SEMESTER -I

BASIC TOPOLOGY

MULTIPLE CHOICE QUESTIONS

1. Which of the following is false

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

2. Let τ be a topology on a nonempty set X. Then any member of τ is called….

A. Closed set

B. Clopen set

C. Open set

D. None of these

3. The only convergent sequence in discrete space is those which are

A. Convergent to more than one point

B. Alternating

C. Eventually constant

D. All of these

4. Let X be a co finite topological space and X-A is finite set. Then A is

A. Empty set

B. Clopen

C. Closed

D. Open

5. A space in which every finite sets are closed are called

A. Co complement space

B. Indiscrete space

C. Cofinite space

D. Scattered topology

6. Let τ_1, τ_2 are topologies on a non empty set X with $\tau_1 \supset \tau_2$

A. τ_1 stronger than τ_2

B. τ_1 weaker than τ_2

C. τ_1 and τ_2 are uncomparable

D. None of these

7. The topology induced by Euclidean metric on R is

A. Discrete topology

B. Indiscrete topology

C. Usual topology

D. None of these

8. Example of a topology which is not metrisable

A. Discrete topology

B. Usual topology

C. Sierpinski's topology

D. All of these

9. If a topology on a set X has countable base, then the space is called

A. Second category

B. First countable

C. Second countable

D. First category

10. Consider the statements S_1: Second countability is hereditary

S_2: Metrizability is not hereditary

A. Both S_1 and S_2 are true

B. S_1 true , S_2 false

C. S_1 false, S_2 true

D. S_1,S_2 False

11. If τ_1 and τ_2 are two topologies on a set, then which of the following is a topology.

A. $\tau_1 \cup \tau_2$

B. $\tau_1 \cap \tau_2$

C. $\tau_1 \oplus \tau_2$

D. All of these

12. Which statement is correct

A. In a second countable space, every open cover has a finite subcover

B. In a second countable space, every open cover has a countable subcover

C. Both A and B is correct

D. Both A and B is false

13. In a scattered line topology, Which sequence converge to an irrational number

A. Sequence of irrationals

B. Sequence of rationals

C. Eventually constant sequence

D. Alternating sequence

14. The topological space in which all the subsets of the underlying set X are open is called

A. Discrete

B. Indiscrete

C. Scattering

D. None of these

15. Let B is a base for a topological space X then

A. Every open set can be written as union of some members of B

B. Every open set can be written as intersection of some members of B

C. Every closed set can be written as union of some members of B

D. None of these

16. Consider the statements S_1: R with usual topology is second countable

S_2 : R with semi open interval topology is not second countable

A. S_1 True, S_2 false

B. S_1 false, S_2 true

C. S_1,S_2 True

D. S_1,S_2 False

17. Let $X = \{a, b, c\}$ .Which of these is a topology

A. $\{X, \emptyset, \{a\}, \{b\}\}$
B. $\{X, \emptyset, \{a\}, \{b\}, \{c\}\}$
C. $\{X, \emptyset, \{a\}\{c\}\}$
D. $\{X, \emptyset, \{a\}, \{b\}\{a, b\}\}$

18. Every subspace of a metrisable space is…..

A. Second countable
B. Metrisable
C. Separable
D. First countable

19. Let S be a sub base for a topological space X. Which of the following is true
A. Finite union of members of S is a base element
B. Arbitrary union of members of S is a base element
C. Finite intersection of members of S is a base element
D. None of these

20. Let X be a set with n,(n≥ 3) distinct elements. Then which of these statement is true
A. There are at most $2^{(2^n-2)}$ topologies
B. There are at least $2^{(2^n-2)}$ topologies
C. There are at most $2^n - 2$ topologies
D. There are exactly 2^n topologies

21. Let τ_1 be the indiscrete topology and τ_2 be the discrete topology on an arbitrary set X then
A. τ_1 is weaker than τ_2
B. τ_1 is stronger than τ_2
C. $\tau_1 = \tau_2$
D. τ_1 and τ_2 are not comparable

22. Which statement is correct
A. Every metric space is a topological space
B. Every topological space is metrisable
C. Every topological space is second countable
D. Every metric space is second countable

23. In an indiscrete topological space X, which one is true
A. Ful set X and null set are the only open sets
B. Full set X is open but not null set
C. A proper subset of X is open
D. All subsets of X are open

24. R with usual topology is
A. Metrisable and second countable
B. Second countable but not metrisable
C. Neither second countable nor metrisable
D. Metrisable but not second countable

25. Consider R with usual metric' d'. Then which one is an open ball in the metric space (R, d)
A. Every closed intervals
B. Every open intervals
C. Union of open intervals
D. All the above

26. Let X be a space and A be a subset of X such that interior(X-A) = X-A. Then A is

A. Open

B. Closed

C. Not open

D. Both open and closed

27. Which among the following is false statement.

A. Complement of an open set is closed

B. Finite union of closed sets is closed

C. Arbitrary intersection of closed set is closed

D. Arbitrary intersection of open set is open

28. Which of the following is not a property of closure operator.

A. Every closed sets are its fixed points

B. Closure operator commutes with finite unions.

C. Closure operator commutes with finite intersections.

D. Closure operator is idempotent.

29. If closure(A)=X, then

A. A is closed in X

B. A is separable

C. A is dense in X

D. X is dense in A

30. If a set A is a neighborhood of each of its points, then A is

A. Open

B. Closed

C. Clopen

D. Second countable

31. The largest open set contained in A is called

A. Interior of A

B. Derived set of A

C. Closure of A

D. None of these

32. The set which is the intersection of closure(A) and closure(X-A) is

A. Neighborhood of A

B. Neighborhood of X-A

C. Boundary of A

D. Boundary of X

33. Which of the following is true for a continuous function f from X to Y.

A. Inverse image of open set in Y is open in X

B. Inverse image of closed set in Y is closed in X

C. Both A and B

D. None of these

34. Let f be an open map. Then which of the following is necessarily true.

A. Inverse of f is an open map

B. Inverse of f is a closed map

C. Inverse of f is a continuous map

D. Inverse of f is an injective map.

35. Which of the following is true

A. R is homeomorphic to (0,1)

B. (0,1) homeomorphic to [0,1]

C. R is homeomorphic to [0,1]

D. All of these

36. The weak topology determined by projection functions is called

A. Quotient topology

B. Discrete topology

C. Product topology

D. Scattering topology

37. Statement 1 : Property of being discrete space is divisible property

Statement 2 : Second countability is a divisible property

Which of the following is correct.

A. Statement 1 is true but Statement 2 is false
B. Statement 1 is false but statement 2 is true
C. Statement 1 and Statement 2 both true
D. Both statements false

38. The intersection of all closed sets containing A is called

A. Interior of A

B. Boundary of A

C. Closure of A

D. Derived set of A

39. Let X be a space and x belong to X and A subset of X. If every open set containing x contains a point in A other than x, then x is

A. Limit of A

B. Accumulation point of A

C. Accumulation point of X-A

D. None of these

40. Which of the following is false:

A. f is continuous if and only if inverse image of open set is open

B. Composition of continuous function is continuous

C. Projection map is continuous

D. None of these

41. Which of the following are not sufficient for a function to be homeomorphism

A. f is continuous bijection and open

B. f is continuous bijection

C. Inverse of f is open and f is bijection

D. All of these

42. Let A be a set such that A is disjoint from its boundary and B is such that B contains its boundary. Then

A. A is open , B is open

B. A is closed, B is closed

C. A is open, B is closed

D. A is closed , B is open

43. Let X be a discrete space and G non empty subset of X. Set of all accumulation points of G is

A. X
B. Empty set
C. G
D. X-G

44. Which of the following is true

A. Every open balls are open sets

B. Every open sets are open balls

C. Every open sets are complements of closed balls

D. Closure of an open ball is always closed ball

45. A topological property is said to be .... if whenever a space has it, so does every quotient space of it.

A. Hereditary

B. Preserved under continuous functions

C. Divisible

D. All of these

46. The dense subsets of an indiscrete space are

A. Null set
B. All non empty Subsets
C. Full set and nullset
D. None of these

47. Let $A \subset X$.If closure of a set A and the set A are equal then the set A is

A. Open in X
B. Closed in X
C. Dense in X
D. Countable in X

48. Which of the following is True

A. Every open surjective map is a quotient map
B. Every closed surjective map is a quotient map
C. Both A and B
D. Only A

49. Projection maps are

A. Open and surjective
B. Closed and surjective
C. Both closed and open
D. Closed and quotient

50. Exterior of a set is

A. Interior of its complement
B. Interior of the closure of the set
C. Boundary of its complement
D. Closure of the complement

51. If X is a compact space and A is a subset of X is closed in X then A, in its relative topology is ……………… .
(a) Open (b) Closed (c) Compact (d)Lindeloff

52. If X is a Lindeloff space and A is a subset of X is closed in X then A, in its relative topology is ……………… .

(a) Open (b) Closed (c)Lindeloff (d) none of these

53. A topological property is said to be weakly hereditary if whenever a space has it, so does every ……………………. of it.
(a)Open subspace (b)Closed Subspace (c) Subspace (d) Subset

54. A space with a countable local base at each of its points is ?

(a) First Countable (b) Second Countable (c) Compact (d) Separable

5 . Components of a topological space are …………………….sets.

(a) Open (b) Closed (c) Clopen (d) None of these

56. A space which contains a countable dense subset is called …………… .

(a) Separable (b) Connected (c) Compact (d) Lindeloff

57. Every continuous image of a compact space is ………………. .

(a) Compact (b) Dense (c) Separable (d) Lindelofff

58. Which of the following is true.

(a) Compactness and property of Lindeloff are hereditary properties

(b) Compactness and property of Lindeloff are NOT hereditary properties

(c) Compactness is a hereditary property and property of Lindeloff is NOT a hereditary properties

(d) Compactness is NOT a hereditary property and property of Lindeloff is a hereditary properties

59. Which of the following is true.

(a) Compactness and property of Lindeloff are weakly hereditary properties

(b) Compactness and property of Lindeloff are NOT weakly hereditary properties

(c) Compactness is a weakly hereditary property and property of Lindeloff is NOT a weakly hereditary properties

(d) Compactness is NOT a weakly hereditary property and property of Lindeloff is a weakly hereditary properties

60. A subset A of a space X is said to be compact if ……. .

(a) every cover of A by open subsets of X has a finite subcover

(b) every cover of A by closed subsets of X has a finite subcover

(c) every cover of A by subsets of X has a finite subcover

(d) None of these

61. A subset A of a space X is said to be Lindeloff if ……. .

(a) every cover of A by open subsets of X has a countable subcover

(b) every cover of A by closed subsets of X has a countable subcover

(c) every cover of A by subsets of X has a countable subcover

(d) None of these

62. A space is said to be separable if it contains a ……………… subset.

(a) Countable (b) Dense (c) Countable Dense (d) Closed

63. A topological property is said to be weakly hereditary if …………. .

(a) whenever a space has it so does every subspace of it

(b) whenever a space has it so does every open subspace of it

(c) whenever a space has it so does every closed subspace of it

(d) whenever a space has it so does every subset of it

64. A space is said to be first countable at a point if …….

(a) there exist a finite local base at the point

(b) there exist an countable local base at the point

(c) there exist a finite base

(d) there exist a countable base

65. A space is said to be first countable if it is first countable at ………. of the space .

(a) each subset(b) each closed subset (c) each open subset (d)each point

66. If a space is connected then

(a) Only closed subset of X are empty set and X.

(b) Only clopen subset of X are empty set and X.

(c) Only open subset of X are empty set and X.

(d) None of these

67. Every closed and bounded interval is ………… .

(a) Dense (b) Lindeloff (c) Separable (d) Compact

68. Two subsets A and B of a topological space X are said to be separated if

(a)$A \cap B = \emptyset$ and $A \cup B = X$ (b) $\bar{A} \cap \bar{B} = \emptyset$ and $A \cup B = X$

(c) $\bar{A} \cap B = \emptyset$ and $A \cap \bar{B} = \emptyset$ (d) None of these

69. Components of a topological space are ………….. .

(a) Open sets (b) Closed sets (c) Clopen sets (d) None of these

70. Closure of a connected set is ………… .

(a) NOT connected (b) sometimes connected (c) always connected (d) None of these

71. Maximally connected subset of a space is called.

(a) Closure (b) Interior (c) Component (d) None of these

72. A space X is connected if it is impossible to find two non-empty subsets A and B of it such that

(a) $A \cap B = \emptyset$ and $A \cup B = X$ (b) $\bar{A} \cap \bar{B} = \emptyset$ and $A \cup B = X$

(c) $\bar{A} \cap B = \emptyset$ and $A \cup B = X$ (d) $A \cap \bar{B} = \emptyset$ and $A \cup B = X$

73. First countability is .

(a) Hereditary property (b) Weakly hereditary property

(c) Absolute property (d) Relative property

74. Compactness and property of being Lindeloff are

(a) Absolute property (b)Relative property

(c) Both A and B (d) None of these

75. Denseness is a

(a) Absolute property (b) Relative property

(c) Both A and B (d) None of these

76. Which of the following is an example of a locally connected space?

a. Indiscrete space
b. Space of rationals with usual relative topologies
c. Space of irrationals with usual relative topologies
d. Comb space

77. Which of the following statements is true for a locally connected space X?

a. Components of open subsets of X are open in X

b. X has a base consisting of connected subsets

c. For every $x \in X$ and every neighbourhood N of x there exists a connected open neighbourhood M of x such that $M \subseteq N$

d.All of these

78. Which of the following statements is not true for a locally connected space?

a. Every quotient space of a locally connected space is locally connected

b. Local compactness is a hereditary property

c. Comb space is an example of locally connected spaces

d. Discrete spaces are locally connected

79. A path in a topological space X is

a. A continuous function from X to X

b. A continuous function from $[0,1]$ to X

c. An injective function from $[0,1]$ to X

d. An injective function from X to X

80. A path α is said to be simple if the function α is

a. Surjective

b.Not injective

c.Not surjective

d.Injective

81. A simple closed path is

a.A closed path α which is onto except for $\alpha(0) = \alpha(1)$

b.A closed path α which is one-one except for $\alpha(0) = \alpha(1)$

c.Any path α which is onto except for $\alpha(0) = \alpha(1)$

d.Any path α which is onto except for $\alpha(0) = \alpha(1)$

82. Which of the following is not an example of a path-connected space?

a.Topologist’s sine curve

b.Real line

c.Unit sphere

d.Euclidean spaces

83. Which of the following statements is correct for a path-connected space?

a.Path-connectedness is not preserved under continuous functions

b.Every path-connected space is connected

c.Topological product of a finite number of non-empty path-connected spaces need not be path-connected

d.Every connected space is path-connected

84. Which of the following is not a hereditary property?

a.Metrisability

b.Regularity

c.Local connectedness

d. T_2

85. Which of the following is the weakest separation axiom?

a.T_0

b.T_1

c.T_2

d. T_3

86. Which of the following is not an equivalent statement for a T_1 topological space (X, T)?

a.Every finite subset of X is closed

b.Topology T is stronger than the cofinite topology on X

c.For every $x \in X$, singleton sets $\{x\}$ are closed

d.Every infinite subset of X is closed

87. T_2 space is also called a

a.Completely normal space

b.Hausdorff space

c.Regular space

d.Normal space

88. Which of the following is the correct hierarchy of the separation axioms?

a. $T_4 \Rightarrow T_3 \Rightarrow T_2 \Rightarrow T_1 \Rightarrow T_0$

b. $T_0 \Rightarrow T_1 \Rightarrow T_2 \Rightarrow T_3 \Rightarrow T_4$
c. $T_3 \Rightarrow T_4 \Rightarrow T_1 \Rightarrow T_2 \Rightarrow T_0$
d. $T_4 \Rightarrow T_2 \Rightarrow T_3 \Rightarrow T_1 \Rightarrow T_0$

89. A topological space X is said to be completely regular if

a.The space is normal and T_1

b.The space is regular and T_1

c.For a point $x \in X$ and a closed set C not containing x there exists a continuous function $f: X \to [0,1]$ such that $f(x) = 0$ and $f(y) = 1, \forall\, y \in C$

d.For a point $x \in X$ and an open set C not containing x there exists a continuous function $f: X \to [0,1]$ such that $f(x) = 0$ and $f(y) = 1, \forall\, y \in C$

90. A topological space X is said to be regular if

a.For each point x and a closed set C not containing the point x there exists disjoint open sets U and V such that $x \in U$ and $C \subset V$

b.For each point x and an open set C not containing the point x there exists disjoint closed sets U and V such that $x \in U$ and $C \subset V$

c.For every two disjoint closed sets C and D there exists disjoint open sets U and V such that $C \subset U$ and $D \subset V$

d.For every two disjoint open sets C and D there exists disjoint closed sets U and V such that $C \subset U$ and $D \subset V$

91. Every T_3 space is

a.Regular and T_2

b.Regular and T_1

c.Normal and T_1

d.Normal and T_2

92. Every T_4 space is

a.Regular and T_2

b.Regular and T_1

c.Normal and T_1

d.Normal and T_2

93. Which of the following statements is true?

a.Every T_2 space is T_1

b.Every T_2 space is T_3

c.Every T_2 space is T_4

d.Every T_1 space is T_2

94. Which of the following statements is false?

a.Every completely normal space is normal

b.Every completely regular space is regular

c.All metric spaces are T_4

d.Every T_3 space is Tychonoff

95. A space is said to be Tychonoff if it is

a.Regular and T_1

bNormal and T_1

c.Completely regular and T_1

d.Completely normal and T_1

96. Let T be the topology on the set of reals $\boldsymbol{R}$ whose members are $\emptyset$, $\boldsymbol{R}$ and sets of the form (a, ∞) for $a \in \boldsymbol{R}$. Then $(\boldsymbol{R}, T)$ is a

a.T_0 space

b.T_1 space

c.T_2 space

d. T_3 space

97. All metric spaces are

a.T_2

b.T_3

c.T_4

e. All of these

98. Which of the following is a weakly hereditary property?

a. Regularity
b. Complete regularity
c. Normality
d. T_2

99. Which of the following is an equivalent statement for a normal topological space $(X,\ T\ )$?

a. For any open set C and any closed set G containing C, there exists an open set H such that $C \subset\ H$ and $\overline{H}\ \subset\ G$
b. For any closed set C and any open set G containing C, there exists an open set H such that $C \subset\ H$ and $\overline{H}\ \subset\ G$
c. The family of all closed neighbourhoods of any point of X forms a local base at that point.
d. For any $x\ \in X$ and any open set G containing x, there exists an open set H containing x and $\overline{H}\ \subset\ G$

100. A topological space X is said to be completely normal if

a. For a point $x\ \in X$ and a closed set C not containing x there exists a continuous function $f: X\ \to [0,1]$ such that $f(x) = 0$ and $f(y) = 1, \forall\ y\ \in C$
b. For each point x and a closed set C not containing the point x there exists disjoint open sets U and V such that $x\ \in U$ and $C \subset V$
c. For every two mutually separated subsets C and D there exists disjoint open sets U and V such that $C \subset U$ and $D \subset V$
d. For every two disjoint closed sets C and D there exists disjoint open sets U and V such that $C \subset U$ and $D \subset V$