(1109)

SEAT NO:_____

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SARDAR PATEL UNIVERSITY

M.Sc. Semester-III: (Physical Chemistry) Examination (CBCS)-2018

Tuesday,30th October,2018

02:00 p.m. to 05:00 p.m.

PS03EPHC22, Advanced Characterization Techniques

N.B.: *i. Attempt all questions.*
ii. Figures to right indicate full marks.
iii. Unless otherwise mentioned, symbols and notations have their usual standard meanings.
iv. Neat sketches are to be drawn to illustrate answers, wherever required.
v. Assume suitable data, if necessary and indicate the same clearly.

Q.1 The question i) to viii) contain a Multiple Choice Questions (MCQs).Each question has four alternative responses marked (a),(b),(c) and (d) out of which *only one* is the correct response. Please mark correct response i e (a) /(b) /(c) /(d). **[08]**

i) The deformation per unit length is called
(a) Strain (b) Stress
(c) Elasticity (d) None of these

ii) Two parallel, equal and opposite forces acting tangentially to the surface of the body is called as _____
(a) Complementary stress (b) Compressive stress
(c) Shear stress (d) Tensile stress

iii) Viscoelasticity exhibits which of the following properties?
(a) Time-dependent (b) Temperature-dependent
(c)Temperature and time dependent (d) Temperature and time independent

iv) Shape of true stress-strain curve for a material depends on
(a) Strain (b) Strain rate (c) Temperature (d) All

v) The presence of solvent in a crystalline sample of a compound could be detected and quantified using:
(a) UV-VIS (b) AAS (c) TGA (d) ESI-MS

vi) In DTA, sharp endothermic peaks give ideas of changes in _____, whereas broad endotherms signify _____ reactions.
(a) amorphous, hydration (b) crystallinity,dehydration
(c) amorphous, dehydration (d) crystallinity, hydration

vii) **Statement 1:** Brookfield viscometer is very robust, is supported by software and even shows values of K and n, but, sometimes particles suspended in the fluid cause problems.
Statement 2: Drawbacks of plate and cone viscometer: edge-effects, turbulence and temperature effects.
(a) True, False (b) True, True (c) False, False (d) False, True

(P.T.O.)

viii) What is the correct definition of a pseudoplastic liquid?
(a) A liquid which becomes less viscous as the rate of shear increases
(b) A liquid which becomes more viscous as the rate of shear increases
(c) A liquid which becomes less viscous over time when a constant shear stress is applied
(d) A liquid which becomes more viscous over time when a constant shear stress is applied

Q.2 Answer the following questions as directed **(ANY SEVEN).** **[14]**

i) Explain how liquid crystalline polymers at the molecular and supermolecular level are useful to understand mechanical properties of polymer.
ii) Define: Poison's ratio (υ), Shear modulus (G)
iii) Discuss *viz-a-viz* : Elastic solid and Viscous liquid.
iv) Define: Storage modulus G_1 and Loss Modulus G_2
v) How instrument for Thermogravimetry records the results?
vi) List one application each of Differential Thermal Analysis (DTA) in Physical chemistry and Analytical chemistry.
vii) Explain Basic continuum and multi-scale models as a foundation rheology.
viii) Describe succinctly: Network of Entanglements.
ix) Mention one application of rheology in Food and processing industries.

Q.3 a) Elucidate how blends, grafts and copolymers at the molecular and supermolecular level are valuable to recognize mechanical properties of polymer. **[06]**

b) Discuss Engineering components of strain. Present component of strain. **[06]**

OR

b) **(i)** Define: Deformation ratio. Give details of finite strain deformation of a cube, of unit dimensions in the undeformed state to the rectangular parallelepiped. **[03]**
(ii) Define: Young Modulus (E) and Bulk Modulus (K) **[03]**

Q.4 a) Derive the Strain energy function $U = \Delta A = \frac{1}{2} NkT (\lambda_1^2 + \lambda_2^2 + \lambda_3^2 - 3)$ **[06]**

b) Describe Kelvin model and derive the expression: **[06]**

$e = J\sigma[1-\exp(-\frac{t}{\tau})]$ where J is the Spring compliance.

OR

b) **(i)** Define: Creep and Creep compliance $J(t)$;Retardation time(τ);Relaxation time (τ) **[03]**
(ii) What is Stress Relaxation? Show that for amorphous linear polymers at high temperature the stress may eventually decay to zero. **[03]**

Q.5 **a)** Write working principle of differential thermal analysis (DTA). How Environmental factors and sample factors affect the DTA curve? **[06]**

b)

i) Compare: Derivative Thermogravimentry (DTG) and Thermogravimentry analysis (TGA). **[03]**

ii) Write Borchardt and Daniels theoretical basis to find a relationship between sample parameters and the area under the peak of differential thermal analysis (DTA). **[03]**

OR

b) Explain working principal, instrumentation and applications of differential scanning calorimetry (DSC). **[06]**

Q.6 **a)** Expound following non-Newtonian behaviour with suitable illustrations: **[06]**
(i) Shear Thinning Fluids (ii) Dilatant Fluids (iii) Bingham Plastic

b) Elaborate viscoelastic effects of following common non-Newtonian behavior with appropriate examples: **[06]**
(i) Weissenberg effect (ii) Fluid memory and (iii) Die Swell

OR

b)

(i) Define: Relaxation modulus. Explain log$G$ *vs* log$T$ graph for stress relaxation. **[03]**

(ii) Define: Deborah number. How D_e is valuable to understand solid and liquid behavior? **[03]**