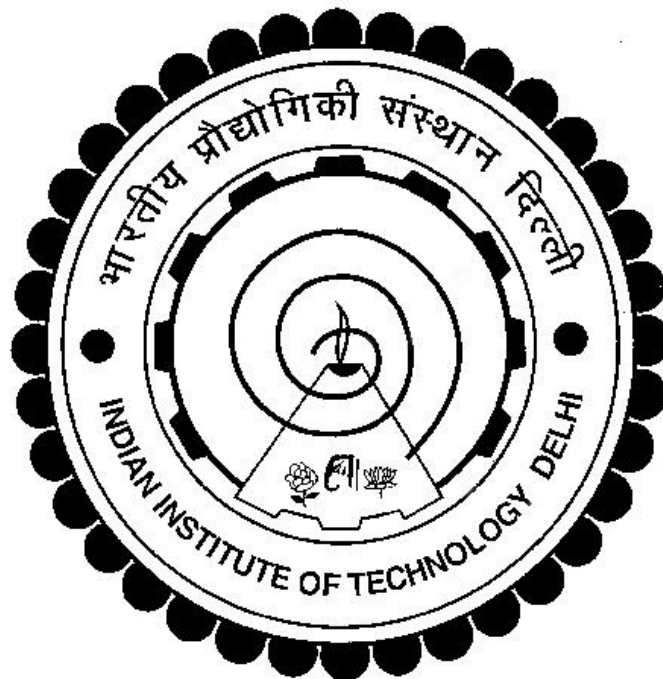


Certificate Programme in Industrial polymer production:

Combined Chemistry and Chemical Engineering Approaches

Live Online / Starting in February 2025



Programme offered by Continuing Education Programme (CEP), IIT Delhi

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Polymers – Present and Future

The global polymer market was valued at \$589 billion in 2021, and it is expected to reach \$950 billion by 2030, growing at a CAGR of 5.4% between 2021 and 2030. Naturally extracted or synthetically derived from crude oil downstreams, polymers have been used in all industrial verticals owing to their easy and well-developed processability, high specific strength and light weight, diverse grades and ease in customization to suit the needs of various industries. Some of the key trends that will drive polymer industry in future are smart manufacturing, circular economy, recycling and reuse, bio-based raw materials and substitution using biodegradable components, and energy efficiency. Why polymers still, and always, remain a relevant material are due to:

- Favourable trends associated with the packaging industry
- Increasing penetration of plastics in the automotive industry
- Positive outlook for a circular economy associated with polymers
- Proliferating growth of the healthcare sector in developing nations
- Supportive regulatory policies for the industrial sector growth
- Rising popularity of bio-based & biodegradable polymers

Course Overview

Life without polymers is unimaginable!

We use polymers, originating from both natural and synthetic routes, in a variety of ways in our day-to-day life. Synthetic polymers have distinctive prepositions in the world of materials due to their unmatched properties and cost. More than 70% of chemical industries are dependent on polymers in one way or the other starting from automobile, aviation, pharma, paints and coatings, biomedical, food and beverages and packaging to various commodity items that we use. Polymer production thus is of immense economic importance. Polymer production in a lab is completely different from what it takes to produce the same polymer at commercial levels in a plant. Chemistry based approaches which work well in a lab to successfully synthesize a polymer often fail when the methodology is scaled up to a plant level. The gap primarily arises from the disconnect between chemistry and engineering.

The certificate program will provide a unique opportunity to cater to the unfulfilled needs of personnel from different academic backgrounds by providing the basic and advanced concepts from chemistry and chemical engineering which are not only helpful in interfacing the information from both domains but also enabling them with a working knowledge of polymer synthesis encompassing from a lab to commercial scale. The program content is designed in a manner which is suitable for participants at different levels from R&D, business development, sales and marketing, new product development and management in varied industries involving use of polymers. The program is set to provide the training and development needs for Industry 4.0 to ultimately support smart manufacturing, enhanced productivity and expertise.

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Program Highlights

- Equip yourself to be ready for challenges and opportunities for Industry 4.0
- Comprehensive curriculum: covering both basic and advanced concepts in chemistry and chemical engineering
- Bridging the gap between academic knowledge and industrial know-how
- Certificate of successful completion from CEP-IITD
- Live interactive sessions with IITD faculty
- Advanced industry-oriented curriculum developed by trained IITD faculty
- Peer-to-peer learning with regular assessments
- Industrial connect in an academic background; industry relevant training – tailored for professionals from different background and hierarchical level
- Taught by experienced IITD faculty with long standing experience in both academic and industry

Key Learning Outcomes

- Interdisciplinary knowledge of academic fundamentals and industrial technologies, relevance, policy and various standards
- Deep understanding of conversion from molecules to macromolecules – requirements and limitations
- New and advanced polymerization techniques – controlled, co-polymerization, ring-opening etc. and their adaptability for next-generation polymers
- Critical inherent properties of macromolecules and their variations based on industrial processes
- Various fundamental theories covering solution, chain, solubility and rheology and their effect on polymer properties
- Detailed analyses of various industrial processes including bulk, solution, suspension and emulsion and interfacial
- Connection with Industry 4.0 and its application to innovate solutions and problem-solving techniques for challenges in polymer production
- Machine learning approach and its adaptation for predicting properties and designing optimal polymer production processes
- Define and renovate policies to meet demands of the environment and legislation in India and abroad

Who Should Attend?

- Working professionals, both fresh and experienced, in established sectors of polymer production and applications to get a refreshing and comprehensive overview of the technology and future trends
- Individuals involved in polymer research and industrial production to enhance their basic and practical skills

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- Mid and senior level professionals in various roles including R&D, business development, sales and marketing, new product development, and management.
- Engineers and quality control professionals who use and handle polymers in various industries viz. pharma, packaging, paints, aerospace, automobiles, recycling etc.
- Entrepreneurs who aspire to establish themselves in the business of polymer production or applications

Modules

Module	Topic	Details
Module 1	Macromolecular structure of polymers Polymer structure-property relation	Uniqueness of polymers, molecular weight, isomerism Thermal and mechanical properties of polymers
Module 2	Intermolecular forces Polymer Solutions	Basics of various interaction forces and their role in polymer properties Solution theory, Chain dimension, F-H theory, solubility parameter
Module 3	Industrial reactions Reaction feasibility analysis Polymerization processes	Reaction chemistry and mechanistic insights Thermodynamic and kinetic features, rate laws
Module 4	Polymer synthesis – I Polymer synthesis – II Advanced polymer synthesis	Chain-growth polymerization Step-growth polymerization Controlled polymerizations, copolymerization, ring-opening
Module 5	Unit operation required during polymerization processes Engineering aspects of chain growth polymerization Engineering aspects of step growth polymerization	Basics of reaction engineering, Heat transfer, mass transfer & thermodynamics Solution of a model problem involving chain growth polymerization Solution of a model problem involving growth polymerization
Module 6	Process control & Machine learning from the perspective of polymer synthesis	
Module 7	Sustainability goals and future trends	

Professor Rajiv K. Srivastava Department of Textile and Fibre Engineering Indian Institute of Technology Delhi Hauz Khas, New Delhi 110016, India	Professor Sudip K. Pattanayek Department of Chemical Engineering Indian Institute of Technology Delhi Hauz Khas, New Delhi 110016, India	Professor Bijay P. Tripathi Department of Material Science and Engineering Indian Institute of Technology Delhi Hauz Khas, New Delhi 110016, India
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Prof. Sudip K. Pattanayek, Department of Chemical Engineering, IIT Delhi

Dr. Sudip K Pattanayek is a Professor in the Department of Chemical Engineering, IIT Delhi and has been a faculty member of the department for the last 16 years. Before joining IIT Delhi, he completed PhD from IIT Bombay and did postdoc research from various institutes abroad. He has a wide field of research experience: structure and dynamics of Proteins at Interfaces, Aggregation of Proteins, Polymer-surfactant interactions, Rheology of dilute polymer solution, Polymer nanocomposites, Interfacial Rheology, Rheology of slurry. He has used experimental methods and molecular simulation techniques such as MC, MD, BDS, and SCFT to understand the above systems. He has been a member of a few committees of funding agencies to review proposals for support funding. He has completed over ten projects sponsored by government funding agencies and Industries on materials and processes and has two ongoing projects. Prof Pattanayek has supervised 9 PhD students and currently has 7 PhD students and two post-docs working on various materials-related projects. He has published 57 papers in International Journals. He has taught undergraduate students the core course Fluid-particle Mechanics for 11 years. In addition, he has taught various other undergraduate and postgraduate courses like Transport Processes I, Polymer Science and Engineering, Structure Properties of the Polymer in Solutions, and Experimental Characterization of Biomacromolecules etc.



Prof. Rajiv K. Srivastava, Department of Textile and Fibre Engineering, IIT Delhi

Dr. Rajiv K. Srivastava is currently a Professor in the Department of Textile and Fibre Engineering, IIT Delhi and has been associated with the department for the past 15 years. He earned a PhD in polymer technology from KTH, Sweden and had seven plus years of industrial experience in

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corporates of repute including General Electric and Procter & Gamble prior to joining IIT Delhi. His research experience encompasses polymer synthesis and structure-property relationship to new product innovation and business development. Currently his research group has been working on biodegradable polymers, porous and fibrous matrices, smart manufacturing and plastic waste valorization. Prof. Srivastava has supervised 10 PhD students and currently has 4 PhD students in his group who are working on various polymer synthesis and fabrication-based projects. He has completed seven projects sponsored by government funding agencies on polymers and processes and has two ongoing projects. He has published more than 100 articles in international journals, has 9 International/Indian patents and 2 Indian patent applications. He has actively been involved in teaching both under- and post-graduate courses on polymer and fiber science.



Prof. Bijay P. Tripathi, Department of Material Science and Engineering, IIT Delhi

Dr. Tripathi is an Associate Professor in the Department of Materials Science and Engineering at IIT Delhi, where he has served since 2017. Before this, he was an Alexander von Humboldt postdoctoral fellow and Group Leader at the Leibniz Institute of Polymer Research Dresden, Germany. He received his Ph.D. from CSIR-CSMCRI, Bhavnagar, and Helmholtz-Zentrum Geesthacht, Germany. Dr. Tripathi has received various awards, including the INSA Medal for Young Scientists and the Veena Arora Early Career Research Award, along with DAAD, JSPS, Marie-Curie, DST-INSPIRE, and UGC-FRP fellowships. He is part of the review committees of funding agencies and successfully completed 5 government- and 4 industry-sponsored projects, with 5 currently ongoing. He has also coordinated several CEP courses for industries like Maruti Suzuki, Indian Oil, etc. He has supervised 6 Ph.D. students and currently 10 Ph.D. students are working with him. With more than 80 publications in international journals, his research focuses on polymers, nanomaterials, and membranes for energy, water purification, catalysis, and environmental solutions.

Fee structure

Fee per participant: INR 40,000/- (excluding 18% GST)

- All fees should be submitted in the IITD CEP account only; details will be shared post-selection.
- If a participant is outside from India, the payment should be made in USD (exchange rates applicable of the day of the transaction).
- Application should be sent with relevant documents and transaction proof by 20th February 2025. Fee Once paid is non-refundable/non-transferable.

Certification



- Candidates who completed the programme will receive a certificate from CEP, IIT Delhi.
- The organizing department of this programme is the Department of Chemical Engineering, IIT Delhi.

*Only e-certificates will be issued by CEP, IIT Delhi, as per the sample above.

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Application requirement

Please fill the application form on the link https://docs.google.com/forms/d/e/1FAIpQLSffob8y_APmESaSW_j0AXxJpUyPWgEDPkmmn2VI8GO4ta9CRg/viewform?usp=sf_link and submit the relevant documents as mentioned in the form.

Upon application review the selected candidates will receive registration email through which payment link will be provided.

About IIT Delhi



Indian Institute of Technology Delhi is one of the 23 IITs created to be Centres of Excellence for training, research and development in science, engineering and technology in India.

Established as College of Engineering in 1961, the Institute was later declared as an Institution of National Importance under the “Institutes of Technology (Amendment) Act, 1963” and was renamed as “Indian Institute of Technology Delhi”. It was then accorded the status of a Deemed University with powers to decide its own academic policy, to conduct its own examinations, and to award its own degrees.

Since its inception, over 48000 have graduated from IIT Delhi in various disciplines including Engineering, Physical Sciences, Management and Humanities & Social Sciences. Of these, nearly 5070 received Ph.D. degrees. The number of students who graduated with B.Tech. degree is over 15738. The rest obtained Master’s Degree in Engineering, Sciences and Business Administration. These alumni today work as scientists, technologists, business managers and entrepreneurs. There

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are several alumni who have moved away from their original disciplines and have taken to administrative services, active politics or are with NGOs. In doing so, they have contributed significantly to building of this nation, and to industrialization around the world. For more Details, please visit: www.iitd.ac.in

About Continuing Education Programme (CEP)

Executive education is a vital need for companies to build a culture that promotes newer technologies and solutions and builds a workforce that stays abreast of the rapidly transforming needs in the technological, business, and regulatory landscape. Committed to the cause of making quality education accessible to all.

IIT Delhi has launched Online Certificate Programmes under eVIDYA@IITD(ई-विद्या@IITD), enabling Virtual and Interactive learning for Driving Youth Advancement@IITD for Indian as well as international participants.

These outreach programmes offered by the Indian Institute of Technology Delhi (IIT Delhi) are designed to cater to the training and development needs of various organisations, industries, society, and individual participants at national and international levels with a vision to empower thousands of young learners by imparting high-quality Online Certificate Programmes in cutting-edge areas for their career advancement in different domains of engineering, technology, science, humanities and management.

For more details, please visit: <http://cepqip.iitd.ac.in>