INTER BACHELOR OF SCIENCE EXAMINATION, 2019

(2nd Year, 1st Semester)

PHYSICS

Paper : CORE - 6

Time : 2 hrs.

Full Marks : 50

(25 marks for each group)

Use a separate Answer Script for each group.

GROUP - A

Answer any *five* questions.

1. (a) What are cathode rays? Explain the properties of cathode rays.

(b) In the Millikan's oil drop method, the distance between the plates is 2.1×10^{-2} m, and the potential difference applied is 2250 volts. If a drop of water carrying a single electronic charge remains balanced, find the radius of the drop.

$$1 + 1\frac{1}{2} + 2\frac{1}{2} = 5$$

2. (a) Explain the laws of photoelectric emission. Why does the classical electromagnetic theory fail to explain the photoelectric effect?

(b) The stopping potential for copper surface illuminated by radiation of 2537 Å from mercury arc is 0.24 volt. What is the threshold wavelength for copper?

$$1\frac{1}{2} + 1\frac{1}{2} + 2 = 5$$

3. How many revolutions does an electron in the $n=2$ state of a hydrogen atom make before dropping to the $n=1$ state? (The average lifetime of an excited state is about 10^{-8} s).

(b) How do you explain the spectrum of singly ionized helium using the Bohr's theory of Atomic structure?

$$3 + 2 = 5$$

4. (a) State and explain Bragg's law of diffraction of X-rays.

(b) What is Moseley's law? What is its importance?

$$3 + 2 = 5$$

5. (a) Explain why Compton shift is independent of the scattering material.

(b) An X-ray tube with Cu target is operated at 20 kV. The smallest glancing angle for NaCl crystal for the CuK_α line is $14°$. Find the wavelength of this line. Also find the glancing angle for photons at the short wavelength limit. (d of NaCl = 0.282 nm).

$$2+3 = 5$$

6. (a) State and explain Geiger-Nuttal law.

(b) 1 gram of radium is reduced by 2.1 mg in 5 years by α-decay. Calculate the half-life period of radium.

(c) What is mean life of radioactive substance?

$$2\frac{1}{2} + 1\frac{1}{2} + 1 = 5$$

7. (a) Explain secular and transient radioactive equilibrium.

(b) Explain spontaneous and stimulated emission of radiation? What is population inversion?

$$2\frac{1}{2} + 1\frac{1}{2} + 1 = 5$$

GROUP - B

Answer any *five* questions.

1. How you differentiate between holonomic and nonholonomic constraints? Explain why a disc rolling on a floor without slipping is an example of nonholonomic constraint?   2+3

2. Write D' Alembert's equation. What are the advantages of D' Alembert's equation over Newton's equations of motion? Write Hamilton's Principle. Obtain Euler Lagrange equation from Hamilton's Principle.   1+1+1+2

3. Write the Lagrangian of Atwood Machine (shown in the figure). Then find the equation of motion. Write the Lagrangian of a two body system under central force. How it is converted to a one-body system?
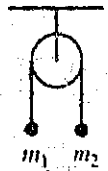
1+2+1+1

4. What do you mean by Euler's angles in Rigid body dynamics? Obtain the transformation matrix in terms of Euler's angles to transform from space set to body set of axis.

1+4

5. What is coriolis force? What is Faucult's pendulum? With proper diagram and deduction show that the plane of oscillation of the pendulum rotates due to earth's rotation?

1+1+3

6. What is canonical transformation? Show that transformation $P=1/Q$, $q=PQ^2$ is   canonical. Find the generating function.   1+2+2

7, If a particle is acted on by potential energy given by $U(x)=U_0(-ax^2+bx^4)$ where U_0, a, b are constants find points of equilibrium. Obtain normal mode frequency for small oscillations of a double pendulum.

2+3