Ref. No. : Ex/PHARM/PH/IB/T/114/2019

B. PHARMACY FIRST YEAR FIRST SEMESTER - 2019
Subject : PHYSICS IB

Time :Three Hours **Full Marks : 100**

Answer any ***five*** questions

1. (a) Explain the terms: decay constant, half-life and average life as applied to a radioactive substance. Find the relation among them.
(b) If a radioactive element disintegrates for a period of time equal to its average life, what fraction of the original amount remains?
(c) What happens to the atomic number and mass number of a nucleus when it (i) emits electron, (ii) emits positron and (iii) emits alpha particle?
(d) What do you mean by activity of a radioactive nuclide? Define its SI unit. Calculate the activity of 10 g of ^{232}Th. Given: $\lambda_{Th} = 1.58 \times 10^{-18} s^{-1}$.

[(6+3)+3+3+5]

2. (a) What is successive disintegration?
(b) If radionuclide (parent) 'A' decays to radionuclide (daughter) 'B' and 'B' decays to stable nuclei (granddaughter) 'C', determine the number of nuclei of A, B and C type at any given time t. Consider that at the beginning (t=0) only parent nuclei are present.
(c) Plot the variation of number of nuclei of A, B and C type with time. At what time B will attain its maxima.

[2+12+(3+3)]

3. (a) Explain the formation of Newton's ring. Obtain the expressions for the diameter of the bright and dark rings of Newton's ring due to reflected light. Are the fringes of equal width? Explain.
(b) In a Newton's ring experiment the diameter of the 15th dark ring was found to be 0.590 cm and that of the 5th ring was 0.336 cm. If the radius of the plano-convex lens is 100 cm, calculate the wavelength of the light used.

[(2+10+3)+5]

4. (a)Two masses 1.0 kg and 2.0 kg are placed at a separation of 50 cm. Assumingthat the only forces acting on the particles are their mutual gravitation, findthe initial accelerations of the two particles.
(b) The masses of two particles are m_1 and m_2 and r is the separation betweenthem. Calculate the gravitational potential energy of a two-particle system.
(c) Find the distance of a point from the earth's centre where the resultant gravitational field due to the earth and the moon is zero. The mass of the earthis 6.0×10^{24} kg and that of the moon is 7.4×10^{22} kg. The distance betweenthe earth and the moon is 4.0×10^{6} km.

[6+6+8]

5. (a) State Kepler's laws. Prove that the sector velocity $\frac{d\vec{A}}{dt}$ is constant. Here, the area dA sweeps out by the radius vector (joining the origin (sun) to the planet)in time dt. Further, show the conservation of angular momentum of the planetimplies that the orbit lies in a plane.
(b) Let the mass of the sun be M and that of the planet under study be m.The planet is moving around the sun at speed v in a orbit of radius a. Calculatethe total mechanical energy of the sun-planet system.
(c) Calculate the radius of the circular orbit of a stationary Earth's satellite,which remains motionless with respect to its surface. The value of G is 6.67×10^{-11} in SI unit and mass of the Earth is 5.97×10^{24} kg. [(3+6)+6+5]

6. (a) Imagine that we drill a hole through the earth along a diameter and dropa stone down the hole. Derive an expression for the gravitational force F_g on the stone as a function of its distance from the earth's center. Assume that theearth's density is uniform.
(b) A simple pendulum has a time period exactly 2 s when used in a laboratoryat north pole. What will be the time period if the same pendulum is usedin a laboratory at equator? Account for the earth's rotation only. Take $g = GM/R^2 = 9.8$ m/s^2 and radius of earth = 6400 km.
(c) Write a short note on "Black Hole". Calculate the Schwarzschild radius ifsun collapses under its own gravity to form a black hole. Given that the massof the sun = 1.99×10^{30} kg and $G = 6.67 \times 10^{-11}$ in SI unit. [6+6+(4+4)]

7. (a) Explain the theory of plane transmission grating and hence obtain the condition for the principal and secondary maxima and minima. On what factors does the width of the principal maxima depend? Plot a typical grating intensity profile.
(b) What do you mean by absent spectra of a grating? What is the highest order spectrum which may be seen with monochromatic light of wavelength 6000 Å by means of a diffraction grating with 5000 lines/cm. [(10+3+2)+1+4]

8. (a) What are the various optical phenomenon by which plane polarized light can be produced from an unpolarised light. What is Brewster's law?
(b) An unpolarized light falls on two polarized sheets placed one on top of the other. What must be the angle between the characteristic direction of the sheets if the intensity of the transmitted light is one-third the intensity of the incident light?
(c) What are the necessary conditions for sustained interference of light. A 10 μm transparent plate when placed in the path of one of the interfering beams of a double slit experiment [λ = 5800 Å], the central fringe shifts by a distance equal to ten fringes. Calculate refractive index, μ of the plate.

[(3+3) +5+4+5]