LAIKIPIA UNIVERSITY

UNIVERSITY EXAMINATIONS

1ST SEMESTER 2022/2023 ACADEMIC YEAR

THIRD YEAR EXAMINATION FOR THE DEGREE OF BACHELOR OF EDUCATION (SCIENCE)

PHYS 312: QUANTUM MECHANICS

STREAM: R ***TIME: 2 HRS***

DAY: MONDAY [8.30AM – 10.30AM] ***DATE: 05/12/2022***

THIS QUESTION PAPER CONSISTS OF THREE (3) PAGES

PLEASE DO NOT OPEN UNTIL THE INVIGILATOR SAYS SO.

<u>INSTRUCTIONS</u>: -

Read the question paper and questions carefully then answer question ONE (40 marks – compulsory) and any other TWO questions (15 marks each)

QUESTION ONE

(a) State the following as used in quantum mechanics

(i)	mHamiltonian operator	(1 mark)
(ii)	Complimentarity	(1 mark)
(iii)	Scrodinger equation	(1 mark)
(iv)	Harmonic oscillator	(1 mark)
(v)	Matrix mechanics	(1 mark)
(vi)	Normalization condition	(1 mark)
(vii)	Hermitian adjoint	(1 mark)
(viii)	Uncertainity principle	(1 mark)
(ix)	Born probability density	(1 mark)
(x)	Hermitian operator	(1 mark)

(b) Given thatA = d/dx and B = X^2, show that,

i) $A^2 f_{(x)} = Af(x)$ (2 marks)

ii) $ABf_{(x)} = BAf(x)$ (2 marks)

(c) Determine whether the following are linear or non-linear,

i) A SQRT (square root operator) (2 marks)

ii) $A = X^2$ (multiply by X^2 operator) (2 marks)

(d) Discuss any five postulates in quantum mechanics. (10 marks)

(e) Differentiate between time dependent and time independent Schrodinger equation. (4 marks)

(f) In order to represent a physically observable, a wave must satisfy certain constraints. Explain any four constraints. (8 marks)

QUESTION TWO

In classical mechanics, the angular momentum, L, of a particle of position vector r and linear momentum P. Show that,

(a) $[Lx, Ly] = i\hbar Lz$ (3 marks)

(b) $[Ly, Lz] = i\hbar Lx$ (3 marks)

(c) $[Lz, Lx] = i\hbar Ly$ (3 marks)

(d) $\left[L^2, L_X\right] = \left[L^2, L_Y\right] = \left[L^2, L_Z\right] = 0$ (3 marks)

(e) $\left[L_+, L_Z\right] = i\hbar L_+$ (3 marks)

QUESTION THREE

(a) Schrodinger Equation is an eigen value problem. Explain (4 marks)

(b) Discuss three interpretative postulates and energy eigen functions (6 marks)

(c) Find α^+ (Hermitian adjoint) if α is a differential operator (5 marks)

QUESTION FOUR

(a) Discuss in detail any five postulates in quantum mechanics (10 marks)

(b) Explain two wave like and three particles like properties in quantum mechanics. (5 marks)