PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

Special Functions - CSIR NET Physics PYQs

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

7 questions . Answer key included

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Q1. [Dec 2015] . 5.0 marks

Mathematical Physics > Special Functions

CSIR NET	2015 Dec	5 M

The Hermite polynomial $H_n(x)$ satisfies the differential equation $\frac{d^2H_n}{dx^2} - 2x\frac{dH_n}{dx} + 2nH_n(x) = 0$

The corresponding generating function

$G(t,x) = \sum_{n=0}^{\infty} \frac{1}{n!} H_n(x)t^n$ satisfies the equation

1. $\frac{\partial^2 G}{\partial x^2} - 2x\frac{\partial G}{\partial x} + 2t\frac{\partial G}{\partial t} = 0$
2. $\frac{\partial^2 G}{\partial x^2} - 2x\frac{\partial G}{\partial x} - 2t^2\frac{\partial G}{\partial t} = 0$
3. $\frac{\partial^2 G}{\partial x^2} - 2x\frac{\partial G}{\partial x} + 2\frac{\partial G}{\partial t} = 0$
4. $\frac{\partial^2 G}{\partial x^2} - 2x\frac{\partial G}{\partial x} + 2\frac{\partial^2 G}{\partial x \partial t} = 0$

Q2. [Dec 2018] . 3.5 marks

Mathematical Physics > Special Functions

CSIR NET	2018 Dec	3.5M

The polynomial $f(x) = 1 + 5x + 3x^2$ is written as linear combination of the Legendre polynomials $\left(P_0(x) = 1, P_1(x), P_2(x) = \frac{1}{2}(3x^2 - 1)\right)$ as $f(x) = \sum_n c_n P_n(x)$. The value of c_0 is

1. $\frac{1}{4}$
2. $\frac{1}{2}$
3. 2
4. 4

Q3. [June 2018] . 5.0 marks

Mathematical Physics > Special Functions

CSIR NET	2018 June	5M

In the function $P_n(x)e^{-x^2}$ of a real variable $x, P_n(x)$ is polynomial of degree n. The maximum number of extrema that this function can have is

1. n+2
2. n-1
3. n+1
4. n

Q4. [June 2021] . 5.0 marks

Mathematical Physics > Special Functions

CSIR NET	2021 June	5M

The Legendre polynomials $P_n(x), n = 0,1,2, \dots$, satisfying the orthogonality condition $\int_{-1}^{1} P_n(x)p_m(x)dx = \frac{2}{2n+1}\delta_{nm}$ on the interval $[-1, +1]$, may be defined by the Rodrigues formula $P_n(x) = \frac{1}{2^n n!}\frac{d^n}{dx^n}(x^2 - 1)^n$. The value of the definite integral $\int_{-1}^{1}(4 + 2x - 3x^2 + 4x^3)P_3(x)dx$ is

1. 3/5
2. 11/15
3. 23/32
4. 16/35

Q5. [June 2023] . 5.0 marks

Mathematical Physics > Special Functions

CSIR NET	2023 June	5M

If the Bessel function of integer order n is defined as

$J_n(x) = \sum_{k=0}^{\infty} \frac{(-1)^k}{k!(n+k)!} \left(\frac{x}{2}\right)^{2k+n}$ then $\frac{d}{dx}[x^{-n}J_n(x)]$ is

1. $-x^{-[n+1]}J_{n+1}(x)$
2. $-x^{-[n+1]}J_{n-1}(x)$
3. $-x^{-n}J_{n-1}(x)$
4. $-x^{-n}J_{n+1}(x)$

Q6. [Dec 2025] . 5.0 marks

Mathematical Physics > Special Functions

CSIR NET	2025 Dec	5M	MMP

A sequence of polynomial $Q_n(x)[n = 0,1,2 \ldots]$ satisfies the recursion relation

$$Q_{n+1}(x) - 2xQ_n(x) + 2nQ_{n-1}(x) = 0, \text{ for all } n \geq 0$$

$$[\text{ here } Q_{-1}(x) = 0]$$

The generating function for the polynomials,

$g(x,t) = \sum_{n=0}^{\infty} \frac{t^n}{n!} Q_n(x)$, satisfies

1. $\frac{\partial g}{\partial t} = 2(t + x)g$
2. $\frac{\partial g}{\partial t} = 2(x - t)g$
3. $\frac{\partial g}{\partial t} = \frac{2(x-t)}{t} g$
4. $\frac{\partial g}{\partial t} = 2 + (x + t)g$

Q7. [June 2025] . 5.0 marks
Mathematical Physics > Special Functions

CSIR NET	2025 June	5M	MMP

Let $P_n(x)$ be a polynomial of degree n with real coefficients, where $n = 0,1,2,3,\cdots$. If

$\int_2^4 P_n(x)P_m(x)dx = \delta_{mn}$, then

1. $P_1(x) = \pm\sqrt{\frac{3}{2}}(3-x)$

2. $P_1(x) = \pm\sqrt{\frac{3}{2}}(2-x)$

3. $P_1(x) = \pm\sqrt{\frac{3}{2}}(1-x)$

4. $P_1(x) = \pm\sqrt{3}(3+x)$

Answer Key

7 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	Mathematical Physics	Special Functions	**1**
Q2	Mathematical Physics	Special Functions	**3**
Q3	Mathematical Physics	Special Functions	**3**
Q4	Mathematical Physics	Special Functions	**4**
Q5	Mathematical Physics	Special Functions	**4**
Q6	Mathematical Physics	Special Functions	**2**
Q7	Mathematical Physics	Special Functions	**1**

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