

LINEAR IC APPLICATIONS
(Electrical and Electronics Engineering)**Time: 3 hours****Max. Marks: 70***Question paper consists of Part-A and Part-B**Answer ALL sub questions from Part-A**Answer any FOUR questions from Part-B*

PART-A (14 Marks)

1. a) What is the purpose of level translator in an op-amp? [3]
- b) List the different feedback configurations of an op-amp. [2]
- c) Draw a circuit to find $V_O = (V_1 + V_2) - (V_3 + V_4)$. [3]
- d) What are the disadvantages of passive filter? [2]
- e) Draw the block schematic of the PLL. [2]
- f) What is the output analog voltage of a 4 bit DAC for an input bit stream of 1101 and reference voltage of 5V? [2]

PART-B (4x14 = 56 Marks)

2. a) Derive the expression for voltage gain, input resistance and output resistance of Dual input Balanced output Differential Amplifier. [7]
- b) List out the characteristics of single ended input, balance output differential amplifier. [7]
3. a) A differential amplifier has a common mode gain $A_C = 0.1$ and difference mode gain $A_d = 200$. Let the input signal be $V_1 = 1050 \mu\text{V}$ and $V_2 = 950 \mu\text{V}$. Compute the output voltage and CMRR. [7]
- b) What is the need for frequency compensation in practical op-amps and how do you achieve them? [7]
4. a) Find R_1 and R_f in the practical integrator (lossy integrator), so that the peak gain is 20 dB and the gain is 3 dB down from its peak when $\omega = 10,000$ rad/sec. Use a capacitance of $0.01 \mu\text{F}$. [7]
- b) What is a voltage to current converter? How can an op-amp be used as a voltage to current converter for grounded load? [7]
5. a) Compare the frequency response characteristics of first order and second order Butterworth filters. [7]
- b) With neat sketches, explain the response of II order Butterworth Filter. Derive an expression for the critical frequency. [7]
6. a) A Schmitt trigger with the upper threshold level $V_{UT} = 0\text{V}$ and hysteresis width $V_H = 0.2\text{V}$ converts a 1KHz sine wave of amplitude $4V_{PP}$ into a square wave. Calculate the time duration of the negative and positive portion of the output waveform. [7]
- b) List the applications of Astable multivibrator. [7]
7. a) A certain ADC has a full-scale of 2.55V (i.e., $V_A = 2.55\text{V}$ produces a digital output of (11111111)). It has a specified of 0.1% F.S. determine the maximum amount by which the V_{AX} output can differ from the analog input. [7]
- b) Explain parallel comparator (flash) ADC. [7]

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1. a) Define the term Differential amplifier. [3]
- b) What is an op-amp? [2]
- c) What is the difference between ac and dc amplifiers? [3]
- d) Draw the circuit diagram of all pass filter. [2]
- e) What is PLL? [2]
- f) What is meant by the resolution of a D/A converter? [2]

PART-B (4x14 = 56 Marks)

2. a) Compare the different configurations of differential amplifiers. [7]
- b) Draw and explain the block diagram of an op-amp. [7]
3. a) Explain the operation of op-amp based instrumentation amplifier. [7]
- b) Write a brief note on the importance of compensating networks. [7]
4. a) A Schmitt trigger with the upper threshold level $V_{UT} = 0V$ and hysteresis width $V_H = 0.2V$ converts a 1KHz sine wave of amplitude $4V_{PP}$ into a square wave. Calculate the time duration of the negative and positive portion of the output waveform. [7]
- b) Draw an op-amp summing amplifier circuit and obtain an expression for the output voltage. [7]
5. a) Discuss the characteristics of Butterworth filter. [7]
- b) Design a wide band pass filter having $f_L = 400Hz$, $f_H = 2KHz$ and pass band gain=4. Find the value of Q of the filter. [7]
6. a) Sketch the functional schematic of 555 timer and explain how it can be used as a monostable multivibrator? And also draw the waveforms. [7]
- b) How can 555 timer can be used as Schmitt trigger? [7]
7. a) Draw the block diagram of 3-bit R-2R ladder DAC and explain its operation. [7]
- b) Write the total number of clock pulses needed for counter type, flash, SAR, and dual slope ADC's. [7]

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PART-A (14 Marks)

1. a) What is meant by current mirror? Explain. [3]
- b) What are the merits and demerits of Dominant pole compensation method? [2]
- c) List the applications of sawtooth wave generator. [3]
- d) What are the advantages of active filters over passive filters? [2]
- e) Why is Schmitt trigger called as regenerative comparator? [2]
- f) What are the limitations of weighted resistor type D/A converters? [2]

PART-B (4x14 = 56 Marks)

2. a) Draw the circuit of Dual input and unbalanced output differential amplifier and derive the expression for its output voltage. [7]
- b) Explain in detail about the operation of level translator with the help of neat diagrams. [7]
3. a) What are the characteristics of an ideal op-amp? [7]
- b) What are the limitations of open loop configuration of an op-amp? [7]
4. a) Draw the circuit diagram of a typical instrumentation amplifier and explain why two stage op-amp circuit is used as an instrumentation amplifier. [7]
- b) What are the limitations of an ordinary op-amp integrator? Draw the circuit of a practical integrator and explain how it will eliminate these limitations. [7]
5. a) Design a second order Butterworth LPF having upper cutoff frequency 1KHz. [7]
- b) Design a wide band pass filter having $f_L=400\text{Hz}$, $f_H=2\text{KHz}$ and pass band gain=4. Find the value of Q of the filter. [7]
6. a) Explain the working of a Schmitt trigger. [7]
- b) Explain how a PLL can be used as a frequency multiplier. [7]
7. a) Explain the 4-bit weighted resistor type D/A converter in detail. [7]
- b) Describe the successive approximation A/D conversion principle. [7]

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Set No. 4

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PART-A (14 Marks)

1. a) What are the advantages of IC's over discrete circuits? [3]
- b) The output voltage of a certain op-amp circuit changes by 20V in 4 μ s. What is its Slew rate? [2]
- c) What are the applications of peak detectors? [3]
- d) Draw the frequency response of notch filter. [2]
- e) Which is greater "capture range" or "lock in range"? [2]
- f) Which type of A/D converter is faster? Why? [2]

PART-B (4x14 = 56 Marks)

2. a) With a neat sketch explain the operation of current mirror circuit. [7]
- b) Draw the circuit diagram of level translator. Explain the operation with suitable examples [7]
3. a) Define the terms:
(i) Slew Rate (ii) CMRR [7]
- b) Distinguish between practical and ideal Op-amp. Draw its equivalent circuit. [7]
4. a) Design an op-amp differentiator that will differentiate an input signal with $f_{\max} = 100$ Hz. Draw the output waveform for a sine wave of 1v peak at 100 Hz applied to the differentiator. [7]
- b) Explain in detail about Logarithmic amplifier. [7]
5. a) With a neat diagram, explain about IC1496 modulator. [7]
- b) Draw 4th order Butterworth high pass filter. [7]
6. a) Using a block diagram explain the functioning of 555. [7]
- b) Draw and explain the 555 timer circuit in Astable mode to get output waveform with 50% duty cycle. [7]
7. a) An 8-bit A/D converter accepts an input voltage signal of range 0 to 10V. What is the minimum value of the input voltage required to generate a change of 1 LSB? [7]
- b) Describe the operation of dual slope A/D converter. [7]