Subject Name: LINEAR IC APPLICATIONS

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Unit-1: INTEGRATED CIRCUITS

Important Points /Definitions:

1. The Integrated circuit or IC is a miniature, low-cost electronic circuit fabricated on a single crystal chip of silicon
2. In IC's all the components are fabricated on the same chip. There are two technologies used: Monolithic technology and Hybrid technology.
3. According to the mode of operation ,IC's are basically two types: Digital IC's and Linear IC's
4. The three popular packages available for IC's are: a) The metal can (TO) package
   b) The Dual-in-line package (DIP)
   c) The Flat package
5. Most Linear IC's require both positive and negative supply. The standard supply voltages for Op-amps are ±15V. On the other hand, most Digital IC's require only one positive supply voltage
6. An operational amplifier is a direct coupled high gain amplifier usually consisting of one or more differential amplifier and usually followed by a level translator and an output stage.
7. There are five basic terminals of op-amp: Two input terminals, one output terminal and two supply terminals
8. An Ideal op-amp has
   a) infinite voltage gain,
   b) infinite input resistance,
   c) infinite CMRR,
   d) infinite slew rate,
   e) infinite bandwidth,
   f) zero output resistance and
   g) zero output offset voltage

9. The block diagram of an Op-amp is

10. A circuit that amplifies the difference between two signals is called a Difference or Differential Amplifier
11. Negative feedback stabilizes the gain. The two feedback connections used are: a) Inverting Amplifier and b) Non-inverting amplifier
12. If the input is applied to only inverting terminal and non-inverting terminal is grounded then it is called inverting amplifier.
13. In this configuration, the input voltage is applied to non-inverting terminals and inverting terminal is ground
14. A practical op-amp is not ideal and has finite values of input offset voltage, input offset current and input bias current. These produce a dc offset voltage at the output
15. The DC characteristics of op-amp are: a) Input bias current
    b) Input offset current
    c) Input offset voltage
    d) Thermal drift
16. The AC characteristics of op-amp are: a) Frequency response
    b) Slew rate
17. 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.
18. The common mode rejection ratio (CMRR) can be defined as the ratio of differential gain to common mode gain.

    $$CMRR = |A_d/A_c|$$

19. . The 741 op-amp is a high performance monolithic operation amplifier. It is available in 8 pin, 10 pin or 14 pin configuration. It can operate over a temperature of -55 to 125 degree centigrade.

Short Questions: (As per previous JNTUH papers)

1. Draw the equivalent circuit of an ideal OP-AMP.(May-2019)
2. Define slew rate. What causes it?(May-2016)
3. Derive the gain of non inverting amplifier.(May-2018)
4. List out the ideal characteristics of an operational amplifier (Oct/Nov – 2016)
5. What is CMRR? Give an ideal value for an Op-amp. (Oct/Nov – 2016)
6. List the AC characteristics of op-amp.(May-2018)
7. Define the Op-Amp parameters: (i) Input offset voltage (V_{io}) and (ii) Input bias current, I_{io}.(Nov/Dec-2018)
8. List features of 741 op-amp.(Nov/Dec-2017)
9. Differentiate between monolithic and hybrid circuits with suitable examples.(May/June-2012)
10. Draw the differential Amplifier circuit using BJT.(Nov/Dec– 2012)
11. Draw an ideal voltage transfer curve of an op – amp(Nov- 2007)
12. What are the temperature grades of integrated circuits?(Oct/Nov – 2016)
13. Draw the pin configuration of the IC 741C(Oct/ Nov – 2017)

Long Questions: (As per previous JNTUH papers)

1. Explain the working of Non-Inverting amplifier and derive the equation of its Gain.(May-2018)
2. How op-amp is used as a differentiator? Explain. .(May-2018)
3. What is an Op-amp. Briefly explain the necessity and function of different stages of an Op-amp with respect to its block schematic. (Oct/Nov – 2018)
4. Draw the circuit diagram of a two input non-inverting type summing amplifier and derive the expression for the output voltage.(Nov/Dec-2017)
5. Define Slew rate. How it effect the op-amp performance? Explain.(May-2019)
6. What are the differences between the inverting and non inverting terminals? What do you mean by the term "virtual ground"?(March-2019)
7. Explain about input offset voltage with a neat diagram. .(May-2019)
8. Design an op-amp differentiator circuit that varies in frequency from 10Hz to about 1KHz.(May/June-2019)
9. Briefly explain the various types of IC packages. Mention the criteria for selecting an IC package. (May-2018)
10. What are the features of 741 op - amp and also draw the pin diagram.(Nov-2007)
11. What are the differences between the inverting and non inverting terminals? What do you mean by the term "virtual ground"?(Mar– 2017)
12. Explain the IC 741 op-amp block diagram & its features in detail.(Oct/ Nov– 2017)

Fill in the blanks/ Choose the best:

1. Which pin is used for the output of the OPAMP in µA 741 IC (B)
   (A) 5 (B) 6 (C) 2 (D) 8
2. Open loop Gain of an ideal op-amp (D)
   (A) 0 (B) 1 (C) -1 (D) ∞
3. How many leads does the TO-5 metal can package of an operational amplifier have? (A)
   (A) 8, 10, or 12 (B) 6, 8, or 10 (C) 8 or 14 (D) 8 or 16
4. Operational amplifiers use ………….. (B)
   (A) Linear ICs (B) Digital ICs
   (C) Both linear and digital ICs (D) None of the above
5. Which of the following is most difficult to fabricate in an IC? (D)
   (A) Diode (B) Transistor (C) FET (D) Capacitor
6. The purpose of level shifter in Op-amp internal circuit is to (A)
   (A) Adjust DC voltage (B) Increase impedance
   (C) Provide high gain (D) Decrease input resistance
7. What is the purpose of differential amplifier stage in internal circuit of Op-amp? (D)
   (A) Low gain to differential mode signal (B) Cancel difference mode signal
   (C) Low gain to common mode signal (D) Cancel common mode signal
8. Which of the following is not a linear/digital IC? (C)
   (A) Phase-locked loop (B) Voltage-controlled oscillator
   (C) Passive filter (D) Comparator
9. The most popular types of ICs are ………….. (D)
   (A) Thin-film (B) Hybrid (C) Thick-film (D) Monolithic

10. Which of the following is not preferred for input stage of Op-amp? (C)

(A) Dual Input Balanced Output (B)Differential Input Single ended Output

(C) Cascaded DC amplifier (D)Single Input Differential Output

11. The input offset current equals the ………. (A)

(A) difference between two base currents (B) average of two base currents

(C) collector current divided by current gain (D) none of these

12. The input stage of an Op-amp is usually a ………. (A)

(A) differential amplifier (B) class B push-pull amplifier

(C) CE amplifier (D) swamped amplifier

13. Current cannot flow to ground through ……. (C)

(A) a mechanical ground (B) an a.c. ground

(C) a virtual ground (D) an ordinary ground

Unit-2: OP-AMP AND APPLICATIONS

Important Points / Definitions:

1. An op-amp can be used to perform mathematical operations such as scale changer, addition and subtraction.
2. An Instrumentation amplifier is useful for amplifying low level signals which are obtained by sensing with a transducer in the measurement of physical quantities like temperature, water flow etc.
3. The Instrumentation amplifier is intended for precise, low-level signal amplification where low noise, low thermal and time drifts, and high input resistance are required.
4. Summing, Scaling and averaging amplifiers can be constructed by using inverting, non-inverting and differential configurations.
5. A direct-coupled op-amp can be used for amplifying both ac and dc inputs. A capacitively coupled amplifier is used for amplifying ac signals.
6. The differential input and output amplifier can be used as a preamplifier and also in driving push-pull arrangements.
7. The V-to-I converters are useful in low voltage dc and ac voltmeters, LED and zener diode testers.
8. The I-to-V converters are useful in digital-to-analog circuits, as well as in testing photosensitive devices.
9. The op-amp integrator and differentiator are used in signal wave shaping applications.
10. Integrators are used in analog computers as the gain of integrator decreases with increasing frequency.
11. The signal to noise ratio of integrator is higher than that of differentiator.
12. The differentiator is used as a rate of change detector in FM modulation.
13. A sample and hold circuit samples an input signal and holds on to its last sampled value until the input is sampled again.
14. The sample and hold circuit is used in analog to digital interfacing and pulse modulating systems.
15. A comparator is an open loop op-amp with analog inputs and a digital output ($\pm V_{sat} = V_{cc}$).
16. A Schmitt trigger is a comparator with positive feedback that converts an irregular waveform to a square or pulse waveform
17. In the Schmitt trigger the input voltage triggers the output every time it exceeds certain voltage levels called upper threshold (V_{ut}) and lower threshold (V_{lt}).
18. A monostable multivibrator is used to generate pulses of desired duration and is also called a gating circuit.
19. A voltage regulator should be capable of providing substantial output current. They are classified as : Series regulator and Switching regulator
20. A voltage regulator is an electronic circuit that provides a stable dc voltage independent of the load current, temperature and ac line voltage variations.
21. The 723 regulator can give adjustable output voltage in a wide range. It provides short circuit protection and current foldback using external components.

Short Questions: (As per previous JNTUH papers)

1. What are the different features of IC 723?(May-2018)
2. Discuss the features of voltage regulator.(Nov/Dec-2018)
3. What are the applications of sample and hold circuit?(May/June-2013)
4. Explain, How to obtain triangular wave using a square wave generator.(Nov-2007)
5. Significance and definition of upper and lower threshold points of a Schmitt trigger.(Nov– 2015)
6. Draw the internal architecture of IC 723 voltage regulator and explain. .(Nov– 2015)

7. How op-amp is used as a differentiator? Explain.(May – 2018)
8. Design a two bit comparator circuit and explain its operation.(Nov/Dec– 2018)
9. List the important features of an instrumentation amplifier.(May – 2019)
10. Explain how the average circuit can be derived from the summer.(May-2017)
11. Draw a sample and hold circuit.(Oct/Nov– 2016)
12. What are the applications of V-I and I-V converters?(Oct/Nov– 2017)
13. Show the standard representation of IC voltage regulator.(Mar- 2017)

Long Questions: (As per previous JNTUH papers)

1. How op-amp is used for comparator? Explain its working. (May-2018)
2. Draw the circuit diagram of instrumentation amplifier using 741 op - amp and explain its operation.(Oct/Nov-2018)
3. Explain the operation of a multiplying DAC and mention its applications.(May/June-2012)
4. Write about Instrumentation Amplifier with neat diagram (May/June-2012)
5. Explain how op-amp is used as differentiator with necessary equations. Draw the input and output waveforms by considering the sine wave as a input.(Nov/Dec– 2012)
6. Draw the Schmitt trigger circuit using OPAMP and explain its operation.(Nov/Dec– 2012)
7. Draw the circuit diagram of a two input non-inverting type summing amplifier and derive the expression for the output voltage.(Nov- 2007)
8. With neat circuit diagram explain the operation of Schmitt trigger.(Nov/Dec– 2016)
9. Explain the working of instrumentation amplifier with suitable diagram.(Nov/Dec – 2017)
10. With a neat diagram explain about the voltage to current converter in details.(May – 2019)
11. What is an integrator circuit? Discuss the relative advantages and disadvantages if IC'S over discrete assembly. How will you make a monolithic IC explain in detail?(May – 2019)
12. Explain the monostable multivibrator operation by using op amp(Oct/Nov – 2017)
13. Explain the operation of a sample and hold amplifier.(Oct/Nov – 2018)

Fill in the blanks/ Choose the best:

1. In hysteresis width, the hysteresis voltage is equal to _______ upper & lower threshold voltages (V_{UT} & V_{LT}). (B)
   (A) sum of (B) difference between (C) product of (D) division of
2. The Schmitt trigger is a two-state device that is used for: (A)
   (A) pulse shaping (B) peak detection (C) input noise rejection (D) filtering
3. Which circuit converts irregularly shaped waveform to regular shaped waveforms? (A)
   (A) Schmitt trigger (B) Voltage limiter (C) Comparator (D) None of the mentioned
4. The most commonly used amplifier in sample and hold circuit is …………… (B)
   (A) a unity gain non-inverting amplifier (B) a unity gain inverting amplifier
   (C) an inverting amplifier with a gain of 10 (D) an inverting amplifier with a gain of 100
5. In an OP-amp differentiator (A)
   (A)The amplitude of output is proportional to rate of change of input
   (B) The amplitude of output is proportional to input
   (C) Output occurs when input is finite and constant
   (D)Polarity of input and output is the same
6. Which of the following circuits constitute an oscillator? (B)
   (A) Bistable multivibrator (B) Astable multivibrator
   (C) Schmitt trigger (D) Monostable multivibrator

7. As the frequency increases, input impedance of differentiator __________. (B)
(A) Increases (B) Decreases (C) Remains constant (D) None of the above

8. In absence of any applied AC input signal, what would be the gain of an ideal integrator? (C)
(A) Zero (B) Unity (C) Infinity (D) Unpredictable

9. When a step input is given to an op-amp integrator, the output will be (A)
(A) a ramp (B) a sinusoidal wave
(C) a rectangular wave (D) a triangular wave with dc bias

10. Multivibrators are characterized by ____________ (D)
(A) Registers (B) Capacitors (C) Transistors (D)All of the Mentioned

11. What are the features of instrumentation amplifier? (D)
(A) Low noise (B) High gain accuracy
(C) Low thermal and time drift (D) All of the mentioned

12. What instrument is used to amplify output signal of transducer (B)
(A) Peaking amplifier (B) Instrumentation amplifier
(C) Differential amplifier (D) Bridge amplifier

13. General purpose op-amps are used in applications as (B)
(A) Instrumentation amplifier (B) Differential instrumentation amplifier
(C) Inverting instrumentation amplifier (D) Non-inverting instrumentation amplifier

14. Instrumentation Amplifier is extension of (D)
(A) Non-inverting Amplifier (B) inverting Amplifier
(C) Summing Amplifier (D) Difference Amplifier

Unit-3: ACTIVE FILTERS AND OSCILLATORS

Important Points /Definitions:

1. An electric filter is a frequency selective circuit that allows a specified band of frequencies and attenuates the frequencies outside this band.
2. Filters are classified in a number of ways: analog or digital, passive or active, audio or radio frequency.
3. The most commonly used filters are: a) Low-pass filter
   b) High-pass filter
   c) Band-pass filter
   d) Band-reject filter
   e) All-pass filter
4. Filter behavior is usually described by frequency response plot.
5. Low pass filters pass low frequencies and stop high frequencies. It has a constant gain from 0 Hz to a certain frequency called cutoff frequency (f_H), at which gain is down by 3 dB, above f_H, the gain decreases with an increase in frequency.
6. High pass filters pass high frequencies and stop low frequencies. It allows all frequencies above a certain frequency called the low cutoff frequency (f_L)
7. A Band pass filter has a pass band between the two cutoff frequencies f_H and f_L and all signals outside this pass band are stopped.
8. A Band reject filter also called as notch filter or band-stop or band-elimination filter, stops all frequencies between two cutoff frequencies f_H and f_L and all signals outside this pass band are passed.
9. All pass filter has input and output amplitudes equal at all frequencies, without attenuation, while providing predictable phase shifts for different frequencies of the input signal. All-pass filter also called as delay equalizers or phase correctors.
10. The order of filter indicates the rate at which the gain changes while the input frequency is approaching or exceeding the cutoff frequency of the filter.
11. A first order filter consists of a single RC network connected to the (+) terminal of a non-inverting op-amp amplifier and has a roll-off rate of -20dB/decade.
12. A second order filter consists of two RC pairs and has a roll-off rate of -40dB/decade.
13. Higher order filters are made by cascading first and second order filters.
14. An Oscillator is a type of feedback amplifier in which part of the output is fed back to the input via a feedback circuit.
15. Oscillators are used in radio, televisions, computers and communication.
16. The ability of an oscillator circuit to oscillate at one exact frequency is called frequency stability.
17. The two requirements for oscillation are:
    a) The magnitude of loop gain $|A\beta|$ must be at least one i.e, unity
    b) The total phase shift of the loop gain $A\beta$ must be equal to 0^0 or 360^0.

    This is called Barkhausen criteria.
18. There are different types of wave form generators : a) Square wave generator
    b) Triangular wave generator
    c) Saw tooth wave generator
19. Square wave generator is also called a Free running oscillator or Astable multivibrator. In square wave generator, square wave outputs are generated when the op-amp is forced to operate in the saturation region.

20. Triangular wave generator can be formed by simply connecting an integrator to the square wave generator.
21. The Triangular wave generator using a comparator and an integrator can be converted to obtain a Sawtooth waveform.
22. The difference between the triangular and sawtooth waveforms is that:
    a) rise time and fall time are equal in Triangular wave
    b) rise time and fall time are unequal Sawtooth wave
23. The Oscillator whose output frequency depends on the amplitude of the input voltage is called a voltage-controlled oscillator (VCO) or a voltage-to-frequency (V/F) converter. The VCO is used in phase-locked-loop circuits.

Short Questions: (As per previous JNTUH papers)

1. List out the applications of Wein Birdge Oscillator.(May/June-2012)
2. Compare active and passive filters.(May – 2018)
3. What is an all-pass filter? Mention some of its applications.(May – 2016)
4. Discuss in detail about band pass and band reject filters.(May – 2018)
5. Explain relationship between Q and bandwidth of a bandpass active filter(Oct/Nov– 2016)
6. What are the advantages of active filter over a passive filter?(Oct/Nov– 2016)
7. Design a first order LPF for Cut-off frequency 1KHz and pass band gain 2.(Oct/Nov– 2017)
8. Give the differences between Phase shift oscillator and Wein bridge oscillator?(Mar – 2017)
9. Discuss the principles of oscillations(Mar – 2017)

Long Questions: (As per previous JNTUH papers)

1. List the conditions for oscillation in all the three types of oscillators, namely, RC phase shift, Wien - bridge and quadrature oscillators(Nov-2007)
2. Design and explain the operation of All Pass Filter with its characteristics.(Mar– 2017)
3. With a neat diagram explain the band reject filter. Derive the expression for output voltage(May – 2019)
4. Classify the filters based on range of frequencies, frequency response, type of components used and type of input signal.(Oct/Nov– 2016)
5. Derive frequency of oscillations by using triangular wave generator.(Oct/ Nov – 2017)
6. Explain the operation of narrow band reject filter with characteristics.(Oct/Nov– 2017)
7. Explain the operation of Square wave generators along with circuit diagram.(Nov– 2015)
8. Explain Wein bridge oscillator with neat waveforms.(Mar-2017)

Fill in the blanks/ Choose the best:

1. An oscillator whose frequency can be controlled by an input "control voltage" is called a(n) (C)
   (A) PLL (B) Schmitt trigger (C) VCO (D) S-R latch
2. An oscillator produces oscillations due to (A)
   (A) Positive feedback (B) Negative feedback
   (C) Partly positive and partly negative (D) Neither positive nor negative
3. An oscillator circuit is mainly ..... converter (D)
   (A) A.C. to A.C. (B) D.C. to D.C. (C) A.C. to D.C. (D)D.C. to A.C.
4. In order to sustain oscillations in an oscillator (C)
   (A) Phase should be 0^0 (B) Feedback factor should be unity
   (C) Both (a) and (b) (D) Feedback should be negative

5. The oscillator that is mostly used for generating audio frequency signals is (A)

(A) Wein bridge (B) Tuned base (C) Tuned collector (D) RC phase shift

6. An electrical filter is a (B)

(A) Phase-selective circuit (B) Frequency-selective circuit

(C) Filter-selective circuit (D) None of the mentioned

7. What are the most commonly used active filters? (A)

(A) All of the mentioned (B) Low pass and High pass filters

(C) Band pass and Band reject filters (D)All-pass filters

8. Choose the op-amp that improves the filter performance. (B)

(A) µA741 (B) LM318 (C) LM101A (D)MC34001

Unit-4: TIMERS & PHASE LOCKED LOOPS

Important Points /Definitions:

1. 555 IC Timer can produce very accurate and stable time delays, from microseconds to hours.
2. Timer is available in two packages: circular can and DIP. It can be used in Monostable or Astable mode of operation.
3. The various applications of Timer are: a) waveform generator
   b) missing pulse detector
   c) frequency divider
   d) pulse width modulator
   e) burgular alarm
   f) FSK generator
   g) ramp generator
   h) pulse position modulator etc.
4. Phase locked loop is an important building block of linear systems. PLL basically consists of :
   a) a phase detector
   b) low pas filter
   c) amplifier and
   d) a VCO in feedback loop
5. The important characteristics of PLL are: a) Lock-in range b) capture range pull-in-time
6. The lock range is usually greater than the capture range. The capture range depends upon the Low pass filter characteristics.
7. The phase detector is basically a multiplier. The Phase detectors are of two types: a) analog and b) digital.
8. The low pass filter may be passive or active type. The low pass filter controls the capture range and lock range of PLL.
9. The frequency of VCO can be set by an external capacitor and resistor. The output frequency f_o of VCO is compared with the incoming signal f_s. When $f_o=f_s$, the PLL is said to be locked.
10. The PLLs are used as : a) frequency multiplier
    b) divider
    c) AM and FM demodulator
    d) FSK demodulator etc.
11. The range of frequencies over which PLL can maintain lock with input signal is called the Lock range.
12. The range of frequencies over which PLL can acquire lock is called the Capture range.
13. The lock range is always greater than the Capture range.
14. The variation from center frequency f_0 of VCO is called the Tracking range. It is half of the Lock range.

$$f_0=1.2/4R_1C_1$$

Short Questions: (As per previous JNTUH papers)

1. What are the applications of PLL? Explain any one of it in detail.(May/June-2013)
2. List various applications of IC 555 Timer.(Nov– 2015)
3. Draw the block diagram for PLL and explain in detail.(Nov– 2015)
4. List the application of 565 PLL.(Nov/Dec– 2017)
5. Why is capture range always smaller than the lock in range? Explain.(Nov/Dec– 2018)
6. Define capture range and lock in range of a PLL.(May – 2016)

7. Illustrate the pin configuration of 555 timer IC mentioning the name of each pin.(Oct/Nov– 2016)
8. Draw a pin configuration for 555 IC Timer.(Oct/Nov – 2017)
9. Define lock range, capture range and pull-in-time.(Oct/Nov– 2018)
10. Mention any two applications of 555 Timer in Mono stable mode. (Mar – 2017)

Long Questions: (As per previous JNTUH papers)

1. Draw the block diagram of a 565 PLL and explain its salient features. Derive the expression for capture range.(Nov/Dec– 2012)
2. Explain the operation of the PLL with the help of the block diagram.(Nov/Dec– 2012)
3. Explain an application in which the 555 timer can be used as Astable multivibrator.(Nov- 2007)
4. Explain with neat diagram how 555 timers can be used as a Schmitt trigger(Nov-2007)
5. Draw the circuit of an Astable multivibrator using 555 IC Timer and derive the expression for its frequency of oscillations.(Nov/Dec– 2018)
6. With a clear block diagram explain frequency multiplier using PLL.(Oct/Nov – 2016)
7. What is VCO ,draw and explain the functional block diagram of VCO(Oct/Nov– 2017)
8. Describe PLL with block diagram. Also discuss applications of PLL in phase detector and voltage controlled oscillator.(Oct/Nov – 2018)
9. Draw and Explain the principles and description of individual blocks of PLL in detail.(Nov– 2015)
10. Draw the circuit diagram of Monostable multivibrator by using IC 555 timer and explain its operation. (Nov – 2015)

Fill in the blanks/ Choose the best:

1. Which of the following applications include a phase-locked loop (PLL) circuit? (D)
(A) Modems (B) Am decoders (C) Tracking filters (D) All of the above
2. How many Vcc connections does the 565 PLL use? (C)
(A) 0 (B) 1 (C) 2 (D) 3
3. In a PLL, to obtain lock, the signal frequency must: (C)
(A) come within the lock range (B) be less than the capture frequency
(C) come within the capture range (D) be greater than the capture frequency
4. A PLL can be used as a(n)___. (B)
(A) series voltage regulator (B) frequency multiplier
(C) relaxation oscillator (D) Schmitt trigger
5. A monostable 555 timer has the following number of stable states: (B)
(A) 0 (B) 1 (C) 2 (D) 3
6. A PLL can be used as a(n)____________. (B)
(A) series voltage regulator (B) frequency multiplier
(C) relaxation oscillator (D) Schmitt trigger
7. To obtain a 50% duty cycle in an astable 555 timer circuit: (A)
(A) tLO = tHI
(B) RA = RB and short RB with a diode during the capacitor charging cycle (C)
capacitor voltage must rise above 1/3 VCC
(D) tLO = tHI, RA = RB, and short RB with a diode during the capacitor charging cycle
8. A________is not a multivibrator. (A)
(A) one-shot (B)flip-flop (C) VCO (D) bistable

9. The 555 timer can be connected to operate a(n)____________. (D)

(A) astable multivibrator (B) bistable multivibrator

(C) monostable multivibrator (D) (A) and (C)

10. What controls the output pulse width of a one shot? (D)

(A) the clock frequency (B) the width of the clock pulse

(C) an RL time constant (D) an RC time constant

Unit-5: D-A AND A-D CONVERTERS

Important Points /Definitions:

1. The Analog-to-Digital (A/D) converter changes an analog input into a digital output i.e, binary output (zeros and ones).
2. The Digital-to-Analog (D/A) converter changes a digital input into an analog output.
3. D/A converters (DACs) are used when
   a) The variation of the quantity with time is large or when a wide bandwidth is required b) low precision is required
4. A/D converters (ADCs) are used when
   a) High precision is required
   b) The physical quantity being measured varies slowly.
5. The D/A converter can be formed by using an op-amp and either binary-weighted resistors or an R and 2R ladder network
6. The three resistive techniques for D/A conversion are: a) Weighted resistor DAC converter
   b) R-2R ladder DAC converter
   c) inverter R-2R ladder DAC converter
7. A Weighted resistor DAC requires a wide range of resistor values for better resolution whereas a R-2R ladder type DAC requires only two values of resistors
8. In an inverted R-2R ladder, the current through the resistors remains constant, irrespective of the input data. The constant node voltages therefore eliminate stray capacitance effect and improve circuit performance.
9. A/D converters are either direct type or indirect type. Most direct type ADCs require a D/A converter.
10. The important direct ADC techniques are: a) Parallel comparator (Flash) A/D converter
    b) Counting type converter
    c) Servo Tracking type converter
    d) Successive approximation technique
11. Integrating type ADCs perform conversion in an indirect manner. The two important converters are:
    a) Charge balancing ADC
    b) Dual slope ADC
12. The important converter characteristics are: a) Resolution
    b) Linearity
    c) Accuracy
    d) Monotonicity
    e) Settling time
    f) Stability etc
13. 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) = $V_{FS} / 2^n-1$ = 1 LSB increment
14. The Linearity of an A/D or D/A converter is an important measure of its accuracy and tells us how close the converter output is to its ideal transfer characteristics.
15. Absolute Accuracy is the maximum deviation between the actual converter output and the ideal converter output
16. Relative Accuracy is the maximum deviation after gain and offset errors have been removed.
17. A Monotonic DAC is the one whose analog output increases for an increase in digital input.

18. Settling time represents the time it takes for the output to settle within a specified band ± (1/2) LSB of its final value following a code change at the input.
19. The performance of converter changes with temperature, age and power supply variations. So all the relevant parameters such as offset, gain, linearity error and monotonicity must be specified over the full temperature and power supply ranges.

Short Questions: (As per previous JNTUH papers)

1. Define the following terms as related to DAC: i. Linearity ii. Resolution (May/June-2012)
2. Write short notes on A/D converters.(Nov-2007)
3. List out different types of A/D converters(Mar – 2017)
4. What are the limitations of weighted resistor type D/A converter? (Nov/Dec– 2016)
5. What do you mean by quantization error in an A/D converter?(Nov/Dec– 2016)
6. List different ADC and DACs.(Nov/Dec– 2017)
7. Define Resolution. Give its importance in data converters.(May/June – 2019)
8. What are the disadvantages and advantages of weighted resister DAC?(Nov/Dec– 2018)
9. What are the different techniques for DAC?(Oct/Nov– 2017)
10. Define conversation time and settling time in ADC and DAC.(Oct/Nov– 2017)
11. Draw the circuit of R-2R ladder DAC.(Oct/Nov– 2018)
12. Define the terms Linearity and accuracy of A/D convertors.(Nov– 2015)

Long Questions: (As per previous JNTUH papers)

1. Discuss about successive approximation converter with necessary diagrams. (May/June-2013)
2. Explain about ladder type DAC with neat diagram. (May/June-2013)
3. Explain the working of the weighted resistor digital to analog converter and state the features. (Nov/Dec- 2012)
4. Draw the schematic block diagram of Dual-slope A/D converter and explain its operation. Derive expression for its output voltage Vo.(Mar– 2017)
5. With a neat diagram explain about the counter type A/D converter in detail.(May – 2019)
6. Give short notes on successive approximation ADC.(Oct/Nov– 2017)
7. What are the draw backs of weighted resistor DAC? How they can be overcome by using R-2R ladder DAC(Oct/Nov– 2017)
8. Draw the circuit diagram of dual slope ADC and explain its operation.(Oct/Nov – 2017)
9. Explain the operation of R-2R ladder D/A converter with neat diagrams. (Mar – 2017)

Fill in the blanks/ Choose the best:

1. In DAC, resolution increases with the _________ in number of bits. (A)
   (A) Increase (B) Decrease (C) Constant (D) None of the above
2. The inverted R-2R ladder can also be operated in (B)
   (A) Inverted mode (B) Current Mode (C) Voltage mode (D) Non inverted mode
3. Dynamic range of ADC is depended on _______________ (D)
   (A) Resolution (B) Linearity
   (C) Accuracy (D) All of the mentioned
4. Which of the slope intervals of the integrator does the counter in the analog-to-digital converter (ADC) operate? (C)
   (A) Positive (B) Negative
   (C) Both positive and negative (D) Neither positive nor negative

5. In ADCs, it is possible to reduce the quantization error by _______the number of bits. (A)

(A) Increasing (B) Decreasing

(C) Maintaining consistency in (D) All of the above

6. What is the main function of (A/D) or ADC converter? (B)

(A) Converts Digital to Analog Signal (B) Converts Analog to Digital signal

(C) All of the mentioned (D) None of the mentioned

7. The time required to complete the conversion of Analog to Digital is ________ the duration of the hold mode of S/H. (C)

(A) Greater than (B) Equals to (C) Less than (D) Greater than or Equals to

8. What is (are) the input(s) to the comparator in the ladder-network conversion of an ADC? (C)

(A)Staircase voltage (B)Analog input voltage

(C)Both staircase and analog input voltage (D)None of the above

9. For a 10-bit DAC, the Resolution is defined by which of the following (B)

(A) 1024 (B) 1/1024 (C) 10 (D) None

10. What is the resolution of a digital-to-analog converter (DAC)? (C)

(A) It is the comparison between the actual output of the converter and its expected output.

(B) It is the deviation between the ideal straight-line output and the actual output of the converter.

(C) It is the smallest analog output change that can occur as a result of an increment in the digital input.

(D) It is its ability to resolve between forward and reverse steps when sequenced over its entire range