GATE-2023 (EC) Q.13

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Question :-

Let $w^4 = 16j$. Which of the following can not be the value of w?

(A) $2e^{\frac{j2\pi}{8}}$
(B) $2e^{\frac{j\pi}{8}}$
(C) $2e^{\frac{j5\pi}{8}}$
(D) $2e^{\frac{j9\pi}{8}}$

Solution:-

$$\left(w^4\right)^{\frac{1}{4}} = (16j)^{\frac{1}{4}} \tag{1}$$

Using De-Moivre's theorem for n^{th} root of w ,

$$w = \pm 2j^{\frac{1}{4}} \tag{2}$$

$$e^{j\theta} = \cos\theta + j\sin\theta \tag{3}$$

Using equation (**??**) and put $\theta = (2n+1)\frac{\pi}{2}$

$$w = \pm 2e^{[j(2n+1)\frac{\pi}{2}]\frac{1}{4}} \tag{4}$$

For different values of n ,

$$n = 0 \implies w = \pm 2e^{\frac{j\pi}{8}} \tag{5}$$

$$n = 2 \implies w = \pm 2e^{\frac{j5\pi}{8}} \tag{6}$$

$$n = 4 \implies w = \pm 2e^{\frac{j9\pi}{8}} \tag{7}$$

Ans . (A) $2e^{\frac{j2\pi}{8}}$