

# GATE ASSIGNMENT 2

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Download all python codes from

<https://github.com/Dishank422/EE3900/blob/main/Gate-Assignment2/codes>

and latex-tikz codes from

[https://github.com/Dishank422/EE3900/blob/main/Gate-Assignment2/latex\\_code.tex](https://github.com/Dishank422/EE3900/blob/main/Gate-Assignment2/latex_code.tex)

Therefore option (A) is the correct option.

1 EC 2019 Q.33

The DFT of a vector  $(a \ b \ c \ d)$  is the vector  $(\alpha \ \beta \ \gamma \ \delta)$ . Consider the product

$$(p \ q \ r \ s) = (a \ b \ c \ d) \begin{pmatrix} a & b & c & d \\ d & a & b & c \\ c & d & a & b \\ b & c & a & d \end{pmatrix} \quad (1.0.1)$$

The DFT of the vector  $(p \ q \ r \ s)$  is a scaled version of

- (A)  $(\alpha^2 \ \beta^2 \ \gamma^2 \ \delta^2)$
- (B)  $(\sqrt{\alpha} \ \sqrt{\beta} \ \sqrt{\gamma} \ \sqrt{\delta})$
- (C)  $(\alpha + \beta \ \beta + \delta \ \delta + \gamma \ \gamma + \alpha)$
- (D)  $(\alpha \ \beta \ \gamma \ \delta)$

2 SOLUTION

We note that  $(p \ q \ r \ s)$  is the circular convolution of  $(a \ b \ c \ d)$  with itself. Therefore

$$(p \ q \ r \ s) = (a \ b \ c \ d) \circledast (a \ b \ c \ d) \quad (2.0.1)$$

Therefore, the Fourier transform of  $(p \ q \ r \ s)$  is given by the element-wise product of the Fourier transform of  $(a \ b \ c \ d)$  with itself. Therefore

$$\mathcal{F}(p \ q \ r \ s) = \mathcal{F}(a \ b \ c \ d) \odot \mathcal{F}(a \ b \ c \ d) \quad (2.0.2)$$

$$= (\alpha \ \beta \ \gamma \ \delta) \odot (\alpha \ \beta \ \gamma \ \delta) \quad (2.0.3)$$

$$= (\alpha^2 \ \beta^2 \ \gamma^2 \ \delta^2) \quad (2.0.4)$$