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Part III — PHYSICS

(English Version)

Time Allowed : 3 Hours]

[Maximum Marks : 150

PART - IN. B. : i) Answer *all* the questions.

ii) Choose and write the correct answer.

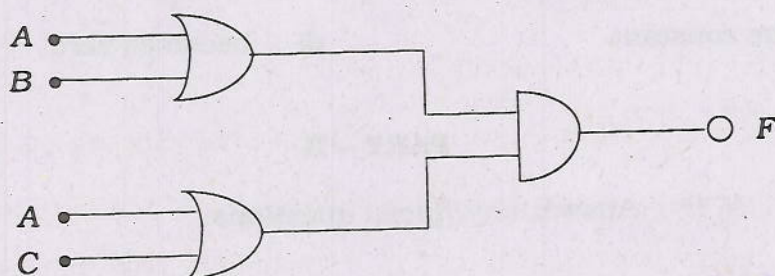
iii) Each question carries *one* mark. $30 \times 1 = 30$

1. The forbidden energy gap for silicon is of the order of
 - a) 0.7 eV
 - b) 1.1 eV
 - c) 0.3 eV
 - d) 10 eV.
2. According to the laws of Boolean algebra, the expression $(A + AB)$ is equal to
 - a) A
 - b) AB
 - c) B
 - d) \overline{A} .
3. An example for non-sinusoidal oscillator is
 - a) Multivibrator
 - b) RC oscillator
 - c) Colpitts oscillator
 - d) Crystal oscillator.
4. The RF channel in a radio transmitter produces
 - a) audio signals
 - b) high frequency carrier waves
 - c) both audio signal and high frequency carrier waves
 - d) low frequency carrier waves.

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12. In a discharge tube, the source of positive rays (canal rays) is
- a) cathode
 - b) anode
 - c) gas atoms present in the discharge tube
 - d) fluorescent screen.
13. The minimum wavelength of X-rays produced in an X-ray tube at 1000 kV is
- a) 0.0124 Å
 - b) 0.124 Å
 - c) 1.24 Å
 - d) 0.00124 Å.
14. The ionisation potential of hydrogen atom is
- a) 13.6 eV
 - b) - 13.6 eV
 - c) 13.6 V
 - d) - 13.6 V.
15. At the threshold frequency, the velocity of the electrons is
- a) zero
 - b) minimum
 - c) maximum
 - d) infinite.
16. In an A.C. circuit
- a) the average value of current is zero
 - b) the average value of square of current is zero
 - c) the average power dissipation is zero
 - d) the rms current is $\sqrt{2}$ times of peak current.
17. In an electromagnetic wave the phase difference between electric field \vec{E} and magnetic field \vec{B} is
- a) $\frac{\pi}{4}$
 - b) $\frac{\pi}{2}$
 - c) π
 - d) zero.
18. A ray of light is incident on a glass surface such that the reflected ray is completely plane polarised. The angle between the reflected ray and the refracted ray is
- a) 57.5°
 - b) 32.5°
 - c) 90°
 - d) 115°.

35. Define mobility of electrons. Give its unit.
36. State Ampere's circuital law.
37. Calculate the mutual inductance between two coils when a current of 4 A changing to 8 A in 0.5 s in one coil, induces an *e.m.f.* of 50 mV in the other coil.
38. State Fleming's right hand rule.
39. A 300 mm long tube containing 60 c.c. of sugar solution produces a rotation of 9° when placed in a polarimeter. If the specific rotation is 60° , calculate the quantity of sugar contained in the solution.
40. Why is the centre of the Newton's ring dark ?
41. Calculate the longest wavelength of X-rays that can be analysed by a rock salt crystal of spacing $d = 2.82 \text{ \AA}$ in the first order.
42. State Moseley's law.
43. What are the limitations of electron microscope ?
44. What is meant by breeder reactor ?
45. Mention any three properties of nuclear force.
46. Give the Boolean equation for the given logic diagram :



47. Draw the circuit for summing amplifier.
48. What is rectification ?
49. State de Morgan's theorems.
50. Mention the advantages of frequency modulation.

PART - III

- N. B. : i) Answer Question No. 54 compulsorily.
 ii) Answer any six of the remaining 11 questions.
 iii) Draw diagrams wherever necessary.

7 × 5 = 35

51. Define electric potential at a point. Obtain an expression for electric potential due to a point charge.
52. A copper wire of 10^{-6} m^2 area of cross-section, carries a current of 2 A. If the number of electrons per cubic metre is 8×10^{28} , calculate the current density and average drift velocity.
 (Given $e = 1.6 \times 10^{-19} \text{ C}$).
53. Mention any five applications of superconductors.
54. A moving coil galvanometer of resistance 20Ω produces full scale deflection for a current of 50 mA. How will you convert the galvanometer into (i) an ammeter of range 20 A and (ii) a voltmeter of range 120 V ?

OR

- A circular coil of radius 20 cm has 100 turns of wire and it carries a current of 5 A. Find the magnetic induction at a point along its axis at a distance of 20 cm from the centre of the coil.
55. Explain how an e.m.f. can be induced by changing the area enclosed by the coil in a uniform magnetic field.
56. State and prove Brewster's law.
57. Explain the origin of characteristic X-rays.
58. What is photoelectric effect ? State the laws of photoelectric emission.
59. Derive an expression for the de Broglie wavelength of matter waves.
60. The binding energy per nucleon for ${}_6\text{C}^{12}$ nucleus is 7.68 MeV and that for ${}_6\text{C}^{13}$ is 7.47 MeV. Calculate the energy required to remove a neutron from ${}_6\text{C}^{13}$ nucleus.
61. Explain the working of a half wave diode rectifier.
62. With the help of block diagram, explain the operation of an FM superheterodyne receiver.

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PART - IV

N. B. : i) Answer any *four* questions in detail.

ii) Draw diagrams wherever necessary.

$4 \times 10 = 40$

63. What is an electric dipole ? Derive an expression for the electric field due to an electric dipole at a point on its axial line.
64. Deduce an expression for the force on a current carrying conductor placed in a magnetic field. Find the magnitude of the force.
65. What are eddy currents ? Explain their applications. How are they minimised ?
66. Derive an expression for bandwidth of interference fringes in Young's double slit experiment.
67. Draw a neat sketch of Ruby Laser. Explain its working with the help of energy level diagram.
68. Discuss the principle and action of a Bainbridge mass spectrometer to determine the isotopic masses.
69. What is meant by feedback ? Derive an expression for voltage gain of an amplifier with negative feedback.
70. Make an analysis of amplitude modulated wave. Plot the frequency spectrum.
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