2008   )4   1002

PHYSICS (Optional)

भौतिकशास्त्र (वैकल्पिक)

Time : 3 hours   **Maximum Marks : 200**

Note :

(i)   *In all attempt Five Questions.*

(ii)   *Question No. 1 is compulsory.*

(iii)   *Of the remaining Questions, Attempt Any four by selecting <u>one Question</u> from each section.*

(iv)   *Numbers of optional questions upto the prescribed number in the order in which questions have been solved, will only be assessed and excess answers of the question/s will not be assessed.*

(v)   *Candidate should not write roll number, any name (including his/her own), signature, address or any indication of his/her identity anywhere inside the answer book otherwise he/she will be penalised.*

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1.   Answer *any four* of the following :

     (a)   A particle is subjected to two rectangular S.H.M.s given by $x = a \sin(\omega t + \phi)$ and   **10**

          $y = b \sin(\omega t)$. Show that for $a = b$ and $\phi = \dfrac{\pi}{2}$ the resultant path of the particle is circle.

     (b)   What is a chromatic aberration ? Represent it diagrammatically. Describe with a   **10**
          diagram, working of Ramsden's eyepiece.

     (c)   Describe stroboscopic method to determine the frequency of a tuning fork. Hence   **10**
          determine the frequency of A.C.

     (d)   Define packing fraction and show that packing fraction for BCC crystal structure   **10**
          is $\dfrac{\sqrt{3}\,\pi}{8}$.

     (e)   Explain intensity level of a sound. Give its formula. Calculate the change in   **10**
          intensity level when the intensity of sound increases 10 times its original intensity.

SECTION-A

2.   (a)   Derive an expression for M.I. of solid sphere about its diameter and about its   **20**
          tangent.
          Assuming that the earth is a homogeneous sphere of radius 6.4×10^3 km and
          density 5.4 gm/cm^3, calculate the moment of inertia about its axis of rotation and
          rotational K.E. of the earth when spinning about its axis.

                                                     -P.T.O.

(b) Describe the platinum resistance thermometer. Explain how it is used to measure the unknown temperature.

The resistance of platinum wire is 6 Ω at 0°C and 7.2 Ω at 100°C. Calculate the temperature coefficient of resistance.

3. (a) Define surface tension in terms of surface energy. Give its S.I. unit and C.G.S. **20** unit. Explain angle of contact. Obtain the relation between surface tension, excess pressure and radius of curvature of thin film.

Hence find out the excess pressure for a liquid drop in a liquid, spherical soap bubble and spherical drop of liquid.

(b) With the help of schematic diagram, explain the working of otto engine. Explain **20** otto cycle with an indicator diagram. Hence deduce the expression for efficiency of otto engine.

SECTION-B

4. (a) What is interference of light ? Obtain condition for constructive and destructive **10** interference in reflected system of rays from parallel thin film.

(b) State and explain Coulomb's law in electrostatics. Express it in vector form. **20**

Derive an expression for the electric potential at any point due to electric dipole.

Hence deduce the electric potential due to dipole at an axial point and at an equatorial point.

(c) Obtain an expression for the current flowing through the circuit containing **10** inductance, resistance and capacitance connected in series with an emf

$e = e_0 \sin wt$.

Hence explain the phenomenon of resonance in series L – C – R circuit.

5. (a) (i) Distinguish between Fresnel and Fraunhofer class of diffraction. **5**

(ii) State Brewster's law of polarization. **5**

(b) (i) Obtain relation between three electric vectors i.e. $\vec{D} = \epsilon_0 \vec{E} + \vec{P}$. **10**

(ii) State Ohm's law in electricity. Using Ohm's law derive the relation $\vec{J} = \sigma \vec{E}$ **10**

(c) (i) State and prove Ampere's circuital law. Hence derive the equation $B = \dfrac{\mu_0 I}{2\pi r}$ for magnetic induction at a point situated outside the cylindrical wire.

(ii) An aluminium wire of diameter 0.4 m carries a current of 25 ampere. Find the magnetic induction at the surface of the wire.
(Given : $\mu_0 = 4\pi \times 10^{-7}$ wb/A – m).   **4**

SECTION-C

6. (a) What is nuclear fission ? Explain how energy is liberated during the process. Give suitable example in agreement with your argument.   **20**

   (b) What are different quantum numbers associated with electron ? Explain each quantum number in detail.   **20**

7. (a) Write a short note on wave velocity and group velocity. Obtain expression for group velocity. Show that the group velocity is equal to the particle velocity.   **20**

   (b) Explain the basic principle of nuclear detectors. Describe with neat diagram construction and working of G.M. tube.   **20**

SECTION-D

8. (a) Obtain expression for energy levels and density of states in one dimension electron gas.   **20**

   (b) State and prove DeMorgan's theorems in Boolean algebra.   **20**

   Convert the following numbers :

   (i) 10110110_2 into decimal number.

   (ii) $1 B 2 C_{16}$ into decimal number.

   (iii) 5107_8 into decimal number.

   (iv) $F F F F_{16}$ into Binary number.

P.T.O.

9. (a) Distinguish between conductors, semiconductors and insulators on the basis of energy bands.
Explain :

   (i) Intrinsic semiconductors

   (ii) Extrinsic semiconductors

   (iii) p type semiconductors

   (iv) n type semiconductors.

   Draw I-V characteristics of p n junction diode. Give the formula for intrinsic stand off ratio for Unit Junction Transistor (UJT).

   (b) (i) Draw a circuit diagram for adder using operational Amplifier. Explain its working.   5

   (ii) Draw a circuit diagram for integrator and differentiator using operational Amplifier. Explain their working.   5

   (iii) What is Barkhausen criteria for oscillations.   5

   (iv) Draw a circuit diagram for Astable multivibrator using IC 555.   5

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