PARUL UNIVERSITY
FACULTY OF APPLIED SCIENCE
M.Sc., Winter 2017-18 Examination

Semester: 1   Date: 18/12/2017
Subject Code: 11204101   Time: 02:00pm to 04:30 pm
Subject Name: Quantum Mechanics-I & Mathematical Physics-I   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) Brief note (Each of 04 marks)   **(08)**
    (a) Explain Stark effect.
    (b) Give equations of any one state for Perturbation for discrete levels.

Q.1. B) Answer the following questions (Any two)
    (a) Short note (Each of 02 marks)   **(04)**
      1. Give a short note on applications to excited states.

      2. Short note on Bohr -Somerfield quantum condition.
    (b) Explain one dimensional Schrodinger Equation.   **(04)**
    (c) Give a note on Upper bound on ground state energy.   **(04)**

Q.2. A) Answer the following questions.
    (a) Brief note (Each of 02 marks)   **(04)**
      1. Give one application of Schrodinger equation.
      2. Explain WKB Approximation.
    (b) Give the restatement of Bloch theorem with necessary justification. **(04)**

Q.2. B) Answer the following questions (Any two)
    (a) Do as directed. (Each of 01 marks)   **(03)**
      1. Define Propagators.
      2. What is a electrical analog of Zeeman Effect?
      3. Schematically represent energy band gap in metals and non metals.
    (b) Discuss non degenerate case.   **(03)**
    (c) Explain Variational Principle.   **(03)**

Q.3. A) Answer the following questions (Each of 04 marks)   **(08)**
    (a) Solve the differential equation by Laplace transform

$$y'' + 2y' + 5y = e^{-t} \sin t, \quad y(0) = 0 \; y'(0) = 1$$

    (b)Explain dihedral group in detail with example.

Q.3. B) Answer the following questions (Any two)
    (a) Definition (Each of 02 marks)   **(04)**
      1.   Group and subgoups
      2.   Laplace
    (b) Using partial fraction, find the inverse Laplace transform of following **(04)**

$$\frac{s+10}{s^2 - s - 2}$$

    (c) Discuss: Contravariant and Covariant vectors   **(04)**

Q.4. A) Answer the following questions.
    (a) Definition   (Each of 02 marks)   **(04)**
      1. Homomorphism and Isomorphism
      2.Cyclic group with example
    (b) Find Laplace transform of 1) $\int_0^t e^t \frac{\sin t}{t} dx$ 2) $L\{te^{-t} \cos ht\}$ **(04)**

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

    (a) Do as directed   (Each of 01 marks)   **(03)**

        1. Invariant tensors

        2. Fundamental tensors

        3.Write formula for second shifting theorem.

    (b) Using convolution theorem, find   **(03)**

$$L^{-1}\left\{\frac{1}{s^2(s-1)}\right\}$$

    (c) Explain right cosets with example   **(03)**