DEPARTMENT OF CHEMISTRY
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
FIRST SEMESTER EXAMINATION 2022/2023 SESSION

COURSE TITLE: POLYMER CHEMISTRY
COURSE CODE: CHM 315
CREDIT UNITS: 3
TIME ALLOWED: 2 HOURS 30 MINUTES

INSTRUCTION: ANSWER FOUR THREE QUESTIONS

Q1 (a). Define the following terms:
(i)Polymer (ii) Copolymer (iii) Degree of Polymerization (iv) Oligomer
(v) Rheology (vi) Polymer morphology **(6 marks)**

(b) In a tabular form, write the structural formular of the monomer and repeating units of the following polymers (i) polystyrene (ii) poly vinyl acetate (iii) polyvinyl chloride (iv) poly methyl metaacrylate **(4 marks)**

(c) Using structures only, illustrate the following types of polymers
(i) homopolymer (ii) Random copolymer (iii) Block copolymer (iv) Graft copolymer
(v) Alternate copolymer **(5 marks)**

Q2.(a).Define the following terms (i) Number average molecular weight (ii) Weight average molecular weight (iii) viscosity average molecular weight (iv) thermoplastics and thermosetting **(4 marks)**

(b) A sample of polystyrene is composed of a series of fractions of different sized molecules:

Fraction	Weight fraction	Molecular weight
A	0.10	12000
B	0.19	21000
C	0.24	35000
D	0.18	49000
E	0.11	73000
F	0.08	102000
G	0.06	122000
H	0.04	146000

Calculate (i) number average molecular weight (ii) weight average molecular weight
(iii) Polydispersity index **(6 marks)**

(c) In a tabular form, highlight any five differences between flexible and rigid plastics **(5 marks)**

Q3.(a) Describe the working principle of Gel Permeation Chromatography. **(5 marks)**

(b) 0.1 g sample of polystyrene was dissolved in 100 cm^3 of butanone at 2.5% in an Ubbelohde capillary viscometer, if the flow times for pure butanone was 220 sec and that of 0.1% polystyrene was 280 second. Determine the viscosity average molecular weight of the solution. [Given the value of k and a to be 3.9×10^{-3} and 0.581 respectively] **(7 marks)**

(c). Briefly discuss the limitations of Membrane Osmometry **(3 marks)**

Q4. (a) A 21.3 g sample of poly (hexamethylenediamide) was found to contain 2.5×10^{-3} mol of carboxyl groups by both titration with base and acid. From the data, the polymer was found to have a number average molecular weight of 8520.

(i) Describe experimentally how to obtain the correct value of Mn.
(ii) Highlight any four limitations of this technique
(iii)List any three factors complicating this analysis **(10 marks)**

(b). In a tabular form, enumerate any four differences between industrial and suspension polymerization **(2 marks)**

(c). List any three factors governing the mechanical properties of a polymer **(3 marks)**

Q5. (a). Briefly explain the textural behaviour of polymer in (i) dilute solution (ii) molten state **(4 marks)**

(b) Consider the reaction below

$$nHO-R-OH + nHOOC-R'-COOH \rightarrow S \text{ and } T$$

(i) Identify the products S and T
(ii) Suggest the class name of the polymer formed
(iii) what type of polymerization is applicable here?
(iv) propose a suitable mechanism for the formation of S and T **(6 marks)**

(c). Briefly discuss any two of the following models

(i) Folded Chain Lamellar (ii) Extended chain crystals (iii) Fringed micelle **(5 marks)**