Roll No. ....

Question Booklet Number

O. M. R. Serial No. | | | | | | | |

M. A./M. Sc. (Second Semester)
(NEP) EXAMINATION, 2025-26
MATHEMATICS
(Advanced Topology)

Paper Code							
B	0	3	0	8	0	2	T

Questions Booklet Series

D

Time : 1:30 Hours] [*Maximum Marks : 75*

Instructions to the Examinee :

1. Do not open the booklet unless you are asked to do so.
2. The booklet contains 100 questions. Examinee is required to answer 75 questions in the OMR Answer-Sheet provided and not in the question booklet. All questions carry equal marks.
3. Examine the Booklet and the OMR Answer-Sheet very carefully before you proceed. Faulty question booklet due to missing or duplicate pages/questions or having any other discrepancy should be got immediately replaced.

(Remaining instructions on the last page)

परीक्षार्थियों के लिए निर्देश :

1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।
2. प्रश्न-पुस्तिका में 100 प्रश्न हैं। परीक्षार्थी को 75 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। सभी प्रश्नों के अंक समान हैं।
3. प्रश्नों के उत्तर अंकित करने से पूर्व प्रश्न-पुस्तिका तथा OMR आन्सर-शीट को सावधानीपूर्वक देख लें। दोषपूर्ण प्रश्न-पुस्तिका जिसमें कुछ भाग छपने से छूट गए हों या प्रश्न एक से अधिक बार छप गए हों या उसमें किसी अन्य प्रकार की कमी हो, तो उसे तुरन्त बदल लें।

(शेष निर्देश अन्तिम पृष्ठ पर)

(Only for Rough Work)

1. Let $f : \mathrm{I} \to \mathrm{X}$ be a path. Then $f(\mathrm{I})$ is a :
   (A) Connected set
   (B) Disconnected set
   (C) Regular set
   (D) All are correct

2. Connectedness is a :
   (A) Topological property
   (B) Not topological property
   (C) Never topological property
   (D) None is correct

3. Let Y is a connected set is (X, **T**). Then the closure of Y in $\overline{\mathrm{Y}}$ is :
   (A) Disconnected set
   (B) Connected set
   (C) Locally disconnected
   (D) None of the above

4. Let (X, **T**) be a topological space and $\mathrm{A} \subset \mathrm{X}$ is disconnected iff it is :
   (A) Union of two separated sets
   (B) Intersection of two separated sets
   (C) Disconnected set
   (D) Above all are correct

5. Subset of a real line is connected if :
   (A) It is an interval
   (B) It is union of two disjoint intervals
   (C) Set of rationals
   (D) Set of integers

6. Let (X, **T′**) is finer topology than (X, **T**) and (X, **T**) is disconnected. Then (X, **T′**) is :
   (A) Connected
   (B) Disconnected
   (C) Locally connected
   (D) Path connected

7. Let (X, **T**) be a discrete topological space then it is disconnect if it has :
   (A) Single element
   (B) At least 2 elements
   (C) Empty set
   (D) None of the above

8. The closed internal [*a*, *b*] is :
   (A) Connected set
   (B) Disconnected
   (C) Neither connected nor disconnected
   (D) Connected as well as disconnected

9. A component of a topological space is :
   (A) Open
   (B) Closed
   (C) Neither open nor closed
   (D) Both open as well as closed

10. A Banach space is :

(A) Locally connected

(B) Connected

(C) Path connected

(D) All are correct

11. The discrete topology is :

(A) Connected

(B) Not connected

(C) Locally connected

(D) None of the above

12. If X is a topological space, which of the following is incorrect ?

(A) Interaction of non empty class of connected subspace of X is non empty

(B) The components of totally disconnected space are points

(C) Each component of locally connected space is closed

(D) Every compact Hausdorff space is normal

13. Two sets A and B are not separated if :

(A) A = (2, 3) & B = (3, 4)

(B) A = (2, 3), B = (4, 5)

(C) A = (3, 4) and B = [4, 5]

(D) None of the above

14. The topological space $\mathbf{T} = \{\phi, X, \{a, c\}, \{b\}\}$ on $X = \{a, b\}$ is :

(A) Connected

(B) Disconnected

(C) Not locally connected

(D) Locally connected

15. Two sets A and B are separated set if :

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

(B) $A \cap \overline{B} = \phi$

(C) $\overline{A} \cap B = \phi$

(D) $A \cap \overline{B} = \phi$ and $\overline{A} \cap B = \phi$

16. A space (X, **T**) is arcwise connected if :

(A) For any two points $x, y \in X$ there is a path

(B) Locally connected

(C) Not connected space

(D) None of the above

17. In Discrete space (X, **T**) on X is :

(A) Connected space

(B) Locally connected

(C) Connected as well as locally connected

(D) All are correct

18. A topological space (X, **T**) is locally connected if :

(A) It is connected space

(B) If all connected open neighbourhoods of a point forms of a basic

(C) If all connected open neighbourhood forms a countable local base

(D) None of the above

19. A path on the topological space (X, **T**) is a :

(A) Map

(B) A continuous map $f : 1 \rightarrow X$ where I = [a, b] and $a, b \in X$

(C) A continuous map $f : [0, 1] \rightarrow X$ and $a, b \in X$ such that $f(0) = a$, $f(1) = b$

(D) None of the above

20. A set S is maximal connected set, if :

(A) A is connected set and largest one

(B) A is connected and $A \neq X$

(C) A is connected set

(D) None of the above

21. A totally disconnected space is :

(A) T_2 space

(B) Not T_2 space

(C) Not separation

(D) Not T_1 space

22. Let $f_n(x) = x^n$ where $x \in [0, 1]$ and n = 1, 2, 3,.... $\lim_{n \to \infty} f_n(x) = g(x)$. Then $g(x)$ is :

(A) Continuous

(B) Discontinuous

(C) Pointwise convergent

(D) Unfirmly convergent

23. Let $f(x) = \frac{1}{3}x$ where $f : \mathbf{R} \rightarrow \mathbf{R}$ is a map. Then f is :

(A) Contraction map

(B) Magnification

(C) Many one map

(D) Into map

24. Let A = [0, 1]. Then this set is :

(A) Disconnected set

(B) Totally disconnected set

(C) Connected set

(D) None of the above

25. If (X, **T**) is a topological space and A is said to be disconnected subset of X if $\exists$ G and H $\in$T such that :

(A) $A \cap G, A \cap H \neq \phi$

(B) $(A \cap G) \cap (A \cap H) \neq \phi$

(C) $A \neq (A \cap G) \cup (A \cap H)$

(D) None of the above

26. Which of the following is incorrect in (X, **T**) ?
   (A) A subset a compact space X is compact
   (B) Continuous image of a compact set is compact
   (C) If X = R and **T** is usual topology then A = (0, 1) is compact
   (D) Closed subset and compact space is compact

27. A space is Lindeloff space if :
   (A) Every open cover has finite subcover
   (B) Every countable cover has finite subcover
   (C) Every cover is reducible to countable subcover
   (D) All are correct

28. A sequentially compact metric space has :
   (A) BWP (Bulzano Weirstrass Property)
   (B) Compact
   (C) Not compact
   (D) None of the above

29. A topological subspace is compact if it is :
   (A) Closed
   (B) Bounded
   (C) Closed and bounded
   (D) None of the above

30. The closed interval [0, 1] is :
   (A) Compact
   (B) Connected
   (C) Both connected
   (D) All are correct

31. Compactness is :
   (A) Topological properly
   (B) Not topological properly
   (C) Not hereditary
   (D) None of the above

32. Continuous image of compact set is :
   (A) Compact
   (B) Closed
   (C) Connected
   (D) Not connected

33. A compact Hausdorff space is :
   (A) Regular
   (B) Normal
   (C) Completely normal
   (D) All are correct

34. In E-net the E is :
   (A) Positive real
   (B) Negative real
   (C) Any real number
   (D) None of the above

35. A compact Hausdorff space is :
   (A) Normal
   (B) Completely normal
   (C) Not normal
   (D) All are correct

36. Finite intersection property is :

(A) Intersection of two subsets is non empty in the family of collections

(B) Intersection of finite subcollection is finite set

(C) Both (A) and (B)

(D) None of the above

37. A cofinite topological space is :

(A) Compact

(B) Not compact

(C) Connected

(D) None of the above

38. A closed subset of compact space is :

(A) Not compact

(B) Compact

(C) Unbounded

(D) All of the above

39. A topological space (X, **T**) is sequentially compact if :

(A) Every sequence in (X, **T**) is convergent

(B) Every sequences has convergent subsequence

(C) Countably compact space

(D) None of the above

40. An example of locally compact space which is not a compact is :

(A) Discrete space of **R**

(B) Discrete space on a finite set

(C) Every indiscrete space

(D) None of the above

41. A topological space is countably compact if :

(A) Every cover provides finite subcover

(B) Every countable cover provides finite subcover

(C) Every cover of the space provides countable cover

(D) None of the above

42. A topological space (X, **T**) has B.W.P. if :

(A) Every open cover has finite subcover

(B) A closed and bounded infinite set has a limit point

(C) Every cover if X has countable subcover

(D) All of the above

43. Balzano Weirstrass theorem says :

(A) A closed subset of **R** has a limit point

(B) A bounded subset of **R** has a no-limit point

(C) A closed and bounded infinite set of **R** has a limit point

(D) None of the above

44. A topological space (X, **T**) is locally compact if :

(A) It is not compact

(B) It is locally bounded

(C) It is Lindeloff space

(D) Let $x \in X$ if the closure and any closure of neighbourhood of X is compact

45. Lindeloff space is a space in which :

(A) Every open cover is reducible to finite subcover

(B) A cover of the space has no finite subcover

(C) Every open cover is reducible to a countable subcover

(D) None of the above

46. According to Heine Borel theorem :

(A) A closed subset of **R** is compact

(B) A bounded subset of **R** is compact

(C) A closed and bounded subset of **R** is compact

(D) All of the above

47. A collection of subsets of F has FIP if :

(A) Every sub-collection of F is finite

(B) Every finite sub-collection has finite intersection

(C) Every sub-collection has infinite intersection

(D) None of the above is correct

48. Which of the following is correct statement ?

(A) Every topology is compact

(B) No topology is compact

(C) A topology on finite set is compact

(D) None of the above

49. Which of the following is not correct ?

(A) Every indiscrete space is compact

(B) Every infinite subset of discrete space is compact

(C) Every topological space X is compact if X is finite

(D) Discrete topology on a finite set is compact

50. A topological space (X, **T**) is compact if :

(A) X = **R**

(B) X is not finite

(C) Every cover provides finite subcover

(D) Every open cover is reducible to finite subcover

51. Let $\pi_1 : X \times Y \to X$ and $\pi_2 : X \times Y \to Y$ are projection maps. Then :

(A) π_1 is continuous

(B) π_2 is continuous

(C) both π_1 and π_2 are continuous

(D) All are correct

52. The product space $\prod_{i=1}^{\infty} X_i$ is to be 2nd countable. Then which of the following is a required condition ?

(A) Each X_i is 2nd countable

(B) Each X_i is 2nd countable and product is finite

(C) Each X_i is 2nd countable is index set is almost countable

(D) Each X_i is Hausdorff

53. The Tychonoff theorem fails for :

(A) Box topology

(B) Discrete topology

(C) Product topology

(D) None of the above

54. Let (X, **T**) and (Y, U) are two topological space. Then which of the following is true if X × Y is first countable ?

(A) Both X and Y are first countable

(B) X and Y must be metrizable

(C) X and Y must be second countable

(D) Only one of them is first countable

55. Let X and Y be locally compact, their product X × Y is locally compact is true for :

(A) Only finite products

(B) Any arbitrary product

(C) Only if the index is countable

(D) Only if XΔY are discrete

56. Let $X = \mathbf{R}^n$ be a product of countably many copies of **R** under the product topology X is :

(A) Not first countable

(B) Second countable

(C) Non connected

(D) Locally compact

57. The product space X × Y, a set U × V is closed if and only if :

(A) U is closed in X and V is closed in Y

(B) U is open and V is closed

(C) U or V is empty

(D) U × V is a whole space

58. The product of uncountably many [0, 1] copies is :

(A) No compact

(B) Compact

(C) Metrizable

(D) Discrete

59. Let X be a compact space and Y is a Hausdorff space. Then any surjective continuous map $f : X \to Y$ is :

(A) A quotient map

(B) A homeomorphism

(C) An open map

(D) Not necessarily a quotient map

60. Let the projection map π : $\mathbf{R} \times \mathbf{R} \to \mathbf{R}$. Then the image of the set :

$$A = \{(x, y) : xy = 1\}$$

is :

(A) **R**

(B) $[0, \infty)$

(C) $\mathbf{R} \times \{0\}$

(D) $\{1\}$

61. When are the Box topology and the product topology equal ?

(A) When the index is finite

(B) When the index is infinite

(C) Never equal

(D) When all spaces are T_1

62. The product space πX_i is Hausdorff space if :

(A) At least are of X_i is Hausdorff

(B) Each X_i is T_2

(C) The index set is finite

(D) Projection map is closed

63. The projection map $\pi_x : X \times Y \to X$ is a closed map if :

(A) X is compact

(B) Y is compact

(C) Both X and Y are T_2 spaces

(D) X is discrete

64. Let X be a non-empty set and B is a basis of topological space (X, **T**). Then **T** is equal to :

(A) Collection of all intersections of elements of B

(B) The collection of all unions of elements of B

(C) The collection of all sum elements of B

(D) None of the above

65. The product of finitely many compact spaces is :

(A) Compact space

(B) Open set

(C) Null set

(D) None of the above

66. The correct statement is :

(A) Every topological space is metrizable

(B) Every metric space is topological space

(C) No metric space is a topology

(D) No topology is metric space

67. A subset of **R** is compact iff it is closed and bounded, is the statement of :

(A) Heine Borel theorem

(B) Tychonoff theorem

(C) Urysohn Lemma

(D) None of the above

68. The product of two second countable spaces is :

(A) Second countable space

(B) First countable space

(C) Both first and second countable space

(D) All are correct

69. Let $(X_1, \mathbf{T}_1)$ and $(X_2, \mathbf{T}_2)$ be two Hausdorff space. Then the product space is :

(A) Hausdorff space

(B) T_1 space

(C) T_0 space

(D) All are correct

70. Product space of two compact spaces $(X_1, \mathbf{T}_1)$ and $(X_2, \mathbf{T}_2)$ is :

(A) Not compact

(B) Compact

(C) Non-connected

(D) Connected space

71. Product space of two connected spaces $(X_1, \mathbf{T}_1)$ and $(X_2, \mathbf{T}_2)$ is a :

(A) Connected space

(B) Not connected space

(C) Sometimes connected and sometimes not connected

(D) None of the above is correct

72. Every projection map π_p on the product space $X \times Y$ is :

(A) Continuous map

(B) Not continuous map

(C) Differentiable map

(D) Smooth map

73. Let $(X, \mathbf{T})$ and (Y, U) be two topological spaces. Then a map is projection map if :

(A) $\pi_p : X \to X \times Y$

(B) $\pi_p : X \times Y \to X$

(C) $\pi_p : X \times Y \to X \times Y$

(D) All are correct

74. Let $(X_1, \mathbf{T}_1)$ and $(X_2, \mathbf{T}_2)$ are two topological spaces and $B = \{G_1 \times G_2 : G_1 \in \mathbf{T}_1 \text{ and } G_2 \in \mathbf{T}_2\}$. Then :

(A) B is product topology

(B) B is base of a product topology

(C) B is not a topology

(D) All are correct

75. An example of product space is :

(A) Real line **R**

(B) **R** × **R**

(C) Complex plane

(D) Set of integers **Z**

76. The ultrafilter has a :

(A) Base

(B) No base

(C) Does not satisfy FIP

(D) None is correct

77. The ultrafilter :

(A) is existence

(B) does not exists sometimes

(C) is unique

(D) None of the above

78. Let $\{f_\alpha : \alpha \in \Delta\}$ be a family of filters. Then :

(A) Intersection is filter

(B) Union is filter

(C) Both union and intersection are filter

(D) None of the above

79. Let A be a subset of X and F is a filter on X, is frequently in A iff :

(A) $A \cap F = \phi, \ \forall F \in \mathbf{F}$

(B) $A \cap F = \phi$

(C) $A \cap F = F$

(D) $A \cap F = A$

80. Let F be a filter on X and $A \subset X$. Then F is said to be eventually in A if :

(A) $A \notin F$

(B) $A \in F$

(C) $A = F$

(D) $A = \phi$

81. A filter F is ultrafilter if :

(A) F is larger

(B) F is largest

(C) F is not filter

(D) None of the above

82. Let F_1 be a filter on X and F_2 is another filter such that $F_1 \subset F_2$. Then :

(A) F_1 is coarser

(B) F_2 is finer

(C) Filters are comparable

(D) All are correct

83. A filter F is cofinite filter if :

(A) F contains subsets whose complement is finite

(B) F contains finite subsets

(C) F is not finite

(D) $\phi \in F$

84. A filter F :

(A) has FIP

(B) does not satisfy FIP

(C) is a filter net

(D) None is correct

85. Let F be a filter on X. Then :

(A) $\phi \in F$

(B) $\phi \notin F$

(C) $A, B \in F$ then $A \cup B \in F$

(D) All are correct

86. A net is a :

(A) map

(B) set

(C) relation

(D) None of the above

87. Let (X, **T**) be a topological space and $Y \subset X$. Then $x_0 \notin X$ is limit point of Y iff $\exists$ a net in $Y - \{x_0\}$:

(A) Converges to x_0

(B) Converges to Y

(C) Converges to $y_0 \neq x$

(D) None is correct

88. A topological space (X, **T**) is compact if :

(A) X has a cluster point

(B) X has no cluster point

(C) X is closed

(D) X is bounded

89. Let (X, **T**) be a topological space and x is a cluster point of f if :

(A) Some subnet of f converges to x

(B) No subnet of f converges to x

(C) No such relation with a subnet

(D) None is correct

90. Let (X, **T**) be a Hausdorff space. Then every net in X converges :

(A) On atmost one point

(B) One more than one point

(C) Only at two points

(D) None of the above is correct

91. A subset A of a topological space is closed iff :

(A) No net in A converges to a point X–A

(B) No net in A converges to X

(C) No net is convergent

(D) Every net is convergent

92. Cluster point in a net is identified by being :

(A) Eventually in the neighbourhood

(B) Frequently in the neighbourhood

(C) Both eventually and frequently

(D) Neither eventually nor frequently

93. B is cofinal of set A if for any :

(A) $x \in A, \exists y \notin B$ s.t. $y \geq x$

(B) B = A

(C) $x \in A, y \notin B$ s.t. $y \leq x$

(D) None of the above

94. A net f is eventually in Y iff :

(A) B is residual subset of A and $f(B) \subset Y$

(B) B is cofinal

(C) Both residual and cofinal

(D) None of the above

95. A net is a map :

(A) from directed set to the directed set

(B) from directed set to the space

(C) space to space

(D) All are correct

96. Let (X, **T**) be indiscrete topological space. Then every net in X converges to :

(A) Every point in X

(B) Only one point in X

(C) A point $x_0 \notin X$

(D) None of the above

97. Let (A, $\geq$) be a directed set. Then B $\subset$ A is residual of A iff :

(A) $\exists a_0 \in A$ s.t. $a \geq a_0$ in A then $a \in B$

(B) $A \subset B$

(C) A = B

(D) None of the above

98. Which of the following sets is not a directed set ?

(A) **N**

(B) **R**

(C) **C**

(D) **Z**

99. A binary relation in A is direct if it satisfies :

(A) $a \in A \Rightarrow a \geq a$

(B) $a \geq b, b \geq c \Rightarrow a \geq c$

(C) $a, b \in A \Rightarrow \exists P \in A$ s.t. $p \geq a,\ p \geq b$

(D) All are correct

100. A binary operation on set A is a map f :

(A) from A to A

(B) from A to A × A

(C) from A × A to A

(D) from A to **N**

(Only for Rough Work)

4. Four alternative answers are mentioned for each question as—A, B, C & D in the booklet. The candidate has to choose the correct answer and mark the same in the OMR Answer-Sheet as per the direction :

Example :

Question :

Q. 1 (A) ● (C) (D)

Q. 2 (A) (B) ● (D)

Q. 3 (A) ● (C) (D)

Illegible answers with cutting and over-writing or half filled circle will be cancelled.

5. Each question carries equal marks. Marks will be awarded according to the number of correct answers you have.
6. All answers are to be given on OMR Answer Sheet only. Answers given anywhere other than the place specified in the answer sheet will not be considered valid.
7. Before writing anything on the OMR Answer Sheet, all the instructions given in it should be read carefully.
8. After the completion of the examination candidates should leave the examination hall only after providing their OMR Answer Sheet to the invigilator. Candidate can carry their Question Booklet.
9. There will be no negative marking.
10. Rough work, if any, should be done on the blank pages provided for the purpose in the booklet.
11. To bring and use of log-book, calculator, pager and cellular phone in examination hall is prohibited.
12. In case of any difference found in English and Hindi version of the question, the English version of the question will be held authentic.

Impt. : On opening the question booklet, first check that all the pages of the question booklet are printed properly. If there is any discrepancy in the question Booklet, then after showing it to the invigilator, get another question Booklet of the same series.

4. प्रश्न-पुस्तिका में प्रत्येक प्रश्न के चार सम्भावित उत्तर—A, B, C एवं D हैं। परीक्षार्थी को उन चारों विकल्पों में से सही उत्तर छाँटना है। उत्तर को OMR आन्सर-शीट में सम्बन्धित प्रश्न संख्या में निम्न प्रकार भरना है :

उदाहरण :

प्रश्न :

प्रश्न 1 (A) ● (C) (D)

प्रश्न 2 (A) (B) ● (D)

प्रश्न 3 (A) ● (C) (D)

अपठनीय उत्तर या ऐसे उत्तर जिन्हें काटा या बदला गया है, या गोले में आधा भरकर दिया गया, उन्हें निरस्त कर दिया जाएगा।

5. प्रत्येक प्रश्न के अंक समान हैं। आपके जितने उत्तर सही होंगे, उन्हीं के अनुसार अंक प्रदान किये जायेंगे।
6. सभी उत्तर केवल ओ. एम. आर. उत्तर-पत्रक (OMR Answer Sheet) पर ही दिये जाने हैं। उत्तर-पत्रक में निर्धारित स्थान के अलावा अन्यत्र कहीं पर दिया गया उत्तर मान्य नहीं होगा।
7. ओ. एम. आर. उत्तर-पत्रक (OMR Answer Sheet) पर कुछ भी लिखने से पूर्व उसमें दिये गये सभी अनुदेशों को सावधानीपूर्वक पढ़ लिया जाये।
8. परीक्षा समाप्ति के उपरान्त परीक्षार्थी कक्ष निरीक्षक को अपनी OMR Answer Sheet उपलब्ध कराने के बाद ही परीक्षा कक्ष से प्रस्थान करें। परीक्षार्थी अपने साथ प्रश्न-पुस्तिका ले जा सकते हैं।
9. निगेटिव मार्किंग नहीं है।
10. कोई भी रफ कार्य, प्रश्न-पुस्तिका के अन्त में, रफ-कार्य के लिए दिए खाली पेज पर ही किया जाना चाहिए।
11. परीक्षा-कक्ष में लॉग-बुक, कैलकुलेटर, पेजर तथा सेल्युलर फोन ले जाना तथा उसका उपयोग करना वर्जित है।
12. प्रश्न के हिन्दी एवं अंग्रेजी रूपान्तरण में भिन्नता होने की दशा में प्रश्न का अंग्रेजी रूपान्तरण ही मान्य होगा।

महत्वपूर्ण : प्रश्नपुस्तिका खोलने पर प्रथमत: जाँच कर देख लें कि प्रश्न-पुस्तिका के सभी पृष्ठ भलीभाँति छपे हुए हैं। यदि प्रश्नपुस्तिका में कोई कमी हो, तो कक्षनिरीक्षक को दिखाकर उसी सिरीज की दूसरी प्रश्न-पुस्तिका प्राप्त कर लें।