

# Entrance Test for Ph.D. Programme-2018

**Time: 120 Minutes**

**Max Marks: 100**

**Discipline: Mathematical Sciences**

**Set: A**

**Test ID: 57**

**Name:**.....

**Father Name:** .....

**Roll Number:** ..... **Date:** ...../...../.....

**Roll Number in words:**.....

**Signature of Candidate:**

**Signature of Invigilator:**

## INSTRUCTIONS FOR CANDIDATES

1. Do not open seal before start of Exam.
2. Carefully fill all your details in top portion of this question paper. Don't leave any column blank.
3. Use blue/black ball point pen to fill details on question paper. Write only in capital letters.
4. Carefully fill all your details in top portion of OMR answer sheet. Also put your signatures at bottom portion of OMR.
5. **Use only black ball point pen to fill details & darken circles on OMR sheet. Using pencil is strictly prohibited.**
6. **Carefully fill your Roll No, Test ID, Category, Paper Set and other required details on the OMR sheet.**
7. Question paper consists of two sections. Section-I is of Research Methodology and Section-II is Subject specific. Each section contains 50 multiple choice questions. Total 100 questions of one mark each.
8. **Maximum marks are 100.**
9. **Time allowed is 120 minutes.**
10. **Qualifying marks shall be 50% for General Category and 45% for Reserved Categories.**
11. All questions are compulsory. No negative marking for wrong answers.
12. There are four alternative answers for each question out of which only one is correct.
13. You have to darken the circle of right answer on OMR answer sheet.
14. Questions left blank or attempted with two or more options/answers will not be evaluated.
15. Also read carefully the instructions on OMR answer sheet before attempting the questions.
16. Use of calculator is not allowed.
17. Log tables may be provided for calculation work, if required.
18. OMR sheet should not be folded or crushed. Don't put any stray marks on the sheet.
19. Circles on **OMR sheet** should be darkened completely. Incomplete/half filled circles will not be evaluated.
20. Do not use marker or white fluid on the OMR sheet.
21. **The medium of the examination is English only.**
22. No extra sheet will be provided for the rough work. Use the space inside the question paper pages for rough work.
23. Carrying mobile phones, electronic gadgets, notes or extra papers in examination hall is strictly prohibited.
24. Indulging in any form of unfair means, canvassing, impersonation or misbehaviour with examination staff will result in disqualification of your candidature.

**Section-I**  
**Research Methodology**

1. Who authored the book "Methods in Social Research"?
  - A) Wilkinson
  - B) C R Kothari
  - C) Kerlinger
  - D) Goode and Halt
  
2. Social Science deals with
  - A) Objects
  - B) Human beings
  - C) Living things
  - D) Non-living things
  
3. "The Romance of Research" is authored by
  - A) Redmen and Mory
  - B) P. V. Young
  - C) Robert C. Meir
  - D) Harold Dazier
  
4. Which of the following is an example of primary data?
  - A) Book
  - B) Journal
  - C) Newspaper
  - D) Census Report
  
5. ICSSR stands for
  - A) Indian Council for Survey and Research
  - B) Indian Council for Strategic Research
  - C) Indian Council for Social Science Research
  - D) Inter National Council for Social Science Research

6. JRF stands for
- A) Junior Research Functions
  - B) Junior Research Fellowship
  - C) Junior Fellowship
  - D) None of the above
7. In the formulation of problem, which of the following we need to give?
- A) Title
  - B) Index
  - C) Bibliography
  - D) Concepts
8. Analogies are sources of
- A) Data
  - B) Concept
  - C) Research
  - D) Hypothesis
9. When a hypothesis is stated negatively, it is called
- A) Relational Hypothesis
  - B) Situational Hypothesis
  - C) Null Hypothesis
  - D) Casual Hypothesis
10. In a survey, there is an enumerator and
- A) Guide
  - B) Respondent
  - C) Supervisor
  - D) Messenger
11. A short summary of Technical Paper is called
- A) Article
  - B) Research Abstract

C) Publication

D) Guide

12. Ph.D. stands for

A) Doctor of Philosophy

B) Degree in Philosophy

C) Doctor of Psychology

D) None of the above

13. Failure to acknowledge the borrowed material; is called (Take and use of others as one's own)

A) Acknowledgement

B) Foot Notes

C) Index

D) Plagiarism

14. Data related to the Human beings are called

A) Territorial data

B) Organisational data

C) Peripheral data

D) Demographic data

15. Schedule is filled by which of the following?

A) Respondent

B) Enumerator

C) Everybody

D) None of the above

16. Questions in which only two alternatives are possible are called

A) Multiple choice questions

B) Dichotomous Questions

C) Open ended questions

D) Structured questions

17. Assigning numerals or other symbols to the categories or response is called
- A) Editing
  - B) Coding
  - C) Transcription
  - D) Tabulation
18. Tippet table refers to
- A) Table of random digits
  - B) Table used in sampling methods
  - C) Table used in statistical investigations
  - D) All of the above
19. Research and development become the index of development of country. Which of the following reasons are true with regards to the statement?
- A) Because R&D reflect the true economic and social conditions prevailing in a country.
  - B) Because R&D targets the human development.
  - C) Because R&D can improve the standard of living of the people in a country.
  - D) All of the above.
20. The word "Anusandhan" implies
- A) Attaining an aim
  - B) Goal orientation
  - C) Following an aim
  - D) Praying to achieve an aim
21. A Researcher wants to study the relationship of family size to income. He classifies his population into different income slabs and then takes a random sample from each slab in order. Which technique of sampling is he working with?
- A) Cluster sampling
  - B) Random sampling

C) Stratified Random sampling

D) Systematic sampling

For Q. 22-23. The following table gives the sales of batteries manufactured by a company over the years.

Number of different batteries sold (in thousands)

Year	Types of Batteries					Total
	4AH	7AH	32AH	35AH	55AH	
1992	75	144	114	102	108	543
1993	90	126	102	84	126	528
1994	96	114	75	105	135	525
1995	105	90	150	90	75	510
1996	90	75	135	75	90	465
1997	105	60	165	45	120	495
1998	115	85	160	100	145	605

22. What was the approximate percentage increase in the sales of 55AH batteries in 1998 compared to that in 1992?

A) 28%

B) 31%

C) 33%

D) 34%

23. The percentage of 4AH batteries sold to the total number of batteries sold was maximum in the year?

A) 1994

B) 1995

C) 1996

- D) 1997
24. Look the series: 22, 21, 23, 22, 24, 23, .....
- A) 22
  - B) 24
  - C) 25
  - D) 26
25. Which word does not belong to others?
- A) Dodge
  - B) Flee
  - C) Duck
  - D) Avoid
26. Which of the following is not an essential element of report writing?
- A) Research Methodology
  - B) Reference
  - C) Conclusion
  - D) None of the above
27. Which of the following is non-probability sampling?
- A) Snowball
  - B) Random
  - C) Cluster
  - D) Stratified
28. In group interview, there are
- A) One interviewer and one interviewee
  - B) More than one interviewer and one interviewee
  - C) One interviewer and more than one interviewee
  - D) More than one interviewer and more than one interviewee
29. Uniting various qualitative methods with quantitative methods can be called as
- A) Coalesce

B) Triangulation

C) Bipartite

D) Impassive

30. Books and records are the primary sources of data in:

A) clinical research

B) historical research

C) laboratory research

D) participatory research

31. The important pre-requisites of a researcher in sciences, social sciences and humanities are

A) laboratory skills, records, supervisor, topic

B) Supervisor, topic, critical analysis, patience

C) archives, supervisor, topic, flexibility in thinking

D) topic, supervisor, good temperament, pre-conceived notions

32. A college wants to give training in use of Statistical Package for Social Sciences (SPSS) to researchers. For this the college should organize

A) Lecture

B) Seminar

C) Workshop

D) Conference

33. Which One of the following is not a quality of researcher?

A) Keenness in enquiry

B) He must be of alert mind

C) His assertion to outstrip the evidence

D) Unison with that of which he is in search

34. Null means?

A) One

B) Two



- C) Zero
- D) None of the above

35. The depth of any research can be judged by:

- A) title of the research
- B) duration of the research
- C) objectives of the research
- D) total expenditure on the research

36. Fundamental research reflects the ability to:

- A) Expound new principles
- B) Synthesize new ideals
- C) Evaluate the existing material concerning research
- D) Study the existing literature regarding various topics

37. A ratio represents the relation between

- A) Part and Part
- B) Part and Whole
- C) Whole and Whole
- D) All of the above

38. Circle graphs are used to show:

- A) How one part is related to other parts?
- B) How various sections share in the whole?
- C) How one whole is related to other whole?
- D) How various parts are related to the whole?

39. Field-work based research is classified as:

- A) Historical
- B) Empirical
- C) Biographical
- D) Experimental

40. Statistical measure based upon the entire population is called parameter while measure based upon a sample is known as:
- A) Inference
  - B) Statistics
  - C) Sample parameter
  - D) None of these
41. The importance of the correlation co-efficient lies in the fact that:
- A) It is one of the most valid measure of statistics.
  - B) It is a non-parametric method of statistical analysis.
  - C) There is a linear relationship between the correlated variables.
  - D) It allows one to determine the degree or strength of the association between two variables.
42. Which one of the following is the most comprehensive source of population data?
- A) Census
  - B) National Sample Surveys
  - C) Demographic Health Surveys
  - D) National Family Health Surveys
43. Which correlation co-efficient best explains the relationship between creativity and intelligence?
- A) 0.3
  - B) 0.5
  - C) 0.6
  - D) 1.0
44. Normal Probability Curve should be
- A) Zero skewed
  - B) Positively skewed
  - C) Negatively skewed
  - D) Leptokurtic skewed

45. A doctor studies the relative effectiveness of two drugs of dengue fever. His research would be classified as
- A) Case Study
  - B) Ethnography
  - C) Descriptive Survey
  - D) Experimental Research
46. Newton gave three basic laws of motion. This research is categorized as
- A) Sample Survey
  - B) Applied Research
  - C) Descriptive Research
  - D) Fundamental Research
47. When two or more successive footnotes refer to the same work which one of the following expressions is used?
- A) et.al
  - B) op.cit
  - C) loc.cit
  - D) ibid
48. Nine year olds are taller than seven year olds. This is an example of a reference drawn from
- A) Vertical study
  - B) Time series study
  - C) Experimental study
  - D) Cross-sectional study
49. Which one of the following belongs to the category of good 'research ethics'?
- A) Publishing the same paper in two research journals without telling the editors
  - B) Trimming outliers from a data set without discussing your reasons in a research paper

- C) Conducting a review of the literature that acknowledges the contributions of other people in the relevant field or relevant prior work
  - D) Including a colleague as an author on a research paper in return for a favor even though the colleague did not make a serious contribution to the paper
50. Which of the following are the basic rules of APA style of referencing format?
- A) Alphabetically index reference list
  - B) Invert authors' names (last name first)
  - C) Italicize titles of longer works such as books and journals
  - D) All of the above

## Section-II

### Mathematical Sciences

51. Suppose  $A_1, A_2, A_3, \dots, A_{30}$  are thirty sets each having 5 elements and  $B_1, B_2, \dots, B_n$  are  $n$  sets each with 3 elements. Let  $\bigcup_{i=1}^{30} A_i = \bigcup_{j=1}^n B_j = S$  and each element of  $S$  belongs to exactly 10 of the  $A_i$ 's and exactly 9 of the  $B_j$ 's. Then,  $n$  is equal to
- (a) 15                      (b) 3                      (c) 45                      (d) 55
52. For the sequence:  $1, -\frac{1}{2}, \frac{1}{3}, -\frac{1}{4}, \frac{1}{5}, -\frac{1}{6}, \dots$ , the limit superior and limit inferior are respectively
- (a)  $-\frac{1}{2}, 1$                       (b)  $0, 0$                       (c)  $1, -\frac{1}{2}$                       (d)  $1, 0$
53. Let  $S = [0, 1) \cup [2, 3]$  and  $f: S \rightarrow \mathbb{R}$  be a strictly increasing function such that  $f(S)$  is connected. Which of the following statements is true?
- (a)  $f$  has exactly one discontinuity                      (b)  $f$  has exactly two discontinuities
- (c)  $f$  has infinitely many discontinuities                      (d)  $f$  is continuous
54. Let  $f: \mathbb{R} \rightarrow \mathbb{R}$  be a continuous function and  $f(x+1) = f(x)$  for all  $x \in \mathbb{R}$ . Then
- (a)  $f$  is bounded above, but not bounded below
- (b)  $f$  is bounded above and below, but may not attain its bounds
- (c)  $f$  is bounded above and below and attains its bounds
- (d)  $f$  is not uniformly continuous

55. Let  $f$  be a Lebesgue integrable function on  $[0, 1]$ . Then  $\lim_{\alpha \rightarrow \infty} \int_0^1 f(x) e^{i\alpha x} dx$

(a) May not exist

(b) exists and equals  $f(0)$

(b) exists and equals  $f(1)$

(d) exists and equals zero

56. Consider the improper Riemann integral  $\int_0^x y^{-\frac{1}{2}} dy$ . Then, integral is

(a) Continuous on  $[0, \infty)$

(b) Continuous only in  $(0, \infty)$

(c) Discontinuous in  $(0, \infty)$

(d) Discontinuous only in  $(\frac{1}{2}, \infty)$

57. Suppose that a function has partial derivatives  $\frac{\partial f}{\partial x} = x^2 - y - 1$ , and  $\frac{\partial f}{\partial y} = y - x + 1$ .

Which of the following is a critical point of  $f(x, y)$ ?

(a)  $(-1, 0)$

(b)  $(1, -1)$

(c)  $(0, -1)$

(d) none of these

58. For a subset  $A$  of a metric space, which of the following implies the other three?

(a)  $A$  is closed

(b)  $A$  is bounded

(c) closure of  $B$  is compact for every  $B \subseteq A$

(d)  $A$  is compact

59. Let  $X$  and  $Y$  be metric spaces, and let  $f: X \rightarrow Y$  be a continuous map. For any subset  $S$  of  $X$ , which of the following statements is true?

(a) If  $S$  is open, then  $f(S)$  is open

(b) If  $S$  is connected, then  $f(S)$  is connected

(c) If  $S$  is closed, then  $f(S)$  is closed

- (d) If  $S$  is bounded, then  $f(S)$  is bounded
60. Let  $f : X \rightarrow Y$  be a continuous map between metric spaces. Then,  $f(X)$  is a complete subset of  $Y$  if
- (a) The space  $X$  is compact                      (b) The space  $Y$  is compact  
(c) The space  $X$  is complete                      (d) The space  $Y$  is complete
61. Let  $p$  be a vector space of all polynomials over  $C$  and  $T : p \rightarrow b$  given by  $T(f(x)) = xf(x)$ . Then
- (a) 0 is the only eigenvalue of  $T$                       (b) every  $\lambda \in \mathcal{R}$  is an eigenvalue of  $T$   
(c)  $T$  has no eigenvalue                      (d) 1, -1 are the only eigenvalues of  $T$
62. Let  $T : \mathcal{R}^4 \rightarrow \mathcal{R}^4$  be a linear map defined by  $T(x, y, z, w) = (x + z, 2x + y + 3z, 2y + 2z, w)$ . Then the rank of  $T$  is equal to
- (a) 1                      (b) 2                      (c) 3                      (d) 4
63. Let  $M$  be a  $3 \times 3$  singular matrix and suppose that 2 and 3 are eigenvalues of  $M$ . Then the number of linearly independent eigen-vectors of  $M^3 + 2M + I_3$  is equal to
- (a) 1                      (b) 2                      (c) 3                      (d) 4
64. A real quadratic form is equivalent to the diagonal form:  
 $f(x_1, x_2, x_3) = (x_1 - 2x_2 + 4x_3 - 5x_4)^2$ . Then,  $\sum a_{ij}$  is
- (a) 2                      (b) 3                      (c) 4                      (d) 9

65. The function  $w = e^z$  is

(a) Entire and periodic

(b) entire, periodic and 1-1 mapping

(c) analytic, periodic and not 1-1 mapping

(d) analytic, periodic and 1-1 mapping

66. Let  $f: C \rightarrow C$  be an entire function with  $f(0)=1, f(1)=2$  and  $f'(0)=0$ . If there exists  $M > 0$  such that  $|f''(z)| \leq M$  for all  $z \in C$ , then  $f(2)$  is equal to

(a) 2

(b) 5

(c)  $2+5i$

(d)  $5+2i$

67. If  $u(x, y) = xy$  is a harmonic function, then harmonic conjugate of  $u(x, y)$  is

(a)  $\frac{x^2}{2}$

(b)  $x^2 + y^2$

(c)  $\frac{x^2 + y^2}{2}$

(d)  $\frac{y^2 - x^2}{2}$

68. In a Laurent series expansion of  $f(z) = \frac{1}{z(z-1)}$  valid for  $|z-1| > 1$ , the coefficient of

$\frac{1}{z-1}$  is

(a) -2

(b) -1

(c) 0

(d) 1

69. The nature of the singularities of  $f(z) = \frac{(z+3)}{z^2} \sin\left(\frac{1}{z-2}\right)$  is

(a)  $z = -3$ , isolated essential singularity,  $z = 0$ , pole of order 2

(b)  $z = 2$ , isolated essential singularity,  $z = 0$ , pole of order 2

(c)  $z = 2$ , pole of order 2,  $z = 0$ , non-isolated essential singularity

(d)  $z = 2$ , pole of order 1,  $z = 0$ , pole of order 2



70. Let  $f$  be a bi-linear transformation that maps  $-i$  to  $-1$ ,  $1$  to  $0$  and  $i$  to  $1$ , then  $f(1)$  is equal to
- (a) 0                      (b) -2                      (c)  $i$                       (d)  $-i$
71. The total number of divisors of number 38808 excluding 1 and the number itself is
- (a) 68                      (b) 69                      (c) 70                      (d) 72
72. For any integer  $n > 1$ , which of the following statements is true?
- (a) Euler function  $\phi(n) = n - 1$ , if  $n$  is not prime
- (b) Euler function  $\phi(n) = n - 1$ , if  $n$  is prime
- (c) If  $n$  is prime, then Euler function  $\phi(n) = n + 1$
- (d) If  $n$  is prime, then Euler function  $\phi(n) \neq n + 1$
73. Which of the following is a group?
- (a)  $\mathfrak{R}$  with subtraction                      (b) non-zero integers with division
- (c) natural numbers with addition                      (d)  $\mathfrak{R}$  with addition
74. If  $N$  is a normal subgroup of  $G$ , then the right and left cosets of  $N$  in  $G$
- (a) Do not exist    (b) are coincident    (c) exist but are different    (d) none of these
75. Let  $H$  and  $K$  be normal solvable subgroups of a group  $G$ . Then  $HK$  is
- (a) Solvable but not normal in  $G$     (b) not solvable but normal in  $G$
- (c) neither solvable nor normal in  $G$     (d) Solvable and normal in  $G$

76. If  $U$  is an ideal of ring  $R$  and  $1 \in U$ , then

- (a)  $U$  is a proper subset of  $R$  (b)  $U$  is equal to  $R$   
(c)  $U$  is a super set of  $R$  (d)  $U = \phi$

77. Which of the following rings is an integral domain?

- (a)  $R[x]/(x^2 + 5x + 1)$  (b)  $R[x]/(x^2 + 5x + 6)$   
(c)  $R[x]/(x^3 - 2)$  (d)  $R[x]/(x^7 + 1)$

78. The number of irreducible polynomials of the form  $x^2 + px + q$ , with  $p$  and  $q$  in the field  $F_7$  of 7 elements is

- (a) 7 (b) 21 (c) 35 (d) 49

79. Let  $F$  and  $F'$  be fields such that  $|F| = 9$ ,  $|F'| = 4$ . The total number of field homomorphism from  $F$  to  $F'$  is

- (a) 2 (b) 1 (c) 0 (d) 3

80. Let  $E$  be the minimal splitting field of  $x^6 + 1 = 0$ , over  $Z_2$ . Then, the degree of  $E$  over  $Z_2$  is

- (a) 24 (b) 3 (c) 2 (d) 6

81. Which of the following statements is connected?

- (a) The subspace  $[-1, 1]$  of the real line  $\mathfrak{R}$   
(b) The subspace  $Q$  of rational of real line  $\mathfrak{R}$   
(c) The subspace  $X = \{x \times y \mid y = 0\} \cup \left\{x \times y \mid x > 0 \text{ and } y = \frac{1}{x}\right\}$  of plane  $\mathfrak{R}^2$

(d) None of these

82. Separable space is

- (a) A topological space having a countable dense subset
- (b) A topological space having a countable non-dense subset
- (c) A topological space having an uncountable dense subset
- (d) A topological space having a countable as well as uncountable dense subset

83. Which of the following is compact?

- (a) The real line  $\mathbb{R}$
- (b) The subspace  $X = \{0\} \cup \left\{ \frac{1}{n} \mid n \in \mathbb{Z}_+ \right\}$  of  $\mathbb{R}$
- (c) The interval  $(0, 1]$
- (d) None of the above

84. Equation of a curve passing through  $(3, 9)$  and which satisfies the differential equation:

$$\frac{dy}{dx} = x + \frac{1}{x^2} \text{ is}$$

- (a)  $6xy = 3x^2 - 6x + 29$
- (b)  $6xy = 3x^3 - 29x + 6$
- (c)  $6xy = 3x^3 + 29x - 6$
- (d)  $6xy = 3x^3 + 6x - 6$

85. The singular solution of  $p^3 - 4xy p + 8y^2 = 0$ , where  $p = \frac{dy}{dx}$  is

- (a)  $27y - 4x^2 = 0$
- (b)  $27y - 4x^3 = 0$
- (c)  $27y + 4x^3 = 0$
- (d)  $27y + 4x^2 = 0$

86. Let  $p_n(x)$  be the polynomial solution of the differential equation:

$$\frac{d}{dx} [(1-x^2)y'] + n(n+1)y = 0, \quad \text{with } p_n(1) = 1 \quad \text{for } n = 1, 2, 3, \dots \quad \text{If}$$

$$\frac{d}{dx} [p_{n+2}(x) - p_n(x)] = \alpha_n p_{n+1}(x), \quad \text{then } \alpha_n \text{ is}$$

- (a)  $2n$                       (b)  $2n+1$                       (c)  $2n+2$                       (d)  $2n+3$

87. Sturm-Liouville boundary value problem:  $\frac{d^2 y}{dx^2} + \lambda y = 0, y(0) = 0, y'(\pi) = 0$  has its eigenvalue given by

- (a)  $\sin nx$                       (b)  $\sin\left(n + \frac{1}{2}\right)x$                       (c)  $\cos nx$                       (d)  $\cos\left(n + \frac{1}{2}\right)x, n = 0, 1, \dots$

88. The partial differential equation:  $x \frac{\partial^2 u}{\partial x^2} + (x-y) \frac{\partial^2 u}{\partial x \partial y} - y \frac{\partial^2 u}{\partial y^2} + \frac{1}{4} \left( \frac{\partial u}{\partial y} - \frac{\partial u}{\partial x} \right) = 0$ , is

- (a) Hyperbolic along the line  $x+y=0$                       (b) elliptic along the line  $x+y=0$   
 (c) elliptic along the line  $x-y=0$                       (d) parabolic along the line  $x+y=0$

89. The initial boundary value problem:  $u_t = u_{xx}, 0 < x < 1, t > 0; u(0,t) = u(1,t) = 0;$

$u(x,0) = x(1-x), 0 \leq x < 1$  has a solution  $u(x,t) = \sum_{n=1}^{\infty} a_n \exp(-n^2 \pi t) \sin n \pi x$ , where

$a_n$  is equal to

- (a)  $\frac{8}{n^3 \pi^3}$  if  $n$  is odd and 0 if  $n$  is even                      (b)  $\frac{4}{n^3 \pi^3}$  if  $n$  is odd and 0 if  $n$  is even  
 (c)  $\frac{8}{n^3 \pi^3}$  if  $n$  is even and 0 if  $n$  is odd                      (d)  $\frac{4}{n^2 \pi^2}$  if  $n$  is even and 0 if  $n$  is odd

90. If  $x=r$  is a root of order  $m$  of the equation  $f(x)=0$ , then Newton's method will converge

- (a) Linearly                      (b) quadratically                      (c) cubically                      (d) super-linearly

91. Gauss-Seidel method is also known as

- (a) Displacement method                      (b) successive displacement method

(c) simultaneous method

(d) diagonal method

92. The highest order of polynomial integrand for which Simpson's rule of integration is exact is

(a) First

(b) second

(c) third

(d) fourth

93. Given  $x: 0 \quad 10 \quad 16$   
 $y: 6 \quad 16 \quad 28$ . The interpolated value at  $x=4$  using piecewise linear interpolation is

(a) 11

(b) 4

(c) 22

(d) 10

94. The Euler-Lagrange equation is

(a)  $\frac{\partial F}{\partial y} - \frac{d}{dx} \left[ \frac{\partial F}{\partial y'} \right] = 0$

(b)  $\frac{\partial F}{\partial y} - \frac{d}{dx} \left[ \frac{\partial F}{\partial y} \right] = 0$

(c)  $\frac{\partial F}{\partial y} - \left[ \frac{\partial F}{\partial y'} \right] = 0$

(d)  $\frac{\partial F}{\partial y} - \frac{d}{dx} \left[ \frac{\partial F}{\partial y'} \right] = 1$

95. On which curve, the functional:  $\int_0^1 [(y')^2 + 12xy] dx$  with  $y(0)=0$  and  $y(1)=1$  be extremized?

(a)  $y=x$

(b)  $y=x^2$

(c)  $y=x^3$

(d)  $y=x^4$

96. The integral equation of the initial value problem:  $\phi''(x) + \lambda\phi(x) = F(x)$ , with  $\phi(0) = 1$ ,  $\phi'(0) = 0$  is

(a)  $\phi(x) = x + \int_0^x (x-\xi)\{F(\xi) - \lambda\phi(\xi)\}d\xi$  (b)  $\phi(x) = 1 + \int_0^x (x-\xi)\{F(\xi) - \lambda\phi(\xi)\}d\xi$

(c)  $\phi(x) = \int_0^x (x-\xi)\{F(\xi) - \lambda\phi(\xi)\}d\xi$  (d)  $\phi(x) = x - \int_0^x (x-\xi)\{F(\xi) + \lambda\phi(\xi)\}d\xi$

97. Which of the following statements is true for the integral equation:

$$\phi(x) = \frac{1}{e^2 - 1} \int_0^1 2e^x e^\xi \phi(\xi) d\xi ?$$

- (a) The solution of the equation is  $\phi(x) = 1$
- (b) The solution of the equation is  $\phi(x) = \cos x$
- (c) The equation is Fredholm integral equation
- (d) The equation is Volterra integral equation

98. The principle of least action

- (a) Is a variational principle
- (b) being applied in the theory of relativity, quantum mechanics and quantum field
- (c) When applied to the action of mechanical system, can be used to obtain equation of motion of the system
- (d) All of the above

99. Euler's theorem states that

- (a) The general displacement of a rigid body with one point fixed is a rotation about some axis
- (b) The general displacement of a rigid body is translation with a rotation
- (c) Lgrange's bracket is canonical invariant

(d) Poisson's bracket is invariant under canonical transformation

100. If a random variable  $X$  follows normal distribution with mean  $\mu$  and variance  $\sigma^2$ , then random variable  $z = \frac{x - \mu}{\sigma}$ , follows normal distribution with

(a) Mean = 1, variance = 1

(b) mean  $\frac{\mu}{2}$ , variance =  $\frac{\sigma^2}{4}$

(c) Mean = 1, variance = 0

(d) Mean = 0, variance = 1

