NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCE

DEPARTMENT OF APPLIED CHEMISTRY

POLYMER SCIENCE I
SCH 2107
FOR SCH STUDENTS ONLY

First Semester Examination Paper
December 2016

This examination paper consists of 3 pages

Time Allowed: **3 hours**

Total Marks: **100**

Special Requirements: NONE

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 mechanisms, 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) What is the degree of polymerisation of each of the following?
PE with molecular weight 16492
PVC with molecular weight 23436

(4 Marks)

(b) When styrene reacts with a radical it produces two styrene radicals. Draw the structures of both and explain briefly which one of them is stable.

(6 Marks)

(c) Why does natural rubber need to be vulcanised?

(4 Marks)

(d) Why are viscose fibres more hygroscopic than natural cellulose fibres?

(2 Marks)

(e) Indicate five factors that characterise chain growth polymerisation.

(5 Marks)

(f) Draw the structures of melamine formaldehyde.

(3 Marks)

(g) Write the structure of PET and indicate by a drawing circle on the functional group that indicate that PET is a polyester.

(3 Marks)

(h) Draw the structure of cotton [poly(1,4-β-anhydroglucopyranose)] fibre.

(2 Marks)

(i) When can Q – e method be used?

(2 Marks)

(j) How many ways can an initiation reaction be carried out in addition polymerisation?

(4 Marks)

(k) You are given five different polymers and their examples are mixed up. Rewrite the polymers with their correct examples.

(i) natural polymers	(i) poly methylmethacrylate
(ii) addition polymers	(ii) wool
(iii) crossed link polymers	(iii) lyocell
(iv) condensation polymer	(iv) UF
(v) regenerated fibres	(v) terylene

(1x5 Marks)

SECTION B:

2. (a) Solution polymerisation is the preferred technique for varnish and adhesives production. Describe the process and indicates the advantages and disadvantages. (10 Marks)

(b) Write synthetic steps with the reaction conditions for the formation of carbon fibres from acrylonitrile. Suggest two uses of carbon fibres. (no mechanism required). (7 Marks)

(c) What are the composition of acrylic fibre and modeacrylic fibre? Suggest one use of modacrylic? (3 marks)

3. (a) On polymerisation, butadiene forms different types of stereopolymers. Draw as many structures as possible and indicate the type of polymerisation and the polymer that has produced. (12 Marks)

(b) Explain with the aid of chemical equations, why polyvinyl alcohol cannot be synthesised from vinyl alcohol but it can be synthesised from polyvinyl acetate. (8 Marks)

4. (a) Write reaction mechanism for the cationic polymerisation of propene. The reaction involves:
(i) initiation (ii) propagation and (iii) termination steps (8 Marks)

(b) Draw the structures of (i) Nomex polyamide and (ii) Kevlar polyamide. Indicate one use of each polyamide. (4 Marks)

(c) Given the following pairs:

Compound	Q	e
acrylonitrile	+0.06	+1.20
Butadiene	+2.39	-1.05

Calculate r_1 and r_2 and suggest the type of polymer that will be produced. (8 Marks)

5. (a) Phenol is used in the manufacture of phenolic resin. On an industrial scale phenol is manufactured through the cumene process. Write chemical reactions step by step, for the formation of phenol.(No mechanism required). (7 Marks)

(b) Caprolactum is used for the production of nylon 6.
How would you synthesise caprolactum from benzene? (No mechanism required). (7 Marks)

(c) Describe the procedure to produce cellulose triacetate fibres. Write the chemical reaction involved. (No mechanism required). (6 Marks)

**********END OF THE PAPER**********