DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE TOLD TO DO SO

TBC : RT/SL/Mts/P2/2024 **Booklet No :** 0284

ROLL NO.								

D

Time Allowed : 2 Hours] [Maximum Marks : 100

IMPORTANT INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, CANDIDATE SHOULD CHECK THAT THIS TEST BOOKLET DOES NOT HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. Please note that it is the candidate's responsibility to encode and fill in the Roll Number, Application No. and Test Booklet Series A, B, C or D carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet with blue or black ball pen. Any error detected in the scanned data of the Answer Sheet due to wrong encoding of either Application No. or Roll No. or both by the candidate, his/her Answer Sheet shall not be evaluated and shall be rejected straight away.
3. You have to enter your Roll Number in the space provided in the Test Booklet. DO NOT write anything else on the Test Booklet. Sheet(s) for rough work is/are appended in the Test Booklet at the end.
4. This Test Booklet contains **100** items (questions). Each question (item) comprises four (A, B, C, D) responses/answers. The candidate will have to encode/blacken with blue/black ball pen on the circle of the option he/she thinks is correct in OMR answer sheet. You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose ONLY ONE response for each item. IN CASE THE CANDIDATE DOES NOT WANT TO ANSWER A QUESTION TO AVOID NEGATIVE MARKING, HE/SHE SHALL HAVE TO ENCODE/BLACKEN THE OPTION "E" IN THE OMR ANSWER SHEET AS UNDER :

Response				If you do not want to answer a question, darken the option Ⓔ.
Ⓐ	Ⓑ	Ⓒ	Ⓓ	● E
IF ANY ANSWER IS LEFT BLANK AND NONE OF THE OPTION IS ENCIRCLED/BLACKENED THEN IT WILL ALSO RESULT IN NEGATIVE MARKING.				

5. You shall have to mark your responses ONLY on the separate OMR Answer Sheet provided. See directions in the OMR Answer Sheet. All items carry equal marks.
6. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the OMR Answer Sheet as per entries given in their downloaded Admission Letter.
7. After you have completed filling in all your responses on the OMR Answer Sheet and the examination has concluded, you will have to hand over Original Copy of OMR Answer Sheet to the Invigilator only. You are permitted to take away with you Test Booklet & candidate's copy of OMR Answer Sheet only.
8. There shall be *NEGATIVE* marking for wrong answer(s) marked by the candidate as under :–
   (*a*) For each question for which a wrong answer has been given by the candidate, one-fourth (0.25) of the marks assigned to that question will be deducted as penalty.
   (*b*) If a candidate gives more than one answer, it will be treated as a wrong answer even if one of the given answers happens to be correct and there will be same penalty as above for that question also i.e. one-fourth (0.25) of the marks assigned to that question will be deducted as penalty.
   (*c*) If a question is left blank i.e. no circle is blackened/encoded by the candidate, there will be same penalty as above for that question i.e. one-fourth (0.25) of the marks assigned to that question will be deducted as penalty.
   (*d*) Where there are two correct answers instead of one correct answer out of four options (A, B, C, D) of a question, all those candidates who will encircle/blacken any one of these two correct answers will be awarded marks allotted to that question.
9. No marks shall be awarded for scrapped question.

USE OF MOBILE PHONE OR COMMUNICATION DEVICE IS STRICTLY BANNED IN THE EXAMINATION

1. For any real number $x, \lim_{n\to\infty} \frac{x^n}{n!} =$

(A) 0

(B) 1

(C) ∞

(D) does not exist

2. $\lim_{n\to\infty} \sqrt[n]{n} =$

(A) 0

(B) 1

(C) n

(D) ∞

3. Let A be the series $\frac{2^2}{3^2} + \frac{2^2 \cdot 4^2}{3^2 \cdot 5^2} + \frac{2^2 \cdot 4^2 \cdot 6^2}{3^2 \cdot 5^2 \cdot 7^2} + \ldots\ldots\ldots$ and

let B be the series $0 - \frac{1}{2} + \frac{1}{2^2} - \frac{1}{3} + \frac{2}{3^2} - \frac{1}{4} + \frac{3}{4^2} - \ldots\ldots\ldots$ then

(A) A converges and B diverges

(B) A diverges and B converges

(C) A and B both converge

(D) A and B both diverge

4. Let f be defined by $f(x) = \begin{cases} x^2 \sin \frac{1}{x} & x \neq 0 \\ 0 & x = 0 \end{cases}$

Then :

(A) f is differentiable at 0 and $\lim_{x\to 0} f'(x) = f'(0)$

(B) f is differentiable at 0 and $\lim_{x\to 0} f'(x) \neq f'(0)$

(C) f is not differentiable at 0 and $\lim_{x\to 0} f'(x)$ does not exist

(D) f is not differentiable at 0 but $\lim_{x\to 0} f'(x)$ exist

5. Lagrange's mean value theorem states that : if a function f is defined on $[a, b]$ and is continuous $[a, b]$ and differentiable on (a, b), then there exists at least one real number $c \in (a, b)$ such that :

(A) $\frac{f(b) - f(a)}{b - a} = f(c)$

(B) $\frac{f'(b) - f'(a)}{b - a} = f(c)$

(C) $\frac{f'(b) - f'(a)}{b - a} = f'(c)$

(D) $\frac{f(b) - f(a)}{b - a} = f'(c)$

6. $\lim_{x \to 0} \frac{x - \tan x}{x^3} =$

(A) 0

(B) $\frac{1}{3}$

(C) $-\frac{1}{3}$

(D) ∞

7. If $f(x) = [x]$ where $[x]$ denotes the greatest integer not greater than x, then $\int_0^3 f(x)\,dx =$

(A) 0

(B) 3

(C) 3–{1, 2}

(D) is not integrable

8. If P* is a refinement of the partition P and L(P, f, α) and U(P, f, α) denote the lower and upper sum of f corresponding to the partition P and α, which is monotonic increasing function on $[a, b]$, then :

(A) $L(P^*, f, \alpha) \geq L(P, f, \alpha)$ and $U(P^*, f, \alpha) \leq U(P, f, \alpha)$

(B) $L(P^*, f, \alpha) \leq L(P, f, \alpha)$ and $U(P^*, f, \alpha) \leq U(P, f, \alpha)$

(C) $L(P^*, f, \alpha) \leq L(P, f, \alpha)$ and $U(P^*, f, \alpha) \geq U(P, f, \alpha)$

(D) $L(P^*, f, \alpha) \geq L(P, f, \alpha)$ and $U(P^*, f, \alpha) \geq U(P, f, \alpha)$

9. If f is continuous on $[a, b]$ and α is monotonic increasing on $[a, b]$, then there exists a number ξ in $[a, b]$ such that $\int_a^b f\, d\alpha =$

(A) $f'(\xi)\,(\alpha(b) - \alpha(a))$

(B) $f(\xi)\,(\alpha(b) - \alpha(a))$

(C) $\alpha'(\xi)\,(f(b) - f(a))$

(D) $\alpha(\xi)\,(f(b) - f(a))$

10. Let $\{f_n\}$ be the sequence defined by $f_n(x) = x^n$ and $\{g_n\}$ be the sequence defined by $g_n(x) = \frac{1}{x+n}$. Then :

(A) $\{f_n\}$ is uniformly continuous in $[0, k]$ for $k < 1$ and $\{g_n\}$ is uniformly continuous in $[0, k]$ for $k > 0$

(B) $\{f_n\}$ is uniformly continuous in $[0, k]$ for $k > 1$ and $\{g_n\}$ is uniformly continuous in $[0, k]$ for $k > 0$

(C) $\{f_n\}$ is uniformly continuous in $[0, k]$ for $k < 1$ and $\{g_n\}$ is uniformly continuous in $[0, k]$ for $k > 0$

(D) both $\{f_n\}$ and $\{g_n\}$ are never uniformly continuous in $[0, k]$ for any positive real number k

11. Which of the following is a *correct* statement ?

(A) Every field is also a ring and every ring has multiplicative identity

(B) Every field is also a ring and every element in a ring has additive inverse

(C) Every ring is a field and every element in a field has multiplicative inverse

(D) Every ring is a field and every element in a field has additive inverse

12. Which of the following is NOT a correct statement ?

(A) Every field is an integral domain

(B) Every finite integral domain is a field

(C) Every integral domain is a field

(D) Cancellation law holds in any ring which is isomorphic to an integral domain

13. If UFD denotes unique factorization domain and PID denotes principal ideal domain, then which of the following is NOT true ?

(A) Every field is UFD

(B) Every PID is UFD

(C) Every UFD is PID

(D) A UFD has no divisors of zero

14. Cayley's theorem states that :

(A) Every group is isomorphic to a group of permutation

(B) Only finite groups are isomorphic to a group of permutation

(C) Every group of prime order is cyclic

(D) Every cyclic group is abelian

15. If $\sigma = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 3 & 1 & 4 & 5 & 6 & 2 \end{pmatrix}$ and $\tau = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 2 & 4 & 1 & 3 & 6 & 5 \end{pmatrix}$ are two permutations in the symmetric group S_6, then $\sigma\tau^2 =$

(A) $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 6 & 4 & 2 & 1 & 5 & 3 \end{pmatrix}$

(B) $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 2 & 3 & 4 & 5 & 6 & 1 \end{pmatrix}$

(C) $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 3 & 2 & 4 & 5 & 6 & 1 \end{pmatrix}$

(D) $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 2 & 4 & 1 & 5 & 6 & 3 \end{pmatrix}$

16. The number of generators of cyclic groups of orders 6, 8, 12 respectively are :

(A) 3, 4, 6

(B) 2, 4, 4

(C) 2, 4, 6

(D) 2, 4, 3

17. Which of the following is NOT correct ?

(A) Every subgroup of a cyclic group is cyclic

(B) Every subgroup of an abelian group is a normal subgroup

(C) Every subgroup of an abelian group is cyclic

(D) Every group of prime order is cyclic

18. Let **Z** and **Q** respectively denote the set of all integers and all rationals, then all the units of the rings **Z** + **Z** and the ring **Q** respectively are :

(A) 2, 1

(B) (1, 1), (1, –1), (–1, 1), (–1, –1) and all non-zero rationals

(C) (0, 1), (1, 0), (–1, 0), (0, –1) and all non-zero rationals

(D) (0, 1), (1, 0), (–1, 0), (0, –1) and 1, –1

19. Which of the following is NOT correct ?

(A) Every subgroup of an abelian group is a normal subgroup

(B) A factor group of a cyclic group is abelian

(C) A group is simple if it has no proper normal subgroup

(D) A group is simple if it has no subgroup

20. If H and K are finite subgroups of a group G, then :

(A) $|HK| = \frac{|H||K|}{|H \cup K|}$

(B) $|HK| = \frac{|H||K|}{|H \cap K|}$

(C) $|HK| = \frac{|H \cup K|}{|H \cap K|}$

(D) $|HK| = \frac{|H \cap K|}{|H||K|}$

21. A set A in a topological space X is said to be compact if :

(A) Every open cover of A has a countable subcover

(B) Every uncountable open cover of A has a countable subcover

(C) Every open cover of A has a finite subcover

(D) There exists an open cover of A which has a finite subcover

22. In a topological space X, which of the following is NOT correct ?

(A) Arbitrary union of open sets is open

(B) Finite intersection of open sets is open

(C) Finite union of open sets is open

(D) Arbitrary intersection of open sets is open

23. Let A be the open interval $(-1, 1)$ and let B be the closed interval $[-2, 2]$ in the real line R. Then :

(A) A is an open set and B is also an open set

(B) A is a closed set and B is also a closed set

(C) A is not open and B is also not open

(D) A is an open set and B is a closed set

24. Given the following differential equations :

(a) $3x^2y\,dx + (y + x^3)dy = 0$

(b) $xy\,dx + y^2\,dy = 0.$

Then :

(A) the equation (a) is exact and the equation (b) is also exact

(B) the equation (a) is exact and the equation (b) is not exact

(C) equation (a) is not exact and the equation (b) is exact

(D) the equation (a) is not exact and the equation (b) is also not exact

25. Given the following differential equations :

(a) $y'' - y = 0$

(b) $2e^x y''' + e^x y'' = 1.$

Then :

(A) the differential equation (a) is homogeneous and the differential equation (b) is non-homogeneous

(B) the differential equation (a) is homogeneous and the differential equation (b) is also homogeneous

(C) the differential equation (a) is non-homogeneous and the differential equation (b) is homogeneous

(D) the differential equation (a) is non-homogeneous and the differential equation (b) is also non-homogeneous

26. Consider the differential equations :

(*a*) $xy'' + y' + (x^2 + 1 + \lambda)y = 0$

(*b*) $e^x y'' + e^x y' + \lambda y = 0$

with the boundary conditions $y(0) = 0$, $y'(1) = 0$. Then :

(A) (*a*) is a Strum-Liouville problem (*b*) is a Strum-Liouville problem

(B) (*a*) is a Strum-Liouville problem (*b*) is not a Strum-Liouville problem

(C) (*a*) is not Strum-Liouville problem (*b*) is a Strum-Liouville problem

(D) (*a*) is not Strum-Liouville problem (*b*) is not a Strum-Liouville problem

27. Let V be a vector space over a field F. Let B = $\{a_1, a_2, \ldots\ldots, a_n\}$ be a finite non-empty subset of V. Let <B> denote the span of B. Then which of the following is NOT valid ?

(A) <B> is the set of all linear combinations of B

(B) <B> is a subspace of V

(C) If a subspace W contains B, then <B> $\subseteq$ W

(D) <B> is the largest subspace of V that contains B

28. Consider the vector space $\mathbf{R}^2$. Let $\alpha_1 = (1, 2)$, $\alpha_2 = (2, 1)$, $\alpha_3 = (1, 1)$, $\alpha_4 = (0, 0)$, $\alpha_5 = (1, 3)$. Then which of the following is NOT true ?

(A) α_1 and α_2 are linearly independent

(B) α_1, α_2 and α_3 are linearly dependent

(C) α_4 and α_5 are linearly independent

(D) α_4 and α_5 are linearly dependent

29. Let W_1 and W_2 be two finitely generated subspaces of a vector space V over a field F. Then which of the following is NOT true ?

(A) $W_1 + W_2$ is finitely generated

(B) $\dim (W_1 + W_2) = \dim (W_1) + \dim (W_2)$

(C) $\dim (W_1 + W_2) = \dim (W_1) + \dim (W_2) - \dim (W_1 \cap W_2)$

(D) there exists a subspace W_3 of W_2 such that $W_2 = (W_1 \cap W_2) + W_3$

30. For any $n \times n$ matrix A over a field F, three of the below statements are equivalent. Find the statement which is NOT equivalent ?

(A) Rank (A) = n

(B) A is singular

(C) A is non-singular

(D) The solution space of the system of homogeneous linear equations $AX = 0$ is the zero space

31. The eigen value of the matrix $\begin{bmatrix} 5 & -1 \\ 1 & 3 \end{bmatrix}$ is :

(A) 2

(B) 3

(C) 4

(D) 5

32. The eigen value λ and the corresponding eigen vector u for the matrix $\begin{bmatrix} 2 & -1 \\ -2 & 3 \end{bmatrix}$ are :

(A) $\lambda = 1, u = (1, 1) ; \lambda = 4, u = (1, -2)$

(B) $\lambda = 1, u = (1, -2) ; \lambda = 4, u = (1, 1)$

(C) $\lambda = 2, u = (2, 3) ; \lambda = 3, u = (-1, -2)$

(D) $\lambda = -2, u = (2, 3) ; \lambda = -1, u = (2, 3)$

33. The conjugate transpose of a matrix $A = \begin{bmatrix} 3-5i & 2+4i \\ 6+7i & 1+8i \end{bmatrix}$ is :

(A) $\begin{bmatrix} 3i-5 & 2i+4 \\ 6i+7 & i+8 \end{bmatrix}$

(B) $\begin{bmatrix} 3i-5 & 6i+7 \\ 2i+4 & i+8 \end{bmatrix}$

(C) $\begin{bmatrix} 3+5i & 6-7i \\ 2-4i & 1-8i \end{bmatrix}$

(D) $\begin{bmatrix} 6+7i & 1+8i \\ 3-5i & 2+4i \end{bmatrix}$

34. With the usual notations, the equations of osculating plane, normal plane and rectifying plane respectively are :

(A) $(\mathbf{R} - r) \cdot b = 0, (\mathbf{R} - r) \cdot t = 0, (\mathbf{R} - r) \cdot n = 0$

(B) $(\mathbf{R} - r) \cdot b = 0, (\mathbf{R} - r) \cdot n = 0, (\mathbf{R} - r) \cdot t = 0$

(C) $(\mathbf{R} - r) \cdot n = 0, (\mathbf{R} - r) \cdot t = 0, (\mathbf{R} - r) \cdot b = 0$

(D) $(\mathbf{R} - r) \cdot b = 1, (\mathbf{R} - r) \cdot t = 1, (\mathbf{R} - r) \cdot n = 1$

35. With the usual notations, the Serret-Frenet formulae are :

(A) $t' = -n,\ n' = \tau b - \kappa t,\ b' = -\kappa n$

(B) $t' = \kappa n,\ n' = \tau b - \kappa t,\ b' = -n$

(C) $t' = \kappa n,\ n' = \tau b + \kappa t,\ b' = n$

(D) $t' = -n,\ n' = \tau b + \kappa t,\ b' = -\kappa n$

36. If the function $f(x) = \begin{cases} c\ x^2 & 0 < x < 3 \\ 0 & \text{otherwise} \end{cases}$

is a density function, then the value of c must be :

(A) 9

(B) $\frac{1}{9}$

(C) 3

(D) $\frac{1}{3}$

37. If density function of a random variable X is given by $f(x) = \begin{cases} \frac{x}{2} & 0 < x < 2 \\ 0 & \text{otherwise} \end{cases}$,

then the expected value E(X) =

(A) $\frac{1}{2}$

(B) 1

(C) $\frac{3}{4}$

(D) $\frac{4}{3}$

38. If X is a random variable having mean μ and variance σ^2 which are finite. Then if $\in$ is any positive number, then :

(A) $P(|X-\mu| \geq \in) \leq \frac{\sigma^2}{\in^2}$

(B) $P(|X-\mu| \geq \in) \leq \frac{\sigma}{\in^2}$

(C) $P(|X-\mu| \geq \in) \leq \frac{\sigma^2}{\in}$

(D) $P(|X-\mu| \geq \in) \leq \frac{\sigma}{\in}$

39. A random variable is said to have Student's t-distribution with υ degrees of freedom if the random variable has density function $f(t)$ =

(A) $\frac{\Gamma\left(\frac{\upsilon+1}{2}\right)}{\sqrt{\upsilon\pi}\,\Gamma\left(\frac{\upsilon}{2}\right)}\left(1-\frac{t^2}{\upsilon}\right)^{-(\upsilon+1)/2}, \quad -\infty < t < \infty$

(B) $\frac{\Gamma\left(\frac{\upsilon+1}{2}\right)}{\sqrt{\upsilon\pi}\,\Gamma\left(\frac{\upsilon}{2}\right)}\left(1+\frac{t^2}{\upsilon}\right)^{(\upsilon+1)/2}, \quad -\infty < t < \infty$

(C) $\frac{\Gamma\left(\frac{\upsilon+1}{2}\right)}{\sqrt{\upsilon\pi}\,\Gamma\left(\frac{\upsilon}{2}\right)}\left(1+\frac{t^2}{\upsilon}\right)^{-(\upsilon+1)/2}, \quad -\infty < t < \infty$

(D) $\frac{\Gamma\left(\frac{\upsilon-1}{2}\right)}{\sqrt{\upsilon\pi}\,\Gamma\left(\frac{\upsilon}{2}\right)}\left(1+\frac{t^2}{\upsilon}\right)^{(\upsilon-1)/2}, \quad -\infty < t < \infty$

40. If X and Y are two continuous random variables, then the covariance of X and Y is given by Cov (X, Y) =

(A) $E(X + Y) - E(X - Y)$

(B) $E(X \cup Y) - E(X \cap Y)$

(C) $E(XY) - \{E(X) + E(Y)\}$

(D) $E(XY) - E(X)E(Y)$

41. If $X = \{a, b, c\}$, then which of the below is NOT a topology on X ?

(A) $\tau = \{X, \phi, \{a\}\}$

(B) $\tau = \{X, \phi, \{a\}, \{b\}, \{a, b\}\}$

(C) $\tau = \{X, \phi, \{a\}, \{b\}, \{c\}\}$

(D) $\tau = \{X, \phi, \{a\}, \{b\}, \{c\}, \{a, b\}, \{b, c\}, \{c, a\}\}$

42. Let $X = \{a, b, c, d, e\}$ and $\tau = \{X, \phi, \{a\}, \{a, b\}, \{a, c, d\}, \{a, b, c, d\}, \{a, b, e\}\}$ then the derived set of $\{c, d, e\}$ is :

(A) $\{a\}$

(B) $\{a, b\}$

(C) $\{c, d\}$

(D) $\{c, d, e\}$

43. If C is a connected subset of a topological space X which has a separation $X = A|B$, then :

(A) $C \subseteq A$ and $C \subseteq B$

(B) either $C \subseteq A$ or $C \subseteq B$

(C) either $A \subseteq C$ or $B \subseteq C$

(D) either $A = C$ or $B = C$

44. In a topological space if i (A) denotes interior of A and c(A) denotes closure of A, then :

(A) $i(A \cup B) = i(A) \cup i(B)$

(B) $c(A \cap B) = c(A) \cap c(A)$

(C) $i(i(A) = A$

(D) If A and B are open sets, then $i(c(A \cap B)) = i(c(A)) \cap i(c(B))$

45. Which of the following statements is NOT correct ?

(A) Every subset of compact space is compact

(B) Continuous image of compact set is compact

(C) Every closed subset of compact space is compact

(D) Continuous image of connected set is connected

46. Let X = $\{a, b, c\}$ and $\tau = \{X, \phi, \{a\}, \{b, c\}\}$, then (X, τ) is :

(A) regular and T_1 space

(B) regular but not T_1 space

(C) not regular but T_1 space

(D) not regular and not T_1 space

47. Which of the following is NOT true ?

(A) Every Hausdorff space is a T_1 space

(B) Every T_4 space is a T_3

(C) Every regular space is completely regular

(D) Every metric space is T_4 space

48. Let X be an uncountable set and τ be the family consisting of ϕ and all complements of countable sets, then (X, τ) is :

(A) not a topological space

(B) T_1 space but not T_2 space

(C) T_2 space but not T_3 space

(D) T_3 space but not T_4 space

49. Let (X, τ) and (X^*, τ^*) be topological spaces. Then which of the following is NOT equivalent to (A) ?

(A) $f : X \to X^*$ is continuous on X

(B) If V is any open set in X^*, then $f^{-1}(V)$ is open in X

(C) If V is any closed set in X^*, then $f^{-1}(V)$ is closed in X

(D) If V is any open set X, then $f(V)$ is open in X^*

50. Which of the following is true ?

(A) Connected topological space is arcwise connected

(B) Arcwise connected topological space is connected

(C) An open and connected subset of the plane is not arcwise connected

(D) None of the above

51. Let A be the open interval (–1, 1) and B be the closed interval [–2, 2] in the complex plane **C**. Then :

(A) A is an open set and B is a closed set

(B) A is open set and B is also open set

(C) A is a closed set and B is also a closed set

(D) None of the above

52. The function $f(z) = \frac{\sin z}{z}$ has :

(A) pole at 0

(B) isolated essential singularity at 0

(C) non-isolated singularity at 0

(D) removable singularity at 0

53. Let $f(z) = u(x, y) + i\, v(x, y)$ be analytic in a region D. Then :

(A) $\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}, \frac{\partial v}{\partial x} = \frac{\partial u}{\partial y}$

(B) $\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}, \frac{\partial v}{\partial x} = -\frac{\partial u}{\partial y}$

(C) $\frac{\partial u}{\partial x} = -\frac{\partial v}{\partial y}, \frac{\partial v}{\partial x} = \frac{\partial u}{\partial y}$

(D) $\frac{\partial u}{\partial x} = -\frac{\partial v}{\partial y}, \frac{\partial v}{\partial x} = -\frac{\partial u}{\partial y}$

54. The radius of convergence of the series $\sum_{n=1}^{\infty} \frac{z^{2n}}{4^n n^k}$ is :

(A) 0

(B) 1

(C) 2

(D) ∞

55. Let $f(z) = \int_{\Gamma} e^{\sin z}\, dz$ where Γ is the unit circle $e^{i\theta}, (0 \le \theta \le 2\pi)$. Then the value of $f(z)$ is :

(A) $\frac{e^{\sin\theta}}{\cos\theta}$

(B) 0

(C) ∞

(D) does not exist

56. A Mobius transformation which maps 2, i, –2 to the point 1, i, –1 respectively is :

(A) $\frac{3z - 2i}{iz + 6}$

(B) $\frac{3z + 2i}{iz + 6}$

(C) $\frac{3z + 2}{iz + 6}$

(D) $\frac{3z + 2i}{iz + 6i}$

57. $\int_{|z|=2} \frac{z - 3\cos z}{\left(z - \frac{\pi}{2}\right)^2} dz =$

(A) $8\pi i$

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

(C) 8π

(D) $\frac{1}{8}\pi i$

58. The Taylor's series expansion of log z in $|z - 1| < 1$ is :

(A) $(z-1)+\frac{(z-1)^2}{2}+\frac{(z-1)^3}{3}+\ldots\ldots$

(B) $(z-1)-\frac{(z-1)^2}{2}+\frac{(z-1)^3}{3}-\ldots\ldots$

(C) $(z-1)+\frac{(z-1)^2}{2!}+\frac{(z-1)^3}{3!}+\ldots\ldots$

(D) $(z-1)-\frac{(z-1)^2}{2!}+\frac{(z-1)^3}{3!}-\ldots\ldots$

59. The function $f(z) = e^{1/z}$ has 0 as :

(A) removable singularity

(B) pole

(C) non-isolated singularity

(D) isolated essential singularity

60. Let $f(z) = \frac{z+3}{z^2 - 2z}$. Then the residues at the poles of f are :

(A) $\frac{3}{2}$ and $\frac{5}{2}$

(B) $-\frac{3}{2}$ and $\frac{5}{2}$

(C) $\frac{3}{2}$ and $-\frac{5}{2}$

(D) $-\frac{3}{2}$ and $-\frac{5}{2}$

61. Let $(X, \| \ \|)$ be a normed linear space. Then for $x \in X$ and α scalar :

(A) $\|\alpha x\| = \|\alpha\| \|x\|$

(B) $\|\alpha x\| = |\alpha| |x|$

(C) $\|\alpha x\| = |\alpha| \|x\|$

(D) $|\alpha x| = |\alpha| |x|$

62. On the linear space $l^p(n)$ define the norm by $\|x\|_p = \left(\sum_{i=1}^{n} |x_i|^p\right)^{\frac{1}{p}}$ for $x = (x_1, x_2, \ldots\ldots, x_n)$. Then l^p (2) is not a normed linear space if :

(A) $0 < p < 1$

(B) $p = 1$

(C) $1 < p < 2$

(D) $p \geq 2$

63. Let X and Y be normed linear spaces over a field K. Let $T : X \to Y$ be a linear operator, then which of the following is NOT in the equivalent condition ?

(A) T is continuous at the origin

(B) T is continuous

(C) T is bounded

(D) T is unbounded

64. Let X any Y be normed linear spaces over a field K. Let $T : X \to Y$ be a bounded linear operator, then which of the following is NOT correct ?

(A) $\|T\| = \sup\{k : k > 0 \text{ and } \|T(x)\|_Y \le k\|x\|_x, \text{ for all } x \in X\}$

(B) $\|T\| = \sup\{\|T(x)\|_Y : x \in X, \|x\|_x \le 1\}$

(C) $\|T\| = \sup\{\|T(x)\|_Y : x \in X, \|x\|_x = 1\}$

(D) $\|T\| = \sup\left\{\frac{\|T(x)\|_Y}{\|x\|_X} : x \in X,\ x \neq 0\right\}$

65. Let X and Y be normed linear spaces over a field K. Let $T : X \to Y$ be a surjective linear transformation. Then T is a topological isomorphism if and only if for every $x \in X$:

(A) there exists a constant k such that $\|T(x)\|_Y \le k\|x\|_X$

(B) there exists a constant k such that $\|x\|_X \le k\|T(x)\|_Y$

(C) there exist constants k_1, k_2 such that $k_1\|x\|_X \le \|T(x)\|_Y \le k_2\|x\|_X$

(D) None of the above

66. If x, y are any two vectors in an inner product space X, then :

(A) $\| < x, y > \| \leq \|x\| \|y\|$

(B) $\| < x, y > \| \geq \|x\| \|y\|$

(C) $| < x, y > | \leq \|x\| \|y\|$

(D) $| < x, y > | \geq |x| |y|$

67. Let $(X, \| \ \|)$ be a norm linear space over the field **C** and which satisfies the parallelogram law. Then this can be made into an inner product space by defining the polarization identity which is given by $<x, y>$ =

(A) $\frac{1}{4}\left[\left(\|x+y\|^2 - \|x-y\|^2\right) + i\left(\|x+iy\|^2 - \|x-iy\|^2\right)\right]$

(B) $\frac{1}{4}\left[\left(\|x+y\|^2 - \|x-y\|^2\right) - i\left(\|x+iy\|^2 - \|x-iy\|^2\right)\right]$

(C) $\frac{1}{4}\left[\left(\|x+y\|^2 + \|x-y\|^2\right) + i\left(\|x+iy\|^2 - \|x-iy\|^2\right)\right]$

(D) $\frac{1}{4}\left[\left(\|x+y\|^2 + \|x-y\|^2\right) + i\left(\|x+iy\|^2 + \|x-iy\|^2\right)\right]$

68. If $\{e_1, e_2, \ldots\ldots\ldots\ldots e_n\}$ is a finite orthonormal set in an inner product space X. Then for any $x \in X$:

(A) $\sum_{i=1}^{n} | < x, e_i > | \leq \|x\|$

(B) $\sum_{i=1}^{n} | < x, e_i > |^2 \leq \|x\|^2$

(C) $\left(x - e_j\right) \perp \sum_{i=1}^{n} | < x, e_i > |$

(D) $x \perp \sum_{i=1}^{n} | < x, e_i > |$

69. Let $T \in \mathbf{B}(H)$, the space of all bounded linear operator on Hilbert space H. Then three of the below statements are equivalent. Point out the statement which is not equivalent ?

(A) T is normal

(B) T is unitary

(C) T is surjective and $<T(x), T(y)> = <x, y>$ for all $x, y \in H$

(D) T is surjective and $\|T(x)\| = \|x\|$ for all $x \in H$

70. Let X be a normed linear space and X* be its dual space. Then :

(A) X separable implies X* is separable and the converse is not true

(B) X* separable implies X is separable and the converse is not true

(C) X separable if and only if X* is separable

(D) None of the above

71. Let $f : X \to Y$ where X is a measurable space and Y is a topological space. Then f is called as measurable function if :

(A) for every open set V of Y, $f^{-1}(V)$ is open set in X

(B) for every measurable set V of Y, $f^{-1}(V)$ is measurable set in X

(C) for every open set V of Y, $f^{-1}(V)$ is measurable set in X

(D) for every measurable set V of Y, $f^{-1}(V)$ is open set in X

72. Let $f(x) = \begin{cases} 1 & \text{if } 1 \le x \le 3 \\ 0 & \text{otherwise} \end{cases}$, then $\int_0^5 f(x)\,dx =$

(A) 5

(B) 3

(C) 2

(D) does not exist

73. Let $f(x) = \begin{cases} 1 & \text{if } x \text{ is irrational number in } [-4, 4] \\ -2 & \text{if } x \text{ is rational number in } [-4, 4] \end{cases}$, then $\int_{-4}^{4} f(x)\,dx =$

(A) 4

(B) 8

(C) 12

(D) does not exist

74. If A_1 and A_2 are measurable subsets of $[a, b]$, then :

(A) $m(A_1) + m(A_2) = m(A_1 \cup A_2) + m(A_1 \cap A_2)$

(B) $m(A_1) + m(A_2) = m(A_1 \cup A_2) - m(A_1 \cap A_2)$

(C) $m(A_1) + m(A_2) = m(A_1 \cup A_2)$

(D) $A_1 \cup A_2$ and $A_1 \cap A_2$ are not measurable

75. Let $f : [a, b] \to \mathbf{R}$ and $P = \{a = x_0, x_1, x_2, ..., x_n = b\}$ be a partition of $[a, b]$. Then the variation of f over $[a, b]$ with respect to partition P is defined by

$V_a^b(P, f) =$

(A) $\sum_{k=1}^{n} (f(x_k) - f(x_{k-1}))$

(B) $\sum_{k=1}^{n} |f(x_k) - f(x_{k-1})|$

(C) $\left(\sum_{k=1}^{n} |f(x_k) - f(x_{k-1})|^p\right)^{1/p}, p \ne 1$

(D) $\left(\sum_{k=1}^{n} \frac{|f(x_k) - f(x_{k-1})|^p}{p}\right)^{1/p}, p \ne 0, 1$

76. Let E be a given set :

(A) If E is measurable then given $\in > 0$, there exists an open set $G \supseteq E$ such that the outer measure $m^*(G - E) < \in$. And the converse is not true

(B) If given $\in > 0$, there exists an open set $G \supseteq E$ such that the outer measure $m^*(G - E) < \in$, then E is measurable. And the converse is not true

(C) If given $\in > 0$, there exists an open set $G \supseteq E$ such that the outer measure $m^*(G - E) < \in$, then E is measurable. And the converse is also true

(D) None of the above

77. Let (X, d) be a metric space and A, B be subsets of X. Let A^o denote the interior of A. Then :

(A) $(A^o)' \cap (A')^o$ is the boundary of A

(B) $A^o \subseteq B^o$ implies $A \subseteq B$

(C) $(A \cup B)^o \subseteq A^o \cup B^o$

(D) $A^o \cup B^o \subseteq (A \cup B)^o$

78. If p is a prime and $p \nmid a$, then :

(A) $a^{p+1} \equiv 1 \pmod p$

(B) $a^{p-1} \equiv 1 \pmod p$

(C) $a^p - 1 \equiv 1 \pmod p$

(D) $a^{p-1} \equiv a \pmod p$

79. All the positive integers a, b that satisfy the equation $\phi(ab) = \phi(a) + \phi(b)$ where ϕ is the Euler's function are :

(A) 2, 2; 3, 3; 4, 4

(B) 2, 3; 3, 4; 4, 3

(C) 2, 2; 3, 4; 4, 3

(D) 2, 3; 3, 2; 4, 4

80. Wilson's theorem states that if p is a prime then :

(A) $(p - 1)! \equiv 0 \pmod{p}$

(B) $(p - 1)! \equiv 1 \pmod{p}$

(C) $(p - 1)! \equiv -1 \pmod{p}$

(D) $(p)! \equiv 0 \pmod{p}$

81. The ultimate purpose of Gandhian education is the :

(A) Creation of a classless society

(B) Development of a human and awakened society

(C) Promotion of human beings

(D) Salvation for all

82. Education was brought in concurrent list according to which amendment of Constitution ?

(A) 41st amendment of Constitution

(B) 42nd amendment of Constitution

(C) 43rd amendment of Constitution

(D) 44th amendment of Constitution

83. "Free and Compulsory Education" was recommended by :

(A) Secondary Education Commission

(B) National Education Policy-1968

(C) Kothari Commission

(D) National Education Policy-1986

84. Which committee was set by government of India in 1990 to review the implementation of National Policy on Education 1986 ?

(A) Ramamurti Committee

(B) Janardan Reddy Committee

(C) Yashpal Committee

(D) Kasturirangan Committee

85. Which is the first school for a child's education ?

(A) Society

(B) Friends

(C) Family

(D) School

86. Which Committee was appointed to suggest improvement in the University Education system ?

(A) Whitley Commission

(B) Philip Hartog Commission

(C) Lord Chancellor Commission

(D) Sadler Commission

87. Exchange of ideas between two or more persons is :

(A) Understanding (B) Telling

(C) Communication (D) Speaking

88. You are training in public speaking and debate. Which of the following characteristics can you not expect to develop ?

(A) Concept

(B) Control over emotions

(C) Using language creatively

(D) Voice modulation

89. Which of the following is the *incorrect* pair ?

(A) Sign Theory of Learning – Tolman

(B) Field Theory of Learning – Lewin

(C) Social Learning Theory – Bruner

(D) Trial and Error Theory – Thorndike

90. Which of the following principles is used in shaping behaviour in Skinner's Operant Conditioning ?

(A) Principle of keeping the response simple and specific

(B) Principle of keeping the response soft and sweet

(C) Principle of successive approximation

(D) Principle of reward and punishment

91. Which one of the following is NOT a web browser ?

(A) Firefox

(B) Facebook

(C) Chrome

(D) Safari

92. SWAYAM is a portal for :

(A) Promoting high quality education

(B) Improving access to high quality education

(C) Telecasting high quality educational content free of charge

(D) Both (B) and (C)

93. Government has approved the SWAYAM Prabha project for operationalising how many DTH TV channels ?

(A) 32

(B) 33

(C) 34

(D) 35

94. RAM is placed on :

(A) Hard Disk

(B) Extension board

(C) Motherboard

(D) USB

95. Which of the following Commission/Committee was required exclusively to address Teacher Education of India ?

(A) Yashpal Committee

(B) Justice Verma Committee

(C) National Knowledge Commission

(D) Mudaliar Commission

96. The 'Internship Programme' in teacher education has been provided to help :

(A) The teachers in school

(B) The student teachers in the training programme

(C) The teachers educators in the training institutions

(D) The principals of the schools where internship is conducted

97. At the district level which of the following institutions has been entrusted with the responsibility of in-service teacher education for primary and elementary schools ?

(A) CTEs
(B) IASEs
(C) SCERTs
(D) DIETs

98. Broad functions of SCERT are :

(A) Design and development of integrated teacher education courses of four year duration

(B) Preparation of a code of professionalism ethics for teachers

(C) Accreditation of teacher education institutions and their monitoring

(D) Development of curriculum, textbooks, training, research and innovation

99. Which of the following institutions is directly responsible for the professional growth of school teachers in India ?

(A) NCERT
(B) NAAC
(C) NIOS
(D) IGNOU

100. Sarva Shiksha Abhiyan (SSA) adopted which of the following ?

(A) Zero Resource Room Policy

(B) Zero Rejection Policy

(C) Zero Acceptance Policy

(D) Zero Failure Policy