Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/INTPBR/SEM-4/CH-523/2010

2010

ADVANCED ORGANIC CHEMISTRY

Time Allotted : 3 Hours Full Marks : 50

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer any *five* questions.

GROUP - A

1. Answer any *two* questions : 2 × 5

   a) Given that (S)-bromobutane has a specific rotation of + 23·1° and (R)-bromobutane has a specific rotation of – 23·1°, what is the optical purity and % composition of a mixture whose specific rotation was found to be + 18·4° ?

   b) What is the structure of β-lactam ring ? How does it work ?

c) Suggest two methods for the synthesis of a chiral compound. How it can be detected ?

2. Complete the following reactions for any *four* of the following : $4 \times 2\frac{1}{2}$

3. Write down the reagents for any *five* of the following transformations, it may involve more than one step : 5 × 2

4. Complete any *four* of the following synthesis (it may involve more than one step) : $4 \times 2\frac{1}{2}$

5. Suggest a method to lable the fullerene with the following fluorophore. 10

6. a) Write down the synthetic method of the following amino acid : 5

b) Complete the synthesis for any *one* of the following : 5

GROUP - B

7. Determine the energy levels and their degeneracies when an electron contained in a cube of volume $L^3 (L \to \infty)$ interacts with a magnetic field characterized by the vector potential

$A = B_0 x e_y \left(|e_y| = 1 \right)$. How are the degeneracies linked to quantum Hall effect ? 10

8. a) The Schroedinger equation for the wavefunction of a particle is $i\hbar \frac{\partial \psi(x,t)}{\partial t} = -\frac{\hbar^2}{2m} \frac{\partial^2 \psi(x,t)}{\partial t^2} + V(x)\psi(x,t)$. Obtain the same equation in momentum representation.

b) Obtain the operator $\frac{1}{r}$ in momentum representation. 10

9. Starting with the expression of energy (E) of a free electron with rest mass m_0

$$E = \sqrt{c^2 p^2 + m_0^2 c^4}$$

arrive at the Dirac's equation for the electron. How does it automatically lead to the existence of spin - angular momentum of the electron ? 10

10. A particle with magnetic moment $\mu = \mu_0 s$ and spin s, with magnitude $\frac{1}{2}$ is placed in a constant magnetic field (B) pointing along the x-axis. At t = 0, the particle is forced to have $s_z = +\frac{1}{2}$. Find the probability of finding the particle with $s_y = \pm\frac{1}{2}$ at any later time (t). 10

11. Starting from Dirac's equation for an electron in a static electromagnetic field, proceed to obtain an estimate of the magnetic moment of the electron, neglecting terms $O\left(v^2/c^2\right)$ and higher. 10

12. While solving the time - dependent Schroendinger equation for a diatomic molecule irradiated with a pulsed laser field, show the details of the following techniques :

    a) Fast Fourier transformation for evaluating the kinetic energy operator;

    b) Lanczos reduction based iteration to obtain time dependent wave function. 5 + 5

13. Explain :

    a) What is Schroendinger current and how it's expression is used for calculating dissociation probability from a time-dependent wave function ?

    b) What is absorbing potential and how it is used while solving Time-Dependent Schroendinger equation ?

    5 + 5

14. Use 1d harmonic oscillator eigenfunctions as primitive basis and derive the form of kinetic energy operator exploiting

Discrete Variable Representation (DVR) of the wave function. 10