Total No. of Printed Pages-4 **Roll No. _____**

1(CCE-M)6

PHYSICS-II

[18]

Time Allowed -3 Hours *Maximum Marks-300*

INSTRUCTIONS

i) *Answers 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 **nos.1 and 5** which are compulsory and any **four** out of the the remaining questions, selecting **two** questions from each section.*

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

viii) *Candidates are in their own interest are 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.*

xiv) *In no circumstances help of scribe will be allowed.*

SECTION-A

1. a) A square loop of conducting wire of side 10.0 cm carries a current of 1.5 A. Find the magnitude of magnetic field $|\vec{B}|$ at the centre of the loop.**(4×12.5=50)**

b) A 10.0 Watt laser beam has a diameter 0.5 cm. Determine the time averaged poynting vector and the amplitude of electric field of the laser beam.

c) A series RLC circuit has R=2.0 Ω , L=10.0 mH and C=1.0 μF. A variable frequency voltage source of 9.0 V is connected across the circuit. At resonance, find the voltage across L,C and R. What is the Q-value of the resonant circuit?

d) An uncharged square plate [20.0 cm × 20.0 cm] of a conductor is placed in a region of uniform electric field of 8000 N/C. The direction of the field is perpendicular to the surface of the plate. Find the total charge on each face of the plate.

2. a) Consider a thick insulating cylindrical shell with inner and outer radii a and b. It has uniform volume charge density ρ. Find the electric field in the regions (i) $r \leq a$, (ii) $r \geq b$ and (iii) $a \leq r \leq b$ **(30)**

b) A long solenoid of radius 5.0 cm has 10 turns per cm. A ring of wire of radius 2.0 cm is placed within the solenoid perpendicular to the axis of the solenoid.what is the value of mutual inductance? **(20)**

3. a) Write down Maxwell's equations in integral forms. What does each of these equations signify? **(25)**

b) An atom makes a transition from an excited state to the ground state with emission of photons of wavelength $\lambda = 600$ nm. If the life time of the excited state is 10^{-8} s, What is the spectral width of the transition line? **(25)**

4. a) Write down the Schrodinger equation for hydrogen atom is spherical coordinate system. Solve it to obtain expressions for its ground state energy and wave function. **(35)**

b) Consider the emission of radiation of wavelength $\lambda = 500$ nm due to transition from p-state to s-state of an electron in an atom. Estimate the wavelength separation between two components of radiations from the split p-states to the s-state due to Zeeman effect, if the atom is placed in a magnetic field of 1.0T. **(15)**

SECTION-B

5. a) A photon of energy 2.0 KeV makes a collision with a free electron and is deflected by 90^0. How much energy is gained by the electron as a result of the collision with the photon? **(4×12.5=50)**

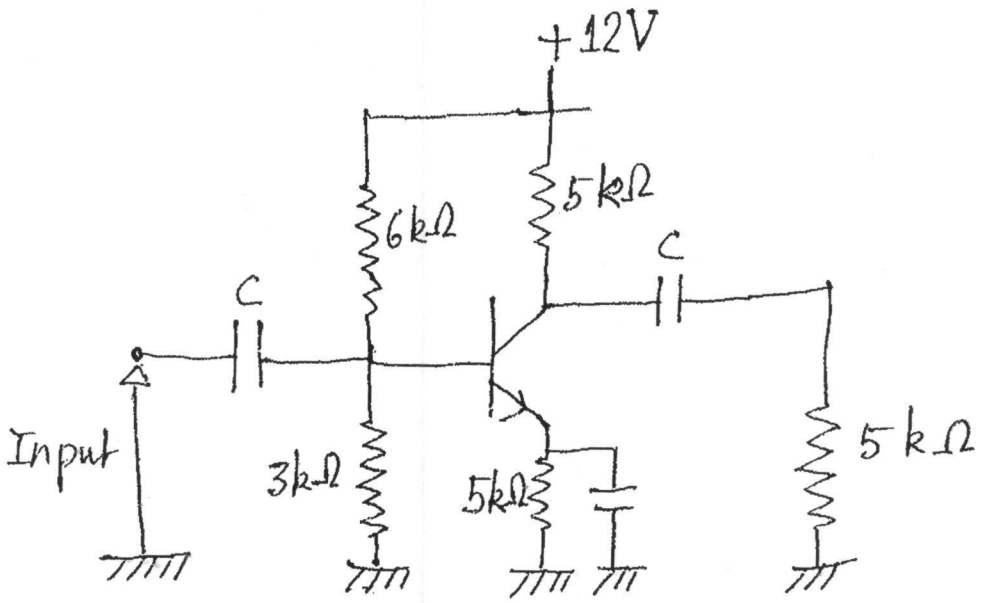
b) A cyclotron operates with magnetic field B= 5.2 T and produces accelerated protons of energies 30 Mev. What is the radius of the cyclotron?

c) An electron is confined to move in a 1- dimensional box. Its energy in the ground state (n=1) is 2.0 eV. How much energy will be needed to excite it to its first excited state?

d) A 6.0 V Zener diode is connected across a voltage source of 24.0 V through a series resistor R. If a load resistor of 3.0 KΩ is connected across the Zener diode. What is the maximum value of R which would give a constant voltage of 6.0 V across the load?

6. a) Find the concentration of holes and electrons in a p-silicon semiconductor of resistivity 100 Ω cm. The hole and electron mobilities are 500 cm^2/ v.sec and 1500 cm^2/ v.sec, respectively and the intrinsic carrier concentration is 1.5×10^3 cm^{-3}. **(25)**

b) Find the voltage gain of the amplifier represented by the circuit given below



(25)

7. a) What is Raman effect? Obtain expressions for wave numbers corresponding to spectral lines in a pure rotational spectra of a linear molecule. **(30)**

b) Write down nuclear fusion reaction involving deuterium (D) and tritium (T) What are the essential conditions to be met for nuclear fusion of D and T to occur? **(20)**

8. a) Explain the fine structure of hydrogen atom arising due to l-s coupling. **(20)**

b) List elementary particles alongwith their classification. Explain strong and weak electromagnetic interactions. **(20)**

c) What are various types of modulations employed in radio frequency communication? Discuss their relative merits. **(10)**

Physical Constants

Velocity of light in vacuum $C = 3 \times 10^8$ m/s

Mass of electron $m_e = 9.11 \times 10^{-31}$ Kg.

Charge of electron $e = 1.602 \times 10^{-19}$ C

Specific charge of electron $e/m_e = 1.76 \times 10^{11}$ C/kg

1 u = 1 amu = 1.660566×10^{-27} Kg = 931.5_M eV/c^2

Rest mass energy of electron $m_e c^2 = 0.511_M$ eV

Permittivity in free space $\epsilon_0 = 8.8542 \times 10^{-12}$ $C^2/N/m^2$

Permeability of free space $\mu_0 = 4\pi \times 10^{-7}$ N/A^2

Gas constant R = 8.314 J/mol/K

Boltzman constant $K_B = 1.381 \times 10^{-23}$ J/K

Planck constant $h = 6.626 \times 10^{-34}$ Js

$h = 1.0546 \times 10^{-34}$ J_s

Bohr magneton $\mu B = 9.274 \times 10^{-24}$ J/T

Nuclear magneton $\mu n = 5.051 \times 10^{-27}$ J/T

Fine structure constant $\alpha = 1/137.03599$
