NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF APPLIED CHEMISTRY

BACHELOR OF SCIENCE HONOURS DEGREE

END OF SECOND SEMESTER EXAMINATIONS – JUNE 2011

POLYMER SCIENCE II – SCH 2207

TIME: THREE (3) HOURS

INSTRUCTIONS TO STUDENTS

1. **ANSWER *ALL* QUESTIONS FROM SECTION A AND *ANY THREE* FROM SECTION B. SECTION A CARRIES 40 MARKS AND EACH QUESTION IN SECTION B CARRIES 20 MARKS.**

2. **START EACH QUESTION ON A NEW PAGE.**

3. **GRAPH PAPER WILL BE PROVIDED ON REQUEST.**

TOTAL MARKS = 100

THIS QUESTION PAPER CONSISTS OF *THREE PRINTED PAGES* (ON ONE SIDE ONLY) INCLUDING THE TOP PAGE WITH THE INSTRUCTIONS.

SECTION A: (Answer all questions in this section)

1. a) Differentiate between an ideal solution and a regular solution. (6 marks)

   b) What are colligative properties of materials? Give examples. (4 marks)

   c) Name five properties of a polymer that are dependent on the molecular weight. (5 marks)

   d) Give an expression of an ideal solution in thermodynamic terms i.e. using Gibbs energy. (4 marks)

   e) Name five factors that affect the dissolution of a polymer. (5 marks)

   f) What do you understand by molecular weight distribution (MWD) of a polymer? (3 marks)

   g) Draw a polymer Stress/Strain graph and indicate the following: Dilatant Substance; Newtonian Fluid and Pseudoplastic Material. (5 marks)

   h) Explain the relationship between CED and Solubility Parameter. (4 marks)

   i) What information about a polymer can we learn from using: IR-Spectroscopy and Proton NMR? (4 marks)

SECTION B: (Choose and answer three questions from this section)

2. a) Explain the underlying principles of **any two** of the following methods of polymer analysis;

   i) differential thermal analysis

   ii) differential scanning calorimeter

   iii) x-ray diffraction analysis

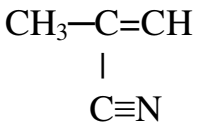
   iv) spectroscopic method of analysis (20 marks)

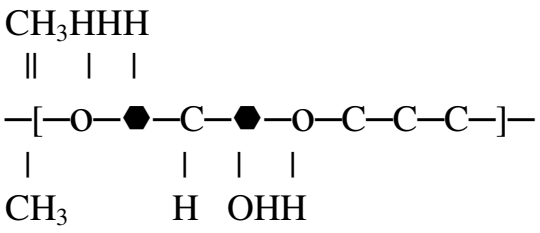
3. a) If the average molecular weight (M_n) of LDPE is $2.4x10^5$, what is the value of the degree of polymerization (DP) of the polymer? (6 marks)

b) List these in order of decreasing value: M_v; M_w; M_z and M_n. (4 marks)

c) What are the M_n and M_w values for a mixture of five molecules each having the following molecular weights: $1.25x10^6$, $1.35x10^6$, $1.50x10^6$, $1.75x10^6$ and $2.00x10^6$? (10 marks)

4. Estimate the solubility parameters of the following materials using SMALL/HOY attraction constants given below:

a)


b)


(20marks)

*⬣- 6-member ring

—O—	*114.98*
—C=	*117.12*
—CH_2—	*131*
>CH—	*85.99*
6-member ring	*-23.44*
OH	*225.84*
—C—	*32.03*

Density of polymer: 1.15g/cm^{-3}

5. a) Outline the three stages of formation of a polymer crystal from a dilute solution. (12 marks)

b) Name four parameters that affect Tg. (4 marks)

c) Differentiate between crystalline and amorphous polymers. (4 marks)

End of question Paper