Syllabus for Multi-Disciplinary Minor (MDM) Degree

In

Polymer Engineering and Technology

Under the National Education Policy- NEP 2020 in

(2023-2024)

Offered by

DEPARTMENT OF POLYMER AND SURFACE ENGINEERING

Institute of Chemical Technology

(University Under Section-3 of UGC Act, 1956)

Elite Status and Center for Excellence

Government of Maharashtra

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A. PREAMBLE

Welcome to the Department of Polymer and Surface Engineering, where innovation meets material science. Our commitment to advancing the field is unwavering, fostering a dynamic environment for research, learning, and discovery. Explore the intricate world of polymers and surfaces as we embark on a journey to shape the future of materials engineering.

Within the Department of Polymer and Surface Engineering, we delve into the fascinating realm of polymers, examining their diverse applications and manipulating their properties to meet the evolving needs of technology and industry. Our focus extends beyond conventional materials as we explore cutting-edge advancements in polymer science.

The department also places a significant emphasis on surface engineering, a crucial discipline that addresses the interface between materials and their environments. Through meticulous research and experimentation, we unravel the complexities of surface interactions, paving the way for innovative solutions in areas such as adhesion, coatings, and biomaterial interfaces.

Our faculty comprises distinguished experts and researchers, dedicated to pushing the boundaries of knowledge in polymer and surface engineering. Students within our programs benefit from a curriculum that blends theoretical foundations with hands-on experiences, preparing them for careers at the forefront of materials innovation.

Collaboration is at the heart of our ethos, as we engage with industry partners and interdisciplinary teams to tackle real-world challenges. Whether you are a student eager to explore the intricacies of materials or a researcher seeking a vibrant academic community, the Department of Polymer and Surface Engineering welcomes you to join us on this journey of discovery and transformation. The design, development, and production of polymer-based goods are the main topics of the technical course multidisciplinary minor degree in Polymer Engineering and Technology. It addresses a broad variety of subjects, including material science, polymer chemistry, processing, and applications of polymers in many sectors. The study of the synthesis, processing, and testing of various polymers and polymer products is the focus of polymer technology. Polymers contain a wide range of materials, such as plastics, rubber, fibers, paints, adhesives, sealants, varnishes, and many more. These days, these materials rule the high-tech period completely, and life would be impossible without these essentials.

A. Programme Specific Outcomes (PSOs)

Multidisciplinary Minor Degree in Polymer Engineering and Technology

PSO1	**Polymer Classification and Analysis**: Able to analyze and classify different type of polymers and understanding the structure and properties of polymers used in various applications.
PSO2	**Polymer Processing Techniques**: Knowledge of polymer processing techniques, such as extrusion, injection molding, and blow molding. Understanding the effects of processing on the final properties of polymer materials.
PSO3	**Polymer Modification and Functionalization**: Ability to modify and functionalize polymers to enhance their properties and analyze the chemical reactions and methods for introducing desired functionalities.
PSO4	**Polymer Testing and Performance Assessment**: Ability to measure and quantify polymer performance attributes such as mechanical strength, thermal stability, and chemical resistance.
PSO5	**Development of Sustainable Polymer Materials**: Capability to create sustainable, biodegradable polymer materials and other eco-friendly alternatives.

B. Recommended batch size: Minimum 15; Maximum 35

C. Duration: Three years

D. Eligibility criteria:

First and Second semester CGPA. If second semester CGPA is not available, then first semester CGPA and students HSC CET/ JEE percentile. In addition to this preference will be given to students based on their score in the first-year courses such as Chemistry theory and practical courses.

E. Prerequisites: 12^{th} Standard Physics, Chemistry and Maths / JEE

F. Pedagogy/ Teaching method:

- Lecture/Discussions: The course material will be covered in these sessions.
- Experiential Learning: The sessions will involve demonstrating some machines used for Polymer processing as well as the characterization techniques.
- Tutorials: Problem solving / case studies / relevant real-life applications / student presentations / home assignments / individual or group projects

G. Method of Evaluation/Delivery:

Subject Code	Semester	Course	Method of Evaluation	Methods of Delivery

PST1101	III	Polymer Science & Technology I	• Mid-Semester Examination • End-Semester Examination • Four class tests • Assignments • Seminar/ Presentation • Report submission on case studies	• Lectures • Tutorials • Case studies • Presentations • Practical/ Demonstrations • Projects (Individual and/or group)
PET1201	IV	Introduction to Polymer Engineering and Technology	• Mid-Semester Examination • End-Semester Examination • Four class tests • Assignments • Seminar/ Presentation • Report submission on case studies	• Lectures • Tutorials • Case studies • Presentations • Practical/ Demonstrations • Projects (Individual and/or group)
PST1303	V	Polymer Chemistry and Technology	• Mid-Semester Examination • End-Semester Examination • Four class tests • Assignments • Seminar/ Presentation • Report submission on case studies	• Lectures • Tutorials • Case studies • Presentations • Practical/ Demonstrations • Projects (Individual and/or group)
PST1611	VI	Technology of Thermoplastic Polymers	• Mid-Semester Examination • End-Semester Examination • Four class tests • Assignments • Seminar/ Presentation • Report submission on case studies	• Lectures • Tutorials • Case studies • Presentations • Practical/Demonstrations • Projects (Individual and/or group)
PET1703	VII	Additives and compounding of Polymers	• Mid-Semester Examination • End-Semester Examination • Four class tests • Assignments • Seminar/ Presentation • Report submission on case studies	• Lectures • Tutorials • Case studies • Presentations • Practical/Demonstrations • Projects (Individual and/or group)
PET1816	VIII	Polymer Processing	• Mid-Semester Examination • End-Semester Examination • Four class tests • Assignments • Seminar/ Presentation • Report submission on case studies	• Lectures • Tutorials • Case studies • Presentations • Practical/ Demonstrations • Projects (Individual and/or group)

H. **Structure of MDM Course:**

Semester	Course Code	Subjects	Credits	Hrs/Week			Marks for various Exams			
				L	T	P	CA	MS	ES	Total
III	PST1101	Polymer Science & Technology I	2	1	1	0	20	30	50	100
IV	PET1201	Introduction to Polymer Engineering and Technology	2	1	1	0	20	30	50	100
V	PST1303	Polymer Chemistry and Technology	4	3	1	0	20	30	50	100
VI	PST1611	Technology of Thermoplastic Polymers	2	1	1	0	20	30	50	100
VII	PET1703	Additives and compounding of Polymers	2	1	1	0	20	30	50	100
VIII	PET1816	Polymer Processing	2	1	1	0	20	30	50	100
		TOTAL:	**14**	**8**	**6**	**0**				**600**

I. **Instructors** (Tentative):

Semester	Course Code	Subjects	Faculty
III	PST1101	Polymer Science & Technology I	APM
IV	PET1201	Introduction to Polymer Engineering and Technology	ARR
V	PST1303	Polymer Chemistry and Technology	VF (MAS)
VI	PST1611	Technology of Thermoplastic Polymers	VF
VII	PET1703	Additives and compounding of Polymers	STM/ VF
VIII	PET1816	Polymer Processing	ARR

J. Detailed Syllabus:

MDM-I	Course Code: PST1101	Course Title: Polymer Science & Technology I	Credits = 2		
			L	T	P
	Semester: III	Total Contact Hours: 30	1	1	0

List of Prerequisite Courses
HSC (Science)
List of Courses where this course will be prerequisite
Introduction to Polymer Engineering and Technology, Polymer Chemistry and Technology, Technology of Thermoplastic Polymers, Additives and compounding of Polymers, Polymer Processing
Description of relevance of this course in the MDM programme
To train the students with respect to the basics of polymers, Overview of Polymer and Coating Industry Manufacturing Chemistry, properties applications of monomers for synthetic and natural polymers and their handling hazards.

	Course Contents (Topics and Subtopics)	Required Hours
1	Overview of Polymer and Coating Industry, Historical developments in polymeric materials with introduction and classification of polymers	5
2	Basic concepts & definitions: monomer & functionality, oligomer, polymer, repeating unites, degree of polymerization, molecular weight & molecular weight distribution commodity engineering polymers specialty polymer definitions	15
3	Manufacturing Chemistry, properties applications of raw material for synthetic polymers like Ethylene, propylene, butadiene, vinyl chloride, vinylidene dichloride, styrene etc.	10
	Total	**30**

List of Textbooks/Reference Books	
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	Polymer Science by Gowarikar, Johan wiley and Sons 1986.
4	Encyclopedia of Polymer Science and Technology, Johan Wiley and Sons, Inc 1965.
5	Encyclopedia of Polymer Science and Engineering, Johan Wiley and Sons, Inc 1988.
6	Petrochemicals: The Rise of an Industry by Peter H. Spitz, Johan Wiley and sons 1988.
7	Polymer Chemistry by Malcolm P. Stevens, Oxford University Press, Inc, 1990
Course Outcomes (Students will be able to….)	
CO1	Identify the basic concept of monomer, polymer and repeating units and their properties (K1)
CO2	Define the physical and chemical properties of raw materials (K1)
CO3	Describe the manufacturing routes and impurities in monomers and raw materials (K1)
CO4	Demonstrate plan about evaluation of raw materials and reactants for synthesis & manufacturing of resins and polymers. (K2)

Mapping of Course Outcomes (COs) with Programme specific Outcomes (PSOs)

		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	K1	3	3	2	3	3
CO2	K1	3	3	1	2	1
CO3	K1	3	2	1	3	2
CO4	K2	2	3	3	2	3
Course	K2	3	2	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

MDM-II	Course Code: PET1201	Course Title: Introduction to polymer engineering and technology	Credits = 2		
			L	T	P
	Semester: IV	Total Contact Hours: 30	1	1	0

List of Prerequisite Courses

HSC (Science), Polymer science and technology I

List of Courses where this course will be prerequisite

Polymer Chemistry and Technology, Technology of Thermoplastic Polymers, Additives and compounding of Polymers, Polymer Processing

Description of relevance of this course in the MDM programme

The course "Introduction to Polymer Engineering and Technology" is highly relevant in today's world due to the widespread use of polymers in various industries. Polymers have become integral materials in everyday life, including packaging, automotive, electronics, medical devices, and many more. Understanding the properties, processing methods, and applications of polymers is crucial for aspiring engineers and technologists to design innovative products, reduce production costs, and address environmental challenges associated with polymer waste and disposal. Additionally, with the growing demand for sustainable materials, this course equips students with knowledge about eco-friendly polymers and their potential in future industries.

	Course Contents (Topics and Subtopics)	Required Hours
1	Introduction to materials and polymer	6
2	Polymer industry	6
3	Various types of polymers	6
4	Introduction to polymer processing	6
5	Various applications of polymers; Environmental and sustainability aspects related to the use of polymers in industry	6
	Total	**30**

List of Textbooks/Reference Books

1	Polymer chemistry- Charles E Carraher Jr., 2003
2	Introduction to Polymer Science- Robert J. Young, Peter A. Lovell, 2011
3	Plastic Materials and Processing- A. Brentstrong, 2006

Course Outcomes (Students will be able to…..)

CO1	Define the fundamental principles of polymer engineering and technology, including the molecular structure and properties of various types of polymers, and their applications in different industries. (K1)
CO2	Match the manufacturing processes involved in the production of polymers and analyze their impact on the final properties of the materials. (K1)
CO3	Identify and understand the diverse applications of polymers in everyday products and advanced technologies and evaluate their advantages over traditional materials. (K1)
CO4	Interpret and classify different types of polymers based on their chemical structure, physical properties, and processing techniques to determine their suitability for specific applications. (K2)
CO5	Demonstrate the environmental and sustainability aspects related to the use of polymers in industry and evaluate potential solutions for mitigating their impact on the ecosystem. (K2)

Mapping of Course Outcomes (COs) with Programme specific Outcomes (PSOs)						
		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	K1	1	3	3	2	2
CO2	K1	3	3	2	2	1
CO3	K1	3	2	2	3	3
CO4	K2	2	2	1	3	3
CO5	K2	3	3	2	2	3
Course	K2	3	3	3	2	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

MDM -III	Course Code: PST1303	Course Title: MDM-III : Polymer Chemistry & Technology	Credits = 4		
			L	T	P
	Semester: V	Total Contact Hours: 60	3	1	0

List of Prerequisite Courses

Polymer Science & Technology I, Introduction to Polymer Engineering and Technology

List of Courses where this course will be prerequisite

Technology of Thermoplastic Polymers, Additives and compounding of Polymers, Polymer Processing

Description of relevance of this course in the MDM programme

To teach students basic concepts of Polymer Chemistry & Technology so that they can have good base to learn other subjects

	Course Contents (Topics and Subtopics)	Required Hours
1	Detailed classification of polymers Addition, condensation, commodity engineering and speciality copolymers, Monomer structure and Polymerizability. Crystalline/amorphous, step growth /chain growth, homochain/heterochain, crystalline/amorphous polymers, confirmation etc.	5
2	Homo& copolymers, graft, block alt, ladder, etc. & nomenclature, configuration: cis/trans; tacticity, branched/ crosslinked, Addition and condensation polymerization mechanism	5
3	Techniques of polymerization: bulk, solution, suspension, emulsion, plasma etc.	5
4	Molecular weight and its distribution determination methods (Mn to Mz+1& MWD, Poly dispersity Index), calculations & problems based on it,	5
5	Carothers equation for condensation polymers & conditions to get high or desired molecular weight, calculations & problems based on it.	5
6	Transition temperatures such as Tg, Tc, Tm, their relevance to properties &processing and factors affecting them	5
7	Solubility parameter, solution properties, temperature, good/ bad solvent.	5
8	Different initiating systems such as free radical polymerization, redox with examples & their use choice of initiator half-life period. Measurement of polymer viscosity by different method	5
	Copolymerization, reactivity ratios & kinetics of copolymerization (copolymer composition equation). Polymerization: Probability and statistics-statistics of polycondensation, chain polymerization, branching and gelation. Copolymer sequence distribution	5
9	Basic Rheological concepts of polymer solutions and melts, Newtonian / non Newtonian, time dependent/ independent	5
10	Mixing operations: Typical agitation system, dissolution, suspension,	5

	removal of water condensates high speed (low viscosity) stirring, low speed (high viscosity) stirring selection criterion, power consumption. Heat transfer characteristics, powder mixing times etc	
11	Commercial applicability of Polymers as Plastics, paints, rubbers, fibres & adhesives	5
	Total	**60**
List of Textbooks/Reference Books		
1	Principles of Polymer Science, Bahadur and Sastry, Narosa Publishing House 2002	
2	Polymer Science, Gowarikar, Johan wiley and Sons 1986	
3	Encyclopedia of Polymer Science and Technology, Johan Wiley and Sons, Inc 1965	
4	Encyclopedia of Polymer Science and Engineering, Johan Wiley and Sons, Inc 1988	
5	Polymer Chemistry, Malcolm P. Stevens, Oxford University Press, Inc, 1990.	
6	Text book of polymer Science, Billmeyer, John Wiley ans Sons 1984.	
7	Principles of Polymer Systems, Rodriguez, Hemisphere Publishing Corpn, 1982	
8	Introduction to Polymer Science and Technology, H. S. Kaufman and J. J. Falcetta, Wiley – Inter science Publication, 1977	
9	Principles of polymerization, G. Odian, Wiley – Inter science (1981)	
Course Outcomes (Students will be able to….)		
CO1	Define the basics of polymers and various terminologies. (K1)	
CO2	Calculate the problems regarding Calculation of MW – MWD & its relevance (K3)	
CO3	Interpret the basics of rheology & its effect on processing & application, mixing operations. (K2)	
CO4	Differentiate various techniques of polymerization & initiating systems (K2)	
CO5	Classify the various types of copolymerization & their commercial applications. (K2)	

Mapping of Course Outcomes (COs) with Programme specific Outcomes (PSOs)						
		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	K1	3	2	3	2	1
CO2	K3	3	3	2	3	2
CO3	K2	2	2	3	2	1
CO4	K2	3	3	2	3	2
CO5	K2	3	3	2	3	2
Course	K3	3	3	2	3	2

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

MDM -IV	**Course Code: PST1611**	**Course Title: Technology of Thermoplastic Polymers**	**Credits = 2**		
			L	**T**	**P**
	Semester: VI	**Total Contact Hours: 30**	**1**	**1**	**0**
List of Prerequisite Courses					
Polymer Science & Technology I, Introduction to Polymer Engineering and Technology, Polymer Chemistry and Technology					
List of Courses where this course will be prerequisite					
Additives and compounding of Polymers, Polymer Processing					
Description of relevance of this course in the MDM programme					
To give an understanding of industrial manufacturing processes, properties and applications, and processing of various types of thermoplastic polymers. Knowledge of the subject will help students conduct research and development in polymer blends polymer nanocomposites, coating formulation development, Fiber reinforces composites, Polymer processing, Rheology of polymers					

etc. To make aware of Environmental concerns of Polymer products, Recycling of Polymers, industrially produced different grades trade names of polymers.		
	Course Contents (Topics and Subtopics)	**Required Hours**
1	Industrial Manufacturing processes, properties and applications, processing environmental concerns of various types of polymers polyolefins like LDPE HDPE etc.	4
2	Polypropylene and copolymer of PP Plastomers, The copolymer of polyolefines like EVA LLDPE EAA etc.	5
3	Polyvinyl chloride & its copolymers Compounding of PVC, Polystyrene, HIPS, SAN	4
4	ABS, important copolymers of styrene maleic anhydride and styrene acrylic copolymers, toughening mechanism of impact-modified plastics.	5
5	Saturated Polyesters such as PET, PBT, PTT	3
6	Polycarbonates, Polyacetals, Polyamide- Nylon 6, Nylon 6,6, Nylon 11 etc., aromatic polyamide such as Kevlar etc.	3
7	Acrylic polymers & copolymers, Polyacrylamide, PMMA, Polyacrylonitrile etc.	3
8	Thermoplastic PU, Polyvinyl acetate, Polyvinyl alcohol, etc.	3
	Total	**30**
List of Textbooks/Reference Books		
	Plastics Materials, 7th Edition by John Brydson, Elsevier 1999.	
	Text book of polymer Science by Bill Meyer, John Wiley and Sons 1984	
	Principles of Polymer Science, by Bahadur and Sastry, Narosa Publishing House 2002.	
	Polymer Science by Gowarikar, John Wiley and Sons 1986.	
	Encyclopedia of Polymer Science and Technology, Johan Wiley and Sons, Inc.1965.	
	Encyclopedia of Polymer Science and Engineering, Johan Wiley and Sons, Inc1988.	
	Handbook of Thermoplastics, Second Edition Olagoke Olabisiby CRC Press2015	
	Thermoplastic Materials by Ibeh, Christopher C, Taylor Francis Inc 2013	
	Introduction to Polymer Science and Technology by H. S. Kaufman and J. J. Falcetta, Wiley Inter science Publication, 1977	
	Handbook of Polyethylene, A. J. Peacock, Marcel Dakker Inc,2000	
	PVC Technology, A. S. Athalye and Prakash Trivedi, Multi-Tech Publishing Co, 1994.	
	Engineering Thermoplastics Polycarbonates Polyacetals Cellulose Esters, L. Bottenbruch, Hanser Publishers, 1996.	
	Polymer and Resins; Their Chemistry and Chemical Engg, Brage Golding, D. Van Nostrand Company Inc, 1959.	
	Structures of Cellulose, Atlla, American Chemical society, 2003.	
Course Outcomes (Students will be able to…..)		
CO1	Examine the industrial manufacturing process, compare the advantages disadvantages of such processes, define the process parameters of the thermoplastics polymers and discuss the environmental concerns of their products (K1)	
CO2	Describe properties like physical mechanical thermal rheological etc (K1)	
CO3	Explain basic processing methods related to the thermoplastics polymers. Discuss the practical applications of thermoplastics in real world and structure properties and relationship. (K2)	

Mapping of Course Outcomes (COs) with Programme specific Outcomes (PSOs)						
		PSO1	PSO2	PSO3	PSO4	PSO5

CO1	K1	3	3	2	1	2
CO2	K1	2	3	2	3	2
CO3	K2	3	2	1	2	1
Course	K2	2	3	2	3	1

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

MDM-V	**Course Code:** PET1703	**Course Title:** MDM-V: Additives and Compounding of polymers	**Credits = 2**		
			L	**T**	**P**
	Semester: VII	**Total contact hours: 30**	**1**	**1**	**0**
List of Prerequisite Courses					
	Polymer Science & Technology I, Introduction to Polymer Engineering and Technology, Polymer Chemistry and Technology, Technology of Thermoplastic Polymers				
List of Courses where this course will be prerequisite					
	Polymer Processing				
Description of relevance of this course in the MDM programme					
To give understanding of various additives used in polymer. To understand the chemistry and mechanism of additives					
Sr. No.	**Course Contents (Topics and subtopics)**		**Required Hours**		
1	An overview of additives, type of additives, main trends of additives, Fillers, mechanical properties due to fillers		3		
2	UV stabilizers, Heat Stabilizers, Flame Retardants		2		
3	Conductivity, Antistatic Agent		2		
4	Curing & Curing agents		2		
5	Coupling agents and Compatibilization agents		1		
6	Plasticizer, Blowing Agents, Processing and modifier aid		2		
7	Lubricants Mould Release Agents, Antislip and Antiblocking additives		2		
8	Additives for rubber and recycling, mixing, compounding, Health and Safety		2		
9	Polymer compounding and requirements, Fundamentals of Compounding and processing & Classification and Discussion of Melting Mechanisms, Devolatilization Equipment		3		
10	Mechanisms and Theory of mixing, Basic Concepts, Dispersive Mixing of Solid Additives, Distributive Mixing Distribution,		3		
11	Blenders, Internal Mixers - Single Screw Extruders - Twin Screw Extruders - Intermeshing Twin Screw Extruders - Reciprocating Screws		4		
12	Material Consideration, Properties and Characterization Solid additives (inorganic) - Solid additives (organic), Compatibalizer (mechanisms, theory)		4		
	Total		**30**		
List of Text Books/ Reference Books					
1	Text book of Polymer Science by Billmeyer, John Wiley ans Sons 1984.				

2	Additives for plastic by Raymond B. Seymour, Academic Press 1978.	
3	Additives for plastic handbook by John Murphy, Elsevier advance technology 1996.	
4	Determination of Additives in Polymers and Rubbers by T R. Crompton, Rapra Technology Ltd 2007.	
5	Polymer Modifiers and Additives by Richard F. Grossman , John T. Lutz Jr, CRC Press 2000.	
6	The Complete Technology Book on Industrial Polymers, Additives, Colourants and Fillers by NIIR Board of Consultants & Engineers. Asia Pacific Business Press Inc. 2006.	
7	Additives in Polymers: Industrial Analysis and Applications by Jan C. J. Bart John Wiley and Sons 2005.	
Course Outcomes (students will be able to….)		
CO1	Describe about polymer additives depending upon their requirement and final applications (K1)	
CO2	Select the proper dosage of additives based on their requirements and chemistries (K2)	
CO3	Choose the various additive in chemistry (K3)	
CO4	Calculate the problems during processing, and end application by selecting proper additives, their dosage, and combination based on requirement (K3)	
CO5	Select the requirement of processing for any batch with the proper quantity of each and every ingredient such as fillers and additives etc. (K4)	

Mapping of Course Outcomes (COs) with Programme specific Outcomes (PSOs)						
		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	K1	2	2	3	2	1
CO2	K2	1	3	2	2	2
CO3	K3	2	2	3	1	2
CO4	K3	2	2	2	2	1
CO5	K4	2	3	3	2	2
Course	K4	2	3	2	2	2

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

MDM -VI	**Course Code:** PET1816	**Course Title:** MDM-VI: Polymer Processing	**Credits = 2**		
			L	**T**	**P**
	Semester: VIII	**Total Contact Hours: 30**	**1**	**1**	**0**
List of Prerequisite Courses					
Polymer Science & Technology I, Introduction to Polymer Engineering and Technology, Polymer Chemistry and Technology, Technology of Thermoplastic Polymers, Additives and compounding of Polymers					
List of Courses where this course will be prerequisite					
NA					

Description of relevance of this course in the MDM programme		
The course gives an insight into the processing techniques of polymers. It will help in troubleshooting the various problems faced during processing. The need for compounding of polymer and techniques involved.		
	Course Contents (Topics and Subtopics)	**Required Hours**
1	Extruders: single screw and twin screw extruders, Film blowing, Fiber spinning, Pipe extrusion, Co-extrusion of pipes, Extrusion of cable material, extrusion of the sheet, Calendaring, Thermoforming	10
2	Molding: Injection molding,	5
3	Blow molding, Compression molding	5
4	Injection stretch blow molding, Resin transfer molding	5
5	The one-dimensional process is like Coating and Adhesives.	5
	Total	**30**
List of Textbooks/Reference Books		
1	Encyclopedia of Polymer Science and Technology, Johan Wiley and Sons, Inc 1988.	
2	Polymer processing by Mckelvey, J.M, John wiley & sons inc 1962.	
3	Polymer processing fundamentals by T. A. Osswald, Munich hanser publishers 1998.	
4	Polymer reaction engineering by K. H. Reichert and W. Heiseler, VCH publishers, 1989	
5	Plastics Compounding by David Burton Todd, Hanser Publishers 1998.	
6	Principles of Polymer Processing, 2nd Edition by Zehev Tadmor, Costas G. Gogos, John Wiley & Sons, Inc., 2006.	
7	Fundamentals of Modern Manufacturing: Materials, Processes, and Systems by Mikell P. Groover, 2009.	
8	Polymer Extrusion by Chris Rauwendaal, Carl Hanser Verlag GmbH & Co; 3rd Revised edition edition (1 August 1994).	
9	Polymer Processing: Principles and Design, 2nd Edition by Donald G. Baird, Dimitris I. Collias, Wiley-Interscience, 2014.	
10	Polymer Processing and Characterization by Sabu Thomas, Deepalekshmi Ponnamma, Ajesh K. Zachariah. Apple Academic Press 2012.	
Course Outcomes (Students will be able to….)		
CO1	Interpret the polymers by various technique and able to solve the problems observed during processing. Ability to understand the degradation/stabilization of polymers and to analyses the respective case studies (K2)	
CO2	Illustrate effect of temperature during processing, screw dimensions, the rate of addition as well as the concentration of addition of filler etc. (K3)	
CO3	Calculate the batch for any processing with proper quantity of each and every ingredient such as fillers and additives etc. (K4)	

Mapping of Course Outcomes (COs) with Programme specific Outcomes (PSOs)						
		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	K2	3	1	3	3	2
CO2	K3	1	3	2	3	2
CO3	K4	3	3	3	2	3
Course	K4	3	3	3	3	2

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution
K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain