PUNJAB TECHNICAL UNIVERSITY
JALANDHAR

Max. Marks: 90 **Time: 90 Mins.**

Entrance Test for Enrollment in Ph.D. Programme

Important Instructions

- ***Fill all the information in various columns, in capital letters, with blue/black ball point pen.***
- ***Use of calculators is not allowed. Use Blue/Black ball point pen for attempting the questions.***
- ***All questions are compulsory. No negative marking for wrong answers.***
- ***To attempt a question, make a tick mark (√) at the right option/answer.***
- ***Each question has only one right answer.***
- ***Questions attempted with two or more options/answers will not be evaluated.***

Stream *(Engg./Arch./Pharm./Mgmt./App.Sci./Life Sci.)* **Applied Science**

Discipline **Mathematics**

Name .....

Father's Name .....

Roll No. ..... Date: **15-01-2011**

Signature of Candidate .....

Signature of Invigilator .....

Q. 1 The objective of a research is
(a) Theoretical
(b) Factual
(c) Practical
(d) all of above

Q. 2 If you are repeating the mistake again and again then you are called a/an
(a) excellent researcher
(b) excellent forgetter
(c) foolish person
(d) normal person

Q. 3 The principles formulated by the fundamental research are used in
(a) applied research
(b) philosophical research
(c) action research
(d) none of these

Q. 4 The problem can be stated as
(a) posing a question
(b) making a declarative statement
(c) both of above
(d) none of above

Q. 5 Defining a problem means
(a) raising a boundary wall around the problem
(b) fencing of the problem
(c) drawing a perimeter around the problem
(d) all of above

Q. 6 The research papers are written in order to
(a) gain name and fame
(b) communicate the research
(c) get promotions
(d) None of above

Q. 7 The research papers are generally prepared by
(a) the research scholar
(b) the research supervisor
(c) the scientists
(d) All of above

Q. 8 The process of writing a research paper is
(a) Scientific
(b) Unscientific
(c) Original
(d) None of above

Q. 9 "Acknowledgment" in a research thesis is written because
(a) It is the effort on the part of researcher to repay the academic debts
(b) It is the custom to recognize the other's contribution in your work
(c) It is a obligatory in nature in order to forget the bad taste in mouth during its completion.
(d) All of the above

Q. 10 The title page of research thesis should be

(a) Brief and meaningful

(b) Scientific and logical

(c) Aesthetic and attractive

(d) all of the above

Q. 11 Which of the journal is related to Mathematics
(a) IEEE Transactions on Power Systems

(b) ASME

(c) Electric Power Research System

(d) The Mathematics student

Q. 12 Let $V_1 = (1,-1, 0)$, $V_2 = (0, 1,-1)$ and $V_3 = (0, 0, 1)$ be elements of R^3.Then the set $\{V_1, V_2, V_3\}$ is
(a) linearly independent

(b) linearly dependant

(c) both (1) and (2)

(d) None of these

13. Let T : $R_3 \to R_2$ be a linear transformation such that TX = AX , where

A = $\begin{bmatrix} 1 & 1 & 0 \\ -1 & 0 & 1 \end{bmatrix}$ and X = $\begin{bmatrix} x \\ y \\ z \end{bmatrix}$

Then the dimensions of Ker(T) is
(a) 1

(b) 2

(c) 3

(d) None of these

Q. 14 Which of the following statements is true.

(a) If A is a square matrix, then the row echelon form of A is lower triangular matrix.

(b) If A is a square matrix, then the column echelon form of A is an upper triangular matrix.

(c) The number of non zero rows in the row echelon form of a matrix A gives the rank of A.

(d) Echelon form of A can not be used to find rank of A.

Q. 15 Which of the following statements is false .

(a) Eigen values of a symmetric matrix corresponding to distinct eigen values are orthogonal.

(b) Product of two orthogonal matrices of the same order is also an orthogonal matrix.

(c) Eigen values of a unitary matrix are of magnitude1.

(d) Eigen values of a skew symmetric matrix are always real.

Q. 16 Let a 3 × 3 matrix A has eigen values 1, 2, −1. Then the trace of the matrix $B = A - A^{-1} + A^2$ is
(a) 15
(b) 15/2
(c) 2/15
(d) None of these

Q. 17 Let f' (x) = 1 / $(3-x^2)$ and f(0) = 1. Then the interval in which f(1) lies is
(a) [0, 1]

(b) [1/3, 1/2]

(c) [4/3 , 3/2]

(d) None of these

Q. 18 If a right angled triangle has hypotenuse h, then its maximum area will be
(a) $h^2/2$

(b) h^2

(c) $h^2/4$

(d) None of these.

19. The inclined asymptote of $x^3 + y^3 + 3xy = 0$ is
(a) x + y + 1 = 0

(b) x − y + 1 = 0

(c) x + y − 1 = 0

(d) None of these

Q. 20 If sin u = $x^2 y^2 / (x^2 + y^2)$, then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ =
(a) 2 sin u

(b) 2 tan u

(c) 2 cot u

(d) None of these

Q. 21 If x = r cosθ, y = r sinθ, then $\frac{\partial(r,\theta)}{\partial(x,y)}$ =
(a) r

(b) r^2

(c) - r

(d) None of these

Q. 22 The value of the integral $\int_0^{\frac{\pi}{2}} \frac{dx}{1+tan^3 x}$ =
(a) π/4

(b) π/2

(c) 0

(d) None of These

Q. 23 The value of $\int_0^{\infty} \int_x^{\infty} \frac{e^{-y}}{y} dxdy$=
(a) 1

(b) 0

(c) π/4

(d) None of these

Q. 24 The values of p for which the improper integral $\int_1^{\infty} \frac{dx}{x^p}$ diverges are
(a)p > 1

(b) p ≥ 1

(c) p ≤ 1

(d) None of these

Q. 25 The coordinates of the point of intersection of the line $\frac{x+1}{1} = \frac{y+3}{3} = \frac{z+2}{-2}$ with the plane $3x + 4y + 5z = 5$ is
(a) (5, 15, -14)
(b) (3, 4, 5)
(c) (1, 3, -2)
(d) None of these

Q. 26 The plane $ax+by+cz = 0$ cuts the cone $xy+yz+zx = 0$ in perpendicular lines if
(a) $a + b + c = 0$
(b) $a^{-1} + b^{-1} + c^{-1} = 0$
(c) $a2 + b^2 + c^2 = 0$
(d) None of these

Q. 27 The sum of the direction cosines of a straight line is
(a) 0
(b) 1
(c) Constant
(d) None of these

Q. 28 The equation of the plane passing through the point (3,−3, 1) and parallel to the plane $2x + 3y + 5z + 6 = 0$ is
(a) $2x + 3y + 5z + 2 = 0$
(b) $2x + 3y + 5z - 2 = 0$
(c) $2x + 3y + 7z + 3 = 0$
(d) None of these

Q. 29 The perpendicular distance between planes $2x + 2y + z - 6 = 0$ & $4x + 4y + 2z - 7 = 0$ is
(a) 1/3
(b) 5/6
(c) 13/3
(d) None of these

Q. 30 The line $(x-1)/1 = (y-2)/2 = (z-3)/3$ and plane $x + y - z = 0$ are
(a) parallel
(b) perpendicular
(c) line lies in the plane
(d) None of these

Q. 31 The family of straight lines passing through the origin is represented by the differential equation
(a) $ydx + xdy = 0$
(b) $xdy - ydx = 0$
(c) $xdx + ydx = 0$
(d) None of these

Q. 32 The general solution of the differential equation $(D^4 - 6D^3 + 12D^2 - 8D)y = 0$ is
(a) $y = c_1 + [c_2 + c_3x + c_4x^2]e^{2x}$
(b) $y = [c_1 + c_2x + c_3x^2]e^{2x}$
(c) $y = c_1 + c_2x + c_3x^2 + c_4e^{2x}$
(d) None of these.

Q. 33 The solution curve of the equation $xy' = 2y$ passing through (1, 2) also passes through
(a) (2, 1)
(b) (4, 24)
(c) (0, 0)
(d) None of these

Q. 34 $y = e^{-x} [c_1 \cos\sqrt{(3x)} + c_2 \sin\sqrt{(3x)}] + c_3e^{2x}$ is the general solution of
(a) $[D^3 + 4]y = 0$
(b) $[D^3 - 8]y = 0$
(c) $[D^3 + 8]y = 0$
(d) None of these

Q. 35 The particular integral of the differential equation $(D^3 - D)y = e^x + e^{-x}$ is
(a) $\frac{1}{2}(e^x + e^{-x})$
(b) $\frac{1}{2}x(e^x + e^{-x})$
(c) $\frac{1}{2}x^2(e^x + e^{-x})$
(d) None of these

Q. 36 $L^{-1}[1 / s^n]$ is possible only when n is
(a) Zero
(b) Negative integer
(c) Positive integer
(d) None of these

Q. 37 Directional derivative of $f(x, y, z) = xy^2 + yz^3$ at the point (2,−1, 1) in the direction of vector $\hat{i} + 2\hat{j} + 2\hat{k}$ is
(a) −11/3
(b) 11/3
(c) 14/3
(d) None of these

Q. 38 Let
$\vec{F} = (ax^2y + yz)\hat{i} + (xy^2 - xz^2)\hat{j} + (2xyz - 2x^2y^2)\hat{k}$
If $\vec{\nabla}.\vec{F} = 0$, then the value of a is
(a) 2
(b) ½
(c) -2
(d) None of these

Q. 39 If $\vec{A} = x^2y\hat{i} + y^2z\hat{j} + z^2y\hat{k}$, then $\vec{\nabla} \times (\vec{\nabla} \times \vec{A}) =$
(a) $2(x + z)\hat{j} + 2y\hat{k}$
(b) $2x\hat{i} + 2z\hat{j} + 2y\hat{k}$
(c) 0
(d) None of these

Q. 40 For a plane curve, torsion (τ) =
(a) 0
(b) 1
(c) ∞
(d) None of these

Q. 41 Curvature of the curve $x = a \cos t$, $y = a \sin t$, $z = bt$ is
(a) $a^2 / (a^2 + b^2)$
(b) $b^2 / (a^2 + b^2)$
(c) $a / (a^2 + b^2)$
(d) None of These

Q. 42 The value of line integral $\int_C[(xy+y^2)dx+x^2dy]$, where C is bounded by y = x and $y = x^2$ is
(a) – 1 / 20
(b) 1 / 20
(c) 20
(d) None of these

Q. 43 If S is any closed surface enclosing a volume V and $\vec{F} = ax\hat{i} + by\hat{j} + cz\hat{k}$, then $\int_S \vec{F}.\hat{n}ds$ =
(a) abcV
(b) (abc/3) V
(c) 3abcV
(d) None of these

Q. 44 If G is a group, which of the following statements are true?
(a) The identity element of G is unique.
(b) Every a ∈ G has unique inverse in G.
(c) For every a ∈ G, $(a^{-1})^{-1} = a$.
(d) For all a, b ∈ G, $(a.b)^{-1} = (a^{-1}.b^{-1})$

Q. 45 Which of the following statements are true?
(a) Every subgroup of an abelian group is normal.
(b) Intersection of two normal subgroups of a group G may not be a normal subgroup of G.
(c) If G is a finite group and N is a normal subgroup of G, then O(G/N) = O(G).O(N).
(d) If N and M are normal subgroups of G, then NM may not be a normal subgroup of G.

Q. 46 Choose the correct answer to fill in the blank in the following:
Every permutation is the ..... of its cycles.
(a) sum
(b) difference
(c) product
(d) none of these

47. If R is the set of even integers under the usual operations of addition and multiplication, then
(a) R is a commutative ring with unit element.
(b) R is a commutative ring without unit element.
(c) R is non-commutative ring.
(d) None of these.

48. Which of the following statements is correct?
(a) A commutative ring is an integral domain if it has zero divisors.
(b) A ring is a division ring if its elements form a group under multiplication.
(c) A finite integral domain is a field.
(d) None of these.

49. Any field is
(a) an integral domain.
(b) not an integral domain.
(c) a division ring.
(d) None of these.

50. If F is a field, then
(a) {0} is its only ideal.
(b) {0} is one of its ideal.
(c) {0} is not its ideal.
(d) None of these.

51. If x ∈ R (set of real numbers) satisfies $|x - 1| > |x + 1|$, then
(a) x > 0.
(b) x < 0.
(c) x = 0.
(d) None of these.

52. If S is a non-empty finite subset of R, then
(a) S contains its supremum.
(b) S does not contain its supremum.
(c) S does not have any supremum.
(d) None of these.

Q. 53 Let S = {(1 / n), n ∈ N. Then inf S =
(a) 1.
(b) 0.
(c) does not exist
(d) None of these.

Q. 54 The open interval (0, 1) is
(a) complete.
(b) not complete.
(c) compact but not complete.
(d) None of these.

55. $\text{Lim}_{n\to\infty} \{2 + (1/n)\}^2$ =
(a) 4
(b) 2
(c) ∞
(d) None of these

56. Which of the following statements is not correct?
(a) Every convergent sequence of real numbers is a cauchy sequence.
(b) Every cauchy sequence of real numbers is bounded
(c) Every cauchy sequence of real numbers is convergent
(d) None of these

57. Consider the geometric series $1+r+r^2+r^3+...$ Which of the following is not true?
(a) The series converges for |r| < 1.
(b) The series diverges for r = 1.
(c) the series oscillates for r = −1
(d) None of these.

58. The infinite series $(\sin x / 1^3) - (\sin 2x / 2^3) + (\sin 3x / 3^3) - \ldots$ is
(a) absolutely convergent.
(b) conditionally convergent.
(c) divergent.
(d) None of these.

59. Which of the following statements is not true?
(a) f(x) = 1/x is uniformly continuous on A = [1,∞)
(b) $f(x) = 1/x^2$ is uniformly continuous on A = [1, ∞).
(c) $f(x) = x^2$ is uniformly continuous on A = [0, ∞).
(d) f(x) = sin (1/x) is not uniformly continuous on A = (0, ∞).

Q. 60 Which of the following statements is not true?
(a) If f : [a, b] → R is a step function, then f ∈ R[a,b].
(b) If f : [a, b] → R is continuous on [a, b], then f ∈ R[a, b].
(c) If f; [a, b] → R is monotonic in [a, b], then f ∈ R[a, b].
(d) None of these.

61. The relation |3 − z| + |3 + z| = 5 represents
(a) a circle.
(b) a parabola.
(c) an ellipse.
(d) None of these.

62. If z is a complex number with |z| = 1 and arg z = 3π/4, then value of z is
(a) (1+ i)/√2.
(b) (−1+ i)/√2.
(c) (1− i)/√2.
(d) None of these.

63. The curves u(x, y) = c and v(x, y) = c' are orthogonal if
(a) u + iv is analytic.
(b) u − iv is analytic.
(c) v + iu is analytic.
(d) none of these.

64. If f(z) = $-\frac{1}{z-1} - 2[1 + (z-1) + (z-1)^2 + \ldots]$, then residue of f(z) at z = 1 is
(a) 1.
(b) -1.
(c) 0.
(d) None of these

Q. 65 The function $f(z) = \bar{z}$ is analytic at
(a) z = 0.
(b) z = 1.
(c) no point in the complex plane.
(d) none of these.

Q. 66 The invariant points of the transformation, $w = \frac{1+z}{1-z}$, are
(a) ± i.
(b) ± 1.
(c) ± 2.
(d) None of these.

67. The value of $\int_C \frac{1}{z-1} dz$, C being |z| = 1, is
(a) π.
(b) 2π.
(c) 2πi.
(d) None of these.

68. Image of |z| = 2 under w = z + 3 + 2i is
(a) plane Rew ≥ 0.
(b) a circle with centre (3, 2) and radius 2.
(c) plane Imw ≥ 0.
(d) None of these.

69. Order of convergence of Newton-Raphson method is
(a) 2.
(b) 3.
(c) 1.
(d) None of these.

70. If $f(x) = 3x^3 - 2x^2 + 1$, then $\Delta^3 f(x)$ =
(a) 27.
(b) 18.
(c) 0.
(d) None of these.

71. Relationship between E and D is
(a) $E = e^{hD}$.
(b) $E = e^{-hD}$.
(c) $D = e^{hE}$.
(d) None of these.

72. If the interval of differencing is 1, then $\Delta^3[(1 - x)(1 - 3x)(1 - 5x)]$ =
(a) -45.
(b) -15.
(c) -90.
(d) None of these.

73. Newton Raphson algorithm to find cube root of N is
(a) $2x_n + \frac{N}{3x_n^2}$
(b) $\frac{1}{3}(2x_n + \frac{N}{x_n^2})$
(c) $x_n - \frac{N}{3x_n^2}$
(d) None of these

74. Jacobi's iteration method can be used to solve a system of
(a) Non linear equations
(b) Linear equations
(c) Linear differential equations
(d) None of these

75. In comparison to Jacob's Method convergence of /Gauss-Seidal Method is
(a) fast
(b) slow
(c) same
(d) None of these

76. If the 5th and higher order differences of a function vanish, then the function represents a polynomial of degree
(a) 5
(b) 4
(c) 6
(d) None of these

77. The periodic time of the motion described by the differential equation $\frac{d^2x}{dt^2} + \mu x = 0$
(a) 2π / μ
(b) 4π /μ
(c) 2π / √μ
(d) 4π / √μ

78. A particle is projected at an angle of 30° to the horizontal with a velocity of 1962cm/sec, then its time of flight is
(a) 1 Sec
(b) 2 Sec
(c) 2.5 Sec
(d) None of these

79. A particle executing Simple Harmonic Motion of amplitude 5 cm has a speed of 8 cm/sec when at a distance of 3 cm from the center of the path. The period of the motion of the particle is
(a) $\pi/2$ sec
(b) π seconds
(c) 2π seconds
(d)None of these

80. Two particles of m_1 and m_2 gms are projected vertically upward such that velocity of projection of m_1 is double that of m_2. If the maximum heights to which these two particles reach be h_1 and h_2 respectively, then
(a) $h_1 = 2h_2$
(b) $2h_1 = h_2$
(c) $h_1 = 4h_2$
(d) None of these

81. Three parallel forces P, Q and R act at the vertices A, B and C of a triangle and are proportional to a, b and c. Then, their resultant passes through
(a) centroid
(b) orthocenter
(c) in-center
(d) None of these

82. Work-done by a force in comparison to the sum of the works-done by its components is
(a) More
(b) Less
(c)Equal
(d)None of these

83. The complementary function of the partial differential equation $(D^2 - 4DD' + 4D'^2)z = x + y$ is
(a) $z = f_1(y + 2x) + xf_2(y + 2x)$
(b) $z = f_1(x + 2y) + yf_2(x + 2y)$
(c) $z = f_1(x + y) + f_2(x + 2y)$
(d) None of these

84. A solution of $(y - z)p + (z - x)q = x - y$ is
(a) $xyz = f(x + y + z)$
(b) $x^2 + y^2 + z^2 = f(x + y + z)$
(c) $z = f(x + y + z)$
(d) None of these

85. The partial differential equation obtained from $z = ax + by + ab$ by eliminating a and b is
(a) $xp + yq = z$
(b) $xq + yp = z$
(c)$z = ap + bq$
(d) None of these

86. Solution of the wave equation $\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$ is
(a) $y = (c_1e^{px} + c_2e^{-px})(c_3e^{cpt} + c_4e^{-cpt})$
(b) $y = (c_5 \cos px + c_6 \sin px)(c_7 \cos cpt + c_8 \sin cpt)$
(c) $y = (c_9x + c_{10})(c_{11}t + c_{12})$
(d) None of these

87. The significance of the $(Z_j - c_j)$ row in the Simplex Method is that
(a) It provides an optimality test
(b) It ensures that feasibility conditions are satisfied
(c) It helps to identify incoming and outgoing variables
(d) None of these

88. Any solution of a L.P.P. which satisfies the non-negativity restrictions of the problem is called its
(a) Solution
(b)Optimal solution
(c) Feasible solution
(d) None of these

89. Which of the followings are the characteristics of canonical form of an L.P.P
(a) Objective function is of maximization type
(b) All constraints are of ($\leq$) type
(c) All variables x_i are non negative
(d) All above

90. Which of the followings are the characteristics of the standard form of an L.P.P.
(a) Objective function is of maximization type and all variables are non negative
(b) All constraints are expressed as equations
(c) Right hand side of each constraint is non negative
(d)All the above