UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 04 Examination in Engineering: November 2022

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

Part – B
[1 hours and 45 minutes]
Answer **all questions. Each question carries 12.0 marks.**

Q1. a) Smart materials are materials that respond to changes in their environment and then change the material properties accordingly.

i. Name any four different type of smart materials and describe briefly their responses to the applied stimuli.

[4.0 Marks]

ii. Piezoelectric behavior can be expressed in two distinct ways as "Direct piezoelectric effect" and "Inverse piezoelectric effect". Discuss these two effects briefly with neat sketches.

[4.0 Marks]

b) The mechanism of adhesion has been investigated for years and several theories have been proposed in an attempt to provide an explanation for adhesion phenomena.

Discuss briefly the following theories by using an appropriate example.

i. Diffusion Theory
ii. Wetting Theory

[4.0 Marks]

Q2. a) Discuss two advantages of using advanced composite manufacturing techniques to produce structural parts used in the transportation sector.

[3.0 Marks]

b) What are the five basic types of composite materials?

[2.0 Marks]

c) Describe briefly the steps of conducting the Vacuum Assisted Resin Transfer Molding (VARTM) process.

[2.0 Marks]

d) Mention four reasons for defects in composite structures.

[2.0 Marks]

e) Write the laminate code for the following stacking sequences.

i. (0°/90°/0°/0°/90°/0°)

ii. (0°/+45°/-45°/+45°/-45°/+45°/-45°/+45°/-45°/0°)

iii. (+45°/-45°/90°/90°/90°/90°/-45°/+45°/+45°/-45°/90°/90°/90°/90°/-45°/+45°)

[3.0 Marks]

Q3. a) Write four (04) concerns specifically related to the mold design and briefly explain all four concerns mentioned.

[4.0 Marks]

b) Briefly explain four (04) objectives of feed systems. Use neat sketches whenever necessary.

[4.0 Marks]

c) Estimate the total pressure drop through the hot runner system design shown in Figure Q1 during the molding of part having 27.5 cc volume. The analysis assumes that ABS is molded with a volumetric flow rate at the inlet of 125 cc/s and the flow rate through each leg of the hot runner system is assumed to be 50% of the inlet flow rate. The power law model is used with k =17,000 Pa s^n and n equal to 0.35. For the nozzle section, instead of tapered section uses a constant section with a radius of 3.5 mm and a length of 108 mm.

The power law model is given as,

$$\Delta P = \frac{2\,k\,L}{R}\left[\frac{\left(3+\frac{1}{n}\right)\dot{V}_{melt}}{\pi\,R^3}\right]^n$$

Where,

ΔP - pressure drop

k - the reference viscosity

n - power law index of the polymer melts at the melt temperature

[4.0 Marks]

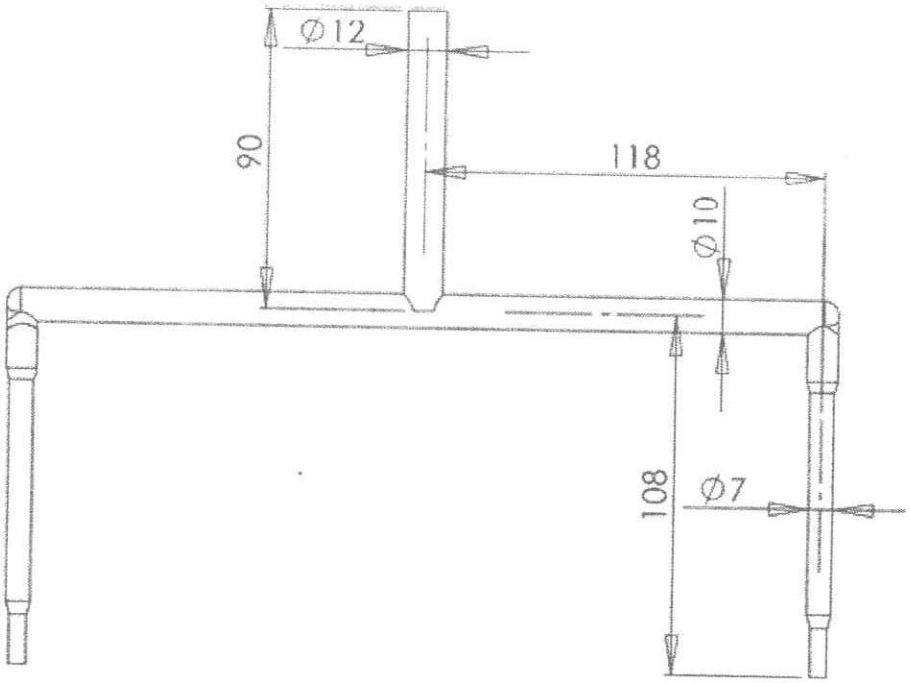

Figure Q3