Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Science

End Sem (Odd) Examination Dec-2019

BC3EP04 Quantum Mechanics and Spectroscopy

Programme: B.Sc. (CS) Branch/Specialisation: Computer Science

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. The photoelectric effect takes place only when the wavelength of incident light is **1**

(a) Above threshold wavelength
(b) Below threshold wavelength
(c) Equal to threshold wavelength
(d) Any wavelength

ii. The wavelength of the scattered light in Compton effect is equal to input wavelength when the scattering angle θ is **1**

(a) 0 (b) $\pi/2$ (c) π (d) $\pi/4$

iii. A wavefunction is admissible if **1**

(a) It is single valued and finite
(b) It is finite
(c) It is single valued
(d) None of these

iv. A stationary state is that for which the probability of finding the particle at a point in space is **1**

(a) Dependent of time (b) Dependent of x
(c) Independent of time (d) Independent of x

v. Electron's potential energy at the most probable distance in the ground state of hydrogen atom is **1**

(a) Zero (b) -13.6 ev (c) -27.2 ev (d) 13.6 ev

P.T.O.

vi. When E >V_0 the width of barrier contains **1**
(a) Integral multiple of de-Broglie wavelength
(b) Half Integral multiple of de-Broglie wavelength
(c) Odd multiple of de-Broglie wavelength
(d) Fraction of de-Broglie wavelength

vii. Quantum particles are **1**
(a) Identical
(b) Identical and distinguishable
(c) Identical but indistinguishable
(d) Indistinguishable

viii. The principal series of hydrogen atom is observed during the transition of the electron from **1**
(a) s to p state (b) p to s state (c) d to p state (d) p to d state

ix. Time during which pulses are recorded but are of smaller size in G.M. counter is called **1**
(a) Recovery time (b) Dead time
(c) Resolving time (d) No specific name

x. In fission the percentage of mass converted into energy is about **1**
(a) 0.01 % (b) 0.1 % (c) 1 % (d) 10 %

Q.2 i. Write four properties of matter waves. **2**
ii. Why Compton effect cannot be observed with visible light? **3**
iii. Explain Davission-Germer experiment. **5**
OR iv. Differentiate between Photoelectric effect and Compton effect and explain with schematic diagram working of Compton effect. **5**

Q.3 i. What is a wavefunction? Given its physical significance. **3**
ii. Show that, in one-dimensional problems, the energy spectrum of the bound states is always non-degenerate. **7**
OR iii. In what respect Schrodinger equation differ from classical wave equation? Derive Schrodinger time independent wave equation? **7**

Q.4 i. What do you mean by free state and bound state of a particle? **3**
ii. What is one dimensional tunnelling effect? Explain the phenomenon of alpha-decay. **7**

OR iii. Write and solve Schrodinger's wave equation for the fixed axis rigid rotator. **7**

Q.5 Attempt any two:
i. Explain normal Zeeman effect and anomalous Zeeman effect. **5**
ii. What are the selection rules for j for observing doublet spectra in single electron system? **5**
iii. Write short note on Stern-Gerlach experiment. **5**

Q.6 Attempt any two:
i. Give the main assumption of liquid drop model. Justify the name liquid drop model. **5**
ii. Explain the working of Linear particle accelerator. **5**
iii. Explain the working of G.M. counter. **5**

******

Marking Scheme

BC3EP04 Quantum Mechanics and Spectroscopy

Q.1	i.	The photoelectric effect takes place only when the wavelength of incident light is (b) Below threshold wavelength	**1**
	ii.	The wavelength of the scattered light in Compton effect is equal to input wavelength when the scattering angle θ is (b) $\pi/2$	**1**
	iii.	A wavefunction is admissible if (a) It is single valued and finite	**1**
	iv.	A stationary state is that for which the probability of finding the particle at a point in space is (b) Dependent of x	**1**
	v.	Electron's potential energy at the most probable distance in the ground state of hydrogen atom is (b) -13.6 ev	**1**
	vi.	When E >V_0 the width of barrier contains (b) Half Integral multiple of de-Broglie wavelength	**1**
	vii.	Quantum particles are (c) Identical but indistinguishable	**1**
	viii.	The principal series of hydrogen atom is observed during the transition of the electron from (b) p to s state	**1**
	ix.	Time during which pulses are recorded but are of smaller size in G.M. counter is called (a) Recovery time	**1**
	x.	In fission the percentage of mass converted into energy is about (b) 0.1 %	**1**

Q.2	i.	Four properties of matter waves 0.5 mark for each	(0.5 mark * 4)	**2**
	ii.	Reason for Compton effect cannot be observed with visible light		**3**
	iii.	Explain Davission-Germer experiment. Diagram Working Result	1 mark 2 marks 2 marks	**5**
OR	iv.	Difference b/w Photoelectric effect and Compton effect Working of Compton effect	2 marks 3 marks	**5**

Q.3	i.	Wavefunction Its physical significance	2 marks 1 mark	**3**
	ii.	Show that, in one-dimensional problems, the energy spectrum of the bound states is always non-degenerate Proof – equation Result	 5 marks 2 marks	**7**
OR	iii.	Schrodinger equation differ from classical wave equation Schrodinger time independent wave equation	 2 marks 5 marks	**7**

Q.4	i.	Free state of a particle Bound state of a particle	1.5 marks 1.5 marks	**3**
	ii.	One dimensional tunnelling effect Phenomenon of alpha-decay	2 marks 5 marks	**7**
OR	iii.	Schrodinger's wave equation for the fixed axis rigid rotator Explanation Solution	 2 marks 5 marks	**7**

Q.5		Attempt any two:		
	i.	Normal Zeeman effect and anomalous Zeeman effect Setup diagram Equation Explanation	 1 mark 1 mark 3 mark	**5**
	ii.	Selection rules for j for observing doublet spectra in single electron system Stepwise marking		**5**
	iii.	Stern-Gerlach experiment Diagram Setup Explanation	 1 mark 1 mark 3 marks	**5**

Q.6		Attempt any two:		
	i.	Main assumption of liquid drop model Name liquid drop model	2 marks 3 marks	**5**
	ii.	Working of Linear particle accelerator Diagram	4 marks 1 mark	**5**
	iii.	Working of G.M. counter Diagram	4 marks 1 mark	**5**

******