



**University of Ruhuna- Faculty of Technology**  
**Bachelor of Engineering Technology Honours**  
**Level 1V (Semester 1) Examination, December 2020**  
**Academic year 2019/2020**

**Course Unit: ENT 4162 Polymer Materials**

**Duration: 2 hours**

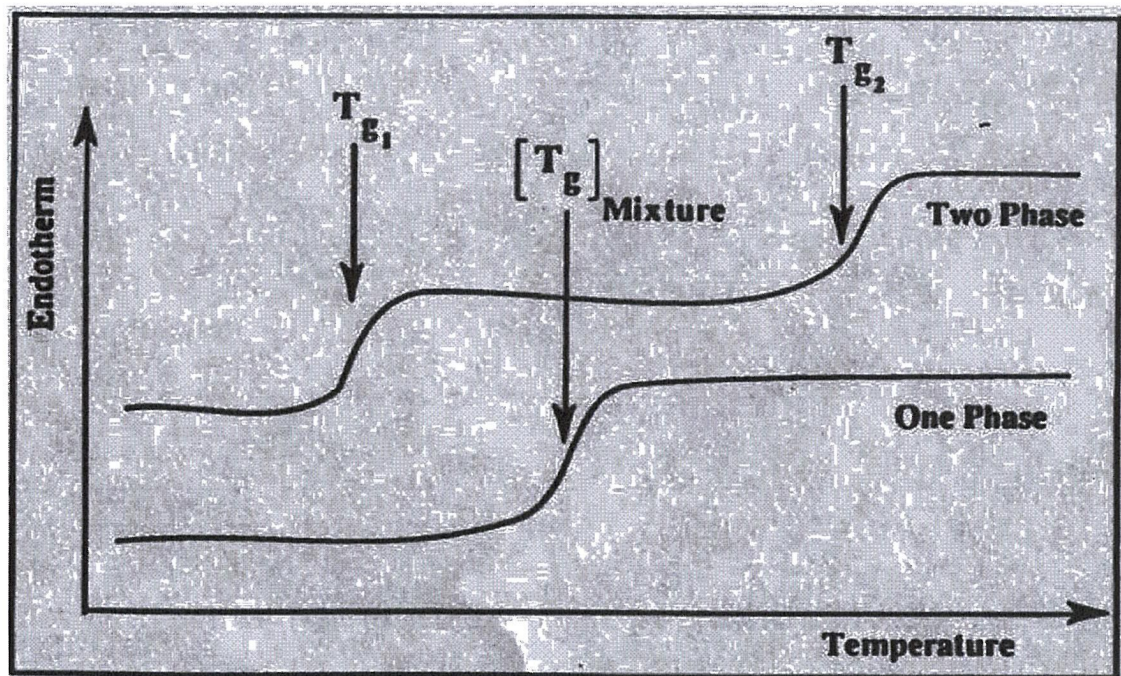
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**Instruction to Candidates**

- This paper contains five questions on five pages.
- The examination accounts for 60% of the module assessment.
- This is a closed book examination.
- Answer **all** questions.
- The answers should be provided for Part A and Part B in separate booklets.
- All questions carry equal marks. The maximum marks attainable for the parts of the questions are indicated in brackets.
- Electronic/communication devices are not permitted. Only allowed is a calculator approved and labelled by the Faculty of Technology.

## PART A

1. Polymers are large molecules which are made up of repeating units of the small molecules called monomers. Polymers play a crucial role in living and non-living things, providing basic structural materials and participating in vital manufacturing processes.
  - a) Draw the monomer, repeating unit, and the polymer structure of following commonly used polymers.
    - I. Polypropylene (PP)
    - II. Polytetrafluoroethylene (PTFE)
    - III. Poly (vinyl chloride) (PVC)
    - IV. Poly (methyl methacrylate) (PMMA)(6 marks)
  - b) State three characteristic features of the addition polymerization process. (3 marks)
  - c) What do you mean by a polymer composite? Explain using a relevant figure. (4 marks)
  - d) Tabulate differences between thermoplastic polymers and thermosetting polymers. (7 marks)
2. A plasticizer is a substance that is added to a material to make it softer and more flexible. As an example, in polyvinyl chloride (PVC) industry, dioctyl phthalate (DOP) is added as a plasticizer and possible Differential Scanning Calorimetry (DSC) curves are shown in the following figure.



- a) Explain the effect of adding DOP into PVC by referring the DSC curves in the figure. (4 marks)
- b) Instead of adding plasticizers, state another four factors affecting for the “T<sub>g</sub>” of the polymers? (4 marks)
- c) A manufacturer needs to produce PVC in a pure form and with a low cost. What would be the appropriate polymerization technique out of bulk polymerization, solution polymerization and suspension polymerization? Explain your answer by comparing those three polymerization techniques. (6 marks)
- d) Ultrahigh Molecular Weight Polyethylene and Styrene-butadiene block copolymers can be considered as advance polymeric materials. Explain. (6 marks)



## PART B

1. Rubber industry is one of the most emerging industries in Sri Lanka. Rubber compounding and processing are two main processes of rubber product manufacturing.
  - a) Write down three examples for diluent fillers used in rubber compounding?  
(03 marks)
  - b) Briefly discuss the three main features of the carbon black in terms of how they affect the compounding process.  
(06 marks)
  - c) Compare and contrast between two roll milling and internal mixture.  
(06 marks)
  - d) Calendaring is the one of widely used shaping operations in rubber industry. To obtain a rubber sheet with uniform thickness, which calendaring operation is more preferred? Write down the reasons behind your selection.  
(05 marks)
2. In plastic product manufacturing industry, injection moulding plays a vital role due to its ability to manufacture wide range of plastic products such as automotive parts, electrical switches, toys, medical tools etc.
  - a) Write down the four major units of an injection moulding machine?  
(04 marks)
  - b) Briefly explain the three main zones of the reciprocation screw in terms of its design features and functions.  
(06 marks)
  - c) Briefly describe the role of following components of injection moulding machine.
    - I. Mould
    - II. Hopper
    - III. Nozzle  
(06 marks)
  - d) Suppose that, you are provided to manufacture, an automotive component using injection moulding. Suggest the most suitable L/D (Length to Diameter) ratio of the screw to manufacture given product? Give the reasons behind your suggestion.  
(04 marks)

3. Variety of polymer processing techniques are employed in manufacturing of products depending on the properties of selected polymer material and the expected requirements of the finished product.

a) Identify the most suitable manufacturing technique for following plastic products.

- I. Food wrapping films
- II. Microwave containers
- III. Water pipes
- IV. Shampoo bottles
- V. Canopy

(5 marks)

b) Describe transfer moulding and compression moulding processes mentioning their similarities and differences.

(5 marks)

c) Briefly discuss three main factors considering when selecting a polymer material for a particular manufacturing process?

(6 marks)

d) Briefly explain, adverse environmental and health impacts of plastic waste and possible solutions to overcome them.

(4 marks)