Institute of Mathematics and Applications, Bhubaneswar

Entrance Test for Admission Into M.A./M.Sc. Courses

(Mathematics with Data Science / Computational Finance)

2025-2026

Maximum Marks : 100 Time : 2 Hours.

INSTRUCTIONS

1. This question booklet contains 7 pages (including this page) with 50 multiple choice questions.

2.Each of the questions/incomplete statements is followed by four choices marked as (A), (B),(C), and(D) below each question of which only one of them is correct.

3. Answer each question by writing exactly one choice A or B or C or D in the space provided for it in the answer sheet, which is supplied separately. This question paper is meant to be retained by you .

4. More than one choice marked against a question will be deemed as incorrect answer.

5. Each correct answer carries 2 marks and incorrect or no answer carries 0 mark.

6. Use of calculator, log table, mobile phone, or any electronic gadget is not allowed.

QUESTIONS

1. Which of the following is a vector space?

A) Set of all integers under addition B) Set of all 2×2 matrices under matrix addition and scalar multiplication
C) Set of all prime numbers under addition D) Set of all natural numbers under multiplication

2. The rank of a matrix is:

A) The number of rows B) The number of columns
C) The number of non-zero rows in its row-echelon form D) The sum of the diagonal elements

3. A square matrix A is invertible if and only if:

A) det(A) is equal to 0 B) det(A) is not equal to zero

C) Transpose of A is equal to A D) All elements are non-zero

4. Which of the following sets of vectors is linearly dependent?

A) {(1, 0, 0), (0, 1, 0)} B) {(1, 2, 3), (2, 4, 6), (0, 0, 1)}
C) {(1, 2, 3), (4, 5, 6), (7, 8, 9)} D) {(1, 0, 0), (0, 1, 0), (0, 0, 1)}

5. The eigenvalues of a matrix are:

A) Always real B) Always non-negative
C) Solutions to the characteristic polynomial D) Entries on the main diagonal

6. A basis of a vector space is:

A) A set of vectors with maximum length B) A set of linearly dependent vectors
C) A minimal spanning set of linearly independent vectors D) A matrix that diagonalizes the space

7. The determinant of a triangular matrix is:

A) The sum of the diagonal entries B) Always zero
C) The product of the diagonal entries D) Equal to the number of non-zero rows

8. The eigenvalues of a triangular matrix are:

A) All equal to zero B) The elements on the main diagonal
C) The inverse of the diagonal elements D) The square roots of the diagonal elements

9. If A is a 3×3 matrix, then the characteristic polynomial is of degree:

A) 1 B) 2
C) 3 D) 6

10. An eigenvector v of a matrix A corresponding to eigenvalue λ satisfies:

A) $Av=v+\lambda$ B) $Av=\lambda v$
C) $Av=v\lambda v$ D) $Av=v/\lambda$

11. If a matrix A has a zero eigenvalue, then A:

A) Must be invertible B) Is not diagonalizable
C) Is not invertible D) Is a diagonal matrix

12. For a symmetric real matrix A, all eigenvalues are:

A) Zero B) Real
C) Complex D) Positive

13. The sum of the eigenvalues of a square matrix A is equal to:

A) The determinant of A B) The trace of A
C) The number of rows in A D) The number of linearly independent eigenvectors

14. Which of the following is an example of an abelian group?

A) GLn(R), the group of invertible $n\times n$ real matrices B) $(Z,+)$,the integers under addition
C) S3, the symmetric group on 3 elements. D) The set of real numbers under multiplication

15. A field is a ring in which:

A) Every non-zero element has a multiplicative inverse B) Every element has an additive inverse only
C) Multiplication is not necessarily associative D) Addition is not commutative

16. The group of integers modulo n denoted as Z_n, is a field if and only if:

A) n is an even number B) n is a prime number
C) n=1 D) n is a power of a prime

17. The order of a group element $a\in G$ is:

A) The number of elements in G B) The number of generators of G
C) The number of elements in the cyclic subgroup generated by a D) none of these

18. The kernel of a group homomorphism $f:G\rightarrow H$ is:

A) The set of all elements in H B) The set of all elements $g\in G$ such that $f(g)=e$
C) The image of G under H D) None of the above

19. In a finite group, Lagrange's Theorem states:

A) Every element has an inverse
B) The order of any subgroup divides the order of the group
C) All subgroups are normal
D) The group is cyclic if and only if it is abelian

20. A group G is cyclic if:

A) Every element is of finite order
B) Every element has an inverse
C) There is an element $g \in G$ such that each element in G is a power of g
D) The group is abelian

21. How many generators does the cyclic group Z_7 have?

A) 1 B) 2 C) 6 D) 7

22. In a ring R, a unit is an element that:

A) Has no additive inverse
B) Has a multiplicative inverse
C) Is zero
D) Is a generator

23. A ring is called an integral domain if:

A) It has characteristic zero
B) It has no zero divisors and is commutative with unity
C) It has only one ideal
D) Every element is invertible

24. Which of the following sets is a field?

A) Z , the integers
B) Z_6 — integers modulo 6
C) Q — rational numbers
D) Z_9— integers modulo 9

25. In a field, which of the following always holds?

A) There are zero divisors
B) Every element has a square root
C) Every non-zero element has a multiplicative inverse
D) Addition is not commutative

26. Which of the following sequences is not convergent?

A) $1/n$
B) $(-1)^n$
C) $1/n^2$
D) $n/(n+1)$

27. Which of the following functions is uniformly continuous on $(0,\infty)$?

A) $f(x)=x$
B) $f(x)=1/x$
C) $f(x)=\ln x$
D) $f(x)=\arctan x$

28. The set of rational numbers Q is

A) Closed and bounded
B) Open and bounded
C) Dense in R but not closed
D) Compact

29. Which of the following set is compact in R?

A) (0,1)
B) R
C) [0,1]∪[2,3]
D) (0,1]

30. The Bolzano-Weierstrass Theorem states:

A) Every sequence has a limit
B) Every bounded sequence has a convergent subsequence
C) Every increasing sequence is bounded
D) Every function has a maximum

31. Which of the following statements is false :

A function f is Riemann integrable on [a,b] if:

A) f is continuous
B) f is bounded and has only finitely many discontinuities
C) f is monotonic
D) None of these statements is true

32. Which of the following is true for every Cauchy sequence in R?

A) It diverges
B) It converges to 0
C) It may be convergent or divergent
D) It converges

33. The set S= { 7+1 , 7+½ , 7+1/3 , ...} ⊂ R is

(A) closed
(B) open
(C) neither open nor closed
(D) Both open and closed.

34. Which of the following statements is false?

(A) a set is a closed if it contains all its limit points
(B) a set is closed if its complement is open
(C) S is closed if S= $\bar{S}$
(D) one of the above statement is false

35. Which of the following must be true for Rolle's Theorem to apply to a function f on an interval ?

A) f(a)=f(b),and f is differentiable at a point in (a,b)
B) f is continuous on (a,b) and differentiable on [a,b]
C) f(a)=f(b), f is continuous on [a,b], and differentiable on (a,b)
D) f has a maximum at a or b

36.Choose Maclaurin's series expansion of sinx from the following alternatives.

(A) $1+x+\frac{x^2}{2!}+\frac{x^3}{3!}+\frac{x^4}{4!}+\cdots \ \forall x \in R.$ (B) $x-\frac{x^3}{3!}+\frac{x^5}{5!}-\cdots \ \forall x \in R.$

(C) $1-\frac{x^2}{2!}+\frac{x^4}{4!}-\frac{x^6}{6!}+\cdots \ \forall x \in R.$ (D) None of these.

37. If the function $f(x)=\sqrt{x^2-4}$ in [2, 4] satisfies the Lagrange's mean value theorem , then there exists some cϵ (2 , 4) that satisfies the conclusion of the theorem. What is the value of c?

(A) 12 (B) 6 (C) $\sqrt{2}$ (D) $\sqrt{6}$.

38.The solution of $dy/dx = x^2/y^2$ is

A) $y^3=x^3+C$ B) $y^3=x^2+C$
C) $y^4=3x^3+C$ D) $y^3=x^4+C$

39. The differential equation $\frac{d^2y}{dx^2}+6\frac{dy}{dx}+9y=50e^{2x}$ have particular integral

(A) $(2e^{2x})/3$ (B) $2e^{2x}$ (C) e^{2x} (D) None of these.

. 40. The particular solution to the initial value problem $y''-2y'+y=0$, $y(0)=1$, $y'(0)=-1$ is

(A) $(1+2x)e^x$ (B) $(1-2x)e^x$

(C) $(2x-1)e^x$ (D)None of these

41. Which of the following methods is used to find the root of a nonlinear equation?
A) Euler's method B) Newton-Raphson method
C) Trapezoidal rule D) Gauss-Seidel method

42. Round-off error is mainly due to:
A) Method of solving B) Truncation of infinite series
C) Representation of numbers in finite precision D) Incorrect initial guess

43. Which of the following numerical integration rules gives exact results for polynomials up to degree three?
A) Trapezoidal rule B) Midpoint rule
C) Simpson's 1/3 rule D) Simpson's 3/8 rule

44. A continuous random variable X is uniformly distributed on [0,1]. Then P(0.3<X<0.7)= :

A) 0.3 B) 0.4
C) 0.5 D) 0.7

45. Which of the following distributions is used to model the number of successes in n independent Bernoulli trials?

A) Poisson distribution B) Normal distribution
C) Binomial distribution D) Exponential distribution

46. Let X be a standard normal random variable. Then P(X<0) is:

A) 0.25 B) 0.5
C) 1 D) Depends on the value

47. A fair coin is tossed three times. What is the probability of getting at most one head?

A) 1/8 B) 3/8
C) 4/8 D) 5/8

48.If $f(x,y) = \begin{cases} \frac{x-y}{x+y}, for\ x \neq -y \\ 1, for\ x = -y \end{cases}$ **then as (x, y) → (0 , 0), f (x , y) approaches**

(A) 1 (B) -1 (C) 0 (D) no limit.

49. The gradient of a scalar function f(x,y,z) is:

A) A scalar field B) A vector field pointing in the direction of steepest descent
C) A vector field pointing in the direction of steepest ascent D) Always zero

50. Let S be the surface of the unit sphere $x^2+y^2+z^2=1$, and F(x,y,z)= (x,y,z). Then the value of the surface integral of F.n over the surface S , where n is the unit outward normal vector, is

A) 0 B) 1 C) 3 D) 4π

The End