Roll No. .....

B010701T

M. Sc. (First Semester)

EXAMINATION, 2022-23

(NEP)

PHYSICS

(Mathematical Physics—I)

Time : Two Hours] [*Maximum Marks : 75*

Note : This paper consists of three Sections A, B and C. Carefully read the instructions of each Section in solving the question paper. Candidates have to write their answers in the given answer-copy only. No separate answer-copy **(B Copy)** will be provided.

P. T. O.

Section—A

(Short Answer Type Questions)

Note : All questions are compulsory. Answer the following questions as short answer type questions. Each question carries 5 marks.

1. (A) Find the eigen values and eigen vectors of the matrix :

$$A = \begin{bmatrix} 3 & -1 \\ 4 & -2 \end{bmatrix}$$

(B) Expand the following as $i, j = 1, 2$:

(a) $a_{ij}\, x^i$

(b) $a_{ij}\, x^i x^j$

(C) Find the value of $\int \frac{z+4}{z^2+2z+5} dz$, if C is the circle $|z+1| = 1$.

(D) Prove the recurrence relation :

$$(n+1)P_{n+1}(x) = (2n+1)x\,P_n(x) - nP_{n-1}$$

(E) If H is a Hermitian matrix and U is a unitary matrix, then prove that U^{-1} HU is Hermitian.

(F) $\{\alpha, \beta, \gamma\}$ are linearly independent set of vectors. Determine whether or not the set $\{\alpha + \beta, \beta + \gamma, \gamma + \alpha\}$ are linearly independent.

(G) Evaluate :

$$\int_0^{2\pi} \frac{d\theta}{a + b\sin\theta} \text{ if } a > |b|.$$

Prove that :

$$J_n(-x) = (-1)^n J_n(x).$$

(H) Convert Hermite polynomial :

$$2H_4(x) + 3H_3(x) - H_2(x) + 5H_1(x) + 6H_0$$

into ordinary polynomial.

(I) Show that δ^i_j is a mixed tensor of mark two.

Section—B
(Long Answer Type Questions)

Note : This section contains four questions from which *one* question is to be answered as long question. Each question carries 15 marks.

2. (a) Prove that Hermite polynomials are orthogonal that is :

$$\int_{-\infty}^{\infty} e^{-x^2} H_n(x) H_m(x) dx = 2^n n! \sqrt{\pi}\, \delta_{mn}$$

Where δ_{mn} is the Kronecker delta symbol.

(b) Prove that :

$$H_n'(x) = 2n H_{n-1}(x)$$

where $H_n'(x) = \frac{d}{dx} H_n(x)$

Or

3. (a) Prove the Residue theorem.

(b) Using Residue theorem, evaluate :

$$\frac{1}{2\pi i} \int_C \frac{e^{zt} dz}{z^2(z^2 + 2z + 2)}$$

Or

4. (a) Define Laguerre polynomials $L_n(x)$ and show that $L_1(x) = 1 - x$.

(b) Show that :

$$\exp\left\{\frac{x}{2}\left(t-\frac{1}{t}\right)\right\} = \sum_{n=-\infty}^{\infty} J_n(x)t^n$$

where $J_n(x)$ is a Bessel function of first kind.

Or

5. (a) For the function $f(z) = \frac{4z-1}{z^4-1}$, find all Taylor series about the centre zero.

(b) Expand cos z in a Taylor series about $z = \frac{\pi}{4}$.

Section—C
(Long Answer Type Questions)

Note : This section contains four questions from which *one* question is to be answered as long question. Each question carries 15 marks.

6. (a) Write down the expression of Binomial distribution $P_{(r)}$. Find out the probability of getting 4 heads in 6 tosses of a fair coin.

(b) Show that Poisson distribution is a limiting form of the Binomial distribution when $P_{(orq)}$ is very small and n is large enough.

Or

7. (a) Show that the eigen value of two similar matrices are invariant under similar transformation.

(b) In a plane, T maps $[x, y]$ in to $[x + y, x - y]$. Find the matrix $\hat{T}$ with respect to the basis $\{[1, 1], [1, -1]\}$.

Or

8. Verify Cayley-Hamilton theorem for the matrix :

$$\hat{A} = \begin{bmatrix} 1 & 2 & 3 \\ 2 & -1 & 4 \\ 3 & 1 & 1 \end{bmatrix}$$

Hence find A^{-1}.

Or

9. What is contraction of a tensor ? Explain by taking an example of mixed tensor A^{ijk}_{lm} using law of co-ordinate transformation.

Roll No. .....

B010702T

M. Sc. (First Semester)

EXAMINATION, 2022-23

(NEP)

PHYSICS

(Classical Mechanics)

Time : Two Hours] [*Maximum Marks : 75*

Note : This paper consists of three Sections A, B and C. Carefully read the instructions of each Section in solving the question paper. Candidates have to write their answers in the given answer-copy only. No separate answer-copy **(B Copy)** will be provided.

P. T. O.

Section—A

(Short Answer Type Questions)

Note : All questions are compulsory. Answer the following questions as short answer type questions. Each question carries 5 marks.

1. (A) What are generalised co-ordinates ? What is advantage of using them ?

   (B) Derive equation of motion of simple pendulum using Hamilton's equation of motion.

   (C) Discuss physical significance of Hamiltonian H.

   (D) If $[u, v]$ be the Poisson bracket of u and v, then prove that :

$$\frac{\partial}{\partial t}[u, v] = \left[\frac{\partial u}{\partial t}, v\right] + \left[u, \frac{\partial u}{\partial t}\right]$$

   (E) Discuss the principle of virtual work.

   (F) Prove the laws of conservation of linear momentum and angular momentum.

(G) Obtain the Bilinear invariant condition for the transformation to be canonical.

(H) Show that the transformation :

$q = \sqrt{2P}\ \sin\theta$ and $p = \sqrt{2P}\cos\theta$

is canonical.

(I) What are ignorable co-ordinates ? Illustrate with examples.

Section—B

(Long Answer Type Questions)

Note : This section contains four questions from which *one* question is to be answered as long question. Each question carries 15 marks.

2. What is Hamilton's principle ? Deduce Hamilton's principle from D'Alembert's principle.

Or

3. What are the Kepler's laws of planetary motion ? Give the proof of Kepler's law of planetary motion and hence deduce that areal velocity is constant.

Or

4. What is Δ-variation ? Discuss how it differs from δ-variation. State and prove the principle of least action.

Or

5. What is D'Alembert's principle ? Derive Lagrange's equation of motion from it for conservative system. How will the result be modified for non-conservative system ?

Section—C

(Long Answer Type Questions)

Note : This section contains four questions from which *one* question is to be answered as long question. Each question carries 15 marks.

6. Write short notes on any *two* of the following :

   (a) Hamilton-Jacobi equation

   (b) Normal co-ordinates

   (c) Inertia tensor and moment of inertia.

Or

7. Obtain Hamilton's equations of motion in Cartesian co-ordinates, cylindrical co-ordinates and spherical co-ordinates.

Or

8. Derive transformation equations for the generating function of types :

$F_1(q, Q, t)$, $F_2(q, P, t)$, $F_3(p, Q, t)$ and $F_4(p, P, t)$.

Or

9. Solve the linear differential equations for small amplitude oscillations for two-body coupled oscillator to show that each co-ordinate is a superposition of two simple harmonic motions.

Roll No. .....

B010703T

M. Sc. (First Semester)

EXAMINATION, 2022-23

(NEP)

PHYSICS

(Electromagnetic Theory)

Time : Two Hours] [*Maximum Marks : 75*

Note : This paper consists of three Sections A, B and C. Carefully read the instructions of each Section in sølving the question paper. Candidates have to write their answers in the given answer-copy only. No separate answer-copy **(B Copy)** will be provided.

P. T. O.

Section—A

(Short Answer Type Questions)

Note : All questions are compulsory. Answer the following questions as short answer type questions. Each question carries 5 marks.

1. (A) State and explain Poynting theorem.

   (B) Write down Maxwell's equations. Explain the physical meaning of second Maxwell equation.

   (C) What are scalar and vector potentials ?

   (D) Differentiate between spatial inversion and time reversal.

   (E) What do you mean by plasma state of matter ? Mention its characteristics.

   (F) What is critical angle ? Explain total internal reflection.

   (G) Explain normal and anamolous dispersions.

   (H) Differentiate between TE and TM modes.

(I) What are guided modes in a cylindrical wave guide ?

Section—B
(Long Answer Type Questions)

Note : This section contains four questions from which *one* question is to be answered as long question. Each question carries 15 marks.

2. State Ampere's circuital law and discuss why and how it was modified to include the displacement current.

Or

3. Deduce Maxwell's equations of electromagnetic field and discuss their empherical basis.

Or

4. Establish non-uniqueness of electromagnetic potentials and gauge transformations.

Or

5. Show that under Coulomb gauge, the electromagnetic scalar potential is exactly the electrostatic potential while vector potential is described in terms of transverse current.

Section—C

(Long Answer Type Questions)

Note : This section contains four questions from which *one* question is to be answered as long question. Each question carries 15 marks.

6. Solve Maxwell equations in free space. Show that electric vector, magnetic vector and direction of propagation form a set of orthogonal vectors.

Or

7. A plane electromagnetic wave is incident on a dielectric surface. Find the amplitudes of reflected and refracted waves.

Or

8. What are wave guides ? Discuss the propagation of electromagnetic waves in rectangular wave guides.

Or

9. Find the expression for the power radiated by an auxiliary electric dipole and describe its angular distribution.

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B010704T

M. Sc. (First Semester)

EXAMINATION, 2022-23

(NEP)

PHYSICS

(Quantum Mechanics—I)

Time : Two Hours] [*Maximum Marks : 75*

Note : This paper consists of three Sections A, B and C. Carefully read the instructions of each Section in solving the question paper. Candidates have to write their answers in the given answer-copy only. No separate answer-copy **(B Copy)** will be provided.

P. T. O.

Section—A
(Short Answer Type Questions)

Note : All questions are compulsory. Answer the following questions as short answer type questions. Each question carries 5 marks.

1 (A) What are orthonormal sets ?

(B) Show that Hermitian operators have real eigen values.

(C) What is Angular Momentum Operator ? Show that :

$$[L_x, L_y] = i\hbar L_z .$$

(D) What are Ladder operators ? Find commutation relation of ladder operutor with J_z :

(E) Prove that :

$$[J^2, J_2] = 0$$

(F) What do you mean by 'Expectation Value' ?

(G) What is the property of Schrödinger Picture ?

(H) Show that *two* eigen functions of Hermitian operators, belonging to different eigen values are orthogonal.

(I) Write down basic postulates of quantum mechanics in operator formulism.

Section—B

(Long Answer Type Questions)

Note : This section contains four questions from which *one* question is to be answered as long question. Each question carries 15 marks.

2. Explain linear vector space and linear operators. Using linear vector space, define expansion theorem, inner product space and unitary space.

Or

3. Explain eigen value equation. Find the value of the constant B that makes e^{-ax^2} an eigen function of the operator $\left[\frac{d^2}{dx^2} - Bx^2\right]$. Write the corresponding eigen value.

Or

4. What do you mean by Hermitian operator ? Show that momentum operator is Hermitian operator.

Or

5. Write down commutation relation between :

   (a) Position and Momentum

   (b) Momentum and Hamiltonian

Section—C

(Long Answer Type Questions)

Note : This section contains four questions from which *one* question is to be answered as long question. Each question carries 15 marks.

6. What are Clebsch-Gordon coefficients ? Calculate Clebsch-Gordon coefficients for $J_1 = \frac{1}{2}, J_2 = \frac{1}{2}$.

Or

7. Find angular momentum matrices for the following :

   (i) $J = 1$

   (ii) $J = \frac{1}{2}$

   (iii) $J = \frac{3}{2}$

Or

8. What is Pauli's exclusion principle ? Deduce the expression for Pauli spin matrices.

Or

9. Write short notes on the following :

   (a) Symmetric and Antisymmetric wave function

   (b) Ehrenfest theorem

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O. M. R. Serial No. | | | | | | | | |

Question Booklet Number

263329

M. Sc. (Second Semester) (NEP)
EXAMINATION, 2022-23

PHYSICS

(Mathematical Physics–II)

Paper Code							
B	0	1	0	8	0	1	T

Questions Booklet Series

A

Time : 1:30 Hours]

[*Maximum Marks : 75*

Instructions to the Examinee :

1. Do not open the booklet unless you are asked to do so.
2. The booklet contains 100 questions. Examinee is required to answer 75 questions in the OMR Answer-Sheet provided and not in the question booklet. All questions carry equal marks.
3. Examine the Booklet and the OMR Answer-Sheet very carefully before you proceed. Faulty question booklet due to missing or duplicate pages/questions or having any other discrepancy should be got immediately replaced.

परीक्षार्थियों के लिए निर्देश :

1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।
2. प्रश्न-पुस्तिका में 100 प्रश्न हैं। परीक्षार्थी को 75 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। सभी प्रश्नों के अंक समान हैं।
3. प्रश्नों के उत्तर अंकित करने से पूर्व प्रश्न-पुस्तिका तथा OMR आन्सर-शीट को सावधानीपूर्वक देख लें। दोषपूर्ण प्रश्न-पुस्तिका जिसमें कुछ भाग छपने से छूट गए हों या प्रश्न एक से अधिक बार छप गए हों या उसमें किसी अन्य प्रकार की कमी हो, तो उसे तुरन्त बदल लें।

(Remaining instructions on the last page)

(शेष निर्देश अन्तिम पृष्ठ पर)

1. The differential equation that contains unknown function of two or more variables is called :

(A) ordinary differential equation

(B) partial differential equation

(C) ordinary difference equation

(D) partial difference equation

2. A partial differential equation requires :

(A) Equal number of dependent and independent variables

(B) Exactly one independent variable

(C) Two or more independent variables

(D) More than one dependent variables

3. The order and degree of the $\frac{\partial^2 z}{\partial x^2} + 3xy\left(\frac{\partial z}{\partial x}\right)^2 + 5\frac{\partial z}{\partial y} = g$ are :

(A) 1, 1

(B) 1, 2

(C) 2, 1

(D) 2, 2

4. In PDE, what is the highest power of derivative ?

(A) order of a differential equation

(B) solution of a differential equation

(C) degree of a differential equation

(D) None of the above

5. The partial differential equation of $z = f(x^2 + y^2)$ formed by the elimination of arbitrary function is :

(A) $xp + yq = 0$

(B) $xp + xq = 0$

(C) $xq + yp = 0$

(D) $yp - xq = 0$

6. The differential equation whose solution is $z = (x-a)(y-b)$, is :

(A) $pq = 2z$

(B) $pq = z$

(C) $p = 2zq$

(D) $p = 2q$

7. If partial differential equation has first degree in the unknown function and its partial derivative, it is called :

(A) Linear

(B) Non-linear

(C) Homogeneous

(D) Non-homogeneous

8. The differential equation $r^2 - 6s - t^2 = 0$ is of order :

(A) one

(B) two

(C) three

(D) None of the above

9. The linear partial differential equation of order one is known as :

(A) Lagrange's linear PDE

(B) Cauchy's linear PDE

(C) Charpit's linear PDE

(D) None of the above

10. The partial differential equation of $z = (a^2 + x^2)(b^2 + y^2)$ by eliminating arbitrary constant is :

(A) $xyz = 4pq$

(B) $2xyz = pq$

(C) $4xyz = pq$

(D) $xyz = pq$

11. The solution of $x^2p + y^2q = (x + y)z$ is :

(A) $f(xy, x - y) = 0$

(B) $f\left(\frac{xy}{z}, \frac{x-y}{z}\right) = 0$

(C) $f(zx, z - x) = 0$

(D) None of the above

12. The differential equation $yzp + zxy = xy$, where $p = \frac{\partial z}{\partial x}$, $q = \frac{\partial z}{\partial y}$ has order and degree as :

(A) order 2, degree 2

(B) order 1, degree 2

(C) order 1, degree 1

(D) order 2, degree 1

13. The partial differential equation of the sphere $(x-a)^2 + (y-b)^2 + z^2 = r^2$ is :

(A) $z^2(p^2 + q^2 + 1) = r^2$

(B) $z(p^2 + q^2 + 1) = r^2$

(C) $z(p^2 + q^2 + 1) = r$

(D) $z^2(p^2 + q^2 - 1) = r^2$

14. The partial differential equation of $z = f(x+t) + f(x-t)$ formed by elimination of arbitrary function is :

(A) $r - t = 0$

(B) $r + t = 0$

(C) $r - s = 0$

(D) $r + s = 0$

15. Which of the following is a Lagrange's partial differential equation ?

(A) $pq = z$

(B) $p^2 - q^2 = 1$

(C) $px^2 + qx^2 = z^2$

(D) None of the above

16. The differential equation $\frac{\partial^3 z}{\partial x^3} - 4\frac{\partial^2 z}{\partial x \partial y} + \left(\frac{\partial z}{\partial x}\right)^4 = 0$ has degree :

(A) One

(B) Two

(C) Three

(D) Four

17. The solution of

$$q^2 x(1+y^2) = py^2$$

is :

(A) $z = a(1+y^2)$

(B) $z = \frac{ax^2}{2} - a(1+y^2) + b$

(C) $z = \frac{ax^2}{2} + \sqrt{a(1+y^2)} + b$

(D) $z = \frac{ax}{2} + \sqrt{a(1+y^2)} + b$

18. Form a PDE of :

$$z = (x-y)\phi(x^2 - y^2)$$

(A) $py - xq = z$

(B) $py + xq = z$

(C) $px + yq = z$

(D) $px - yq = z$

19. Solve $(2p+1)q = pz$:

(A) $a\log(z-a) = x - ay + b$

(B) $2a\log(z+a) = ay + b$

(C) $2a\log(z-a) = x + ay + b$

(D) $a\log(z+a) = 3x + ay + b$

20. The second order partial differential equation

$$3x^2\frac{\partial^2 u}{\partial x^2}-6xy\frac{\partial^2 u}{\partial x\partial y}+3y^2\frac{\partial^2 u}{\partial y^2}-5\frac{\partial u}{\partial x}+7\frac{\partial u}{\partial y}=6x^2y$$

is :

(A) Elliptic equation

(B) Parabolic equation

(C) Hyperbolic equation

(D) Depends on the value of x and y

21. The solution of partial differential equation

$x(y-z)p+y(z-x)q=z(x-y)$

is :

(A) $f(xyz,\ x+y+z)=0$

(B) $f(xyz,\ x-y+z)=0$

(C) $f(xyz,\ x+y-z)=0$

(D) None of the above

22. The solution of partial differential equation $p\tan x+q\tan y=\tan z$ is :

(A) $f\left(\frac{\sin x}{\sin y},\frac{\cos y}{\cos z}\right)=0$

(B) $f\left(\frac{\cos x}{\cos y},\frac{\cos y}{\cos z}\right)=0$

(C) $f\left(\frac{\sin x}{\sin y},\frac{\sin y}{\sin z}\right)=0$

(D) None of the above

23. In the one-dimensional diffusion equation $\frac{\partial u}{\partial t}=D\frac{\partial^2 u}{\partial x^2}$, $u(x,t)$ and D represent respectively :

(A) density and diffusion coefficient

(B) diffusion and density coefficient

(C) viscosity and diffusion coefficient

(D) diffusion and viscosity coefficient

24. The one-dimensional wave equation is :

(A) $\frac{\partial u}{\partial t}=c\frac{\partial u}{\partial x}$

(B) $\frac{\partial^2 u}{\partial t^2}=c^2\frac{\partial^2 u}{\partial x^2}$

(C) $\frac{\partial^2 u}{\partial x^2}=c^2\frac{\partial^2 u}{\partial t^2}$

(D) None of the above

25. The partial differential equation of $z=Ax^2+By^2$ by eliminating arbitrary constant is :

(A) $z=xp+yq$

(B) $2z=xp+yq$

(C) $z=xp-yq$

(D) $2z=xp-yq$

26. Every group of order 4 is :

(A) cyclic

(B) abelian

(C) non-abelian

(D) None of the above

27. Which of the following is an example of field ?

(A) Z_4

(B) Z_6

(C) Z_7

(D) Z_{10}

28. Which of the following is not an Integral Domain ?

(A) Z_2

(B) Z_7

(C) Z_5

(D) Z_4

29. How many properties can be held by a group ?

(A) 2

(B) 3

(C) 5

(D) 4

30. A cyclic group can be generated by :

(A) singular element

(B) non-singular element

(C) inverse element

(D) multiplicative element

31. Which of the following is not a group ?

(A) $(R, +, \cdot)$

(B) $(Z, -, \cdot)$

(C) $(R^*, \cdot)$

(D) $(Q^*, +, \cdot)$

32. Which of the following is not a field ?

(A) Z_4

(B) Z_7

(C) Z_5

(D) Z_2

33. Characteristic of Ring Z_4 is :

(A) 0

(B) 2

(C) 3

(D) 4

34. Which of the following is an example of an ideal of ring R ?

(A) Z

(B) O

(C) Q

(D) 2Z

35. Which of the following is an example of transcendental number ?

(A) $\sqrt{2}$

(B) π

(C) i

(D) 2

36. Find the polynomial which is reducible over Q :

(A) x^2+3

(B) x^2+5x

(C) x^4-2

(D) x^2+1

37. Number of elements in D_4 is :

(A) 2

(B) 1

(C) 8

(D) 4

38. Which sentence is true ?

(A) set of all matrices forms a group under multiplication.

(B) set of all rational negative numbers for a group under multiplication.

(C) set of all non-singular matrices forms a group under multiplication

(D) None of the above

39. Find the polynomial which is irreducible over Q :

(A) x^2+3

(B) x^2+5x+4

(C) x^4

(D) x^2-1

40. Number of zero divisors of Q is :

(A) 1

(B) 3

(C) 2

(D) 0

41. Find the number of units in the ring Z_5 :

(A) 2

(B) 4

(C) 3

(D) 1

42. Find number of proper subgroups of S_3 :

(A) 5

(B) 4

(C) 3

(D) None of the above

43. Find splitting field of (x^3-2, x^2-3) over Q :

(A) $Q(\sqrt{3}, \sqrt{2})$

(B) $Q(\sqrt{3})$

(C) $Q(\sqrt{2})$

(D) R

44. A non-empty set A is termed as an algebraic structure is :

(A) with respect to binary operation *

(B) with respect to ternary operation ?

(C) with respect to binary operation +

(D) with respect to unary operation –

45. Matrix multiplication is :

(A) commutative property

(B) associative property

(C) additive property

(D) None of the above

46. Which of the following is a maximal ideal of Z ?

(A) 4Z

(B) Z_2

(C) Q

(D) 2Z

47. Find number of proper normal subgroups of Z_6 :

(A) 2

(B) 4

(C) 3

(D) 1

48. $\{1, i, -i, -1\}$ is :

(A) Semigroup

(B) Subgroup

(C) Abelian group

(D) Cyclic group

49. If G is a prime order group, then G has :

(A) No improper subgroup

(B) No proper subgroup

(C) Two improper subgroups

(D) None of the above

7

50. What is an inverse of $-i$ in the multiplicative group of $\{1, -1, i, -i\}$?

(A) -1

(B) 1

(C) i

(D) None of the above

51. Any group of order 3 is :

(A) cyclic and abelian

(B) cyclic but not abelian

(C) infinite cyclic group

(D) None of the above

52. If the function $f(x)$ is even, then which of the following is zero ?

(A) a_n

(B) b_n

(C) a_0

(D) Nothing is zero

53. What are Fourier coefficients ?

(A) The term that are present in a Fourier series.

(B) The term that are obtained through Fourier series.

(C) The terms which consist of the Fourier series along with their sine or cosine values.

(D) None of the above

54. Which of the following is an even function of t ?

(A) t^2

(B) $t^2 - 4t$

(C) $t^3 + 6$

(D) $t^3 - 6$

55. Estimate the value of y for $x = 10$, given that :

x	y
5	12
6	13
9	14
11	16

(A) 14.11

(B) 14.66

(C) 15.66

(D) None of the above

56. The root of the equation $x^3+2x-5=0$ lies in (1, 1.5). Its value by applying the method of false position only once is :

(A) 4/3

(B) 5/4

(C) 35/27

(D) 33/25

57. Find number of labours getting wages between ₹ 100 and ₹ 140, given that :

Wages (in ₹)	No. of Labours
0–50	9
50–100	30
100–150	35
150–200	28

(A) 63

(B) 67

(C) 73

(D) None of the above

58. For finding real root of the equation $x^2-x=2$ by Newton-Raphson method, choose $x_0=1$, then the value of x_2 is :

(A) -1

(B) 3

(C) 11/5

(D) None of the above

59. If 2.236146 is an approximation to $\sqrt{5}$, then the relative error is :

(A) 3.4883×10^{-5}

(B) 4.8383×10^{-5}

(C) 8.3483×10^{-4}

(D) 5.8438×10^{-4}

60. Let $f(x)=x^3-x-5=0$. By Bisection method first two approximation x_0 and x_1 are 1.5 and 2.25 respectively, then x_2 is :

(A) 1.625

(B) 1.875

(C) 1.999

(D) None of the above

61. Find the fourth approximation of the root of the equation $x^3 + x - 11 = 0$, between 2 and 3, using Bisection method :

(A) 1.925

(B) 2.832

(C) 2.5215

(D) 2.0625

62. From the following table, the extrapolated value of y at $x = 14$ is :

x	y
3	6
5	24
7	58
9	108
11	174

(A) 303

(B) 294

(C) 308

(D) None of the above

63. Evaluate :

$$\int_0^3 \frac{1}{2+x^2} dx$$

by using Simpson's $\frac{3}{8}$ rule by taking 3 strips :

(A) 0.507

(B) 0.5007

(C) 0.3939

(D) None of the above

64. The Runge-Kutta method has the error of order :

(A) 1

(B) 3

(C) 5

(D) 2

65. For N = 28 and $x_0 = 55$, the first approximation to $\sqrt{N}$ by Newton's interaction formula is :

(A) 5.295

(B) 5.582

(C) 5.396

(D) None of the above

66. Given the following tabulated values :

x	y
3	168
7	120
9	72
10	63

The correct value of y at $x = 6$ is :

(A) 132

(B) 147

(C) 140

(D) 127

67. The absolute error Bisection method is :

(A) 2^n

(B) $\frac{1}{2^n}|b-a|$

(C) $\frac{1}{|b-a|}$

(D) $|b-a|2^n$

68. If the first two approximation x_0 and x_1 to a root of $x^3 - x - 4 = 0$ are 1.666 and 1.780 respectively, then find x_2 by Regula-Falsi method :

(A) 1.974

(B) 1.794

(C) 1.896

(D) 1.687

69. Find the value of $\int_2^6 x \log x \, dx$ taking 4 strips by Simpson's $\frac{1}{3}$rd rule up to four decimals :

(A) 21.8901

(B) 23.6581

(C) 22.8661

(D) 20.8356

70. A periodic function is given by a function which :

(A) has a period $T = 2\pi$

(B) satisfies $f(t+T) = -f(t)$

(C) has a period $T = \pi$

(D) satisfies $f(t+T) = f(t)$

71. The Newton's iterative formula to find the value of $3\sqrt{N}$ is :

(A) $x_{i+1} = \left(2x_i - \frac{N}{x_i^2}\right)$

(B) $x_{i+1} = \frac{1}{3}\left(x_i - \frac{N}{x_i^2}\right)$

(C) $x_{i+1} = \frac{1}{3}\left(2x_i + \frac{N}{x_i^2}\right)$

(D) None of the above

72. If the first approximation of $x^3 - 3x - 5 = 0$ is $(x_0) = 2$, then find x_1 by Newton-Raphson method :

(A) 2.2806

(B) 2.2790

(C) 2.3333

(D) 3.9468

73. Find the value of $\int_2^3 \frac{1}{1+x^2} dx$ taking four intervals by Trapezoidal rule and also find the error when compared to its exact value :

(A) 0.1759, 0.000004

(B) 0.1826, 0.04

(C) 0.1953, 0.004

(D) 0.1423, – 0.0004

74. The Lagrange's interplation polynomial corresponding to the pairs of values of x and y given in the following table is :

x	y
1	36
3	16
4	9
7	72

(A) $x^3 - 6x^2 + 9x + 36$

(B) $x^3 - 6x^2 + 18x - 45$

(C) $3x^3 + 4x^2 - 5x + 27$

(D) $x^3 - 7x^2 + 5x + 37$

75. The estimate of $\int_{0.5}^{1.5} \frac{dx}{x}$ obtained using Simpson's rule with three point function evaluation exceeds the exact value by :

(A) 0.235

(B) 0.012

(C) 0.024

(D) 0.068

76. The Fourier cosine transform of the function $f(x)$ is :

(A) $F_c(\lambda) = \int_0^\infty f(u) \cos \lambda u \, du$

(B) $F_c(\lambda) = \int_0^\infty f(u) \cos u \, du$

(C) $F_c(\lambda) = \int_0^\infty f(\lambda u) \cos u \, du$

(D) None of the above

77. If $f(t)$ is even function, then its Fourier transform F(s) is :

(A) Real and odd

(B) Real and even

(C) Imaginary and even

(D) Imaginary and odd

78. The Fourier sine transform of $\frac{e^{-ax}}{x}$ is :

(A) $\tan^{-1}(s)$

(B) $\tan^{-1}(a/s)$

(C) $\tan^{-1}(s/a)$

(D) None of the above

79. If $F\{f(x\} = F(\lambda)$, then $F\{f(x-a)\}$ is :

(A) $e^{i\lambda a}F(\lambda)$

(B) $e^{i\lambda t}F(\lambda)$

(C) $e^{-i\lambda a}F(\lambda)$

(D) $e^{-i\lambda t}F(\lambda)$

80. The Fourier cosine transform $F_c(\lambda)$ of $f(x) = e^{-x}, x > 0$ is given by :

(A) $\frac{2}{1+\lambda^2}$

(B) $\frac{1}{1-\lambda^2}$

(C) $\frac{\lambda}{1+\lambda^2}$

(D) $\frac{1}{1+\lambda^2}$

81. The Fourier cosine transform $f(x) = e^{-x^2}$ is :

(A) $\frac{\sqrt{\pi}}{2}e^{\frac{s^2}{4}}$

(B) $\frac{\sqrt{\pi}}{2}e^{\frac{-s^2}{4}}$

(C) $e^{\frac{-s^2}{4}}$

(D) None of the above

82. If $f(t)$ is odd function, then its Fourier transform F(s) is :

(A) real and odd

(B) real and even

(C) imaging and even

(D) imaginary and odd

83. If $F(s)$ is Fourier transform of $f(x)$, then which of the following is true ?

(A) $F\{x f(x)\} = -\frac{d}{d^s} F(s)$

(B) $F\{x f(x)\} = -i\frac{d}{ds} F(s)$

(C) $F\{x f(x)\} = \frac{d}{ds} F(s)$

(D) $F\{x f(x)\} = i\frac{d}{ds} F(s)$

84. If $F\{f(x)\} = F(s)$ and $F\{g(x)\} = G(s)$, then by Parseval's identity $\frac{1}{2\pi}\int_{-\infty}^{\infty} F(s)G(s)ds =$:

(A) $\int_0^{\infty} f(x)g(x)dx$

(B) $\frac{1}{2\pi}\int_{-\infty}^{\infty} f(x)g(x)dx$

(C) $\int_{-\infty}^{\infty} f(x)g(x)\dot{dx}$

(D) None of the above

85. $L^{-1}[1] =$

(A) $\delta(t)$

(B) 1

(C) $u(t)$

(D) Doesn't exist

86. Laplace transformation of $\delta(t-a)$ is :

(A) $e^{\delta g}$

(B) e^{ag}

(C) e^{-ag}

(D) $e^{\delta t}$

87. $L^{-1}[e^{-ag}] =$

(A) $H(t-a)$

(B) $u(t)$

(C) $\delta(t-a)$

(D) $f(t-a)$

88. The Fourier transform of the function $f(x)$ is $F(\lambda)$. The inversion formula is :

(A) $\frac{1}{2\pi}\int_{-\infty}^{\infty} F(\lambda)e^{i\lambda x}d\lambda$

(B) $\frac{1}{\pi}\int_{-\infty}^{\infty} F(\lambda)e^{-i\lambda x}d\lambda$

(C) $\frac{1}{2\pi}\int_0^{\infty} F(\lambda)e^{-i\lambda x}d\lambda$

(D) None of the above

89. The polynomial x^2+1 is irreducible over :

(A) C

(B) Q(i)

(C) Z(i)

(D) R

90. Let E is $Q(\sqrt{3},\sqrt{7})$ and F is Q. Then index of E over F is :

(A) 2

(B) 3

(C) 4

(D) 1

91. Which are the Fourier coefficients in the following ?

(A) a_0, a_n and b_n

(B) a_n

(C) b_n

(D) a_n and b_n

92. Fourier series uses which domain representation of signals ?

(A) Time domain representation

(B) Frequency domain representation

(C) Neither depends on the situation

(D) Both (A) and (B)

93. How does Fourier series make it easier to represent periodic signals ?

(A) Harmonically related

(B) Periodically related

(C) Sinusoidally related

(D) Exponentially related

94. Number of automorphisms from $Q(\sqrt{2})$ to $Q(\sqrt{3})$ is :

(A) 1

(B) 2

(C) 3

(D) 0

95. Select Ring from the following :

(A) $(R, +, \bullet)$

(B) $(Z, -, \bullet)$

(C) $(R^*, +, \bullet)$

(D) $(Q^*, +, \bullet)$

96. Which of the following is a prime ideal of Z ?

(A) Z

(B) Z_2

(C) Q

(D) 2Z

97. The field $Q(\sqrt{3}+\sqrt{7})$ is isomorphic to :

(A) Q

(B) R

(C) $Q(\sqrt{3}, \sqrt{7})$

(D) None of the above

98. Find k_1, by Runge-Kutta method of fourth order if $\frac{dy}{dx} = 2x + 3y^2$ and $y(0,1) = 1.1165$, $h = 0.1$:

(A) 0.3993

(B) 0.9393

(C) 0.3939

(D) 0.9933

99. The partial differential equation of

$$z = (x-a)^2 + (y-b)^2,$$

by eliminating arbitrary constant is :

(A) $p^2q^2 = 4z$

(B) $p^2 + q^2 = 4z$

(C) $p^2 - q^2 = 4z$

(D) $pq = 4z$

100. Find number of generators of the group Z_{10} :

(A) 4

(B) 2

(C) 1

(D) 3

Roll No. .....

O. M. R. Serial No. | | | | | | | | |

Question Booklet Number

267001

M. Sc. (Second Semester) (NEP) EXAMINATION, 2022-23

PHYSICS

(Solid State Physics)

Paper Code							
B	0	1	0	8	0	2	T

Questions Booklet Series

A

Time : 1:30 Hours]

[*Maximum Marks : 75*

Instructions to the Examinee :

1. Do not open the booklet unless you are asked to do so.
2. The booklet contains 100 questions. Examinee is required to answer 75 questions in the OMR Answer-Sheet provided and not in the question booklet. All questions carry equal marks.
3. Examine the Booklet and the OMR Answer-Sheet very carefully before you proceed. Faulty question booklet due to missing or duplicate pages/questions or having any other discrepancy should be got immediately replaced.

परीक्षार्थियों के लिए निर्देश :

1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।
2. प्रश्न-पुस्तिका में 100 प्रश्न हैं। परीक्षार्थी को 75 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। सभी प्रश्नों के अंक समान हैं।
3. प्रश्नों के उत्तर अंकित करने से पूर्व प्रश्न-पुस्तिका तथा OMR आन्सर-शीट को सावधानीपूर्वक देख लें। दोषपूर्ण प्रश्न-पुस्तिका जिसमें कुछ भाग छपने से छूट गए हों या प्रश्न एक से अधिक बार छप गए हों या उसमें किसी अन्य प्रकार की कमी हो, तो उसे तुरन्त बदल लें।

(Remaining instructions on the last page)

(शेष निर्देश अन्तिम पृष्ठ पर)

1. The numbers of 3D crystal systems and Bravais lattices are respectively :

(A) 7, 7

(B) 14, 14

(C) 7, 14

(D) 14, 7

2. The atomic packing factor for simple cubic (sc), body centered cubic (bcc) and face centered are respectively :

(A) $\frac{\pi}{6}, \frac{\sqrt{3\pi}}{8}, \frac{\pi}{3\sqrt{2}}$

(B) $\frac{\sqrt{3\pi}}{8}, \frac{\pi}{6}, \frac{\pi}{3\sqrt{2}}$

(C) $\frac{\pi}{3\sqrt{2}}, \frac{\pi}{6}, \frac{\sqrt{3\pi}}{8}$

(D) $\frac{\pi}{3\sqrt{2}}, \frac{\sqrt{3\pi}}{8}, \frac{\pi}{6}$

3. The coordination number and packing fraction of hexagonal close packed structure is equivalent to :

(A) Simple cubic structure

(B) Boby centered cubic structure

(C) Face centered cubic structure

(D) None of the above

4. If M_A, N_A, n and a are respectively atomic weight, Avogadro's number, number of atoms per unit cell and lattice constant for a cubic structured material, then the density of material is :

(A) $\rho = \frac{N_A n}{M_A a^3}$

(B) $\rho = \frac{M_A a^3}{N_A n}$

(C) $\rho = \frac{a^3 n}{N_A M_A}$

(D) $\rho = \frac{M_A n}{N_A a^3}$

5. If interplanar spacing $d_{100} : d_{110} : d_{111}$ is $1 : \sqrt{2} : \frac{1}{\sqrt{3}}$, then the crystal structure is :

(A) Diamond structure

(B) Boby centered cubic structure

(C) Face centered cubic structure

(D) Zinc blende structure

6. If lattice parameter for cubic lattic is 'a', then the spacing between two adjacent parallel planes of Miller indices (111) is :

(A) $3a$

(B) $\sqrt{3a}$

(C) $\frac{a}{\sqrt{3}}$

(D) $\frac{a}{3\sqrt{3}}$

7. If a lattice plane intercepts the three crystallographic axis by amount $2a, 3a$ and a, then the Miller indices for the plane will be :

(A) (2, 3, 1)

(B) (1, 3, 2)

(C) (2, 3, 6)

(D) (3, 2, 6)

8. The value of axial ratio $\frac{c}{a}$ for hcp structure is :

(A) $\sqrt{\frac{8}{3}}$

(B) $\sqrt{\frac{3}{8}}$

(C) $\frac{\sqrt{8}}{3}$

(D) $\frac{\sqrt{3}}{8}$

9. The ratio of volume occupied by the atoms to the volume of the unit cell of diamond structure is :

(A) 0.52

(B) 0.34

(C) 0.68

(D) 0.74

10. In reciprocal lattice, the Bragg's diffraction condition is :

(A) $\vec{k} \cdot \vec{G}' = 0$

(B) $2\vec{k} \cdot \vec{G} - \vec{G}^2 = 0$

(C) $\vec{k} \cdot \vec{G} + 2\vec{G}^2 = 0$

(D) $2\vec{k} \cdot \vec{G} + \vec{G}^2 = 0$

11. In a tetragonal lattice $a = b = 2\,\text{Å}$ and $c = 2.5\,\text{Å}$. Find the lattice spacing between (111) planes :

(A) 2.15 Å

(B) 1.23 Å

(C) 1.57 Å

(D) 2.75 Å

12. Types of Bravais lattices available in a tetragonal system are :

(A) Simple and body centered

(B) Simple and face centered

(C) Simple and base centered

(D) Body and base centered

13. Identify the type of crystal, for the lattice parameter $a \neq b \neq c$ and $\alpha = \gamma = 90 = \beta$:

(A) trigonal

(B) triclinic

(C) monoclinic

(D) haxagonal

14. Coordination number for SC, BCC, FCC and HCP structures are respectively :

(A) 6, 8, 12, 8

(B) 6, 8, 12, 16

(C) 6, 8, 12, 18

(D) 6, 8, 12, 12

15. If X-ray is scattered by a crystal then its intensity at a point on screen depends :

(A) Only on the wavelength of X-ray

(B) Only on the intensity of X-ray

(C) On the Fourier transform of the density of the scattered material

(D) Only on the electronic density of scattered material

16. If lattice parameter of simple cubic structure is 'a', then lattice parameter of its reciprocal lattice is :

(A) $2\pi a$

(B) $\frac{2\pi}{a}$

(C) πa

(D) $\frac{\pi}{a}$

17. If $\vec{B}$ is primitive vector in y-direction for reciprocal lattice of bcc, then correct expression for $\vec{B}$ is :

(A) $\frac{2\pi}{a}(\hat{x} + \hat{y})$

(B) $\frac{2\pi}{a}(\hat{y} + \hat{z})$

(C) $\frac{2\pi}{a}(\hat{z} + \hat{x})$

(D) $\frac{a}{2}(-\hat{x} + \hat{y} + \hat{z})$

18. What will be the minimum wavelength of the X-ray if it is generated by a potential difference of 50 kV ?

(A) 0.025 Å

(B) 0.25 Å

(C) 2.5 Å

(D) 25 Å

19. The atomic number of Cu and Mo is 29 and 42 respectively. If wavelength of K_α line of Cu is 1.54 Å, then K_α line of Mo is :

(A) 0.35 Å

(B) 0.72 Å

(C) 1.54 Å

(D) 3.45 Å

20. In which X-ray diffraction experiment, characteristic X-ray is not used ?

(A) Laue diffraction method

(B) Powder crystal method

(C) Rotating crystal method

(D) All of the above

21. If Z and f are the atomic number and atomic scattering factor, then the appropriate relation between them is :

(A) $f = Z$

(B) $f \leq Z$

(C) $f \geq Z$

(D) $f \cdot Z = 1$

22. If Miller indices are even for bcc and fcc structures, then the ratio of geometrical structure factor for sc, bcc and fcc structures is :

(A) 1 : 2 : 4

(B) 4 : 2 : 1

(C) 1 : 4 : 16

(D) 16 : 4 : 1

23. Choose incorrect statement for semiconductor :

(A) It is insulator at 0 K.

(B) Its energy band gap is order of 1eV.

(C) Its conductivity increases with temperature or by doping.

(D) Carrier concentration in it is only function of temperature.

24. If E_g and T are energy band gap and temperature of the intrinsic semiconductor material respectively, which one is correct relation for the charge carrier concentration ?

(A) $n_i^2 \propto T^3 e^{\frac{E_g}{kT}}$

(B) $n_i^2 \propto T^{\frac{3}{2}} e^{-\frac{E_g}{2kT}}$

(C) $n_i^2 \propto T^{\frac{3}{2}} e^{\frac{E_g}{2kT}}$

(D) $n_i^2 \propto T^3 e^{-\frac{E_g}{kT}}$

25. The quantity σ represents conductivity of material. The slope of graph between $\log \sigma$ and $\frac{1}{T}$ for extrinsic semiconductor in comparison to intrinsic semiconductor is :

(A) High

(B) Low

(C) Equal

(D) All of the above

26. The correct expression for conductivity of intrinsic semiconductor is :

(A) $\sigma = \sigma_0 e^{-\frac{E_g}{kT}}$

(B) $\sigma = \sigma_0 e^{\frac{E_g}{kT}}$

(C) $\sigma = \sigma_0 e^{-\frac{E_g}{2kT}}$

(D) $\sigma = \sigma_0 e^{\frac{E_g}{2kT}}$

27. If E_D and E_C are energies of donor level and conduction band, then the expression of Fermi energy for N-type semiconductor at low temperature is :

(A) $E_F = (E_C + E_D)/2$

(B) $E_F = (E_C - E_D)/2$

(C) $E_F = E_g/2$

(D) None of the above

28. Which expression is not true for Fermi energy of P-type semiconductor ?

(A) $E_F = (E_V + E_A)/2; T = 0$

(B) $E_F \approx E_g/2; kT > E_A - E_V$

(C) $E_F = (E_V - E_A)/2;$

$kT < (E_A - E_V)$

(D) $E_F = E_V + kT \log (N_V/N_A)$

29. Which one correctly defines the Fermi level ?

(A) At $T = 0, f(\varepsilon) = 1; \varepsilon \leq \varepsilon_f$

(B) At $T = 0, f(\varepsilon) = 0; \varepsilon \geq \varepsilon_f$

(C) At $T \neq 0, f(\varepsilon) = 0.5; \varepsilon = \varepsilon_f$

(D) All of the above

30. The concentration of an electron in P-type semiconductor and concentration of holes in N-type semiconductor are respectively equal to :

(A) $n = N_A; p = N_D$

(B) $n = \frac{n_i^2}{N_A}; p = \frac{n_i^2}{N_D}$

(C) $n = \frac{n_i^2}{N_D}; p = \frac{n_i^2}{N_A}$

(D) $n = N_A + \left(\frac{n_i^2}{N_A}\right);$

$p = N_D + \left(\frac{n_i^2}{N_D}\right)$

31. Which statement is not accurate for extrinsic semiconductor ?

(A) It is a impurity doped semiconductor.

(B) N-type semiconductor is formed by pentavalent impurity doping and $n >> p$.

(C) P-type semiconductor is formed by trivalent impurity doping and $n << p$.

(D) Fermi level lies in the mid of conduction band and valence band and is unaltered by doping.

32. If an N-type semiconductor slab having breadth (b_Y) and thickness (t_Z) is placed in magnetic field B_Z and current I_X is flowing along x-direction, then correct expression for Hall field is :

(A) $\vec{E}_Y = -\frac{B_Z I_X}{n e b_Y t_Z} \hat{j}$

(B) $\vec{E}_Y = \frac{B_Z I_X}{n e b_Y t_Z} \hat{j}$

(C) $\vec{E}_Y = -\frac{B_Z I_X}{n e} \hat{j}$

(D) $\vec{E}_Y = \frac{B_Z I_X}{n e} \hat{j}$

33. Hall effect is used for :

(A) determination of nature of material

(B) determination carrier concentration and mobility

(C) measurement of magnetic flux density and power flow of e.m. wave

(D) All of the above

34. Hall resistance for N-type semiconductor, P-type semiconductor and gold are respectively :

(A) negative, positive, positive

(B) negative, positive, negative

(C) positive, negative, positive

(D) positive, negative, negative

35. The E_X and E_Y are applied and Hall fields. If B_Z is applied magnetic field to specimen, then mobility of charge carrier in the specimen is equal to :

(A) $\mu = E_X E_Y B_Z$

(B) $\mu = (E_X E_Y)/B_Z$

(C) $\mu = E_X/(E_Y B_Z)$

(D) $\mu = E_Y/(E_X B_Z)$

36. The ratio of change in electrical resistance under magnetic field and zero field resistance is called as :

(A) Hall resistance

(B) Critical resistance

(C) Magneto-resistance

(D) All of the above

37. Which statement is true regarding magneto-resistance ?

(A) It is due to non-linear path of electron in presence of magnetic field.

(B) It increases with B^2 for small fields.

(C) It saturates at high fields for case of dominant lattice scattering.

(D) All of the above

38. The specific heat at constant volume for metals varies with temperature as :

(A) $C_V = A + BT$

(B) $C_V = AT + BT^2$

(C) $C_V = AT + BT^3$

(D) $C_V = AT^2 + BT^3$

39. If n is density of electron, then expression of Fermi energy of electron gas at 0 K is :

(A) $E_f = \frac{h^2}{2m}\left(\frac{3n}{8\pi}\right)^{\frac{2}{3}}$

(B) $E_f = \frac{2m}{h^2}\left(\frac{3n}{8\pi}\right)^{\frac{2}{3}}$

(C) $E_f = \frac{h^2}{2m}\left(\frac{8\pi}{3n}\right)^{\frac{2}{3}}$

(D) $E_f = \frac{h^2}{2m}\left(\frac{8n}{3\pi}\right)^{\frac{2}{3}}$

40. If E_f is Fermi energy of electron gas at 0 K, then mean energy of electron gas at 0 K is :

(A) $\frac{5}{3}E_f$

(B) $\frac{3}{5}E_f$

(C) $\frac{2}{3}E_f$

(D) $\frac{3}{2}E_f$

41. According to Weidemann-Franz's law, the ratio of thermal conductivity and product of electrical conductivity and temperature for metals is equal to :

(A) Relaxation time

(B) Mean free path

(C) Franz's number

(D) Lorentz number

42. Under Sommerfeld quantum modification in free electron theory, the quantity Lorentz's number becomes equal to :

(A) $\frac{3}{2}\left(\frac{k_B}{e}\right)^2$

(B) $\frac{2}{3}\left(\frac{k_B}{e}\right)^2$

(C) $\frac{\pi^2}{3}\left(\frac{k_B}{e}\right)^2$

(D) $\frac{\pi^2}{2}\left(\frac{k_B}{e}\right)^2$

43. As per free electron theory, the expression of d.c. electrical conductivity for metals is :

(A) $\frac{ne^2\tau}{m}$

(B) $\frac{m}{ne^2\tau}$

(C) $\frac{ne^2}{m\tau}$

(D) $\frac{m\tau}{ne^2}$

44. If relaxation time is independent of velocity, then the value of magneto-resistance is :

(A) Infinite

(B) Zero

(C) Only negative

(D) Only positive

45. At high temperature, which distribution is followed by the particle having half integral spin ?

(A) Maxwell-Boltzmann distribution

(B) Fermi-Dirac distribution

(C) Bose-Einstein distribution

(D) Both (B) and (C)

46. The occupancy of state in F-D distribution is given by :

(A) $\frac{1}{e^{\frac{(E-E_f)}{kT}} - 1}$

(B) $\frac{1}{e^{\frac{(E-E_f)}{kT}} + 1}$

(C) $\frac{1}{e^{\frac{(E-E_f)}{kT}} \pm 1}$

(D) $\frac{1}{e^{\frac{(E-E_f)}{kT}}}$

47. Which one is correct Richardson Dushman equation for thermionic emission ?

(A) $J = AT \exp\left(\frac{\phi}{k_B T}\right)$

(B) $J = AT^2 \exp\left(-\frac{\phi}{k_B T}\right)$

(C) $J = AT^{-2} \exp\left(\frac{\phi}{k_B T}\right)$

(D) $J = AT^3 \exp\left(-\frac{\phi}{k_B T}\right)$

48. Which statement is incorrect regarding the thermal conductivity of metals ?

(A) It is nearly temperature independent at high temperature region.

(B) It is temperature dependent at very low temperature region.

(C) It is zero at absolute zero temperature.

(D) None of the above

49. Which is not correlated with thermoelectric effect ?

(A) Seebeck effect

(B) Peltier effect

(C) Thomson effect

(D) Josephson's effect

50. The generation of potential difference across the junctions of two metals due to their temperature gradient is called as :

(A) Thermionic emission

(B) Thermal effect

(C) Seebeck effect

(D) Thomson effect

51. The resistivity of metals in conditions $T >> \theta_D$ and $T << \theta_D$ are proportional to :

(A) $\rho \propto T^{-2}$ and $\rho \propto T^{1}$

(B) $\rho \propto T^{-1}$ and $\rho \propto T^{3}$

(C) $\rho \propto T$ and $\rho \propto T^{5}$

(D) $\rho \propto T^{-1}$ and $\rho \propto T^{7}$

52. The velocity of charge carriers per unit electric field is called as :

(A) Mobility

(B) Drift velocity

(C) Diffusion velocity

(D) Electric Drift velocity

53. Which expression is correct for total current density for hole in intrisic semiconductor ?

(A) $J_h = e\mu_h pE + eD_h \frac{dp}{dx}$

(B) $J_h = -e\mu_h pE - eD_h \frac{dp}{dx}$

(C) $J_h = e\mu_h pE - eD_h \frac{dp}{dx}$

(D) $J_h = -e\mu_h pE + eD_h \frac{dp}{dx}$

54. An N-type semiconductor has conductivity $8\,\Omega^{-1}\,cm^{-1}$. Find out the number density of donor atoms if mobility of electrons is $0.5\ m^2V^{-1}s^{-1}$:

(A) $1 \times 10^{21}\ m^{-3}$

(B) $8 \times 10^{21}\ m^{-3}$

(C) $8 \times 10^{19}\ m^{-3}$

(D) $1 \times 10^{19}\ m^{-3}$

55. If the top of valence band and bottom of conduction band lies at same wave vector, then band gap is termed as :

(A) Indirect band gap

(B) Direct band gap

(C) Coherent band gap

(D) Incoherent band gap

56. The specific heat at constant volume of the solid at $T >> \theta_D$ (Debye temperature) is equal to :

(A) $3\,Nk_B$

(B) $3\,Nk_B\left(\frac{T}{\theta_D}\right)$

(C) $9\,Nk_B\left(\frac{T}{\theta_D}\right)^3$

(D) $234\,Nk_B\left(\frac{T}{\theta_D}\right)^3$

57. Which is not true for superconductors below critical temperature ?

(A) Its electrical resistance is zero while electrical conductivity is hight.

(B) It behaves like diamagnetic material.

(C) Its specific heat is less than normal conductors.

(D) Skin depth is equal to penetration depth.

58. The ratio of magnetization $(-4\pi\vec{M})$ and applied magnetic field strength $(\vec{H})$ for type-I superconductor is equal to :

(A) 1

(B) -1

(C) μ_0

(D) $-\mu_0$

59. Which equation governs the variation of critical magnetic field with temperature for the superconductors ?

(A) $H_c = H_0\left\{1-\left(\frac{T}{T_c}\right)^2\right\}$

(B) $H_c = H_0\left\{1+\left(\frac{T}{T_c}\right)^2\right\}$

(C) $H_c = H_0\left\{1-\left(\frac{T_c}{T}\right)^2\right\}$

(D) $H_c = H_0\left\{1+\left(\frac{T_c}{T}\right)^2\right\}$

60. The distance upto which the magnetic field can penetrate within the superconducting material below critical temperature is equal to :

(A) $\sqrt{\frac{\mu_0 ne^2}{m}}$

(B) $\sqrt{\frac{m}{\mu_0 ne^2}}$

(C) $\sqrt{\frac{ne^2}{\mu_0 m}}$

(D) $\sqrt{\frac{\mu_0 m}{ne^2}}$

61. When the temperature of superconductor is less than critical temperature, then according to London's theory the magnetic field strength is governed by equation :

(A) $H = H_0 \exp\left(-\frac{x}{\lambda}\right)$

(B) $H = H_0 \exp\left(-\frac{\lambda}{x}\right)$

(C) $H = H_0 \exp\left(\frac{x}{\lambda}\right)$

(D) $H = H_0 \exp\left(\frac{\lambda}{x}\right)$

62. The expression London's penetration depth for superconductor as function of temperature is :

(A) $\lambda = \lambda_0 \left\{1 - \left(\frac{T}{T_c}\right)^4\right\}^{-\frac{1}{2}}$

(B) $\lambda = \lambda_0 \left\{1 - \left(\frac{T}{T_c}\right)^4\right\}^{\frac{1}{2}}$

(C) $\lambda = \lambda_0 \left\{1 + \left(\frac{T}{T_c}\right)^4\right\}^{-\frac{1}{2}}$

(D) $\lambda = \lambda_0 \left\{1 + \left(\frac{T}{Tc}\right)^4\right\}^{\frac{1}{2}}$

63. The critical temperature (T_c) of superconductor varies with isotopic mass as :

(A) $T_c \propto \sqrt{M}$

(B) $T_c \propto \frac{1}{\sqrt{M}}$

(C) $T_c \propto M$

(D) $T_c \propto \frac{1}{M}$

64. Cooper pairs are result of :

(A) weak electron-electron interaction via phonon

(B) strong electron-electron interaction via phonon

(C) strong electron-phonon interaction via electron

(D) strong phonon-phonon interaction via electron

65. The width of the energy gap of superconductor at 0 K is :

(A) $0.5\ k_B T_C$

(B) $1.5\ k_B T_C$

(C) $2.5\ k_B T_C$

(D) $3.5\ k_B T_C$

66. SQUIDS are based on :

(A) Meissner effect

(B) Josephson's effect

(C) Thermoelectric effect

(D) Schottky effect

67. Which statement is not correct for Type-II superconductor ?

(A) If follows both Meissner effect and Silsbee's rule.

(B) It has two critical magnetic fields.

(C) It shows intermediate state between superconductor and normal conductor.

(D) It is also termed as hard superconductor.

68. Which one is correlated with superconductivity ?

(A) Meissner effect

(B) Magnetic laviation

(C) AQUIDS

(D) All of the above

69. Under Debye model if V_L and V_T are longitudinal and transverse velocities in longitudinal and both transverse acoustical modes, then expression of Debye average velocity is :

(A) $V_D = \left[\frac{1}{3}\left(\frac{1}{V_L^3} + \frac{2}{V_T^3}\right)\right]^{-\frac{1}{3}}$

(B) $V_D = \left[\frac{1}{3}\left(\frac{1}{V_L^3} + \frac{2}{V_T^3}\right)\right]^{-1}$

(C) $V_D = \left[\left(\frac{1}{V_L^3} + \frac{2}{V_T^3}\right)\right]^{-1}$

(D) $V_D = \left[\frac{1}{3}\left(\frac{1}{V_L^3} + \frac{2}{V_T^3}\right)\right]^{\frac{1}{3}}$

70. If ν_D is Debye frequency, then Debye temperature will be :

(A) $\frac{3k_BT}{2h\nu_D}$

(B) $\frac{2h\nu_D}{3k_B}$

(C) $\frac{h\nu_D}{k_B}$

(D) $\frac{3k_B}{2h\nu_D}$

71. Under Debye theory, the average energy and specific heat at constant volume of the solid with in low temperature region $(T << \theta_D)$ is respectively proportional to :

(A) T^3 and T^2

(B) T^4 and T^3

(C) T^2 and T^3

(D) T^3 and T^4

72. If V_D is Debye average velocity, then density of vibrational modes in lattice in frequency range ν to $\nu + d\nu$ will be :

(A) $\frac{4\pi\nu^3 d\nu}{V_D^3}$

(B) $\frac{4\pi\nu^2 d\nu}{V_D^2}$

(C) $\frac{4\pi\nu^3 d\nu}{V_D^2}$

(D) $\frac{4\pi\nu^2 d\nu}{V_D^3}$

73. If β and m are the spring constant and mass of atom for each lattice point respectively in a linear lattice, then the Einstein temperature (θ_E) is :

(A) $\frac{\hbar}{k_B}\sqrt{\frac{4\beta}{m}}$

(B) $\frac{\hbar}{k_B}\sqrt{\frac{\beta}{m}}$

(C) $\hbar k_B\sqrt{\frac{4\beta}{m}}$

(D) $\hbar k_B\sqrt{\frac{\beta}{m}}$

74. According to Einstein's theory, the specific heat at constant volume of solid in low temperature region ($T << \theta_E$) is proportional to :

(A) $T^2 \exp\left(\frac{\theta_E}{T}\right)$

(B) $T^{-2} \exp\left(-\frac{\theta_E}{T}\right)$

(C) $T^2 \exp\left(-\frac{\theta_E}{T}\right)$

(D) $T^{-2} \exp\left(\frac{\theta_E}{T}\right)$

75. If 'a' is lattice parameter for one-D lattice, then according to Bloch theorem, the wave function associated with electron at x and $x + a$ are correlated as :

(A) $\psi(x + a) = e^{\pm ika}\, \psi(x)$

(B) $|\psi(x + a)| = |\psi(x)|$

(C) $\psi(x + a) = e^{-ika}\, \psi(x)$

(D) Both (A) and (B)

76. It 'a' is lattice parameter, then range of first Brillouin zone is :

(A) $-\frac{\pi}{a}$ to $\frac{\pi}{a}$

(B) $-\frac{2\pi}{a}$ to $\frac{2\pi}{a}$

(C) $\pm\frac{\pi}{a}$ to $\pm\frac{2\pi}{a}$

(D) 0 to $\frac{\pi}{a}$

77. An electron is moving within crystal lattice, then for which value of wave vector the energy associated with it is discontinuous ?

(A) $\pm\frac{2n\pi}{a}; n = 1, 2, 3, \ldots$

(B) $\frac{2n\pi}{a}; n = 1, 2, 3, \ldots$

(C) $\pm\frac{n\pi}{a}; n = 1, 2, 3, \ldots$

(D) $-\frac{n\pi}{a}; n = 1, 2, 3, \ldots$

78. The effective mass of electron within crystal lattice can be :

(A) zero

(B) positive

(C) negative

(D) All of the above

79. The effective masses of electron at and after the point of inflection in E-K curve for electron in crystal lattice are :

(A) Zero and positive

(B) Minimum and negative

(C) Maximum and negative

(D) Negative and positive

80. Which value of effective mass of electron confirms the existence of holes or vacant states ?

(A) zero

(B) infinite

(C) positive

(D) negative

81. If 'a' is lattice parameter, then the region of second allowed energy band for the electron is :

(A) $-\frac{\pi}{a}$ to $\frac{\pi}{a}$

(B) $-\frac{2\pi}{a}$ to $\frac{2\pi}{a}$

(C) $\pm\frac{\pi}{a}$ to $\pm\frac{2\pi}{a}$

(D) 0 to $\pm\frac{2\pi}{a}$

82. Which material has least energy band gap ?

(A) metals

(B) semi-metals

(C) semiconductors

(D) insulators

83. The effective mass of current carriers in crystals can be determined by :

(A) electron spin resonance

(B) nuclear magnetic resonance

(C) cyclotron resonance

(D) All of the above

84. Which effect offers the most precise measurement of Fermi surface in metals ?

(A) Mössbauer effect

(B) Meissner effect

(C) De Hass-Van Alphen effect

(D) Early effect

85. If $V(x)$ is potential energy of an electron in a linear lattice of lattice parameter 'a', then under Bloch assumption :

(A) $V(x+a) = V(x)$

(B) $V(x+a) = e^{\pm ika}\, V(x)$

(C) $V(x+a) = e^{\pm ika}\, V(a)$

(D) None of the above

86. The velocity of an electron at the boundary of first Brillouin zone is :

(A) zero

(B) infinite

(C) $\frac{\hbar K}{m}$

(D) $\frac{1}{\hbar}\frac{dE}{dK}$

87. If β is spring constant for a linear lattice, then the maximum frequency of vibration which may exist and supports Bragg's reflection condition is :

(A) $\sqrt{\frac{\beta}{m}}$

(B) $\sqrt{\frac{2\beta}{m}}$

(C) $\sqrt{\frac{4\beta}{m}}$

(D) $\sqrt{\frac{m}{\beta}}$

88. The maximum value of wave vector of a wave that can travel through a linear lattice of N + 1 atoms and 'a' lattice parameter is :

(A) $\frac{\pi}{a}$

(B) $N\frac{\pi}{a}$

(C) $(N+1)\frac{\pi}{a}$

(D) $\frac{N-1}{N}\frac{\pi}{a}$

89. A linear lattice has N + 1 atoms and lattice parameter 'a'. The number of normal modes of vibration is :

(A) N

(B) 2N

(C) N + 1

(D) N – 1

90. The wave propagating through linear monoatomic lattice can have :

(A) unique frequency with unique wavelength

(B) unique frequency with different wavelength

(C) different frequency with unique wavelength

(D) different frequency with different wavelength

91. The wavelength of wave propagating through monoatomic linear lattice at wave propagation vector $K = \frac{\pi}{a}$ is :

(A) a

(B) $2a$

(C) $3a$

(D) $4a$

92. If a wave of wavelength of twice of lattice parameter is propagating through monoatomic linear lattice, then group velocity is :

(A) zero

(B) finite

(C) infinite

(D) equal to sound velocity

93. Let a linear lattice with a basis of two atoms in the primitive cell has lattice parameter 'a' and spring constant β. If m and M ($m < M$) are the masses of atoms, then maximum frequency of vibration in acoustical region shall be :

(A) $\sqrt{\frac{2\beta}{m+M}}$

(B) $\sqrt{\frac{2\beta}{M}}$

(C) $\sqrt{\frac{2\beta}{m}}$

(D) $\sqrt{\frac{4\beta}{m+M}}$

94. Let a linear lattice with a basis of two atoms in the primitive cell has lattice parameter 'a' and spring constant β. If m and M (m < M) are the masses of atoms then minimum frequency of vibration in optical region is :

(A) $\sqrt{\frac{2\beta mM}{m+M}}$

(B) $\sqrt{\frac{4\beta}{M}}$

(C) $\sqrt{\frac{2\beta}{m}}$

(D) $\sqrt{\frac{4\beta mM}{m+M}}$

95. A linear lattice with a basis of two atoms (m < < M) in the primitive cell has lattice parameter's 'a'. In which case, the acoustical branch yields completely ?

(A) $M \rightarrow 0$

(B) $M \rightarrow \infty$

(C) $m \rightarrow 0$

(D) Both (B) and (C)

96. In which region, the optical frequency of vibration in ionic crystal belong ?

(A) UV region

(B) Visible region

(C) IR region

(D) X-ray region

97. Phonon is :

(A) energy quanta of e.m. wave

(B) energy quanta of spin wave

(C) energy quanta of lattice vibration

(D) energy quanta of ionic vibration

98. In neutron scattering, the gain or loss of phonon at each event is equal to :

(A) $\hbar\Omega$

(B) $2\hbar\Omega$

(C) $4\hbar\Omega$

(D) $6\hbar\Omega$

99. Which confirms the existence of Phonon ?

(A) X-ray scattering

(B) Neutron scattering

(C) Superconductivity

(D) All of the above

100. Under Tight Binding Approximation, if β is overlap integral, then width of energy band for simple cubic structure is :

(A) 3β

(B) 6β

(C) 9β

(D) 12β

Roll No. .....

O. M. R. Serial No. | | | | | | | | |

Question Booklet Number

268509

M. Sc. (Second Semester) (NEP) EXAMINATION, 2022-23

PHYSICS

(Statistical Mechanics)

Paper Code							
B	0	1	0	8	0	3	T

Questions Booklet Series

A

Time : 1:30 Hours]

[*Maximum Marks : 75*

Instructions to the Examinee :

1. Do not open the booklet unless you are asked to do so.
2. The booklet contains 100 questions. Examinee is required to answer 75 questions in the OMR Answer-Sheet provided and not in the question booklet. All questions carry equal marks.
3. Examine the Booklet and the OMR Answer-Sheet very carefully before you proceed. Faulty question booklet due to missing or duplicate pages/questions or having any other discrepancy should be got immediately replaced.

(Remaining instructions on the last page)

परीक्षार्थियों के लिए निर्देश :

1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।
2. प्रश्न-पुस्तिका में 100 प्रश्न हैं। परीक्षार्थी को 75 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। सभी प्रश्नों के अंक समान हैं।
3. प्रश्नों के उत्तर अंकित करने से पूर्व प्रश्न-पुस्तिका तथा OMR आन्सर-शीट को सावधानीपूर्वक देख लें। दोषपूर्ण प्रश्न-पुस्तिका जिसमें कुछ भाग छपने से छूट गए हों या प्रश्न एक से अधिक बार छप गए हों या उसमें किसी अन्य प्रकार की कमी हो, तो उसे तुरन्त बदल लें।

(शेष निर्देश अन्तिम पृष्ठ पर)

1. A system where there is exchange of energy E and mass M is called :

(A) isolated system

(B) open system

(C) closed system

(D) None of the above

2. Consider the general labelling of systems as open, closed or isolated. Which one of the following statements is correct ?

(A) An open system obeys the rules of Canonical Ensembles.

(B) An open system obeys the rules of Micro-Canonical Ensembles.

(C) An isolated system obeys the rules of μ-Canonical Ensembles.

(D) An isolated system obeys the rule of Canonical Ensembles.

3. A 2-D space formed by position and momentum co-ordinates is known as :

(A) momentum space

(B) micro space (μ-space)

(C) Γ space

(D) phase space

4. A 6-D space for one particle formed by 3 position and 3 momentum co-ordinates is known as :

(A) μ-space

(B) Γ space

(C) momentum space

(D) phase space

5. A body of mass m is just released from certain height and is allowed to fall under gravity. The phase trajectory of the body of mass m for height h above the ground will be :

(A) hyperbolic curve

(B) ellipse curve

(C) parabolic curve

(D) straight line

6. The trajectory of a one-dimensional Simple Harmonic Oscillator of mass m and total energy E in phase space is :

(A) parabolic curve

(B) straight line

(C) ellipse of constant area

(D) hyperbolic curve

7. μ-space is associated with a :

(A) whole system

(B) single molecule

(C) molecules

(D) All of the above

8. Γ space is associated with a :

(A) whole system

(B) molecules

(C) single molecule

(D) All of the above

9. Entropy change depends on :

(A) heat transfer

(B) mass transfer

(C) change of temperature

(D) thermodynamic state

10. How many macrostates are possible for the assembly of 6 particles having U = 6E obeying M- B statistics ?

(A) 10

(B) 11

(C) 12

(D) 13

11. The ratio of r. m. s. velocity to most probable velocity is :

(A) $\sqrt{3} : \sqrt{2}$

(B) $\sqrt{2} : \sqrt{3}$

(C) 2 : 3

(D) 3 : 2

12. If $\Omega > 1$, then S will be :

(A) 0

(B) > 0

(C) 1

(D) < 0

13. According to Planck statement S approaches to 0, if :

(A) V = 0

(B) P = 0

(C) T = 0

(D) S = T

14. In a microcanonical ensemble a system A of fixed volume is in contact with a large reservoir B, then :

(A) a can exchange only E with B

(B) a can exchange only particle with B

(C) neither E nor V, A can exchange with B

(D) a can exchange both E and N

15. A system where there is exchange of E but not mass is called :

(A) insulated system

(B) isolated system

(C) open system

(D) closed system

16. In an canonical ensemble, a system A of fixed volume is in contact with a large reservoir B, then :

(A) a can exchange only E with B

(B) a can exchange only particle with B

(C) a can neither exchange E nor particle with B

(D) None of the above

17. Consider the microcanonical, canonical and grand canonical ensembles. Which one physical property is constant in all these ensembles ?

(A) Total number of particles N

(B) Pressure P

(C) Volume V

(D) Temperature T

18. Which of the following is not true for micro- canonical ensembles ?

(A) E, V, N constant

(B) System is isolated

(C) It has special total energy

(D) The temperature T of the system is fixed

19. Which of the following parameters remain constant in canonical ensemble ?

(A) [N, V, T]

(B) [μ, V, T]

(C) [P, V, T]

(D) None of the above

20. Two distinguishable molecules are distributed in 3 equal sized compartments. The number of possible macrostates and microstates are :

(A) (6, 6)

(B) (6, 9)

(C) (9, 9)

(D) (3, 9)

21. The possible states of a mechanical system that has an exactly specified total energy E is represented by :

(A) microcanonical ensemble

(B) grand canonical ensemble

(C) canonical ensemble

(D) partition function

22. M-B statistics cannot be applied to :

(A) atoms

(B) molecules

(C) photons

(D) lattice

23. In B-E statistics an energy state can be occupied by more than one particle. Is it True, False, Don't know ?

(A) True

(B) False

(C) Don't know

(D) None of the above

24. During B-E condensation all the atoms fall back to the :

(A) ground state

(B) first excited state

(C) highest excited state

(D) None of the above

25. Similarity between M-B and B-E statistics is :

(A) distinguishable particle

(B) no restriction of number of particles

(C) indistinguishable particles

(D) None of the above

26. Change in number of particles in a system refers to change in :

(A) number of microstate

(B) number of macrostate

(C) occupation number

(D) no effect

27. If volume is constant for any system, then work done will be :

(A) 0

(B) ∞

(C) variable

(D) no change

28. In the limit of high temp. the particles are distributed over a large range energy values therefore the occupancy on each state is :

(A) very small

(B) same

(C) very large

(D) 0

29. Number of ways in which 4 molecules can be distributed in two different energy levels is :

(A) 4

(B) 8

(C) 16

(D) 24

30. How many different ways can two indistinguishable balls can be placed in two boxes ?

(A) 1

(B) 2

(C) 3

(D) 4

31. How many different ways can four indistinguishable balls can be placed in two boxes ?

(A) 9

(B) 7

(C) 3

(D) 5

32. The fundamental postulate of equal a priori probabilities states that :

(A) an isolated system in equilibrium is equally likely to be in any of its accessible states.

(B) all accessible microstates corresponding to possible macrostates are not equally probable.

(C) all the cells in phase space are of equal size.

(D) None of the above

33. The probabilities of the various possible states of a closed system of fixed volume in thermal equilibrium with a heat bath is given by :

(A) canonical ensemble

(B) microcanonical ensemble

(C) grand canonical ensemble

(D) partition function

34. Natural process are allowed for which :

(A) $0 \leq \Delta S$

(B) $0 \geq \Delta S$

(C) $0 = \Delta S$

(D) $\Delta S > 0$

35. Statistical mechanics provide multiplicative interpretation of concept of :

(A) entropy

(B) thermodynamics

(C) sum of thermodynamic probability for macrostate

(D) energy of the system

36. The $\hbar$ is the universal constant called Planck's constant which value is :

(A) 1.055×10^{-34}

(B) 6.62×10^{-34}

(C) Both (A) and (B)

(D) None of the above

37. The momentum cubical box :

(A) $P_j^2 = n_j^2 h^2 / 2l$

(B) $P_j^2 = n_j^2 h^2 / 4L$

(C) $P_j^2 = n_j h/2L$

(D) None of the above

38. If the system is degenerate, then their degeneracy is more than one and if the system is non-degenerate then their degeneracy is :

(A) 1

(B) 2

(C) 3

(D) 4

39. A schematic representation of a set of energy level E_j, their degeneracie's G_j and their occupation number is :

(A) N_x

(B) N_y

(C) N_j

(D) N_z

40. In which statistics number of particles is limited ?

(A) F-D statistics

(B) B-E statistics

(C) M-B statistics

(D) None of the above

41. Which conditions are required for Fermi-Dirac statistics ?

(A) $n_j \leq g_j$

(B) $n_j \geq g_j$

(C) $n_j \neq g_j$

(D) None of the above

42. Occupation number is called to a particle present in :

(A) energy level

(B) excited level

(C) thermodynamic level

(D) None of the above

43. Relation between entropy (S) and thermodynamic probability (Ω) is :

(A) $S = k_B$

(B) $S = k_B \log \Omega$

(C) $S = \Omega$

(D) $S = k_B$

44. Which statistics follows Pauli's exclusion principle ?

(A) F-D

(B) B-E

(C) M-B

(D) None of the above

45. Which statistics follows classical mechanics ?

(A) M-B

(B) F-D

(C) B-E

(D) None of the above

46. In B-E statistics particle have spin :

(A) add half integer

(B) integer

(C) Both (A) and (B)

(D) None of the above

47. Which statistics follow quantum mechanics ?

(A) F-D and B-E

(B) M-B

(C) Both of the above

(D) None of the above

48. When a system is not influenced in any way by surroundings, it is said to be :

(A) open system

(B) closed system

(C) isolated system

(D) None of the above

49. In the relation $\omega_k = \pi_j \omega_j$, π is :

(A) Drift of all the particles

(B) Sum of all the particles

(C) Product of all the particles

(D) Constant

50. If the only one state in $g_i = 1$, then what will be the ω_j in B-E statistics ?

(A) 1

(B) 0

(C) g_i^{-1}

(D) g_i^{+1}

51. A set of shelves at different elevations is called :

(A) Energy level

(B) Energy state

(C) Occupation number

(D) Degeneracy level

52. The principle of classical mechanics described correctly behaviour of :

(A) Wave

(B) Matter

(C) Electron

(D) Neutron

53. The number of different states having same energy shows :

(A) Degeneracy

(B) Energy difference

(C) Energy states

(D) None of the above

54. The statistical approach has a closed connection with :

(A) Kinetic theory

(B) Thermodynamics

(C) Both (A) and (B)

(D) None of the above

55. Which is the correct relation of 1st law of thermodynamics ?

(A) $d\theta = du + dw$

(B) $H = PV + U$

(C) Both (A) and (B)

(D) None of the above

56. Which is the correct relation of IIIrd law ?

(A) $dS = \frac{d\theta}{dt}$

(B) $G = H - TS$

(C) Both (A) and (B)

(D) None of the above

57. Which is the correct canonical pair of entropy ?

(A) Temperature

(B) Pressure

(C) Volume

(D) None of the above

58. The M-B law is given by the expression :

(A) $\frac{1}{e^{(\alpha + E/kT)}}$

(B) $\frac{1}{e^{(1 + E/kT)}}$

(C) $\frac{1}{e^{kT}}$

(D) None of the above

59. Number of microstates in a macrostate may be :

(A) Equal

(B) $\geq$

(C) $\leq$

(D) Greater

60. In canonical ensembles the individual system are separated by :

(A) rigid, permeable, conducting walls

(B) rigid, impermeable, conducting walls

(C) rigid, impermeable, non-conducting walls

(D) None of the above

61. Which one of the processes in irreversible ?

(A) Slow compression of an elastic spring

(B) Slow evaporation of substance in an isolated vessels

(C) Slow compression of a gas

(D) A chemical explosion

62. The average K.E. associated with each degree of freedom is :

(A) kT

(B) $2kT$

(C) $kT/2$

(D) $kT/4$

63. The sum of all the microscopic form of energy is called :

(A) total energy

(B) phase energy

(C) system energy

(D) internal energy

64. Which of the following is the property of a system ?

(A) P and T

(B) Internal energy

(C) V and P

(D) All of the above

65. Mixture of ice and H_2O form a :

(A) closed system

(B) open system

(C) Isolated system

(D) heterogeneous system

66. Entropy change depends on :

(A) heat transfer

(B) mass transfer

(C) change of temperature

(D) thermodynamic state

67. Work done is positive when :

(A) $V_f < V_i$

(B) $V_f > V_i$

(C) $V_f = V_i$

(D) $V_f \geq V_i$

68. The difference between the fermions and bosons is that bosons do not obey :

(A) Aufbau's principle

(B) Pauli's exclusion principle

(C) Hund's rule of maximum multiplicity

(D) Heisenberg's uncertainty principle

69. The difference between fermions and bosons is that Boson's wave function is :

(A) continuous

(B) single valued

(C) symmetric

(D) differentiable

70. B-E statistics can be applied to :

(A) Neutron

(B) Proton

(C) Fermions

(D) Photons

71. In B-E statistics one energy state can be occupied by more than one particle.

(A) True

(B) False

(C) Cannot say

(D) None of the above

72. When Bosons are cooled to a low enough temperature, their behaviour changes.

(A) True

(B) False

(C) Can't say

(D) None of the above

73. What is B-E condensation ?

(A) Ground state of matter

(B) First excited state of matter

(C) Highest excited state of matter

(D) Insufficient information

74. The radiations emitted by hot bodies are called as :

(A) X-rays

(B) Blackbody radiation

(C) Gamma (γ) radiation

(D) Visible lights

75. A blackbody is defined as a perfect absorber of radiations. It may or may not be a perfect emitter of radiations.

(A) True

(B) False

(C) Cannot say

(D) None of the above

76. The unit of absorptive power is :

(A) T

(B) T/S

(C) TS

(D) No unit

77. Which equation represents the Helmholtz- Gibbs free energy ?

(A) $F = U - TS$

(B) $G = U + PV - TS$

(C) $H = U + PV$

(D) $Q = TdS$

78. The probability of an event is :

(A) total number of cases

(B) total number of events

(C) the ratio of the number of cases in which event occurs to the total number of cases

(D) None of the above

79. Suppose we toss a coin, then probability of the head may come :

(A) 0

(B) 1

(C) 2/3

(D) 1/2

80. Natural processes are allowed for which :

(A) $0 \leq \Delta S$

(B) $0 \geq \Delta S$

(C) $\Delta S > 0$

(D) None of the above

81. $S = NK \log Z + \frac{E}{T}$. This is the relation between :

(A) Partition Function and Entropy

(B) Partition Function and Enthalpy

(C) Entropy and Enthalpy

(D) None of the above

82. The equation $S = NK \log Z + \frac{3}{2}NK$ gives the entropy of an ideal gas in :

(A) Canonical ensemble

(B) Microcanonical ensemble

(C) Grand canonical ensemble

(D) None of the above

83. Gibbs paradox involves the contradiction between mixing :

(A) two differential gases of different kinds and that of same kind

(B) two differential gases of same kind and that of same kind

(C) two or more same ideal gases of same kind and that of same kind

(D) None of the above

84. The energy fluctuations are same for the canonical and grand canonical ensemble but only when we are :

(A) away from the critical point
(B) near the critical point
(C) at the critical point
(D) None of the above

85. The total energy density is bT^4 is known as :

(A) Maxwell's law
(B) Maxwell-Stefan's law
(C) Stefan-Boltzmann's law
(D) None of the above

86. The compressibility of alkali metals is close to the compressibility of an :

(A) Proton gas
(B) Neutron gas
(C) Deuteron gas
(D) Electron gas

87. Degeneracy is the different state of :

(A) unequal energy
(B) different heat energy
(C) low energy
(D) equal energy

88. Condensation is the change of physical state of matter :

(A) liquid phase into vapour phase
(B) solid phase into liquid phase
(C) gas phase into liquid phase
(D) None of the above

89. In the case of phase transition of IInd kind the state of the body changes :

(A) stepwise
(B) continuously
(C) no change
(D) None of the above

90. The transition from non-ferromagnetic state to ferromagnetic state called the phase transitions of :

(A) Ist kind
(B) IInd kind
(C) IIIrd kind
(D) IVth kind

91. The one-dimensional Ising model cannot be ferromagnetic because :

(A) there is transition temperature.
(B) there is high pressure.
(C) there is no transitions temperature.
(D) None of the above

92. Weiss' theory of ferromagnetism is also called as :

(A) Planck' theory
(B) Domain theory
(C) Landan theory
(D) Kinetic theory

93. In the equation $\frac{\rho}{RT} = \rho + B\rho^2 + C\rho^3 + ...$ the second virial coefficient represents the :

(A) Initial departure from ideal gas behaviour

(B) Final departure from ideal gas behaviour

(C) No change in the behaviour

(D) None of the above

94. The equations $\left(P + \frac{a}{V_m^2}\right)(V_m - b) = RT$ is called :

(A) Virial equation

(B) van der Waals equation

(C) Maxwell's equation

(D) None of the above

95. Landau's theory only describes the :

(A) separate behaviour of a system

(B) cooling behaviour of a system

(C) universal behaviour of a system

(D) None of the above

96. The partition function of any ..... system is a continuous function of all the parameters.

(A) ∞

(B) 0

(C) finite

(D) None of the above

97. The energy is defined as the highest reversible work gained by a given system is known as :

(A) Helmholtz free energy

(B) Gibbs free energy

(C) Internal energy

(D) None of the above

98. Helmholtz free energy is given by the formula :

(A) $F = U - TS$

(B) $H = U + PV$

(C) $G = H - TS$

(D) $dS = \frac{Q}{T}$

99. The relation between Fermi energy and density of electrons :

(A) $E_f \propto \rho$

(B) $E_f \propto \rho^{3/2}$

(C) $E_f \propto \rho^{2/3}$

(D) $E_f \propto \rho^{1/2}$

100. Consider M-B distribution. How can the fluctuation in velocity be related to temperature ?

(A) αT

(B) αT^2

(C) αT^3

(D) $\alpha T^{1/2}$

Roll No. .....

O. M. R. Serial No. | | | | | | | | |

Question Booklet Number

271091

M. Sc. (Second Semester) (NEP)
EXAMINATION, 2022-23
PHYSICS
(Electronics)

Paper Code							
B	0	1	0	8	0	4	T

Questions Booklet Series

C

Time : 1:30 Hours]

[Maximum Marks : 75

Instructions to the Examinee :

1. Do not open the booklet unless you are asked to do so.
2. The booklet contains 100 questions. Examinee is required to answer 75 questions in the OMR Answer-Sheet provided and not in the question booklet. All questions carry equal marks.
3. Examine the Booklet and the OMR Answer-Sheet very carefully before you proceed. Faulty question booklet due to missing or duplicate pages/questions or having any other discrepancy should be got immediately replaced.

परीक्षार्थियों के लिए निर्देश :

1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।
2. प्रश्न-पुस्तिका में 100 प्रश्न हैं। परीक्षार्थी को 75 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। सभी प्रश्नों के अंक समान हैं।
3. प्रश्नों के उत्तर अंकित करने से पूर्व प्रश्न-पुस्तिका तथा OMR आन्सर-शीट को सावधानीपूर्वक देख लें। दोषपूर्ण प्रश्न-पुस्तिका जिसमें कुछ भाग छपने से छूट गए हों या प्रश्न एक से अधिक बार छप गए हों या उसमें किसी अन्य प्रकार की कमी हो, तो उसे तुरन्त बदल लें।

(Remaining instructions on the last page)

(शेष निर्देश अन्तिम पृष्ठ पर)

1. What type of light sources is usually present in the cut-back method ?

(A) Tungsten or Xenon

(B) LED

(C) Laser

(D) Photosensor

2. Op-Amp. performs which type of mathematical type operations ?

(A) Linear

(B) Non-linear

(C) Frequency dependent

(D) All of the above

3. The op-amp. can amplify :

(A) A. C. signal only

(B) D. C. signal only

(C) Both A. C. and D. C. signals

(D) Neither A. C. nor D. C. signals

4. The semiconductor material does not use in LED is :

(A) Silicon carbide

(B) GaAsP

(C) GaAs

(D) Si

5. What is the unit of measurement of the optical attenuation per unit length ?

(A) dB - km

(B) dB - km

(C) km / dB

(D) V

6. In op-amp., the small difference between both bias current I_B^+ and I_B^- is called :

(A) Input bias current

(B) Input offset current

(C) Base current

(D) None of the above

7. Wien Bridge measures :

(A) Power

(B) Power factor

(C) Frequency

(D) Resistance

8. What is the typical range of the forward voltage of an LED ?

(A) 5 – 12 V

(B) 1.7 – 3.3 V

(C) 5 – 12 mv

(D) 1·7 – 3.3 mV

9. Following measurements give an indication of the distortion to the optical signals as they propagate down optical fibers :

(A) Attenuation

(B) Dispersion

(C) Encapsulation

(D) Frequency

10. If op-amp's input is a differential amplifier, then average value of the base currents entering into the terminals is called :

(A) Difference bias current

(B) Input bias current

(C) Input offset current

(D) None of the above

11. The type of feedback used in the Wien Bridge oscillator is :

(A) Negative feedback only

(B) Positive feedback only

(C) No feedback

(D) Both negative and positive feedbacks

12. In LED, light is emitted because :

(A) Light falls on LED

(B) Recombination of charges takes place

(C) P-N junction emits light when heated

(D) IR light falls on LED

13. Intermodel dispersion is non-existent in the following fibers :

(A) Multimode

(B) Single mode

(C) Step index-multimode

(D) Al-GU

14. The open loop voltage gain of an op-amp. with only one corner frequency (F_1) can be given as :

(A) $A = A_{OL} / 1 + J (F/F_1)$

(B) $A = A_{OL} / 1 - J (F/F_1)$

(C) $A = A_{OL} / 1 \pm J (F/F_1)$

(D) None of the above

15. A phase shift oscillator uses 5 PF capacitors. Find the value of R to produce a frequency of 800 kHZ :

(A) 39.8 kΩ

(B) 28.1 kΩ

(C) 16.2 kΩ

(D) 22.9 kΩ

16. The efficiency of an LED for generating light is directly proportional to the :

(A) Applied voltage

(B) Current injected

(C) Temperature

(D) Level of doping

17. How many domains support the measurement of fiber dispersion ?

(A) One

(B) Three

(C) Four

(D) Two

18. In op-amp., the max. rate of change of output voltage caused by a step input voltage is called :

(A) Current rate

(B) Power rate

(C) Slew rate

(D) None of the above

19. In the R-C phase shift oscillator to generate sustained the minimum value of h_{fe} is :

(A) 44.5

(B) 47.4

(C) 46.4

(D) 45.5

20. Phototransistor is a form of the following transistor which is sensitive of light :

(A) Unipolar

(B) Bipolar

(C) Tripolar

(D) None of the above

21. A particular GaAs fiber has a Fresnel reflection magnitude of 17.6% i.e. 0.176. The power loss between source and the fiber will be :

(A) 0.86 dB

(B) 0.78 dB

(C) 0.84 dB

(D) 0.83 dB

22. The theory which describes strong interactions is called :

(A) Quantum chromodynamics

(B) Quantum electrodynamics

(C) Fermi's theory

(D) Gamow's theory of α decay

23. R-C phase shift and Wien Bridge Oscillators are the commonly used circuits for generating the following waveform of a required frequency :

(A) Sine

(B) Negative

(C) Cosine

(D) Both sine and cosine

24. When light enters the base region of a phototransistor, it generates the following pair :

(A) Electron-Hole

(B) Emitter-Resistor

(C) Current-Voltage

(D) None of the above

25. Losses caused by factors such as core-cladding diameter numerical aperture, relative refractive index differences, different refractive index profiles, fiber faults are known as :

(A) Intrinsic joint losses

(B) Extrinsic losses

(C) Insertion losses

(D) Coupling losses

26. Am op-amp. with negative feedback provides the following output parameter :

(A) Gain

(B) Bandwidth

(C) Input-output Impedance

(D) All of the above

27. How many RC loops are needed in phase shift oscillators ?

(A) Two

(B) Three

(C) Four

(D) Five

28. Phototransistor offers a reasonable :

(A) Temperature

(B) Speed

(C) Light

(D) Distance

29. What is dispersion in optical fiber Communication ?

(A) Compression of light pulses

(B) Broadening of transmitted light pulses along the channel

(C) Overlapping of light pulses on compression

(D) Absorption of light pulses

30. Voltage when applied at 2 inputs of op-amp to get OV of output is called :

(A) input offset voltage

(B) output offset voltage

(C) in-out offset voltage

(D) None of the above

31. Frequency of oscillation for three Selection R-C phase shift network is given by :

(A) $\frac{1}{(\pi\sqrt{6}\,RC)}$

(B) $\frac{2}{(\pi\sqrt{6}\,RC)}$

(C) $\frac{1}{(2\pi\sqrt{6}\,RC)}$

(D) $\frac{1}{(2\sqrt{6}\,RC)}$

32. Normal phototransistor are designed using :

(A) Si

(B) Ge

(C) In GaAs

(D) PbS

33. In waveguide dispersion, refractive index is independent of :

(A) Bit rate

(B) Index difference

(C) Velocity of medium

(D) Wavelength

34. What is the value of CMRR of an ideal instrumentation amplifier ?

(A) 1

(B) 0

(C) ∞

(D) 0.5

35. If the input to a comparator is a sine wave, the output is a :

(A) Ramp voltage

(B) Sine wave

(C) Rectangular wave

(D) Sawtooth wave

36. Phototransistor has the following frequency response compared to photodiodes :

(A) high

(B) less

(C) medium

(D) None of the above

37. In optical communication system, the zero dispersion wavelength is given by :

(A) 0 nm

(B) 1310 nm

(C) 1550 nm

(D) 900 nm

38. Instrumentation amplifier built with 2 op-amps has gain :

(A) + 2 dB

(B) + 3 dB

(C) + 6 dB

(D) + 8 dB

39. Clamp diodes used in comparators work as :

(A) To protect the op-amp. from damage

(B) To develop the input offset current

(C) To increase the output voltage

(D) To increase the gain of op-amp.

40. A solar cell is basically a :

(A) A semiconductor triode

(B) A semi conductor diode

(C) A junction between two good conductors

(D) None of the above

41. An optical transmitter transmits 10 W power, compute its equivalent power in dB :

(A) 10 dBm

(B) – 40 dBm

(C) 30 dBm

(D) 40 dBm

42. Which of the following is the disadvantage of op-amp ?

(A) Are designed for low power operation only

(B) Not suitable for high output

(C) Requires passive components

(D) All of the above

43. The equivalent weight of LSB in a four bit variable resistive divider D/A converter is :

(A) 1/4

(B) 1/16

(C) 1/15

(D) 8/15

44. Which material is used for making solar cell ?

(A) Gold

(B) Iron

(C) Aluminium

(D) Silicon

45. Fiber optics was invented by :

(A) Thomas Mensah

(B) Thomas Edison

(C) John Henry Holmes

(D) None of the above

46. 741 op-amp has the following no. of gain stages :

(A) 2

(B) 3

(C) 4

(D) 5

47. Binary ladder network is better than resistive divider for D/A conversion, because :

(A) It requires lesser no. of resistors.

(B) It requires resistor having two values only.

(C) It is cheaper.

(D) It gives better accuracy.

48. Solar cells work on the principle of :

(A) Isolation and Opto-coupling

(B) Isolation

(C) Photovoltaic

(D) Opto-coupling

49. Fiber optic cable operate at frequencies near :

(A) 2 GHz

(B) 20 MHz

(C) 200 MHz

(D) 800 THz

50. Slew rate is expressed in terms of :

(A) volts / sec.

(B) Amperes / sec.

(C) seconds

(D) Both (A) and (B)

51. The fastest A/D converter is :

(A) Single slope ramp comparator

(B) Dual slope integrator

(C) Successive approximation

(D) Counter type

52. Which of the following is the amount of voltage a solo solar cell generates ?

(A) 0.5 V

(B) 0.7 V

(C) 1.5 V

(D) 3.0 V

53. Which materials are unsuitable for the fabrication of graded index fiber ?

(A) Glass like materials

(B) Mono-crystalline structures

(C) Amorphous material

(D) Silica based material

54. In ideal op-amp., input impedance is :

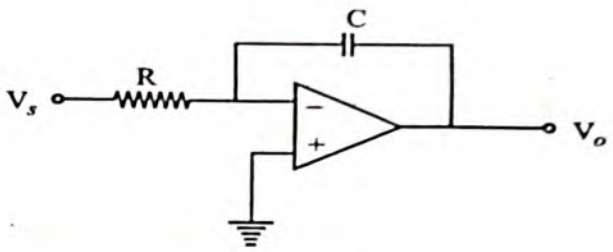
(A) $R_i = 0$

(B) $R_i = 1$

(C) $R_i = \infty$

(D) $R_i = -1$

55. The given fig. represents :



(A) Summing amplifier

(B) Precision rectifier

(C) Integrator

(D) Differentiator

56. The mobility of electrons is large in comparison to holes because they :

(A) are lighter than holes

(B) are higher than holes

(C) have negative charge

(D) None of the above

57. Multimode step index fiber has a large core diameter of range is :

(A) 100 to 300 μm

(B) 100 to 300 nm

(C) 200 to 500 μm

(D) 200 to 500 nm

58. In op-amp., the voltage gain for non-inverting is given by :

(A) $A_{CL} = -\frac{R_F}{R_1}$

(B) $A_{CL} = \frac{R_F}{R_1}$

(C) $A_{CL} = -\frac{R_1}{R_F}$

(D) $A_{CL} = 1 + -\frac{R_F}{R_1}$

59. A special case of non-inverting amplifier in which all of the voltage output is fed-back to the inverting input of the op-amp. is called :

(A) Differentiator

(B) Integrator

(C) Logarithmic amplifier

(D) Voltage follower

60. Photodiode works in :

(A) Forward biasing

(B) Reverse biasing

(C) Zero biasing

(D) None of the above

61. Multimode step index has :

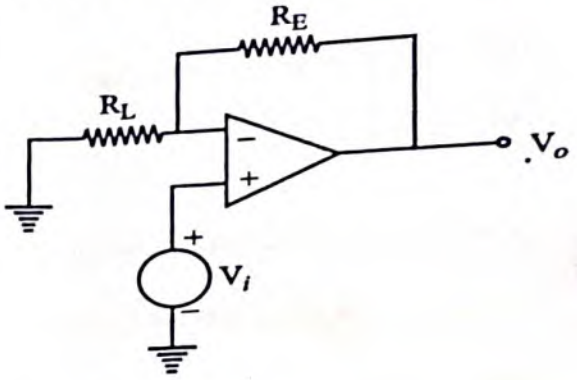
(A) Large core diameter and large numerical aperture

(B) Large core diameter and small numerical aperture

(C) Small core diameter and large numerical aperture

(D) Small core diameter and small numerical aperture

62. In the non-inverting amplifier of fig.



if $R_F = 0$ and $R_1 = \infty$ then :

(A) $V_o = -V_i$

(B) $V_o = \infty$

(C) $V_o = V_i$

(D) $V_o = \infty$

63. Schmidt trigger exhibits the following effects :

(A) Hysteresis

(B) Hall

(C) Accelerator

(D) Illumination

64. Which one of these diode is used for detection of light signal ?

(A) Photodiode

(B) LED

(C) Zener diode

(D) Tunnel diode

65. The performance characteristics of multi-mode graded index fibers are :

(A) Better than multimode step index fibers

(B) Same as multimode step index fibers

(C) Lesser than multimode step index fibers

(D) Negligible

66. A circuit that amplifies the difference between two signals is called :

(A) Push-Pull amplifier

(B) SCR

(C) Differential amplifier

(D) Comparator

67. The op-amp. used in Schmidt trigger is basically :

(A) Capacitor with negative feedback

(B) Capacitor with positive feedback

(C) A triangular wave generator

(D) None of the above

68. Diffusion current flow across the junction diode due to :

(A) Concentration difference of electrons and holes on both sides of the junction

(B) Potential difference across the junction

(C) Pressure difference across the junction

(D) None of the above

69. In single mode fibers, which is the most beneficial index profile ?

(A) Step index

(B) Graded index

(C) Step and graded index

(D) Coaxial cable

70. Common-Mode Rejection Ratio (CMRR) is given by :

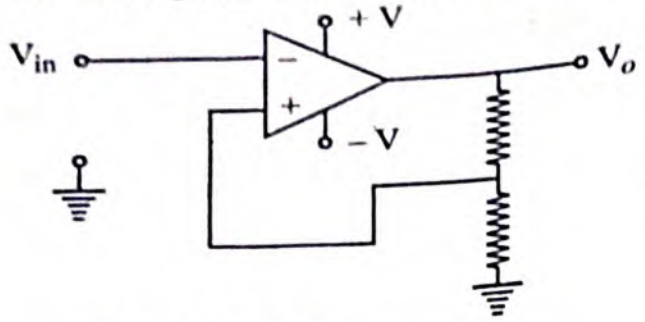
(A) $|A_d - A_c|$

(B) $\left|\frac{A_c}{A_d}\right|$

(C) $\left|\frac{A_d}{A_c}\right|$

(D) None of the above

71. The fig. shows the following circuit :



(A) Wien Bridge

(B) SCR

(C) Schmidt trigger

(D) S-R flip-flop

72. An LED produces the following energy in the form of light when recombination of excess charge carrier occurs :

(A) Electrical energy

(B) Mechanical energy

(C) Electromagnetic energy

(D) None of the above

73. The fibers mostly used nowadays for optical fiber communication system are :

(A) Single mode fibers

(B) Multimode fibers

(C) Coaxial cable

(D) Multimode graded index fibers

74. If a capacitor is placed in the feedback path of an op-amp. circuit, then the circuit can act as :

(A) Integrator

(B) Multiplier

(C) Divider

(D) Differentiator

75. An oscillator circuit which is meant for converting sine wave signal into square wave signal is called :

(A) Schmidt trigger

(B) Blocking oscillator

(C) Multivibrator

(D) Wien bridge oscillator

76. In LED the wavelength of emitted radiation is given by :

(A) $\lambda = \frac{hv}{E_g}$

(B) $\lambda = \frac{E_g}{hv}$

(C) $\lambda = Eg \,.\, hv$

(D) $\lambda = \frac{hc}{E_g}$

77. Single mode fibers allow single mode propagation, the cladding diameter must be at least :

(A) twice the core diameter

(B) thrice the core diameter

(C) five times the core diameter

(D) ten times the core diameter

78. CMRR for an op-amp. should be :

(A) as large as possible

(B) close to zero

(C) close to unity

(D) as small as possible

79. The initial slope of a sine wave is directly proportional to :

(A) Slew rate

(B) Frequency

(C) Voltage gain

(D) Capacitance

80. In photodiode, the reverse saturation current in absence of incident light is known as :

(A) Base current

(B) Emitter current

(C) Collector current

(D) Dark current

81. Standard Single Mode Fibers (SSMF) are utilized mainly for operation in :

(A) C-band

(B) L-band

(C) O-band

(D) C-band and L-band

82. Which of the following is an operational amplifier ?

(A) IC 8085

(B) IC 7805

(C) IC 555

(D) IC 741

83. An op-amp. can be used to generate the wave form having shape :

(A) Source

(B) Pulse

(C) Triangular

(D) All of the above

84. The absorption coefficient of semi-conductor materials is strongly dependent on :

(A) Properties of material

(B) Wavelength

(C) Amount of light

(D) Amplitude

85. When optical fibers are to be installed in a working environment, the most important parameter to be considered is :

(A) Transmission property of the fiber

(B) Mechanical property of the fiber

(C) Core cladding ratio of the fiber

(D) Numerical aperture of the fiber

86. Which of the following is not a characteristic of an ideal op-amp. ?

(A) BW is ∞

(B) Perfect balance $V_0 = 0$ when $V_1 = V_2$

(C) Gain is ∞

(D) Input resistance is zero

87. A summing amplifier can have :

(A) No more than two input signals

(B) Two or more input signals

(C) A closed-loop input impedance of infinity

(D) A small open loop voltage gain

88. The absorption of photons in photodiodes is dependent on :

(A) Absorption coefficient a_0

(B) Properties of material

(C) Charge carrier at junction

(D) Amount of light

89. Optical fibers for communication use are mostly fabricated from :

(A) Plastic

(B) Silica or multi-component glass

(C) Ceramic

(D) Copper

90. An instrumentation amplifier has a high :

(A) Output impedance

(B) Power gain

(C) CMRR

(D) Supply voltage

91. A D/A converter is an application of the :

(A) Adjustable bandwidth circuit

(B) Non-inverting amplifier

(C) Voltage to current converter

(D) Summing amplifier

92. The semiconductor material for which the lowest energy absorption take place is :

(A) G*a*As

(B) Silicon

(C) GaSb

(D) Germanium

93. A technique used for determining the total fiber attention per unit length is :

(A) Frank

(B) Cut-off

(C) Cut-back

(D) Erlangen

94. Op-Amp. is the following type of amplifier :

(A) Current

(B) Voltage

(C) Power

(D) Resistance

95. A D/A converter with four inputs has :

(A) Two outputs

(B) Four outputs

(C) Eight outputs

(D) Sixteen output

96. The threshold for indirect absorption occurs at wavelength :

(A) 3.01 μm

(B) 2.09 μm

(C) 0.92 μm

(D) 1.09 μm

97. How many parameters are usually worked upon by the measurement techniques in attenuation ?

(A) Three

(B) Two

(C) One

(D) Five

98. Op-Amp. is originated from the following computers :

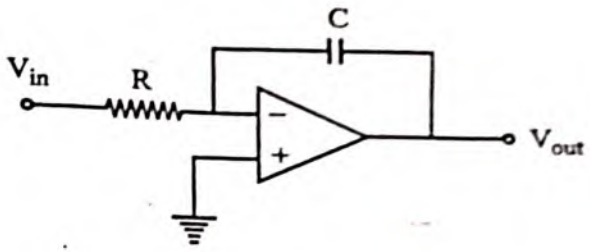
(A) Analog

(B) Digital

(C) Both (A) and (B)

(D) None of the above

99. What is the output waveform ?



(A) Sine wave

(B) Square wave

(C) Sawtooth wave

(D) Triangle wave

100. A photodiode should be chosen with the following less than photon energy :

(A) Direct absorption

(B) Bandgap energy

(C) Wavelength range

(D) Absorption coefficient