ঢাকা বোর্ড—২০১৫

বিষয় কোড : ২ ৬ ৫

সময় — ৩ ঘণ্টা

উচ্চতর গণিত (তত্ত্বীয়) : প্রথম পত্র

পূর্ণমান — ৭৫

[দ্র. ডান পাশের সংখ্যা প্রশ্নের পূর্ণমান জ্ঞাপক।]

ক বিভাগ : বীজগণিত

১। যে কোনো **দুইটি** প্রশ্নের উত্তর দাও: ২×২=১০

(ক) কর্ণ ম্যাট্রিক্স কাকে বলে? $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$, $B = \begin{bmatrix} 4 \\ 6 \\ -1 \end{bmatrix}$

$C = [1 \quad 2 \quad -5 \quad 6]$ হলে, $(AB)C$ নির্ণয় কর।

(খ) প্রমাণ কর যে,

$\begin{vmatrix} a & b & ax+by \\ b & c & bx+cy \\ ax+by & bx+cy & 0 \end{vmatrix} = (ax^2 + 2bxy + cy^2)(b^2 - ac)$.

(গ) যদি $A = \begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 3 & 1 & 1 \end{bmatrix}$ হয়, তবে A^{-1} নির্ণয় কর।

২। যে কোনো **একটি** প্রশ্নের উত্তর দাও: ৫×১=৫

(ক) একটি পরীক্ষায় ১২টি প্রশ্ন থেকে ৬টি প্রশ্নের উত্তর দিতে হবে। তাকে প্রথম ৫টি থেকে অবশ্যই ৪টি প্রশ্ন নির্বাচন করতে হবে। সে কত প্রকারে প্রশ্নগুলো বাছাই করতে পারবে?

(খ) 'PERMUTATIONS' শব্দটির বর্ণগুলি থেকে ১টি স্বরবর্ণ এবং ২টি ব্যঞ্জনবর্ণ নিয়ে কতগুলি শব্দ গঠন করা যাবে যেন স্বরবর্ণটি সবসময় মাঝখানে থাকে?

খ বিভাগ : জ্যামিতি ও ভেক্টর

৩। যে কোনো **একটি** প্রশ্নের উত্তর দাও: ৫×১=৫

(ক) $\vec{x} = \hat{i} + 2\hat{j} - 3\hat{k}$ এবং $\vec{B} = 3\hat{i} - \hat{j} + 2\hat{k}$ হলে, দেখাও যে, $\vec{x} + \vec{B}$ এবং $\vec{x} - \vec{B}$ ভেক্টর দুইটি পরস্পর লম্ব।

(খ) $\vec{x} = 3\hat{i} + \hat{j} - 2\hat{k}$, $\vec{B} = 2\hat{i} - \hat{j} + \hat{k}$ এবং $\vec{C} = \hat{i} + 3\hat{j} - 2\hat{k}$ হলে, $\vec{x} \times (\vec{B} \times \vec{C})$ নির্ণয় কর।

৪। যে কোনো **তিনটি** প্রশ্নের উত্তর দাও: ৫×৩=১৫

(ক) OABC একটি সামান্তরিক; x-অক্ষ বরাবর OA অবস্থিত। OC রেখার সমীকরণ $y = 2x$ এবং B বিন্দুর স্থানাঙ্ক $(4, 2)$। A ও C বিন্দুর স্থানাঙ্ক এবং AC কর্ণের সমীকরণ নির্ণয় কর।

(খ) $\frac{x}{a} - \frac{y}{b} = 1$ রেখার উপর লম্ব এবং প্রদত্ত রেখা ও x-অক্ষের ছেদবিন্দুগামী সরলরেখার সমীকরণ নির্ণয় কর।

(গ) b বাহুবিশিষ্ট OABC একটি বর্গ। OA ও OC বরাবর অক্ষদ্বয় ধরে দেখাও যে, বর্গটির পরিবৃত্তের সমীকরণ হবে $x^2 + y^2 = b(x + y)$.

(ঘ) $\sqrt{2}$ ব্যাসার্ধবিশিষ্ট দুইটি বৃত্তের সমীকরণ নির্ণয় কর যারা $x + y + 1 = 0$ রেখাকে স্পর্শ করে এবং যাদের কেন্দ্র x অক্ষের উপর অবস্থিত।

গ বিভাগ : ত্রিকোণমিতি

৫। যে কোনো **দুইটি** প্রশ্নের উত্তর দাও: ৫×২=১০

(ক) $cosecA + cosecB + cosecC = 0$ হলে দেখাও যে, $(\sum \sin A)^2 = \sum \sin^2 A$.

(খ) যদি $\tan\frac{\theta}{2} = \sqrt{\frac{1-e}{1+e}} \tan\frac{\phi}{2}$ হয়, প্রমাণ কর যে, $\cos\phi = \frac{\cos\theta - e}{1 - e\cos\theta}$.

(গ) লেখচিত্র অঙ্কন কর; $y = \cos^2 x$ যখন $-\pi \le x \le \pi$.

৬। যে কোনো **দুইটি** প্রশ্নের উত্তর দাও: ৫×২=১০

(ক) প্রমাণ কর যে, $\tan 70° - 2\tan 50° = \tan 20°$.

(খ) প্রমাণ কর: $\cos^4 \frac{\pi}{8} + \cos^4 \frac{3\pi}{8} + \cos^4 \frac{5\pi}{8} + \cos^4 \frac{7\pi}{8} = \frac{3}{2}$.

(গ) $\triangle ABC$-এ $a = \sqrt{3} + 1$, $b = \sqrt{3} - 1$ এবং $\angle C = 60°$ হলে ত্রিভুজটি সমাধান কর।

ঘ বিভাগ : ক্যালকুলাস

৭। যে কোনো **একটি** প্রশ্নের উত্তর দাও: ৫×১=৫

(ক) A, B বাস্তব সংখ্যার সেট; R এর দুইটি উপসেট এবং $f : A \to B$; যেখানে $f(x) = \frac{x-3}{2x+1}$.

(i) ফাংশনটির ডোমেন এবং রেঞ্জ নির্ণয় কর। (ii) $f^{-1}(1)$ নির্ণয় কর।

(খ) যদি $f(x) = 2x - 5$ এবং $g(x) = x^2 + 6$ হয়, তবে $g\{f(2)\}$ এবং $f\{g(5)\}$ এর মান নির্ণয় কর।

৮। যে কোনো **তিনটি** প্রশ্নের উত্তর দাও: ৫×৩=১৫

(ক) মান নির্ণয় কর : $\displaystyle \lim_{x \to 0} \frac{\tan x - \sin x}{x^3}$ ৫

(খ) x এর প্রেক্ষিতে অন্তরজ নির্ণয় কর (যে কোনো দুইটি): $\frac{৫}{২}$ ×২=৫

(i) $\sqrt{\sin^{-1} x}$ (ii) $\tan^{-1} \frac{2\sqrt{x}}{1-x}$ (iii) $\frac{\sqrt{x}+1}{\sqrt{x}-1}$

(গ) $y = \tan^{-1} x$ হলে, প্রমাণ কর যে, $(1 + x^2)y_2 + (2x - 1)y_1 = 0$ ৫

(ঘ) যে কোনো **দুইটি** প্রশ্নের উত্তর দাও: $\frac{৫}{২}$ ×২=৫

(i) $\int \frac{\sin x}{3 + 4\cos x} dx$ (ii) $\int \frac{x^2 - 1}{x^2 - 4} dx$ নির্ণয় কর;

(iii) $\int \frac{x \, dx}{\sqrt{9 - 2x^2}}$ নির্ণয় কর।

১। (ক) $\begin{bmatrix} 13 & 26 & -65 & 78 \\ 40 & 80 & -200 & 240 \end{bmatrix}$

(গ) $\begin{bmatrix} \frac{1}{2} & -\frac{1}{2} & \frac{1}{2} \\ -4 & 3 & -1 \\ \frac{5}{2} & -\frac{3}{2} & \frac{1}{2} \end{bmatrix}$

২। (ক) 105

(খ) 155

৩। (খ) $17\hat{i} - 19\hat{j} + 16\hat{k}$

৪। (ক) $(3, 0), (1, 2)$; $x + y - 3 = 0$

(খ) $ax + by = a^2$

(ঘ) $x^2 + y^2 - 2x - 1 = 0$, $x^2 + y^2 + 6x + 7 = 0$

৫। (গ) $A = 105°$, $B = 15°$, $C = \sqrt{6}$

৭। (ক) (i) ডোমেন $f = R - \left\{-\frac{1}{2}\right\}$, রেঞ্জ $f = R - \left\{\frac{1}{2}\right\}$

(ii) $f^{-1}(1) = -4$

(খ) $g\{f(2)\} = 7$ এবং $f\{g(5)\} = 57$

৮। (খ) $\frac{1}{2}$

(খ) (i) $\frac{5x^4}{\sqrt{(1 - x^{10})} \cdot 2\sqrt{\sin^{-1} x}}$ (ii) $\frac{1}{\sqrt{x}(1 + x)}$ (iii) $-$

(ঘ) (i) $\frac{1}{4} \ln\left(3 + 4\cos x\right) + c$ (ii) $x + \frac{3}{4} \ln\left|\frac{x-2}{x+2}\right| + c$ (iii) 1.

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