KUMARAGURU college of technology
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Register Number:……..

PH.D DEGREE EXAMINATIONS: NOV/DEC 2023

(Regulation 2018)

First Semester

MASTER OF TECHNOLOGY MANAGEMENT

P18TME0075: Polymer Rheology

COURSE OUTCOMES

CO1: Learn about fluid flow and its related aspects with respect to melt and solution spinning

CO2: Characterize the rheological behaviour of fluids

CO3: Analyze the effect of molecular parameters on the fluid flow

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. The principle or model describes the viscoelastic behavior of materials by combining the response of an elastic element in parallel with a viscous element is_____ CO1 [K_1]

   a) Voiget model b) Classical rubber elasticity

   c) Newton's law of viscosity d) Maxwell model

2. _____model describes the behavior of materials that exhibit both elastic and viscous responses. CO1 [K_2]

   a) Maxwell model Hooke's Law

   c) Newton's Law of Viscosity Boltzmann superposition principle

3. In the context of viscosity, what does "activation energy" refer to_____ CO1 [K_4]

   a) Energy required for boiling a liquid b) Energy needed to initiate molecular motion in a fluid

   c) Energy released during polymerization d) Energy required for crystallization

4. Determine the correctness of the following Assertion [A] & Reason [R] CO2 [K_5]

   [A] Increase in molecular weight, generally leads to an increase in the viscosity of a polymer solution.

   [R]Increase in pressure, generally leads to an increase in the viscosity of a polymer

solution.

a) Both [A] & [R] are true and [R] is the correct reason for [A]
b) Both [A] & [R] are true and [R] is not the correct reason for [A]
c) Both [A] & [R] are false
d) [A] is true but [R] is false

5. _____factor is most likely to reduce the viscosity of a polymer solution. CO2 [K_1]

a) Increased cross-linking
b) Enhanced crystallinity
c) Increase the temperature
d) High molecular weight distribution

6. _____condition typically leads to swelling in materials subjected to shear or tensile stresses. CO2 [K_1]

a) Decrease in molecular weight
b) Reduced temperature
c) Decreased flow rat
d) Increased cross linking

7. Determine the correctness of the following Assertion [A] & Reason [R] CO2 [K_4]

[A] Increase in pressure drop leads to, fluid flow transitions from laminar to turbulent flow

[R] Power law model describes the behavior of non-Newtonian fluids, such as polymer melts or solutions,

a) Both [A] & [R] are true and [R] is the correct reason for [A]
b) Both [A] & [R] are true and [R] is not the correct reason for [A]
c) Both [A] & [R] are false
d) [A] is true but [R] is false

8. _____is ideal for investigations on samples with a primarily an-isotropic nature that show birefringence. CO 3 [K_2]

a) NMR spectroscopy
b) Dielectric spectroscopy
c) Polarized microscopy
d) IR spectroscopy

9. _____rheological property is particularly crucial for determining the material's behavior during extrusion or injection molding. CO3 [K_2]

a) Shear stress
b) Viscosity
c) Elastic modulus
d) Yield stress

10. _____ thermoplastics, one typically exhibits a shear-thinning behavior under applied stress. CO3 [K_4]

a) Polyethylene (PE)
b) Polystyrene (PS)
c) Polypropylene (PP)
d) Polyvinyl chloride (PVC)

PART B (10 x 2 = 20 Marks)
Answer All the Questions

11.	Define the Boltzmann superposition principle in the context of viscoelasticity.	CO1	[K_2]
12.	Outline the oscillatory shear in viscoelastic materials.	CO1	[K_2]
13.	Recall the classical rubber elasticity and its main characteristic.	CO1	[K_1]
14.	Summarize the impact of molecular weight on viscosity.	CO1	[K_1]
15.	Infer the effect of temperature on viscosity.	CO2	[K_2]
16.	Discuss the characteristics of laminar flow through various profiles.	CO2	[K_1]
17.	Recall the role of spectroscopy in rheo-optical methods.	CO2	[K_2]
18.	Outline the principle behind the linear displacement method in shear rheometry.	CO3	[K_2]
19.	Summarize the rheological behavior of polyethylene (PE) as a thermoplastic.	CO3	[K_2]
20.	Omit the rheology benefit polymer processing techniques like extrusion.	CO3	[K_1]

PART C (6 x 5 = 30 Marks)
Answer All the Questions

21.	Explain about basic modes of deformation.	CO1	[K_3]
22.	Discuss about start-up deformation and step strain.	CO1	[K_2]
23.	Infer effect of pressure and activation energy on viscosity.	CO1	[K_4]
24.	Explain swelling concerning shear and tensile stresses.	CO2	[K_5]
25.	Summarize the nuclear magnetic resonance and fluorescence spectroscopy.	CO3	[K_2]
26.	Compare the parallel disks and cone plate rheometer.	CO3	[K_4]

PART D (4 x 10 = 40 Marks)
Answer any FOUR Questions

27.	Explain in detail about linear and viscoelastic responses.	CO1	[K_4]
28.	Elaborate effect of molecular weight and shear rate dependence of viscosity.	CO1	[K_6]

29.	Discuss in detail about power law in flow analysis and turbulent flow analysis	CO2	[K_4]
30.	Explain in detail about linear displacement, sliding plate rheometer, and co-cylinder axial sliding rheometer.	CO2	[K_5]
31.	Elaborate on applications of rheology to polymer processing.	CO3	[K_6]

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