



# UNIVERSITY OF RUHUNA

## Faculty of Engineering

End-Semester 7 Examination in Engineering: July 2017

Module Number: ME 7314

Module Name: Polymer Engineering (TE)

[Three Hours]

[Answer all questions, each question carries 12 marks]

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- Q1. a) Define the following terms.
- i) Degree of polymerization
  - ii) Cis-polyisoprene
  - iii) Synthetic polymer
  - iv) Stereo regularity
  - v) Thermoplastic
  - vi) Monomer
- [3.0 Marks]
- b) Copolymers can be described according to the arrangement of monomers in the polymer structure. What are the types of copolymers? (use suitable diagrammatic representation where necessary)
- [2.0 Marks]
- c) Calculate the degree of polymerization and the average molecular weight of a sample of polyethylene made using hydrogen peroxide,  $H_2O_2$ , as initiator. The amount of hydrogen peroxide used was 450 g per 1000 kg of ethylene. Assume that all peroxides are used to create terminal groups. Take atomic mass number of hydrogen, carbon, and oxygen are 1, 12, and 16, respectively.
- [3.0 Marks]
- d) Define and distinguish terms, "bulk polymerization" and "solution polymerization".
- [2.0 Marks]
- e) Briefly explain what glass transition temperature is and its significance.
- [2.0 Marks]
- Q2. Extrusion is a manufacturing process where a polymer is melted and expelled through a die under pressure. The process usually creates long length of the final product and may be continuous or semi-continuous in nature.
- a) Identify the main components of an extrusion machine by presenting a sketch and briefly explain the function of each component.
- [4.0 Marks]
- b) What are the three zones in extrusion machine? Briefly explain the involvement of each zone to the extrusion process.
- [1.5 Marks]

- c) What are the advantages and disadvantages of the extrusion process?  
[2.0 Marks]
- d) The blow molding machine is based on a standard extruder barrel and screw assembly to melt the polymer. The molten polymer is led through a right angle and through a die to emerge as a hollow (usually circular) pipe section called a parison. Discuss the blown film extrusion cycle for producing "plastic bags" with the aid of sketches.  
[2.5 Marks]
- e) Compare and contrast extrusion and injection molding.  
[2.0 Marks]

- Q3. a) Injection stretch blow molding is the process of manufacturing high quality and high clarity bottles. Describe the injection stretch blow molding cycle for producing "a water bottle" with the aid of sketches.  
[4.5 Marks]
- b) What are the three types of materials used in the compression molding process?  
[1.5 Marks]
- c) Explain the transfer molding process steps with the aid of sketches.  
[3.0 Marks]
- d) Compare vacuum forming and plug assist forming.  
[3.0 Marks]

- Q4. a) Define the meaning of "plastic resin identification number".  
[1.0 Mark]
- b) Explain the meaning of the following resin identification numbers with applications.



- [4.5 Marks]
- c) Explain the potential danger to environment caused by plastic products manufacturing processes.  
[2.0 Marks]
- d) Briefly explain how you can reduce the harmful effects of plastic products to the environment in your day to day life.  
[2.5 Marks]
- e) How would you attempt to make environmental friendly plastic products manufacturing processes?  
[2.0 Marks]

Q5. "Injection molding is the most commonly used manufacturing process for the fabrication of plastic parts. A wide variety of products are manufactured using injection molding, which vary greatly in their size, complexity, and application. The injection molding process requires the use of an injection molding machine, raw plastic material, and a mold".

a) An injection molding machine setup is shown in Figure Q5(a) and main components are labeled from A to N. Name and briefly describe functions of 10 components.

[3.0 Marks]

b) Describe the process flow of plastic part production by using an injection molding machine.

[2.0 Marks]

c) Sketch four (4) types of gates used in plastic injection molding and name one application for each.

[2.0 Marks]

d) Identify and explain major design issues of plastic products shown in Figure Q5(b)(i) to Q5(b)(iv). Recommend possible corrections by providing suitable sketches.

[5.0 Marks]

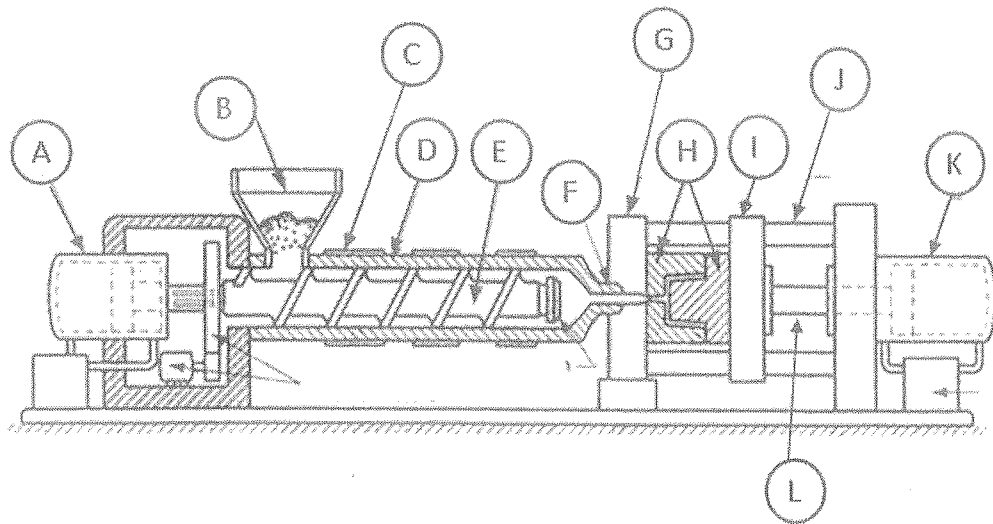


Figure Q5(a)

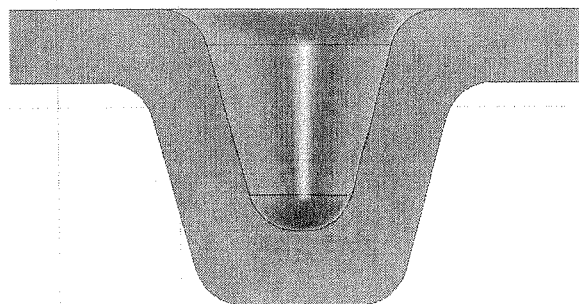


Figure Q5(b)(i)

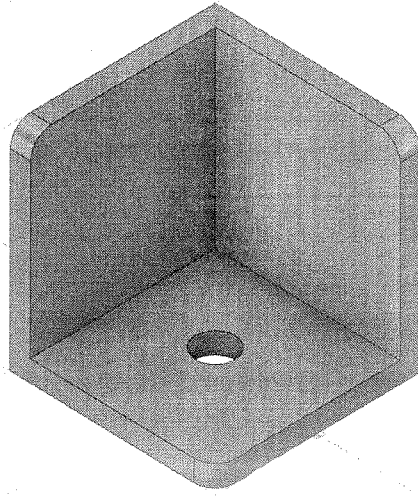


Figure Q5(b)(ii)

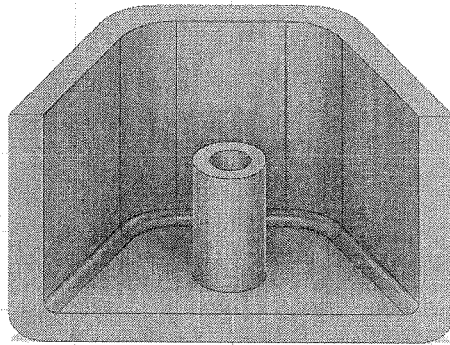


Figure Q5(b)(iii)

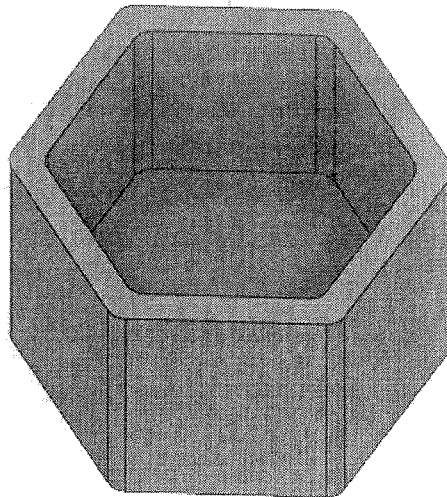


Figure Q5(b)(iv)