الدور الأول

University of Technology
Department of Applied Sciences
Final Examination 2014/2015

Subject : Mathematics
Branch : Material
Examiner : Asst.Prof. Atheer J. Kadhim

Class : 3rd year
Time : 3 hours
Date : 14/6/2015

Note: **Answer only five questions. Each question has (14) marks.**

Q1: Solve the following partial differential equation:

$$\frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial y} \quad \text{where} \quad \frac{\partial u(0,y)}{\partial x} = 0 \quad \text{and} \quad \frac{\partial u(x,0)}{\partial y} = \cos \pi x$$

Q2: Prove that:

(a) $\displaystyle\int_0^1 x^a \, dx = \frac{1}{a+1}$ where $a > 0$.

(b) $\displaystyle\Gamma n = \int_0^1 (\ln x^{-1})^{n-1} \, dx$ where $n > 0$ and Γ is the gamma function.

Q3: Use modified Euler method to find the numerical solution at $x = 0.2$, where the initial value problem is:

$$y' = -xy \qquad y(0) = 1 \qquad \text{and} \quad h = 0.1$$

Q4: Solve the following differential equation by using power series:

$$xy - y' = \frac{3}{2} + \frac{1}{2}x \qquad y(0) = 0$$

Q5: Use trapezoidal rule to evaluate $\displaystyle\int_{1.8}^{2.6} e^x \, dx$ to four decimal places where N=4

Q6: Prove that:

$$\beta(m,n) = \int_0^\infty \frac{y^{m-1}}{(1+y)^{n+m}} \, dy$$

where $\beta(m,n)$ is the beta function and $m, n > 0$

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University of Technology
Department of Applied Sciences
Branch of Material Science

Branch: Material Science
Subject: Quantum mechanics
Examiner: Lecturer.Hassan Hadi

Final Exam
2014 - 2015

Class : 3rd year
Time : 3 hours
Date : 8/6/2015

Q/1 a) Derive time – Independent Schrödinger equation.

b) if $\psi_{x,t} = \cos(kx - \omega t) + i\sin(kx - \omega t)$. derive the momentum operator.

Q/2 a) show that $\psi_{x,t} = e^{\left(\frac{-x^2}{2}\right)}$ is an eign function of A
where $A = \frac{d^2}{dx^2} - x^2$, then find the eign value.

b) Solve: chose 2 only

1) $[P_x, y]$ 2) $[H, X]$ 3) $[P_x, X^n] = -i\hbar n X^{n-1}$

Q/3 a) Show that the eign value of any hermition operator always gives real value.

b) Prove that the wave function of a particle in a box – 3dimension in the ground state is normalized.

Q/4 a) prove that $\langle T\rangle = \langle V\rangle = \frac{E_0}{2}$ in simple harmonic oscilator
where $\langle T\rangle$ is the kienetic energy and $\langle V\rangle$is the potential energy

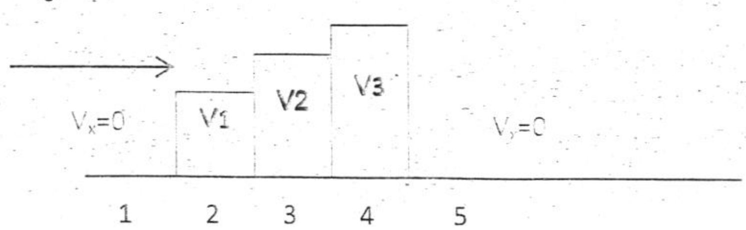
b) Prove that the x – component operator is a hermition operator.

Q/5 a) prove that $\frac{\Delta E}{E} = \frac{2n+1}{n^2}$ for a particle in a box in one dimension
where ΔE = the deference between any two consicutive levles,
suppose that n = the first levle and n + 1 = is the second levle

b) Find the probability current density if $\psi_r = e^{\frac{iPr}{\hbar}}$

Q/6 a) Find the energy level and the wave function of the ground state in simple harmonic oscillator in one dimension and prove its normalized

b) A free particle moving along the x-axes from left to right described as shown below , write the wave function which describe this particle if $V_1<E$ and $V_2>E>V_3$



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