NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCE

DEPARTMENT OF APPLIED CHEMISTRY

POLYMER SCIENCE II
SCH 2207

FOR SCH STUDENTS ONLY

Supplementary Examination Paper

July 2016

This examination paper consists of 4 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: Graph Paper

Examiner's Name: DR C T PAREKH

INSTRUCTIONS
1. Answer <u>all</u> questions from Section A and <u>any three</u> 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

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SECTION A:

1. (a) Explain briefly "The degree of crystallinity". (3 Marks)

   (b) Indicate three characteristics of a true polymer solution. (3 Marks)

   (c) Differentiate between good and poor solvent. (2 Marks)

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

   (e) Describe the influence of temperature on viscosity. (4 Marks)

   (f) Draw the structures of Ideal crystals, crystalline polymer and amorphous state.
   (6 Marks)

   (g) What are the properties required to produce a good polymer solution? (6 Marks)

   (h) How does a polymer solution differ from a micromolecule solution? (4 Marks)

   (j) What do you understand by the term 'morphology'? (2 Marks)

   (k) On X-ray diffraction, illustrate what a crystalline polymer and an amorphous polymer look like. (2 Marks)

   (l) What are the characteristics of a true polymer solution? (3 Marks)

SECTION B:

2. (a) Draw an Oswald viscometer. Briefly explain how one can measure viscocity.
   (5 Marks)

   (b) In a solution viscosity experiment the efflux time for the pure solvent was 84.2 sec. The efflux times for the solution at different concentrations is given in the data below:

Concentration g/dl	0.40	0.50	0.67	1.00
Efflux time in sec.	112.7	121.4	134.6	164.6

   Find the viscosity average molecular weight (Mv) of the polymer if:

   $K = 1.34 \times 10^{-4}$ dl/g $a = 0.71$ (15 Marks)

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3. (a) Given the following information, calculate the solubility parameter (δ) of polypropylene (PP). Density of PP is $0.968g/cm^3$.
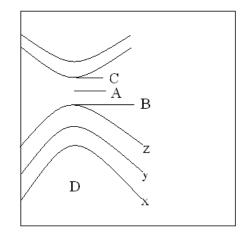
GROUP	SMALL/HOY FACTOR $[(J\text{-}CM^3)^{½}]$
-CH3	303
-CH2	269
>C<	65
-COO-	668
>CH<	176
>C=O	538

(10 Marks)

(b) With the aid of a block diagram describe the DTA technique of polymer analysis. (10 Marks)

4. (a) Outline the mechanism of polymer crystallisation with special emphasis on:
   (i) Nucleation and
   (ii) Rate of growth of crystallites. (kinetic equations not required).
(10 Marks)

(b) Sketch a graph of relaxation modulus vs temperature and indicate all distinguishable stages which are within the amorphous range. (10 Marks)

5. (a) From the labelled diagram below:

   (i) Identify B and C (2 Mark)
   (ii) Comment on position A , D and E (3 Mark)
   (iii) Comment on x, y and z (2 Mark)
   (iv) What does the curve on the diagram indicate? (1 Mark)
   (v) Explain briefly what do you think can happen. (2 Marks)

(b) Suppose in a polymer sample there are 10 polymer molecules of molecular mass 103, 20 molecules of molecular mass 104 and 20 molecules of molecular mass 105. Calculate:

      (i)   Mn
      (ii)   Mw
      (iii)   Mw/Mn
      (iv)   Is the polymer monodispersed or polydispersed?

(10 Marks)

*************************End of question Paper************************

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