SYLLABUS FOR THE BATCH FROM YEAR 2025 TO 2026

FOR

Certificate course in Quality Assessment in Polymer Processing and Product

(Credit-Based Evaluation and Grading System)

Semester: I

Programme Code: _____

EXAMINATIONS: 2025-2026

The Certificate Program Offered:

- **Certificate Course in Quality Assessment in Polymer Processing and Product (6 Months duration)**

Program Objective:

- Understand the fundamentals of polymer processing and the impact of processing parameters on polymer quality.
- Learn various quality assessment techniques and standards for polymer materials.
- Analyze defects in polymer products and propose corrective actions.
- Explore the polymer industry landscape in India, including major companies, market trends, and government policies.

Program outcomes

- Comprehensive knowledge of various polymer processing techniques such as extrusion, molding, fiber spinning, and film production
- Ability to optimize processing parameters for improved material properties and product quality.
- Knowledge of common polymer defects (e.g., shrinkage, warpage, voids) and their causes.
- Become familiar with industrial standards (ASTM, BIS, ISO) and quality assessment methods.
- Basic knowledge of polymer testing instruments (DSC, TGA, FT-IR, UV-vis spectroscopy, etc.)
- Understanding India's polymer industry landscape, key manufacturers, and market trends.

Name of the Department: Chemistry

In collaboration with

Directorate of Open & Distance Learning and Online Studies

GURU NANAK DEV UNIVERSITY AMRITSAR

Certificate/Diploma in Quality Assessment in Polymer Processing and Product (SEMESTER SYSTEM) under Directorate of Open & Distance Learning, Guru Nanak Dev University, Amritsar

Eligibility:

- +2 in any stream with at least 45% marks in aggregate (40% for SC/ST candidates).
- Any student doing Bachelor Degree, Master Degree, M.Phil., Ph.D. from GNDU.

SEMESTER-I

Paper Code	Subject	Marks			Credits
		Internal Assessment	End Term	Total	
ODQAP111T	Basics of Polymer and Overview of Industries	30	70	100	4
ODQAP112T	Quality Control in Polymer Industries	30	70	100	4
ODQAP113T	Polymer Testing	30	70	100	4
ODQAP114T	Rheological Behavior of Polymer	30	70	100	4
	Total Marks & Credits	**120**	**280**	**400**	**16**

Certificate/Diploma in Quality Assessment in Polymer Processing and Product (SEMESTER SYSTEM) under Directorate of Open & Distance Learning, Guru Nanak Dev University, Amritsar

Subject Name: Basics of Polymer and Overview of Industries

Subject Code: ODQAP111T

(Semester – I)

Time: 03 Hours **Max. Marks: 100 Marks**

Internal Assessment: 30 Marks

End Term: 70 Marks

Instructions for the Paper-Setter/examiner:

1. The question paper shall consist of **Four sections**.
2. The paper setter shall set **eight questions** in all by selecting **two questions** of equal marks from each section. However, a question may have sub-parts (not exceeding four sub-parts), and appropriate marks should be allocated for each sub-part.
3. Candidates shall attempt **Five questions** in all, by at least selecting **One question** from each section and the **5th question** may be attempted from any of the **Four sections**.
4. The question paper should be strictly according to the instructions mentioned above. In no case a question should be asked outside the syllabus.

Section – A

Basics of Polymer: Introduction and history of polymeric materials, classification of polymers, configuration and conformation of polymers, nature of molecular interaction in polymers, Various structures of copolymers such as linear branched and cross-linked copolymers and their types

Section – B

Characteristics of Polymers: Physical properties, stress–strain behaviour, introduction to flow & mechanical properties (tensile, flexural, impact, fatigue, hardness, creep, abrasion), electrical properties (dielectric strength, surface resistivity, volume resistivity, power factor, arc resistance), Polymer solutions, solubility parameter, solution viscosity, thermodynamics of polymer solutions

Section – C

Major Polymer Producers in India: Details of the polymer industry—National and International level; and India's role in global polymer trade. Polymer Production & Consumption Trends: The demand-supply chain, market growth, and major consuming sectors (packaging, automotive, healthcare, construction)

Section – D

Government Policies & Regulations: BIS standards, Central Pollution Control Board guidelines. Plastic Waste Management Rules, Polymer Recycling & Circular Economy Initiatives: Sustainable plastics, biodegradable polymer projects, Extended Producer Responsibility

Certificate/Diploma in Quality Assessment in Polymer Processing and Product (SEMESTER SYSTEM) under Directorate of Open & Distance Learning, Guru Nanak Dev University, Amritsar

Subject Name: Quality Control in Polymer Industries

Subject Code: ODQAP112T

(Semester – I)

Time: 03 Hours **Max. Marks: 100 Marks**

Internal Assessment: 30 Marks

End Term: 70 Marks

Instructions for the Paper-Setter/examiner:

1. The question paper shall consist of **Four sections**.
2. Paper setter shall set **Eight questions** in all by selecting **Two questions** of equal marks from each section. However, a question may have sub-parts (not exceeding four sub-parts) and appropriate allocation of marks should be done for each sub-part.
3. Candidates shall attempt **Five questions** in all, by at least selecting **One question** from each section and the **5th question** may be attempted from any of the **Four sections**.
4. The question paper should be strictly according to the instructions mentioned above. In no case a question should be asked outside the syllabus.

Section – A

Introduction: Quality Assurance (QA) and Quality Control (QC), Importance of Quality Control in Polymer Manufacturing Steps, evaluation of errors in polymer testing, correction of errors, Documentation for QC, report preparation, equipment validation and calibration, and compliance with regulatory guidelines

Section – B

Thermal and mechanical analysis of polymer: Short term strengths: tensile, flexural, impact, tear resistance, abrasion, etc. Long term strengths: creep and fatigue properties, compression set c. Thermal properties: thermal stability, thermal conductivity, thermal diffusivity, specific heat capacity, linear thermal expansion, heat distortion temperature, vicat softening point, low temperature flexibility etc.

Section – C

Properties of polymer: Flow properties - Melt flow index, cup flow test, solution and inherent viscosity, melt viscosity etc. Optical and electrical properties – Different optical properties (reflection, refraction, diffraction etc), color matching, refractive index etc., dielectric strength, surface and volume resistivity, electro active properties.

Section – D

Environmental Assessments: Definitions, permeability to gases, standard methods of measuring the permeability of gases, other methods of measuring permeability, environment resistance – cause of deterioration of polymer by aging & weathering, assessment of deterioration, natural weathering, artificial weathering, chemical resistance

Certificate/Diploma in Quality Assessment in Polymer Processing and Product (SEMESTER SYSTEM) under Directorate of Open & Distance Learning, Guru Nanak Dev University, Amritsar

Subject Name: Polymer Testing

Subject Code: ODQAP113T

(Semester – I)

Time: 03 Hours **Max. Marks: 100 Marks**

Internal Assessment: 30 Marks

End Term: 70 Marks

Instructions for the Paper-Setter/examiner:

1. The question paper shall consist of **Four sections**.
2. Paper setter shall set **Eight questions** in all by selecting **Two questions** of equal marks from each section. However, a question may have sub-parts (not exceeding four sub-parts) and appropriate allocation of marks should be done for each sub-part.
3. Candidates shall attempt **Five questions** in all, by at least selecting **One question** from each section and the **5th question** may be attempted from any of the **Four sections**.
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Section – A

Introduction to Polymer Instrumentation: Importance of instrumentation in polymer research and industry. Classification of polymer characterization techniques: Thermal analysis, Spectroscopic analysis, Chromatographic analysis, Structural characterization, Morphological analysis

Section – B

Spectroscopic Analysis of Polymers: Fourier Transform Infrared Spectroscopy (FTIR) – Identification of functional groups in polymers, UV-Visible Spectroscopy (UV-Vis) – Analysis of polymer additives and colorants, Nuclear Magnetic Resonance (NMR) Spectroscopy – Molecular structure and polymer chain analysis.

Section – C

Thermal and Mechanical Analysis of Polymers: Differential Scanning Calorimetry (DSC) – Measurement of melting and glass transition temperatures, Thermogravimetric Analysis (TGA) – Thermal stability and degradation of polymers, Dynamic Mechanical Analysis (DMA) – Study of viscoelastic properties, Mechanical Testing – Tensile, compression, and impact tests for polymer strength

Section – D

Structural and Morphological Characterization of Polymers: Scanning Electron Microscopy (SEM) & Transmission Electron Microscopy (TEM) **–** Surface morphology and microstructure analysis**,** X-ray Diffraction (XRD) **–** Crystallinity and structural analysis of polymers**,** Zeta Potential and Particle Size Analysis **–** Stability of polymer dispersions**,** Atomic Force Microscopy (AFM) **–** Surface and nanomechanical property evaluation

Certificate/Diploma in Quality Assessment in Polymer Processing and Product (SEMESTER SYSTEM) under Directorate of Open & Distance Learning, Guru Nanak Dev University, Amritsar

Subject Name: Rheological Behavior of Polymer

Subject Code: ODQAP114T

(Semester – I)

Time: 03 Hours **Max. Marks: 100 Marks**

Internal Assessment: 30 Marks

End Term: 70 Marks

Instructions for the Paper-Setter/examiner:

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2. The paper setter shall set **eight questions** in all by selecting **two questions** of equal marks from each section. However, a question may have sub-parts (not exceeding four sub-parts), and appropriate marks should be allocated for each sub-part.
3. Candidates shall attempt **Five questions** in all, by at least selecting **One question** from each section and the **5th question** may be attempted from any of the **Four sections**.
4. The question paper should be strictly according to the instructions mentioned above. In no case should a question be asked outside the syllabus.

Section – A

Polymer solutions: Crystallization and melting and glass transition temperature; Degree of crystallization, factors affecting the crystallizability, Measurements of crystallinity, T_g - Definition, Factors influencing the glass transition temperature, T_g and Molecular weight, T_g, effect of plasticizers, T_g and co-polymers, T_g and T_m, Importance of T_g

Section – B

Polymers rheology: Introduction to rheology, fundamental concepts of creep and stress relaxation. Boltzmann superposition principle, Rheological models - Maxwell, Kelvin, Voight, Standard linear model. Response of elastic, viscous, and viscoelastic materials for static and cyclic load, complex modulus and compliance.

Section – C

Linear viscoelasticity: Introduction to linear viscoelasticity, real materials-relaxation and retardation time spectra. Master curve and time-temperature superposition, analysis of time-temperature scans, frequency scans.

Section – D

Applications of rheology in polymer processing: Importance of rheology in polymer processing, time dependence of viscous flow, rheology of injection molding and blow molding. Flow in capillaries, slits and dies.

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Outcome

Upon completing this course,

- Students will be able to identify polymer functional groups using spectroscopic techniques like FTIR, UV-Vis, and NMR.
- They will analyze thermal stability and mechanical properties using DSC, TGA, DMA, and mechanical testing.
- Students will also learn structural and morphological characterization using SEM, TEM, and XRD.
- Overall, they will develop practical skills in polymer analysis for research and industrial applications

Books recommended:

1. Raw Materials for Industrial Polymers by H Ulrich, Hanser Publication1989.
2. Principles of Polymer Science, by Bahadur and Sastry, Narosa Publishing House 2002.
3. Handbook of Plastics Testing and Failure Analysis by Vishu Shah, Wiley, 2007.
4. Handbook of Polymer Testing- Physical Methods by Roger Brown, Taylor & Francis Group, 1999.
5. Quality Management in Plastics Processing by Robin Kent, Elsevier, 2016.