

009/2024

Maximum : 100 marks

Time : 1 hour and 30 minutes

1. If A is an $m \times n$ matrix then the homogeneous system of linear equation $AX = 0$ has a non trivial solution if
- (A) $m < n$ (B) $m > n$
(C) $m = n$ (D) $m \neq n$
2. Let T be a linear transformation from V into W . Then T preserve linear independence iff
- (A) T is onto (B) T is singular
(C) T is non singular (D) None of these
3. Let V be an n dimensional vector space and W an m dimensional vector space then $L(V, W)$, the set of all linear transformation from V into W is of dimension
- (A) $\frac{m}{n}$ (B) $m + n$
(C) $m - n$ (D) mn
4. Let F be a field and T be a linear operator on F^2 defined by $T(x_1, x_2) = (x_1, 0)$. T to then matrix of T relative to the standard ordered basis is
- (A) $\begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}$ (B) $\begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$
(C) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ (D) $\begin{bmatrix} 1 & 1 \\ 0 & 0 \end{bmatrix}$
5. If T is a linear operator on a finite dimensional vector space V and let c be a scalar then the operator $T - cI$ is
- (A) Non singular (B) Singular
(C) Invertible (D) None of these

6. Let W be a subspace of an inner product space V and β be an arbitrary vector in V . Then best approximation to β by vectors in W is a vector α in W such that for every vector γ in W
- (A) $\|\beta - \alpha\| \geq \|\beta - \gamma\|$ (B) $\|\beta - \alpha\| > \|\beta - \gamma\|$
(C) $\|\beta - \alpha\| \leq \|\beta - \gamma\|$ (D) $\|\beta - \alpha\| < \|\beta - \gamma\|$
7. Let V be an inner product space and S be a set of vectors in V which is orthogonal. Then S is said to be orthonormal set if for every α in S
- (A) $\|\alpha\| = 1$ (B) $\|\alpha\| > 1$
(C) $\|\alpha\| < 1$ (D) $\|\alpha\| \neq 1$
8. Using Squeeze theorem the value of the $\lim\left(\frac{\sin n}{n}\right) =$
- (A) 0 (B) 1
(C) ∞ (D) None of these
9. If (x_n) be a bounded sequence of real numbers then it has a
- (A) Convergent Subsequence (B) Divergent Subsequence
(C) Divergent Sequence (D) None of these
10. Let I be a closed bounded interval and let $f : I \rightarrow \mathbb{R}$ continuous on I . Then f is
- (A) Continuous on I (B) Discontinuous on I
(C) Uniformly continuous on I (D) None of these
11. Which of the following function on $[a, b]$ is not Riemann integrable.
- (A) Step function (B) Monotone function
(C) Dirichlet function (D) Continuous function
12. If f is a real valued function then which of the following is not true for Rolle's theorem
- (A) f is continuous on (a, b) (B) Differentiable on (a, b)
(C) $f(a) = f(b)$ (D) f is continuous on $[a, b]$

13. If $a > 0$ then the improper integral is $\int_a^{\infty} \frac{1}{x^p} dx$ is
- (A) Convergent if $p < 1$ (B) Convergent if $p > 1$
(C) Divergent if $p > 1$ (D) None of these
14. If f is real valued function then the following is not true for mean value theorem
- (A) f is continuous on $[a, b]$
(B) Differentiable on (a, b)
(C) There exist at least one $c \in (a, b)$ such that $f'(c) = \frac{f(b) - f(a)}{b - a}$
(D) $f'(c) = 0$
15. If the outer measure, $m^*(A) = 0$ then A is
- (A) Finite (B) Countable
(C) Uncountable (D) Can't say
16. If E is measurable set and consider the following statements:
- (i) E is a cantor set
(ii) E is an F_σ or G_δ set
(iii) E is a Borel set
(iv) E is \mathbb{R} , set of real numbers
- Then which of the following is correct
- (A) Only (i) and (iv) are correct (B) Only (i), (ii) and (iv) are correct
(C) All (i), (ii), (iii) and (iv) are correct (D) Only (iv) is correct
17. A sphere of unit radius is centered at the origin. The unit normal at a point (x, y, z) on the surface of the sphere is the vector
- (A) (x, y, z) (B) $\left(\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}\right)$
(C) $\left(\frac{x}{\sqrt{3}}, \frac{y}{\sqrt{3}}, \frac{z}{\sqrt{3}}\right)$ (D) $\left(\frac{x}{\sqrt{2}}, \frac{y}{\sqrt{2}}, \frac{z}{\sqrt{2}}\right)$

18. If $x = r \cos \theta, y = r \sin \theta$ then $\frac{\partial(x,y)}{\partial(r,\theta)}$ equals

(A) 0

(B) 1

(C) r

(D) $\frac{1}{r}$

19. The value of the integral $\int_0^{\infty} \sqrt{x} \cdot e^{-x} dx$ is

(A) $\sqrt{\pi}$

(B) $\frac{\sqrt{\pi}}{2}$

(C) $-\sqrt{\pi}$

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

20. The value of $\beta(m, n+1)$ is

(A) $\frac{m}{m+n}$

(B) $\frac{m}{m+n} \beta(m, n)$

(C) $\frac{n}{m+n} \beta(m, n)$

(D) $\beta(n, m+1)$

21. The value of a_0 for the function $f(x) = \begin{cases} 0, & -\pi \leq x < 0 \\ x^2, & 0 \leq x \leq \pi \end{cases}$ in the Fourier series

$$f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty} (a_n \cos nx + b_n \sin nx)$$

(A) π^2

(B) $\frac{\pi^2}{3}$

(C) $\frac{\pi^2}{6}$

(D) $\frac{\pi^2}{2}$

22. Let G be a group and $a \in G$ such that $a^{10} = e = a^{25}$ and $a \neq e$ where e is the identity element of G . Then order of a is

(A) 10

(B) 250

(C) 1

(D) 5

23. The number of group homomorphism from \mathbb{Z}_{10} to \mathbb{Z}_{20} is

(A) 0

(B) 1

(C) 5

(D) 10

24. Let G be an infinite cyclic group. Then number of generators of G is
- (A) 1 (B) Infinite
(C) 2 (D) 3
25. Number of elements of order 6 is S_6
- (A) 240 (B) 360
(C) 120 (D) 720
26. Let G be a group of order 15. Then the number of Sylow subgroups of G of order 3 is
- (A) 0 (B) 1
(C) 3 (D) 5
27. The number of elements of order 5 in the group $\mathbb{Z}_{15} \times \mathbb{Z}_5$
- (A) 16 (B) 24
(C) 8 (D) 4
28. Let G be a cyclic group of order 24 generated by a . Then order of a^{10} is
- (A) 24 (B) 18
(C) 12 (D) 6
29. Let $(\mathbb{Z}, \oplus, *)$ be the ring of integers with \oplus and $*$ defined by $a \oplus b = a + b - 1$ and $a * b = a + b - ab$. Consider the following statements:
- (i) 1 and 0 are additive and multiplicative identities.
- (ii) $2 - a$ and $\frac{a}{a-1}$ are additive and multiplicative inverses of 'a'
- (iii) 1 and a are additive and multiplicative identities.
- (iv) $2 - a$ and 0 are additive and multiplicative inverses of 'a'

Then choose the correct option:

- (A) Only (i) is true (B) Only (i) and (ii) are true
(C) Only (iii) is true (D) Only (iii) and (iv) are true

30. $\frac{\mathbb{Z}[i]}{n\mathbb{Z}[i]}$ is a field when x is
- (A) 2 (B) 9
(C) 13 (D) 19
31. The solution of $3x = 4$ in the field $(\mathbb{Z}_7, +_7, \cdot_7)$ is
- (A) 0 (B) 2
(C) 4 (D) 6

32. Consider the statements:

- (i) $x^2 - 3$ is irreducible over the field of rational numbers.
(ii) $x^2 - 5$ is irreducible over the field of rational numbers.
(iii) $x^2 - 7$ is reducible over the field irrational numbers.

Then which of the following options are correct.

- (A) (i) and (ii) are correct (B) (i) and (iii) are correct
(C) (i), (ii) and (iii) are correct (D) Only (iii) is correct
33. Which of the following cannot be the cardinality of a field.
- (A) 10 (B) 125
(C) 8 (D) 27

34. If $ED =$ Euclidean domain,

PID = Principal Ideal Domain,

UFD = Unique Factorization Domain

$F =$ Field, then which of the following is correct.

- (A) $PID \Rightarrow UFD \Rightarrow ED$ (B) $ED \Rightarrow PID \Rightarrow UFD$
(C) $UFD \Rightarrow PID \Rightarrow ED$ (D) $UFD \Rightarrow F$

35. Let R be a ring and C -denotes, a commutative ring with unity, D -denotes a commutative ring with unity and without zero divisors, E -denotes integral domain and F -denotes a field.

Choose the incorrect option:

- (A) If R is C , then $R[x]$ is also C (B) If R is D , then $R[x]$ is also D
(C) If R is E , then $R[x]$ is also E (D) If R is F , then $R[x]$ is also F

36. Which of the following is a correct statement?

- (A) Every metric space is a topological space
(B) Every topological space is a metric space
(C) All topological spaces are pseudo metrisable
(D) All of the above

37. Which of the following statement is wrong about compactness of a topological space?

- (A) Compactness is preserved under continuous function
(B) Compactness is an absolute property
(C) Compactness is hereditary
(D) Every infinite subset A of a compact space X has at least one accumulation point in X

38. Strongest topology on the real line R is

- (A) Usual topology (B) Cofinite topology
(C) Semi open interval topology (D) Discrete topology

39. Which of the following is a connected subset of R with usual topology?

- (A) $(1,2)$ (B) $(0,3) \cup (5,6)$
(C) $\{1,2,3\}$ (D) The set N of natural numbers

40. Which of the following is true about a Hausdorff space (X, τ)

- (A) Limits of sequences are unique
(B) Every singleton set $\{x\}$ is closed
(C) Every compact subset of X are closed
(D) All of the above

41. Let $X = \{1, 2, 3, 4\}$, $\tau = \{X, \emptyset, \{1\}, \{2, 3\}, \{1, 2, 3\}, \{4\}, \{1, 4\}, \{2, 3, 4\}\}$
- Which of the following is a base for τ ?
- (A) $B_1 = \{\{1\}, \{2, 3\}\}$ (B) $B_2 = \{\{1\}, \{2\}, \{3\}, \{4\}\}$
(C) $B_3 = \{\{1\}, \{2, 3\}, \{4\}\}$ (D) $B_4 = \{X, \{1\}\}$
42. Choose the correct statement:
- (A) Every surjective map is a quotient map
(B) Every closed, injective map is a quotient map
(C) Every bijective map is a quotient map
(D) Every open bijective map is a quotient map
43. Real part of $\frac{1}{1+i}$ is
- (A) 1 (B) -1
(C) $\frac{1}{2}$ (D) 0
44. Cauchy Riemann equations are given by
- (A) $u_x = v_x, u_y = v_y$ (B) $u_x = v_y, u_y = -v_x$
(C) $u_x = -v_y, u_y = v_x$ (D) $u_x = v_x, u_y = -v_y$
45. Which of the following functions is harmonic
- (A) $u = e^x \cos 2y$ (B) $u = x^3 - 3xy^2$
(C) $u = x^3 + 2xy$ (D) $u = x^2 + y^2$
46. Evaluate $\int_C \frac{1}{z} dz$ where C is any positively oriented closed contour surrounding the origin.
- (A) $2\pi i$ (B) 0
(C) 2π (D) π
47. The transformation $W = \frac{1}{z}$ maps a vertical line $x = c$ onto
- (A) Horizontal line (B) Vertical line
(C) Circle (D) Ellipse

48. Find the radius of convergence of the power series $\sum_{n=0}^{\infty} \frac{z^n}{n!}$
- (A) 0 (B) 1
(C) $\frac{1}{2}$ (D) ∞
49. Identify the singularity of $f(z) = \frac{\sin z}{z}$ at $z=0$
- (A) Essential Singularity (B) Removable Singularity
(C) Pole of order 2 (D) Pole of order 1
50. Let X be an inner product space. Then the orthogonal complement of $\{0\}$ is :
- (A) X (B) $\{0\}$
(C) $X \setminus \{0\}$ (D) X^\perp
51. Which of the following linear space is infinite dimensional?
- (A) R over Q (B) Q over Q
(C) C over C (D) C over R
52. If $T : R^3 \rightarrow R^2$ is the projection operator given by $T(x, y, z) = (x, y)$ then $\|T\|$ is :
- (A) $\frac{1}{\sqrt{2}}$ (B) $\sqrt{2}$
(C) 1 (D) ∞
53. With the usual inner product on R^3 , the vectors x, y, z forms an orthonormal basis. If $x = \left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}, 0\right)$, $y = (0, 0, 1)$ then z can choose to be :
- (A) $(0, 1, 0)$ (B) $\left(0, \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$
(C) $(0, 0, 1)$ (D) $\left(\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}, 0\right)$
54. Let T be any operator on a Hilbert space H and α, β are scalars such that $|\alpha| = |\beta|$, then $\alpha T + \beta T^*$ is :
- (A) Unitary (B) Normal
(C) Selfadjoint (D) None of these

55. Let x, y be elements of a Hilbert space H , such that $\|x\| = 3, \|y\| = 4$ and $\|x + y\| = 7$, then $\|x - y\|$ equals :
- (A) 1 (B) 2
(C) 3 (D) $\sqrt{2}$
56. A bounded operator $A : H \rightarrow H$ where H is a Hilbert space is called self adjoint if and only if :
- (A) $\langle Ax, y \rangle = 0$ (B) $\langle Ax, y \rangle = 1$
(C) $\langle Ax, y \rangle = \langle x, Ay \rangle \forall x, y \in H$ (D) None of these
57. The order and degree of the differential equation $\frac{dy}{dx} = \left[1 + \left(\frac{d^2y}{dx^2} \right)^2 \right]^{\frac{1}{2}}$ is respectively :
- (A) 2, 1 (B) 1, 2
(C) 1, 1 (D) 2, 2
58. Integrating factor of the differential equation $(x^2 + 1) \frac{dy}{dx} + 4xy = x$ is :
- (A) $(x^2 + 1)^2$ (B) $x^2 + 1$
(C) $\frac{1}{x^2 + 1}$ (D) $\frac{1}{(x^2 + 1)^2}$
59. Consider the ordinary differential equation $y'(x) = f(y(x))$. If f is an even function and y is an odd function then :
- (A) $y(-x)$ is a solution (B) $-y(-x)$ is a solution
(C) $-y(x)$ is a solution (D) $y(x)y(-x)$ is a solution
60. The general solution of $\frac{d^2y}{dx^2} - 8\frac{dy}{dx} + 16y = 0$ is :
- (A) $C_1 e^{4x} + C_2 e^{4x}$ (B) $C_1 e^{4x} - C_2 e^{4x}$
(C) $(C_1 + C_2 x) e^{4x}$ (D) $(C_1 x + C_2 x^2) e^{4x}$

61. The Wronskian of the solutions e^x, e^{-x} and e^{2x} of the differential equation $\frac{d^3y}{dx^3} - 2\frac{d^2y}{dx^2} - \frac{dy}{dx} + 2y = 0$:
- (A) $6e^{2x}$ (B) $-6e^{2x}$
(C) $6e^{-2x}$ (D) $-6e^{-2x}$
62. The partial differential equation $5\frac{\partial z^2}{\partial x^2} + 6\frac{\partial z^2}{\partial y^2} = xy$ is :
- (A) Elliptic (B) Parabolic
(C) Hyperbolic (D) None of these
63. Let $u(x, y) = 2f(y)\cos(x - 2y)$, $(x, y) \in R^2$ be a solution of the initial value problem $2u_x + u_y = u$, $u(x, 0) = \cos x$, then $f(1)$ equal to :
- (A) $\frac{1}{2}$ (B) $\frac{e}{2}$
(C) e (D) $\frac{3e}{2}$
64. $\sigma_o(p^a)$ where p is a prime number is :
- (A) 1 (B) a
(C) $a+1$ (D) O
65. $\phi(55)$ is :
- (A) 54 (B) 40
(C) 55 (D) 51
66. If p is prime, then for any integer a :
- (A) $a^{p-1} \equiv 1 \pmod{p}$ (B) $a^{p-1} \equiv -1 \pmod{p}$
(C) $a^p \equiv -a \pmod{p}$ (D) $a^p \equiv a \pmod{p}$
67. The solution of $25x \equiv 15 \pmod{29}$ is :
- (A) $x \equiv 18 \pmod{29}$ (B) $x \equiv 29 \pmod{29}$
(C) $x \equiv 18 \pmod{19}$ (D) $x \equiv 17 \pmod{19}$
68. The linear congruence $ax \equiv b \pmod{m}$ has exactly one solution if :
- (A) $(b, m) = 1$ (B) $(a, b) = 1$
(C) $(b, m) = a$ (D) $(a, m) = 1$

69. $\phi(101^3)$ is :
- (A) 1021100 (B) 1020100
(C) 1021000 (D) 1022000
70. $3^{31} \pmod{7}$ is :
- (A) 3 (B) 7
(C) 31 (D) 17
71. Which of the following is a crucial factor for fostering a positive teacher-student relationship?
- (A) Maintaining a distant and authoritative demeanor
(B) Ignoring students' personal experiences and backgrounds
(C) Demonstrating empathy, understanding, and respect
(D) Minimizing student participation in discussions
72. In the context of the flipped classroom model, what is the primary role of in-class time?
- (A) Traditional lectures
(B) Homework assignments
(C) Collaborative and interactive activities
(D) Standardized testing
73. The main objective of teaching is to :
- (i) Maintain strict classroom discipline
(ii) Develop a sense of competition among students
(iii) Facilitate learning and promote understanding
- (A) Only (i) (B) Only (ii)
(C) Only (iii) (D) Both (ii) and (iii)
74. What cognitive attribute is associated with the concept of the "zone of proximal development" (ZPD)?
- (A) Mastery of independent tasks
(B) Tasks that are too difficult for the learner
(C) Tasks that can be performed with assistance
(D) Evaluation of prior knowledge

75. Teacher-student rapport and communication skills are examples of :
- (i) Internal factors affecting teaching
 - (ii) External factors affecting teaching
 - (iii) Socio-economic factors affecting teaching
- (A) Only (i) (B) Only (ii)
(C) Only (iii) (D) Both (i) and (ii)
76. Applied research is primarily conducted to :
- (i) Expand theoretical knowledge without practical application
 - (ii) Address specific real-world problems and provide solutions
 - (iii) Ignore the relevance of practical implications
- (A) Only (i) (B) Only (ii)
(C) Only (iii) (D) Both (ii) and (iii)
77. The term “Hypothesis” in research refers to :
- (A) A proven fact
 - (B) A tentative statement that can be tested and verified
 - (C) Ignoring the need for systematic inquiry
 - (D) Final solution of the Research Problem
78. What is a key consideration during the data collection phase of research?
- (A) Minimizing the diversity of data sources
 - (B) Collecting data without a specific plan
 - (C) Ensuring data reliability and validity
 - (D) Relying solely on secondary data
79. What distinguishes experimental research from other research methods?
- (A) Absence of manipulation of variables
 - (B) Focus on qualitative data collection
 - (C) Control over independent variables to establish causation
 - (D) Reliance on naturalistic observations
80. Informed consent in research involves :
- (i) Withholding information from participants to avoid bias
 - (ii) Ensuring that participants are fully aware of the study’s purpose, procedures, and risks before agreeing to participate
 - (iii) Ignoring the need for transparency in the research process
- (A) Only (i) (B) Only (ii)
(C) Only (iii) (D) Both (ii) and (iii)

81. On which day is 'Samvidhan Divas' celebrated in our country?
(A) January 26 (B) November 26
(C) August 26 (D) October 26
82. An interpretation of the Constitution of India is based on the spirit of :
(A) Preamble (B) Directive Principles
(C) Fundamental Rights (D) Fundamental Duties
83. Fundamental Rights can be suspended during :
(A) National Emergency
(B) Financial Emergency
(C) Both National and Financial Emergency
(D) None of the above
84. To uphold and protect the sovereignty, unity and Integrity of India is a provision mentioned in :
(A) Article 51 (B) Article 51A
(C) Article 37 (D) Article 32
85. Right to privacy as a fundamental right is implied in :
(A) Article 22 (B) Article 17
(C) Article 21 (D) Article 50
86. Who called the preamble to Indian Constitution as 'Soul of the Constitution'?
(A) Dr. B.R. Ambedkar (B) Pandit Jawaharlal Nehru
(C) Pandit Thakur Das Bhargava (D) Dr. Rajendra Prasad
87. Which is known as the 'Mini Constitution'?
(A) 42nd Amendment (B) 44th Amendment
(C) 52nd Amendment (D) 73rd Amendment
88. Which of the rights was considered the 'Heart and Soul' of the Indian Constitution by Dr. B.R. Ambedkar?
(A) Right to Freedom of speech (B) Right to Equality
(C) Right to Freedom of Religion (D) Right to Constitutional Remedies
89. Which of the following Articles of the Constitution of India safeguards the rights of minorities to establish and run educational institutions of their own liking?
(A) Article 19 (B) Article 30
(C) Article 34 (D) Article 33

90. Right to property is a :
- (A) Fundamental Right
(B) Constitutional Right
(C) Both Fundamental and Constitutional Right
(D) Neither Fundamental nor Constitutional Right
91. Which organisation released the impact of disaster on agriculture and food security?
- (A) NABARD (B) NITI AAYOG
(C) FAO (D) UNEP
92. In which year the Kerala state literacy mission authority was set up?
- (A) 1997 (B) 1998
(C) 1999 (D) 1996
93. Who was the first Non-Brahmin to ring the temple bell of the famous Guruvayoor temple?
- (A) P. Krishna Pillai (B) A.K. Gopalan
(C) K. Kelappan (D) Sree Narayana Guru
94. In which year Kerala Infrastructure Investment Fund Board (KIIFB) was established?
- (A) 11.11.1998 (B) 10.10.1999
(C) 11.11.1999 (D) 9.9.1999
95. Which of the following statement is/are correct about Malayali Memorial?
- (i) The Malayali Memorial was a petition given in 1891 during the time of Srimoolam Thirunal Maharaja
(ii) Barrister G.P. Pillai was the leader of Malayali Memorial
(iii) K.P. Shankara Menon first signed the Malayali Memorial
(iv) In Travancore, Political agitation started in 1891 with Malayali Memorial
- (A) Only (i) and (ii) (B) Only (ii)
(C) Only (i), (ii) and (iii) (D) All the above

96. Which of the following statement is/are wrong about Anna Chandy?
- (i) First woman Judge of India
 - (ii) She was born in 1905
 - (iii) Jeevitha katha is the autobiography of Anna Chandy
 - (iv) She founded and edited the journal 'Shreemati'
- (A) Only (i) (B) Only (ii)
(C) Only (iii) (D) Only (iv)
97. Who is the author of the book Athmavilasam?
- (A) Sree Narayana Guru (B) K.P. Keshava Menon
(C) Ayya Vaikunda (D) Chattampi Swamikal
98. Which of the following statement is/are wrong?
- (i) The Nair Service society was founded in 1916
 - (ii) The Temple entry proclamation was signed by Sri. Chithira Thirunal on the eve of his 24th birthday
 - (iii) A. G. Velayudhan was killed in a police lathi charge during Paliyam Sathyagraha
 - (iv) In 1928 Sahodaran Ayyappan became the editor of the Magazine Yukthivadi
- (A) Only (i), (ii) and (iii) (B) Only (iii) and (iv)
(C) Only (i) (D) Only (i) and (ii)
99. Who organised Savarnajatha during Vaikom Sathyagraha?
- (A) Mannath Padamanabhan (B) T. K. Madhavan
(C) K. Kelappan (D) A.K. Gopalan
100. Who is appointed as Managing Director of State Bank of India
- (A) Maneesh Kapoor (B) Sandip Garg
(C) Vinay Tonse (D) Navneet Munof

SPACE FOR ROUGH WORK

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