

**UNIT III : APPLICATIONS OF OP – AMPS****2 Marks Questions:****1.Mention some of the linear applications of op – amps :**

Adder, subtractor, voltage –to- current converter, current –to- voltage converters, instrumentation amplifier, analog computation ,power amplifier, etc are some of the linear op-amp circuits.

**2.Mention some of the non – linear applications of op-amps:-**

Rectifier, peak detector, clipper, clamper, sample and hold circuit, log amplifier, anti –log amplifier, multiplier are some of the non – linear op-amp circuits.

**3.What are the areas of application of non-linear op- amp circuits?**

- ”” industrial instrumentation
- ”” Communication
- ”” Signal processing

**4.What is the need for an instrumentation amplifier?**

In a number of industrial and consumer applications, the measurement of physical quantities is usually done with the help of transducers. The output of transducer has to be amplified So that it can drive the indicator or display system. This function is performed by an instrumentation amplifier.

**5.List the features of instrumentation amplifier:**

- ”” high gain accuracy
- ”” high CMRR
- ”” high gain stability with low temperature co-efficient
- ”” low dc offset
- ”” low output impedance

**6.What are the applications of V-I converter?**

- ”” Low voltage dc and ac voltmeter
- ”” L E D
- ”” Zener diode tester

**7. What do you mean by a precision diode?**

The major limitation of ordinary diode is that it cannot rectify voltages below the cut – in voltage of the diode. A circuit designed by placing a diode in the feedback loop of an op – amp is called the precision diode and it is capable of rectifying input signals of the order of millivolt.

**8. Write down the applications of precision diode.**

- ”” Half - wave rectifier
- ”” Full - Wave rectifier
- ”” Peak – value detector
- ”” Clipper
- ”” Clamper

**9. List the applications of Log amplifiers:**

- ”” Analog computation may require functions such as  $\ln x$ ,  $\log x$ ,  $\sin hx$  etc. These functions can be performed by log amplifiers
- ”” Log amplifier can perform direct dB display on digital voltmeter and spectrum analyzer
- ”” Log amplifier can be used to compress the dynamic range of a signal

**10. What are the limitations of the basic differentiator circuit?**

- ”” At high frequency, a differentiator may become unstable and break into oscillations
- ”” The input impedance decreases with increase in frequency, thereby making the circuit sensitive to high frequency noise.

**11. Write down the condition for good differentiation :-**

For good differentiation, the time period of the input signal must be greater than or equal to  $R_f C_f$

$$T \geq R_f C_f$$

Where,  $R_f$  is the feedback resistance

$C_f$  is the input capacitance

**12. What is a comparator?**

A comparator is a circuit which compares a signal voltage applied at one input of an op-amp with a known reference voltage at the other input. It is an open loop op - amp with output  $\pm V_{sat}$  .

**13.What are the applications of comparator?**

- ”” Zero crossing detector
- ”” Window detector
- ”” Time marker generator
- ”” Phase detector

**14.What is a Schmitt trigger?**

Schmitt trigger is a regenerative comparator. It converts sinusoidal input into a square wave output. The output of Schmitt trigger swings between upper and lower threshold voltages, which are the reference voltages of the input waveform.

**15.What is a multivibrator?**

Multivibrators are a group of regenerative circuits that are used extensively in timing applications. It is a wave shaping circuit which gives symmetric or asymmetric square output. It has two states either stable or quasi- stable depending on the type of multivibrator.

**16.What do you mean by monostable multivibrator?**

Monostable multivibrator is one which generates a single pulse of specified duration in response to each external trigger signal. It has only one stable state. Application of a trigger causes a change to the quasi-stable state.An external trigger signal generated due to charging and discharging of the capacitor produces the transition to the original stable state.

**17.What is an astable multivibrator?**

Astable multivibrator is a free running oscillator having two quasi-stable states. Thus, there is oscillations between these two states and no external signal are required to produce the change in state.

**18.What is a bistable multivibrator?**

Bistable multivibrator is one that maintains a given output voltage level unless an external trigger is applied . Application of an external trigger signal causes a

change of state, and this output level is maintained indefinitely until a second trigger is applied. Thus, it requires two external triggers before it returns to its initial state

**19. What are the requirements for producing sustained oscillations in feedback circuits?**

For sustained oscillations,

- ”” The total phase shift around the loop must be zero at the desired frequency of oscillation, i.e.,  $\angle A\beta = 0^\circ$
- ”” At  $f_o$ , the magnitude of the loop gain  $|A\beta|$  should be equal to unity

**20. Mention any two audio frequency oscillators :**

- ”” RC phase shift oscillator
- ”” Wein bridge oscillator

**21. What are the characteristics of a comparator?**

- ”” Speed of operation
- ”” Accuracy
- ”” Compatibility of the output

**22. What is a filter?**

Filter is a frequency selective circuit that passes signal of specified band of frequencies and attenuates the signals of frequencies outside the band

**23. What are the demerits of passive filters?**

Passive filters work well for high frequencies. But at audio frequencies, the inductors become problematic, as they become large, heavy and expensive. For low frequency applications, more number of turns of wire must be used which in turn adds to the series resistance degrading inductor's performance i.e., low Q, resulting in high power dissipation.

**24. What are the advantages of active filters?**

Active filters use op-amp as the active element and resistors and capacitors as passive elements.

- ”” By enclosing a capacitor in the feedback loop, inductorless active filters can be obtained

- ” Op-amp used in non – inverting configuration offers high input impedance and low output impedance, thus improving the load drive capacity.

**25. Mention some commonly used active filters :**

- ” Low pass filter
- ” High pass filter
- ” Band pass filter
- ” Band reject filter.

**16 marks questions:**

**1. Discuss the need for an instrumentation amplifier? Give a detailed analysis for the same.**

**Ans:**

In a number of industrial and consumer applications, the measurement of physical quantities is usually done with the help of transducers. The output of transducer has to be amplified so that it can drive the indicator or display system. This function is performed by an instrumentation amplifier.

Circuit diagram, instrumentation amplifier with transducer bridge,  
Analysis, Expression for output voltage.

**2. Explain the operation of the Schmitt trigger.**

**Ans:**

Schmitt trigger is a regenerative comparator. It converts sinusoidal input into a square wave output. The output of Schmitt trigger swings between upper and lower threshold voltages, which are the reference voltages of the input waveform.

Circuit diagram, Analysis.

Expression for upper and lower threshold voltages with and without  $V_{ref}$ .

Hysteresis width.

Waveforms.

**3. Discuss in detail the operation of Astable multivibrator.**

**Ans:**

Astable multivibrator is a free running oscillator having two quasi-stable states. Thus, there is oscillations between these two states and no external signal are required to produce the change in state.

Circuit diagram, Analysis.

Expression for time period ,  $T = 5RC \ln \left( \frac{V_D}{V_{sat}} \right) / (1 - \frac{V_D}{V_{sat}})$

Waveforms.

Circuit for asymmetric square wave generator.

#### 4. Discuss in detail the operation of Monostable multivibrator.

**Ans:**

Monostable multivibrator is one which generates a single pulse of specified duration in response to each external trigger signal. It has only one stable state. Application of a trigger causes a change to the quasi-stable state. An external trigger signal generated due to charging and discharging of the capacitor produces the transition to the original stable state.

Circuit diagram, Analysis.

Expression for time period ,  $T = RC \ln \left( \frac{1 + V_D / V_{sat}}{1 - \frac{V_D}{V_{sat}}} \right)$

Waveforms.

#### 5. What are the requirements for producing sustained oscillations in feedback circuits? Discuss any two audio frequency oscillators.

**Ans:**

For sustained oscillations,

- ”” The total phase shift around the loop must be zero at the desired frequency of oscillation, fo. ie,  $\angle \beta A = 0^\circ$
- ”” At fo, the magnitude of the loop gain  $| \beta A |$  should be equal to unity.

**RC phase shift oscillator:** Circuit diagram, Derive the condition for frequency of oscillation.

$$\text{Gain, } A_v \geq -29$$

**Wein bridge oscillator :** Circuit diagram, Derive the condition for frequency of oscillation.

$$\text{Gain, } A_v = 3$$

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