ST.ANNE'S

COLLEGE OF ENGINEERING AND TECHNOLOGY

QUESTION BANK

Subject: Linear Integrated Circuits and Applications

Department: Electrical and Electronics Engineering

Semester: III

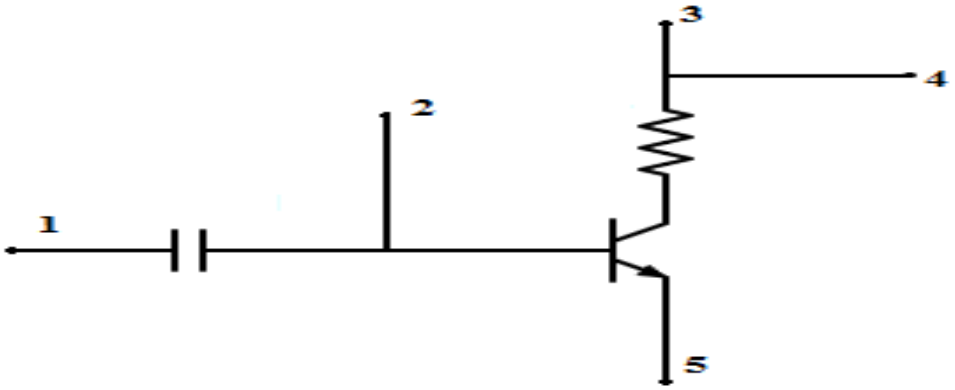
UNIT I: IC FABRICATION

Part-A (2 Marks)

1. What is an IC?
2. Classify ICs on the basic of application, device used and chip complexity.
3. List the basic processes used in the silicon planar technology.
4. What is the function of silicon –di- oxide on an IC?
5. What is photolithography?
6. Name the major crystal growth technique. What are ingots?
7. What are positive photoresists?
8. What are negative photoresists?
9. What are the two types of capacitors that can be fabricated in IC?
10. What is ion implementation?
11. List the advantages of ion implantation technique.
12. What is meant by parasitic capacitance?
13. What is the undesirable by-product of PN diode isolation?
14. What is the advantage of using Aluminium in metallization?
15. State the limitations of IC technology. **(May 2016)& (Dec 2016)**
16. What are the advantages of PNP transistor over NPN transistor in IC technology?
17. What is meant by hybrid IC?
18. Give the advantages of Schottky barrier diode over PN junction diode.
19. What is the purpose of oxidation process in IC fabrication?
20. List advantages of IC over discrete circuit. **(May 2013) (Nov 2013) & (Dec 2016)**
21. Explain why inductors are difficult to fabricate? **(May 2013)**
22. Name the different types of IC packages. **(May 2013)& (Nov 2013)**
23. What are the advantages of plasma etching? **(Nov 2013) & (May 2016)**
24. What are the major categories of Integrated circuits? **(Nov 2014)**
25. Mention the advantages of Integrated circuits over discrete circuits. **(Nov 2014) & (Nov 2016)**

Part – B (16 Marks)

1. Explain with diagram how a JFET is fabricated in monolithic IC implementation.**(May 2016)**
2. Explain the basic processes used in silicon planar technology with neat diagram.
3. Draw the typical structures of the monolithic transistor with (a) PN junction isolation (b) Dielectric isolation and list the different technological process used in both the methods.
4. Describe metallization process, assembly processing and packaging with diagram.**(May 2016)**
5. Detail the fabrication methods for transistors and diodes. **(Nov 2013)**
6. (i)Give the various ways for making diodes in ICs.**(May 2013,Nov 2014,May 2016)**
   (ii)Explain the operation of a Schottky barrier diode
7. Write down the various steps involved in the fabrication of a typical circuit.**(Nov 2014)**



8.Explain about the following: **(Nov 2013) (Nov 2014) (May 2016) & (Nov 2016)**

i) Epitaxial growth and diffusion. ii) Photolithography iii) Masking and Photo etching.

9.(i)Explain the different isolation techniques. **(May 2013)**

(ii)Describe in detail about the diffusion process of IC fabrication. **(May 2013)**

10.(i)Distinguish diffusion and ion implantation process in IC fabrication. **(May 2016)**

(ii)Explain how a monolithic capacitor can be fabricated. **(Nov 2014)**

UNIT-II CHARACTERISTICS OF OPAMP

Part-A (2 Marks)

1. What is an op-amp? List its functions.
2. List the ideal characteristics of an op-amp.
3. Explain the virtual ground concept with a suitable example.
4. What are the factors that affect the stability of an op-amp?
5. What are the various methods available for frequency compensation?
6. Explain the roll off gain in op-amp.
7. Mention some applications of op-amp. **(Dec 2016)**
8. Mention the significance of R_{comp} in an op-amp.
9. Define input bias current.
10. Define slew rate. Mention its ideal value expected in an op-amp.
11. Define PSRR or SVRR. **(Nov 2012)& (Nov 2013)**
12. What are the limitations of basic differentiator?
13. What is the limitation of basic integrator?
14. How do you construct a voltage follower circuit? List its applications.
15. What is the significance of level shifters used internally in an op-amp?
16. What is the necessity for an active load in an op-amp?
17. What is the value of open loop gain and output impedance of an ideal op-amp? **(Nov 2013)**
18. What is integrator? Give its output equation. **(May 2016) & (Nov 2016)**
19. What is a practical op-amp? Draw its equivalent circuit.
20. Why are FET op-amps better than BJT op-amps?
21. Define input offset current and input offset voltage. **(Nov 2013)**
22. What is the input impedance of a non-inverting amplifier? **(May 2013)**
23. Draw a non-inverting amplifier with voltage gain of 3. **(Nov 2013)**
24. A 100pF capacitor has a maximum charging current of 150 μA. What is the slew rate? **(Nov 2014)**
25. Draw an adder circuit using an op-amp to get the output expression as 1. What is an op-amp? List its functions.
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3. Explain the virtual ground concept with a suitable example.
4. What are the factors that affect the stability of an op-amp?
5. What are the various methods available for frequency compensation?
6. Explain the roll off gain in op-amp.
7. Mention some applications of op-amp. **(Dec 2016)**
8. Mention the significance of R_{comp} in an op-amp.
9. Define input bias current.
10. Define slew rate. Mention its ideal value expected in an op-amp.
11. Define PSRR or SVRR. **(Nov 2012)& (Nov 2013)**
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23. Draw a non-inverting amplifier with voltage gain of 3. **(Nov 2013)**
24. A 100pF capacitor has a maximum charging current of 150 μA. What is the slew rate? **(Nov 2014)**
25. Draw an adder circuit using an op-amp to get the output expression as V_o=-($0.1V_1$+V_2+$10V_3$) where V_1,V_2 and V_3 are the inputs.**(Nov 2014)**

Part – B (16 Marks)

IDEAL OP-AMP CHARACTERISTICS, DC CHARACTERISTICS

1.List the six characteristics of an ideal op-amp and explain in detail. Give the practical op-amp equivalent circuit.**(May 2013)**
2.Explain and derive the condition for DC-characteristics of an operational amplifier. (16) **(May 2013) (Nov 2013) & (Nov 2016)**
3(a) The input offset voltage of op-amp is 0.5mV. The bias current is 30pA. Find the value of R_{comp} to take care of the effect of I_B for a non-inverting amplifier having a gain of 15.
(b)In a practical non-inverting amplifier, R_1=1kΩ, R_f=10kΩ, A_{OL}=2 X 10^5, R_{in}=2mΩ, R_o=75 Ω and f_o=5Hz. Supply voltages = ±12V. Calculate A_{CL}, R_{inf}, R_{of} and f_f.
4. With neat diagram explain the types of feedback configurations available.

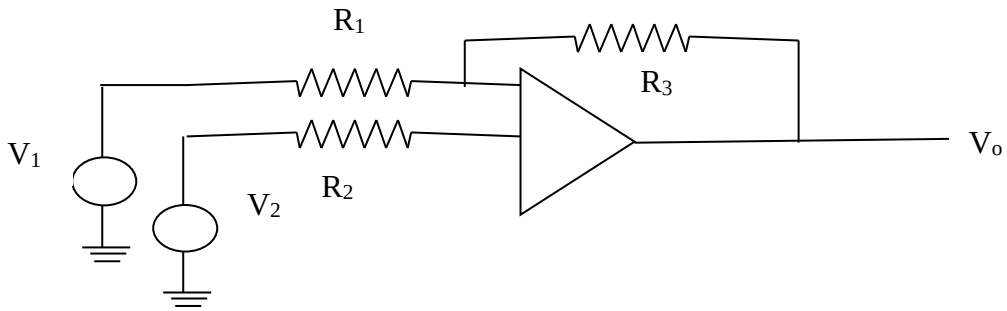
AC CHARACTERISTICS, FREQUENCY RESPONSE OF OP-AMP,DIFFERENTIAL AMPLIFIER

1 Explain and derive the condition for AC-characteristics of an operational amplifier.(16) **(May 2013) (Nov 2013) & (Nov 2016)**
2.Explain the frequency response characteristics and compensation of op-amp with neat diagrams.**(May 2016)**
3.(i) Explain in detail about the methods of frequency compensation used in operational amplifiers.(10) **(APRIL/MAY 2015)**
(ii) What is a slew rate? How it can be improved?(6) **(APRIL/MAY 2015)**

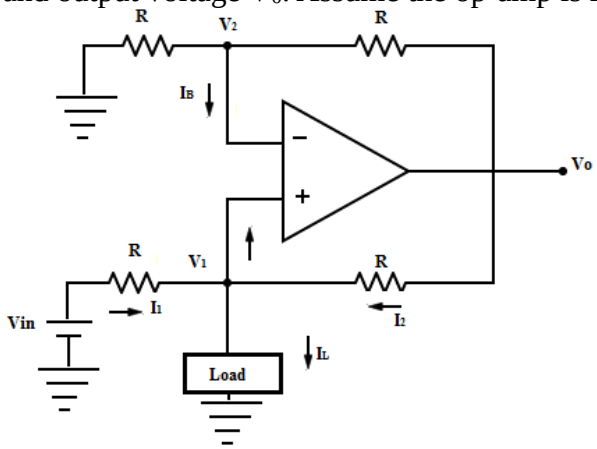
4. (i) What is slew rate? List the causes of the slew rate and Explain its significance in applications.(10) (**Nov/DEC 2015)**
(ii) Briefly explain the methods used for frequency compensation.(**Nov/DEC 2015)**

INVERTING AND NON INVERTING AMPLIFIERS, VOLTAGE TO CURRENT CONVERTER AND CURRENT TO VOLTAGE CONVERTERS, SUMMER,DIFFERENTIATOR AND INTEGRATOR

1.Explain in detail about voltage series feedback amplifier. (16)
2.Explain in detail about voltage shunt feedback amplifier. (16)
3.Derive the gain of inverting and non-inverting. (16)
4.Draw the circuits for inverting, non-inverting and difference amplifier using op amp. Derive an expression for gain for these three configurations.
5. i) Explain the differential amplifier using op-amp. **(Nov 2016)**
ii) Derive the expression for the output voltage V_o for the circuit shown below.



6.(i)Explain voltage to current converter using operational amplifier. Also explain the application of OP-Amp as integrator.(8) **(APRIL/MAY 2015)**
(ii)Explain current to voltage converter using operational amplifier. Also explain the application of OP-Amp as Differentiator.(8) **(APRIL/MAY 2015)**
7.(i)Draw and explain the operation of a current to voltage converter (8) **(NOV/DEC 2015)**
(ii)What are the limitations of an ordinary op-amp differentiator? Draw the circuit of a practical differentiator that will eliminate the limitations.(8) **(NOV/DEC 2015)**
8.Draw the circuit diagram of op-amp differentiator, integrator and derive an expression for the output in terms of the input. (16)
9. Briefly explain summing amplifier. Draw an adder circuit for the given expression
$V_0 = -(0.1V_1 + V_2 + 5V_3)$. (16)
10.(i) For a V-I converter shown in figure, V_{in} = 5V, R=10KΩ, V_1=1V.Find the load current and output voltage V_0. Assume the op-amp is initially nulled.(8) **(Nov 2014)**



(ii) For a max frequency of 100Hz, design a differentiator circuit and draw the frequency response for the same.(8) **(Nov 2014)**

PART C (16 Marks)

DC CHARACTERISTICS AND AC CHARACTERISTICS

1.Explain the frequency compensation techniques of op-amp?(16)
2.(i)Explain various DC and AC Characteristics of an Op-amp. Distinguish between ideal and Practical characteristics?(12)
(ii)write a short notes on slew rate?(4)
3.Explain the following terms in an OP-AMP
(i)Bias current (4)
(ii)Input offset current (4)
(iii)Input offset voltage (4)
(iv)Thermal Drift (4)

DIFFERENTAL AMPLIFIER, INVERTING AND NON INVERTING AMPLIFIER,SUMMER,DIFFERENTIAOR,INTEGRATOR

4. a. Draw the circuit of differential amplifier and derive the expression for output voltage in it. (8)
b. With neat diagram explain the working of an OP-AMP base integrator. (8)
5.With neat circuit diagram explain the operation of a OP-AMP differentiator and derive and expression for the output of a practical differentiator. (16)
6.Show the help of circuit diagram an OP-AMP used as a. i)Summer (8)
b. II) Integrator and explain their operation. (8)
7.With circuit and waveforms explain the application of OPAMP as (1) Integrator (2) Voltage series Feedback Compensation(16)

UNIT III- APPLICATIONS OF OPAMP

Part-A (2 Marks)

1. Name four applications of comparator.
2. How do a Schmitt trigger acts as a regenerative comparator?
3. State the important criteria required for sustained oscillations to occur in any circuit.
4. What is a notch filter?
5. What is a Sallen- Key filter?
6. How do we get a notch filter from a band pass filter?
7. Name one application for V - I converter and I - V converter.
8. Explain the concept of window detection.
9. Write the difference between positive clipper over negative clipper circuits. **(May 2016)**
10. What is the advantage of using active clipper over passive clipper? **(Dec 2016)**
11. What is the drawback in a weighted resistor DAC?
12. What is the advantage of R-2R DAC?
13. What are the applications of sample and hold circuit? (**Nov 2013) (June 2016)**
14. Which is the fastest ADC and why?
15. Give the conversion time for (i) counting ADC (ii) successive approximation ADC (iii) dual-slope ADC.
16. What are the uses of dual slope ADCs?
17. An 8-bit DAC has a resolution of 20 mV/bit. What is the analog output voltage for the digital input code 11000000(the MSB is the leftmost bit)?

18. What are the applications of peak detector?
19. Define the term settling time and conversion time related to DAC's. **(May 2013)**
20. How many resistors are required in a 12-bit weighted resistor DAC? **(May 2013)**
21. List the essential features of an op-amp based instrumentation amplifier. **(Nov 2013)**
22. Give an application for each of the following circuits. **(Nov 2013)**Voltage follower, peak detector, Schmitt trigger and clamper.
23. State the principle of single slope A/D converter. **(Nov 2013)**
24. How many comparators are required to design a 10 bit flash ADC? **(Nov 2014)**
25. Draw the fundamental sample and hold circuit. What is the purpose of S/H in data converters **(Nov 2013) (Nov 2014) & (June 2016)**

PART – B (16 Marks)

1.(i) Draw circuit of II order Butterworth active low pass filter and derive its transfer function.
(ii)Design a II order active high pass filter for a cut-off frequency of 1 KHz.
2.Explain the principle of Instrumentation amplifier and derive the gain for that circuit. Give its applications. **(May 2013) (May 2016)**
3.Design a first order low pass filter for a high cut off frequency of 2 KHz and pass band gain of 2. **(May 2013) (May 2016)**
4.Explain the operation of a square wave generator by drawing the capacitor and output voltage waveforms. **(May 2013)**
5.Design a 4 bit R-2R ladder network determine the size of each step if R=10kΩ, R_f =40kΩ and Vcc= ±15V. Calculate the output voltage for D_0=1, D_2=1, D_3=1 if bit '1' applied as 5V and bit '0' applied as 0V. **(May 2013)**
6.With circuit diagram, explain the following applications of operational amplifier
(i) V/I converter **(May 2013) (Nov 2013)** (ii) Peak detector (iii) Monostable multivibrator.
(ii)I/V converter **(May 2013)** Schmitt trigger **(Nov 2016)**
7.Explain the operation of Astable multivibrator using op-amp. **(Nov 2013)**
8.Describe about the following with neat diagram. **(Nov 2013)**
i) R-2R Ladder type D/A converter ii) SAR Type **(May 2016)** and Flash ADC **(Nov 2016)**
9.(i) In a triangular wave generator given R_2 = 1.2KΩ, R_3 = 6.8 KΩ, R_1 = 120KΩ, C_1=0.01μF. Determine peak to peak output amplitude of triangular wave and frequency of triangular wave.
ii) Design a RC phase shift oscillator for a frequency of 1KHz. **(Nov 2014)**
10.(i) A dual slope ADC uses 16 bit counter and 4MHz clock rate. The maximum input voltage is + 10V. The maximum integrator output voltage should be -8V when the counter has cycled through 2^n counts. The capacitor used in the integrator is 0.1μF. Find the value of resistor R of the integrator.**(Nov 2014)**
(ii) Derive expression for log and anti-log amplifiers with diagrams. **(Nov 2014) & (Nov 2016)**

UNIT IV – SPECIAL ICs

Part-A (2 Marks)

1. What is the function of 555 timer?
2. List the features of 555 timer.
3. What are the modes of operation of a timer?
4. Explain the function of reset.
5. Define capture range.(May 2016)
6. Which is greater 'capture range' or 'lock range'?
7. What are the types of digital phase meters?
8. List the applications of PLL.
9. What is the range of modulation input voltage applied to a VCO?
10. What is VCO?

11. What is pull in time of PLL?
12. What are the features of VCO?
13. List the application of 555 timers.
14. In an astable multivibrator using 555 timer $R_A = 6.8k\Omega$, $R_B = 3.3k\Omega$, $C=0.1\mu F$. Calculate the free running frequency.
15. Why VCO is called voltage to frequency converter?
16. List the applications of analog multiplier ICs. (**May 2013) & (June 2016)**
17. List the applications of 555 timer IC. **(Nov 2013)**
18. Define lock range of a PLL. **(Nov 2013).**
19. What is meant by frequency synthesizing? **(Nov 2013)**
20. What are the essential parts of PLL? **(Nov 2013)**
21. Draw the pin diagram of IC 555 timer. **(Nov 2013)**
22. A PLL frequency multiplier has an input frequency of "f" and a decade counter is included in the loop. What will be the frequency of the PLL output**?(Nov 2014)**
23. Define PLL**. (May 2016)**
24. What is analog multiplier IC? **(May 2016)**
25. Where Analog multiplier IC is used? **(May 2016)**

Part – B

1. Describe the operation and applications of astable multivibrator using IC555.**(May 2016)**
2. Explain the working of PLL using appropriate block diagram and explain any one application of the same. **(May 2016)&(Nov 2016)**
3. Derive the expression for voltage to frequency conversion factor of VCO with its block diagram and explain one of its applications.**(Nov 2016)**
4. (i) Explain how the frequency of an oscillator can be shifted by a small factor using PLL.
   (ii)Draw the circuit of an Analog multiplier and explain.
5. List the important features of the 555 timer. Also write about the two basic modes in which the 555 timer operates.
6. Explain IC 566 VCO operation **(Nov 2013) & (Nov 2016)** and detail any two applications.
7. Explain with a schematic how a PLL can be used as. **(Nov 2013)**

(i) Frequency multiplier (ii) Frequency translator.

8. Draw and explain the functional block diagram of IC 555 timer. **(Nov 2013)**
9. Describe any two application of IC555 timer when it is working in monostable mode. **(Nov 2013)**
10. (i) For the VCO circuit, assume $R_2 = 2.2\ K\Omega$, $R_1 = R_3=15K\Omega$ and $C_1 = 0.001\mu F$. Assume $V_\infty = 12V$.Determine the output frequency, the change in output frequency if modulating input V_c is varied from 7V to 8V. **(Nov 2014)**

    (ii) For a 555 astable circuit, determine the high state time interval, low state time interval period, frequency and duty cycle. **(Nov 2014)**

(iii) Design and draw the waveform of a 1kHz square wave generator using 555 timer for a duty cycle of 50% **(May 2016)**

UNIT V – APPLICATION ICS

Part-A

1. How do you classify regulators?
2. What is a series voltage regulator?
3. What is a switching voltage regulator?(May 2016)
4. Give the important parts of a series regulated power supply using discrete components.
5. Show the standard representation of a three terminal positive IC voltage regulator.
6. List the characteristics of three terminal IC regulators.

7. What is meant by an IC voltage regulator?
8. Give examples of monolithic IC regulators.(May 2016)
9. What are the limitations of three terminal regulator?
10. What is meant by current limiting?
11. Draw the functional diagram of 723 regulator and explain two separate sections of 723 regulator.
12. How current boosting is achieved in a 723 regulator?
13. What is meant by current fold back technique?
14. Draw the characteristic curve of a current limited regulator.
15. List the limitations of linear voltage regulator.
16. What is the principle of switch mode power supplies? **(May 2013) & (Nov 2016)**
17. How three pin regulators can be used as adjustable regulator?
18. Name the various protection circuits used for voltage regulators.
19. Draw the characteristic curve of a current fold back circuit.
20. What are the advantages of switching regulator?
21. What are the limitations of switching power supplies?
22. What is the function of a voltage regulator? **(May 2013)**
23. List and explain the performance parameters of regulators. **(Nov 2013)**
24. What is meant by thermal shutdown applied to voltage regulators?**(Nov 2014)**
25. Draw the internal block diagram of a function generator IC**.(Nov 2014)**

Part-B

1. Explain the working principle of switched mode power supply.**(Nov 2014)**
2. Design an adjustable voltage regulator (3V to 28V) with a short circuit limit of 60mA using a 723 regulator.
3. Draw and explain the following protection circuits,

(i)Short circuit protection (ii) Fold back current limiting.

4. Explain the working of series voltage regulator.**(May 2016) & (Nov 2016)**
5. What is a switching regulator? With a neat block diagram explain the internals of µA 7840.
6. Draw and explain the functional block diagram of 723 general purpose regulator.**(Nov 2013)**
7. Draw schematic of function generator IC 8038 and explain its functions.**(Nov 2013),(May 2016) &(Nov 2016)**
8. Design an adjustable voltage regulator (5V to 15V) with a short circuit limit of 50mA using a 723 regulator.**(May 2013) (May 2016) & (Nov 2016)**
9. Explain the circuit diagram of LM 380 audio power amplifier.**(Nov 2013),(Nov 2014) (May 2016) &(Nov 2016)**
10. (i) State the advantages of IC voltage. Explain the features and internal structure of general purpose linear IC 723 regulator. Design a regulator using IC 723 to meet the following specifications. V_0=5V,I_0=100mA,V_{in}=15$\pm$ 20%; I_{sc}=150mA V_{sense}=0.7V**(Nov 2014)**

(ii) With a neat diagram explain the working of step down switching regulators. **(Nov 2014)**