

2023

MATHEMATICS — GENERAL

Paper : GE/CC-4

Full Marks : 65

*The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.**The symbols and notations have their usual meanings.*

Group - A

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1. Choose the correct alternative :

1×10

(a) For what real values of ' α ' does the set $S = \{(\alpha, 0, 1), (1, \alpha + 1, 1), (1, 1, 1)\}$ of \mathbb{R}^3 is linearly independent?(i) $\mathbb{R} - \{-1, 1\}$ (ii) $\mathbb{R} - \{-1, 0\}$ (iii) $\mathbb{R} - \{0, 1\}$ (iv) $\mathbb{R} - \{-1, 0, 1\}$.(b) In a Ring $(R, \circ, *)$, where $x \circ y = x + y - 1$, $x * y = x + y - xy$, $\forall x, y \in R$, the zero element is

(i) -1

(ii) 0

(iii) 2

(iv) 1.

(c) The eigenvalues of the square matrix $\begin{pmatrix} 2 & 0 & 1 \\ 0 & 3 & 0 \\ 1 & 0 & 5 \end{pmatrix}$ are

(i) all real

(ii) all purely imaginary

(iii) all purely imaginary or zero

(iv) either purely real or purely imaginary.

(d) If for two events A and B , $P(A) = \frac{1}{2}$; $P(B) = \frac{2}{5}$; $P(AB) = \frac{3}{10}$, then $P(\bar{A} | B)$ is(i) $\frac{1}{3}$ (ii) $\frac{2}{3}$ (iii) $\frac{1}{2}$ (iv) $\frac{1}{4}$.

Please Turn Over

- (e) For what value of ' β ' the function $f(x)$ defined by

$$f(x) = \begin{cases} \beta x(1-x), & 0 < x < 1 \\ 0, & \text{elsewhere} \end{cases}$$

is a probability density function?

- (i) 6 (ii) 5
 (iii) 2 (iv) 4.
- (f) If X and Y are two random variables such that $\text{Var } X = 16$, $\text{Var } Y = 9$ and the correlation coefficient is $\frac{3}{4}$, then value of $\text{Cov}(X, Y)$ is

- (i) 9 (ii) 16
 (iii) 12 (iv) 24.

- (g) A random variable X has probability density function

$$f(x) = \begin{cases} \frac{1}{6}, & -3 < x < 3 \\ 0, & \text{elsewhere} \end{cases}$$

Then $P(X > 1)$ is given by

- (i) $\frac{1}{3}$ (ii) $\frac{1}{2}$
 (iii) $\frac{1}{6}$ (iv) $\frac{3}{4}$.

- (h) The value of the FORTRAN expression : $J + L * I/3 + J/I - K * * L/I$, where $I = 4$, $J = 5$, $K = 3$ and $L = 2$ is

- (i) 5 (ii) 6
 (iii) 7 (iv) -6.

- (i) FORTRAN expression of $\log_e \sqrt{\frac{a}{bc}} + \log_{10} |a|$ is

- (i) $\text{ALOG}(\text{SQRT}(A/(B * C))) + \text{ALOG10}(\text{ABS}(A))$
 (ii) $\text{ALOG10}(\text{SQRT}(A/(B * C))) + \text{ALOG}(\text{ABS}(A))$
 (iii) $\text{LOG}(\text{SQRT}(A/(B * C))) + \text{LOG10}(\text{ABS}(A))$
 (iv) $\text{LOGE}(\text{SQRT}(A/(B * C))) + \text{ALOG10}(\text{ABS}(A)).$

- (j) Octal number corresponding to the binary number $(1101.10111)_2$ is

- (i) $(15.52)_8$ (ii) $(14.56)_8$
 (iii) $(15.56)_8$ (iv) $(15.46)_8$.

(3)

Z(4th Sm.)-Mathematics-G/(GE/CC-4)/CBCS

Group - B

Unit - 1

(Algebra-II)

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2. Answer *any three* questions :

- (a) Let $M = \left\{ \begin{pmatrix} a & b \\ c & d \end{pmatrix} : a, b, c, d \in \mathbb{R} \text{ and } ad - bc = 1 \right\}$. Show that M forms a group under matrix multiplication. 5
- (b) Define a subring of a ring $(R, +, \cdot)$. Check whether $S = \{2n : n \in \mathbb{Z}\}$ is a subring of the ring $(\mathbb{Z}, +, \cdot)$ of integers. 5
- (c) Let $W = \{(x, y, z) \in \mathbb{R}^3 : x - 4y + 3z = 0\}$. Show that W is a subspace of \mathbb{R}^3 . Find the basis and dimension of W . 3+1+1
- (d) Examine whether the real quadratic form $5x^2 + y^2 + 3z^2 + 4xy - 2yz - 2zx$ is positive definite or not. 5
- (e) Verify Cayley-Hamilton's theorem for the following matrix A given by $A = \begin{pmatrix} 0 & 0 & 1 \\ 3 & 1 & 0 \\ -2 & 1 & 4 \end{pmatrix}$. If possible find A^{-1} from the result. 3+2

Unit - 2

(Computer Science and Programming)

3. Answer *any four* questions :

- (a) Evaluate the octal arithmetic $(576)_8 + (116)_8 - (477)_8$. 5
- (b) Write an algorithm to find HCF and LCM of two distinct positive integers 'm' and 'n'. 5
- (c) Write a flowchart for finding the maximum of n given real numbers. 5
- (d) (i) Write the full form of the terms of BIT and ASCII. 2+3
(ii) Write three differences between high level language and assembly language. 2+3
- (e) (i) Write the FORTRAN expression of $\sqrt{x^3 + y^2} \tan(y/x) + \frac{7}{3\sqrt{2}} \log_e z$. 3+2
(ii) Let $A = 4.7$, $B = 5.6$ and $M = ABS(A - 4.0 * B)/7$. Find what value of M will be stored. 3+2
- (f) Write a FORTRAN program to find the sum of squares of first 10 natural numbers. 5
- (g) Write a FORTRAN program to find the area, perimeter and diagonal of a rectangle whose two adjacent sides are x and y . 5

Please Turn Over

Unit - 3

(Probability and Statistics)

4. Answer any four questions :

- (a) There are two urns A and B . The urn A contains 3 white and 4 red balls while the urn B contains 4 white and 3 red balls. One ball is transferred from urn A to urn B and a ball is drawn from urn B . What is the probability that the ball is red? 5
- (b) Find the mean and variance of a Binomial distribution with parameters n and p . 5
- (c) There are 4 red and 6 blue balls in an urn. A man draws 2 balls at a time at random. He will get ₹ 15.00 if the balls are of same colour and he will pay ₹ 10.00 if the balls are of different colours. Find the expected value of the money which the man will receive. 5
- (d) Construct a frequency distribution table with class intervals 50 – 69, 70 – 89, 90 – 109, 110 – 119, ... from the following data :
95, 131, 53, 117, 155, 100, 65, 122, 71, 78, 153, 90, 125, 80, 105, 137, 65, 136, 145, 120.
Also draw the histogram for the above distribution in plane paper. 3+2
- (e) If two regression lines involving two variables x and y are $y = 5.6 + 1.2x$ and $x = 12.5 + 0.6y$. Find the mean of x, y and their correlation coefficient. 5
- (f) Define an unbiased and consistent estimate of a parameter in population distribution. For a random sample of size n for any (m, σ) population, prove that the sample mean is an unbiased estimate of population mean. 1+1+3
- (g) Find a 95% confidence interval for the mean of a normal distribution with $\sigma = 3$, given the sample (2.3, -0.2, -0.4, -0.9). Given $P(U \geq 1.96) = 0.025$, where U is $N(0, 1)$ variate. 5
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