



M. Sc.(Physical Chemistry)
Semester- III

Course Code	PS03EPHC22	Title of the Course	Advanced Characterization Techniques – I
Total Credits of the Course	04	Hours per Week	04
Main Focus of the Course outcomes	Employability	Skill Development	Entrepreneurship
	√		√

Course Objectives:	The students will be taught the basics to advanced level concepts of characterization techniques based on mechanical properties of polymers, rheological and linear viscoelastic behaviour of complex fluids including polymeric materials. The thermal methods of analysis are dealt in details along with few practical examples.
--------------------	---

Course Content		
Unit	Description	Weightage* (%)
I	Mechanical properties of polymers : Introduction, general considerations, objectives, different types of mechanical behaviour, elastic solids and polymer, state of stress and strain, generalized Hook's law. Behaviour of polymers in rubber like state : finite strain elasticity, generalized definition of strain and stress, strain-stress relationship, use of strain energy function, experimental studies of finite elastic behaviour in rubbers.	25
II	Statistical molecular theories of the rubber like state, thermodynamic considerations, statistical considerations. Linear viscoelastic behaviour : viscoelastic behaviour, mathematical treatment of linear of viscoelastic behaviour, dynamical measurements, the complex modulus and complex compliance, the relationship between the complex moduli and the stress relaxation modulus, the relaxation strength	25
III	Rheology : Introduction, Subject and goals, Continuum mechanics as a foundation rheology, Viscoelasticity : liquids, solids, gels, Rheometry experimental methods, analysis and modelling of rheomechanical responses in static and dynamic modes, Applications of rheology in Polymers, Food and processing industries, paint, high energy materials etc. as case studies.	25
IV	Thermal Analysis : Thermogravimetry (TGA): Definition, types of TGA, instrumentation, information from TGA curve, factor affecting TGA curves (instrumental as well as characteristics of sample factors); Application of thermogravimetry, Calculation of percent decomposition and composition of compounds, limitation and advantages of TGA. Derivative thermogravimetry (DTG) and its advantages. Differential Thermal Analysis (DTA) : Definition, Theoretical basis of DTA, Instrumentation for DTA apparatus, Factors	25





	affecting the DTA curve, Application of DTA, Advantages and disadvantages of DTA. Differential Scanning Calorimetry (DSC) :General definition, Nanochemistry basics, distinction between molecules, nanoparticles and bulk materials. Physico-chemical considerations of nanomaterials, Sizedependent properties. Thermo Mechanical Analysis (TMA), Dynamic Mechanical Analysis (DMA) : Instrumentation and Applications.	
--	---	--

Teaching-Learning Methodology	Chalk and board method along with ICT tools Model demonstration as per the demand of the topic
--------------------------------------	---

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	To interpret the mechanical properties and behavior of polymers in rubber like state.
2.	To understand and apply statistical molecular theories of the rubber like state, thermodynamic considerations, statistical considerations, linear viscoelastic behavior of polymers.
3.	To appropriate rheometry experimental methods, analysis and modelling of rheomechanical responses in static and dynamic mode and applications of rheology in industry.
4.	To understand instrumentation and applications, advantages and disadvantages of thermogravimetry (TGA), derivative thermogravimetry (DTG), differential thermal analysis (DTA), differential scanning calorimetry(DSC) and thermos-mechanical analysis (TMA).

Suggested References:	
Sr. No.	References
1.	Mechanical Properties of Solid Polymers, I. M. Ward, Wiley – Interscience, JohnWiley and





SARDAR PATEL UNIVERSITY
Vallabh Vidyanagar, Gujarat
(Reaccredited with 'A' Grade by NAAC (CGPA 3.25))
Syllabus with effect from the Academic Year 2018-19

	Sons Ltd., New York.
2.	Mechanical Properties of Polymers, L. E. Nielson, Reinhold Publishing Co., Chapman and Hall Ltd., London.
3.	Physics and Chemistry of Interface, Hans-Jurgen Butt, Karlheunz Graf, MiCaelKappl, Wiley VCH, 2nd Edition.
4.	Physical Chemistry of Polymers, A. Tager, Mir Publishers, Moscow.
5.	Rheology : Concepts, methods and Applications. Alexander Ya. Malkin and AvraamI. Isayev, Chem Tec Publishing, 3 rd Edition. 2006.
6.	Introduction to Polymer Rheology, Montgomery T. Shaw, Wiley Publication, 2012.
7.	Understanding Viscoelasticity, Phan-Thien, Nhan, 2017. Springer Publication.
8.	Principles of Instrumental Analysis, D. A. Skoog, E. James Holler and S. R. Crouch, Thomson Brooks, 2nd Edition.
9.	Instrumental Methods of Analysis, H. H. Willard, L. L. Merritt, Jr., J. A. Dean, F. A. Settlw Jr., CBS Publishers and Distributors, New Delhi, 7 th Edition
10.	Fundamentals of Analytical Chemistry, Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, Brooks/Cole Cengage Learning. 8 th Edition.
11.	Introduction to Instrumental Analysis, Pharma Med. Press., Hyderabad, Indian Reprint.
12.	Instrumental Methods of Chemical Analysis, B. K. Sharma, Goel Publishing House, 28 th Edition.

On-line resources to be used if available as reference material

On-line Resources

www.nptel.ac.in

www.swayam.gov.in

www.epgp.inflibnet.ac.in (e-PG pathshala)

www.ndl.iitkgp.ac.in (National Digital Library)

