



# JEE (MAIN) 2024

MEMORY BASED QUESTIONS & SOLUTIONS

SHIFT-1

**DATE & DAY:** 30<sup>th</sup> January 2024 & Tuesday

**PAPER-1**

**Duration:** 3 Hrs.

**Time:** 09:00 - 12:00 IST

**SUBJECT: MATHEMATICS**

**ADMISSIONS OPEN FOR CLASS 12+**

ACADEMIC SESSION 2024-25



**TARGET: JEE (ADV.) 2024**

For Class XII Passed Student

**VISHESH COURSE**

MODE: OFFLINE/ONLINE



CLASS STARTS  
08<sup>th</sup> APRIL, 2024



**TARGET: JEE (MAIN) 2024**

For Class XII Passed Student

**ABHYAAS COURSE**

MODE: OFFLINE/ONLINE



CLASS STARTS  
08<sup>th</sup> APRIL, 2024

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**PART : MATHEMATICS**

1. Number of integral term in the expansion of  $\left(\frac{1}{7^2} + \frac{1}{11^6}\right)^{824}$

- Ans. (1) 139 (2) 138 (3) 140 (4) 137

Sol.  $T_{r+1} = {}^{824}C_r \left(\frac{1}{7^2}\right)^{824-r} \left(\frac{1}{11^6}\right)^r$

$\Rightarrow r$  must be multiple of 6  
 $\Rightarrow r = 0, 6, 12, \dots, 822$   
 $\Rightarrow 138$  terms

2. For any real number  $x$ , Let  $[x]$  denote the largest integer less than or equal to  $x$ . The value of

$$9 \int_0^9 \sqrt{\frac{10x}{x+1}} dx$$

Ans. (155)

Sol.  $\frac{10x}{x+1} = 1 \Rightarrow x = \frac{1}{9}$   
 $\frac{10x}{x+1} = 4 \Rightarrow x = \frac{2}{3}$   
 $\frac{10x}{x+1} = 9 \Rightarrow x = 9$

$$I = \int_0^{\frac{1}{9}} 0 dx + \int_{\frac{1}{9}}^{\frac{2}{3}} 1 dx + \int_{\frac{2}{3}}^9 2 dx$$

$$I = 0 + \left[ x \right]_{\frac{1}{9}}^{\frac{2}{3}} + \left[ 2x \right]_{\frac{2}{3}}^9$$

$$I = \frac{2}{3} - \frac{1}{9} + 18 - \frac{4}{3}$$

So,  $I = \frac{155}{9}$

3. If  $S_n$  denotes sum of first  $n$  terms of an A.P. such that,  $S_{20} = 790$ ,  $S_{10} = 145$  then  $S_{15} - S_5$

(1) 540 (2) 395 (3) 555 (4) 575

Ans. (2)

Sol.  $S_{20} = \frac{20}{2}(2a + 19d) = 790 \Rightarrow 2a + 19d = 79$

$$S_{10} = S_{20} = \frac{10}{2}(2a + 9d) = 145 \Rightarrow 2a + 9d = 29$$

$$\frac{10d}{d} = \frac{50}{5}$$

$$S_{15} - S_5 = \frac{15}{2}(2a + 14d) - \frac{5}{2}(2a + 4d)$$

$$10a + 95d = 395$$

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4.  $\vec{a} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$   $|a| = 1$   $\vec{a} \cdot \vec{b} = 2$   
 $\vec{b} = b_1\hat{i} + b_2\hat{j} + b_3\hat{k}$   $|b| = 4$

$$\vec{c} = 2(\vec{a} \times \vec{b}) - 3\vec{b}$$
 then angle between  $\vec{c}$  and  $\vec{b}$

Ans. (150°)

Sol.  $\therefore \vec{c} = 2(\vec{a} \times \vec{b}) - 3\vec{b} \dots (1)$

$$|\vec{c}|^2 = 4(\vec{a} \times \vec{b}) \cdot (-3\vec{b}) + 9\vec{b} \cdot \vec{b} = 4(|a|^2|b|^2 - (\vec{a} \cdot \vec{b})^2) + 9b^2$$

$$|\vec{c}|^2 = 4(1 \cdot 16 - 4) + 9 \cdot 16 = 16(3 + 9) = 16 \times 12$$

Again, equation ....(1).  $\vec{b} \cdot \vec{c} = 0 - 3|\vec{b}|^2$

$$|\vec{b}||\vec{c}| \cos \theta = -3|\vec{b}|^2$$

$$\cos \theta = \frac{-3 \cdot 4}{4 \cdot 2\sqrt{3}} = \frac{-\sqrt{3}}{2} \Rightarrow \theta = 150^\circ$$

5. A line making an angle  $30^\circ$  with positive x-axis at  $(4, 0)$ . Now it is rotated by an angle  $15^\circ$  in clockwise direction. The equation of line is

(1)  $x + y - 4 = 0$

(2)  $x - y - 4 = 0$

(3)  $(\sqrt{3} - 2)x + y + 8 - 4\sqrt{3} = 0$

(4)  $(2 - \sqrt{3})x - y - 8 + 4\sqrt{3} = 0$

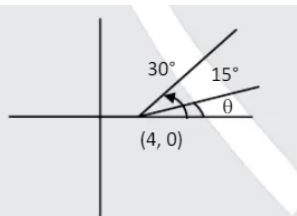
Ans. (4)

Sol.

$$\theta = 30^\circ - 15^\circ$$

$$\text{Line } y - 0 = \tan 15^\circ (x - 4)$$

$$(2 - \sqrt{3})x - y - 8 + 4\sqrt{3} = 0$$



6. Let  $(\alpha, \beta, \gamma)$  be the foot of perpendicular from the point  $(1, 2, 3)$  on the line  $\frac{x+3}{5} = \frac{y-1}{2} = \frac{z+4}{3}$  then

$$19(\alpha + \beta + \gamma)$$

Ans. (101)

Sol.  $Q(5\lambda - 3, 2\lambda - 1, 3\lambda - 4) \equiv (\alpha, \beta, \gamma)$

Since lines are perpendicular there for

$$a_1a_2 + b_1b_2 + c_1c_2 = 0$$

$$5(5\lambda - 4) + 2(2\lambda - 1) + 3(3\lambda - 7) = 0, 38\lambda - 43 = 0$$

$$\text{Now } 19(\alpha + \beta + \gamma) = 19(10\lambda - 6)$$

$$= 19\left(\frac{430}{38} - 6\right) = 101$$



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7. Area bounded by curves  $y^2 = 4(x - 2)$  and  $y = 2x - 8$  is

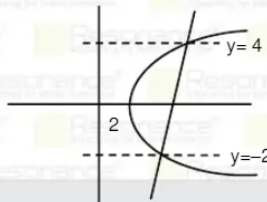
Ans. (9)

Sol.  $\frac{y+8}{2} = x \Rightarrow y^2 - 2y - 8 = 0 \Rightarrow -2, 4$

Area

$$= \int_{-2}^4 \left( \frac{y+8}{2} - \left( \frac{y^2}{4} + 2 \right) \right) dy = \left( \frac{y^2}{4} + 2y - \frac{y^3}{12} \right)_{-2}^4$$

$$= 9$$



8. Circle  $(x + 1)^2 + (y + 2)^2 = r^2$  &  $x^2 + y^2 - 4x - 4y + 4 = 0$

Cuts each other at two different points then value of  $r$  is

- (1)  $\frac{1}{2} < r < 7$       (2)  $0 < r < 7$       (3)  $3 < r < 7$       (4)  $5 < r < 9$

Ans. (3)

Sol.  $C_1 (-1, -2) : r_1 = r$

$$C_2 (2, 2) : r_2 = \sqrt{4 + 4 + 2} = 2$$

Circle intersect each other  $\therefore |r_1 - r_2| < C_1C_2 < |r_1 + r_2|$   $|r - 2| < 5 < r + 2$

$$|r - 2| < 5 \quad \text{and} \quad 5 < r + 2$$

$$-5 < r - 2 < 5 \quad r > 3 \quad \text{---(2)}$$

$$-3 < r < 7 \quad \text{---(1)}$$

$$(1) \cap (2) \quad r \in (3, 7)$$

9.  $f(0) = \frac{1}{2}$ , find  $\lim_{x \rightarrow 0} \frac{\int_0^x f(t) dt}{e^{x^2} - 1} = \alpha$  then find  $8\alpha^2$ .

- (1) 3      (2) 1      (3) 2      (4) 0

Ans. (3)

Sol.  $\lim_{x \rightarrow 0} \frac{\int_0^x f(t) dt + xf(x)}{e^{x^2} (2x)} = \lim_{x \rightarrow 0} \frac{\int_0^x f(t) dt}{x e^{x^2} (2x)} + \lim_{x \rightarrow 0} \frac{f(x)}{e^{x^2} (2)}$

$$= \lim_{x \rightarrow 0} \frac{f(x)}{2(e^{x^2} + xe^{x^2} (2x))} + \frac{1}{4} = \frac{1}{2}$$

$$\Rightarrow 8\alpha^2 = 2$$

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10. Let A (2, 3, 5) and C (-3, 4, -2) be opposite vertices of a parallelogram ABCD. If the diagonal  $\vec{BD} = \hat{i} + 2\hat{j} + 3\hat{k}$ , then area of parallelogram is equal to

Ans.  $\frac{1}{2}\sqrt{474}$

Sol.  $\frac{1}{2}|\vec{AC} \times \vec{BD}| = \frac{1}{2} \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 5 & -1 & 7 \\ 1 & 2 & 3 \end{vmatrix}$

$$= \frac{1}{2}|-17\hat{i} - 8\hat{j} + 11\hat{k}|$$

$$= \frac{1}{2}\sqrt{289+64+121}, = \frac{1}{2}\sqrt{474}$$

11. If  $\alpha = 1^2 + 4^2 + 8^2 + 13^2 + \dots$  up to 10 terms and  $\beta = \sum_{N=1}^{10} N^4$  such that  $4\alpha - \beta = 55k + 40$ , then find k.

Ans. (353)

Sol. 1, 4, 8, 13, .....

Difference 3, 4, 5, ..... A.P.

$$t_n = an^2 + bn + c$$

$$n = 1, 1 = a + b + c; n = 2, 4 = 4a + 2b + c;$$

$$n = 3, 8 = 9a + 3b + c$$

$$a = \frac{1}{2}, b = \frac{3}{2}, c = -1$$

$$\alpha = \sum_{N=1}^{10} \left( \frac{N^2}{2} + \frac{3N}{2} - 1 \right)^2$$

$$4\alpha - \beta = \sum_{N=1}^{10} (6N^3 + 5N^2 - 12N + 4)$$

$$= 6(55)^2 + 5(5 \cdot 11 \cdot 7) - 12 \cdot 5 \cdot 11 + 40$$

$$= 55(353) + 40$$

$$\therefore k = 353$$

12.

Class	Frequency
0-4	2
4-8	9
8-12	10
12-16	8
16-20	7
<b>Total</b>	<b>36</b>

If median is M then find the value of 20M

(1) 208

(2) 104

(3) 52

(4) 216

Ans. (4)

Sol.  $N = \sum f_i = 36$

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$$\frac{N}{2} = 18$$

Class	fi	cfi
0-4	2	2
4-8	9	11
8-12	10	21
12-16	8	29
16-20	7	36
	N= 36	

$$\begin{aligned} \ell &= 8 \\ f_m &= 10 \\ h &= 12 - 8 = 4 \\ c.f_{m-1} &= 11 \end{aligned}$$

$$\text{Median} = \ell + \left( \frac{\frac{N}{2} - c.f_{m-1}}{f_m} \right) h$$

$$= 8 + \frac{18 - 11}{10} \times 4$$

$$M = 8 + \frac{7}{5} \times 2 = 8 + \frac{14}{5} = \frac{54}{5}$$

$$20M = 20 \times \frac{54}{5} = 216$$

13.  $\sec x \, dy - (2(1-x) \tan x + x(2-x)) \, dx = 0$

Ans.  $y = (\sin x)(2x - x^2) + c$

Sol.  $dy = \frac{2(1-x)\tan x + x(2-x)}{\sec x} \, dx$

$$dy = (2(1-x)\sin x + x(2-x)\cos x) \, dx$$

$$y = (\sin x)(2x - x^2) + c$$

14. The value of  $\lim_{n \rightarrow \infty} \sum_{k=1}^n \frac{n^3}{(n^2+k^2)(n^2+3k^2)}$  is

(1)  $\frac{\pi}{2\sqrt{2}} - \frac{\pi}{4}$

(2)  $\frac{\pi}{2\sqrt{3}} - \frac{\pi}{8}$

(3)  $\frac{\pi}{2\sqrt{3}} + \frac{\pi}{4}$

(4)  $\frac{\pi}{\sqrt{3}} - \frac{\pi}{8}$

Ans. (2)

Sol.  $= \lim_{n \rightarrow \infty} \sum_{k=1}^n \frac{1}{\left(1 + \frac{k^2}{n^2}\right)\left(1 + \frac{3k^2}{n^2}\right)}$

$$= \int_0^1 \frac{1}{(1+x^2)(1+3x^2)} \, dx$$

$$= \frac{1}{2} \int_0^1 \left( \frac{3}{1+3x^2} - \frac{1}{1+x^2} \right) \, dx$$

$$= \frac{1}{2} \left( \sqrt{3} \tan^{-1} x \sqrt{3} - \tan^{-1} x \right) \Big|_0^1 = \frac{1}{2} \left( \frac{\sqrt{3}\pi}{3} - \frac{\pi}{4} \right)$$

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15. If  $z = x + iy$ ,  $xy \neq 0$  satisfy the equation  $z^2 + i\bar{z} = 0$ , then  $|z^2|$  equal to

Ans. (1)

Sol.  $z^2 = -i\bar{z}$

$$|z^2| = |\bar{z}| \Rightarrow |z| = 1$$

$$|z^2| = 1$$

16. If the length of the minor axis of an ellipse is equal to half of the distance between the foci then the eccentricity of the ellipse is

(1)  $\frac{2}{\sqrt{5}}$

(2)  $\frac{3}{\sqrt{5}}$

(3)  $\frac{2}{\sqrt{3}}$

(4)  $\frac{3}{\sqrt{5}}$

Ans. (1)

Sol.  $2b = \frac{1}{2}(2ae)$

$$\frac{b}{a} = \frac{e}{2} \Rightarrow \frac{b^2}{a^2} = \frac{e^2}{4}$$

$$1 - e^2 = \frac{e^2}{4} \Rightarrow e^2 \left( \frac{5}{4} \right) = 1 \Rightarrow e = \frac{2}{\sqrt{5}}$$

17. If  $f(x) = \begin{vmatrix} 2\cos^4 x & 2\sin^4 x & 3 + \sin^2 2x \\ 3 + 2\cos^4 x & 2\sin^4 x & \sin^2 2x \\ 2\cos^4 x & 3 + 2\sin^4 x & \sin^2 2x \end{vmatrix}$  then  $\frac{1}{5} f'(0)$  is equal to

Ans. (0)

Sol. on expanding  $f(x) = 45, \Rightarrow f'(x) = 0$

18. If  $x, y \in \{0, 1, 2, 3, \dots, 10\}$  then the probability that  $|x - y| > 5$  is

- (1)  $\frac{30}{121}$                           (2)  $\frac{31}{121}$                           (3)  $\frac{60}{121}$                           (4)  $\frac{62}{121}$

Ans. (1)

Sol. Total number of ways =  $11 \times 11 = 121$   
 $x = 0, |y| > 5 \Rightarrow y = 6, 7, 8, 9, 10 \Rightarrow 5$  ways  
 $x = 1, |1 - y| > 5 \Rightarrow y = 7, 8, 9, 10 \Rightarrow 4$  ways  
 So on

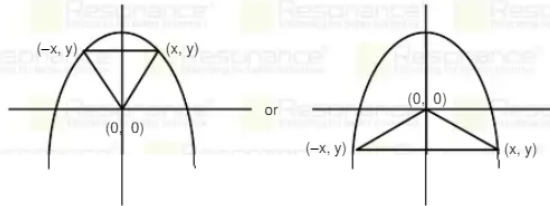
$$\text{Required probability} = \frac{2(5 + 4 + \dots + 2 + 1)}{11 \times 11} = \frac{30}{121}$$

19. A triangle is formed by vertices  $(0, 0), (x, y), (-x, y)$  on  $xy$ -plane. If the point  $(x, y)$  and  $(-x, y)$  lies on  $y = -x^2 + 54$ , then maximum area of triangle is

- (1)  $18\sqrt{2}$                           (2)  $108\sqrt{2}$                           (3)  $36\sqrt{2}$                           (4)  $54\sqrt{2}$

Ans. (2)

Sol.



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$$\text{Area} = \frac{1}{2}(2x)(54 - x^2)$$

$$A = 54x - x^3 \Rightarrow \frac{dA}{dx} = 54 - 3x^2$$

$$x = \pm\sqrt{18}$$

$$\text{Maximum area } A = (54 - 18)\sqrt{18} = 108\sqrt{2}$$

20. If  $x^2 - 70x + \lambda = 0$  have roots  $\alpha, \beta \in \mathbb{N}, \frac{\lambda}{2}, \frac{\lambda}{3} \notin \mathbb{N}$ . Find minimum value of  $\lambda$ .

- (1) 320                          (2) 325                          (3) 330                          (4) 335

Ans. (2)

Sol.  $\alpha + \beta = 70$

$$\alpha\beta = \lambda$$

$\lambda$  Minimum when  $\alpha = 5, \beta = 65$

$$\Rightarrow \lambda = 325$$

21.  $g(x)$  is non constant differentiable functions  $g'\left(\frac{1}{2}\right) = g'\left(\frac{3}{2}\right)$  and  $f(x) = \frac{1}{2}[g(x) + g(2-x)]$

(1)  $f'\left(\frac{1}{2}\right) + f'\left(\frac{3}{2}\right) = 1$

(2)  $f''(x) = 0$ , for at least 1 value of  $x \in (0, 2)$

(3)  $f'''(x) = 0$ , for number of values of  $x \in (0, 1)$

(4)  $f''(x) = 0$ , for exactly one value of  $x \in (0, 1)$

Ans. (2)

Sol.  $f(x) = \frac{1}{2}(g'(x) - g'(2-x))$   
 $f\left(\frac{1}{2}\right) + f\left(\frac{3}{2}\right) = 0 + 0 = 0$   
 Since  $f\left(\frac{1}{2}\right) = f\left(\frac{3}{2}\right) = 0$  (Rolle theorem)  
 $\Rightarrow f''(x) = 0$  for atleast 1 value of  $x \in (0, 2)$

22.  $\lim_{x \rightarrow 0} \frac{ae^{x^2} + b \cos x}{x^2} = \frac{1}{2}$  then

(1)  $a = \frac{1}{3}, b = \frac{1}{3}$

(2)  $a = \frac{1}{2}, b = -\frac{1}{2}$

(3)  $a = -\frac{1}{3}, b = -\frac{1}{2}$

(4)  $a = \frac{1}{3}, b = -\frac{1}{3}$

Ans. (4)

Sol.  $a + b = 0$

$$\lim_{x \rightarrow 0} \frac{2xae^{x^2} - b \sin x}{2x} = \frac{1}{2}$$

$$\lim_{x \rightarrow 0} ae^{x^2} - \frac{b \sin x}{2x} = \frac{1}{2}$$

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$$a - \frac{b}{2} = \frac{1}{2} \Rightarrow 2a - b = 1$$

$$a + b = 0 \quad a = \frac{1}{3}, b = -\frac{1}{3}$$

23. If latus rectum of the hyperbola  $\frac{x^2}{9} - \frac{y^2}{b^2} = 1$  subtends  $60^\circ$  at centre of hyperbola and

$$b^2 = \frac{\ell}{m} (1 + \sqrt{n}), \ell, m, n \in \mathbb{N}, \ell, m \text{ being co-prime, then } \ell^2 + m^2 + n^2 \text{ is}$$

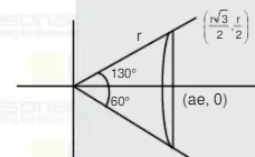
(1) 180

(2) 181

(3) 182

(4) 183

Ans. (3)  
Sol.



$$r = \frac{2b^2}{3} \Rightarrow \frac{r}{2} = \frac{b^2}{3}$$

$$ae = \frac{r}{2} \sqrt{3} = \frac{b^2}{\sqrt{3}}$$

$$\therefore a^2 e^2 = \frac{b^4}{3} = a^2 + b^2 = 9^2 + b^2$$

$$b^4 - 3b^2 - 27 = 0$$

$$\text{+ve } b^2 = \frac{3 + \sqrt{9 + 108}}{2} = \frac{3}{2}(1 + \sqrt{13})$$

$$\therefore \ell + m^2 + n^2 = 3^2 + 2^2 + 13^2 = 182$$

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**Resonance**  
Educating for better tomorrow

Boost your Percentile with

# PERCENTILE BOOSTER COURSE

**COURSE COMMENCEMENT: 5<sup>th</sup> FEBRUARY 2024**

**TARGET** JEE (Main) 2024  
April Attempt

MODE:  
OFFLINE/  
ONLINE

**COURSE**  
**Concept**

Percentile Booster Course (PBC) is for those students who want to boost their percentile in JEE-Main 2024 through a systematic complete course revision & practice plan.

In this course, daily chapter wise tests, Full Syllabus Test, JEE Preparatory Test will be conducted and each test will be followed by proper offline/online discussion class.

**COURSE FEE**  
Offline: ₹4999 | Online: ₹2499



**COURSE FEATURES**

-  Complete Course Coverage
-  Regular Practice through Daily Online Practice Test
-  Full Syllabus Test
-  Approx 2500 practice Que.
-  Chapter wise Test
-  Joint Preparatory Test
-  Back up support of recorded lectures
-  Regular Test discussion classes for concept clearance

**JEE (Main) 2024 April Attempt में**  
**अधिकतम %ile प्राप्त करने के लिए आज ही Join करें।**

**SCAN TO APPLY**



\*T & C Apply

## ADMISSIONS OPEN FOR CLASS 12+

ACADEMIC SESSION 2024-25



**TARGET: JEE (ADV.) 2024**

For Class XII Passed Student

### VISHESH COURSE

MODE: OFFLINE/ONLINE



CLASS STARTS  
**08<sup>th</sup> APRIL, 2024**



**TARGET: JEE (MAIN) 2024**

For Class XII Passed Student

### ABHYAAS COURSE

MODE: OFFLINE/ONLINE



CLASS STARTS  
**08<sup>th</sup> APRIL, 2024**

SCHOLARSHIP ON THE BASIS OF JEE (MAIN) 2024 %ILE/AIR



## 《 JEE (Advanced) 2023 RESULT 》

**AIR**  
**7**



**BIKKINA A. CHOWDARY**

All India Ranks (AIR-CRL) in  
Top 50 : 8 Top 100 : 15  
All Students are from Our  
Offline/Online Classroom Programs

**AIR 22**



DESHANK P. SINGH

**AIR 26**



MAYANK SONI

**AIR 29**



TANISHQ M. MANDHANE

**AIR 32**



KRITIN GUPTA

**AIR 33**



RAMAN GOVAL

**AIR 37**



S S SUMEDH

**AIR 44**



KAUSHAL VIJAYVERGIYA

## 《 JEE (Main) 2023 RESULT 》

22 वर्षों से लगातार... श्रेष्ठ शिक्षण, श्रेष्ठ परिणाम...

**6 AIRs in TOP-50**

<b>AIR 5</b>	<b>AIR 26</b>	<b>AIR 29</b>	<b>AIR 31</b>	<b>AIR 34</b>	<b>AIR 50</b>
300/300 Marks	100%ile	100%ile	100%ile	100%ile	100%ile (Maths)
					
KAUSHAL VIJAYVERGIYA	SOHAM DAS	ASHIK STENNY	KRISH GUPTA	MAYANK SONI	HARSHAL LASOD

**ADMISSIONS OPEN**

Academic Session 2024-25

**Class: V to XII & XII+**



**JEE**  
(Advanced)



**JEE**  
(Main)



**NEET**  
(UG)

**SCHOLARSHIP UPTO**



**100%**

Based on ResoNET (Scholarship Test)

REGISTERED & CORPORATE OFFICE (CIN: U80302RJ2007PLC024029)

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