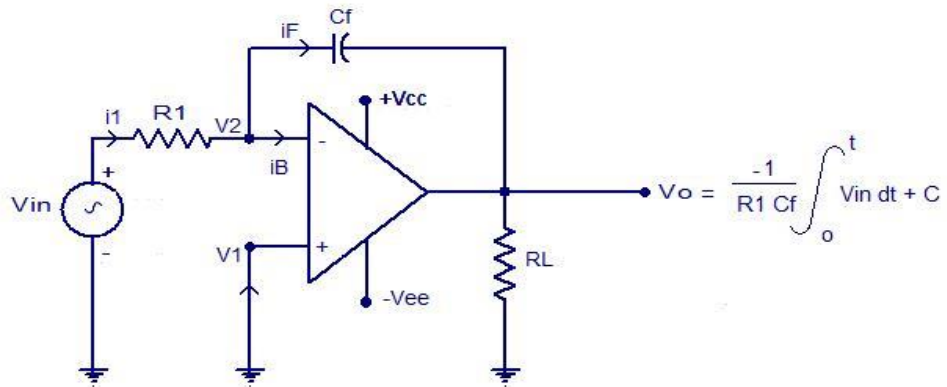
4.Design an amplifier with a gain of 10 and input resistance of 10 k

Ans:

R_1=10 K Ω

R_f=-(-10)x10 K Ω =100 K Ω

5.Define slew rate and state its significance (Apr/May 2010)

Ans:

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.

6.Define input offset voltage.(Nov/Dec 2011)

Ans:

It is the voltage that must be applied between the input terminals of an op-amp to nullify the output. Since this voltage could be positive or negative its absolute value is listed on the data sheet.

7.List the four non ideal dc characteristics of opamp (May/June 2012)

Ans:
1. Input impedance
2. Output impedance
3. Frequency response
4. Slew rate

8.Define CMRR (Nov/Dec 2012)

Ans:

It is defined as the ratio of the differential voltage gain to common mode voltage gain.

CMRR= ρ = Ad/Ac

9. What is OPAMP?

Ans:

An operational amplifier is a direct coupled high gain amplifier consisting of one or more differential amplifiers, followed by a level translator and an output stage. It is a versatile device that can be used to amplify ac as well as dc input signals & designed for computing mathematical functions such as addition, subtraction, multiplication, integration and differentiation.

10. Mention the frequency compensation methods.

Ans:

1. Dominant-pole compensation
2. Pole-zero compensation.

11. Define Differential gain.

Ans:

The gain with which differential amplifier amplifies the difference between two input signals, is called differential gain (Ad).

12.What are the D.C Characteristics of Op-amp?

Ans:

1. Input Bias current.
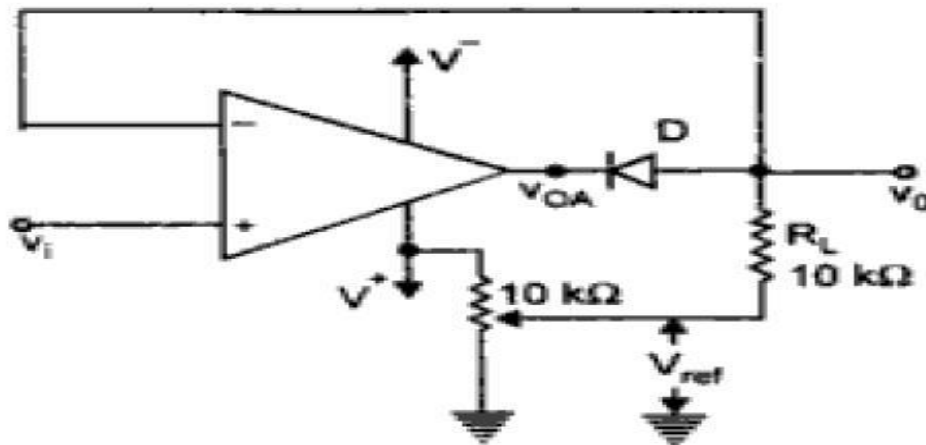2. Input offset current.
3. Input offset voltage.
4. Thermal Drift.

UNIT-III

PART-A (Each 2 Marks)

1.Draw the circuit diagram of an op-amp positive clipper. (Nov/Dec 2010)

Ans:

2.What is the fastest ADC and why? (Nov/Dec 2010)

Ans:

The circuit of successive approximation ADC consists of a successive approximation register (SAR), to find the required value of each bit by trial & error. With the arrival of START command, SAR sets the MSB bit to 1. The O/P is converted into an analog signal & it is compared with I/P signal. This O/P is low or high. This process continues until all bits are checked.

3.Define slew rate and state its significance (Apr/May 2010)

Ans:

The circuit of successive approximation ADC consists of a successive approximation register (SAR), to find the required value of each bit by trial & error. With the arrival of START command, SAR sets the MSB bit to 1. The O/P is converted into an analog signal & it is compared with I/P signal. This O/P is low or high. This process continues until all bits are

checked.

4.What is parasitic capacitance? (Apr/May 2010)

Ans:

In electrical circuits, capacitance parasitic 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.An 8 bit DAC has a resolution of 20mV/bit.what is the analog output voltage for the digital input code 00010110(the MSB is the left most bit)?.(Apr/May 2010)
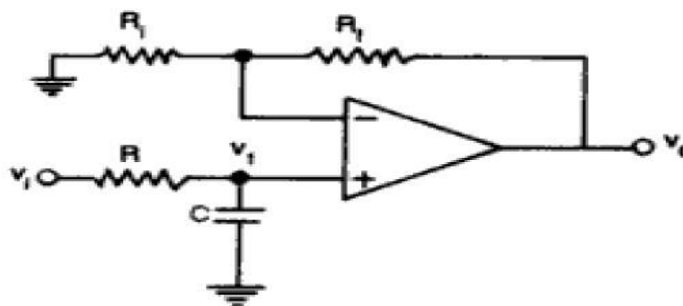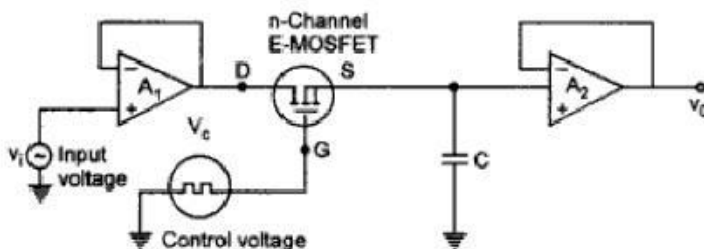
Ans:

The output voltage for input 00010110 is

$$=20\left(0\times 2^8 +0\times 2^7 +0\times 2^6 +1\times 2^5 +0\times 2^4 +1\times 2^3 +1\times 2^2 +0\times 2^1\right)$$
$$=20\times 44$$
$$=880 \text{ mV}$$

6.Draw the circuit of first order active filter.(Nov/Dec 2011)
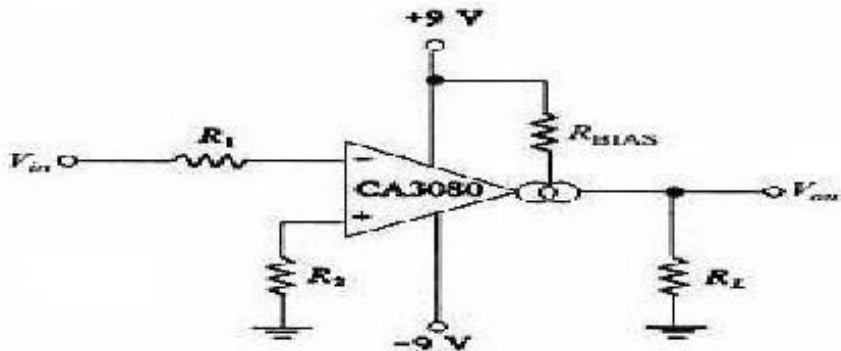
Ans:

7. Draw the circuit of sample and hold circuit.(Nov/Dec 2011) Ans:

8. Draw the circuit of I-V converter using op-amp.(May/June 2012) Ans:

9. Define monotonicity with respect to data converters.(May/June 2012)
Ans:

The resolution of a converter is the smallest change in voltage which may be produced at the output or input of the converter.

Resolution (in volts) = VFS/2n-1=1 LSB increment. The resolution of an ADC is defined as the smallest change in analog input for a one-bit change at the output.

10.What are the applications of peak detector.(Nov/Dec 2012)
Ans:

1. Directional couplers to measure forward and reflected power on a transmission line (it is the original application of this circuit);
2. Low power wattmeter's
3. RF mill voltmeters
4. Field strength meters
5. Radio receivers

11.Why active filters are preferred.(Nov/Dec 2012)

Ans:

1. Gain & Frequency adjustment flexibility: Since op-amp provides some gain, input signal is not attenuated. Active filters are easier to time or adjust.

2. No Loading Problem: Because of high i/p impedance & low o/p impedance of Op-amp, active filters does not cause loading of source or load.

3. Cost: Active filters are more economical, because of cheaper op-amps and absence of inductors.

12.List the applications of analog multipliers.(May/June 2013)

Ans:

1. Analog computer
2. Analog signal processing
3. Automatic gain control
4. True RMS converter
5. Analog filter (especially voltage-controlled filters)
6. PAM-pulse amplitude modulation

UNIT-IV

PART-A (Each 2 Marks)

1. List the applications of NE565. (Nov/Dec2010)

Ans:

1. Frequency multiplier
2. FM Demodulator is the applications of NE565.

2. Draw the relation between capture range and lock range relationship in PLL (Nov/Dec2010)

Ans:

3. Draw the pin diagram of IC555 timer (April/May2010)

Ans:
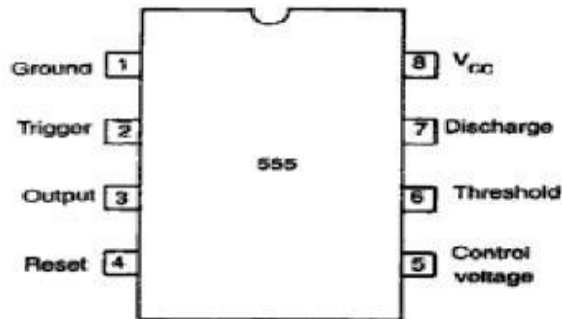
4. Mention any two applications of multiplier (April/May2010)

Ans:

The multiplier is used for

1. Frequency shifting
2. Voltage divider

5. Define the capture range of PLL (Nov/Dec2011)

Ans:

The range of frequencies over which the PLL can acquire lock with an input signal is called the capture range. It is also expressed as a percentage of f_O.

6. What are the one, two and four quadrant multiplier (Nov/Dec2011)

Ans:

1. In one quadrant multiplier the polarities of both the inputs must always be positive.
2. A two quadrant multiplier functions properly if one input is held positive and the other is allowed to swing in both positive and negative.
3. If both the inputs are allowed to swing in both positive and negative directions, the operation is four quadrant multiplier operations.

7. In what way VCO is different from other oscillator (May/June 2012)

Ans:

1. To adjust the output frequency to match (or perhaps be some exact multiple of) an accurate external reference.

2. Where the oscillator drives equipment that may generate radio-frequency interference, adding a varying voltage to its control input can disperse the interference spectrum to make it less objectionable. See spread spectrum clock.

8. Mention any two application of IC555 timer in mono stable mode (May/June 2012)

Ans:

The applications of IC555 timer in mono stable mode are

1. Frequency divider
2. Pulse width modulation

9. In a astable multivibrater using 555 timer R_A=6.8KΩ, R_B=3.3KΩ,C=0.1μF

Calculate the free running frequency.(Nov/Dec 2012) Ans:

$f =$ 1.45

$$\overline{(R_A + R_B)C}$$

$$f = \frac{1.45}{\left\lceil (6.8\,K\Omega) + (2)(3.3\,K\Omega) \right\rceil (0.1\mu F)}$$

$$f = 1.07\mu F$$

10. Why the VCO is called voltage to frequency converter (Nov/Dec 2012)

Ans:

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.

11. Define the terms relation to DAC (May/June 2013)

Ans:

settling time

It represents the time it takes for the output to settle within a specified band+-(1/2) LSB of its final value. It depends upon the switching time of the logic circuitry due to internal parasitic capacitances and inductances. Settling time ranges from 100ns to 10μs depending on word length and type of circuit used.

conversion time

It is the time taken for the D/A converter to produce the analog output for the given binary input signal. It depends on the response time of switches and the output of the Amplifier. D/A converters speed can be defined by this parameter. It is also called as setting time.

12. what is function voltage regulator (May/June 2013)

Ans:

A regulator circuit is a circuit used after the filter, which not only makes the dc

voltage smooth and almost ripple free but also keeps the dc output voltage constant though input dc voltage varies under certain condition. Thus input to a regulator is an unregulated dc voltage while the output of a regulator is a regulated dc voltage, to which the load is connected.

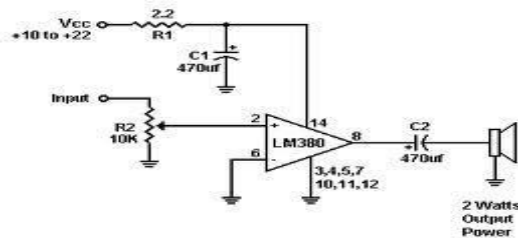## UNIT-V

PART-A (Each 2 Marks)

1. How will you increase the output of a general purpose op-amp? (Nov/Dec2010)

Ans:

A simple method of increasing the output current of a general purpose op-amp is to connect a

power booster circuit in series with the op-amp.

2. Using LM380 draw the circuit for audio power amplifier. (Nov/Dec2010)

Ans:

3.List the important parts of regulated power supply. (April/May2010)

Ans:

1. Reference voltage circuit
2. Error amplifier
3. Series pass transistor
4. Feedback network

4. What are the advantages of a switch mode power supplies. (April/May2010)

Ans:

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1. Smaller size

2. Lighter weight (from the elimination of low frequency transformers which have a high weight)

3. Lower heat generation due to higher efficiency.

5. What are the disadvantages of linear voltage regulators? (Nov/Dec2011)

Ans:

The input step down transformer is bulky and expensive because of low line frequency. Because of low line frequency, large values of filter capacitors are required to decrease the ripple. Efficiency is reduced due to the continuous power dissipation by the transistor as it operates in the linear region.

6. What is isolation amplifier?(Nov/Dec2011) (Nov/Dec2012)

Ans:

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.

7. Why do switching regulators have better efficiency then series regulators?(May/June 2012)

Ans:

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.

8. What is an optocoupler?(May/June 2012)

Ans:

The combined package of a LED and a photodiode is called an optocoupler.It is also called an optoisolator or an optically coupled isolator.

9. Name the various protection circuits used for voltage regulators. (Nov/Dec 2012)

Ans:

1. Constant current limiting
2. Fold back current limiting
3. Over voltage prodection
4. Thermal prodection

10. What is the principle of switch mode power supplies. (May/June 2013)

Ans:

A switched-mode power supply (switching-mode power supply, SMPS, or switcher) is an electronic power supply that incorporates a switching regulator to convert power efficiently.

11. How many resistors are required in a 12-bit weighted resistor DAC (May/June 2013)

Ans:

This particular converter is a 4-bit **R-2R** resistor ladder network and it differs from the DAC circuit shown in Fig. 10.9 in that it requires only two precision resistance values (**R** and 2R). The digital input to the DAC is a 4-bit binary number represented by bits Q_0, Q_1, Q2, and Q. where Q_O is the LSB and Q_3 is the MSB. Each bit in the circuit controls a switch between ground and the inverting input of the op-amp.