

MAULANA AZAD NATIONAL URDU UNIVERSITY

Ph.D Mathematics (Research Admission Test) RAT - 2022

QUESTION PAPER BOOKLET

Time: 2 hours

Max. Marks: 100

Hall Ticket No.

OMR Serial No.

INSTRUCTIONS TO THE CANDIDATES

1. Candidate should write their Hall Ticket number and OMR number on the space provided above. Candidate should not write their Hall Ticket number and OMR at any other place.
2. This booklet contains 16 pages. The last two pages are for Rough Work. Candidate should check the booklet before taking the test. In case of misprint or irregularity in question numbers / pages, etc., should report to the Invigilator immediately.
3. There are 100 Multiple Choice Questions in the booklet. For each question there are four options. The candidate is required to choose the correct answer and darken the circle with blue / black ballpoint pen in the OMR sheet against the corresponding answer number.
4. Candidate will get one mark each for each correct reply in the OMR sheet. If the candidate does not bubble the correct answer against the corresponding question number in the OMR sheet, he will not get marks.
5. If the candidate bubbles more than one circle in OMR Sheet for any question, marks shall not be awarded for the question.
6. There are no Negative marks.
7. At the end of Entrance Test, candidates are allowed to take their question booklet.

Part - A (Research Methodology)

1. Research is :
(A) Searching again and again
(B) Finding solution to any problem
(C) Working in a scientific way to search for truth of any problem
(D) None of the above
2. A blue print of research work is called.
(A) Research Method (B) Research Abstract
(C) Research Design (D) None of the above
3. Microchip was invented by
(A) Microsoft (B) IBM
(C) DELL (D) Intel
4. Inductive logic begins from
(A) General to general (B) Particular to general
(C) General to particular (D) Particular to particular
5. Which of the following is not a plagiarism detection software.
(A) Page Maker (B) Viper
(C) Plagiarism (D) Plagium
6. Language used in scientific data processing.
(A) FORTRAN (B) COBOL
(C) LISP (D) PASCAL
7. The number at ? in the series
1, 4, 27, 16, ? 36, 343 is
(A) 30 (B) 49
(C) 125 (D) 81
8. Search engine used specifically for scientific information is:
(A) Yahoo (B) Google
(C) SCIRUS (D) None of the above
9. If the code for SELECTION is QCJCARGML then AMERICANS is coded as:
(A) YKCPGAYLQ (B) BNFSJDBMR
(C) QLYAGPCKY (D) YQKLCYPAG
10. Fill in the blanks
AB, EDC, FGHI, OPQRST,
(A) JKLMN (B) JMKNL
(C) NMLKJ (D) NMKLJ
11. Which of the following is not a programming language?
(A) C++ (B) PASCAL
(C) FORTRAN (D) MS-WORD

12. LOTUS is
- (A) Computer software (B) Computer Hardware
(C) Computer (D) None of the above
13. Which of the following is a Social Network?
- (A) amazon.com (B) e.Bay
(C) Whatsapp (D) gmail.com
14. If 'n' is a natural number then
- $$2\binom{n}{2} + n^2 =$$
- (A) $\binom{2n}{2}$ (B) $\binom{2n+1}{2}$
(C) $\binom{2n}{2} + \binom{n}{2}$ (D) None of the above
15. How many real solutions does $\cos x = x$ has?
- (A) 0 (B) 1
(C) 2 (D) None of the above
16. The number of bijections from $S = \{1, 2, 3, 4, 5, 6\}$ onto itself are :
- (A) 120 (B) 720
(C) 6 (D) 620
17. Which of the following is the first step in starting research process?
- (A) Searching sources of information to locate problem
(B) Survey of related literature
(C) Identification of problem (D) None of the above
18. Informal self education is possible in what kind of library?
- (A) National Library (B) Public Library
(C) Specific Library (D) None of the above
19. Information is
- (A) Input data (B) Raw data
(C) Organised data (D) Processed data
20. Mean, Median and Mode are:
- (A) Methods of sampling (B) Measures of Deviation
(C) Measures of Central Tendency (D) None of the above
21. Which of these is not open source software.
- (A) D space (B) Windows
(C) Greenstone (D) Linux

22. Bibliometry is:
(A) Information Management Tool (B) Information Management Survey
(C) Library Service (D) None of the above
23. Conference proceedings are considered to be:
(A) Conventional (B) Primary
(C) Secondary (D) Tertiary
24. Which of the following is not a graphical representation?
(A) Pie chart (B) Bar Chart
(C) Histogram (D) None of the above
25. Questionnaire is
(A) Research Methodology (B) Measurement Technique
(C) Tool for data collection (D) None of the above
26. Population census is kind of research.
(A) Survey (B) Empirical
(C) Medical (D) Diagnostic
27. This is not required in experimental research.
(A) Observation (B) Content Analysis
(C) Manipulation and Replication (D) References
28. 1 G.B is equal to:
(A) 2^{30} bytes (B) 2^{30} bits
(C) 2^{20} bytes (D) 2^{20} bits
29. The next term in the series 3, 11, 23, 39, 59, is
(A) 63 (B) 73
(C) 83 (D) 93
30. In a certain code if 'TEACHER' is coded as VGCEJGT then the code for CHILDREN is
(A) EKNJFTGP (B) EJKNFTGP
(C) KNJFGTP (D) None of the above
31. For the positive real numbers which of the following order is correct?
(A) $\sqrt{2} < \sqrt[6]{6} < \sqrt[3]{3}$ (B) $\sqrt[6]{6} < \sqrt[3]{3} < \sqrt{2}$
(C) $\sqrt[6]{6} < \sqrt{2} < \sqrt[3]{3}$ (D) None of the above
32. If A,B are any two sets then $B-(B-A)=$
(A) $A \cap B$ (B) A
(C) B (D) ϕ

33. What type of research case study is?
(A) Documentary (B) Explanatory
(C) Historical (D) Survey
34. The basic properties of scientific research are:
(A) Empirical (B) Theoretical
(C) Experimental (D) All of these
35. The classification of research is:
(A) Fundamental applied and action research
(B) Qualitative and Quantitative research
(C) Philosophical, Historical, Survey and Experimental
(D) All of these
36. The Middle value of the ordered array is called:
(A) Mid Point (B) Mean
(C) Median (D) Mode
37. Which of the following is not a measure of central tendency?
(A) Percentile (B) Standard Deviation
(C) Mean (D) Median
38. Which of the following is not true about e-journals.
(A) They are distributed through digital methods
(B) They are also have editorial boards
(C) They are publications of serial nature
(D) They are always free of cost
39. High level language is:
(A) Disk space dependent (B) Operating system dependent
(C) Machine independent (D) None of the above
40. Scientific research starts from.
(A) Hypothesis (B) Inference
(C) Observation (D) None of the above
41. Which of the following storage unit is largest?
(A) Kilo Byte (B) Mega Byte
(C) Giga Byte (D) Terra Byte
42. Which of the following is not covered under intellectual property rights?
(A) Copy rights (B) Patents
(C) Trade mark (D) Thesaurus
43. If A is mother of B and C and if D is husband of C then relation of A with D is.
(A) Mother (B) Sister
(C) Mother in law (D) None of the above

44. Which of the following number is not a part of the series 3,5,7,12,17,19,23.....
(A) 7 (B) 17
(C) 12 (D) 23
45. The next term in the series 3, 8, 15, 24, 35,..... is
(A) 48 (B) 49
(C) 51 (D) None of the above
46. The sum of the series $\frac{1}{5} + \frac{1}{25} + \frac{1}{125} + \dots$
(A) 4/5 (B) 5/4
(C) 1/4 (D) 1/5
47. The next term of CKH, DMK, EON, is
(A) FPQ (B) FQP
(C) FQQ (D) FQR
48. Which of the following is research tool.
(A) Questionnaire (B) Graph
(C) Diagram (D) None of the above
49. If A,B are any two sets such that $A-B=B-A$ then.
(A) $A = \phi$ (B) $A \cap B = \phi$
(C) $B = \phi$ (D) $A=B$
50. If $X = \{4^n - 3n - 1 / n \in N\}$ and $Y = \{9(n-1) / n \in N\}$ then XUY is equal to:
(A) X (B) Y
(C) N (D) None of the above

Part - B (Mathematics)

51. If $a_n = \frac{1}{n \log n}$, then
- (A) $\sum a_n$ is convergent
 (B) $\langle a_n \rangle$ is convergent
 (C) $\sum a_n$ is divergent $\langle a_n \rangle$ does not converges to 0
 (D) $\sum a_n$ is divergent
52. $\lim_{n \rightarrow \infty} \left(\frac{1}{n+1} + \frac{1}{n+2} + \dots + \frac{1}{2n} \right)$ is equal to
- (A) 0 (B) 1 (C) 2 (D) $\log_e 2$
53. The series $\sum_{n=1}^{\infty} \frac{2n+1}{(n^2+n)^2}$
- (A) converges to 1 (B) converges to a number >1
 (C) diverges to ∞ (D) has an oscillating sequences of paratial sums
54. For what values of x the infinite series $\sum \frac{n!x^n}{n^n}$ diverges ?
- (A) $x < e$ (B) $x > e$ (C) $x = \sqrt{e}$ (D) None of these
55. The function $f(x) = |x| + |x+1| + |x+2| + |x-1| + |x-2|$ is
- (A) continuous, $\forall x \in R$ (B) differentiable, $\forall x \in R$
 (C) only differentiable at $x = 0, -1, -2, 1, 2$ (D) none of the above.
56. The function $f(x) = \begin{cases} \sin \frac{1}{x}, & x \neq 0 \\ 1, & x = 0 \end{cases}$ has
- (A) removable discontinuity at $x = 0$ (B) non-removal discontinuity at $x = 0$
 (C) mined discontinuity at $x = 0$ (D) continuity at $x = 0$.

57. Let f be the function defined on R by setting $f(x) = x - [x]$, $\forall x \in R$. Here, f will be continuous at the points
- (A) 0 (B) ± 1 (C) ± 2 (D) None of these
58. A function $f(x) = |x|$ is
- (A) Discontinuous (B) discontinuous at $x=0$
 (C) continuous everywhere (D) none of the above
59. The value of c for $f(x) = px^2 + qx + r$, $p \neq 0$ in $[1, b]$ by Lagrange's mean value theorem is
- (A) 5 (B) 15 (C) 25 (D) None of these
60. The function $f(x, y) = x^2 + y^2 - xy - x - y + 5$ has the
- (A) maximum at (1,1) (B) saddle point at (1,1)
 (C) minimum at (1,1) (D) None of the above at (1,1)
61. There are four statements
 (i) Every continuous function is integrable.
 (ii) Every continuous function is differentiable
 (iii) Every Riemann integrable function is continuous
 (iv) Every differentiable function is continuous.
 Then,
 (A) Both (i) and (ii) are correct
 (B) Both (i) and (iv) are correct
 (C) Both (i) and (iii) are correct
 (D) Both (ii) and (iv) are correct
62. Let $f_n(x) = x^n$, $\forall x \in [0, 1]$ and for all positive integers n , Then
- (A) $\langle f_n \rangle$ does not converge at any point
 (B) $\langle f_n \rangle$ converges at some points, but does not converge at some other points
 (C) $\langle f_n \rangle$ converges uniformly
 (D) $\langle f_n \rangle$ converges at every point, but does not converges uniformly.

63. The series $\sum \frac{\sin nx}{n}$ is

- (A) converges uniformly on $[5, 2\pi - 5]$
- (B) converges uniformly on $[10, 2\pi - 10]$
- (C) converges uniformly on $\left[\frac{\pi}{2}, \frac{3\pi}{2}\right]$
- (D) does not converges uniformly

64. Let $f = R^2 \rightarrow R$ be defined by

$$f(x, y) = \begin{cases} x^2 + y^2, & \text{if } x \text{ and } y \text{ are rational} \\ 0, & \text{otherwise} \end{cases}$$

Then,

- (A) f is not continuous at $(0,0)$
- (B) f is continuous at $(0,0)$ as well as differentiable at $(0,0)$
- (C) f is differentiable only at $(0,0)$
- (D) f is differentiable everywhere

65. If $f(x) = \sin x$. Then the total variation of $f(x)$ on $[0, 2]$ is

- (A) ∞
- (B) 1
- (C) 2
- (D) 3

66. If Lebesgue outer measure of a set $E, m^* E = 0$, then

- (A) E is measurable
- (B) E is not measurable
- (C) Both (a) and (b)
- (D) Neither (a) nor (b)

67. A metric space X is sequentially compact, if

- (A) every sequence $\langle x_n \rangle$ from X have convergent subsequence
- (B) every sequence $\langle x_n \rangle$ from X have divergent subsequence
- (C) Both (a) and (b) are false
- (D) Both (a) and (b) are true

68. A set $E \subset R$ is compact, then

- (A) it is closed and bounded
- (B) it is open and bounded
- (C) it is open and unbounded
- (D) it is closed and unbounded.

69. Let $X = (3, 2, -1)$, $Y = (2, 4, 1)$, $Z = (4, 0, -3)$ and $W = (10, 4, -5)$ be vectors in

\mathbb{R}^3 , a real vector space. Which one of the following is correct?

(A) $2X + Z = W, Y + Z = W$ (B) $2X - Y = Z, Y + 2Z = W$

(C) $X + Z = W, 2X + Y = Z$ (D) $Y + 2Z = W, X - Y = Z$

70. If C is a non-singular matrix and $B = C \begin{bmatrix} 0 & x & y \\ 0 & 0 & z \\ 0 & 0 & 0 \end{bmatrix} C^{-1}$, then

(A) $B^2 = 1$ (B) $B^2 = 0$ (C) $B^3 = 1$ (D) $B^3 = 0$

71. Which one of the following is correct?

(A) R is a vector space over N (B) R is a vector space over C

(C) R is a vector space over Z (D) None of the above

72. The dimension of $C(R)$ is

(A) 1 (B) 2 (C) 3 (D) 4

$$x + y + z = 0$$

73. The system of equations $3x + 6y + z = 0$

$$\alpha x + 2y + z = 0$$

has infinitely many solutions, then α is equal to

(A) 7 (B) $\frac{7}{5}$ (C) $\frac{5}{7}$ (D) 4

74. Let $T = R^2 \rightarrow R^3$ be a linear transformation given by $T(x_1, x_2) = (x_1 + x_2, x_1 - x_2, x_2)$ then Rank T is

(A) 0 (B) 1 (C) 2 (D) 3

75. Let $T = V \rightarrow W$ be a linear transformation where V is finite dimensional. Let B be a subspace of W . Then,

(A) $T^{-1}(B)$ is a sub space of V (B) $T^{-1}(B)$ is not a sub space of V

(C) $\dim T^{-1}(B) \leq \dim(\ker T)$ (D) None

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

- (A) 1 (B) $\sqrt{2}$ (C) $\sqrt{3}$ (D) $\sqrt{5}$

77. The function $f(z) = \frac{z-ib}{z^2+b^2}$ is continuous at

- (A) ib (B) $-ib$ (C) i^3b (D) None of these

78. The only function among the following that is analytic, is

- (A) $f(z) = \text{Re}(z)$ (B) $f(z) = \text{Im}(z)$ (C) $f(z) = \bar{z}$ (D) $f(z) = \sin z$

79. The poles of the function $f(z) = \frac{\sin z}{\cos z}$ are at

- (A) $\frac{(2n+1)\pi}{2}$, n is any integers (B) $\frac{2n\pi}{3}$, n is any integer
(C) $n\pi$ (D) None of these

80. The residue of $f(z)$ at $z=2$ where $f(z) = \frac{e^{-z}}{(z-2)^4}$ is :

- (A) $\frac{1}{6}$ (B) $\frac{e^2}{6}$ (C) $-\frac{1}{6e^2}$ (D) $\frac{1}{6e^2}$

81. The invariant points of the transformation $w = \frac{(z-1)}{(z+1)}$ are

- (A) $z = i$ (B) $z = \pm i$ (C) $z = \frac{i}{2}$ (D) $z = -\frac{i}{2}$

82. If $G = \{(0,1,2,3,4), +_5\}$ the order of 2 is

- (A) one (B) two (C) four (D) five

83. Every group of prime order is

- (A) cyclic (B) non abelian (C) Sub-group (D) None

84. If $H \subseteq K$ are two subgroups of G and if $[G : H] = 8$ and $[G : K] = 4$, then $[K : H]$ is
 (A) 2 (B) 3 (C) 5 (D) None of these
85. The number of subgroups of $\frac{Z}{48Z}$ is
 (A) 2 (B) 8 (C) 10 (D) 24
86. If a and b are two distinct element of a group G and H is a subgroup of G then.
 (A) $Ha = Hb \Rightarrow ab^{-1} \in H$ (B) $Ha \neq Hb \Rightarrow ab^{-1} \in H$
 (C) $ab^{-1} \in H \Rightarrow Ha \neq Hb$ (D) None
87. Let a mapping $f : G \rightarrow G$ defined by $f(x) = x^{-1}$, then which of the following is not correct?
 (A) f is one-one
 (B) f is onto
 (C) f is homomorphism as well as automorphism
 (D) G is non-abelian group.
88. A commutative division ring is a
 (A) vector space (B) group (C) integral domain (D) field
89. If R is a ring in which $x^2 = x \forall x \in R$ then
 (A) R is commutative (B) R is not commutative
 (C) R is zero ring (D) None of the above
90. Which of the following is a topology on $X = \{1, 2, 3, 4\}$?
 (A) $T = \{\emptyset, X, \{1\}, \{2\}\}$ (B) $T = \{\emptyset, X, \{1\}, \{2\}, \{1, 2\}, \{3\}\}$
 (C) $T = \{\emptyset, \{1\}, \{2\}, \{1, 2\}\}$ (D) $T = \{\emptyset, X, \{1\}, \{2\}, \{1, 2\}\}$
91. Every compact subset of a Hausdorff space is
 (A) closed set (B) open set (C) null set (D) none of these

92. Separable space
 (A) A topological space having a countable dense subset
 (B) A topological space having a countable non-dense subset
 (C) A topological space having a uncountable dense subset
 (D) None of these
93. The solution of differential equation $\frac{dy}{dx} = \frac{3x^2y^4 + 2xy}{x^2 - 2x^3y^3}$ is
 (A) $x^3y^2 + \frac{x^2}{y} = \frac{x}{y}$ (B) $x^3y^2 + \frac{x^2}{y^2} = x$
 (C) $x^3y^2 + \frac{x^2}{y} = C$ (D) None of these
94. $\frac{d^2y}{dx^2} + \frac{dy}{dx} - 2y = 0$ has the solution
 (A) $y = C_1e^{-2x} + C_2e^x$ (B) $y = Ce^{-2x}$
 (C) $y = C_1e^{-2x} + C_2e^{-x} + C_3$ (D) None
95. The equation $y = Ae^{3x} + Be^{5x}$ can be represented as
 (A) $y'' - 8y' + 15y = 0$ (B) $y'' - 8y' = 0$
 (C) $y'' + 8y' = 0$ (D) $y'' + 8y' + 15y = 0$
96. The solution of $\frac{\partial^2 z}{\partial x^2} - 5\frac{\partial^2 z}{\partial x \partial y} + 4\frac{\partial^2 z}{\partial y^2} = \sin(4x + y)$ is
 (A) $z = \frac{1}{3}x \cos(4x + y)$
 (B) $z = f_1(y + x) + f_2(y + 4x)$
 (C) $z = f(y + x) - \frac{1}{3}x \cos(4x + y)$
 (D) $z = f_1(y + x) + f_2(y + 4x) - \frac{1}{3}x \cos(4x + 3y)$

97. The initial value problem $x \frac{d^2y}{dx^2} + \frac{dy}{dx} + xy = 0$; $y(0) = 1, \left(\frac{dy}{dx}\right)_{x=0} = 0$ has
- (A) a unique solution (B) no solution
 (C) infinitely many solutions (D) two linearly independent solution .
98. The complete integral of PDE $x^2p^2 + y^2q^2 - 4 = 0$ is
- (A) $z = a \log x + \sqrt{4 - a^2} \log y + b$ (B) $z^2 = ax^2 + \sqrt{4 - a^2} y^2 + b$
 (C) $z = ax^2 + by^2 + c$ (D) $z = a \log x^2 \sqrt{4 - a^2} \log y^2 + b$
99. Value of $\frac{\Delta^2}{E}(x^3)$ is
- (A) $6x$ (B) $3x$ (C) $2x$ (D) None of these
100. A rigid body moving in space with one point fixed has degree of freedom
- (A) 1 (B) 3 (C) 6 (D) 9
