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RE-3471-72

M. Sc. (Electronics) (Part - I) Examination

April / May – 2010

Quantum Mechanics, Mathematical & Computational Methods : Paper - I

Time : **3** Hours] [Total Marks : **52**

RE-3471

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ M. SC. (ELECTRONICS) - 1

Name of the Subject :

☛ Quantum Mechanics, Mathematical & Computational Methods - 1

☛ Subject Code No. : 3 4 7 1 ☛ Section No. (1, 2,.....) : 1

Seat No. :

Student's Signature

(2) Use separate answer books.

(3) Symbols used have their usual meaning.

(4) Figures to the right indicate full marks.

1 (a) Explain Hilbert space. **2**

(b) Briefly discuss the admissibility condition on the wave function. **2**

(c) Find $\left[J_z, J_-\right]$ **2**

(d) For Pauli's matrices prove that $\sigma_x\sigma_y = -\sigma_y\sigma_x = i\sigma_z$. **2**

2 (a) Define Normalize and Non normalize wave function. Explain probability interpretation and box normalization procedure. **5**

(b) Find :

(1) $\left[x, P_x\right]$

(2) $\left[L_x, L_y\right]$ **4**

OR

2 (a) Deduce the expression for total scattering cross section and scattering amplitude using Green's function. **5**

(b) Obtain the Schrodinger equation for a linear harmonic oscillator. **4**

3 (a) Using abstract operator method show that the energy eigenvalue of harmonic oscillator is **5**

$\left(n + \frac{1}{2}\right)\hbar w_c, n = 0, 1, 2.....$

(b) For an electron accelerated through 100 volts, calculate the De Broglie wavelength. **4**

OR

3 (a) Discuss the ammonia molecule as a two state system. **5**

(b) Prove that linear moment P_x is self adjoint operator. **4**

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Name of the Examination :

☛ **M. SC. (ELECTRONICS) - 1**

Name of the Subject :

☛ **Quantum Mechanics, Mathematical & Computational Methods - 1**

☛ Subject Code No. : **3 4 7 2** ☛ Section No. (1, 2,.....) : **2**

Seat No. :

Student's Signature

(2) Use separate answer books.
(3) Symbols used have their usual meaning.
(4) Figures to the right indicate full marks.

4 (a) State the necessary and sufficient condition for a differential to be exact differential. **2**

(b) Find the Laplace transform of 1. **2**

(c) Explain the convergence tests for the series solution of the differential equation. **2**

(d) Compare the errors involved in the different methods of numerical integration. Express them in terms of the step size. **2**

5 (a) Obtain the series solution of the hypergeometric equation **5**

$$x(x-1)y''+\left[(1+a+b)x-c\right]y'+aby=0$$

(b) Evaluate the eigenvalues and eigenfunction of the **4**

matrix $\begin{bmatrix} 5 & 0 & 1 \\ 0 & -2 & 0 \\ 1 & 0 & 5 \end{bmatrix}$ using Jacobi method.

OR

5 (a) Show that the Fourier Sine and Cosine transforms of e^{-at} are **5**

$$g_s(\omega)=\sqrt{\frac{2}{\pi}}\,\frac{\omega}{\omega^2+a^2}$$

$$g_c(\omega)=\sqrt{\frac{2}{\pi}}\,\frac{a}{\omega^2+a^2}$$

(b) Test the series solution for convergence. **4**

6 (a) Explain the details of the least square method for the curve fit. Apply it to the case of a linear regression analysis between two dependent variables. **5**

(b) Fit a linear fit to the following data and determine the regression coefficients. **4**

x :	1	2	3	4	5
y :	3	4	5	6	8

OR

6 (a) Obtain the solutions of differential equation **5**

$\frac{d^2y}{dx^2} + f(x)y = 0$ using the WKB method.

(b) Discuss Poisson and Gaussian Distributions in details. **4**