PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

Fourier Transform - CSIR NET Physics PYQs

Mathematical Physics . All PYQs (2015-2025) with answer key

6 questions . Answer key included

www.physicsbyaaryan.com . www.csirnetphysics.com
Contact: 9501976811

Q1. [Dec 2015] . 3.5 marks

Mathematical Physics > Fourier Transform

CSIR NET	2015 Dec	3.5 M

The Fourier transform of $f(x)$ is $\tilde{f}(k) = \int_{-\infty}^{+\infty} dx e^{ikx} f(x)$.

If $f(x) = \alpha\delta(x) + \beta\delta'(x) + \gamma\delta''(x)$, where $\delta(x)$ is the Dirac delta-function (and prime denotes derivative), what is $\tilde{f}(k)$?

1. $\alpha + i\beta k + i\gamma k^2$
2. $\alpha + \beta k - \gamma k^2$
3. $\alpha - i\beta k - \gamma k^2$
4. $i\alpha + \beta k - i\gamma k^2$

Q2. [Dec 2015] . 5.0 marks

Mathematical Physics > Fourier Transform

CSIR NET	2015 Dec	5 M

A function $f(x)$ satisfies the differential equation

$$\frac{d^2f}{dx^2} - \omega^2 f = -\delta(x-a)$$

where ω is positive. The Fourier transform $\tilde{f}(k) = f\int_{-\infty}^{+\infty} dx e^{ikx} f(x)$ of f, and the solution of the equation are, respectively,

1. $\frac{e^{ika}}{k^2+\omega^2}$ and $\frac{1}{2\omega}\left(e^{-\omega|x-a|} + e^{\omega|x-a|}\right)$

2. $\frac{e^{ika}}{k^2+\omega^2}$ and $\frac{1}{2\omega} e^{-\omega|x-a|}$

3. $\frac{e^{ika}}{k^2-\omega^2}$ and $\frac{1}{2\omega}\left(e^{-i\omega|x-a|} + e^{i\omega|x-a|}\right)$

4. $\frac{e^{ika}}{k^2-\omega^2}$ and $\frac{1}{2i\omega}\left(e^{-\omega|x-a|} - e^{i\omega|x-a|}\right)$

Q3. [Dec 2016] . 3.5 marks

Mathematical Physics > Fourier Transform

CSIR NET	2016 Dec	3.5M

The Fourier transform $\int_{-\infty}^{\infty} dx f(x) e^{ikx}$ of the function $f(x) = \frac{1}{x^2+2}$ is

1. $\sqrt{2}\pi e^{-\sqrt{2}|k|}$
2. $\sqrt{2}\pi e^{-\sqrt{2}k}$
3. $\frac{\pi}{\sqrt{2}} e^{-\sqrt{2}k}$
4. $\frac{\pi}{\sqrt{2}} e^{-\sqrt{2}|k|}$

Q4. [June 2016] . 5.0 marks

Mathematical Physics > Fourier Transform

CSIR NET	2016 June	5M

What is the Fourier transform $\int dx e^{ikx} f(x)$ of

$$f(x) = \delta(x) + \sum_{n=1}^{\infty} \frac{d^n}{dx^n} \delta(x)$$

where $\delta(x)$ is the Dirac delta-function?

1. $\frac{1}{1-ik}$
2. $\frac{1}{1+ik}$
3. $\frac{1}{k+i}$
4. $\frac{1}{k-i}$

Q5. [June 2018] . 3.5 marks

Mathematical Physics > Fourier Transform

CSIR NET	2018 June	3.5M

The Fourier transform $\int_{-\infty}^{\infty} dx f(x) e^{ikx}$ of the function $f(x) = e^{-|x|}$

1. $-\frac{2}{1+k^2}$
2. $-\frac{1}{2(1+k^2)}$
3. $\frac{2}{1+k^2}$
4. $\frac{2}{(2+k^2)}$

Q6. [June 2021] . 5.0 marks

Mathematical Physics > Fourier Transform

CSIR NET	2021 June	5M

If we use the Fourier transform

$$\phi(x,y) = \int e^{ikx}\phi_k(y)dk$$

to solve the partial differential equation

$$-\frac{\partial^2\phi(x,y)}{\partial y^2} - \frac{1}{y^2}\frac{\partial^2\phi(x,y)}{\partial x^2} + \frac{m^2}{y^2}\phi(x,y) = 0$$

in the half-plane $\{(x,y): -\infty < x < \infty, 0 < y < \infty\}$ the Fourier modes $\phi_k(y)$ depend on y as y^α and y^β. The value of α and β are

1. $\frac{1}{2} + \sqrt{1 + 4(k^2 + m^2)}$ and $\frac{1}{2} - \sqrt{1 + 4(k^2 + m^2)}$
2. $1 + \sqrt{1 + 4(k^2 + m^2)}$ and $1 - \sqrt{1 + 4(k^2 + m^2)}$
3. $\frac{1}{2} + \frac{1}{2}\sqrt{1 + 4(k^2 + m^2)}$ and $\frac{1}{2} - \frac{1}{2}\sqrt{1 + 4(k^2 + m^2)}$
4. $1 + \frac{1}{2}\sqrt{1 + 4(k^2 + m^2)}$ and $1 - \frac{1}{2}\sqrt{1 + 4(k^2 + m^2)}$

Answer Key

6 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	Mathematical Physics	Fourier Transform	**3**
Q2	Mathematical Physics	Fourier Transform	**2**
Q3	Mathematical Physics	Fourier Transform	**4**
Q4	Mathematical Physics	Fourier Transform	**2**
Q5	Mathematical Physics	Fourier Transform	**3**
Q6	Mathematical Physics	Fourier Transform	**3**

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Contact
9501976811