

## EC 1254. LINEAR INTEGRATED CIRCUITS

### UNIT I IC FABRICATION AND CIRCUIT CONFIGURATION FOR LINEAR IC's

#### Part-A

1. Find the maximum frequency for an opamp with sine wave output voltage of 10V peak and slew rate is to  $v/\mu s$ .
2. What do you mean by input offset current & input offset voltage?
3. Define slew rate.
4. What does the term linear circuit generally convey?
5. Define CMRR
6. Draw the circuit of a widlar current source and write the expression for its output current.
7. Find the maximum frequency for op-amp with sine wave output voltage of 10 V peak and slew rate is  $2 V/\mu s$ .
8. What do you mean by input offset current and input offset voltage.
9. Compare the ideal and practical characteristics of op-amp.
10. Draw the internal block diagram of op-amp.
11. Draw the circuit diagram of voltage follower.
12. When an inverting amplifier is called phase inverter and scale changer?

#### Part-B

- 1 i. Discuss the ideal characteristics of an OPAMP. Compare with practical OPAMP.  
ii. Briefly explain different type frequency compensation techniques applied to OPAMP circuits.
- 2 (i) Explain the concept of wildlar current source used in OPAMP circuits.  
(ii) Explain how the feed forward compensation extends the BW of an OPAMP.
3. i. Explain the frequency response of OP-AMP.  
ii. Derive the open loop voltage gain as a function of frequency.
- 4 .i. Explain how the feed-forward compensation extends the bandwidth Of an OP-AMP.  
ii. Write about the temperature independent biasing provided for differential amplifiers.
5. i. Draw the circuit of a simple bipolar transistor current source and show that its output current is dependent on the  $\beta$  of the transistor.  
ii. Explain how the above circuit can be modified to make in less insensitive to  $\beta$ .
6. i. Draw the circuit of a differential amplifier with current mirror load. Draw its equivalent circuit and derive an expression for its gain

7. i. Discuss the ideal characteristics of an op-amp. Compare with practical op-amp.  
ii. Briefly explain different types of frequency compensation techniques applied to op-amp circuits.
8. i. Explain the concept of Widlar current source used in op-amp circuits.
9. i. Explain various stability criteria of op-amp circuit.  
ii. Write a brief note on frequency compensation in op-amp.
10. i. Determine the output voltage of a differential amplifier having differential amplifier gain 2000 and the CMRR 100dB.  
ii. Explain the concept of current source applicable to differential amplifier.

## UNIT II      APPLICATIONS OF OPERATIONAL AMPLIFIERS

### Part-A

1. What modifications are made in OPAMPs input and output impedance when it has non inverting configuration?
2. What is an antilog amplifier? Draw the circuit diagram of an antilog amplifier?
3. What is precision rectifier? Give the circuit.
4. What are the advantages of instrumentation amplifier?
5. What are the conditions sustained oscillations ?
6. What are the applications of comparators?
7. What is meant by zero crossing detector?
8. What are the applications V-I converter?
9. Draw the circuit diagram of an op-amp integrator. Mention its applications.
10. Two voltage + V<sub>1</sub> and + V<sub>2</sub> are available. Using two operational amplifiers draw a circuit to compute  $5V_1 - 3V_2$ .

### Part-B

1. i. Design a second order Butterworth active high pass filter for a cut off frequency of 5 kHz.  
ii. What is a precision diode? With circuit schematic explain the working principle of full wave precision rectifier.
2. i. With diagram explain the working principle of ICL8038 function generator.  
ii. Explain how a compandor can be used as a zero crossing detector.
3. i. Design a differentiator to differentiate an input signal that varies in frequency from 10Hz to 1KHz.  
ii. If a sine wave of 1V peak at 1000Hz is applied to the differentiator draw its output wave form.  
iii. Give the basic differentiator frequency response.
4. i. Design a band pass filter using op-amp to have  $f_l = 500\text{Hz}$   $f_h = 2\text{KHz}$  with pass band given of 4.

- ii. Explain the triangle wave generators with neat diagram and derive the time period.
5.
  - i. Draw the circuit diagram of a second order Butterworth active low pass filter and derive an expression for its transfer function.
  - ii. Design the above mentioned filter for a cut-off frequency of 1 kHz and a damping factor of 1.4.
- 6 i. Briefly explain the working principle of Schmitt trigger.
7. i. With circuit diagram discuss the following applications of op-amp.
  - 1) Voltage to current converter.
  - 2) Precision rectifier.
- ii. Draw the schematic of a linear IC Saw-tooth generator and explain the principle of operation .
8. i. Draw the circuit diagram of an op-amp integrator. Mention its applications.

### **UNIT III      ANALOG MULTIPLIER AND PLL**

#### **Part-A**

1. Draw the block diagram of NE566 voltage controlled oscillator.
2. What is an operational transconductance amplifier? Draw the schematic.
3. Define lock range and capture range of PLL
4. What is frequency synthesizer?
5. Explain how a frequency doubler can be realized using analog multiplier.
6. A PLL with a free running frequency of 1kHz is connected to a variable frequency oscillator. The frequency was 850 Hz the PLL got locked. The frequency of oscillator was decreased and it went out lock for the oscillator frequency of 800Hz. Calculate the lock range and the capture range of PLL?
7. What is a quadrant multiplier?
8. What is four quadrant multiplier ? Draw the circuit diagram of a squaring circuit using multiplier.
9. What is a compander IC? Enlist the features.
10. What is FSK technique?
11. Draw the diagram of AM detector using PLL.

#### **Part-B**

1. (i) Briefly explain variable transconductance amplifier.  
(ii) How a PLL used as frequency synthesizer.
2. i. Write a note on compander ICs.  
ii. How a PLL used as voltage multiplier.

3. i. Explain the voltage controlled oscillator with its block diagram and connection diagram using **VCO 566 IC**.  
ii. Write the short notes on variable trans conductance multipliers.
4. i. Explain the working of PLL with diagram  
ii. Write short notes on FSK modulator and demodulator
5. i. Draw the block diagram of a PLL and derive its transfer function.  
ii. Draw the circuit of FM demodulator using PLL.
6. i. Explain the working principle of Gilbert cell multiplier circuit.  
ii. With block diagram discuss the principal of operation NE 565 PLL circuit .
7. i. Explain PLL as a frequency synthesizer.  
ii. With circuit diagram explain the working of a NE 566 voltage controlled oscillator.
8. Draw the block diagram of the circuit that converts 1kHz to 10kHz.
9. With circuit diagram explain the working of Gilbert cell multiplier circuit. Explain How a frequency doubler can be realized using this cell?

## **UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS**

### **Part-A**

1. Calculate the quantizing error for an 8 bit A/D converter with full scale input voltage of 2.55V.
2. What is a sample and hold circuit? Mention any two applications.
3. Draw the sample & hold circuit.
4. What is the principle of operation of voltage –to-time conversion?
5. An 8 bit D/A converter has an output voltage range of 0 – 2.55 V. Calculate its resolution.
6. Calculate the number of comparators required for realizing a 4 bit flash A/D converter.
7. Which is the fastest A/D converter? Give reason.
8. An 12 bit D/A converter has resolution of 30 mv/LSB. Find the full scale output voltage.

### **Part-B**

1. i. With circuit schematic explain analog switches using FET.  
Explain the working principle of dual slope A/D converter.
2. (i) Write short note on voltage to time converter?  
(ii) What are the different sources of error in D/A converter?

3. (i) Explain the dual slope A/D convertor with circuit  
(ii) Compare binary weighted DAC with R-2R ladder network DAC
4. For a 4 bit R-2R ladder network determine the size of each step if  $R=10\text{K}\Omega$  and  $V_{cc}=\pm 15\text{V}$ . Calculate the output voltage for  $D_0=1, D_1=0, D_2=1, D_3=1$  if bit '1' is applied as 5 V and bit '0' is applied as 0V.
5. (i) Explain the working principle of high speed sample and hold circuit.  
(ii) For an 8 bit successive approximation type A/D converter is driven by a 2 MHz Clock. Find the conversion time.
6. i. Brief explain the working principle of successive approximation type ADC.  
ii. An 8 bit DAC has a step size of 10mV. Determine the full scale output voltage And percentage resolution. Find the output voltage for the input of 0101010.
7. i. Draw the circuit of a R-2R ladder type digital to analog converter and explain.  
ii. Draw the circuit of a four bit R-2R D/A converter with feedback resistance of 3R for the op-amp. Calculate its output voltage for a digital input of 0100 if the reference voltage is 2.5 V.
8. i. Explain the working of flash analog to digital converter.  
ii. How many comparators are required for a 4-bit flash ADC ? For an input signal in the range of 0 to + 10V. What are the reference voltages needed? Show how they can be generated using a 10 V reference and several 1 kohm resistors.
9. i. Draw the diagram of sample and hold circuit. State how will you reduce its hold mode droop.  
ii. Design a 4 bit binary weighted resistor D/A converter for the following specifications. Use LM741 op-amp.  $R = 10\text{ k}$ ,  $V_{ref} = 2.5\text{ V}$ . Full scale output 5V.
10. i. With neat diagrams explain the working of dual slope A/D converter.  
ii. A dual slope ADC has a full scale input of 2 volts. It uses an integrating time of 10 ms and integrating capacitor of 0.1  $\mu\text{F}$ . The maximum magnitude of the integrator output should not exceed 3 volts. Calculate the value of the integrating resistor.
11. i. Which is the fastest A/D converter? Give reason.  
ii. An 12 bit D/A converter has resolution of 30 mv/LSB. Find the full scale output voltage.

## UNIT V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICs

### Part-A

1. What is a stagger tuned amplifier?
2. What is the need for using switched capacitor filters in MOS technology?
3. How are the internal noises within IC's classified?
4. Give the basic principle of switching regulators.
5. In a linear voltage regulator, the input voltage is 20 V and output voltage is 15V. For a load

- current of 1 ampere, calculate the power dissipated in the series pass element.
6. Draw the internal diagram of an optocoupler.
  7. Draw the internal block diagram of an IC voltage regulator.
  8. Draw the circuit of a switched capacitor integrator.

### Part-B

1. i. Briefly explain LM380 audio amplifier.  
ii. Discuss about protection circuits used in IC regulators.
2. i. What are the design consideration of video amplifier?  
ii. Briefly explain the working principle and the frequency response characteristics of video amplifier IC.
3. Write notes on :
  - i. Frequency to voltage converter
  - ii. Opto couplers
4. i. Design an adjustable voltage regulator (5V to 15V) with short circuit current limit of 50 mA using a 723 regulators  
ii. Explain power amplifiers and the essential characteristics.
5. .i. A 555 timer configured in astable mode with  $R_A = 2k \text{ OHM}$ ,  $R_B = 4 \text{ K ohm}$  and  $C = 0.1 \mu\text{F}$ . Determine the frequency of the output and duty cycle.  
ii. Write a note on switched mode power supply.
6. .i. With circuit diagram explain the working principle of IC 723 voltage regulator.  
ii. Explain the working principle of isolation amplifier IC-ISO 100.
7. i. What are the various blocks that form a basic voltage regulator?  
ii. Explain the series and shunt voltage regulator. List advantages IC voltage regulator.
8. i. Discuss the operation of IC 555 as a monostable mutivibrator. Draw waveform and explain.  
ii. Draw the functional block diagram of switching regulator and explain.
9. Draw the internal block diagram of NE 555 timer IC and explain how it can be used as monostable multivibrator. Derive an expression for its pulse width.
10. With neat diagram explain the working of step down switching regulator.
11. i. State the conditions required for designing a video amplifier.  
ii. What is a switched capacitor filter? Mention any two advantages.