



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 4 Examination in Engineering: January 2022

Module Number: ME4301

Module Name: Advanced Materials Engineering

[Three Hours]

[Answer all questions, each question carries twelve marks]

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- Q1. a) Define the term "Polymerization". [1.0 Mark]
- b) Polymers can be classified into four groups based on,
- the origin of source,
 - structure,
 - molecular forces, and
 - mode of polymerization.
- Briefly explain the sub categories of each classification with suitable examples. [4.0 Marks]
- c) Define the term "tacticity" and briefly explain how does it affect to the properties of polymers with suitable examples. [4.0 Marks]
- d) What is glass transition temperature? Why thermosetting polymers are always amorphous and exhibits no glass transition temperature? [3.0 Marks]
- Q2. a) Briefly explain the functions of extruder machine while identifying the major components of extruder machine by presenting a sketch. [3.0 Marks]
- b) Briefly explain following thermoforming processes.
- i) Vacuum Thermoforming
 - ii) Pressure Thermoforming
 - iii) Mechanical Thermoforming
- [3.0 Marks]
- c) Choose the best polymeric material and the best polymer processing method to produce following each product.
- i) Shampoo bottles
 - ii) Disposable plastic plates
 - iii) Window frames
 - iv) Car dashboard
 - v) Safety helmets
 - vi) Power sockets
- [6.0 Marks]

- Q3. a) What is classical laminate theory? [2.0 Marks]
- b) Why classical laminate theory is useful in composite design? [2.0 Marks]
- c) Describe two design guidelines applicable for the Vacuum Assisted Resin Transfer Moulding (VARTM) process. [4.0 Marks]
- d) Describe the benefits of VARTM integration for the Sri Lankan boat building industry compared to traditional Hand Layup process? [4.0 Marks]
- Q4. a) Describe the meaning of the following defects associated with the injection molded parts, causes and propose one solution for each issue. [4.5 Marks]
- i) Warpage
 - ii) Flashes
 - iii) Welded lines
- b) Figure Q4. (b) shows a top view and the front view of a part with a pass-through hole in one side.

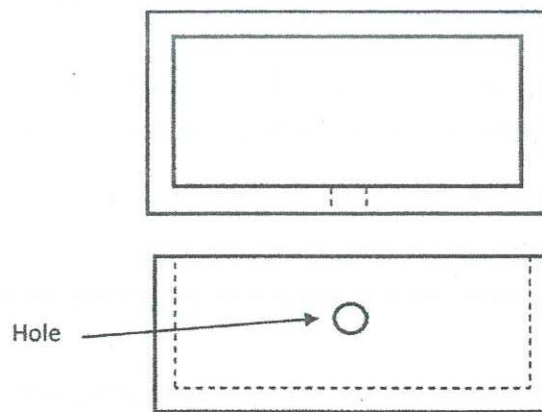


Figure Q4.(b)

- i) Identify possible defects if the part is going to be produced using injection moulding and explain those using suitable sketches.
 - ii) Redesign the part following the design guidelines that you learned in the lectures. Sketch your design.
 - iii) Propose a suitable mould to produce this part taking the side pass through hole into account. [5.0 Marks]
- c) List and briefly describe five (5) factors to be considered when selecting an injection moulding machine to produce a given part. [2.5 Marks]

Q5. a) PZT {lead zirconate titanate ($\text{Pb}[\text{Zr}_x\text{Ti}_{1-x}]\text{O}_3$)}, is one of the world's most widely used piezoelectric ceramic materials. PZT has a perovskite crystal structure, each unit of which consists of a small tetravalent metal ion in a lattice of large divalent metal ions.

i) Briefly describe the solid state synthesis steps of PZT materials.

[2.0 Marks]

ii) After synthesis of PZT materials, it needs to be polarized. Describe the procedure of polarization of synthesized PZT material (Use neat sketches).

[3.0 Marks]

iii) Discuss the reaction of PZT material (device) when the alternating voltage is applied as shown in Figure Q5. (a). Write two possible applications of this kind of device.

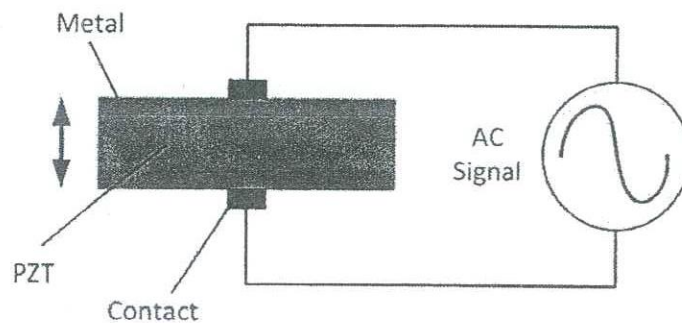


Figure Q5.(a)

[3.0 Marks]

b) An adhesive is a material that is applied to the surfaces of articles to join them permanently by an adhesive bonding process.

i) What are the basic factors to be considered to obtain a good adhesive bond when joining two materials? Explain one of them.

[2.0 Marks]

ii) Write down advantages and disadvantages of joining materials using adhesives.

[2.0 Marks]