IATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCES
DEPARTMENT OFAPPLIED CHEMISTRY

POLYMER SCIENCE I

SCH 2107

First Semester Examination Paper

December 2015

This examination paper consists of 3 pages

Time Allowed: **3 hours**

Total Marks: **100**

Special Requirements:

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. **Use of calculators is permissible**

MARK ALLOCATION

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

SECTION A:

1. (a) Define the concept 'degree of polymerisation'. (2 Marks)

(b) What is the degree of polymerisation of each of the following?
   (i) PE with molecular weight 24976
   (ii) PVC with molecular weight 27500
   (iii) PS with molecular weight 6032 (6 Marks)

(c) Suggest four ways by which free radical initiation reaction can be carried out. (4 Marks)

(d) Draw the repeating unit of each of the following polymers:
   (i) polyvinyl acetate,
   (ii) poly(methyl acrylate),
(2 Marks)

(e) How can Ziegler/Natta catalyst be synthesised? Write chemical equation for one of the known catalysts. (5 Marks)

(f) Give **five** factors that characterise step-growth polymerisation. (5 Marks)

(g) Draw a possible structure of ABS if it is described as……'a graft of styrene and acrylonitrile on a butadiene backbone.' (Do not use abbreviation) (4 Marks)

(h) Draw structures of Nomex and Kevlar polyamide. Indicate one use of each. (4 Marks)

(i) What properties distinguish a thermoplastic polymer from a thermosetting polymer? (6 Marks)

(j) What is the difference between a polymer and a macromolecule? (2 Marks)

SECTION B:

2. (a) Natural rubber is a cis-isomer of isoprene while gutta percha is the trans isomer. Write the repeating units of each of these polymers. (4 Marks)

(b) Describe (i) the art of latex tapping and (ii) creaming method for concentration of rubber. (10 Marks)

(c) What is the purpose of vulcanisation of rubber? Draw the structure of vulcanised rubber. (6 Marks)

3. (a) Taking styrene as an example, write chemical equations for the initiation, propagation and termination steps involved in anionic polymerisation of this monomer.

(10 Marks)

(b) Given the following pairs:

Compound	Q	e
styrene	1.00	-0.80
Vinyl acetate	0.03	-0.22

Calculate r_1 and r_2 and suggest the type of polymer that will be produced.

(6 Marks)

(c) What do you understand by mercerisation?

(4 Marks)

4. (a) Describe how Tencel fibre is produced from wood pulp.

(3 Marks)

(b) Spandex is synthesised from toluene diisocyanate and adipate ester of 1,2-propanediol. Draw the structure of the spandex indicating urethane and ester linkage .

(6 Marks)

(c) Write synthetic steps with reaction conditions for the formation of carbon fibre from acrylonitrile.

(7 Marks)

(d) Suggest with the aid of structures why polystyrene does form through head to tail orientation.

(4 Marks)

5. (a) Write chemical equations for the following reactions in benzoyl peroxide initiated polymerisation of ethene.

(i) initiation
(ii) propagation
(iii) termination by chain transfer.

(10 Marks)

(b) Draw the labelled schematic diagram for emulsion polymerisation. State advantages and disadvantages of the polymerisation.

(6 Marks)

(c) Draw the structure of PET.

(2 Marks)

(d) What is the name used to describe the negatively charged counterion in cationic chain reaction polymerisation? Draw the structure of the ion.

(2 Marks)

END OF QUESTION PAPER!!!!