

PARUL UNIVERSITY
FACULTY OF APPLIED SCIENCE
M.Sc.Winter, 2018-19 Examination

Semester: 2

Subject Code: 11204151

Subject Name: Quantum Mechanics II & Mathematical Physics II

Date: 17/12/2018

Time: 10:30 am to 01:00 pm

Total Marks: 60

Instructions:

1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

Q.1. A) Essay type (08)

- (a) Discuss in detail Spin functions of two electrons.
- (b) Discuss about Hartree equations.

Q.1. B) Answer the following questions (Any two)

(a) Short note (04)

1. State Pauli's Principle
2. Define Indistinguishable particles along with examples.

(b) Short note: The Schrodinger Picture and The Heisenberg Picture. (04)

(c) Short note: The Central Field Approximation. (04)

Q.2. A) Answer the following questions.

(a) Short note (04)

1. Briefly discuss about quantum electrodynamics.
2. Discuss coherent states.

(b) Short note: Einstein's Coefficient. (04)

Q.2. B) Answer the following questions (Any two)

(a) Short note (03)

1. Define Electric dipole.
2. Explain the term momentum transfer.
3. Define perturbation.

(b) Short note: Interaction of radiation with matter. (03)

(c) Short note: Creation and annihilation operators. (03)

Q.3. A) Essay type/ Brief note (4x2) (Each of 04 marks) (08)(a) Prove that if $f(z)$ is analytic on and inside a simple closed curve C , the value of $f(z)$ at point $z=a$ inside C is given by the following contour integral along C :

$$f(a) = \oint \frac{f(z)}{z-a} dz.$$

(b) Convert the differential equation $y''(x) - 3y'(x) + 2y(x) = 5 \sin x$, $y(0)=1$, $y'(0)=-2$ into an integral equation.**Q.3. B) Answer the following questions (Any two)**

(a) Answer the following (04)

1. Is conjugate of z analytic? Give the reason.
2. Find the real and imaginary part of $f(z)=z^2+5z$

(b) Sketch $D = \{z/-1 < (z) < 1\}$. Is it connected? (04)(c) Determine the poles of the function $(z) = z^2 / (z-1)^2(z+2)$ and residue at each pole. Hence evaluate $\int f(z) dz$, where C is the circle $|z|=3$ (04)**Q.4. A) Answer the following questions.**

(a) Define the following (04)

1. Green function.
2. Linear harmonic oscillator.

(b) Show that the function $u = x^2 - y^2 + x$ is harmonic and find the corresponding analytic function. (04)

Q.4. B) Answer the following questions (Any two)

- (a) Answer the following **(03)**
1. What are conditions for a function to be analytic?
 2. State Cauchy's theorem.
 3. _____ expresses the value of a harmonic function within a circle in terms of its value on the boundary.
- (b) Enumerate the conditions which Green's function must satisfy. (i.e., Define Green's function.) **(03)**
- (c) Define Liouville - Neumann series. **(03)**