JBL

2011

PHYSICS (Optional)
(Paper – II)

520031

Standard : Degree | **Total Marks : 200**
Nature : Conventional (Essay) type | **Duration : Three hours**

N.B. : *1) Answers must be written in **English**.*

*2) Question **No. 1** is **compulsory**. Of the remaining questions, attempt **any Four** selecting one question from **each Section**.*

*3) Figures to the **RIGHT** indicate marks of the respective question.*

4) Make suitable assumptions, wherever be necessary and state the same.

5) Number of optional questions upto the prescribed number in the order in which they have been solved will only be assessed. Excess answers will not be assessed.

6) Credit will be given for orderly, concise and effective writing.

7) Candidates should not write roll number, any name (including their own), signature, address or any indication of their identity anywhere inside the answer book otherwise he/she will be penalised.

SEAL

Marks

1. Answer **any four** of the following :

(a) A point charge q is placed at a distance b from the centre of two concentric earthed conducting sphere of radii a and c, $a < b < c$. Find the potential at a point P for $a < r < b$. **10**

(b) What is a blackbody ? Draw the experimental curves of the blackbody radiation for different temperature. Discuss how classical approaches failed to account for the sperical distribution of energy density in a blackbody radiation. **10**

(c) What do you mean by Einstein's A, B coefficients ? Show that the ratio : **10**

$$\frac{Anm}{Bnm} = \frac{8\pi h\upsilon^3}{c^3}$$, the symbols used having their usual significance.

(d) Write a note on near earth orbiting satellites. **10**

(e) Explain the following :

(i) Geostationary and, **5**

(ii) Use of GPS in communication. **5**

P.T.O.

SECTION – A Marks

2. Answer the following sub-questions.

(a) Prove that, the scalar potential, $\phi(x) = \int \frac{\rho(x')}{|x - x'|} d^3 x'$, satisfies Poisson's equation. 10

(b) (i) State Faraday's law of e.m. induction and derive the differential form of Faraday's law of electromagnetic induction. 9

(ii) What are self and mutual inductions ? Define their coefficients and state its unit. 6

(c) (i) Write down Maxwell's equations in electromagnetic theory. Explain the physical significance of each of them. 9

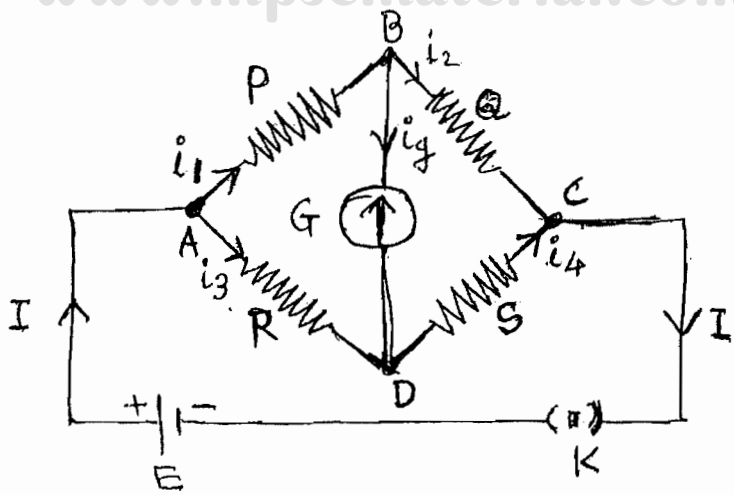
(ii) Prove that the velocity (v) of an e.m. wave in a medium of permeability (μ), permitivity (t) and conductivity $(\sigma) = 0$ (zero), is given by $v = \sqrt{1/\mu t}$. 6

3. Answer the following sub-questions.

(a) A dipole P is located in an external electrostatic field. Derive an expression for the torque acting at that point P. 10

(b) (i) State and explain Kirchhoff's current and voltage law. 6

(ii) Using Kirchhoff's law, deduce the balance condition of Wheatstone bridge. 9



(c) (i) What is Poynting vector ? What does it represent ? State and prove Poynting theorem. 9

(ii) Show that the average value of Poynting vector is given by,

$$(\vec{S}) = \frac{\vec{E}_0}{\sqrt{2}} \times \frac{\vec{H}_0}{\sqrt{2}} = \vec{E}_{rms} \times \vec{H}_{rms} = \frac{1}{2}(\vec{E}_0 \times \vec{H}_0)$$ 6

SECTION – B

Marks

4. Answer the following sub-questions.

(a) State de Broglie hypothesis and explain the various facts which led to this hypothesis. Derive an expression for de Broglie wavelength of a moving partical. **10**

(b) (i) What is harmonic oscillator ? Obtain an expression for potential energy of a classical harmonic oscillator. **9**

(ii) Obtain dimensionless form of Schrodinger's time independent equation for harmonic oscillator. **6**

(c) (i) Write the Schrodinger's equation in sperical co-ordinate for hydrogen atom. State the eigen function and eigen values. **6**

(ii) Show that the energy level in hydrogen atom are n^2 fold degenerate. **9**

5. Answer the following sub-questions.

(a) (i) State and prove Heisenberg's uncertainty principle. **5**

(ii) Calculate the minimum uncertainty in the velocity of an electron, when it is confined to a box of length 10^{-8} m. If the mass of electron, $m_e = 9 \times 10^{-31}$ kg. **5**

(b) (i) What is an operator ? Obtain operators for energy and momentom. **9**

(ii) Find an operator for the function a cos 4x, so that (–16) is the eigen value of an operator, where a is a constant. **6**

(c) (i) Explain orbital angular momentom of an electron. **6**

(ii) State four quantum numbers of an electron and explain their significance. **9**

SECTION – C

6. Answer the following sub-questions.

(a) Describe Stern Gerlach experiment and explain its significance. **10**

(b) What is Raman effect ? Describe experimental arrangement to study the Raman effect. **10**

(c) What are the nuclear forces ? State the characteristics of nuclear forces. **10**

(d) What is the need of nuclear model ? Explain the important observations upon which a liquid drop model is based. **10**

7. Answer the following sub-questions.

(a) State Bohr's postulates and use them to determine the expression for, **10**

(i) radius of Bohr's orbit and

(ii) total energy of electron in a hydrogen atom in the n^{th} state.

(b) What is non-rigid rotator ? Draw energy level diagram of rigid and non-rigid rotator and state the importance of dissociation constant D. **10**

P.T.O.

Marks

(c) Write short notes on,

(i) Binding energy and, nuclear magnetic moment. 5

(ii) Calculate the binding energy of α-partical in MeV. Given that, $m_p = 1.00758$ amu, $m_n = 1.00897$ amu, $m_{He} = 4.0028$ amu and 1 amu = 931.49 MeV. 5

(d) What is Nuclear Fission ? Explain the various stages in Fission process as given by the liquid drop model. 10

SECTION – D

8. Answer the following sub-questions.

(a) (i) Write short notes on, 6

(1) Unit cell and primitive cell, and

(2) Millar indices:

(ii) In a cubic system, show that the distance between (hk*l*) planes is given by,

$$d_{hkl} = \frac{a}{\sqrt{h^2 + k^2 + l^2}}.$$ 9

(b) What is doping ? Explain N-type semiconductor. Draw energy level diagram for N-type material. 10

(c) (i) Explain the fabrication of metal-semiconductor junction diode. Give its name and symbol. 6

(ii) What is rectifier ? Explain the use of a p – n junction diode as a half wave rectifier. Draw input and output waveform. Show that the ripple factor of HWR is 1.21. 9

9. Answer the following sub-questions.

(a) (i) Distinguish between, diamagnetic, paramagnetic and ferromagnetic substances. 6

(ii) Obtain the expression for magnetic susceptibility of a diamagnetic substance. 9

(b) (i) What is intrinsic semiconductor ? Draw energy band diagram for intrinsic semiconductor at 0°K. 4

(ii) Show that for an intrinsic semiconductor, the fermi level is given by

$$E_F = \frac{E_c + E_v}{2} + \frac{3}{4} KT \log_e \left(\frac{m_h}{m_e}\right).$$ 6

(c) (i) Distinguish between BJT, JFET and MOSFET. 6

(ii) Explain the working of N-channel deplesion MOSFET using neat circuit diagram. Draw a set of static drain characteristics for N-channel deplesion MOSFET. 9

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