Solution

Subject : Electronics Engineering Subject Code : KOE038

B.Tech. 3rd SEMESTER

FIRST SESSIONAL EXAMINATION, ODD SEMESTER, (2019-2020)

Branch : Computer Science & Engineering, Electrical Engineering

SECTION - A

Ans 1 a) infinite open-loop gain

- Infinite input impedance R_{in}, and so zero input current.
- Zero input offset voltage.
- Infinite output voltage range.
- Infinite bandwidth with zero phase shift
- infinite slew rate. Zero output impedance R. CMRR infinite

Virtual ground condition $V_1 = V_2$

Ans 1 b) Expression for dynamic resistance of diode

$$I = I_0 \left(e^{V/\eta V_T} - 1\right)$$

$$\frac{dI}{dV} = I_0 \left[\frac{1}{\eta V_T} \cdot e^{V/\eta V_T}\right]$$

$$\frac{dI}{dV} = \frac{I_0 e^{V/\eta V_T}}{\eta V_T}$$

$$\boxed{r = \frac{1}{\left[\frac{dI}{dV}\right]} = \frac{\eta V_T}{I_0 e^{V/\eta V_T}}}$$

Ans 1 C

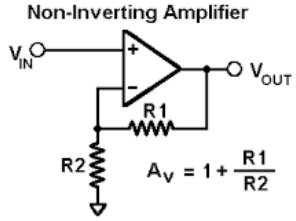
SN	Digital Storage Oscilloscope (DSO)	Analog Oscilloscope
1.	It can store the given signal indefinitely as long as the small amount of power is supplied to the memory.	In this oscilloscope, heavy amount of power is to be supplied to the storage CRT.
2.	It has higher operating speed than analog oscilloscope	It has high operating speed that DSO
3.	It has higher resolution than analog oscilloscope	It has lower resolution that DSO.
4.	Because of aliasing effect, the useful storage bandwidth is limited.	It does not have aliasing effect.

Ans 1 D

Lissajous pattern, which is displayed on the screen, when sinusoidal signals are applied to both horizontal & vertical deflection plates of CRO.

Lissajous patterns may be used for accurate measurement of frequency.

Ans 1 E



Min gain 1, Max gain 101

SECTION - B

Answer 2 a)

The block diagram of a typical OP-AMP is shown in Fig.

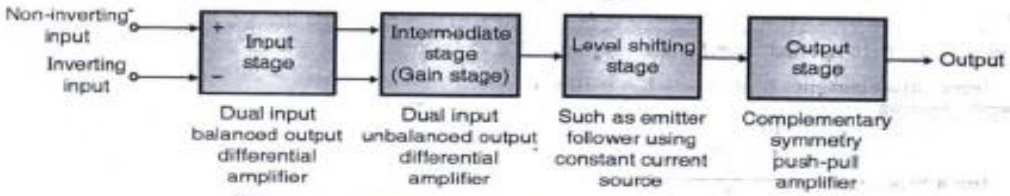


Fig. Block diagram of a typical OP-AMP

The OP-AMP is basically a differential amplifier i.e. it will amplify the voltage which is differentially present between its input terminals.

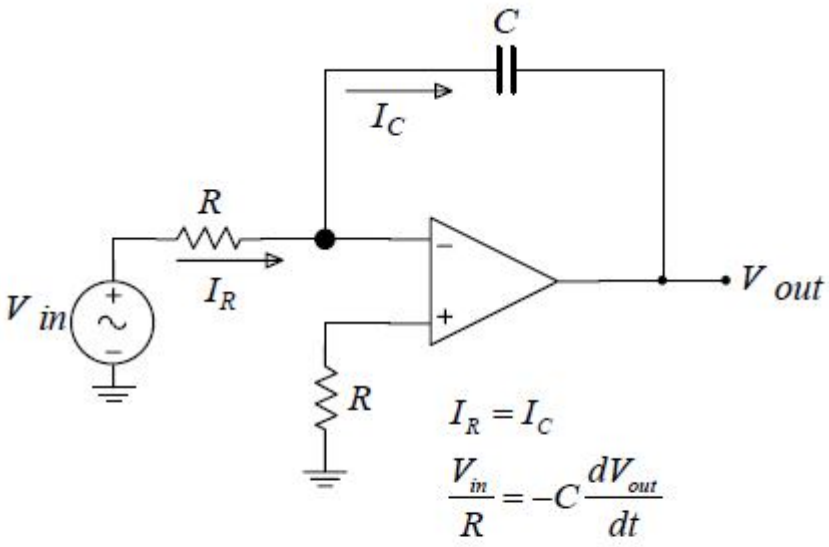
Input stage : The input stage is a dual-input, balanced output differential amplifier. The two inputs are inverting and non-inverting input terminals. This stage provides most of the **voltage gain** of the OP-AMP and decides the input resistance value R_i.

Intermediate stage : This is usually another differential amplifier. It is driven by the output of the input stage. This stage is a dual-input unbalanced output (single ended output) differential amplifier.

Level shifting stage : Due to the direct coupling between the first two stages, the input of level shifting stage is an amplified signal with some non-zero dc level. Level shifting stage is **used to bring this dc level to zero volts with respect to ground.**

Output stage : This stage is normally a complementary output stage. It **increases the magnitude of voltage and raises the current supplying capability of the OP-AMP**. It also provides a **low output resistance**.

Answer 2 b)

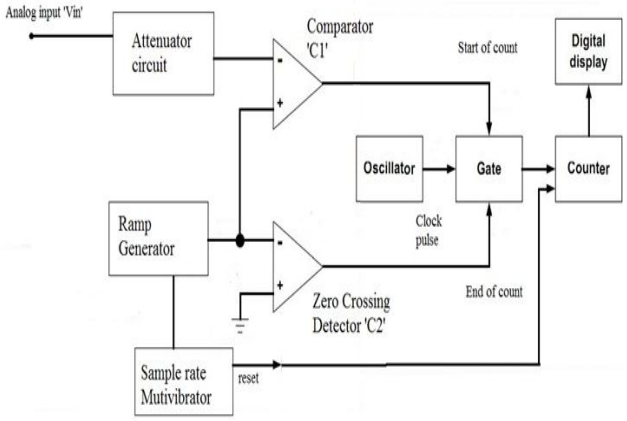


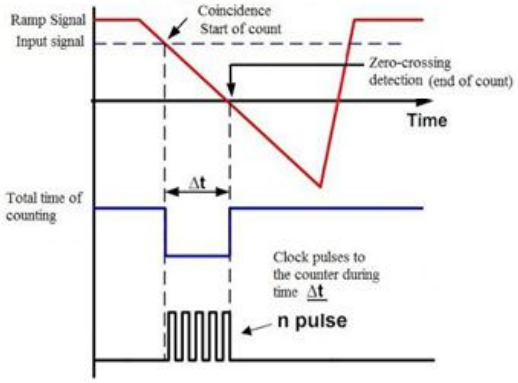
Rearranging Equation and integrating from 0 to t, we obtain

$$\int dV_{out} = -\int \frac{V_{in}(t)}{RC} dt \quad \Rightarrow \quad V_{out}(t) = -\frac{1}{RC}\int_0^t V_{in}(t)dt .$$

Answer 2 c)

Functional Block Diagram : Several techniques are utilized to obtain the voltage to time conversion and the respective DVMs are named accordingly as the ramp type, integrating type, continuous balance type, and successive approximation type.





Principle: Input voltage is converted into digital equivalent by counting the time taken for the ramp wave to decrease from the magnitude of input voltage to 0V.

Operation

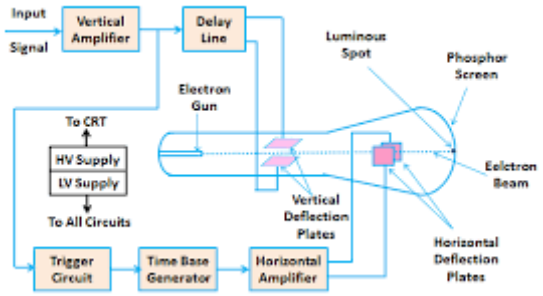
- Initially, the attenuated signal is compared with a negative going ramp signal generated by the ramp generator.
- When the ramp voltage coincides with the input signal, the output of 'C1' becomes low. This point is called coincidence point. This initiates the counting process (start of count).
- The counter continues to count until the ramp voltage reduces and crosses zero (0V). This is detected by zero crossing detector 'C2'. The output of 'C2' becomes high which ends the counting process (end of count).

Merits 1) low cost, 2) simple, easy to design, 3) long distance transmission of output pulse is possible

Demerits: 1) accuracy of output greatly depends on linearity of the ramp.(since only one ramp is used).

2) input filter are needed for filtering noise from input signal.

Answer 2 d)



The Cathode Ray Tube • The CRT is composed of two main parts,

1. Electron Gun 2. Deflection System •

Electron Gun – Electron gun provides a sharply focused electron beam directed toward the fluorescent-coated screen.

– The thermally heated cathode emits electrons in many directions. The control grid provides an axial direction for the electron beam and controls the number and speed of electrons in the beam.

– The momentum of the electrons determines the intensity, or brightness, of the light emitted from the fluorescent coating due to the electron bombardment. Because electrons are negatively charged, a repulsion force is created by applying a negative voltage to the control grid, to adjust their number and speed.

Vertical Amplifier: The input signals are generally not strong to provide the measurable deflection on the screen. Hence the vertical amplifier. stage is used Jo amplify the input signals. The amplifier stages used are generally wide band amplifiers so as to pass faithfully the entire band of frequencies to be measured. Similarly it contains the attenuator stages as well. The attenuators are used when very high voltage signals are to be examined, to bring the signals within the proper range of operation.

Delay line: The delay line is used to delay the signal for some time in the verticClI sections. When the delay line is not used, the part of the signal gets lost. Thus the input signal is not applied directly to the vertical plates but is delClyed bv some time using a delay line circuit.

Trigger circuit: It is necessary that horizontal deflection starts at the same point of the input vertical signal, each time it sweeps. Hence to synchronize horizontal deflection with vertical deflection a synchronizing or

triggering circuit is used. It converts the incoming signal into the triggering pulses, which are used for the synchronization.

Time base generator: The time base generator is used to generate the sawtooth voltage, required to deflect the beam in the horizontal section. This voltage deflects the spot at a constant time dependent rate. Thus the x-axis' on the screen can be represented as time, which, helps to display and analyse the time varying signals.

SECTION – C

Ans 3 a)

$V_o = -V_a + 6V_b + 9V_C$

$V_o = -[V_a - 6V_b - 9V_C]$ — ①

The equation of summing amplifier is

$V_o = -\left[\frac{R_f}{R_1}V_1 + \frac{R_f}{R_2}V_2 + \frac{R_f}{R_3}V_3\right]$ — ②

Comparing equation ① and ②

$\frac{R_f}{R_1} = 1$ ie $R_1 = R_f$

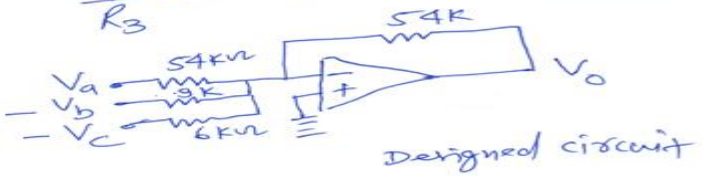
$R_1 = 54K$

$\frac{R_f}{R_2} = 6$

$6R_2 = 54$

$R_2 = 9K$

$\frac{R_f}{R_3} = -9$ or $R_3 = 6K$



Designed circuit

Ans 3 b) From the given circuit assume the output of buffer amp is V_{O1},

$V_{o1} = 5V$, $\frac{V_2}{V_{o1}} = -\frac{R_f}{R_{in}}$

$V_2 = -\frac{100K\Omega}{10K\Omega} \times 5V$

$V_2 = -50V$

$\frac{V_3}{V_{o1}} = 1 + \frac{R_f}{R_{in}}$

$V_3 = \left(1 + \frac{R_f}{R_{in}}\right) \times V_{o1}$

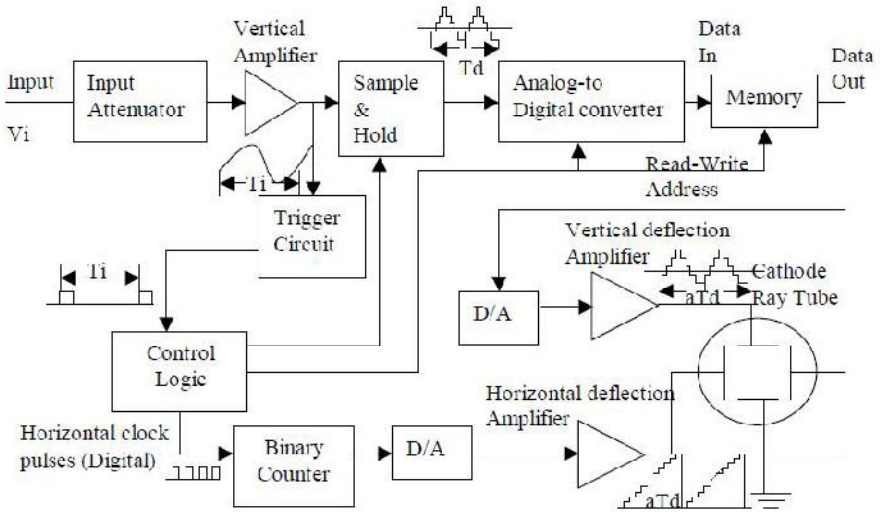
$= \left(1 + \frac{100}{10}\right) \times 5V$

$V_3 = 11 \times 5 = 55V$

Ans 4 a)

The digital storage oscilloscope, has the capability of retaining the image on the screen for longer than those of the previous possible techniques.

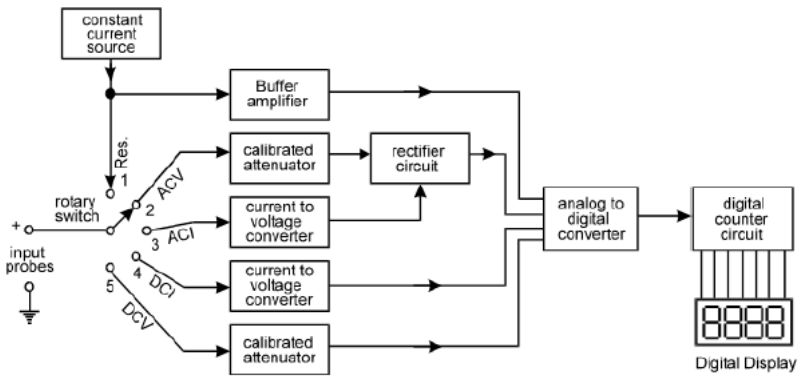
Block diagram consist of : 1.Attenuator and Amplifier 2.Analog to digital converter 3.Memory part. 4.Trigger circuit 5. Control Logic 6.Digital to analog converters 7. CRT



Principles of Operation :

- The input circuitry of the DSO and probes used for the measurement are the same as the conventional oscilloscopes.
- The input is attenuated and amplified with the input amplifiers as in any oscilloscope.
- This is done to scale the input signal so that the dynamic range of the A/D converter can be utilized maximally.
- Many DSOs can also operate in a conventional mode, bypassing the digitizing and storing features.
- The output of the input amplifier drives the trigger circuit that provides signal to the control logic.
- It is also sampled under the control of the control logic. The sample and hold circuit takes the sample and stores it as a charge on a capacitor. Hence, the value of the signal is kept constant during the analog to digital conversion.
- The analog to digital converter (A/D) generates a binary code related to the magnitude of the sampled signal. The speed of the A/D converter is important and "flash" converters are mostly used. The binary code from the A/D converter is stored in the memory. The memory consists of a bank of random access memory (RAM) integrated circuits (ICs).

Ans 4 b) DIGITAL MULTIMETER It is a common & important laboratory instrument. It is used to measure AC/DC voltage, AC/DC current and resistance with digital display.



Measurement of resistance : Connect an unknown resistor across its input probes. Keep rotary switch in the position-1 *(refer block diagram above)*. The proportional current flows through the resistor, from constant current source. According to Ohm's law voltage is produced across it. This voltage is directly proportional to its resistance. This voltage is buffered and fed to A-D converter, to get digital display in Ohms.

Measurement of AC voltage: Connect an unknown AC voltage across the input probes. Keep rotary switch in position-2. The voltage is attenuated, if it is above the selected range and then rectified to convert it into proportional DC voltage. It is then fed to A-D converter to get the digital display in Volts.

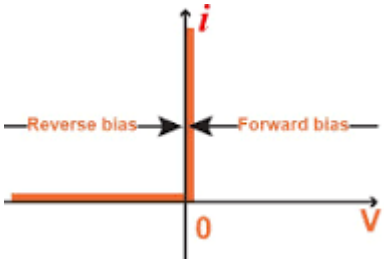
Measurement of AC current : <u>Current is indirectly measured</u> by converting it into proportional voltage. Connect an unknown AC current across input probes. Keep the switch in position-3. The current is converted into voltage proportionally with the help of I-V converter and then rectified. Now the voltage in terms of AC current is fed to A-D converter to get digital display in Amperes.

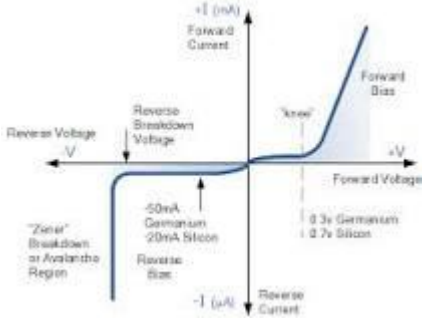
Measurement of DC current : <u>The DC current is also measured indirectly.</u> Connect an unknown DC current across input probes. Keep the switch in position-4. The current is converted into voltage proportionally with the help of I-V converter. Now the voltage in terms of DC current is fed to A-D converter to get the digital display in Amperes.

Measurement of DC voltage : Connect an unknown DC voltage across input probes. Keep the switch in position-5.
The voltage is attenuated, if it is above the selected range and then directly fed to AD converter to get the digital display in Volts.

<u>Answer 5 a)</u>

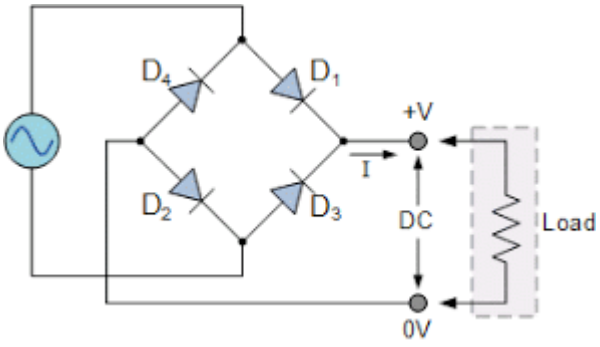
A diode is said to be an Ideal Diode when it is forward biased and acts like a perfect conductor or ON state , with zero voltage across it. Similarly, when the diode is reversed biased, it acts as a perfect insulator or OFF state with zero current through it. The V-I characteristics of the Ideal diode are shown in the figure

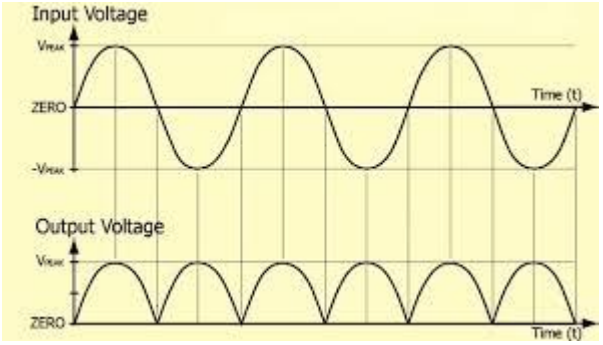




Practical diodes cannot act as perfect conductor and perfect insulator. Draws very low current when reverse biased. Practical diode offers very high resistance when reverse biased.

<u>Answer 5 b)</u>





<u>During positive half cycle.</u> The rectifier current i can be positive only if these assumptions are true:
D1 and D2 are forward biased and D3 and D4 are reverse biased.

<u>During Negative half cycle :</u> The rectifier current i can be positive only if these assumptions are true:
D3 and D4 are forward biased and D1 and D2 are reverse biased.