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**NATIONAL OPEN UNIVERSITY OF NIGERIA**

**PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA**

**FACULTY OF SCIENCES**

**DEPARTMENT OF PURE AND APPLIED SCIENCE**

**JULY 2018 EXAMINATIONS**

**COURSE CODE: PHY 309**

**COURSE TITLE: QUANTUM MECHANICS 1**

**CREDIT UNIT 3**

**TIME ALLOWED (21/2 HRS)**

**INSTRUCTION: *Answer question one (1) and any other four (4) questions***

**QUESTION 1**

1. Find the norms of the following vectors:

and [**3** marks]

1. What is the value of the real number in the normalized vector,

? [**2** marks]

1. Given a set of vectors linearly dependent or independent?

[**4½ marks**]

1. Which of the following functions are even and which ones are odd?
2. [**½**  mark]
3. [**½**  mark]
4. [**1** mark]
5. i. Show that and are orthogonal, [**4** marks]

ii. Evaluate the integral: [**2½** marks]

1. If the matrix is a proper orthogonal matrix, find the value of [**4** marks]

**QUESTION 2**

1. Deduce the Rayleigh Jean’s law from Plank’s radiation Law. (4 Marks)
2. Check whether the following vectors are linearly independent. (4 Marks)

2*i* 3 *j* *k* , *i* *j* 3*k* and 3*i* 2 *j* *k*

1. Find the inner product of the following vectors: ix2+2 and 2x-3i for (4 Marks)

**QUESTION 3**

1. Write down the formula for the average energy of the oscillator? (3 Marks)
2. What are the allowable eigenfunctions of the infinite potential well defined below?

(9 Marks)

**QUESTION 4**

The state of a free particle is described by the following wave function:

ψ

-b 3b

1. Find A using the normalization condition. (3 Marks)
2. What is the probability of finding the particle within the interval [0, *b*]? (3 Marks)
3. Calculate for this state. (6 Marks)

**QUESTION 5**

5a

1. What is a black body? (2 Marks)
2. Define stopping potential. (2 Marks)
3. Write down the Bohr’s quantization condition (2 Marks)
4. Give the formula to calculate the wavelength when electron jumps from one state to another in a hydrogen atom. (2 Marks)

b. Write the function: h(x) = e2xsinx as a sum of odd and even functions. (4 Marks)

**QUESTION 6**

1. Given the basis {(2, 3), (1, 4)}, write the expression for a transformation to {(0, 2), (-1, 5)} (4 Marks)
2. What would the potential function be if is an eigen function of the

Schrödinger equation? Assume that when x→ ∞, V(X) → 0 (8 Marks)