SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

Coimbatore-35

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

19ECB204 – LINEAR AND DIGITAL CIRCUITS

UNIT II –COMPARATORS AND SPECIAL FUNCTION ICs

2 MARKS

1.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 + Vsat .

2. Give some applications of Comparator.

a. Zero crossing detector b. Window detector
c. Time marker generator d. Phase detector

3.What are the characteristics of a comparator?

1.Speed of operation
2.Accuracy
3.Compatibility of the output

4. What is a window detector?

A device, usually consisting of a pair of voltage comparators, in which output indicates whether the measured signal is within the voltage range bounded by two different thresholds (an "upper" threshold and a "lower" threshold).

5. List the types of comparators.

Inverting comparator
Non-inverting comparator

6. Differentiate Schmitt trigger and comparator

S.No	Comparator	Schmitt trigger
1.	Feedback is not used that is Op-amp is used in open loop mode	Feedback is used that is Op-amp is used in closed loop mode
2.	False triggering due to noise voltages is possible.	False triggering due to noise voltages is not possible.
3.	A single reference voltage exists which acts as triggering voltage.i.e. V_{ref} or $-V_{ref}$	Two different threshold voltages exists as V_{UT} and V_{LT}
4.	The hysteresis exists with a width $H=V_{UT} - V_{LT}$	The hysteresis does not exists

7. What is a zero crossing detector?
Zero crossing detector is defined as the basic inverting and non-inverting compactor act as a zero crossing detector provider that Vref is set to zero. This circuit is also called as sine wave to square wave generator.

8. What are the operating modes of a 555 timer?
a. Monostable mode
b. Astable mode

9. List out the applications of 555 timer?
a. Oscillator
b. pulse generator
c. ramp and square wave generator d. mono-shot multivibrator
e. burglar alarm
f. traffic light control.

10. Define sink current and source current?
Sink current: When the output is low, the load current that flows through the load connected between Vcc and o/p terminal is called sink current.
Source current: When the output is high, the load current that flows through the load connected between ground and o/p terminal is called source current.

11. Define normally ON load and normally OFF load?
Normally ON load: The load connected between VCC and output terminal. Normally OFF load: The load connected between output terminal and ground.

12. What is the use of reset pin of 555 timer?
This is an interrupt for the timing device when pin 4 is grounded, it stops the working of device and makes it off.

13. What is the purpose of control voltage pin (5) of 555 timer?
This pin is the inverting input terminal of comparator. This is reference level for comparator with which threshold is compared. If reference level is other than 2/3 VCC, then external input is to be given to pin 5. Pulse width modulation is possible due to pin 5.

14. List out the major blocks of 555 timer functional diagram?
The IC 555 timer combines the following elements.
1) A relaxation oscillator
2) RS flip-flop
3) Two comparators
4) Discharge transistor

15. Define duty cycle?
It is defined as the ratio of on time to the total time of one cycle. D = W/ T
W – time for output is high = TON
T – total time of one cycle.

16. Write the expression for pulse width of 555 timer in monostable mode?
Pulse width W = 1.1 RC seconds
R – resistor in ohms, C – capacitor in farads

17. Write the expression for total time period of 555 timer in astable mode?
T = 0.693 (RA + 2 RB) C seconds

18. What is the frequency of oscillation of free running mode of 555 timer?
F = 1.44/ (RA + 2 RB) C Hz

19. List out the applications of 555 timer in astable mode.
a. missing pulse detector b. Linear ramp generator c. Frequency divider
d. Pulse width modulation.

20. List out the applications of 555 timer in Astable mode.
a. FSK generator
b. Pulse-position modulator

21.Mention the applications of the monostable mode of operation of 555 IC.
The applications of the monostable mode of operation of 555 IC are:
1. Missing pulse detector,
2. Linear ramp generator,
3. Frequency divider and
4. In pulse width modulation.

22. Mention the main applications of missing pulse detector monostable circuit.
The main applications of missing pulse detector monostable circuit are:
1. It is used to detect missing heart beat and
2. It is used for speed control and measurement.

23. Define voltage regulators and give the types?
A voltage regulator is an electronic circuit that provides a stable dc voltage independent of the load current, temperature, and ac line voltage variations.
The classification of voltage regulators:
*Series / Linear regulators
*Switching regulators.

24. What do you mean by linear voltage regulators?

Series or linear regulator uses a power transistor connected in series between the unregulated dc input and the load and it conducts in the linear region .The output voltage is controlled by the continuous voltage drop taking place across the series pass transistor.

25. Define switched voltage regulators?

Switching regulators are those which operate the power transistor as a high frequency on/off switch, so that the power transistor does not conduct current continuously. This gives improved efficiency over series regulators.

26. What are the advantages of adjustable voltage regulators over the fixed voltage regulators?

i) Improved line and load regulation by a factor of 10 or more.
ii) Because of the improved overload protection, greater load current can be drawn.
iii) Improved reliability.

27. List out the parameters related to the fixed voltage regulators?

1) Line regulation
2) Load regulation
3) Ripple rejection
4) Output impedance
5) Maximum power dissipation
6) Rated output current

28. Define dropout voltage of a fixed voltage regulator?

It is the minimum voltage that must exist between input and output terminals. For most of regulators, it is 2 to 3 volts.

29.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 mill volt.

30.Write down the applications of precision diode.

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

31. 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.

32.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.

33.List the broad classification of ADCs.

1. Direct type ADC. 2. Integrating type ADC.

34. List out the direct type ADCs.

1. Flash (comparator) type converter
2. Counter type converter
3. Tracking or servo converter
4. Successive approximation type converter

35.List out some integrating type converters.

1. Charge balancing ADC 2. Dual slope ADC

36.What is integrating type converter?

An ADC converter that perform conversion in an indirect manner by first changing the analog I/P signal to a linear function of time or frequency and then to a digital code is known as integrating type A/D converter.

37. Explain in brief the principle of operation of successive Approximation ADC.

The circuit of successive approximation ADC consists of a successive approximation register (SAR), to find the required value of each bit by trial & error.With the arrival of START command, SAR sets the MSB bit to 1. The O/P is converted into an analog signal & it is compared with I/P signal. This O/P is low or High. This process continues until all bits are checked.

38. What are the main advantages of integrating type ADCs?

i. The integrating type of ADC's do not need a sample/Hold circuit at the input.

ii. It is possible to transmit frequency even in noisy environment or in an isolated form.

39. Where are the successive approximation type ADC's used?

The Successive approximation ADCs are used in applications such as data loggers & instrumentation where conversion speed is important.

40. Write down the condition for good differentiation .

- For good differentiation, the time period of the input signal must be greater than or equal to Rf C1
- T > R f C1 Where, Rf is the feedback resistance

41.Define slew rate.

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.

42. How many resistors are required in a 12-bit weighted resistor DAC?

For 12 bit DAC the resistor required are 2^0R, 2^1R, 2^2R….2^nR. The largest resistor is 2048

times the smallest one for only 12bit DAC.

13 resistors are required.
12Connected with switches
1 is connected as feedback resistor.

43. List different parameters of the D/A and A/D converter given by the manufacturers.

The parameters of the D/A and A/D converters are
i. Resolution
ii. Accuracy
iii. Monotonicity
iv. Conversion time and settling time
v. Stability
vi. Quantization error

44. Define resolution and accuracy of a DAC.

Resolution

It is the number of different analog output values that can be provided by a DAC.
For an n-bit DAC

Resolution=2n

Resolution is also defined as the ratio o a change in output resulting from a change of 1 LSB at the digital inputs. For an n-bit DAC it can be given as

Resolution (in volts) = VFS/2n-1

Accuracy:

It is the maximum deviation between the actual converter output & the ideal converter output.

Relative accuracy:

It is the maximum deviation after gain & offset errors have been removed. The accuracy of a converter is also specified in form of LSB increments or % of full scale voltage.

45. Draw the circuit of a positive clipper.

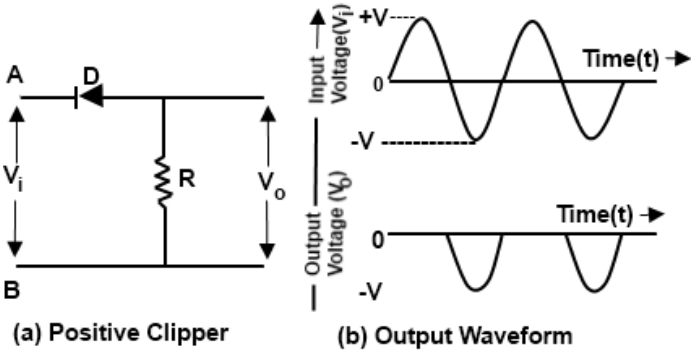

Figure 1:Series Positive Clipper

46. An 8 bit DAC has a resolution of 20mV/bit. what is the analog output voltage for the digital input code 00010110(the MSB is the left most bit)?

The output voltage for input 00010110 is

$=20(0X2^8+0X2^7+0X2^6+1X2^5+0X2^4+1X2^3+1X2^2+0X2^1)$
$=20X44$
$=880mV$

47.What is settling time?

Settling time is the time taken for the output to settle within a specified band + (1/2) LSB of its final value following a code change at the input. It ranges from 100 ns to 10 μs depending on word length and type of circuit used.