

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. FOURTH SEMESTER EXAMINATION, SEPTEMBER 2019

SECOND YEAR (BATCH 2018-21)

PHYSICS (General)

Paper : IV

Date : 01/10/2020

Time : 11.00 am – 1.00 pm

Full Marks : 25

Answer **any five** questions : [5×5]

1. a) What is a rectifying circuit? [1]
b) Draw a bridge rectifying circuit using p-n junction diodes. What is its use? [2]
c) What is the significance of a filter circuit using capacitors and inductors on it? [2]
2. a) What is time dilation? [1]
b) What do you mean by proper time? [1]
c) If A and B two spaceship is moving with velocity .9c to each other. Where c is the velocity of light. What the velocity of 'B' will be observed by 'A'? [3]
3. a) Establish mass energy relation. [2.5]
b) If a particle of velocity v acquire kinetic energy twice that of its rest mass energy. What will be its velocity? [2.5]
4. a) A ball of mass 10 g has velocity 100 cm/s. Calculate the wavelength associated with it. Why this wave nature doesn't show up in our daily observations? Given $h = 6.626 \times 10^{-34} \text{ Js}$. [1+1]
b) What do you mean by wave packet? Why quantum particle can be considered as a wave packet? How can you reduce the extension (localize) a wave packet (quantum particle)? What happen to its momentum then? [0.5+0.5+0.5+0.5]
c) Find the uncertainty in the momentum of a particle when its position is determined within 0.01 cm. [1]
5. a) What do you mean by wave function in quantum mechanics? Mention the characteristics a quantum mechanical wave function must have? [1+1]
b) A certain wave function of a particle of mass m in one dimensional box of length l is given by

$$\psi(x, t) = A \sin\left(\frac{3\pi x}{l}\right) e^{-\frac{9i\hbar\pi^2 t}{2ml^2}} .$$

Determine (i) the normalization constant A, (ii) eigen value of p_x^2 operator where p_x is the momentum along x-direction and (iii) energy eigen value.

[1+1+1]

6. a) Find and prove which of the following nucleus is most stable in terms of binding energy:

${}_2\text{He}^4$, ${}_1\text{H}^2$, ${}_{92}\text{U}^{235}$ and ${}_{26}\text{Fe}^{56}$? Assume necessary values. [3]

b) C^{14} decays with a half life of about 5800 years. In a sample of bone, the ratio of C^{14} to C^{12} is found to be $1/4^{\text{th}}$ of what it is in free air. Find the age of the bone. [2]

7. a) Find the threshold energy of ${}^{14}\text{N}(\alpha, p){}^{17}\text{O}$ reaction. [3]

b) Find the energy produced in the fission of 1gm of ${}^{235}\text{U}$. Given that each ${}^{235}\text{U}$ gives 200Mev in fission. [2]

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