NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCE

DEPARTMENT OF APPLIED CHEMISTRY

POLYMER SCIENCE II
SCH 2207

FOR SCH STUDENTS ONLY

Second Semester Examination Paper

MAY 2016

This examination paper consists of 3 pages

Time Allowed: **3 hours**

Total Marks: **100**

Special Requirements: Graph Paper

Examiner's Name: DR C T PAREKH

INSTRUCTIONS

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. **Show mechanism, chemical steps or synthesis by means of curved arrows.**

MARK ALLOCATION

QUESTION	MARKS
1.	**40**
2.	**20**
3.	**20**
4.	**20**
5.	**20**
TOTAL POSSIBLE MARKS	**100**

SECTION A:

1. (a) With the aid of diagrams explain the following terms in your own words.
   (i) long range order
   (ii) short range order (4 Marks)

   (b) Draw a polymer Stress/Strain graph and indicate the following on the graph: Dilatant polymer; Newtonian Fluid and Pseudoplastic polymer. (4 marks)

   (c) Name at least four parameters that affect Tg. (4 Marks)

   (d) Give three factors which determine the crystallisability of polymers. (3 Marks)

   (e) Name five factors that affect the dissolution of polymers. (5 Marks)

   (f) You are given the following substances:
   Tomato sauce, tooth paste, nail polish, mayonnaise, corn starch dissolved in water, printing ink.

   Identify them as:
   (i) Shear thinning
   (ii) Shear thickening and
   (iii) Bingham plastic. (6 Marks)

   (h) Indicate four characteristics of crystallisable polymer. (4 Marks)

   (i) Differentiate between an ideal solution and a regular solution. (4 marks)

   (j) Define with the aid of a diagram second order phase transition in your own words. (6 Marks)

SECTION B:

2. (a) In a solution viscosity experiment the efflux time for the pure solvent was 9.0 sec. The efflux times for the solution at different concentrations are given in the data below:

Concentration g/dl	10	20	30	40	50
Efflux time in sec,	10	11	13	15	17

   Find the viscosity average molecular weight (Mv) of the polymer if:
   $K = 1{,}04 \times 10^{-3}$ dl g^{-1} and $a = 1.75$ (15 Marks)

   (b) State five properties necessary to produce good polymer solutions. (5 Marks)

3. (a) Given the following information, calculate the solubility parameter (δ) of poly(vinyl acetate). Density of poly(vinyl acetate) is 0.932 g/cm^3.

GROUP	SMALL/HOY FACTOR $[(J\text{-}CM^3)^{½}]$
$-CH_3$	303
$-CH_2-$	269
>CH-	176
>C<	65
- O -	235
-COO-	668
>C=O	538
-COO-	668
-CHO-	599

(10 Marks)

(b) What do you understand by;
(i) limited swelling
(ii) unlimited swelling
(iii) degree of swelling (10 Marks)

4. (a) Calculate the number average molecular weight (Mn) and weight average molecular weight (Mw) of a mixture of five molecules each of mass 125, 135, 150, 175 and 200:
Calculate:
(i) Mn
(ii) Mw
(iii) Mw/Mn
(iv) Is the polymer monodispersed or polydispersed? (10 marks)

(b) Draw different types of morphological structures of a crystalline polymer. (10 marks)

5. (a) With the aid of a simple illustration describe LCST and UCST. (10 Marks)

(b) Fractionation of a polymer into various molecular weights can be carried out by different methods. One of them is fractionation by lowering the temperature. Explain with the aid of diagrams how the fractions can be achieved. (10 Marks)

-END OF EXAMINATION PAPER-