EPHY 101

B. Tech. I[st] SEMESTER EXAMINATION, 2024-25

B.TECH.

Engineering Physics

(CSE, ME)

(CBCS Mode)

AFFIX PRESCRIBED RUBBER STAMP

Date (तिथि) : 18/12/2024

Paper ID
(To be filled in the OMR Sheet)

2102

अनुक्रमांक (अंकों में) :
Roll No. (In Figures) :

2	5	1	4	7	5	0	0	1	0	1	4	7		

अनुक्रमांक (शब्दों में) : _____

Roll No. (In Words) : _____

Time : 1:30 Hrs.
समय : 1:30 घण्टे

Max. Marks : 75
अधिकतम अंक : 75

नोट : पुस्तिका में 50 प्रश्न दिये गये हैं, सभी प्रश्न करने होंगे। प्रत्येक प्रश्न 1.5 अंक का होगा।

Important Instructions :

1. The candidate will write his/her Roll Number only at the places provided for, i.e. on the cover page and on the OMR answer sheet at the end and nowhere else.
2. Immediately on receipt of the question booklet, the candidate should check up the booklet and ensure that it contains all the pages and that no question is missing. If the candidate finds any discrepancy in the question booklet, he/she should report the invigilator within 10 minutes of the issue of this booklet and a fresh question booklet without any discrepancy be obtained.

महत्वपूर्ण निर्देश :

1. अभ्यर्थी अपने अनुक्रमांक केवल उन्हीं स्थानों पर लिखेंगे जो इसके लिए दिये गये हैं, अर्थात् प्रश्न पुस्तिका के मुख्य पृष्ठ तथा साथ दिये गये ओ०एम०आर० उत्तर पत्र पर, तथा अन्यत्र कहीं नहीं लिखेंगे।
2. प्रश्न पुस्तिका मिलते ही अभ्यर्थी को जाँच करके सुनिश्चित कर लेना चाहिए कि इस पुस्तिका में पूरे पृष्ठ हैं और कोई प्रश्न छूटा तो नहीं है। यदि कोई विसंगति है तो प्रश्न पुस्तिका मिलने के 10 मिनट के भीतर ही कक्ष परिप्रेक्षक को सूचित करना चाहिए और बिना त्रुटि की दूसरी प्रश्न पुस्तिका प्राप्त कर लेना चाहिए।

1. Which of the following is a scalar quantity ?

(A) Electric displacement density

(B) Electric field strength

(C) Potential in electric field

(D) None of the above

2. Which of the form of Ampere's law is correct ?

(A) $\oint \vec{B} . \overrightarrow{dl} = \mu_0 I_{enc}$

(B) $\vec{\nabla} \times \vec{B} = \mu_0 \vec{J}$

(C) Both (A) and (B)

(D) None of these

3. The life time of electron in meta stable state is of the order of -

(A) 10^{-9} second

(B) 10^{-3} second

(C) 10^{-8} second

(D) 10^{-7} second

4. In the population inversion -

(A) The number of electrons in higher energy state is more than the ground state

(B) The number of electrons in lower energy state is more than higher energy state

(C) The number of electrons in higher and lower energy state are same

(D) None of these

5. In spontaneous emission the atoms or molecules in the higher energy state E_2 eventually return to the ground state E_1 by emitting their excess energy spontaneously. The rate of spontaneous emission is -

(A) Inversely proportional to the population of the energy level E_2

(B) Directly proportional to the population of the energy level E_2

(C) ✓ Directly proportional to population of the energy level E_1

(D) None of the above

6. Ruby laser is a solid state laser. The active medium is -

(A) Crystalline substance

(B) Non- Crystalline substance

(C) Gaseous substance

(D) None of the above

7. The He-Ne laser is a kind of neutral atom gas laser in which the wavelength of lasers is -

(A) 6328Å

(B) 6943 Å

(C) 10600 Å

(D) 6600 Å

8. The relation for the ratio between the spontaneous emission and stimulated emission coefficients is -

(A) $\frac{A_{21}}{B_{21}} = \frac{8\pi h\nu^4}{C^3}$

(B) $\frac{A_{21}}{B_{21}} = \frac{8\pi h\nu^3}{C^3}$

(C) $\frac{A_{21}}{B_{21}} = \frac{\hbar\omega^3 n_0^3}{\pi^2 C^2}$

(D) $\frac{A_{21}}{B_{21}} = \frac{\hbar\omega^4 n_0^3}{\pi^2 C^2}$

9. In which of the following are the optical fibers commonly used -

(A) Musical instruments

(B) Nuclear reactors

(C) Communication

(D) Rocket technology

10. A glass clad fiber is made with core glass of refractive index ($n_1 = 1.5$) and the cladding is doped to give an index difference of $\Delta = 0.0005$. The cladding refractive index (n_2) is -

(A) 1.59925

(B) 1.49986

(C) 1.4887

(D) 1.49925

11. What principle is responsible for light spreading as it passes. Through a narrow slit ?

(A) Refraction

(B) Polarization

(C) Diffraction

(D) Interference

12. The path difference Δ and the phase difference ϕ are related as -

(A) $\phi = 2\pi\Delta$

(B) $\phi = \frac{2\pi}{\lambda}\Delta$

(C) $\Delta = \frac{2\pi}{\lambda}\phi$

(D) $\Delta = 2\pi\phi$

13. Two light sources are said to be coherent if they -

(A) Are of the same frequency

(B) Are of the same frequency, and maintain a constant phase difference

(C) Are of the same amplitude, and maintain a constant phase difference

(D) Are of the same frequency and amplitude

14. The wavelength of light in Newton's rings is given as :

(A) $\lambda = \frac{D_p^2 - D_{n+p}^2}{4nR}$

(B) $\lambda = \frac{D_{n+p}^2 - D_n^2}{4pR}$

(C) $\lambda = \frac{D_n^2 - D_p^2}{4R}$

(D) None of these

15. The distance between two successive bright fringes formed in Young's experiment is -

(A) $\beta = \frac{d}{D\lambda}$

(B) $\beta = \frac{Dd}{\lambda}$

(C) $\beta = \frac{D\lambda}{d}$

(D) $\beta = \frac{D\lambda^2}{d}$

16. Energy of the particle in one dimensional box is -

(A) $E_n = \frac{n^2\hbar^2\pi^2}{2mL}$

(B) $E_n = \frac{n^2\hbar\pi}{2mL^2}$

(C) $E_n = \frac{n^2\hbar^2\pi^2}{2mL^2}$

(D) $E_n = \frac{n\hbar^2\pi}{2mL}$

17. Time dependent Schrodinger wave equation is -

(A) $i\hbar\frac{\partial\Psi}{\partial t} = -\frac{\hbar^2}{2m}\frac{\partial^2\Psi}{\partial x^2} + V\Psi$

(B) $i\hbar\frac{\partial\Psi}{\partial x} = \frac{-\hbar^2}{2m}\frac{\partial^2\Psi}{\partial t^2} + V\Psi$

(C) $i\hbar\frac{\partial\Psi}{\partial t} = \frac{-\hbar^2}{2m}\frac{\partial^2\Psi}{\partial x^2} + V$

(D) None of these

18. Time independent Schrodinger wave equation is -

(A) $\frac{\partial^2\phi}{\partial t^2} + \frac{2m}{\hbar^2}(E - V)\phi = 0$

(B) $\frac{\partial^2\phi}{\partial x^2} + \frac{2m}{\hbar^2}(E - V)\phi = 0$

(C) $\frac{\partial^2\phi}{\partial x^2} + \frac{2m}{h^2}(E - V)\phi = 0$

(D) None of these

19. Hamiltonian operator is defined as -

(A) $H = \frac{-h^2}{2m}\frac{\partial^2}{\partial x^2} + V$

(B) $H = \frac{-\hbar^2}{2m}\frac{\partial^2}{\partial x^2}$

(C) $H = \frac{-\hbar^2}{2m}\frac{\partial^2}{\partial x^2} + V$

(D) $H = \frac{-\hbar^2}{2m} + \frac{P^2}{2m}$

20. De-Broglie wavelength is given in the terms of average Kinetic energy of the particle -

(A) $\lambda = \frac{h}{\sqrt{3mkT}}$

(B) $\lambda = \frac{h}{\sqrt{2mE}}$

(C) $\lambda = \frac{h}{mv}$

(D) $\lambda = \frac{12.27}{\sqrt{V}}$

21. As the wavelength of the radiation decreases, the intensity of the black body radiations -

(A) Increases

(B) Decreases

(C) First decreases and then increase

(D) First increases then decrease

22. The radiations emitted by hot bodies are called as -

(A) X-rays

(B) Black –body radiation

(C) Gamma radiations

(D) Visible light

23. The energy in electron volt of a photon of wavelength 1Å is -

(A) 12412.5 eV

(B) 13456.7 eV

(C) 14564.7 eV

(D) 15412.5 eV

24. How much power is radiated by the sun if the sun's radius is 6.96×10^{8}m and temperature on surface of the sun is 5700K ?

(A) $P=3.6\times10^{28}$ Watts

(B) $P=4.6\times10^{28}$ Watts

(C) $P=3.6\times10^{30}$ Watts

(D) $P=3.6\times10^{26}$ Watts

25. According to Wein's Displacement law -

(A) $p = \sigma AT^4$

(B) $\lambda_{max}T = b$

(C) $U_\lambda d_\lambda = k_B T\, 8\pi \frac{1}{\lambda^4} d\lambda$

(D) None of these

26. The expression for the Planck's law is -

(A) $U_\lambda d_\lambda = k_B T\, 8\pi \frac{1}{\lambda^4} d\lambda$

(B) $\lambda_{max} T = b$

~~(C)~~ $U_\lambda d_\lambda = 8\frac{\pi ch}{\lambda^5}\left|\frac{1}{\frac{hc}{e^{\lambda k_\beta T}-1}}\right| d\lambda$

(D) None of these

27. If frame S is moving with velocity V relative to S, the circle in S frame appears to be in S frame -

(A) Semi circle

~~(B)~~ Ellipse

(C) Octagon

(D) Triangle

28. The relativistic velocity addition theorem is consistent with -

(A) First postulates of special theory of relativity

(B) Einstein's mass- energy relation

~~(C)~~ Second postulate of special theory of relativity

(D) None of these

29. The quantity which is invariant under Lorentz transformation is -

(A) Time

(B) Space coordinate

(C) Both time and space coordinate

~~(D)~~ Space time interval

30. In a Michelson- Morley experiment, the fringe shift is given by -

(A) $\frac{2lv}{c^2\lambda}$

(B) $\frac{2lv^2}{c^2\lambda}$

(C) $\frac{2l^2v^2}{c^2\lambda}$

(D) $\frac{2lv^2}{c^2\lambda^2}$

31. A clock keeps correct time. With what speed it be moved relative to an observer so that it may appear to loose 4 minutes in 24 hours ?

(A) 2.32×10^7m/s

(B) 3.45×10^7m/s

(C) 2.32×10^6m/s

(D) 3.45×10^6m/s

32. Calculate the percentage contraction of a rod moving with a velocity of 0.8c in a direction inclined to 60° to its own length.

Where $c=3\times10^8$m/s

(A) 7.9%

(B) 8.4 %

(C) 8.6%

(D) 8.1%

33. Which of the following relationship is correct for the inverse Lorentz transformation ?

(A) $x = (x' + vt)\,\lambda, y = y'$, and $z = z'$

(B) $x = (x' - vt)\,\lambda, y = y'$, and $z = z'$

(C) $x = x', y = (y' + vt)\,\lambda$, and $z = z'$

(D) None of these

34. At what speed, the mass of an object will be double of its value at rest?

(A) 2.6×10^5m/s

(B) 2.6×10^8m/s

(C) 2.4×10^6m/s

(D) 2.4×10^8m/s

35. Which of the following is the correct expression of the relativistic Kinetic energy?

(A) $K = m_0c^2\left[\frac{1}{\sqrt{1-v^2/c^2}} + 1\right]$

(B) $K = m_0c^2 - mc^2$

(C) $K = m_0c^2\left[\frac{1}{\sqrt{1-v^2/c^2}} - 1\right]$

(D) $K = mc^2 + m_0c^2$

36. If frame S' is moving with constant velocity V relative to frame S and the particle's velocity in S frame is u and in S' frame is u' then -

(A) $u = \frac{u'+v}{1+\frac{vu'}{c^2}}$

(B) $u = \frac{u'-v}{1+\frac{v}{c^2}u'}$

(C) $u' = \frac{u+v}{1+\frac{v}{c^2}u'}$

(D) None of these

37. Which quantity is invariant under Galilean transformation -

(A) Velocity

(B) Acceleration

(C) Momentum

(D) None of these

38. Relativistic momentum (p) and energy (E) of a particle are related as -

(A) $E^2 = p^2c^2 + m_0^4c^4$

(B) $E^2 = p^2c^2 - m_0^2c^4$

(C) $E^2 = m_0c^4 - p^2c^2$

(D) $E^2 = p^2c^2 + m_0^2c^4$

39. The reference frames where fundamental laws of physics are invariant are called-

(A) Accelerated frames

(B) Rotational frames

(C) Inertial frames

(D) Non-inertial frames

40. Displacement current is due to -

(A) Displacement of electric charge

(B) Time varying magnetic field

(C) Time varying electric field

(D) Both (B) and (C)

41. Which of the following is correct -

(A) $\vec{\nabla}T = \frac{\partial T}{\partial x} + \frac{\partial T}{\partial y} + \frac{\partial T}{\partial z}$

(B) $\vec{\nabla}.\vec{A} = \hat{x}\frac{\partial A_x}{\partial x} + \hat{y}\frac{\partial A_y}{\partial y} + \hat{z}\frac{\partial A_z}{\partial z}$

(C) $\vec{\nabla} \times \vec{A} = \begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ A_x & A_y & A_z \end{vmatrix}$

(D) None of these

42. Which of the following is incorrect -

(A) Stoke's theorem : $\oint_S (\vec{\nabla} \times \vec{A}).\, d\vec{a} = \oint_\rho \vec{A}.\, d\vec{l}$

(B) Volume integral : $\int_V \rho d\tau$

(C) Divergence theorem : $\int_V (\vec{\nabla}.\vec{A}) d\tau = \oint_S \vec{A}.\, d\vec{a}$

(D) Green's theorem : $\int_A^B \vec{\nabla}\phi.\, d\vec{r} = \int_A^B d\,\phi$

43. Find gradient of a scalar field $u = 2x^2y - y^2z^3$ at point (1,2,-1)-

(A) $-12\hat{\imath} - 9\hat{\jmath} - 16\hat{k}$

(B) $8\hat{\imath} + 4\hat{\jmath} - 12\hat{k}$

(C) $8\hat{\imath} + 4\hat{\jmath} + 12\hat{k}$

(D) $8\hat{\imath} - 4\hat{\jmath} - 12\hat{k}$

44. For the irrotational vector, which of the following is correct -

(A) $\vec{\nabla}.\vec{F} = 0$

(B) $\vec{\nabla}.\vec{F} \neq 0$

(C) $\vec{\nabla} \times \vec{F} = 0$

(D) $\vec{\nabla} \times \vec{F} \neq 0$

45. Which of the following volume element written in the spherical polar coordinate is correct -

(A) $dv = dxdydz$

(B) $dv = r^2 sin\theta\, dr d\theta\, d\phi$

(C) $dv = \rho d\rho d\phi dz$

(D) $dv = r sin\theta\, dr d\theta\, d\phi$

46. If the electric field in some region is found to be $\vec{E} = kr^3\hat{r}$ then charge density is given as -

(A) $5\varepsilon_0 k\, r^2$

(B) $5\varepsilon_0 k\, r^3$

(C) $10\varepsilon_0 k\, r^2$

(D) $10\varepsilon_0 k\, r^3$

47. Field due to a uniformly charged insulating sphere is -

(A) Outside the sphere : $\vec{E} = \frac{q}{4\pi\epsilon_0 r^2}\hat{r}$

(B) Outside the sphere : $\vec{E} = \frac{q}{4\pi\epsilon_0 r}\hat{r}$

(C) Inside the sphere : $\vec{E} = \frac{\rho r}{3\epsilon_0}\hat{r}$

(D) Both (A) and (C)

48. Maxwell observed and corrected a discrepancy in -

(A) Gauss law for electrostatics

(B) Faraday's law

(C) Ampere's law

(D) None of these

49. According to Maxwell's equation in free space, which of the following is correct-

(A) $\vec{\nabla}\times\vec{B} = \mu_0\vec{J} + \mu_0\varepsilon_0\frac{\partial\vec{E}}{\partial t}$

(B) $\vec{\nabla}.B \neq 0$

(C) $\vec{\nabla}.\vec{E} = \frac{q}{\varepsilon_0}$

(D) $\vec{\nabla}\times\vec{H} = \vec{J_f} + \frac{\partial\vec{D}}{\partial t}$

50. The wave velocity in non-conducting medium is -

(A) $\sqrt{\mu/\epsilon}$

(B) $\frac{1}{\sqrt{\mu\epsilon}}$

(C) μ_0/ε_0

(D) $\frac{1}{\sqrt{\mu_0\varepsilon_0}}$

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