NATIONAL INSTITUTE OF TECHNICAL TEACHERS TRAINING AND RESEARCH

(DEEMED TO BE UNIVERSITY UNDER DISTINCT CATEGORY)

CHANDIGARH

Ph.D. Entrance Examination - December 2025 Session

Subject / Branch / Department :	**Applied Science (Physics)**
Roll No. :	
Candidate Name :	
Date of Examination :	

Maximum Marks: 25 (There is no negative marking)

Notes: (a) Only one option to be tick-marked out of the four options given as answer

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Q1.	The Cayley-Hamilton theorem states that:
(a)	Every matrix satisfies its own characteristic equation
(b)	The determinant of a matrix equals the product of its eigenvalues
(c)	The trace of a matrix equals the sum of its eigenvalues
(d)	Every matrix is diagonalizable
Q2.	The residue of $f(z) = 1/(z^2(z-1))$ at $z = 0$ is:
(a)	-1
(b)	0
(c)	1
(d)	2
Q3.	In a thermonuclear reaction 1.00×10^{-3} kg of hydrogen is converted into 0.993×10^{-3} kg of helium. How much energy in joules will be released?
(a)	59.0×10^{10} Joules
(b)	19.93×10^{10} Joules
(c)	99.3×10^{10} Joules
(d)	63.0×10^{10} Joules
Q4.	The Lagrangian for a free particle of mass (m), speed (v) and potential energy (V) is:
(a)	$\frac{1}{2}mv^2 - V$
(b)	$\frac{1}{2}mv^2$
(c)	$\frac{1}{2}mv^2 + V$

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(d)	V
Q5.	In Hamiltonian mechanics, Hamilton's equations are:
(a)	$dq/dt = \partial H/\partial p$, $dp/dt = -\partial H/\partial q$
(b)	$dq/dt = -\partial H/\partial p$, $dp/dt = \partial H/\partial q$
(c)	$dq/dt = \partial H/\partial q$, $dp/dt = \partial H/\partial p$
(d)	$dq/dt = \partial H/\partial q$, $dp/dt = -\partial H/\partial p$
Q6.	The Lorentz factor γ is given by:
(a)	$1/\sqrt{(1-v^2/c^2)}$
(b)	$\sqrt{(1-v^2/c^2)}$
(c)	$(1-v^2/c^2)$
(d)	v^2/c^2
Q7.	Gauss's law in differential form is:
(a)	$\nabla \cdot E = \rho/\varepsilon_0$
(b)	$\nabla \times E = 0$
(c)	$\nabla \cdot B = 0$
(d)	$\nabla \times B = \mu_0 J$
Q8.	The speed of electromagnetic waves in vacuum is:
(a)	$\sqrt{(\mu_0\varepsilon_0)}$
(b)	$1/\sqrt{(\mu_0\varepsilon_0)}$
(c)	$\mu_0\varepsilon_0$
(d)	$1/(\mu_0\varepsilon_0)$
Q9.	Assume the rest mass of the body to be 1 gram. What will be the mass of the body when it is moving with a speed 0.8 times the speed of light?
(a)	1.0 gm
(b)	1.66 gm
(c)	1.8 gm
(d)	2.4 gm
Q10.	For a particle in a 1D box of length L, the ground state energy is:
(a)	$\pi^2\hbar^2/(2mL^2)$
(b)	$\pi^2\hbar^2/(8mL^2)$
(c)	$\hbar^2/(2mL^2)$
(d)	Zero
Q11.	The orbital angular momentum quantum number (l) can take values:
(a)	0, 1, 2, ..., n -1
(b)	1, 2, 3, ..., n

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(c)	-l, -l+1, ..., l-1, l
(d)	±1/2

Q12. A He-Ne laser emits light of wavelength 6328 A°. It is having a bandwidth of about 2×10^{-5} A°. Calculate the coherence length of the laser.

(a)	100 m
(b)	126 m
(c)	32.8 m
(d)	60 m

Q13. For a system of N identical particles, the microcanonical ensemble represents:

(a)	Constant T, V, N
(b)	Constant E, V, N
(c)	Constant T, P, N
(d)	Constant μ, V, T

Q14. A p-n junction diode conducts when:

(a)	Forward biased
(b)	Reverse biased
(c)	Zero biased
(d)	Saturated biased

Q15. In phase space, Liouville's theorem states that:

(a)	Density is constant
(b)	Energy is conserved
(c)	Momentum is conserved
(d)	Volume is conserved

Q16. In a plasma, the dispersion relation for electromagnetic waves is:

(a)	$\omega^2 = c^2k^2 + \omega_p^2$
(b)	$\omega^2 = c^2k^2 - \omega_p^2$
(c)	$\omega^2 = \omega_p^2$
(d)	$\omega = c\,k$

Q17. The characteristic impedance of free space is:

(a)	377 Ω
(b)	50 Ω
(c)	75 Ω

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(d)	120 Ω
Q18. The diffusion equation is:	
(a)	$\partial n/\partial t = D\nabla^2 n$
(b)	$\partial n/\partial t = -D\nabla^2 n$
(c)	$\partial^2 n/\partial t^2 = D\nabla^2 n$
(d)	$\partial n/\partial t = D\nabla n$
Q19. Paramagnetic susceptibility follows:	
(a)	Curie law: $\chi \propto 1/T$
(b)	Curie-Weiss law: $\chi \propto 1/(T-T_c)$
(c)	Pauli susceptibility: χ = constant
(d)	Curie law: $\chi \propto T$
Q20. In LS coupling, the total angular momentum is:	
(a)	$J = L + S$
(b)	$J = \|L - S\|, \|L - S\| + 1, ..., L + S - 1, L + S$
(c)	$J = L - S$
(d)	$J = \sqrt{(L^2 + S^2)}$
Q21. The Zeeman effect is:	
(a)	Splitting of spectral lines in a magnetic field
(b)	Splitting of spectral lines in an electric field
(c)	Broadening of spectral lines in a resonant field
(d)	Not related to the splitting of spectral lines.
Q22. The Drude model gives DC conductivity as:	
(a)	$\sigma = ne\tau/m$
(b)	$\sigma = n\mu e/m$
(c)	$\sigma = ne^2\tau/m$
(d)	$\sigma = ne/m$
Q23. What are the basic steps involved in the ADC process for converting an analog signal to digital data?	
(a)	Encoding, quantizing, sampling, and holding.
(b)	Holding, sampling, encoding, and quantizing.
(c)	Sampling, holding, quantizing, and encoding.
(d)	Quantizing, sampling, holding, and encoding.

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Q24. Among the following classes of elementary particles, which are the strongly interacting fermions?	
(a)	Photons
(b)	Leptons
(c)	Baryons
(d)	Mesons
Q25. In beta decay of radioactive nuclei, the energy released is shared among the following pair of particles.	
(a)	Proton, Electron
(b)	Neutron, Electron
(c)	Electron, Neutrino
(d)	Proton, Neutrino

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1. (a)	11. (a)	21. (a)
2. (a)	12. (a)	22. (c)
3. (d)	13. (b)	23. (c)
4. (b)	14. (a)	24. (c)
5. (a)	15. (a)	25. (c)
6. (a)	16. (a)	
7. (a)	17. (a)	
8. (b)	18. (a)	
9. (b)	19. (a)	
10. (a)	20. (b)	

29/08/25

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