

### **16.16 SOLVED NUMERICALS OF BOOK:**

#### **Problem# 16.2**

A radar sends out 0.05us pulses of microwaves whose wave length is 2.5cm. what is the frequency of these microwaves? How many waves does each pulse contain?

#### **GIVEN THAT:**

Duration between pulses

$$t = 0.05/\mu s = 5 \times 10^{-8} \text{ Sec}$$

$$\lambda = 2.5\text{cm} = 2.5 \times 10^{-2} \text{ m}$$

#### **REQUIRED:**

- a)  $\nu = ?$
- b) Number wave =  $n = ?$

#### **SOLUTION:**

##### **FOR FREQUENCY**

As we know that

$$c = \nu \lambda$$

$$\nu = \frac{c}{\lambda} = \frac{3 \times 10^8}{2.5 \times 10^{-2}}$$

$$\nu = 1.2 \times 10^{10} \text{ Hz} \quad (1)$$

##### **FOR NUMBER OF WAVES**

Firs of all calculate time period

$$T = \frac{1}{\nu} = \frac{1}{1.2 \times 10^{10}}$$

$$T = 8.333 \times 10^{-11} \text{ Sec}$$

The ratio between pulse duration and time period is this no of waves does each pulse contain.

$$n = \frac{t}{T}$$

$$n = \frac{5 \times 10^{-8}}{8.333 \times 10^{-11}}$$

$$\boxed{n = 600 \text{ waves}}$$

**Problem# 16.3**

A nanosecond is  $10^{-9}$  sec (a) What is the frequency of electromagnetic wave whose period is 1ns? (b) What is its wave length? (c) To what class of electromagnetic waves does it belong?

**GIVEN THAT:**

$$T = 1 \text{ ns} = 10^{-9} \text{ sec}$$

$$v = c = 3 \times 10^8 \text{ sec}$$

**REQUIRED:**

- (a)  $v = ?$
- (b)  $\lambda = ?$
- (c) Type of electromagnetic wave = ?

**SOLUTION:**

(a) **FOR FREQUENCY**

As we know that

$$vT = 1$$

$$v = \frac{1}{T}$$

$$v = \frac{1}{10^{-9}}$$

$$v = 10^9 \text{ Hz}$$

(b) **FOR WAVE LENGTH**

$$v\lambda = c$$

$$\lambda = \frac{c}{v}$$

$$\lambda = \frac{3 \times 10^8}{10^9}$$

$$\lambda = 3 \times 10^{-1}$$

$$\lambda = 0.3 \text{ m}$$

**16.17 SOLVED NUMERICALS OF PAPERS:**

**YEAR 2007:**

Q.6(d) Calculate the speed of electromagnetic waves, given that

$$\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N-m}^2 \text{ and } \mu_0 = 4\pi \times 10^{-7} \text{ Tm/A}$$

**GIVEN THAT:**

$$\text{Permittivity of air/free space} = \epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N-m}^2$$

$$\text{Permeability of air/free space} = \mu_0 = 4\pi \times 10^{-7} \text{ Tm/A}$$

**REQUIRED:**

$$\text{Velocity of electromagnetic wave} = v = c = ?$$

As we know that

$$\text{Velocity} = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$$

OR

$$C = \frac{1}{\sqrt{4\pi \times 10^{-7} \times 8.85 \times 10^{-12}}}$$

$$C = \frac{1}{\sqrt{4 \times 3.1416 \times 8.85 \times 10^{-19}}}$$

$$C = \frac{1}{\sqrt{1.11213 \times 10^{-17}}}$$

$$C = \frac{1}{3.33486 \times 10^{-9}}$$

$$C = 2.9986 \times 10^8 \text{ m/sec}$$

OR

$$C = 3 \times 10^8 \text{ m/sec}$$