



UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023**

COURSE NAME : POLYMER TECHNOLOGY

COURSE CODE : BNN 30603

PROGRAMME CODE : BNN

EXAMINATION DATE : JULY/ AUGUST 2023

DURATION : 3 HOURS

- INSTRUCTIONS
1. ANSWER ALL QUESTIONS
 2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**
 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

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- Q1** (a) Fiberglass is simply a composite consisting of glass fibers, that it is either continuous or discontinuous, contained within a polymer matrix; this type of composite is produced in the massive quantities. Identify **THREE (3)** functions of the material matrix in the fiberglass composites. (3 marks)
- (b) The temperature at which the transition in the amorphous regions between the glassy and rubbery state occurs is called the glass transition temperature. Summarize how mechanical methods can be used to measure the glass transition temperature. (10 marks)
- (c) Tensile test measures the force required to break a specimen and the extent to which the specimen stretches or elongates to that breaking point. The tensile test is a measurement of the ability of a material to withstand forces that tend to pull it apart and to determine to what extent the material stretches before breaking.
- (i) Discuss the need to perform the tensile test. (5 marks)
- (ii) Illustrate the basic understanding of stress–strain behavior. (7 marks)
- Q2** (a) On heating or cooling most polymers undergo thermal transitions. Thermal transitions are the response of polymer materials to heat and what happens if the polymer is heated.
- (i) Compare the differences between Glass Transition (T_g) and Melting Temperature (T_m). (6 marks)
- (ii) Sketch and interpret the heat vs temperature plot for crystalline polymer and amorphous polymer. (8 marks)
- (b) The properties and behavior of plastics can change under the influence of chemicals. The chemical resistance of any polymer is defined largely by the chemical structure of the material and the strength of the weakest link in this structure. Describe **TWO (2)** of the scope of Chemical Test Methods – ASTM D543. (2 marks)
- (c) The flexural test measures the force required to bend a beam under 3-point loading conditions. The data is often used to select materials for parts that will support loads without flexing. Justify how the flexural properties can vary depending on ambient temperature. (9 marks)

- Q3** (a) Polymer technologies encompasses several materials with a wide range of properties. Those properties ultimately depend on the chemical structure of the polymer and how that affects the way individual polymer chains interact with one another. These interactions, however, have never been studied at the single-molecule level. Explain the **FOUR (4)** categories of chemical interactions with plastic that exist in the industry. (12 marks)
- (b) Polymer blends are a mixture of at least two polymers or copolymers with or without any chemical bonding between them. Blending technology also provides attractive opportunities for the reuse and recycling of polymer waste.
- (i) Define the condition of miscibility and compatibility in polymer blend technology. (3 marks)
- (ii) Explain the condition where the polymers are completely miscible blends. (4 marks)
- (c) Tensile testing, also known as tension testing, is a fundamental materials science and engineering test in which a sample is subjected to controlled tension until failure. Explain how the specimen preparation and size may affect the test results. (6 marks)
- Q4** (a) Nanocomposites refer to composites in which one phase has nanoscale morphology such as nanoparticles, nanotubes, or lamellar nanostructure. Nanocomposite materials are drawing attention that has a small amount of a filler of nano-size less than 100 nm that is dispersed in polymer materials with the aim of reducing the weight.
- (i) Determine **THREE (3)** importance of nanoparticles having small filler sizes. (3 marks)
- (ii) List **ONE (1)** type of nanomaterial and its application. (2 marks)
- (iii) Determine the unique properties of nanoparticles. (7 marks)
- (b) Polymers have been well-known materials in advanced applications for many years. They are versatile materials and easy to mold into any required application. However, there are a few aspects in the field of polymer to consider well, a single polymer cannot meet the requirements in advanced applications. Therefore, polymer composites attracted the attention of the world.

- (i) Define the term composites used in polymer technology. (1 marks)
- (ii) Demonstrate the major classification of composites in polymer technology using a diagram. (6 marks)
- (iii) Identify **SIX (6)** advantages of composites used in our daily activities. (6 marks)

- END OF QUESTIONS -

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