

Sr. No .....

**[SET-V]**  
**Ph.D. Programme (Odd Semester)**  
**PHYSICS**

Marks: 100

Time: 2 hours

Roll No.: _____	Date: _____
Time: _____	Centre Name: _____

<b>INSTRUCTIONS FOR THE CANDIDATES</b>	
1.	<b>Please do not open (Break the seal) of the question booklet before time</b>
2.	An <b>OMR answer sheet</b> is being provided separately along with this question booklet. Please fill up all relevant entries like Roll number, Centre code, Paper Number etc. in the spaces provided on the OMR answer sheet and put your signature in the box provided for this purpose.
3.	<b>There are 100 questions in this booklet.</b> Against each question four alternative choices A., B., C. and D. are given, out of which only one is correct. Indicate your choice of answer by Darkening the suitable circle with <b>Black/Blue Ball Pen</b> in the OMR answer sheet supplied to you separately.
4.	Each question carries one mark. <b>There will be 1/4<sup>th</sup> negative marking.</b>
5.	Read and follow the instructions given on the backside of the OMR answer sheet carefully.
6.	Do not write your name/Roll number or give any identification mark at any place on the OMR sheet.
7.	Keep all your belongings outside the examination hall. Do not retain any paper except the <b>ADMIT CARD.</b>
8.	Do not talk to each other. Do not borrow anything from other candidates.
9.	Use of <b>CALCULATOR (except programmable calculator)</b> is allowed.
10.	Any body found involved in malpractices, will be disqualified from appearing in the entrance test.
11.	At the start of the examination, please ensure that all pages of your booklet are properly printed; your question booklet is not damaged in any manner and contains 100 questions. In case of any discrepancy, report to the invigilator immediately. No claim in this regard will be entertained at the later stage.

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For Rough Work

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**NOTE:**

- (i) Attempt all questions. Each question carries one mark. There will be  $1/4^{\text{th}}$  negative marking.  
 (ii) **There are 100 questions in this booklet.** Against each question four alternative choices (A), (B), (C) and (D) are given, out of which only one is correct. Indicate your choice of answer by Darkening the suitable circle with **Black/Blue Ball Pen** in the OMR answer sheet supplied to you separately.

1. If  $\vec{a}$  is a constant vector, then  $\vec{r} \times \vec{a}$  is  
 A. solenoidal  
 B. Irrotational  
 C. Both solenoidal and irrotational  
 D. Neither solenoidal or irrotational
2. Inverse of a matrix exists if  
 A. Matrix is singular  
 B. Matrix is non-singular  
 C. Matrix is Hermitian  
 D. Matrix is skew Hermitian
3. Using the Fourier Series the value of  $\sum_{n=1}^{\infty} \frac{1}{(2n-1)^2}$  is  
 A.  $1/2$   
 B.  $\pi^2/8$   
 C.  $\pi^2/6$   
 D.  $\pi^2/2$
4.  $L\{1/\sqrt{\pi t}\}$  will be  
 A.  $1/\sqrt{s}$   
 B.  $1/s$   
 C.  $2/\sqrt{s}$   
 D.  $\sqrt{s}$
5. If the standard deviation of the Poisson's distribution is  $\sqrt{2}$ , the probability for  $r=2$  is  
 A.  $1/e$   
 B.  $1/e^2$   
 C.  $2/e^2$   
 D.  $8/e^5$
6. The solution of the Laplace equation in cylindrical coordinates when it has no dependence on the Z-coordinate involves  
 A. Bessel's function  
 B. Legendre's Polynomial  
 C. Associated Legendre's function  
 D. Trigonometric function
7. The trapezoidal rule integrates exactly polynomials of order  
 A. 1  
 B. 2  
 C. 3  
 D. 4
8. The number of generators of SU (x) is  
 A.  $2^n$   
 B.  $2^{n+1}$   
 C.  $n^2 + 1$   
 D.  $n^2 - 1$
9. Which one of the following is the best example of an elastic collision? The collision between  
 A. a ball and the floor  
 B. a bullet and the target  
 C. a truck and a car  
 D. molecules
10. Which one of the following is a non-conservative force?  
 A. Electrostatic force  
 B. Gravitational force  
 C. Viscous force  
 D. Interatomic force
11. A particle is moving in an inverse square field. If the total energy of the particle is positive, then the particle is  
 A. circular  
 B. elliptical  
 C. parabolic  
 D. hyperbolic

12. There are six particles lying in a plane. The degrees of freedom associated with them are
- 6
  - 18
  - 12
  - None
13. If a coordinate is cyclic, Hamiltonian would reduce the number of variables in new formulation by
- One
  - Two
  - Three
  - Four
14. In pair Production
- Mass is converted into energy
  - Energy is converted into mass
  - Two photon are produced
  - Two electrons are annihilated.
15. Relativistic mechanics rules out the concept of
- Rigidity
  - Conservation of linear momentum
  - Conservation of charge
  - Conservation of energy
16. If the relativistic mass of a particle is twice its rest mass, then what is the ratio of its speed to that of light?
- $\sqrt{3}/2$
  - $1/\sqrt{2}$
  - $1/2$
  - $1/4$
17. The electric field intensity on the surface of a charged conductor is
- Zero
  - Directed normal to the surface
  - Directed tangentially to the surface
  - Directed along  $45^\circ$  to the surface
18. The ratio of the intensity of magnetic field at the centre of a very long solenoid to that at the extreme ends is
- 2
  - $1/2$
  - 4
  - $1/4$
19. The Poisson's equation in CGS Gaussian system is
- $\nabla^2 V = -\rho/\epsilon_0$
  - $\nabla^2 V = -4\pi\rho$
  - $\nabla^2 V = -4\pi r$
  - $\nabla^2 V = 0$
20. The Poynting theorem is a mathematical statement for the conservation of
- Momentum
  - Electric Charge
  - Electromagnetic energy
  - Magnetic Charge
21. The orientational polarizability of a molecule is inversely proportional to the temperature but
- Increases with the increasing frequency of the applied field
  - Decreases with the increasing frequency of the applied field
  - Remains unaffected with the increasing frequency of the applied field
  - None of the above
22. Power radiated by an electric dipole is proportional to the frequency by
- $\omega$
  - $\omega^2$
  - $\omega^3$
  - $\omega^4$
23. Consider the reflection and refraction of a plane wave at a dielectric interface. Which of the following is true?
- The frequency of the wave does not change
  - The energy of the wave does not change
  - The polarization does not change
  - The momentum of the wave does not change
24. The cut off wavelength  $\lambda_c$  for  $TE_{20}$  mode for a standard rectangular waveguide is
- $2/a$
  - $2a$
  - $a$
  - $2a^2$

25. The time independent Schrodinger's equation of a system represents the conservation of the
- Total binding energy of the system
  - Total potential energy of the system
  - Total kinetic energy of the system
  - Total energy of the system
26. What is the degeneracy of H-atom in state  $n=3$
- 5
  - 7
  - 9
  - 18
27. For a 1-D harmonic oscillator in the  $n$ th excited state, the value of  $\Delta x \Delta p$  is
- $\hbar/2$
  - $n \hbar/2$
  - $n\hbar$
  - $(n + \frac{1}{2}) \hbar$
28.  $\hat{A}$  and  $\hat{G}$  represent two physical characteristics of a quantum system. If  $\hat{A}$  is a Hermitian, then for the product  $\hat{A}\hat{G}$  to be Hermitian, it is sufficient that
- $\hat{G}$  is Hermitian
  - $\hat{G}$  is anti-Hermitian
  - $\hat{G}$  is Hermitian and  $\hat{A}$  and  $\hat{G}$  commute
  - $\hat{G}$  is Hermitian and  $\hat{A}$  and  $\hat{G}$  anti-commute
29. Pauli exclusion principle is only applicable for
- Bosons
  - Fermions
  - Both
  - None of these
30. The total scattering is
- 0
  - $2\pi$
  - $4\pi$
  - oscillates between 0 and  $4\pi$
31. The particles having spin 0 are described by
- The Klein-Gorden equation
  - The Dirac equation
  - The Pauli equation
  - The Proca equation
32. According to Dirac theory, a position is
- an occupied state of negative energy
  - an unoccupied state of negative energy
  - an occupied state of positive energy
  - an unoccupied state of positive energy
33. The temperature at the surface of the sun is approximately  $6000^\circ\text{K}$ . If we take a big lens and focus at the sun rays and produce a temperature of  $8000^\circ\text{K}$ . This will violate
- Zeroth Law of thermodynamics
  - First Law of thermodynamics
  - Second Law of thermodynamics
  - Third Law of thermodynamics
34. T-S diagram for a Carnot cycle is
- Rectangular
  - Circle
  - Ellipse
  - None of these
35. Entropy remains constant in
- Isothermal process
  - Adiabatic process
  - Cyclic process
  - Isobaric process
36. Which of the following statement is correct
- Chemical potential can not be defined for photon
  - Chemical potential for photon is zero
  - Chemical potential for photon is positive
  - Chemical potential for photon is negative.
37. The quantum statistics reduces to classical statistics under the following condition,
- $\rho\lambda^3 \sim 1$
  - $\rho\lambda^3 \gg 1$
  - $\rho\lambda^3 \ll 1$
  - $\rho = 0$
38. The entropy of a photon gas is proportional to
- T
  - $T^2$
  - $T^3$
  - $T^4$

39. The Planck's formula for black body radiation reduces to Rayleigh and Wien's formula respectively for
- small and large wavelength
  - large and small wavelength
  - large and complex wavelength
  - complex and large wavelength
40. Curie temperature of iron is that temperature below which it is
- Ferromagnetic
  - electrically conducting
  - superconducting
  - diamagnetic
41. If the ratio of the concentration of electrons to that of hole in a semiconductor is  $7/5$  and the ratio of the current is  $7/4$ , then what is the ratio of their drift velocities?
- $4/7$
  - $5/7$
  - $4/5$
  - $5/4$
42. Which of the following factors do not effect the frequency stability of an oscillator
- output load
  - inter element capacitances and stray capacitances
  - temperature variation
  - coil size
43. The high input impedance of Field Effect Transistor (FET) amplifier is due to
- The pinch off voltage
  - Its very low gate current
  - The source and drain are being apart
  - The geometry of the FET
44. Infrared LED is usually fabricated from
- Ge
  - Si
  - Ga As
  - Ga As P
45. The binary number 110000111101 corresponds to a hexadecimal number
- CFD
  - D3C
  - DBF
  - C3D
46. Phase shift through an operational amplifier is caused by
- The internal RC circuit
  - The external RC circuit
  - The gain roll off
  - Negative feedback
47. The greatest negative number which can be stored in a computer that has 8-bit word length and uses 2's complement arithmetic is
- 256
  - 255
  - 128
  - 127
48. The data bus width of 204 x 8 bits is
- 8
  - 10
  - 12
  - 16
49. A random noise generator produces a signal
- whose amplitude varies randomly
  - which has no periodic frequency
  - Has an unpredictable power spectrum
  - All of the above
50. A transducer converts
- Mechanical energy into electrical energy
  - Mechanical displacement into electrical signal
  - One form of energy into another form of energy
  - electrical energy into mechanical form
51. The pulse rise time is defined as the time taken by the pulse
- to go from 10% to 90% of its amplitude
  - to go from 0% to 100% of its amplitude
  - to go from 0% to 90% of its amplitude
  - to go from 10% to 100% of its amplitude
52. In wire bound strain gauges, the change in resistance on application of strain is mainly due to
- Change in length of wire
  - Change in diameter of wire
  - Change in both length and diameter of wire
  - Change in resistivity

53. The correct matching pair of the measuring device with its typical application is
- Dielectric gauge ..... liquid level
  - Piezoelectric pickup .... Particle counting
  - Magnetostriction gauge ..... sound
  - Photovoltaic .... Pressure
54. The inverse Fourier transform of the function  $F(\omega) = (1/j\omega) \pi \delta(\omega)$  is
- $\sin \omega t$
  - $\cos \omega t$
  - $\sin (t)$
  - $u(t)$
55. In FM sound broadcasting system, the maximum frequency deviation is usually
- 15 kHz
  - 75 kHz
  - 200 kHz
  - 5.2 MHz
56. If a signal  $f(t)$  has energy  $E$ , the energy of the signal  $f(2t)$  is equal to
- $E$
  - $E/2$
  - $2E$
  - $4E$
57. The value of one Bohr magneton is approximately
- $10^{23} \text{ Am}^2$
  - $10^{-23} \text{ Am}^2$
  - $10^{10} \text{ Am}^2$
  - $10^{-10} \text{ Am}^2$
58. Which transition is not possible?
- ${}^2f_{5/2} \rightarrow {}^2d_{5/2}$
  - ${}^2d_{3/2} \rightarrow {}^2p_{1/2}$
  - ${}^2d_{3/2} \rightarrow {}^2s_{1/2}$
  - ${}^2p_{1/2} \rightarrow {}^2s_{1/2}$
59. The number of hyperfine components observed in the electronic transition  ${}^2p_{1/2} \rightarrow {}^2s_{1/2}$  of an atom with nuclear spin  $\frac{1}{2}$  is
- 3
  - 4
  - 6
  - 5
60. The Lande g-factor for the level  ${}^3d_3$  is
- $2/3$
  - $3/2$
  - $3/4$
  - $4/3$
61. The total number of levels that could be formed by two electrons in the presence of an external magnetic field is
- 6
  - 36
  - 60
  - 10
62. Pure rotational spectrum of a diatomic molecule consists of
- two equally spaced lines
  - three equally spaced lines
  - many equally spaced lines
  - no regular pattern
63. All vibrations producing a change in the electric dipole moment of molecule, yield
- Raman Spectra
  - Infra red spectra
  - Ultraviolet spectra
  - X-Ray spectra
64. There is no infra red absorption in nitrogen molecule because
- its polarizability is zero
  - it has no vibration level
  - it has no rotational level
  - its dipole moment is zero
65. The number of atoms present in the unit cell of hcp structure are
- 2
  - 4
  - 6
  - 7
66. Which is the second nearest neighbor distance in a fcc lattice whose conventional unit cell parameter is  $a$ ?
- $a/\sqrt{2}$
  - $a/2$
  - $a$
  - $\sqrt{2}/a$

67. For an energy state  $E$  of a photon gas, the density of states is proportional to
- $\sqrt{E}$
  - $E$
  - $E^{3/2}$
  - $E^2$
68. A superconducting ring is cooled in the presence of a magnetic field below its critical temperature ( $T_c$ ). Total magnetic flux that passes through the ring is
- zero
  - $nh/2e$
  - $nh/4\pi e$
  - $ne^2/hc$
69. BCS ground state is defined on the basis of
- stability due to photon excitation
  - energy gap
  - kinetic energy
  - long time stabilized superconductivity
70. Figure out the odd one in the following
- Frenkel defect
  - Tilt boundary
  - Twist boundary
  - stacking fault
71. Frenkel defect is
- missing of an atom or ion from normal lattice site
  - Location of atom at different position from normal lattice
  - Both of the above
  - none of the above
72. The binding energy of Mott- Wannier excitation is
- quantized and directly proportional to  $n^2$
  - quantized and directly proportional to  $n$
  - quantized and directly proportional to  $1/n^2$
  - constant
73. If the nuclear radius of  $^{27}\text{Al}$  is 3.6 Fermi, the approximate nuclear radius of  $^{64}\text{Cu}$  in Fermi is
- 4.8
  - 3.6
  - 1.2
  - 2.4
74. The volume of a nucleus in an atom is proportional to the
- mass number
  - proton number
  - neutron number
  - electron number
75. A thermal neutron having speed  $v$  impinges on a  $^{235}\text{U}$  nucleus. The reaction cross section is proportional to
- $v^{-1}$
  - $v$
  - $v^{1/2}$
  - $v^{-1/2}$
76. A nucleus is in its excited state. If it is not able to de-excite by gamma emission, it can de-excite through
- electron capture
  - internal conversion
  - alpha decay
  - beta decay
77. Weak nuclear forces act on
- both hadrons and leptons
  - hadrons only
  - all the particles
  - all charged particles
78. The strange baryon  $\Sigma^+$  has the quark structure
- uds
  - uud
  - uus
  - uss
79. The quark structure of  $\Delta^{++}$  is
- uuu
  - udu
  - sss
  - ddd
80. The proper mean life of a muon is  $2.2 \times 10^{-6}$  sec. If it is travelling at a speed of  $0.8c$  ( $c$  is the velocity of light), its life time will be
- $3.66 \mu\text{sec}$
  - $2.75 \mu\text{sec}$
  - $2.20 \mu\text{sec}$
  - $1.22 \mu\text{sec}$



81. There are 10 lamps in a hall. Each one of them can be switched on independently. The number of ways in which hall can be illuminated is
- (A)  $10^2$   
 (B) 1023  
 (C)  $2^{10}$   
 (D) 10!

82. What is X in the following table?

8	54	27
9	71	?
10	90	45

- (A) 39  
 (B) 37  
 (C) 35.5  
 (D) 34.5
83. If 'THIS MAN IS GOOD' is coded as 153. What will be the code for 'THAT MAN IS NOT GOOD'?
- (A) 200  
 (B) 195  
 (C) 190  
 (D) 180
84. A earned Rs 84000. One third of it went to taxes. The rest was invested and appreciated by one half. Two third of that went into business. Additional tax was paid equal to  $\frac{2}{3}$  of the remaining amount. How much money was left with A?
- (A) 8790  
 (B) 8777  
 (C) 9000  
 (D) 9333
85. If Aneesh is paternal first cousin of Rahul, how is their father's mother is related to them?
- (A) Mother  
 (B) Grandmother  
 (C) Paternal aunt  
 (D) Maternal aunt
86. I got my first job on May 22, 1983. Which day of the week it was?
- (A) Monday  
 (B) Tuesday  
 (C) Friday  
 (D) Sunday

87. A petrol dealer adds 20% kerosene oil to petrol. If purchase price of petrol is Rs. 60 per litre and that of kerosene is Rs. 20 per litre, and sale price of the petrol is Rs. 61 per litre, what is his percentage profit?
- (A) 14.25  
 (B) 14.37  
 (C) 14.50  
 (D) 14.70

88. Anant parked his motorcycle at 9<sup>th</sup> place from the left and 28<sup>th</sup> from the right. How many motorcycles are parked in the row?
- (A) 37  
 (B) 36  
 (C) 35  
 (D) 34

89. In an imaginary language digits 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9 are substituted by t, d, j, o, r, m, u, x, b and z. 10 is written as dt and so on. Use the above information and find the value of expression given below:

$$\{(or - dj) \times u\} \div dj$$

- (A) 9  
 (B) 10  
 (C) 11  
 (D) 12
90. Seven friends meet at their college reunion, shake hand with each other once. How many hand shake will be there altogether?
- (A) 21  
 (B) 42  
 (C) 27  
 (D) 49
91. Ms Anandita starts at left and moves 8 Kms. She then turns right and moves 4 Kms. Then she turns right again for 8 Kms. How far is she from the initial position?
- (A) 20 Kms  
 (B) 10 Kms  
 (C) 08 Kms  
 (D) 04 Kms
92. Lunch-dinner pattern of a person for 'm' days is given below. He has a choice of VEG or NON-VEG meal for his lunch/dinner.
- (i) If he takes a NON-VEG lunch, he will have only VEG dinner  
 (ii) He takes NON-VEG dinner for 9 days  
 (iii) He takes VEG lunch for 11 days  
 (iv) He takes a total of 14 NON-VEG meals

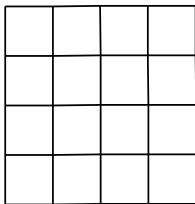
What is 'm'?

- (A) 18
- (B) 20
- (C) 24
- (D) 38

93. 20% students of a particular course get jobs within one year of passing. 20% of the remaining students get jobs by end of the second year of passing. If 16 students are still jobless, how many students had passed the course?

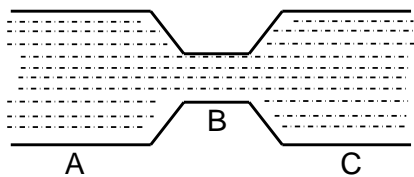
- (A) 25
- (B) 50
- (C) 62
- (D) 84

94. How many rectangles (which are not squares) in the following figure?:



- (A) 56
- (B) 70
- (C) 80
- (D) 96

95. Water is flowing through a tube as shown below:



The cross-sectional area of A and C are equal and greater than the cross-sectional area of B. If the flow of water is steady, then the pressure on the walls at B is

- (A) less than that at A and that at C
- (B) more than that at A and that at C
- (C) same as that at A and that at C
- (D) more than that at A but less than that at C

96. Processor IC chip was developed by?

- (A) AMD
- (B) Intel
- (C) DIX
- (D) Both (A) and (B)

97. If  $5472 = 9$ ,  $6342 = 6$ ,  $7584 = 6$ . What is 9236?

- (A) 2
- (B) 3
- (C) 4
- (D) 5

98. Chipko movement was started by?

- (A) Arundhati Roy
- (B) Medha Patkar
- (C) Ila Bhatt
- (D) Sunder lal Bahuguna

99. What is the following is not a natural hazard?

- (A) Earthquake
- (B) Tsunami
- (C) Flash floods
- (D) Nuclear accident

100. Which of the following team won the 9<sup>th</sup> IPL cricket T-20 tournament?

- (A) Kolkata Knight Riders
- (B) Sun Risers Hyderabad
- (C) Mumbai Indians
- (D) Royal Challengers Bangalore