

Code No.

T – 2127

**Entrance Examination for Admission to the P.G. Courses in the  
Teaching Departments, 2024**

**CSS**

**PHYSICS WITH SPECIALIZATION IN SPACE PHYSICS / APPLIED  
ELECTRONICS / RENEWABLE ENERGY / NANO SCIENCE**

**General Instructions**

1. The Question Paper is having 100 Objective Questions, each carrying one mark.
2. The answers are to be (✓) 'tick marked' **only** in the "**Response Sheet**" provided.
3. **Negative marking : 0.25 marks** will be deducted for each wrong answer .

**Time : 2 Hours**

**Max. Marks : 100**

To be filled in by the Candidate

Register Number	in Figures								
	in words								

Choose appropriate answer from the options in the questions.

**(100 × 1 = 100 marks)**

1. In an optic fiber the propagation angle of light must be equal to or less than the
 

A. Acceptance angle	B. Incident angle
C. Critical angle	D. Refraction angle

**DO NOT WRITE HERE**

- 
2. What is the absorption phenomenon related to the X ray region of electromagnetic spectrum?
- A. Valence electron transitions      B. Innercore electron transitions  
C. Rotational transitions              D. Vibrational transitions
3. Intermodal dispersion results from the fact that the light waves propagate through a fiber in
- A. Different modes                      B. Along different routes  
C. As a group of velocities            D. With same velocities

4. Which of the following statements is NOT correct?
- A. A deuteron can be disintegrated by irradiating it with gamma rays of energy 4 MeV.
  - B. A deuteron has no excited states.
  - C. A deuteron has no electric quadrupole moment.
  - D. The  $^1S_0$  state of deuteron cannot be formed.
5. Which of the following statements is correct about the shear stress distribution in circular pipes with laminar flow?
- A. It is linear with maximum value at the centre
  - B. It is parabolic with zero value at the centre
  - C. It is linear with zero value at the centre
  - D. It is parabolic with maximum value at the centre
6. An XOR gate produces an output only when its two inputs are
- A. High
  - B. Low
  - C. Different
  - D. Same
7. Race around condition can be avoided in digital logic circuits by using which of the following?
- A. Shift register
  - B. Master slave JK flip flop
  - C. RS flip flop
  - D. AND gate
8. How many address lines are needed to address each machine location in a  $2048 \times 4$  memory chip?
- A. 8
  - B. 9
  - C. 10
  - D. 11

9. When a beam of ordinary white light is passed through a Polaroid plate filter, the intensity of the beam that emerges is:
- About one-half that of the incident beam
  - Equal to that of the incident beam
  - About 0.9 that of the incident beam
  - Practically zero
10. X-ray of wavelength  $\lambda = a$  is reflected from the (111) plane of a simple cubic lattice. If the lattice constant is  $a$ , the corresponding Bragg angle (in radian) is
- $\frac{\pi}{8}$
  - $\frac{\pi}{6}$
  - $\frac{\pi}{4}$
  - $\frac{\pi}{3}$
11. In the nuclear shell model the spin parity of  ${}^{15}_7N$  is given by
- $\left(\frac{1}{2}\right)^{-}$
  - $\left(\frac{1}{2}\right)^{+}$
  - $\left(\frac{3}{2}\right)^{-}$
  - $\left(\frac{3}{2}\right)^{+}$
12. Hologram is the result of
- interference of object and reference beam
  - polarization of object and reference beam
  - diffraction of object and reference beam
  - both polarization and diffraction of object and reference beam
13. A radioactive element X has a half-life of 30 hours. It decays via alpha, beta and gamma emissions with the branching ratio for beta decay being 0.75. The partial half-life for beta decay in unit of hours is
- 12
  - 25
  - 32
  - 40

14. Which one of the following conservation laws is violated in the decay  $\tau^+ \longrightarrow \mu^+ \mu^+ \mu^-$
- A. Angular momentum                      B. Total Lepton number  
C. Tau number                                D. Electric charge
15. Which among the following lasers has a quasi 3 level system?
- A. Ruby laser                                 B. He Ne laser  
C. Ar laser                                     D. Yb: YAG laser
16. The isospin and the strangeness of  $\Omega^-$  baryon are
- A. 1,-3                                         B. 0,-3  
C. 1,3    D. 0,3
17. Which of the following acts as quenching gas in Geiger Muller counter?
- A. Alcohol                                     B. Argon gas  
C. Krypton                                     D. Hydrogen
18. An electron is accelerated using a cyclotron. If the magnetic field is 1.5 T and the radius of the "Dees" is 1.2 m, what is the kinetic energy of the outgoing particle?
- A. 543 MeV                                    B. 333 MeV  
C. 512 MeV                                    D. 674 MeV
19. The conventional unit cell of BCC has a volume  $a^3$ . The volume of its primitive unit cell is
- A.  $a^3$     B.  $a^3/2$   
C.  $a^3/4$                                          D.  $a^3/8$
20. The dual of the statement  $(A+1) = 1$  is
- A.  $A.1 = A$                                  B.  $A.0 = 0$   
C.  $A+A = A$                                 D.  $A.A = 1$



27. In order to estimate the specific heat of phonons, the appropriate method to apply would be
- A. Einstein model for acoustic phonons and Debye model for optical phonons
  - B. Einstein model for optical phonons and Debye model for acoustic phonons
  - C. Einstein model for both optical and acoustic phonons
  - D. Debye model for both optical and acoustic phonons
28. A Ge semiconductor is doped with acceptor impurity concentration of  $10^{15}$  atoms/cm<sup>3</sup>. For the given hole mobility of 1800 cm<sup>2</sup> / V-s, the resistivity of the material is
- A. 0.288  $\Omega$  cm
  - B. 0.732  $\Omega$  cm
  - C. 3.472  $\Omega$  cm
  - D. 6.944  $\Omega$  cm
29. The amount of energy available in radio frequency radiation is sufficient for which of the following
- A. Excite an atom
  - B. Vibrate an atom
  - C. Vibrate a molecule
  - D. Affect the nuclear spin of an atom
30. Which statement is incorrect?
- A. The thermodynamic symbol for entropy is S.
  - B. Gibbs free energy is a state function.
  - C. For an endothermic process, H is negative.
  - D. If the work done by the system is greater than the heat absorbed by the system, E is negative.

31. A particle of mass  $m$  is confined in a two dimensional square well potential of dimension  $a$ . This potential  $V(x, y)$  is given by

$$V(x, y) = 0 \text{ for } -a < x < a \text{ and } -a < y < a$$

$$= \infty \text{ elsewhere}$$

The energy of the first excited state for this particle is given by

A.  $\frac{\pi^2 \hbar^2}{ma^2}$

B.  $\frac{2\pi^2 \hbar^2}{ma^2}$

C.  $\frac{4\pi^2 \hbar^2}{ma^2}$

D.  $\frac{5\pi^2 \hbar^2}{8ma^2}$

32. A storage area used to store data to a compensate for the difference in speed at which the different units can handle data is

A. Memory

B. Buffer

C. Accumulator

D. Address

33. The potential of a diatomic molecule as a function of the distance  $r$  between the atoms is given by  $V(r) = -\frac{a}{r^6} + \frac{b}{r^{12}}$ . The value of the potential at equilibrium separation between the atoms is:

A.  $-\frac{4a^2}{b}$

B.  $-\frac{a^2}{2b}$

C.  $-\frac{2a^2}{b}$

D.  $-\frac{a^2}{4b}$

34. If the energy dispersion of a two-dimensional electron system is  $E = u\hbar k$  where  $u$  is the velocity and  $k$  is the momentum, then the density of states  $D(E)$  depends on the energy as

A.  $\frac{1}{\sqrt{E}}$

B.  $\sqrt{E}$

C.  $E$

D. Constant



41. Which of the following is a crystalline solid?
- A. Anisotropic substances                      B. Isotropic substances  
C. Super cooled liquids                         D. Amorphous solids
42. A low pass filter is formed by a resistance R and a capacitance C. At the cut-off angular frequency  $\omega_c = 1/RC$  the voltage gain and the phase of the output voltage relative to the input voltage respectively are
- A. 0.71 and  $-45^\circ$                               B. 0.71 and  $45^\circ$   
C. 0.5 and  $-90^\circ$                                 D. 0.5 and  $90^\circ$
43. If the analog input to an 8-bit successive approximation ADC is increased from 1.0 V to 2.0 V, then the conversion time will
- A. double    B. decrease to half its original value  
C. increase four times                             D. remain unchanged
44. In a first order phase transition, at the transition temperature, specific heat of the system
- A. diverges and its entropy remains the same  
B. diverges and its entropy has finite discontinuity  
C. remains unchanged and its entropy has finite discontinuity  
D. has finite discontinuity and its entropy diverges
45. Which one of the following CANNOT be explained by considering a harmonic approximation for the lattice vibrations in solids?
- A. Deby's  $T^3$  law  
B. Dulong Petit's law  
C. Optical branches in lattices  
D. Thermal expansion



52. Two gases separated by an impermeable but movable partition are allowed to freely exchange energy. At equilibrium, the two sides will have the same
- A. pressure and temperature                      B. volume and temperature  
 C. pressure and volume                            D. volume and energy
53. The velocity of a particle executing SHM if its displacement equation is  $x(t) = 10 \sin(2\pi t + \varphi)$  is
- A.  $v = 20 \sin(2\pi t + \varphi)$                       B.  $v = 20 \cos(2\pi t + \varphi)$   
 C.  $v = 10 \sin(2\pi t + \varphi)$                       D.  $v = 10 \cos(2\pi t - \varphi)$
54. If uncertainty in position measurement of electron is  $0.1 \text{ \AA}$  then uncertainty in momentum measurement is
- A.  $1.158 \times 10^9 \text{ m/s}$                               B.  $1.158 \times 10^8 \text{ m/s}$   
 C.  $1.158 \times 10^7 \text{ m/s}$                               D.  $1.158 \times 10^6 \text{ m/s}$
55. In Bose-Einstein condensation, the particles
- A. have strong interparticle attraction  
 B. condense in real space  
 C. have overlapping wavefunctions  
 D. have large and positive chemical potential
56. A transistor in common base configuration has ratio of collector current to emitter current  $\beta$  and ratio of collector to base current  $\alpha$ . Which of the following is true?
- A.  $\beta = \frac{\alpha}{1 + \alpha}$                                       B.  $\beta = \frac{\alpha + 1}{\alpha}$   
 C.  $\beta = \frac{\alpha}{1 - \alpha}$                                       D.  $\beta = \frac{2\alpha}{1 + \alpha}$







75. A circularly polarized monochromatic plane wave is incident on a dielectric interface at Brewster angle. Which one of the following statements is correct?
- The reflected light is plane polarized in the plane of incidence and the transmitted light is circularly polarized.
  - The reflected light is plane polarized perpendicular to the plane of incidence and the transmitted light is plane polarized in the plane of incidence.
  - The reflected light is plane polarized perpendicular to the plane of incidence and the transmitted light is elliptically polarized.
  - There will be no reflected light and the transmitted light is circularly polarized.
76. Which of the following occurs without a change in the internal energy?
- Isochoric process
  - Isoenthalpic process
  - Steady-state process
  - None of the above
77. A planet of mass  $m$  moves in a circular orbit of radius  $r_0$  in the gravitational potential  $V = -k/r$  where  $k$  is a positive constant. The orbit angular momentum of the planet is
- $2r_0 km$
  - $\sqrt{2r_0 km}$
  - $r_0 km$
  - $\sqrt{r_0 km}$
78. Which one of the following thermodynamic quantities is not a state function?
- Gibbs free energy
  - work
  - entropy
  - internal energy
79. Non-inverting amplifier circuits have
- A very high input impedance
  - A very low input impedance
  - A low output impedance
  - None of the above

80. Which one of the following commutation relations relating angular momentum is NOT CORRECT?
- A.  $[L_Z, L_+] = \hbar L_+$                       B.  $[L_X, L_Y] = i\hbar L_Z$   
 C.  $[L_Z, L_-] = \hbar L_-$                       D.  $[L^2, L_Z] = 0$
81. The entropy will usually increase when
- I. a molecule is broken into two or more smaller molecules.  
 II. a reaction occurs that results in an increase in the number of moles of gas.  
 III. a solid changes to a liquid.  
 IV. a liquid changes to a gas.
- A. I only    B. II and III  
 C. I, III and IV                                    D. I, II, III and IV
82. The order of magnitude of the energy gap of a typical superconductor is
- A. 1 MeV    B. 1 KeV  
 C. 1 eV    D. 1 meV
83. The standard heat of combustion of ethanol,  $C_2H_5OH$ , is 1372 kJ/mol ethanol. How much heat (in kJ) would be liberated by completely burning a 20.0 g sample?
- A. 686 kJ    B. 519 kJ  
 C. 715 kJ    D. 597 kJ
84. Multi user systems provided cost savings for small business because they use a single processing unit to link several
- A. Personal computers  
 B. Workstations  
 C. Dumb terminals  
 D. Mainframes

85. The temperature at which a system goes through a reversible isothermal process without transferring heat is
- A. triple point of water                      B. boiling point of water  
C. absolute zero                                  D. none of the above
86. Which of the following processes is reversible?
- A. Isothermal compression                      B. Transfer of heat by radiation  
C. Transfer of heat by conduction              D. Electrical heating of a nichrome wire
87. Which of the following method is used exclusively in fluid mechanics?
- A. Eulerian method                                  B. Lagrangian method  
C. Hamiltonian method                              D. None
88. A liquid compressed in a cylinder has a volume of  $0.04 \text{ m}^3$  at  $50 \text{ N/cm}^2$  and a volume of  $0.039 \text{ m}^3$  at  $150 \text{ N/cm}^2$ . The bulk modulus of elasticity of liquid is
- A.  $400 \text{ N/cm}^2$                                       B.  $4000 \text{ N/cm}^2$   
C.  $40000 \text{ N/m}^2$                                       D.  $40 \text{ N/cm}^2$
89. In a photoelectric effect experiment, a monochromatic light source emitting photon with energy greater than the work function of the metal under test is used. If the power of the light source is doubled, which one of the following statements is correct?
- A. The number of emitted photoelectrons remains the same  
B. The stopping potential remains the same  
C. The number of emitted photoelectrons decreases  
D. The stopping potential doubles
90. Let  $(p, q)$  and  $(P, Q)$  be two pairs of canonical variables. The transformation  $Q = q^a \cos bp$  and  $P = q^a \sin bp$
- A.  $a = 2, b = \frac{1}{2}$                                       B.  $a = \frac{1}{2}, b = 2$   
C.  $a = \frac{1}{2}, b = \frac{1}{2}$                                       D.  $a = 2, b = 1$

91. An optic fiber excels at rejecting
- A. Cross talk
  - B. Electromagnetic interference
  - C. Radio-frequency interference
  - D. All of the above
92. For a particle moving in a central potential, which one of the following statements is correct?
- A. The motion is restricted to a plane due to the conservation of angular momentum
  - B. The motion is restricted to a plane due to the conservation of energy only
  - C. The motion is restricted to a plane due to the conservation of linear momentum
  - D. The motion is not restricted to a plane
93. Two relativistic particles with opposite velocities collide head-on and come to rest by sticking with each other. Which of the following quantities is/are conserved in the collision?
- A. Total momentum
  - B. Total potential energy
  - C. Total kinetic energy
  - D. Total rest mass
94. Two matrices A and B are said to be similar if  $B = P^{-1}AP$  for some invertible matrix P. Which of the following statements is NOT TRUE?
- A.  $\text{Det } A = \text{Det } B$
  - B. Trace of A = Trace of B
  - C. A and B have the same eigenvectors
  - D. A and B have the same eigenvalues
95. To detect trace amounts of gaseous species in a mixture of gases, the preferred probing tool is
- A. Ionization spectroscopy with X-rays
  - B. NMR spectroscopy
  - C. ESR spectroscopy
  - D. Laser spectroscopy



## ANSWER SHEET

1	A	B	C	D	E	26	A	B	C	D	E	51	A	B	C	D	E	76	A	B	C	D	E
2	A	B	C	D	E	27	A	B	C	D	E	52	A	B	C	D	E	77	A	B	C	D	E
3	A	B	C	D	E	28	A	B	C	D	E	53	A	B	C	D	E	78	A	B	C	D	E
4	A	B	C	D	E	29	A	B	C	D	E	54	A	B	C	D	E	79	A	B	C	D	E
5	A	B	C	D	E	30	A	B	C	D	E	55	A	B	C	D	E	80	A	B	C	D	E
6	A	B	C	D	E	31	A	B	C	D	E	56	A	B	C	D	E	81	A	B	C	D	E
7	A	B	C	D	E	32	A	B	C	D	E	57	A	B	C	D	E	82	A	B	C	D	E
8	A	B	C	D	E	33	A	B	C	D	E	58	A	B	C	D	E	83	A	B	C	D	E
9	A	B	C	D	E	34	A	B	C	D	E	59	A	B	C	D	E	84	A	B	C	D	E
10	A	B	C	D	E	35	A	B	C	D	E	60	A	B	C	D	E	85	A	B	C	D	E
11	A	B	C	D	E	36	A	B	C	D	E	61	A	B	C	D	E	86	A	B	C	D	E
12	A	B	C	D	E	37	A	B	C	D	E	62	A	B	C	D	E	87	A	B	C	D	E
13	A	B	C	D	E	38	A	B	C	D	E	63	A	B	C	D	E	88	A	B	C	D	E
14	A	B	C	D	E	39	A	B	C	D	E	64	A	B	C	D	E	89	A	B	C	D	E
15	A	B	C	D	E	40	A	B	C	D	E	65	A	B	C	D	E	90	A	B	C	D	E
16	A	B	C	D	E	41	A	B	C	D	E	66	A	B	C	D	E	91	A	B	C	D	E
17	A	B	C	D	E	42	A	B	C	D	E	67	A	B	C	D	E	92	A	B	C	D	E
18	A	B	C	D	E	43	A	B	C	D	E	68	A	B	C	D	E	93	A	B	C	D	E
19	A	B	C	D	E	44	A	B	C	D	E	69	A	B	C	D	E	94	A	B	C	D	E
20	A	B	C	D	E	45	A	B	C	D	E	70	A	B	C	D	E	95	A	B	C	D	E
21	A	B	C	D	E	46	A	B	C	D	E	71	A	B	C	D	E	96	A	B	C	D	E
22	A	B	C	D	E	47	A	B	C	D	E	72	A	B	C	D	E	97	A	B	C	D	E
23	A	B	C	D	E	48	A	B	C	D	E	73	A	B	C	D	E	98	A	B	C	D	E
24	A	B	C	D	E	49	A	B	C	D	E	74	A	B	C	D	E	99	A	B	C	D	E
25	A	B	C	D	E	50	A	B	C	D	E	75	A	B	C	D	E	100	A	B	C	D	E

## **ROUGH WORK**

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