

Ganpat University

Faculty of Science

Ph.D Entrance Test – Mathematics

March 2017

SECTION - B

Total Marks: 50

Instructions:

1. All questions are compulsory.
2. Question number 1 to 50 each of one mark.
3. Use of calculator is not permissible.

Choose the correct answer in each of the following. (One mark each 1 - 50)

[50]

1.  $(1 + \Delta)(1 - \nabla) = \underline{\hspace{2cm}}$  where  $\Delta$  is a forward difference operator and  $\nabla$  is a backward differential operator.  
a) 1                                      b) 0                                      c) -1                                      d) 2
2. If  $f(x)$  is a polynomial of degree  $n$  in  $x$  then  $(n+1)$  and higher order difference of this polynomial are  $\underline{\hspace{2cm}}$   
a) Constant                                      b) Variable                                      c) Zero                                      d) None of these
3. Let  $h$  be the finite difference and  $E$  be the shift operator then  $E^r f(x) = \underline{\hspace{2cm}}$   
a)  $f(x)$                                       b)  $f(x + rh)$                                       c)  $f(x - rh)$                                       d)  $rf(hx)$
4. The method of group averages is based on the assumption that the sum of the residuals is  $\underline{\hspace{2cm}}$   
a) Zero                                      b) One                                      c) Infinite                                      d) None of these
5. The residue of  $f(z) = \cot z$  is  
a)  $i$                                       b)  $-i$                                       c) 1                                      d) None of these
6. For the function  $f(z) = \frac{1-e^{-z}}{z}$ , the point  $z = 0$  is  
a) an essential singularity                                      b) a pole of order 0                                      c) a pole of order 1                                      d) a removable singularity
7. The order of convergence in Newton – Raphson method is  $\underline{\hspace{2cm}}$   
a) 0                                      b) 1                                      c) 2                                      d) 3
8. If the mean of a Poisson distribution is  $m$  then Standard deviation of this distribution is  $\underline{\hspace{2cm}}$   
a)  $m^2$                                       b)  $\sqrt{m}$                                       c)  $m$                                       d) none of these
9. Bessel's formula is most appropriate when  $p$  lies between  $\underline{\hspace{2cm}}$   
a)  $-0.25$  to  $0.25$                                       b)  $0.25$  to  $0.75$                                       c)  $0.75$  to  $1.00$                                       d)  $1.00$  to  $1.25$
10. If  $y'' + a_1(x)y' + a_0(x)y = 0$  has continuous coefficients  $a_1(x), a_0(x)$  on an open interval  $I$ . Then two solutions  $y_1$  and  $y_2$  of this equation on  $I$  are Linearly Independent if and only if  $\underline{\hspace{2cm}}$ , where Wronskian is defined as  $W = \begin{bmatrix} y_1 & y_2 \\ y_1' & y_2' \end{bmatrix}$ .  
a)  $W \neq 0$                                       b)  $W = 0$                                       c)  $W > 0$                                       d)  $W < 0$

11. The set of square matrices of order two with respect to matrix multiplication is a \_\_\_\_\_
- a) Group                      b) Semi group                      c) Monoid                      d) None of these
12. The assignment problem is a \_\_\_\_\_
- a) Nonlinear programming problem                      b) Dynamic programming problem                      c) Integer linear programming problem                      d) Integer nonlinear programming problem
13. The Euclidian space  $E^n$  is \_\_\_\_\_
- a) Open set                      b) Closed set                      c) Both open and closed set                      d) Neither open nor closed
14. The residue of  $f(z) = \cot z$  is
- a)  $i$                       b)  $-i$                       c) 1                      d) None of these
15. Let  $V$  be a finite dimensional space.  $T$  is zero transformation on  $V$ . Then range of  $T$  is
- a)  $\{0\}$                       b)  $V$                       c)  $\phi$                       d) None of these
16. If  $A$  is a skew symmetric matrix then trace of  $A$  is \_\_\_\_\_
- a) 1                      b)  $-1$                       c) 0                      d) None of these
17. If one of the roots of equation  $x^3 - 6x^2 + 11x - 6 = 0$  is 3 then other two roots are \_\_\_\_\_
- a) 1 and 2                      b) 0 and 4                      c)  $-1$  and 5                      d) 1 and 6
18. The system of equations  $x + 2y + z = 1$ ,  $2x + 4y + 2z = 2$ ,  $3x + 6y + 3z = 3$  is \_\_\_\_\_
- a) inconsistent                      b) consistent and trivial solution                      c) consistent and infinite solution                      d) none of these
19. The curve  $x^3 + y^3 = 3axy$  is symmetrical about \_\_\_\_\_
- a) X axis                      b) Y axis                      c) Line  $X=Y$                       d) Both axes
20. If  $G$  is a group and  $a \in G$  such that  $a^2 = a$  then  $a$  is \_\_\_\_\_
- a) Identity element                      b) Inverse                      c) Zero element                      d) None of these
21. In LPP, A: Every optimal solution is solution, B: Every optimal solution is feasible solution.
- a) A and B both false                      b) A and B both true                      c) Only A is true                      d) Only B is true
22. If  $f(x, y) = \frac{1}{x^3} + \frac{1}{y^3} + \frac{1}{x^3 + y^3}$  then  $xf_x + yf_y =$  \_\_\_\_\_
- a) 0                      b)  $3f$                       c) 9                      d)  $-3f$
23. The series  $1 - \frac{1}{\sqrt{2}} + \frac{1}{\sqrt{3}} - \frac{1}{\sqrt{4}} + \dots$  is \_\_\_\_\_
- a) oscillatory                      b) conditionally convergent                      c) divergent                      d) absolutely convergent
24. If an error of 1% is made in measuring its length and breath, the percentage error in the area of a rectangle is \_\_\_\_\_
- a) 0.2 %                      b) 0.02 %                      c) 2%                      d) 1%

25. The domain of convergence for  $x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \dots$  is \_\_\_\_\_  
 a)  $(-1,1)$                       b)  $(-1,1]$                       c)  $[-1,1]$                       d)  $[-1,1)$
26. The sequence  $\left\{\frac{n}{n+1}\right\}$  is \_\_\_\_\_  
 a) Increasing sequence    b) Decreasing sequence    c) Unbounded sequence    d) None of these
27. For a matrix  $A = \begin{bmatrix} 2 & 1 \\ 3 & -1 \end{bmatrix}$ , which of the following is the zero matrix?  
 a)  $A^2 - A - 5I$                       b)  $A^2 + A - 5I$                       c)  $A^2 + A - I$                       d)  $A^2 - 3A + 5I$
28. The mean of binomial distribution with  $r$  observations and probability of success  $p$  is \_\_\_\_  
 a)  $pq$                       b)  $rp$                       c)  $\sqrt{rp}$                       d)  $\sqrt{pq}$
29. Any square matrix  $A$  is said to be singular if  
 a)  $|A| = 0$                       b)  $|A| \neq 0$                       c)  $A^T = A$                       d) None of these
30. Let  $P$  be a matrix of order  $m \times n$  and  $Q$  be a matrix of order  $n \times p$ , ( $n \neq p$ ). If  $\text{rank}(P) = n$  and  $\text{rank}(Q) = p$ , then  $\text{rank}(PQ)$  is \_\_\_\_  
 a)  $n$                       b)  $p$                       c)  $np$                       d)  $n + p$
31. If  $\alpha$  and  $\beta$  are the roots of the equation  $x^2 - 2x + 4 = 0$  then  $\alpha^3 + \beta^3$  is equal to \_\_\_\_  
 a)  $-16$                       b)  $-8$                       c)  $8$                       d)  $0$
32. An objective function in general LPP is \_\_\_\_\_  
 a) Linear                      b) Non linear                      c) Constant                      d) None of these
33. If  $B$  is a non-singular matrix and  $A$  is a square matrix. Then  $\det(B^{-1}AB)$  is equal to  
 a)  $\det(A)$                       b)  $\det(BAB)$                       c)  $\det(B^{-1})$                       d)  $\det(A^{-1})$
34. Let  $W_1$  and  $W_2$  be finite dimensional subspaces of a vector space  $V$ .  
 If  $\dim W_1 = 2, \dim W_2 = 2, \dim(W_1 + W_2) = 3$ , then  $\dim(W_1 \cap W_2)$  is \_\_\_\_  
 a)  $1$                       b)  $2$                       c)  $3$                       d)  $4$
35. A function  $f(x) = |x|$  is \_\_\_\_\_  
 a) Continuous and differentiable at  $x = 0$     b) Continuous but not differentiable at  $x = 0$     c) Discontinuous and differentiable at  $x = 0$     d) None of these
36. The Standard deviation of the binomial distribution is \_\_\_\_\_  
 a)  $\sqrt{npq}$                       b)  $\sqrt{np}$                       c)  $npq$                       d)  $pq$
37. If every element of a group  $G$  is its own inverse then  $G$  is \_\_\_\_\_  
 a) Finite                      b) Infinite                      c) abelian                      d) cyclic
38. The number of generators of an infinite cyclic group is \_\_\_\_\_  
 a)  $1$                       b)  $2$                       c) Infinite                      d) None of these

39. The equation  $ax + by + c = 0$  represents a plane perpendicular to \_\_\_\_\_  
 a) XY plane                      b) YZ plane                      c) ZX plane                      d) None of these
40. The angle between the vectors  $2\hat{i} + 3\hat{j} + \hat{k}$  and  $2\hat{i} - \hat{j} - \hat{k}$  is \_\_\_\_\_  
 a)  $\frac{\pi}{2}$                                   b)  $\frac{\pi}{3}$                                   c)  $\frac{\pi}{4}$                                   d) None of these
41. For complex numbers  $z_1$  &  $z_2$ , If  $\arg(z_1 - z_2) = 0$  then  $|z_1 - z_2| =$  \_\_\_\_\_  
 a)  $|z_1| + |z_2|$                       b)  $|z_1| - |z_2|$                       c)  $||z_1| - |z_2||$                       d) 0
42. Three numbers are chosen from 1 to 30. The probability that they are not consecutive is \_\_\_\_\_  
 a)  $\frac{144}{145}$                                   b)  $\frac{143}{145}$                                   c)  $\frac{142}{145}$                                   d) None of these
43. If the constraints in a LPP are changed then \_\_\_\_\_  
 a) The problem is to be re-evaluated                      b) Solution is not defined                      c) The objective function has to be modified                      d) The change in constraints is ignored
44. If  $I_n = \int_0^{\pi/4} \tan^n x \, dx$  then for any positive integer  $n$ ,  $I_{n+2} + I_n =$  \_\_\_\_\_  
 a)  $\frac{1}{n}$                                   b)  $\frac{1}{n+1}$                                   c)  $\frac{1}{n-1}$                                   d)  $\frac{1}{n+2}$
45. Charpit's method can be used to solve \_\_\_\_\_  
 (a) First order linear PDE                      (b) First order nonlinear PDE in p & q                      (c) Higher order nonlinear PDE                      (d) None of these
46. A first order PDE  $x^2p + y^2q = xyz$  is \_\_\_\_\_  
 (a) Linear                                  (b) Semi linear                                  (c) Quasi linear                                  (d) Nonlinear
47. The solution of  $pq = 1$  is \_\_\_\_\_  
 (a)  $z = ax + by$                       (b)  $z = ab$                                   (c)  $ab = 1$                                   (d)  $z = ax + \frac{y}{a} + c$
48. The sum of the eigen values of  $\begin{bmatrix} 2 & 1 & 3 \\ 1 & 3 & 1 \\ 3 & 1 & 4 \end{bmatrix}$  is \_\_\_\_\_  
 a) 0                                  b) 24                                  c) 9                                  d) 5
49. The only function that is analytic from the following is \_\_\_\_\_  
 a)  $f(z) = \sin z$                       b)  $f(z) = \bar{z}$                                   c)  $f(z) = \text{Im}(z)$                                   d)  $\text{Re}(iz)$
50. If the correlation coefficient is 0, the two regression lines are \_\_\_\_\_  
 a) parallel                                  b) perpendicular                                  c) coincident                                  d) inclined at  $45^\circ$  to each other

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**Answer Key**

Question No.	Correct Answer
1	a
2	a
3	b
4	a
5	c
6	d
7	c
8	b
9	b
10	b
11	b
12	c
13	c
14	c
15	a
16	c
17	a
18	c
19	c
20	a
21	b
22	d
23	b
24	c
25	b

Question No.	Correct Answer
26	a
27	a
28	b
29	a
30	b
31	a
32	a
33	a
34	a
35	b
36	a
37	c
38	b
39	a
40	a
41	c
42	a
43	a
44	b
45	b
46	b
47	d
48	c
49	a
50	b