Bachelor of Science (B.Sc.) Semester—II

(C.B.S.) Examination

PHYSICS

Compulsory Paper—II

(Gravitation, Astrophysics, Magnetism and Magnetostatics)

Time—Three Hours] [Maximum Marks—50

N.B. :— (1) **ALL** questions are compulsory.

(2) Draw neat diagrams wherever necessary.

EITHER

1. (a) Define gravitational field and gravitational self energy.

Deduce an expression for gravitational self energy of the Galaxy. 5

(b) (i) Derive an expression for the gravitational potential at a point outside the solid sphere. What is the gravitational potential on the surface of solid sphere ? 3

(ii) The radius of earth is 6.637×10^6 m, its mean density 5.57×10^3 kg/m^3 and gravitational constant 6.66×10^{-11} Nm^2/kg^2. Calculate the earth's surface potential. 2

OR

1. (c) What is acceleration due to gravity ? Obtain relation between g and G. 2½

(d) State Kepler's laws of planetary motion. 2½

(e) What will be gravitational potential and intensity of a thin spherical shell of mass 10 kg and radius 0.1 m at a point 0.2 m outside of its surface ?

(Given G = 6.67×10^{-11} Nm^2/kg^2) 2½

(f) State the Newton's law of gravitation. Define gravitational constant. Give its SI unit and dimensions. 2½

EITHER

2. (a) Describe the interior of the Sun. Obtain an expression for the surface temperature of Sun. 5

(b) (i) Explain parallax method for measuring the distance of a planet from earth. 3

(ii) The distance of the moon from the earth is 3.86×10^8 m. The parallactic angle as measured from two places on the earth is 57 minutes of an arc. Find the distance between the two places. 2

OR

2. (c) Explain the important features of the Milky Way. 2½

(d) Write short note on Big-Bang theory of Universe. 2½

(e) A star will appear red if the wavelength of the maximum emission is in the range of 6500 Å to 7000 Å. Find the temperature range of the star.

(Given Wien's constant = 2.897×10^{-3} mK) 2½

(f) Explain :

(i) Asteroids

(ii) Comets

(iii) Meteors and meteorites. 2½

EITHER

3. (a) Discuss Langevin's theory of diamagnetism and obtain an expression for diamagnetic susceptibility. 5

(b) (i) What is Superconductivity ?

Explain the terms critical temperature and critical magnetic field for superconductor. 3

(ii) Calculate the transition temperature of the Niobium if the critical field for Niobium is 1×10^5 A/m at 8 °K and 2×10^5 A/m at 0 °K. 2

OR

3. (c) Distinguish between ferromagnetic and paramagnetic substances. 2½

(d) What are Ferrites ? State their applications. 2½

(e) Obtain an expression for Curie-Weiss law. 2½

(f) The susceptibility of paramagnetic $FeCl_3$ is 0.37×10^{-2} at 27°C. What will be the value of its susceptibility at 200 °K and 400 °K ? 2½

EITHER

4. (a) (i) Apply Biot-Savart law, to find the magnetic field at a point on the axis of a current carrying circular coil. 3

(ii) The magnetic field at the centre of a circular coil of radius 0.1 m and having 200 turns is 6.28×10^{-4} tesla. Find the current circulating in it.

(Given $\mu_0 = 4\pi \times 10^{-7}$ Wb/A-m). 2

(b) State Ampere's circuital law and express it in vector form.

Using Ampere's circuital law, derive an expression for magnetic field at a point inside a long current carrying solenoid. 5

OR

4. (c) Derive an expression for magnetic moment of an electron considering it as a current carrying loop. What is Bohr magneton ? 2½

(d) Define magnetic induction ($\bar{B}$) and magnetic field strength ($\bar{H}$). Write relation between $\bar{B}$, $\bar{H}$ and $\bar{M}$. 2½

(e) Explain the terms magnetisation and magnetisation current. 2½

(f) A proton enters a magnetic field of intensity 1.5 Wb/m^2 with a velocity 2×10^7 m/s in a direction at an angle 30° with the field. Calculate the force acting on the proton.

(Given charge on proton = 1.6×10^{-19} Coulomb.) 2½

5. Attempt any **TEN** questions :— (1 mark each)

(i) Give mathematical equation of Gauss's law in gravitation.

(ii) Graphically represent the variation of gravitational potential with distance due to thin spherical shell.

(iii) Calculate the force of gravitation between two cars 5 m apart, the masses of the cars are 1000 kg and 1200 kg.

(Given G = 6.67×10^{-11} Nm^2/kg^2)

(iv) Define Solar Luminosity.

(v) Distinguish between star and planet.

(vi) What is a Galaxy ?

(vii) Give two examples of paramagnetic materials.

(viii) What are domains ?

(ix) What is a toroid ?

(x) State Gauss law of magnetization.

(xi) Write down the Lorentz force equation.

(xii) The magnetic susceptibility of a medium is 940×10^{-4}. Calculate relative permeability.