

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:-

$$(w^4)^{\frac{1}{4}} = (16j)^{\frac{1}{4}} \quad (1)$$

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

$$w = 2j^{\frac{1}{4}} \quad (2)$$

$$e^{j\theta} = \cos \theta + j \sin \theta \quad (3)$$

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

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

For different values of n ,

$$n = 0 \implies w = 2e^{\frac{j\pi}{8}} \quad (5)$$

$$n = 2 \implies w = 2e^{\frac{j5\pi}{8}} \quad (6)$$

$$n = 4 \implies w = 2e^{\frac{j9\pi}{8}} \quad (7)$$

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