



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.*

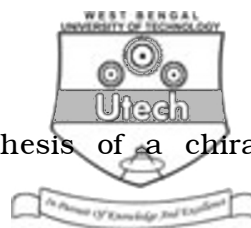
Answer any *five* questions.

**GROUP - A**

1. Answer any *two* questions : 2 × 5

- a) Given that (S)-bromobutane has a specific rotation of  $+ 23.1^\circ$  and (R)-bromobutane has a specific rotation of  $- 23.1^\circ$ , what is the optical purity and % composition of a mixture whose specific rotation was found to be  $+ 18.4^\circ$  ?
- b) What is the structure of  $\beta$ -lactam ring ? How does it work ?

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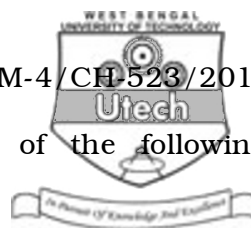
- c) Suggest two methods for the synthesis of a chiral compound. How it can be detected ?

2. Complete the following reactions for any *four* of the

following :

$$4 \times 2\frac{1}{2}$$

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3. Write down the reagents for any *five* of the following

transformations, it may involve more than one step :  $5 \times 2$

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4. Complete any *four* of the following synthesis ( it may involve more than one step ) :



5. Suggest a method to label 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  $L^3$  ( $L \rightarrow \infty$ ) 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  $i\hbar \frac{\partial \psi(x,t)}{\partial t} = -\frac{\hbar^2}{2m} \frac{\partial^2 \psi(x,t)}{\partial x^2} + V(x) \psi(x,t)$ . Obtain the same equation in momentum representation.

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

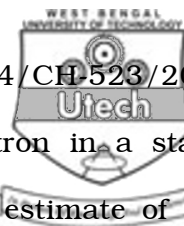
9. Starting with the expression of energy (  $E$  ) of a free electron with rest mass  $m_0$

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

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  $O(v^2/c^2)$  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

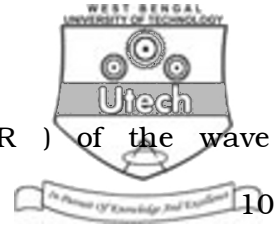
13. Explain :

- 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

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Discrete Variable Representation ( DVR ) of the wave  
function.



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