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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**

**2018\_2 SEMESTER EXAMINATION**

**COURSE CODE: PHY 309**

**COURSE TITLE: QUANTUM MECHANICS 1**

**CREDIT UNIT 3**

**TIME ALLOWED (2½ HRS)**

**INSTRUCTION: *Answer question 1 and any other four questions***

**QUESTION 1**

a) Define the term vector space (3 marks)

b) List the properties of the inner product of a vector space . (9 marks)

c) (i) Determine if the function is even or odd (2*½ marks)*

(ii) Express the function as a sum of odd and even

functions. (2*½ marks)*

d) Find (i) the change in wavelength if a proton is scattered at an angle of

after its collision with an electron initially at rest (2*½ marks)*

(ii)the wavelength of the wave associated with an electron moving at .

(2*½ marks)*

**QUESTION 2**

a) Define the following terms: (i) linear independence (2 marks)

(ii) linear dependence (2 marks)

b) Check if the following sets are linearly independent or not (i) (3 marks)

(ii) (2 marks)

c) Normalise each vector in the set . (3 marks)

**QUESTION 3**

a) Find the coordinates of the vector with respect to the basis

(4 *marks)*

b) Show whether or not the set is a basis for two-dimensional Euclidean space. (4 *marks)*

c) Show that the following are vector spaces over the indicated fields: (i) The set of real numbers over the field of real numbers (2 *marks)*

(ii) The set of quadratic polynomials over the complex field (2 *marks)*

**QUESTION 4**

a) Define the following terms: (i) Norm of a vector (2 *marks)*

(ii) Photoelectric effect (2 *marks)*

(iii) Blackbody radiation (2 *marks)*

b) What value does Rayleigh-Jeans formula predict for the radiation of frequency emitted by a blackbody per unit time, per unit area at . (3 *marks)*

c) Compare this value with that predicted by Planck. (3 *marks)*

**QUESTION 5**

a) Define the following terms (i) odd function (2 *marks)*

(ii) even function (2 *marks)*

b) Generate the relations of writing any real-valued function as a sum of an odd and an even

function. (6 *marks)*

c) Write the function as a sum of odd and even function (2 *marks)*

**QUESTION 6**

a) Define the following terms (i) inverse matrix (*2 marks)*

(ii) unitary matrix (*2 marks)*

(iii) normal matrix (*2 marks)*

b) Write the matrix of transformation between the following bases in , the 3-dimensional

Euclidean plane.

(*3 marks)*

and (*3 marks)*