FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI
SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY
DEPARTMENT OF POLYMER AND TEXTILE ENGINEERING

2014/2015 HARMATTAN SEMESTER EXAMINATION

PTE 303: POLYMER PHYSICS

TIME: 3 HRS DATE: APRIL 29, 2015. INSTRUCTIONS: ANSWER QUESTION ONE (1) AND ANY OTHER FOUR QUESTIONS

1 (a) Derive an expression for a copolymer composition in terms of concentration of the reacting monomers and the reactivity ratios.
(b) The following reactivity ratios have been observed for two monomers of equimolar concentrations involved in a Copolymerization
(i) $r_1 = r_2 = 1$ (ii) $r_1 = 0, r_2 = 2$ (iii) $r_1 = 1, r_2 = 0.5$
predict the type of copolymer formed in each case

2 (a) Explain what you understand by the expression glass transition temperature
(b) Glass transition temperature for thermoplastics is affected by several factors. Mention and explain five of these factors.
(c) Explain why semicrystalline polymers have a melting range rather than a melting point and no sharply defined glass transition temperature.

3 (a) Sketch and label any two capillary viscometer you have studied.
(b) A typical data from measurement of dilute solution viscosity studies of polystyrene in xylene at 25°C are as follows:

Conc (g/dm^3)	0	0.4	0.8	1.2	1.4	1.6
Flow time (sec)	30.7	39.3	47.0	50.9	60.6	72.4

Using the information above, determine the relative viscosity, and specific viscosity at each polymer concentration and hence determine the intrinsic viscosity at infinite dilution.
(c) if K and a are $5.7 \times 10^{-5} m^3 kg^{-1}$ and 0.68 respectively, calculate the average molecular mass of the polystyrene sample

4(a) What is polymer isomerism
(b) Write the possible structures of the following polymers:
(i) Polychloroprene (ii) Polyisoprene
(c) Write Short notes on
(i) Branching in Polyethylene (ii) Branching in Polyvinylacetate
Using appropriate examples and structures

5 (a) Define the following terms
(i) Number average molecular weight (ii) Weight average molecular weight
(b) Calculate the number and weight average molecular weight of the following samples

Number of Samples (N_i)	1	3	5	8	10
Weight of each molecule (M_i)	800,000	750,000	700,000	650,000	600,000

From your answer, determine the polydispersity index.
(c) A mixture was prepared from three mono-dispersed polystyrene samples with molecular weights of 10,000, 15,000 and 20,000. If equal weights of the samples are mixed, determine the number and weight average molecular weight of the mixture.

6(a) Write short notes on the following:
(i) Infrared spectroscopy (ii) Nuclear magnetic resonance spectroscopy (NMR) (iii)X-ray diffraction Analysis
(iv) Differential Thermal Analysis (v) Thermo-gravimetric Analysis
(b) Explain the following engineering terms
(i) Fatique failure (ii) Brittle rupture (iii) Tear resistance (iv) Abrasion Resistance