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**NATIONAL OPEN UNIVERSITY OF NIGERIA**

**University Village, NnamdiAzikiwe Expressway, Plot 91, Cadastral Zone, Jabi, Abuja**

**FACULTY OF SCIENCES**

JANUARY/FEBRUARY 2018 EXAMINATION

COURSE CODE: PHY309

COURSE TITLE: QUANTUM MECHANICS

COURSE UNIT: 3 Units

TIME: 3 hours

INSTRUCTION: Answer question one (1) and any FOUR(4) questions

Necessary Constants:,, ,  

1. a). Show that the setis linearly independent**(5 marks)**

 b). Normalise each vector in the set **(10 marks)**

 c). Check whether the following vectors are linearly independent.**(7 marks)**

2. a). If there exist a linearly independent set , state the condition for ;

 i. orthogonality ii. Orthonormality**(2 marks)**

 b). Show that  and  are orthogonal, when, for range **(5 marks)**
c). Find the normalise function of the following

 i.  ii. **(5 marks)**

3. a). Given the matrix , find the corresponding eigenvectors and the eigenvalues.**(5 marks)**

 b). Find the eigenvalues and the corresponding eigenfunctions of the matrix . Hence determine the normalised wavefunction for each. **(5 marks)**

 c). Given that kinetic energy operator for point energy and operator for momentum, 

 Calculate:

1. 
2. 

Give a brief comment/explanation in the result obtained in (i) and (ii).**(2 marks)**

4. a). i. What is photoelectric effect and give necessary equation

 **(2 marks)**

 ii. With necessary equation explain Compton effect**(2 marks)**

b). Find the change in wavelength if a photon is scattered at an angle of after its collision with an electron initially at rest.

**(2 mark)**

 c). State 2 postulates of Bohr Theory of the Hydrogen atom.

 **(1 mark)**

d). State Heisenberg’s Uncertainty Principle.**(1 mark)**

e). i. Find the maximum kinetic energy with which an electron is emitted from ametal of work function when a radiation of energy falls on it, given that the work function is **(2 marks)**

ii. What is the wavelength of the wave associated with an electron moving at **(2marks)**

5.a). State the time-dependent Schroedinger equation for a free

particle and hence by solving the time-dependent Schroedinger equation, find the condition imposed on the angular frequency and the wavenumber.**(6 marks)**

b). Which of the following functions would you recommend as a possibleeigenfunction in quantum mechanics?

i.  ii.  iii. **(6 marks)**

6. a). State the correspondence principle**(3 marks)**

b). Normalise the wavefunction and find

i.  ii. andiii. **(3 marks)**

c). A particle in a one-dimensional box  is in state 

 i. Find A so that is normalized.**(2 marks)**

ii. What are the possible results of measurements of the energy, and what arethe respective probabilities of obtaining each result?**(2 marks)**

iii. The energy is measured and found to be What is the state of thesystem immediately after measurement?**(2 marks)**