

NOTE: Numbers in the right indicate marks.

All questions are compulsory.

Use of non-programmable calculators is allowed.

Q.1) Answer the following: (20 Marks)

- A) Show how to measure the inductance of a coil using Maxwell's Inductance bridge. What are its limitations? Also find the value of R_x and L_x for the given component values: $R_1 = 1000\Omega$, $R_2 = 100\Omega$, $R_3 = 200\Omega$, $L_3 = 330\text{mH}$. (8M)

OR

- A) State Norton's theorem. Illustrate it with suitable example. (8M)

- B) What is Ballistic Galvanometer? Explain the differences between the Ballistic and the dead beat galvanometer. (7M)

OR

- B) State and explain Reciprocity theorem. (7M)

- C) Explain De Sauty's capacitance bridge. Find the condition for its balance. Is the condition independent of frequency of the applied voltage? (5M)

OR

- C) A coil of a suspended coil galvanometer has 500 turns, each of area 5 cm^2 , the radial magnetic field being 2000 oersted. A current of $0.12\mu\text{A}$ through the galvanometer produces a deflection of 8° . Determine the torque required to twist the suspension through 1 radian. (5M)

Q.2) Answer the following: (20 Marks)

- A) Define: (i) Mass defect, (ii) Binding Energy, (iii) Binding fraction. Using the given data find the B.E. of neutron in the ${}^7_3\text{Li}$ nucleus. Express it in MeV and joules.

Given: ${}^7_3\text{Li} = 7.016004$, ${}^6_3\text{Li} = 6.015125$ and ${}_0^1\text{n} = 1.008665$. (8M)

OR

- A) Explain the law of successive disintegration. Derive an expression for the number of atoms in the first two daughter elements formed in the process. (8M)

- B) Explain why an electron cannot exist inside the nucleus? (7M)

OR

- B) Define half-life time of radioactive element. Show that it is inversely proportional to the decay constant. What is half-life if the activity of a certain preparation of radioactive nuclei reduces 2.5 times after 7 days? (7M)

- C) Define (i) Activity of Radioactive substance (ii) 1 Curie (5M)

OR

- C) Discuss in detail (i) Positron Emission and (ii) Electron capture. (5M)

22
6300

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Q.3) Answer the following:

(20 Marks)

A) Write a note on pair production and also find threshold wavelength for pair production.

OR

A) State and explain Heisenberg uncertainty principle relating variables

a) Position and Momentum

b) Energy and Time

Find de Broglie wavelength of baseball of mass 2.5kg, having velocity of 10 m/s.

B) Define group velocity and phase velocity and show that the phase velocity has no significance.

OR

C) Explain Compton Effect with neat and labelled diagram. Hence show that energy of photon which shows Compton effect is given by

$$h\nu_0 = \frac{h\nu}{1 + \frac{h\nu}{m_0c}(1 - \cos\theta)}$$

D) State and explain de Broglie's hypothesis.

OR

E) If a photon has energy 1 KeV, what will be its wavelength and frequency?

Q.4) Answer the following (Any 3):

(15 Marks)

A) De Sauty's capacitance bridge has $R_1 = 800\Omega$, $R_2 = 1200\Omega$ and $C_2 = 0.47\mu F$. Find the value of the other capacitor when the bridge is balanced.

B) A BG has a steady deflection of 150mm for a current of $0.3\mu A$ at a distance of 1 metre. It completes 10 oscillations in 62.8s. Find current and charge sensitivities. What should be the undamped throw when a charge of $0.15\mu C$ circulates through the BG?

C) Determine (i) radius of a nucleus, (ii) Volume, (iii) Mass of nucleus and (iv) Density of a Copper nucleus, having atomic mass number 63. [$R_0 = 1.4\text{fm}$]

D) Calculate the half-life of a radioactive substance, if the activity of substance decreases to $\left(\frac{1}{5}\right)^{\text{th}}$ of its original value in 60 days.

E) Explain gravitational red shift.

F) Derive the relationship between phase velocity (V_p) and group velocity (V_g).