KNT/KW/16/5081

Bachelor of Science (B.Sc.) Semester—II (C.B.S.) Examination

PHYSICS

(Gravitation, Astrophysics, Magnetism and Magneto Statics)

Compulsory Paper—2

Time : Three Hours] [Maximum Marks : 50

N.B. :— (1) All questions are compulsory.

(2) Draw neat diagrams wherever necessary.

EITHER

1. (A) State Kepler's laws of planetary motion and show that the square of the period of revolution of the planet about the sun is directly proportional to the cube of the major axis of the elliptical orbit. 5

(B) (i) Obtain an expression for acceleration due to gravity at a height h from the earth's surface. 3

(ii) Determine the acceleration due to gravity on the surface of the sun.

Given : Radius of sun = 110 R and mass of sun = 33×10^4 M. Here R and M are the radius and mass of earth respectively. Acceleration due to gravity on the surface of earth is g. 2

OR

(C) State and prove Gauss's theorem in gravitation. 2½

(D) State the Newton's law of gravitation and express it in vector form. 2½

(E) Derive the expression for gravitational potential and intensity of gravitational field due to a solid sphere at a point outside the sphere. 2½

(F) Find the gravitational potential and gravitational potential energy of a body of 0.2 kg at a height of 1600 km above the surface of earth ($G = 6.67 \times 10^{-11}$ $\mu m^2/kg^2$, mass of earth = 6×10^{24} kg, radius of earth = 6400 kms) 2½

EITHER

2. (A) What are planets ? Derive an expression for the mass of sun, when a planet is orbiting in a circular path of radius R around it. 5

(B) (i) Describe the constituents of the universe in detail. 3

(ii) The earth receives an amount of heat radiation 1.4×10^3 Wm^{-2} from the sun. Assume the earth re-emits all the radiation received from the sun. Calculate the surface temperature of the earth.

[Given : $\sigma = 5.67 \times 10^{-8}$ Wm^{-2} K^{-4}] 2

OR

(C) Discuss the characteristics of various layers on the surface of the sun. 2½

(D) Explain the various cosmological theories of the universe. 2½

(E) Describe the method for determination of the size of a planet. 2½

(F) One of the satellites of planet Jupiter has time period 1.769 days and orbits in a circular orbit of radius 4.22×10^8 m. Calculate the mass of Jupiter.

[Given : $G = 6.67 \times 10^{-11}$ μm^2 kg^{-2}] 2½

EITHER

3. (A) Obtain an expression for magnetic moment per unit volume of a paramagnetic substance placed in an external magnetic field B. Draw the variation of Langevin function L(y) with B and temperature T. 5

(B) (i) Explain Meissner effect. Show that substances in superconducting state are perfectly diamagnetic. 3

(ii) The transition temperature for lead is 7.26 K. The maximum critical field for the material is 8×10^5 A/m. What precautions will have to be taken for using Lead in superconducting state in a magnetic field of 4×10^4 A/m^2 ? 2

OR

(C) State the properties of ferromagnets. Explain the origin of permanent magnetic moments in ferromagnetic substances, with examples. 2½

(D) Draw the B-H curve and mark ‘remanence’ and ‘coercivity’ on it. Define saturation magnetization, remanence and coercivity. 2½

(E) What is superconductivity ? Discuss the variation of critical field H_c with temperature. 2½

(F) Find the magnetic flux density B and permeability of a medium, if magnetic field intensity H is 167 A/m and susceptibility is 5000.

Given : $\mu_0 = 4\pi \times 10^{-7}$ N/A^2. 2½

EITHER

4. (A) What is a solenoid ? Derive an expression for the magnetic field inside a solenoid of infinite length. Show the variation of B with length of the solenoid. 5

(B) (i) Obtain an expression for the magnetic moment due to orbital motion of an electron in an atom. What is gyromagnetic ratio ? 3

(ii) A solenoid has length 2 metres and mean diameter 0.05 metre. If has 4 layers of 1000 turns each. Calculate flux density at its centre when a current of 2.5 amperes flows through it. [Given : $\mu_0 = 4\pi \times 10^{-7}$ Wb m^{-2}] 2

OR

(C) Obtain an expression for the force acting on a current carrying conductor in uniform magnetic field. 2½

(D) What is a toroid ? Obtain an expression for the magnetic field in a toroid. 2½

(E) Define magnetic susceptibility and permeability. Establish a relation between them. 2½

(F) A magnetic field of 1.6×10^3 Mks units produces a flux of 2.4×10^{-5} Wb in bar of iron of cross-section 0.2 cm^2. Calculate the permeability and susceptibility of the specimen. (Given : $\mu_0 = 4\pi \times 10^{-7}$ Wbm^{-2}) 2½

5. Attempt any **TEN** questions :—

(i) What is Gravitational self-energy of a body ?

(ii) Draw the graph for variation of the acceleration due to gravity with distance from centre of earth.

(iii) Calculate the gravitational potential due to a point mass of 100 kg at a distance of 1 m.

(iv) What is a stellar spectrum ?

(v) Draw a diagram of the interior structure of the sun.

(vi) Find the diameter of the sun, if the angular diameter of the sun is 0.0093 radians and its distance from the Earth is 1.496×10^{11} m.

(vii) What is the nature of ferromagnetic material below and above the Neel temperature (T_N) ?

(viii) What is ferrimagnetism ?

(ix) What is the meaning of Larmour frequency ?

(x) What is magnetizing field vector ($\bar{H}$) ?

(xi) What is Lorentz force equation ?

(xii) A 20 ampere current is flowing in a long straight wire. What will be the intensity of magnetic field at a distance 10 cm from the wire ?

[Given : $\mu_0/4\pi = 10^{-7}$ Wb m^{-2}, $G = 6.67 \times 10^{-11}$ μ-m^2 Kg^{-2}] 1×10=10