019/2021

Question Booklet Alpha Code **A**

Question Booklet Serial Number

Total No. of Questions : 100	**Time : 75 Minutes**
Maximum : 100 Marks	

INSTRUCTIONS TO CANDIDATES

1. The question paper will be given in the form of a Question Booklet. There will be four versions of question booklets with question booklet alpha code viz. A, B, C & D.
2. The Question Booklet Alpha Code will be printed on the top left margin of the facing sheet of the question booklet.
3. The Question Booklet Alpha Code allotted to you will be noted in your seating position in the Examination Hall.
4. If you get a question booklet where the alpha code does not match to the allotted alpha code in the seating position, please draw the attention of the Invigilator IMMEDIATELY.
5. The Question Booklet Serial Number is printed on the top right margin of the facing sheet. If your question booklet is un-numbered, please get it replaced by new question booklet with same alpha code.
6. The question booklet will be sealed at the middle of the right margin. Candidate should not open the question booklet, until the indication is given to start answering.
7. Immediately after the commencement of the examination, the candidate should check that the question booklet supplied to him contains all the 100 questions in serial order. The question booklet does not have unprinted or torn or missing pages and if so he/she should bring it to the notice of the Invigilator and get it replaced by a complete booklet with same alpha code. This is most important.
8. Blank sheets of paper is attached to the question booklet. These may be used for rough work.
9. **Please read carefully all the instructions on the reverse of the Answer Sheet before marking your answers.**
10. Each question is provided with four choices (A), (B), (C) and (D) having one correct answer. Choose the correct answer and darken the bubble corresponding to the question number using Blue or Black Ball-Point Pen in the OMR Answer Sheet.
11. **Each correct answer carries 1 mark and for each wrong answer 1/3 mark will be deducted. No negative mark for unattended questions.**
12. No candidate will be allowed to leave the examination hall till the end of the session and without handing over his/her Answer Sheet to the Invigilator. Candidates should ensure that the Invigilator has verified all the entries in the Register Number Coding Sheet and that the Invigilator has affixed his/her signature in the space provided.
13. Strict compliance of instructions is essential. Any malpractice or attempt to commit any kind of malpractice in the Examination will result in the disqualification of the candidate.

Total Marks : 100 Marks

Time : 1 hour and 15 minutes

1. Consider the following statement regarding a projectile:
(1) The acceleration is not zero anywhere along its trajectory.
(2) Its velocity at the highest point is zero.
(3) The horizontal and vertical components of its motion are completely independent of each other.
Which among the above statements are true ?
(A) Only (1)
(B) Only (1) & (3)
(C) Only (2) & (3)
(D) All

2. Two objects have equal kinetic energies. How do the magnitudes of their momenta p_1 and p_2 compare ?
(A) $p_1 > p_2$
(B) $p_1 < p_2$
(C) $p_1 = p_2$
(D) Insufficient information

3. If the position coordinates of a particle moving in a plane is given by $\vec{r} = r(\cos\omega t\hat{i} + \sin\omega t\hat{j})$,then the velocity of the particle is given by
(A) $\vec{v} = r\omega(\sin \omega t\hat{i} + \cos \omega t\hat{j})$
(B) $\vec{v} = r\omega(-\sin \omega t\hat{i} + \cos \omega t\hat{j})$
(C) $\vec{v} = r(\sin \omega t\hat{i} + \cos \omega t\hat{j})$
(D) $\vec{v} = r(-\sin \omega t\hat{i} + \cos \omega t\hat{j})$

4. Which among the following is **NOT TRUE** about fictitious forces ?
(A) The fictitious force in a uniformly accelerating system behaves exactly like a constant gravitational force.
(B) The fictitious force in a uniformly accelerating system is constant and is proportional to the mass.
(C) The fictitious force on an extended body acts at the centre of mass.
(D) Fictitious forces originate due to interaction between bodies.

5. Which among the following is NOT a velocity-dependent force ?
(A) Gravitational force
(B) Centrifugal force
(C) Coriolis force
(D) Frictional force

6. There exists a closed curve C to which nearby trajectories can either spiral in or they can spiral away from C. Then C is
(A) a fixed point.
(B) a limit cycle.
(C) a phase space.
(D) an infinite tori.

7. Which among the following is an example of unconstrained motion ?
(A) Two particles moving solely under their mutual gravitational attraction.
(B) A particle sliding on a wire.
(C) A particle attached to a cylinder rolling on a fixed surface.
(D) Swinging bob of a pendulum.

8. The Lagrangian of a system is given by

$L = \frac{1}{2}M\dot{x}^2 + \frac{1}{2}m(\dot{x}^2 + \dot{y}^2 + 2\dot{x}\dot{y}\cos\alpha) + mgy\sin\alpha$. Which among the following represent the components of momenta of the system ?

(A) $p_y = m(\dot{x} + \dot{y}\cos\alpha)$
(B) $p_x = m(\dot{y} + \dot{x}\cos\alpha)$
(C) $p_x = M\dot{x} + m(\dot{x} + \dot{y}\cos\alpha)$
(D) $p_y = M\dot{y} + m(\dot{y} + \dot{x}\cos\alpha)$

9. Which among the following helps in converting the Lagrangian equations into a Hamiltonian ?

(A) Lorentz transform
(B) Legendre transform
(C) Fourier transform
(D) Laplace transform

10. Which among the following correctly represent the Hamiltonian of a simple pendulum ?

(A) $H = \frac{p_\theta^2}{2ml^2} - mg\cos\theta$
(B) $H = \frac{p_\theta^2}{2ml^2} - mgl\sin\theta$
(C) $H = \frac{p_\theta^2}{2ml^2} - mgl\cos\theta$
(D) $H = \frac{p_\theta^2}{2ml^2} - mg\sin\theta$

11. Which among the following is expressed by saying that *the Hamiltonian phase flow preserves volume* ?

(A) Fermat's principle
(B) Hamilton's principle
(C) Euler - Lagrange theorem
(D) Liouville's theorem

12. If Ω is the angular velocity of a particle of mass *m* that moves with velocity v in a non-inertial frame, the magnitude of the Coriolis force acting on the body is given by

(A) $m\dot{\Omega} \times r$
(B) $2\,m\Omega \times v$
(C) $m\Omega \times (\Omega \times r)$
(D) $m\Omega \times (\Omega \times v)$

13. The eigen values of the matrix $\begin{bmatrix} 2 & 3 \\ 3 & 2 \end{bmatrix}$, are :

(A) –1, 1
(B) 1, 1
(C) –1, 5
(D) l, –5

14. Which among the following is NOT a correct representation of complex functions ?

(A) $\cos(z) = \frac{e^{iz} + e^{-iz}}{2}$
(B) $\sin(z) = \frac{e^{iz} - e^{-iz}}{2i}$
(C) $\cosh(z) = \frac{e^{z} + e^{-z}}{2}$
(D) $\sinh(z) = \frac{e^{z} - e^{-z}}{2i}$

15. Which among the following equations relate the Cartesian to the cylindrical unit vectors ?

(A) $\hat{r} = \cos\phi\hat{i} + \sin\phi\hat{j}$; $\phi = -\sin\phi\hat{i} + \cos\phi\hat{j}$; $\hat{z} = \hat{z}$
(B) $\hat{r} = \cos\phi\hat{i} - \sin\phi\hat{j}$; $\phi = \sin\phi\hat{i} - \cos\phi\hat{j}$; $\hat{z} = \cos\phi\hat{z}$
(C) $\hat{r} = \cos\phi\hat{i} + \sin\phi\hat{j}$; $\phi = -\sin\phi\hat{i} + \cos\phi\hat{j}$; $\hat{z} = \cos\phi\hat{z}$
(D) $\hat{r} = \cos\phi\hat{i} + \sin\phi\hat{j}$; $\phi = \sin\phi\hat{i} + \cos\phi\hat{j}$; $\hat{z} = \cos\phi\hat{z}$

16. The value of $(1 + i)^8$ is given by

(A) 8 (B) 2

(C) 16 (D) 4

17. The recurrence relation

$(2n + 1)xP_n(x) = (n + 1)P_{n+1}(x) + nP_{n-1}(x)$ corresponds to

(A) Laguerre polynomials (B) Legendre polynomials

(C) Hermite polynomials (D) Bessel polynomials

18. Bessel functions of the second kind is also known as:

(A) Gamma function (B) Beta function

(C) Generating function (D) Neumann function

19. Four coins are tossed simultaneously. What is the probability that none of them are heads ?

(A) 1/16 (B) 1/4

(C) 3/8 (D) 1/2

20. Which among the following is likely to the be Fourier transform of the function $f(x) = Ne^{-\alpha x^2}$?

(A) $\frac{N}{\sqrt{2\alpha}} e^{-x^2/4\alpha}$ (B) $\frac{N}{\sqrt{2\alpha}} e^{-\omega^2/4\alpha}$

(C) $\frac{N}{\sqrt{2\alpha}} e^{-\omega^2}$ (D) $\frac{N}{\sqrt{2\alpha}} e^{-x^2/\alpha}$

21. Which among the following is a current-controlled negative resistance device ?

(A) A bi-junction transistor (B) A uni-junction transistor

(C) A field-effect transistor (D) A p-n junction diode

22. What is the state of a JFET defined by the condition $V_{GS} = 0$ V, and $V_{DS} > |VP|$?

(A) I_D becomes maximum. (B) Breakdown occurs in the channel.

(C) I_{DSS} becomes maximum. (D) Becomes a voltage controlled resistor.

23. Which among the following materials is used to make a light dependent resistor ?

(A) Gallium Arsenide (B) Indium Phosphide

(C) Silicon (D) Cadmium Sulphide

24. Which is the most commonly used material to make IR LEDs ?

(A) Gallium Arsenide (B) Germanium

(C) Silicon (D) Cadmium Selenide

25. Which among the following materials is the least preferred in making a p-n junction solar cell ?

(A) Amorphous Silicon (B) Cadmium Telluride

(C) Lead Sulphide (D) Copper Indium Gallium diselenide

26. Which among the following is NOT true about the Common Mode Rejection Ratio (CMRR) of an Op-Amp ?

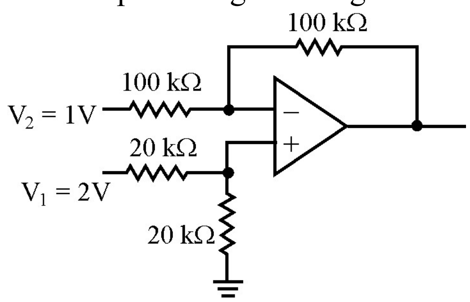
(A) $\text{CMRR} = 20 \log_{10} \dfrac{A_d}{A_c}$ dB.

(B) The larger the value of CMRR, the better the circuit operation.

(C) For large values of CMRR, the output voltage will be due mostly to the difference signal.

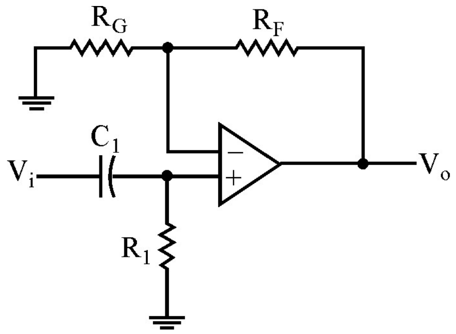
(D) Larger the value of CMRR, the lower the chance that common-mode signal being rejected.

27. What will be the output voltage of the given circuit ?



(A) 1 V (B) 2 V
(C) 0 V (D) 3 V

28. Identify the following circuit :



(A) Second order low pass filter (B) First order high pass filter
(C) First order low pass filter (D) Second order high pass filter

29. The noise produced by the random motion of charge carriers is

(A) flicker noise (B) shot noise
(C) Johnson noise (D) 1/f noise

30. Which is the modulation system in which there are pulses of constant amplitude and length but with varying timing ?

(A) Pulse Position Modulation (B) Pulse Width Modulation
(C) Pulse Code Modulation (D) Pulse Amplitude Modulation

31. Sky waves are refracted back to the Earth from

(A) the mesosphere
(B) the ionosphere
(C) the stratosphere
(D) they penetrate the atmosphere

32. A free electron has a kinetic energy of 100 eV. Its de Broglie wavelength will be

(A) 2.86 nm
(B) 1.226 nm
(C) 0.1226 nm
(D) 0.0286 nm

33. Which among the following is NOT true about the Hilbert space ?

(A) $\mathscr{H}$ is a linear space.
(B) $\mathscr{H}$ is a complete inner product space.
(C) $\mathscr{H}$ has a defined scalar product that is strictly positive.
(D) $\mathscr{H}$ is inseparable.

34. The bra matrix of the ket $|\psi\rangle = \begin{pmatrix} -2i \\ 3+i \\ -4 \end{pmatrix}$ is

(A) $(2i \quad 3-i \quad 4)$
(B) $(2i \quad 3-i \quad -4)$
(C) $(-2i \quad 3+i \quad 4)$
(D) $(2i \quad -3+i \quad 4)$

35. If $\hat{A}$ is an operator satisfying the eigen value equation
$\hat{A}\,|\,\phi\rangle = \alpha\,|\,\phi\,\rangle$, then which among the following equations is TRUE about its inverse ?

(A) $\hat{A}^{-1}\,|\,\phi\,\rangle = \alpha\,|\,\phi\,\rangle$
(B) $\hat{A}^{-1}\,|\,\phi\,\rangle = \alpha^{2}\,|\,\phi\,\rangle$
(C) $\hat{A}^{-1}\,|\,\phi\,\rangle = \alpha^{-2}\,|\,\phi\,\rangle$
(D) $\hat{A}^{-1}\,|\,\phi\,\rangle = \alpha^{-1}\,|\,\phi\,\rangle$

36. Identify the **ODD** one from the following matrices:

(A) $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$
(B) $\begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}$
(C) $\begin{pmatrix} 0 & -i \\ 1 & 0 \end{pmatrix}$
(D) $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$

37. The potential expressed as $V(r) = V_0 \dfrac{e^{-r/R}}{r}$ is known as

(A) harmonic potential
(B) Yukawa potential
(C) hard sphere potential
(D) Gaussian potential

38. Which among the following Hamiltonians stands for the simple harmonic oscillator ?

(A) $\hat{H} = \hbar\omega\left(\hat{a}^{\dagger}\hat{a} + \frac{1}{2}\right)$
(B) $\hat{H} = \hbar\omega\left(\hat{a}^{\dagger}\hat{a} + 1\right)$
(C) $\hat{H} = \hbar\omega\left(\hat{a}^{\dagger}\hat{a} - 1\right)$
(D) $\hat{H} = \hbar\omega\left(\hat{a}^{\dagger}\hat{a} - \frac{1}{2}\right)$

39. The dispersion relation for a type of waves is $\omega^2 = ak + bk^3$. The wave number k_0 for which the phase velocity equals the group velocity is

(A) $\sqrt{\frac{a}{b}}$ (B) $3\sqrt{\frac{a}{b}}$

(C) $\frac{1}{2}\sqrt{\frac{a}{b}}$ (D) $\frac{1}{3}\sqrt{\frac{a}{b}}$

40. The radius of the second Bohr orbit of a singly ionised helium atom is

(A) 0.53 Å (B) 1.06 Å

(C) 0.265 Å (D) 0.132 Å

41. An electric cooker that has 1000 W rating is switched on for ten minutes. How much heat does it produce ?

(A) 600 kJ (B) 60 kJ

(C) 6000 kJ (D) 6 kJ

42. If a measurement x takes values 1, 2, 3 and 4 with probabilities $\frac{1}{4}$ in each case, the values of $\langle x \rangle$ will be

(A) $\frac{1}{4}$ (B) 1

(C) $\frac{5}{2}$ (D) $\frac{2}{5}$

43. A microcanonical ensemble has Ω macro states, each with probability $P_i = 1/\Omega$. The entropy of the system is

(A) Zero (B) $k_B \ln \Omega$

(C) $k_B \ln \frac{1}{\Omega}$ (D) $-k_B \ln \Omega$

44. If a quantum system is in one of a number of states $|\psi_i\rangle$ with probability P_i, then the entity defined by $\rho = \sum_i P_i \,|\,\psi_i\rangle \langle\psi_i|$ is called

(A) Shannon entropy. (B) Probability density.

(C) Von Neumann entropy. (D) Density matrix.

45. The excess pressure p inside a spherical liquid droplet of radius r and surface tension γ is

(A) $p = \frac{\gamma}{r}$ (B) $p = \frac{4\gamma}{r}$

(C) $p = \frac{2\gamma}{r}$ (D) zero

46. A system can occupy energy level $-\delta/2$ or $\delta/2$. Then the partition function of the system is

(A) $Z = \cosh\left(\frac{\beta\delta}{2}\right)$ (B) $Z = 2\cosh\left(\frac{\beta\delta}{2}\right)$

(C) $Z = \sinh\left(\frac{\beta\delta}{2}\right)$ (D) $Z = 2\sinh\left(\frac{\beta\delta}{2}\right)$

47. The Gibbs function per particle of a thermodynamic system is called as

(A) Helmholtz function (B) Enthalpy

(C) entropy (D) Chemical potential

48. Which among the following proportionality is true about Einstein's A and B co-efficients and the frequency ?

(A) $\frac{A}{B} \propto \omega$ (B) $\frac{A}{B} \propto \omega^2$

(C) $\frac{A}{B} \propto \omega^3$ (D) $\frac{A}{B} \propto \omega^{-2}$

49. At high temperatures, the molar heat capacity of a Debye solid saturates to a value of

(A) 3R (B) $\frac{3}{2}R$

(C) 2R (D) R

50. The occupancy of the states for fermions is given by

(A) $\bar{n} = \frac{1}{e^{(\varepsilon-\mu)/kT} - 1}$ (B) $\bar{n} = \frac{1}{e^{(\varepsilon-\mu)/kT} + 1}$

(C) $\bar{n} = \frac{1}{1-e^{(\varepsilon-\mu)/kT}}$ (D) $\bar{n} = \frac{1}{1-e^{-(\varepsilon-\mu)/kT}}$

51. The abrupt accumulation of atoms in the ground state at temperatures below T_c is called

(A) superconducting transition (B) superfluidity

(C) supersaturation (D) Bose-Einstein condensation

52. A white dwarf star is

(A) a degenerate Bose gas. (B) a non-degenerate Fermi gas.

(C) a degenerate Fermi gas. (D) a non-degenerate Bose gas.

53. Which among the following is NOT true about atomic nuclei ?

(A) The atomic number Z equals the number of protons in the nucleus.

(B) The neutron number N equals the number of neutrons in the nucleus.

(C) The mass number A equals the number of nucleons in the nucleus.

(D) The isotopes of an element have the same A value but different N and Z values.

54. Which among the following numerical quantity corresponds to the magnitude of nuclear density ?

(A) 10^9 kg/m^3 (B) 10^{12} kg/m^3

(C) 10^{17} kg/m^3 (D) 10^3 kg/m^3

55. The magnetic resonance imaging (MRI) works exceptionally well for viewing internal tissues in human body. Which among the following is the most likely reason for this ?

(A) About two-thirds of the atoms in the human body are hydrogen.

(B) Human body does not absorb radio waves.

(C) RF signals cause no damage to the cellular structures.

(D) Tissues do not absorb magnetic energy.

56. Identify the missing particle in the nuclear decay

$_{Z}^{A}X \rightarrow _{Z+1}^{A}Y + ? + \nu$

(A) Electron (B) Positron

(C) Neutron (D) Proton

57. Which is the stable end product of the Neptunium radioactive series ?

(A) $_{82}^{206}Pb$ (B) $_{82}^{207}Pb$

(C) $_{82}^{208}Pb$ (D) $_{83}^{209}Bi$

58. Which among the following force carrying particles are exchanged in strong nuclear interaction ?

(A) $W^{\pm}$ bosons (B) Gluons

(C) Z^0 bosons (D) Photons

59. Which is the practical application of pair annihilation process in medical diagnostics ?

(A) Linear accelerator (B) CT scanning

(C) Positron emission tomography (D) Magnetic resonance imaging

60. Identify the reaction that does not conserve strangeness:

(A) $\pi^- + p \rightarrow K^0 + \Lambda^0$ (B) $\pi^- + p \rightarrow K^0 + n$

(C) $\pi^0 + n \rightarrow K^+ + \Sigma^-$ (D) $p + \pi^- \rightarrow K^+ + K^- + n$

61. Which of the following is the quark structure of the Ω^- particle ?

(A) uud (B) uss

(C) uus (D) sss

62. The ratio of thermal to electrical conductivity (K/σ) for any metal is proportional to its temperature T. This is statement is known as

(A) Lorentz law (B) Ohm's law

(C) Wiedemann-Franz law (D) Joule's law

63. Identify the indirect band gap material :

(A) Crystalline Silicon
(B) Indium Arsenide
(C) Amorphous Silicon
(D) Gallium Arsenide

64. Identify the lattice represented by the primitive vectors

$a_1 = a\hat{x}, a_2 = a\hat{y}, a_3 = \frac{a}{2}(\hat{x} + \hat{y} + \hat{z})$

(A) Simple cubic
(B) Body-centred cubic
(C) Face-centred cubic
(D) Hexagonal

65. What is the packing fraction of a simple cubic lattice ?

(A) 0.68
(B) 0.74
(C) 0.34
(D) 0.52

66. Identify the crystal that has ionic bonding

(A) Diamond
(B) Silicon
(C) Sodium Chloride
(D) Magnesium

67. The dispersion relation for an electron is given by $E(k) = \frac{\hbar^2 k^2}{2m}$. Its effective mass is given by

(A) m
(B) m/2
(C) 2 m/3
(D) m/4

68. The density of states for a bulk three-dimensional semiconducting crystal is given by:

(A) $g(E) \propto E$
(B) $g(E) \propto E^{1/2}$
(C) $g(E) \propto E^{3/2}$
(D) $g(E) \propto E^{-1/2}$

69. Identify the Type -1 superconductor among the following :

(A) Niobium
(B) Vanadium
(C) Technetium
(D) Aluminium

70. When a superconducting sample is placed in a magnetic field, super currents are generated to screen the fields from penetrating into the bulk of the sample. This phenomenon is called

(A) Flux quantisation
(B) Josephson effect
(C) Meissner effect
(D) Ginzburg-London effect

71. What is the probability that the electron in the ground state of hydrogen will be found outside the first Bohr radius ?

(A) Zero
(B) 32.3%
(C) 67.7%
(D) 50%

72. Which among the following transitions is responsible for one of the lines in the sodium doublet in a sodium vapour lamp ?

(A) $3P_{3/2} \rightarrow 3S_{3/2}$
(B) $3P_{5/2} \rightarrow 3S_{3/2}$
(C) $3P_{5/2} \rightarrow 3S_{1/2}$
(D) $3P_{1/2} \rightarrow 3S_{1/2}$

73. Identify the correct equation for allowed values of the rotational energy of a diatomic molecule:

(A) $E = \frac{\hbar^2}{2I} J(J+1)$
(B) $E = \frac{\hbar^2}{2I} \sqrt{J(J+1)}$
(C) $E = \left(l + \frac{1}{2}\right)\hbar\omega$
(D) $E = \frac{\hbar^2}{2I}(2J+1)$

74. A particle of rest mass m_0 is moving uniformly along a straight line with relativistic velocity kc, where c is the velocity of light in vacuum and $0 < k < 1$. The phase velocity of de Broglie waves associated with the particle is

(A) $\frac{c}{k^2}$
(B) $\frac{c}{k}$
(C) c
(D) kc

75. A photon of wavelength λ is incident on a free electron at rest and is scattered in the backward direction. The fractional shift in its wavelength in terms of the Compton wavelength λ_C of the electron is

(A) $\frac{\lambda_C}{2\lambda}$
(B) $\frac{3\lambda_C}{2\lambda}$
(C) $\frac{2\lambda_C}{3\lambda}$
(D) $\frac{2\lambda_C}{\lambda}$

76. The activity of a radioactive sample is decreased to one-third of the initial value in 100 days. The half-life of the sample is approximately

(A) 50 days
(B) 63 days
(C) 30 days
(D) 100 days

77. Two spherical nuclei with radii R_1 and R_2 have mass numbers 216 and 27 respectively. Then $\frac{R_1}{R_2}$ is given by

(A) 1.5
(B) 1.8
(C) 1.2
(D) 2

78. A microcontroller is an example of

(A) VLSI
(B) ADC
(C) MSI
(D) EMI

79. The control unit of a microprocessor

(A) reads data from the data bus.
(B) tell the ALU what to do.
(C) controls the rate of the clock.
(D) writes addresses on the address bus.

80. Where does the code used by a microprocessor when it is first switched on is stored ?

(A) RAM (B) Hard disk drive
(C) ROM (D) Cache memory

81. The reduced form of the Boolean expression $\overline{\overline{A}.B.(B+C)}$ is

(A) $\overline{A}+B$ (B) $A+\overline{B}$
(C) $\overline{A}+\overline{B}$ (D) $A+B$

82. The output of a 3-input NAND gate is low when

(A) all inputs are low. (B) one input is high.
(C) more than one input is high. (D) All inputs are high.

83. What is the width of the address bus in 8085 ?

(A) 4 - bit (B) 8 - bit
(C) 16 - bit (D) 32 - bit

84. What is the type of interrupt in 8085 where the interrupt address is known to the processor ?

(A) Vector interrupt (B) Non-Vector interrupt
(C) Maskable interrupt (D) Non-Maskable interrupt

85. How many comparators are required in a flash ADC with 8 - bit output ?

(A) 7 (B) 8
(C) 16 (D) 255

86. What is the capacity of the onboard RAM of the microcontroller 8051 ?

(A) 16 bytes (B) 64 bytes
(C) 128 bytes (D) 256 bytes

87. Which among the following laser has a quasi-three-level system ?

(A) Ruby laser (B) Nd:YAG
(C) He:Ne (D) Yb:YAG

88. Which line broadening is due to the fact that atomic resonance frequencies are distributed over a band of frequencies ?

(A) Homogeneous broadening (B) Natural broadening
(C) Inhomogeneous broadening (D) Pressure broadening

89. Which laser uses chemical pumping to achieve population inversion ?

(A) Argon Laser (B) All Gas-Phase Iodine Laser
(C) Carbon-dioxide Laser (D) Helium-Neon Laser

90. Identify the second order nonlinear optical phenomena related to the quadratic susceptibility $\chi^{(2)}$.

(A) Optical Kerr effect. (B) Four-wave mixing.
(C) Stimulated Raman scattering. (D) Sum-frequency generation.

91. The total number of guided modes in a step index fibre is NOT related to

(A) the V number.
(B) length of the fibre.
(C) radius of the fibre core.
(D) numerical aperture of the fibre.

92. The mean optical power launched into an 8 km long of fibre that has no connectors or splices is 100 μW. If the mean optical power at the fibre output is 10 μW, the overall signal attenuation in decibels is

(A) 10 dB
(B) 16 dB
(C) 23 dB
(D) 46 dB

93. Consider a beam of light of wavelength λ incident normally on a system of a polariser and an analyser. The analyser is oriented at 45° to the polariser. When an optical component is introduced between them, the output intensity becomes zero. The optical component is

(A) a quarter-wave plate.
(B) a thin lens.
(C) a half-wave plate.
(D) a glass plate.

94. Light travelling between two points in a medium takes a path for which

(A) distance is always minimum.
(B) time of flight is extremum.
(C) time of flight is always minimum.
(D) distance is extremum.

95. The wavelength of a photon that has an energy of 3.6 eV is

(A) 870 nm
(B) 542 nm
(C) 450 nm
(D) 345 nm

96. The chemical potential of an ideal Bose gas at any temperature will be

(A) either zero or negative
(B) necessarily positive
(C) necessarily negative
(D) either zero or positive

97. Which among the following crystal structure has a wrong coordination number given ?

(A) face centred cubic - 6
(B) diamond - 4
(C) body centred cubic - 8
(D) hexagonal closed packed - 12

98. A plane cubic lattice intercepts the three crystallographic axes at $\left(a, \frac{a}{2}, \frac{2a}{3}\right)$, respectively. The Miller indices of the plane are

(A) (3 4 2)
(B) (2 4 3)
(C) (6 3 4)
(D) (2 3 1)

99. The exciting radiation in a Raman scattering experiment is 5460 Å and the Stokes line is at 5520Å. The wavelength of the anti-Stokes line is at

(A) 4220 Å
(B) 6550 Å
(C) 5400 Å
(D) 5720 Å

100. The electromagnetic wave passing though a medium has an electric field $\vec{E} = E_0 \cos(10^7 x + 10^7 y - 10^{15} t)\hat{z}$. The refractive index of the medium is

(A) 1.0
(B) 1.5
(C) 3.0
(D) 4.2

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