

(6 pages)

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Code No. : 8386

Sub. Code : HPHM 41

M.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2014.

Fourth Semester

Physics

QUANTUM MECHANICS II

(For those who joined in July 2012 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL the questions.

Choose the correct answer :

1. A sufficient condition for the removal of degeneracy in first order is that $\langle m | H' | l \rangle$ is
 - (a) zero
 - (b) not zero
 - (c) infinity
 - (d) one
2. Variation method is applied to systems that are described by
 - (a) a non separable schrodinger equation
 - (b) a separable schrodinger equation
 - (c) a non relativistic schrodinger equation
 - (d) a relativistic schrodinger equation

3. WKB method can be applied to a system for which
 - (a) potential is constant
 - (b) potential is zero
 - (c) potential is slowly varying
 - (d) potential is fastly varying
4. In the case of very short variation of Hamiltonian in a finite interval of time t_0
 - (a) energy eigen value becomes zero
 - (b) energy eigen value becomes infinity
 - (c) wave function becomes antisymmetric
 - (d) sudden approximation is applied
5. If the interchange of any pair of particles among its arguments leavers the wave function
 - (a) changed
 - (b) partly changed
 - (c) unchanged
 - (d) as its probability density is zero
6. The normalized eigen function S_z have eigen values.
 - (a) $\hbar^2$
 - (b) $-\hbar^2$
 - (c) $\frac{1}{2}\hbar$
 - (d) $\frac{1}{2}\hbar$ and $-\frac{1}{2}\hbar$

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7. The probability of finding system in a state k' that has a corresponding lower energy by about $\hbar\omega$ is proportional to

(a) $|\langle k'|H^{(0)}|n\rangle|^2$ (b) $|\langle k'|H^{(0)}|n\rangle|^2$

(c) $|\langle k'|H^{(02)}|n\rangle|^2$ (d) $|\langle k'|H^{(02)}|n\rangle|^2$

8. The transition between the state u_k and u_n is strictly forbidden if the integral $\int u_k^* e^{ikr} \nabla_A u_n d^3r$ is

(a) One (b) Non-zero

(c) Zero (d) Infinity

9. A coulomb field is described by a potential of the type $V(r)$ is equal to

(a) $\frac{-ze^2}{r}$ (b) $\frac{-ze}{r^2}$

(c) $\frac{-z^2e}{r}$ (d) $\frac{-ze}{r}$

10. The energy spectrum of a free particle has

(a) two branches (b) three branches

(c) four branches (d) five branches

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PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Discuss briefly the perturbation theory of non-degenerate energy states.

Or

- (b) Explain why the hydrogen atom in the ground state does not show a first order stark effect.

12. (a) What do you understand by a classical turning point? How could one get the turning points of the potential is known?

Or

- (b) Discuss briefly the validity conditions of WKB approximation.

13. (a) Show that the symmetry character of a wave function does not change with time.

Or

- (b) Explain how symmetric and antisymmetric wave functions are constructed from unsymmetrized solution of the schrodinger equation of a system of indistinguishable particles.

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[P.T.O.]



14. (a) Explain what is dipole transition.

Or

- (b) What is called Forbidden transition? Obtain the selection rule for the same.

15. (a) Explain charge and current densities.

Or

- (b) Write a note on Negative energy states.

PART C — ($5 \times 8 = 40$ marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Derive the first and second order corrections to the energy of O non-degenerate state. Also obtain the same for eigen function.

Or

- (b) Outline the variation method used for obtaining approximate value of ground state energy of a system.

17. (a) (i) Illustrate the exchange degeneracy with example.
(ii) What is central field approximation? How did Hartree obtain the central field in his theory of many electron atom?

Or

- (b) Obtain the Zeroth-order wave function for helium atom in the excited state $1s2p$.

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18. (a) Explain Fermi's golden rule. Also explain the importance and electric dipole transition.

Or

- (b) Derive the Planck's distribution formula for radiation.

19. (a) Discuss the tunnelling of electron through a barrier.

Or

- (b) Apply the WKB approximation to an oscillator.

20. (a) Derive the schrodinger's relativistic equations.

Or

- (b) Deduce the Dirac's relativistic equation.

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