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**Part III — PHYSICS**

( English Version )

Time Allowed : 3 Hours ]

[ Maximum Marks : 150

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

ii) Choose and write the correct answer.

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

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

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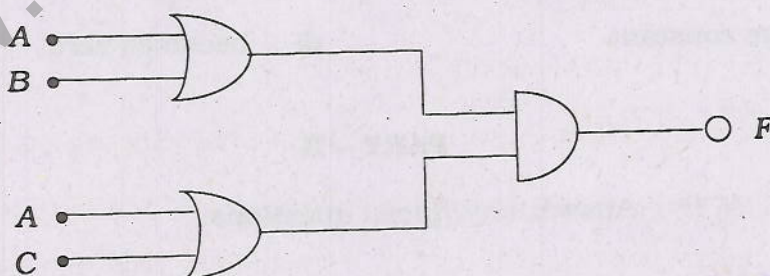


12. In a discharge tube, the source of positive rays ( canal rays ) is
- cathode
  - anode
  - gas atoms present in the discharge tube
  - fluorescent screen.
13. The minimum wavelength of X-rays produced in an X-ray tube at 1000 kV is
- 0.0124 Å
  - 0.124 Å
  - 1.24 Å
  - 0.00124 Å.
14. The ionisation potential of hydrogen atom is
- 13.6 eV
  - 13.6 eV
  - 13.6 V
  - 13.6 V.
15. At the threshold frequency, the velocity of the electrons is
- zero
  - minimum
  - maximum
  - infinite.
16. In an A.C. circuit
- the average value of current is zero
  - the average value of square of current is zero
  - the average power dissipation is zero
  - 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
- $\frac{\pi}{4}$
  - $\frac{\pi}{2}$
  - $\pi$
  - 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
- 57.5°
  - 32.5°
  - 90°
  - 115°.

19. Soap bubbles exhibit brilliant colours in sunlight due to
- scattering of light
  - diffraction of light
  - polarisation of light
  - interference of light.
20. The radii of Newton's dark rings are in the ratio
- 1 : 2 : 3 : .....
  - $\sqrt{1} : \sqrt{2} : \sqrt{3} : \dots\dots$
  - $\sqrt{1} : \sqrt{3} : \sqrt{5} : \dots\dots$
  - 1 : 4 : 9 : .....
21. Of the following devices, which has small resistance ?
- Voltmeter
  - Moving coil galvanometer
  - Ammeter of range 0 - 1 A
  - Ammeter of range 0 - 10 A.
22. The resistance of the filament of a 110 W, 220 V electric bulb is
- 440  $\Omega$
  - 220  $\Omega$
  - 484  $\Omega$
  - 848  $\Omega$  .
23. The self-inductance of a straight conductor is
- zero
  - infinity
  - very large
  - very small.
24. A D.C. ( direct current ) of 5 A produces the same heating effect as an A.C. ( alternating current ) of
- 50 A rms current
  - 5 A peak current
  - 15 A rms current
  - none of these.
25. Q-factor of a series resonant circuit
- $Q = \frac{1}{L} \sqrt{\frac{R}{C}}$
  - $Q = \frac{1}{R} \sqrt{\frac{L}{C}}$
  - $Q = \frac{1}{R} \sqrt{\frac{C}{L}}$
  - $Q = \frac{1}{C} \sqrt{\frac{L}{R}}$



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  $9^\circ$  when placed in a polarimeter. If the specific rotation is  $60^\circ$ , 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  $10^{-6} \text{ m}^2$  area of cross-section, carries a current of 2 A. If the number of electrons per cubic metre is  $8 \times 10^{28}$ , 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  $20 \Omega$  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.

## 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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