HPAS (Main)—2013

PHYSICS

Paper II

Time : 3 Hours   Maximum Marks : 150

Note :— Question No. **1** is compulsory. Attempt any *Four*

questions from the rest. *All* questions carry equal

marks.

1. Answer the following :

    (a) How is Laplace's equation related to Poisson's

         equations ?   6

    (b) Discuss the role of Frank-Hertz experiment in

         Quantum mechanics.   6

    (c) Establish semi empirical mass formula. Also state

         its physical interpretations.   6

(d)   What is phonon ? Compare its properties with a photon.   6

(e)   Discuss the concept of Boolean algebra. Give *one* example to show that Boolean algebra is different from binary algebra.   6

2.   (a)   A right circular cone of semivertical angle α and height h has a uniform polarization p parallel to its axis of symmetry. Find the total polarization charge.   10

    (b)   Why a parallel LC circuit is inductive but a series LC circuit is capacitive below f_0 ? Describe the conditions for resonance in LCR circuits.   10

    (c)   A 20 Volts 5 Watt lamp is to be used as a.c. mains of 200 Volts 50 cycles/sec. Calculate the capacitor and inductor to be put in series to run the lamp.   10

3. (a) If the uncertainty in the position of a moving particle is equal to the wavelength associated with it, show that the uncertainty in its velocity is equal to $\left(\dfrac{1}{2\pi}\right)$ times its velocity.　　　10

(b) State the physical meaning of Schrödinger's wave equation. Establish time independent Schrödinger's equation.　　　10

(c) Describe the phenomena of photoelectric effect and Compton's effect. Establish the formula for Compton shift.　　　10

4. (a) Calculate the de-Broglie wavelength associated with a thermal neutron at 27°C.　　　10

(b) Define fission and its application in energy production. Describe fission mechanism in detail.　　　10

(c)   Describe nuclear forces. Discuss nuclear shell model in detail.   10

5.   (a)   Distinguish between the metals, semiconductors and insulators on the basis of band theory of solids.   10

(b)   The intrinsic resistivity of Ge at room temperature is 47 ohm. cm. Calculate the intrinsic carrier concentration if electron and hole mobilities in germanium at 300 K are 3900 cm^2/volt-sec and 1900 cm^2/volt-sec respectively.   10

(c)   What is Brillouin Zones ? Discuss the importance of first Brillouin Zone with *one* example.   10

6.   (a)   Define semiconductors. What are their characteristic properties ? Mention some uses of typical semiconductors.   10

(b) What is the significance of term 'field effect' ? Why is a field effect transistor called a unipolar transistor ? Draw schematically the structure of an n-channel JFET and discuss its working. 10

(c) State and prove De Morgan's theorems in digital electronics.

10

7. (a) What are the basic segments of a microprocessor ? Briefly mention their functions. 10

(b) What do you mean by rectification ? How can you study the performance of a diode rectifier with the help of its dynamic characteristic ? 10

(c) What do you understand by an electronic oscillator ? Name the different types of oscillators. What classes of oscillators are commonly used in AF and RF ranges and why ? 10

8.   (a)   Describe Biot-Savart's law. Discuss the differences between Biot-Savart's law and Ampere's law related to magnetism.   10

        (b)   Discuss the concept of quarks and their role in nuclear physics.   10

        (c)   Describe Raman effect and its experimental observation.   10