UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 4 Examination in Engineering: February 2020

Module Number: ME4301 **Module Name: Advanced Engineering Materials**

[Three Hours]

[Answer **all questions**, each question carries **12** marks]

Q1. a) Why low-density polyethylene is used as packaging film and plastic grocery bags while high density polyethylene is used to produce objects such as bottles and toys?

[3.0 Marks]

b) How the polymers can be categorized based on molecular forces? Briefly explain with suitable examples.

[4.0 Marks]

c) Write brief descriptions on followings.

i) Homo-polymer
ii) Block copolymer
iii) Random copolymer
iv) Alternative copolymer

[2.0 Marks]

d) What is glass transition temperature? How is it affecting the properties of different plastics?

[3.0 Marks]

Q2. a) Discuss on advantages of *transfer molding* over *compression molding*.

[1.5 Marks]

b) Explain *vacuum-thermoforming* and *pressure-thermoforming* processes with suitable sketches. What are the advantages (03) of *pressure-thermoforming* over *vacuum-thermoforming*?

[2.5 Marks]

c) Suggest and briefly describe the suitable polymer processing methods to produce each and every following product.

i) Shampoo bottles
ii) Packaging films
iii) Biscuit trays
iv) Rubber seals

[8.0 Marks]

Q3. a) Smart (intelligent) materials play main role in smart system which consists of sensors and actuators that are either embedded in or attached to the system containing central control and command unit to form an integral part of it.

i) Describe briefly about *smart materials* by giving four (04) examples.

[2.0 Marks]

ii) Piezoelectric behavior can be expressed in two ways as *direct piezoelectric effect* and *inverse piezoelectric effect*. Explain both phenomena when stimulus is applied parallel to the polling voltage in piezoelectric material. Use neat sketches whenever required.

[4.0 Marks]

iii) Propose four (04) possible places/equipment that can be used to install piezoelectric materials for energy harvesting process. Explain your answer.

[2.0 Marks]

b) Polymeric based adhesives are wildly used to join surfaces of different or same materials permanently.

i) Define the term *adhesion* related to the adhesive bonding.

[1.0 Mark]

ii) Discuss briefly the possible failure modes of a given component that has been joined using polymeric adhesive, under tensile load as shown in Figure Q3.

[3.0 Marks]

Q4. a) Last two decades, composite materials were integrated to a number of structural applications. Boeing 787 Dreamliner is one such application in aircraft manufacturing industry. List out three (03) main advantages of using composite materials for aircraft applications?

[3.0 Marks]

b) Briefly explain the significance of the following guidelines in composite structural design process.

i) It is important to develop components with symmetrical lay-up as a good design practice for composites.

ii) Do not extrapolate test data in composite design process.

iii) The hole size effect on the strength of laminated composites should be considered at the design stage.

[4.5 Marks]

c) Describe the importance of integrating Vacuum assisted resin transfer moulding (VARTM) process for the Sri Lankan boat building sector by describing advantages of VARTM over the hand layup process.

[4.5 Marks]

Q5. a) Identify main components labeled from A to L of the injection molding machine shown in Figure Q5[a]. Briefly describe the functions of 5 components.

[3.5 Marks]

b) Explain meaning of followings with respect to plastic injection molding machine capability and performance, and the molding process.

i) Clamping force

ii) Shot size

[2.0 Marks]

c) Describe how following parameters affect to plastic injection molding and product quality/defects.

i) Injection pressure

ii) Cooling temperature

[2.0 Marks]

d) Identify and briefly explain major design issues of plastic products shown in Figure Q5[d(i)] to Figure Q5[d(iii)] with respect to product defects. Recommend possible corrections by providing suitable sketches.

[4.5 Marks]

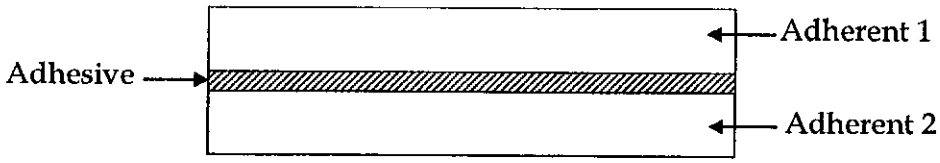

Figure Q3

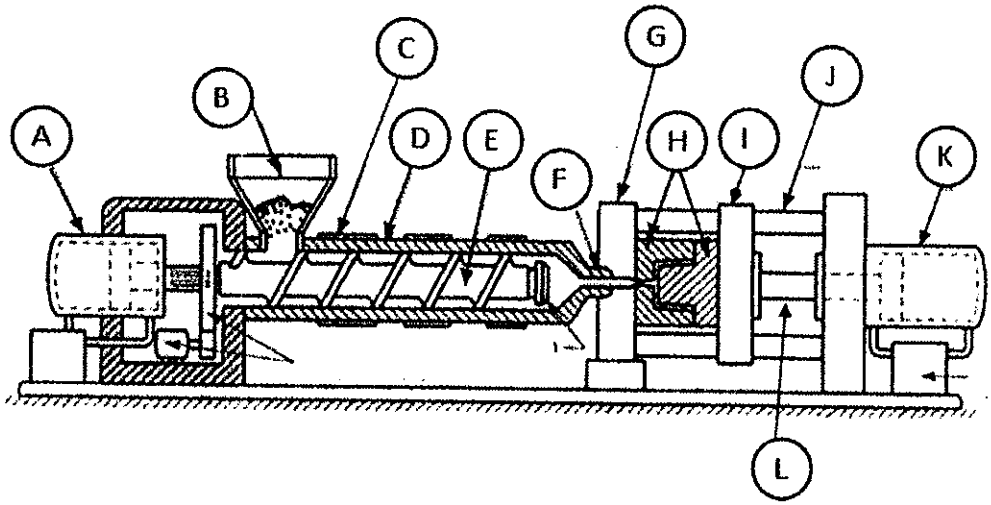

Figure Q5[a]

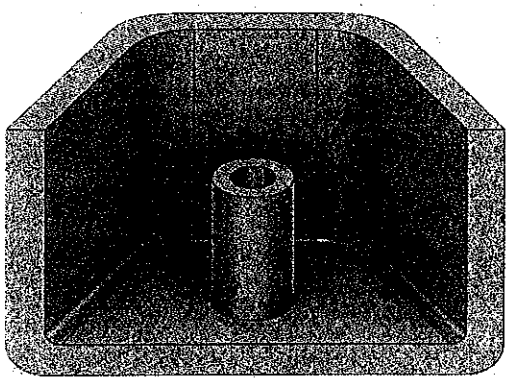

Figure Q5[d(i)]

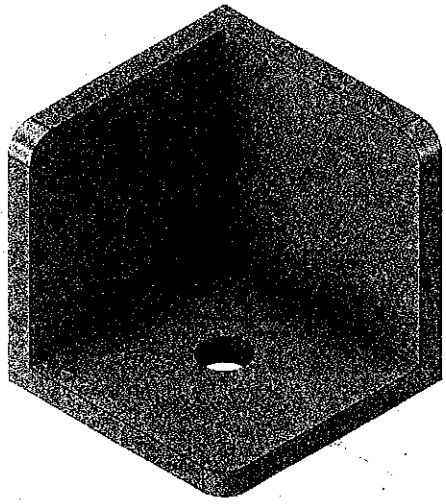

Figure Q5[d(ii)]

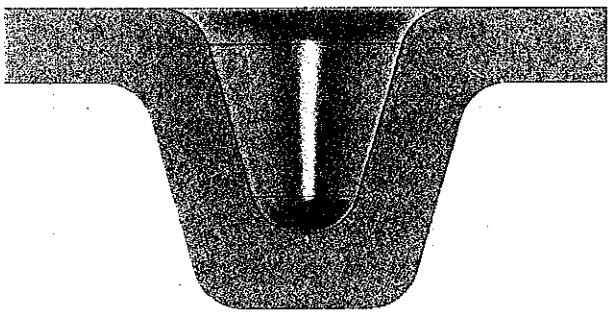

Figure Q5[d(iii)]