Government Polytechnic College Alwar

Department of Electrical Engineering

Second Mid Term Test 2017-18
Basic Electrical Engineering (EE-203)

Time: 1 Hrs | Date: 16/01/2018 | Max Marks: 15

Attemp all.

1. Write the following vector quantity in polar form

(a) 3+j4 (b) 9(cos45°+j sin 45°) (c) 15 e^{-j45° (d) 5+j7

(2x4=8 marks)

2. Derive expression for rms and average value of a sinusoidal wave.

(4+3=7 marks)

solutions of IInd mid term Test 2017-18.

sub:- Basic Electricals code EE-203

Soln ① (a)

$$\vec{A} = 3+j4.$$

Now $$|\vec{A}| = \sqrt{3^2+4^2} = \sqrt{25} = 5$$

Now Angle of vector $\vec{A}$ from x-axis.

$$\theta = \tan^{-1}\frac{4}{3} = 53.13^\circ$$

Now $\vec{A}$ in polar form $= |\vec{A}| \angle\theta$

$$= 5\angle 53.13^\circ \text{ Ans}$$

Soln ① (b)

$$\vec{A} = 9(\cos 45^\circ + j\sin 45^\circ)$$

since this vector is given in Trigonometric form whose standard form is

$$\vec{A} = |\vec{A}|(\cos\theta + j\sin\theta)$$

so vector in polar form θ

$$|\vec{A}| = 9 \text{ & } \theta = 45^\circ$$

$\Rightarrow$ Polar form $= 9\angle 45^\circ$ Ans

Soln ① (c)

$$\vec{A} = 15\, e^{-j45^\circ}$$

since this vector is given in exponential form. whose standard form is

$$\vec{A} = |\vec{A}| \cdot e^{\pm j\theta}$$

Now in this Ca^n $|\vec{A}| = 15$ & $\theta = -45^\circ$

so in polar form $= 15\angle -45^\circ$ Ans

Soln ① (d)

$$\vec{A} = 5 + j7$$

Now $|\vec{A}| = \sqrt{5^2+7^2} = \sqrt{74} = 8.60$

And angle from x-axis.

$$\theta = \tan^{-1}\left(\frac{7}{5}\right) = 54.46^\circ$$

So. in polar form

$$\vec{A} = 8.60 \angle 54.46^\circ$$

Soln ②

RMS value of a sinusoidal wave :-

Let a sinusoidal alternating current is

$$i = I_m \sin\theta.$$

Now square of this current $= i^2 = I_m^2 \sin^2\theta.$

Now mean of square of the Instantaneous value of current over one complete cycle.

$$= \int_0^{2\pi} \frac{i^2 . d\theta}{(2\pi - 0)}$$

Square root of this value

$$= \sqrt{\int_0^{2\pi} \frac{i^2 . d\theta}{(2\pi - 0)}}$$

Now

$$\text{RMS of } I = \sqrt{\int_0^{2\pi} \frac{i^2 . d\theta}{2\pi}} = \sqrt{\frac{I_m^2}{2\pi} \int_0^{2\pi} \sin^2\theta . d\theta}.$$

Now $\sin^2\theta = \frac{1-\cos 2\theta}{2}$

$$\Rightarrow I = \sqrt{\left(\frac{I_m^2}{4\pi}\int_0^{2\pi}(1-\cos 2\theta)\cdot d\theta\right)}$$

$$= \sqrt{\left(\frac{I_m^2}{4\pi}\left|\theta - \frac{\sin 2\theta}{2}\right|_0^{2\pi}\right)}$$

$$= \sqrt{\left\{\frac{I_m^2}{4\pi}\left[(2\pi-0) - \left(\frac{\sin 4\pi}{2} - \frac{\sin 0}{2}\right)\right]\right\}}$$

$$= \sqrt{\frac{I_m^2}{4\pi}\times 2\pi}$$

$$\Rightarrow I_{rms} = \sqrt{\frac{I_m^2}{2}} = \frac{I_m}{\sqrt{2}}$$

$$\boxed{I_{rms} = \frac{I_m}{\sqrt{2}}}$$ Ans

Now Average value of sinusoidal wave in half cycle

$$I_{av} = \int_0^{\pi}\frac{i\cdot d\theta}{\pi-0}$$

$$= \int_0^{\pi}\frac{I_m\cdot\sin\theta\cdot d\theta}{\pi}$$

$$= \frac{I_m}{\pi}\int_0^{\pi}\sin\theta\cdot d\theta$$

$$= \frac{I_m}{\pi}\left[-\cos\theta\right]_0^{\pi}$$

$$= \frac{I_m}{\pi}\left[-\cos\pi + \cos 0^\circ\right] = \frac{I_m}{\pi}\left[-(-1)+1\right]$$

$$\boxed{I_{avg.} = \frac{2I_m}{\pi}}$$ Ans