7. What is the Schrödinger equation for a free particle in one dimension ? Solve this equation to obtain the permitted energy eigen values and the permitted eigen functions for the particle. Is there any quantisation of energy in this case ? 50

8. State the law of radioactive transformation. Obtain expressions for half-life and mean life. Indicate how radioactivity helps in estimating the age of earth. 50

Total No. of Printed Pages : 4 **Roll No. ....**

1(CCE.M)2

Physics–II

(18)

Time : Three 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 thereof 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 remaining questions, selecting **two** questions from each Part.

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

(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 (×) 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

1. (a) A wire carrying a current of 100 ampere is bent into the form of a circle of radius 5.08 cm. Calculate magnetic flux density perpendicular to the plane of the coil at a distance of 12 cm from the coil. 10

   (b) The time constant of a coil is 2.5 milli-sec. On joining 80 Ω in series, the time constant is 0.5 milli-sec. Calculate the self inductance and resistance of the coil. 10

   (c) Calculate the self inductance of an air cored toroid of mean radius 20 cm and a circular cross section of area 5 cm^2. The total number of turns of the toroid is 3000. 15

   (d) A half wave rectifier supplies to a 1 kΩ load. The input supply is 200 V_{rms}. Neglecting the forward resistance of the diode, calculate V_{dc} and I_{dc}. 15

2. (a) Explain Zener breakdown. 15

   (b) Explain the working of junction diode and discuss its V-I characteristics. 35

3. (a) What is electromagnetic induction ? State Faraday's law of electromagnetic induction. 25

   (b) State and explain Lenz's law. Does it contradict the law of conservation of energy ? 25

4. (a) What is quality factor of a circuit ? 15

   (b) Obtain an expression for the current in an a.c. circuit containing resistance R, inductance L and capacitance C in series. Under what conditions will electrical resonance occur ? 35

PART–B

5. (a) Consider a potassium surface that is 75 cm away from a 100 watt bulb. Suppose that the energy radiated by the bulb is 5% of the input power. Treating each potassium atom as a circular disk of diameter 1Å, determine the time required for each atom to absorb an amount of energy equal to its work function of 2 eV, according to the wave interpretation of light. 15

   (b) The potential difference across an X-ray tube is 50000 volt and the current through it is 2.5 mA. Calculate number of electrons striking the anode per second and the speed with which they strike it.

   (Given charge of electron is 1.6×10^{-19}C and mass of the electron is 9×10^{-31} kg). 15

   (c) If the activity of a radioactive sample drops to 1/16 of its initial value in 1 hr. and 20 min., what is its half life ? 10

   (d) A radio station operates at a frequency of 103.7 MHz with a power output of 200 kW. Determine the rate of emission of quanta from the station. 10

6. (a) What are the basic postulates of quantum mechanics ? 10

   (b) Give the main points of similarity and dissimilarity between the Schrödinger wave equation and classical wave equation. 10

   (c) Obtain Schrödinger wave equation for matter waves. 30