UNIT-3

Problems

(1) Voltage measurement

Peak-To-peak value, $V_{p-p} = \left(\frac{\text{Volts}}{\text{div}}\right) \times (\text{no. of divisions})$

(The volts/div. is nothing but deflection sensitivity of CRO)

(2) Amplitude, $V_{max} = \frac{V_{p-p}}{2}$

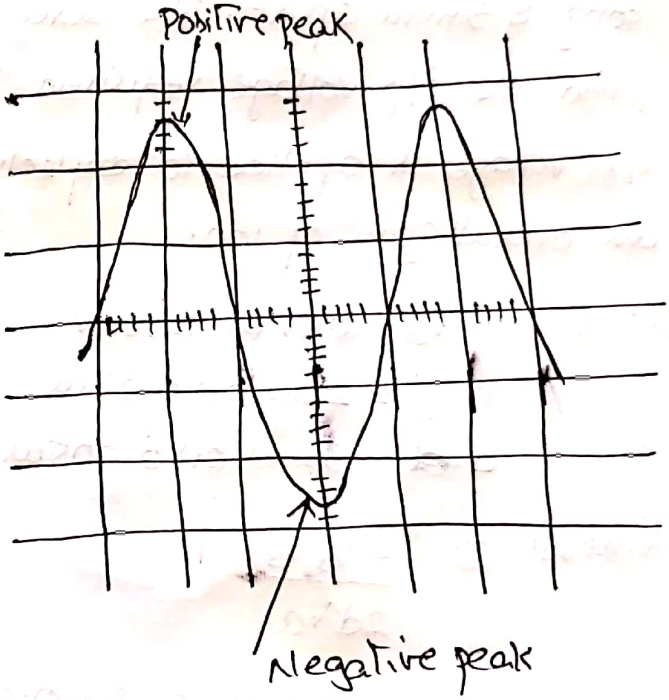
(3) RMS value, $V_{rms} = \frac{V_{p-p}}{2\sqrt{2}}$ (for sinusoidal signals only)

① For the W.F shown in fig, if vertical attenuation is 3mV/div., Determine

(i) peak-to-peak value

(ii) Amplitude &

(iii) R.M.S. value of signal.



Sol:- Vertical attenuation = 3mV/div.

from the diagram it is evident that the screen is divided such that one part is subdivided into 5 units

$\therefore$ 1 Subdivision $= \frac{1}{5} = 0.2$ units

(i) Peak-To-peak value-V_{p-p}:

It can be observed the positive peak of the signal corresponds to 2 full divisions & 3 subdivisions.

Hence positive peak is $2+3\times0.2 = 2.6$ units. while the negative peak also corresponds to 2.6 units

$\therefore V_{p-p} = 2.6+2.6$

$= 5.2$ divisions

$V_{p-p} = \frac{\text{volts}}{\text{division}} \times \text{no. of divisions} = 3\times5.2 = 15.6\,\text{mV}$

(ii) Amplitude, V_{max}: $V_{max} = \frac{V_{p-p}}{2}$

$= \frac{15.6}{2}$

$= \boxed{7.8 \text{ mV}}$

(iii) R.M.S. value, V_{rms}:-

$V_{rms} = \frac{V_{max}}{\sqrt{2}}$

$= \frac{7.8}{\sqrt{2}}$

$= \boxed{5.515 \text{ mV}}$

(2) A CRT has an anode voltage of 2KV & parallel deflecting plates 2cm long & 5mm apart. The screen is 30cm for the centre of the plates find the i/p voltage required, to deflect the beam through 3cm. The i/p voltage is applied to deflecting plates through amplifiers having an overall gain of 100.

Sol:- Given: $V_a = 2\text{KV}$ (or) 2000V $L = 30\text{cm}$ (or) 0.3m

$l_d = 2\text{cm}$ (or) 0.02m $D = 3\text{cm}$ (or) 0.03m

$d = 5\text{mm}$ (or) 0.005m overall gain = 100

We know that $D = \frac{L l_d V_d}{2 d V_a}$

$V_d = \frac{2 d V_a D}{L l_d} = \frac{2 \times 0.005 \times 2000 \times 0.03}{0.3 \times 0.02}$

$= \underline{100\text{V}}$

∴ i/p vol required for deflection of 3cm

$= \frac{V_d}{\text{gain}} = \frac{100}{100} = \underline{1\text{V}}$

③ An electrostatically deflected cathode ray tube has plane parallel deflecting plates are 2.5cm long & 0.5cm apart, & the distance from either centre to the screen is 20cm. The electron beam is accelerated by a potential difference of 2500V & is projected centrally b/w the plates. ④

calculate the deflection vol required to cause the beam to deflect through 3cm & find the corresponding deflection sensitivity of the screen.

Sol:- Given l_d = 2.5cm (or) 0.025m V_a = 2500V

d = 0.5cm (or) 0.005m D = 3cm (or) 0.03m

L = 20cm (or) 0.2m

V_d ? S ?

We know that $\boxed{D = \frac{L l_d V_d}{2 d V_a}}$

Deflection voltage $V_d = \frac{D \times 2 d V_a}{L l_d} = \frac{0.03 \times 2 \times 0.005 \times 2500}{0.2 \times 0.025}$

$= \underline{150V}$

$\therefore$ Deflection sensitivity, $S = \frac{D}{V_d} = \frac{0.03}{150}$ m/V

(or)

$\underline{0.2 mm/V}$

④ The horizontal deflection plates in a CRT are 20mm long & 5mm apart. The centre of the plates is 20cm from the screen. Accelerating voltage is 2500V. Determine the deflection sensitivity.

Sol:- l_d = 20mm (or) 0.02m V_a = 2500V

d = 5mm (or) 0.005m

L = 20cm = 0.2m

$$S = \frac{L I_d}{2 d V_a}$$

$$= \frac{0.2 \times 0.02}{2 \times 0.005 \times 2500} \text{ m/V}$$

$$= 0.16 \text{ mm/V}.$$

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