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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Eighth Semester, B.E. - Semester End Examination; Aug. / Sep. - 2020

Modern Physics

Time: 3 hrs

Max. Marks: 100

Note: i) Answer **TWO** full questions, selecting **ONE** full question from **UNIT - I** and **UNIT - II**.

ii) Answer any **THREE** full questions, choosing from **UNIT - III**, **UNIT - IV** and **UNIT - V**.

Physical constants: Electron mass, $m = 9.11 \times 10^{-31}$ kg, Electron charge, $e = 1.602 \times 10^{-19}$ C; Velocity of light, $c = 3 \times 10^8$ ms^{-1} ; Planck's constant, $h = 6.626 \times 10^{-34}$ Js; Boltzmann constant, $K = 1.38 \times 10^{-23}$ JK^{-1} ; Avogadro number, $N = 6.025 \times 10^{23}$ /mole; Permittivity of free space, $\epsilon_0 = 8.85 \times 10^{-12}$ Fm^{-1} .

UNIT - I

- 1 a. Write a brief note on types of conservation laws in nuclear reactions. 10
- b. Define Exoergic and Endoergic reactions. Obtain the relation between the energy released and the measured quantities E_x , E_y and θ in Q-value reaction. 10

OR

- 2 a. Discuss briefly Compound and Direct nuclear reactions. 10
- b. i) Define nuclear reaction cross section and derive an expression for it.
- ii) Calculate the differential cross section for the Rutherford scattering of 215 MeV (lab energy) ^{48}Ca from ^{208}Pb at an angle of 20° . 10

UNIT - II

- 3 a. Describe the energy loss according to Bremsstrahlung when a photon interacts with matter. 10
- b. Derive Bethe-Block formula in case of non-relativistic speed. 10

OR

- 4 a. i) Discuss briefly on Cerenkov radiation.
- ii) In an absorption experiment with 1.14 MeV γ -radiations from Zn^{65} , it is found that 25 cm of Al reduce the beam intensity of 2%. Calculate the half value thickness and the mass absorption coefficient of aluminum for this radiation. 10
- b. Write a brief note on Gamma ray interaction through matter. 10

UNIT - III

- 5 a. i) Describe the construction and working of an ionization chamber.
- ii) Compute the maximum energy of the Compton recoil electrons resulting from the absorption in Al of 2.19 MeV γ -rays. 10
- b. Write a brief note on Silicon and Germanium Semi-conductor detectors for charge particle detection. 10

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- 6 a. i) Describe a G.M. counter and explain its working as a particle detector. 10
 ii) A GM counter wire collects 10^8 electrons per discharge. When the counting rate is 500 counts/min, what will be the average current in the circuit? 10
- b. Write a brief note on Scintillation counter and construction and working of Photo-Multiplier Tube. 10

UNIT - IV

- 7 a. Develop the theory of linear accelerator and mention its limitations. 10
- b. i) What are the differences between cyclotron and synchrotron? 10
 ii) In a certain Betatron the maximum magnetic field at orbit was 0.4 wb/m^2 , operating at 50 c/s with a suitable orbit diameter of 1.5 m. Calculate the final energy of the electron. 10
- 8 a. Describe the construction and working of cyclotron. Discuss its limitations. 10
- b. Describe the necessary theory for working of Betatron. 10

UNIT - V

- 9 a. Derive an expression for variation of mass with velocity and discuss it with reference to special theory of relativity. 10
- b. Deduce an expression for time dilation and explain the variation of time with velocity. 10
- 10 a. State the fundamental postulates of the special theory of relativity and deduce the Lorentz transformations equations. 10
- b. i) Obtain an expression for Einstein mass-energy equivalence 10
 ii) What is the length of a metre stick moving parallel to its length when it's mass increased to $3/2$ of its original length? 10

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DR. N. L. MURALI KRISHNA
 Controller Of Examinations
 P.E.S. College of Engineering
 (An Autonomous Institution under VTU, Belgaum)
 MANDYA-571 401, Karnataka