



MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

Paper Code : BBAN-202 (N)

ADVANCED MATHEMATICS & STATISTICS

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any ten of the following :

10 × 1 = 10

i) The value of determinant

$$\begin{vmatrix} 1 & \cos 60^\circ & \cos 30^\circ \\ \frac{1}{2} & \sin 30^\circ & \sin 60^\circ \\ 1 & 0 & 2 \end{vmatrix}$$
 is

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

b) $\frac{1}{2}$

c) 0

d) none of these.

ii) Let $A = \begin{pmatrix} 1 & 0 & -1 \\ 0 & -1 & 0 \\ -1 & 0 & 0 \end{pmatrix}$. Then the only correct

statement about A is

a) $A^2 = 0$

b) $A = -1$

c) A is null matrix

d) $A^2 = 1$.

iii)
$$\begin{vmatrix} x + \omega^2 & \omega & 1 \\ \omega & 1 + x & \omega^2 \\ 1 & \omega^2 & x + \omega \end{vmatrix} = 0 \text{ for } x =$$

- a) 0
- b) -1
- c) 1
- d) none of these.

iv) The value of limit $\lim_{x \rightarrow 0} \frac{(1+x)^{9/2} - 1}{x}$ is

- a) 4
- b) 6
- c) 9
- d) none of these.

v) If $P(A) = \frac{3}{8}$, $P(B) = \frac{5}{3}$ and $P(A \cup B) = \frac{3}{4}$, then the value of $P(A/B)$ is

- a) $\frac{2}{5}$
- b) $\frac{3}{5}$
- c) $\frac{3}{2}$
- d) none of these.

vi) The function $f(x) = \frac{|x|}{x}$, $x \neq 0$
 $= 0$, $x = 0$ is

- a) a continuous function
- b) a constant function
- c) differentiable at $x = 0$
- d) none of these.

vii) A random variable x follows binomial distribution with $n = 10$, $p = 0.3$. The variance of x is

- a) 2.1
- b) 21
- c) 3
- d) 0.7.

GROUP - B

(Short Answer Type Questions)

Answer any *three* of the following.

3 × 5 = 15

2. ✓ Find the value of $A^2 - 4A - 5I_3$ if $A = \begin{pmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{pmatrix}$.

Hence find A^{-1} .

3. ✓ If $x + y + z = 0$, then show that $\begin{vmatrix} 1 & 1 & 1 \\ x & y & z \\ x^3 & y^3 & z^3 \end{vmatrix} = 0$.

4. ✓ A function $f(x)$ is defined as $f(x) = kx - 3, x \leq 1$
 $= 3x, 1 < x < 2$
 $= 3x^2 - k, x \geq 2$.

Find k for which the function is continuous at $x = 1$ and $x = 2$. <http://www.makaut.com>

5. If $ax^2 + 2hxy + by^2 = 1$ prove that $\frac{d^2y}{dx^2} = \frac{h^2 - ab}{(hx + by)^3}$.

6. $\int \frac{x - 22}{3x^2 - 2x - 8} dx$

7. Two boxes contain respectively 4 white and 2 black, and 1 white and 3 black balls. One ball is transferred from the first box into the second, and then one ball is drawn from the latter. It turns out to be black. What is the probability that the transferred ball was white ?

GROUP - C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

8. a) Solve the following system of equations by Cramer's rule :

$$x + 2y + 3z = 6, \quad 2x + 4y + z = 7, \quad 3x + 2y + 9z = 14.$$

- b) Evaluate $\lim_{x \rightarrow 4} \frac{\log_e (x - 3)}{x^{5/2} - 4^{5/2}}$.

- c) Express the matrix $A = \begin{pmatrix} 1 & 1 & 1 \\ 2 & -1 & 3 \\ 1 & 3 & -2 \end{pmatrix}$ as a sum

of a symmetric and skew-symmetric matrices.

5 + 5 + 5

9. a) Prove that $\begin{vmatrix} b+c & a-c & a-b \\ b-c & c+a & b-a \\ c-b & c-a & a+b \end{vmatrix} = 8abc$.

- b) If $\sin y = x \sin (a + y)$, $a \neq n\pi$, $n = 0, \pm 1, \pm 2, \dots$... prove that $\frac{dy}{dx} = \frac{\sin^2 (a + y)}{\sin a}$.

- c) Find $\frac{d^2y}{dx^2}$ when $x = a \cos 2t$, $y = a \sin 2t$ at

$$t = \frac{\pi}{4}.$$

5 + 5 + 5

10. a) Solve the following system of equations by matrix inversion method :

$$3x + y + z = 4, \quad x - y + 2z = 6, \quad x + 2y - z = 3.$$

- b) If $y = \sin (m \sin^{-1} x)$ prove that $(1 - x^2) y_2 - xy_1 + m^2 y = 0$.

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- c) The p.d.f. of a continuous random variable is $y = k(x-1)(2-x)$; ($1 \leq x \leq 2$). Determine the value of the constant k ; also find $P\left(X \leq \frac{5}{4}\right)$.

5 + 5 + 5

11. a) If $y = \left(x + \sqrt{1+x^2}\right)^m$, then prove that

$$(1+x^2)y_2 + xy_1 = m^2y.$$

- b) Evaluate: $\int \frac{x \sin^{-1} x}{\sqrt{1-x^2}} dx$.

- c) The overall percentage of failures in a certain examination is 40. What is the probability that out of a group of 6 candidates at least 4 passed the examination? <http://www.makaut.com> 5 + 5 + 5

- ✓ 12. a) Evaluate: $\int e^x \left(\frac{1}{x} - \frac{1}{x^2}\right) dx$.

- ✓ b) For a population of six units, the values of a characteristic x are given below:

3, 9, 6, 5, 7, 10

Consider all possible samples of size two from the above population and show that the mean of the sample means is exactly equal to the population mean.

- c) A simple random sample of size 5 is drawn without replacement from a finite population consisting of 41 units. If standard deviation of the population is 6.25, what is the standard error of sample mean? (Use finite population correction) 5 + 5 + 5

13. a) Prove that the matrix $A = \frac{1}{3} \begin{pmatrix} -1 & 2 & -2 \\ -2 & 1 & 2 \\ 2 & 2 & 1 \end{pmatrix}$ is an orthogonal matrix and hence find A^{-1} .

b) Evaluate $\int_0^{\pi/2} \log(\tan x) dx$.

c) A box contains 4 white and 6 black balls. If 3 balls are drawn at random, find the mathematical expectation of the number of white balls. $5 + 5 + 5$

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