

Booklet Serial No.

Signature Invigilator

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PhD in Mathematics
Entrance Test May 2026
Question Paper cum Answer Script

Hall Ticket No.

OMR Serial No.

Time: 2hrs**Maximum Marks: 70****INSTRUCTIONS FOR CANDIDATES**

1. Candidate should write their Hall Ticket number and OMR number on the space provided above. Candidate should not write their Hall Ticket and OMR number at any other place.
2. This question booklet contains (28) pages. The Candidate should check the booklet before taking the Test. In case of any discrepancy, a new booklet may be provided by the Invigilator.
3. The question booklet consists of Part A and Part B. Part A contains 50 multiple-choice questions, each with four options. The candidate must select the correct answer and mark the corresponding circle on the OMR sheet using a blue or black ballpoint pen. Each question carries one mark. No marks will be awarded if the correct answer is not properly marked against the corresponding question number in the OMR sheet. Further, if more than one option is marked for any question, no marks will be awarded for that question.
4. Part B consists of four descriptive questions, each carrying 5 marks. The answers must be written only in the 8-page answer booklet provided. No additional answer booklet will be issued.
5. There are no Negative marks.
6. At the end of Entrance Test, candidates are allowed to take their question booklet and handover the OMR Sheet and answer booklet to the Invigilator.

Part A**Section 1 – Research Methodology**

1. A research design is primarily concerned with:
 - (A) Data analysis techniques
 - (B) The structure and logic of the research process
 - (C) Literature review writing
 - (D) Sampling methods only

2. Which type of validity refers to the extent to which causal conclusions can be drawn from a study?
 - (A) Internal validity
 - (B) External validity
 - (C) Construct validity
 - (D) Face validity

3. A mixed-methods design that collects quantitative and qualitative data simultaneously, with equal priority, is called:
 - (A) Explanatory sequential design
 - (B) Exploratory sequential design
 - (C) Convergent parallel design
 - (D) Embedded design

4. Which probability sampling method ensures that every possible sample of a given size has an equal chance of being selected?
 - (A) Stratified random sampling
 - (B) Simple random sampling
 - (C) Systematic sampling
 - (D) Cluster sampling

5. One of the following search engine is exclusively meant for scientific information :
 - (A) Google
 - (B) Yahoo
 - (C) SCIRUS
 - (D) Altavista

6. In grounded theory methodology, theoretical sampling means
- (A) Sampling based on population proportions
 - (B) Sampling until data saturation is reached
 - (C) Sampling guided by emerging categories and theory
 - (D) Random sampling of cases from a theory-driven list
7. A p value of 0.03 in hypothesis testing indicates:
- (A) 3% chance that the null hypothesis is true
 - (B) 3% probability of observing the data (or more extreme) if null is true
 - (C) 97% chance that the alternative hypothesis is true
 - (D) The effect size is large
8. Which philosophical paradigm emphasizes multiple, socially constructed realities and is often associated with qualitative research?
- (A) Positivism
 - (B) Postpositivism
 - (C) Interpretivism/Constructivism
 - (D) Pragmatism
9. Which of the following is a characteristic of longitudinal research?
- (A) Data collected at one point in time
 - (B) Data collected from different age groups at the same time
 - (C) Data collected from the same subjects over multiple time points
 - (D) Data collected from different cultures simultaneously
10. A Type II error occurs when:
- (A) The null hypothesis is rejected when it is true
 - (B) The null hypothesis is not rejected when it is false
 - (C) The alternative hypothesis is accepted incorrectly
 - (D) The sample is biased

11. Which method is most appropriate for identifying the factor structure underlying a set of observed variables?
- (A) Multiple regression (B) ANOVA
(C) Factor analysis (D) Chisquare test
12. A research proposal's "problem statement" should
- (A) List all possible research questions
(B) Describe the statistical tests to be used
(C) Clearly identify the gap or issue the study will address
(D) Summarize all previous literature
13. In quasi experimental designs, the main limitation compared to true experiments is:
- (A) Lack of a control group
(B) Lack of random assignment
(C) Lack of pretest
(D) Lack of dependent variable measurement
14. The concept of "transferability" in qualitative research is parallel to which concept in quantitative research?
- (A) Internal validity
(B) Reliability
(C) External validity / generalizability
(D) Objectivity
15. The primary purpose of a pilot study is to:
- (A) Confirm research hypotheses
(B) Test and refine research instruments and procedures
(C) Replace the main study
(D) Select a theoretical framework
16. "Member checking" is a technique used to enhance:
- (A) Statistical power
(B) Internal consistency
(C) Credibility in qualitative research
(D) Random sampling

17. Which of the following is an assumption of linear regression?
- (A) Homoscedasticity (constant variance of errors)
 - (B) Normality of the independent variables
 - (C) Independence of the dependent variable values
 - (D) Multi collinearity among predictors
18. Ethical principles in research with human subjects, as outlined in the Belmont Report, include:
- (A) Respect for persons, beneficence, justice
 - (B) Anonymity, confidentiality, honesty
 - (C) Informed consent, debriefing, deception
 - (D) Objectivity, integrity, openness
19. Who was the proponent of deductive method
- (A) Francis Bacon
 - (B) Christian Huygenes
 - (C) Aristotle
 - (D) Issac Newton
20. All research process starts with
- (A) Hypothesis
 - (B) Experiments to test hypothesis
 - (C) Observation
 - (D) All of these
21. For quantitative data which of the following measure(s) is used.
- (A) Mean
 - (B) Median
 - (C) Mode
 - (D) All of these
22. What should come in the place of question mark?
100, 198, 294, 388, 480, 570, ?
- (A) 652
 - (B) 654
 - (C) 656
 - (D) 658

23. A research paper is a brief report of research work based on
- (A) Primary Data only
 - (B) Secondary Data only
 - (C) Both Primary and Secondary Data
 - (D) None of the above
24. Which of the following is not covered under Intellectual Property Rights?
- (A) Copyrights
 - (B) Patents
 - (C) Trade Marks
 - (D) Thesaurus
25. Population census is an example of ----- research.
- (A) Survey
 - (B) Empirical
 - (C) Clinical
 - (D) None of these

Section 2 – Mathematics

26. Which of the following is true?
- (A) (a, ∞) is Lebesgue measurable
 - (B) (a, ∞) is not Lebesgue measurable
 - (C) $m^*(a, \infty) = 0$
 - (D) $m^*(a, \infty) \neq 0$
27. If A, B are subsets of R then which of the following is incorrect.
- (A) $\bar{B}$ is the largest closed set containing B
 - (B) $(\text{int } A) \cap (\text{int } B) = \text{int } (A \cap B)$
 - (C) $(\text{int } A) \cap (\text{int } B) \subseteq \text{int } (A \cap B)$
 - (D) None

28.

There are four statements

- (1) Every continuous function is integrable
- (2) Every continuous function is differentiable
- (3) Every Riemann integrable functions is continuous
- (4) Every differentiable function is continuous

Then

- (A) Both (1) & (2) are correct
- (B) Both (1) & (4) are correct
- (C) Both (1) & (3) are correct
- (D) Both (2) & (4) are correct

29. $\int_0^1 x^{m-1}(1-x)^{n-1} dx$ is convergent if

- (A) $m > 0$
- (B) $n > 0$
- (C) $m, n > 0$
- (D) $m = 0, n > 1$

30. $\int_{-\infty}^{+\infty} \frac{dx}{(x^2+1)^2}$

- (A) exists and equal to zero
- (B) exists and equal to $\frac{\pi}{2}$
- (C) exists and equal to zero $\frac{2}{\pi}$
- (D) doesn't exists

31. The value of λ for which the system of equation

$$\begin{aligned} x + y + z &= 0 \\ y + 2z &= 0 \\ \lambda x + z &= 0 \end{aligned}$$

has more than one solution is

- (A) -1
- (B) 0
- (C) $\frac{1}{2}$
- (D) None

32.

The alternating group A_n is simple if

- (A) $n < 4$
- (B) $n = 4$
- (C) $n > 4$
- (D) None

33. In a group of order 108 normal subgroups of following orders exists
 (A) 27 (B) 9
 (C) Both (A) and (B) (D) None
34. The degree of the extension of splitting field of $f(x) = x^4 - 2 \in Q[x]$ over Q is
 (A) 4 (B) 6
 (C) 10 (D) 8
35. The Particular integral of $(D^2 - 2D + 4)y = e^x \cos x$ is
 (A) $\cos x$ (B) $\sin x$
 (C) $\frac{1}{2}e^x \cos x$ (D) $\frac{1}{2}e^x \sin x$
36. The particular solution of $(D^3 + 1)y = \cos(2x - 1)$ is
 (A) $\frac{1}{65}(\cos(2x - 1) - 8)$
 (B) $\frac{1}{65}[\cos(2x - 1) - 8 \sin(2x - 1)]$
 (C) $\frac{1}{65}[\cos(2x + 1) + 8]$
 (D) None of these
37. The value of $\Delta^2 x^3$ at $x = 0$ is
 (A) 4 (B) 6
 (C) 8 (D) None of these
38. The function $\phi(x) = 1 + kx$ is a solution of the integral equation

$$x = \int_0^x e^{x-v} \phi(v) dv$$

 (A) $K = -1$ (B) $K = \frac{x+1}{e^x} \neq 0$
 (C) $K = -2$ (D) $K = -3$

39. For the Hamiltonian $H = \frac{1}{2}(Zp^2 + 2Ypq + Xq^2)$ what is $\dot{q}$?
- (A) $\frac{Zp}{2}$ (B) $Zp + Yq$
 (C) $-(Yp + qX)$ (D) None of these
40. Let $K = \begin{bmatrix} 1 & 1+i & 2i & 9 \\ 1-i & 3 & 4 & 7-i \\ -2i & 4 & 5 & i \\ 9 & +i & -i & 7 \end{bmatrix}$ then
- (A) K has purely imaginary Eigen values
 (B) K has only real Eigen values
 (C) K is not diagonalizable
 (D) None of these
41. The Value of m so that $2x - x^2 + my^2$ is harmonic is
- (A) 0 (B) 1
 (C) 2 (D) None of these
42. $\int_C \log z \, dz$ where C is unit circle is
- (A) $2\pi i$ (B) πi
 (C) $4\pi i$ (D) 0
43. Which of the following is/are true?
- (A) Every metrizable space is normal
 (B) Every compact Hausdorff space is normal
 (C) Every well-ordered set X is normal in the order topology
 (D) All of these
44. A coin is tossed $m + n$ times with $m > n$. The probability of getting m consecutive heads is
- (A) $\frac{n+2}{2^{m+1}}$ (B) $\frac{n}{2^{m+1}}$
 (C) $\frac{1+n}{2^{m+1}}$ (D) None of these

45. The eigen values of an Hermitian matrix are
 (A) Zero (B) Imaginary
 (C) Real (D) None of these
46. If T is a linear operator on a finite dimensional vector space V and scalar C is a characteristic value of T then
 (A) $\det(T - CI) = 0$ (B) $\det(T - CI) \neq 0$
 (C) $\det(T - CI) < 0$ (D) $\det(T - CI) > 0$
47. A topological space X is totally disconnected if
 (A) its only connected subsets are one point set
 (B) its only connected subsets are one empty set
 (C) its only connected subsets are ϕ , X itself
 (D) None of these
48. Let $f_n(x) = \frac{x}{1+n^2x^2}$, $x \in [0, 1]$ be a sequence of real valued functions. Then
 (A) $f_n(x)$ is uniformly convergent
 (B) $f_n'(x)$ is uniformly convergent
 (C) uniform limit of $f_n'(x)$ is $f(x) = 0$
 (D) None of these
49. If (I) $f(x) = \frac{1}{x^2}$ is uniformly continuous on $[1, \infty]$
 (II) $g(x) = \frac{1}{x}$ is uniformly continuous on $(0, \infty)$
 Then
 (A) (I) is True and (II) is False (B) (I) is False and (II) is True
 (C) Both (I) and (II) are True (D) Both (I) and (II) are False

50. The complete integral of $q = 3p^2$ is

- (A) $Z = ax + 3b^2y + a$ (B) $Z = ax + 3a^2y + b$
 (C) $Z = a + 3ax + by$ (D) None of these

Part B (Subjective Questions)

Answer all four questions

20 Marks

Research Methodology

(Questions 1-2)

- In methods of proof in Mathematics explain briefly the following:
 - Direct Proof
 - Proof by contrapositive
 - Proof by contradiction
- In first year of research in Mathematics (Analysis, Algebra, Celestial Mechanics, Differential Geometry, Fluid Mechanics, Fractional Calculus or Wavelet Analysis-Choose one area for concreteness) address any two of the following aspects of Research Methodology:
 - Describe a systematic method for conducting a literature review.
 - Role of proof checking and counter example search
 - Role of computational exploration

Mathematics

- Evaluate $\int_C \frac{e^{az}}{z^2+1} dz$ where c is the circle $|z| = 2$ and 'a' is measured in radians.
- Define a prime field. Prove that the Prime field of a field F is either isomorphic to $\mathbb{Q}$ or $\mathbb{Z}/(p)$ (p - prime).

ROUGH WORK

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