[Total No. of Pages :7 Roll No_____

1(CCE-M)4

PHYSICS - II

[18]

Time : 3 Hours **Maximum Marks : 300**

INSTRUCTIONS

i) *Answer must be written in English.*

ii) *The number of marks carried by each question is indicated at the end of the question.*

iii) *The answer to each question or part there of should begin on a fresh page.*

iv) *Your answer should be precise and coherent*

v) *The part/parts of the same question must be answered together and should not be interposed between answers to other questions.*

vi) ***Candidates should attempt question No : 1 and 5 which are compulsory and any three more out of the remaining questions selecting at least one question from each part.***

vii) *If you encounter any typographical error, please read it as it appears in the textbook.*

viii) *Candidates are in their own interest advised to go through the general instructions on the back side of the title page of the answer script for strict adherence.*

ix) *No continuation sheets shall be provided to any candidate under any circumstances.*

x) *Candidates shall put a cross(X) on blank pages of answer script.*

xi) *No blank page be left in between answer to various questions.*

xii) *No programmable calculator is allowed.*

xiii) *No stencil (With different markings) is allowed.*

PART - A

Question number 1 is compulsory. **(4×15=60)**

1. a) The electric vector $\vec{E}$ of an electromagnetic wave is represented by $\vec{E}=\vec{i}\,2\cos(10^{15}\,\pi t-\frac{\pi}{3}\times 10^{7}\,z)\,mV/meter$. Calculate the magnetic field intensity $\vec{H}$, the energy density and momentum density associated with the electromagnetic wave.

b) A long straight cylindrical wire of radius 2 mm carries a direct current of 5A. The resistance per unit length of the wire is 0.1 Ω. Calculate the magnitude of the poynting vector $(\vec{S})$ at the surface of the wire. Determine its direction also.

c) Determine the binding energy of the most loosely bound neutron of $^{17}_{8}O$. Given that $m_n=1.008665u, m(^{17}_{8}O)=16.999132u$ *and* $m(^{16}_{8}O)=15.994915u$

d) A particle of mass $\sim 10^{-28}\, gm$ is confined to move in a spherical region of radius 10 nm. Obtain an estimate (approximate) of the particle's kinetic energy in ground state.

2. a) State Biot - savart law. Calculate the magnitude of the magnetic field at a point 100 cm from a long, thin conductor carrying a current of 1A. **(30)**

b) Discuss with the help of a phasor diagram the phase relationship between the voltages across the elements R,L and C of a series LCR circuit. For a series LCR combination connected across at voltage source of 220 V and 50 Hz, calculate the voltages across L, C and R and the average power delivered to the LCR circuit if R = $500\,\Omega$, C = 2μ F and L = 1.25 H. **(30)**

3. a) Write down Maxwell's equations for vacuum. Obtain wave equation and dispersion relation for electromagnetic waves propagating in a medium. **(30)**

b) Discuss the magnetic fields in the context of diamagnetic, paramagnetic and ferromagnetic materials. What are antiferro and ferri magnetisms **(30)**

4. Write short notes on :

i) Stern Gerlach experiment and its significance. **(30)**

ii) Band theory of solids **(30)**

PART - B

Question number 5 is compulsory. **(4×15=60)**

5. a) A substance exhibits a Raman line at 4500 A^0. When it is illuminated by a light of $\lambda = 4200\ A^0$. If the substance is irradiated by light of $\lambda = 4000\ A^0$, determine the wavelengths of stoke's and anti - stokes lines.

b) A Zener diode connected in series to a resistor of $R = 200\,\Omega$ maintains a voltage of 20 volts across a load of $1k\,\Omega$. If the current rating of the zener diode is 20 mA, determine the range of input voltages over which the zener

diode could be used for providing a stable voltage of 20 volts across the load.

c) A transistor amplifier in common - emitter configuration has the following parameter values : Input resistance = 0.2 $k\Omega$, $R_C = 2k\Omega, R_L = 8k\Omega, and\ \beta = 100$. An input of 0.5 mV is applied to the amplifier. Find the output voltage of the amplifier.

d) If the spin - orbit splitting of $3P_{3/2}$ *and* $3P_{1/2}$ states of Na is 0.002 eV, calculate the magnitude of the internal magnetic field causing the splitting.

6. a) Write down the time independent shrodinger equation for a one dimensional simple harmonic oscillator. Obtain eigen functions and eigen values for the oscillator. Discuss their physical significance. **(40)**

b) Obtain an expression for the magnitude of minimum energy of the simple harmonic oscillator allowed by the uncertainty principle. **(20)**

7. a) What are various types of particle accelerators? Give the theory of accderation of the particles using any one of them. **(30)**

b) What are weak and strong electromagnetic interactions. Give an account of classification of the elementary particles. **(30)**

8. a) How does a solar cell work. Obtain an expression for the maximum delivered power across a load connected to a solar cell and determine the efficiency of the solar cell. **(35)**

b) Describe the techniques of modulation and detection of radio frequency waves. **(25)**