2/22

2603N077

Candidate's Seat No :_____

M.Sc. Sem.-1 (Old Course) Examination

PHY : 401 : Physics

Quantum Mechanics-I & Mathematical Physics-I

March 2021

Time : 2-00 Hours] **[Max. Marks : 50**

Instructions: All questions in **Section I** carry equal marks
Attempt any **THREE** questions from **Section I**
Question IX in **section II** is **COMPULSORY**

Section- I

Q. I	A	What do you mean by perturbation? Obtain 1st order and 2nd order equations of perturbation theory.	7
	B	Solve the 1st order equation of perturbation theory if Eigen value is non-degenerate.	7
Q. II	A	Discuss Upper Bound on Ground state energy using the Variation method.	7
	B	Solve the 2nd order equation of perturbation theory if Eigen value is non-degenerate.	7
Q. III	A	Obtain Asymptotic solution of Schrodinger equation using WKB approximation method.	7
	B	Obtain an expression for the coefficients $C_n(0)$ in the time dependent part of Schrodinger equation.	7
Q. IV	A	Discuss propagators, and obtain an expression for the Green's function G_R.	7
	B	Discuss Alteration of Hamiltonian and Sudden Approximation.	7
Q. V	A	For Laplace transform, show that (i) $L\{e^{-at}\cos bt\} = \frac{s+a}{(s+a)^2+b^2}$ (ii) $L\{t^n e^{-kt}\} = \frac{n!}{(s+k)^{n+1}}$	7
	B	What is an Integral transform? Define Laplace transform and show that Laplace transform is linear.	7
Q. VI	A	Using partial fractional expansions, show that for $a^2 \neq b^2$ the inverse Laplace transform, $L^{-1}\left\{\frac{1}{(s^2+a^2)(s^2+b^2)}\right\} = \frac{1}{(a^2+b^2)}\left\{\frac{\sin at}{a} + \frac{\sin bt}{b}\right\}$	7
	B	Using Laplace transform, solve following equations $y' - 2y + z = 0$, and $z' - y - 2z = 0$, with initial conditions: $y(+0) = 1$, $z(+0) = 0$	7
Q. VII	A	What is a group? Discuss four properties of a group with relevant example.	7
	B	Discuss various properties of a 'TENSOR'. For contravariant tensors of second rank, show that (i) $A^{ik} + B^{ik} = C^{ik}$ (ii) $A^{ik} - B^{ik} = D^{ik}$	7
Q. VIII	A	What is a subgroup? Discuss four postulates of a subgroup with relevant examples	7
	B	Define Symmetric and Antisymmetric tensors. Show that for second rank contravarient tensors; $A^{mn} = \frac{1}{2}(A^{mn} + A^{nm}) + \frac{1}{2}(A^{mn} - A^{nm})$	7

[P. T. O.]

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Section- II

Q. IX Each question carries one Mark 8

1. The self evident criterion of perturbation theory is that the energy change, $l\,W^{(1)} \equiv l\,H'_{mm}$ should be .....
   A. Infinite
   B. 0
   C. larger compared to the spacing between E_m and the levels nearest to it.
   D. small compared to the spacing between E_m and the levels nearest to it.
2. Using ..... perturbation theory we can represent v and W of perturbed Hamiltonian in terms of unperturbed Eigen functions u_m and Eigen values E_m
   A. Perturbed
   B. Rayleigh- Jeans
   C. Schrodinger-Dirac
   D. Rayleigh-Schrodinger
3. In WKB approximation method, at the classical turning points, the solutions must ..... across the boundaries, to be acceptable.
   A. have discontinuity
   B. becomes zero
   C. have reflection
   D. have matchine
4. The differentiation of Heaviside unit function with respect to time is $d\theta\,(t)\,/dt$ = ...
   A. T
   B. 0
   C. 1
   D. d(t)
5. Kroneckar delta, δ^i_{jk} is _____tensor
   A. mix of rank 3
   B. contravariant of rank 2
   C. covariant of rank 2
   D. covariant of rank 3
6. ε^i_{jkl} tensor has _____indices
   A. 1
   B. 2
   C. 3
   D. 4
7. If $f(t)$=1 then $L\{f(t)\}$ =
   A. s
   B. –s
   C. 1/s
   D. (-1/s)
8. If X(s) = $\frac{s}{(s^2+a^2)^2}$ then $L^{-1}\{X(s)\}$ is,
   A. $\frac{1}{a}$ t *sin at*
   B. $\frac{1}{a}$ t *cos at*
   C. $\frac{1}{2a}$ t *sin at*
   D. $\frac{1}{2a}$ t *cos at*

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