CENTRE FOR POLYMER SCIENCE AND ENGINEERING

Interdisciplinary M. Tech. Programme in Polymer Science & Technology

Revised structure for **Interdisciplinary M. Tech. Programme in Polymer Science & Technology**

Total Credits = 54

Program Core (PC)	Program Elective (PE)	Open Elective (OE)	Total Credits
42 (includes project:18 Cr)	6	6	54

Semester I

S.No.	Course Number	Course Title	Type	L-T-P	Credits
1	PTL701	Polymer Chemistry	PC	3-0-0	3
2	PTL703	Polymer Physics	PC	3-0-0	3
3	PTL705	Polymer Characterization	PC	3-0-0	3
4	PTL707	Polymer Engineering and Rheology	PC	3-0-0	3
5	PTP709	Polymer Science Laboratory	PC	0-0-4	2
		Semester total		12-0-4	14

PC = Program Core

Semester II

S.No.	Course Number	Course Title	Type	L-T-P	Credits
1	PTL702	Polymer Processing	PC	3-0-0	3
2	PTL704	Polymer Technology	PC	3-0-0	3
3	PTP720	Polymer Engineering Lab	PC	0-0-2	1
4	PTL713	Polymer Testing and Properties	PC	3-0-0	3
5		Programme Elective-1	PE	3-0-0	3
		Semester total		12-0-2	13

PE = Program Elective

Semester III

S.No.	Course Number	Course Title	Type	L-T-P	Credits
1		Program Elective-2	PE	3-0-0	3
2		Open Elective-1	OE	3-0-0	3
3		Open Elective-2	OE	3-0-0	3
4	JPD801	Major Project Part-I	PC	0-0-12	6
		Semester total		9-0-12	15

OE = Open Elective

Semester IV

S.No	Course Number	Course Title	Type	L-T-P	Credits
1	JPD802	Major Project Part-II	PC	0-0-24	12
-		Total Credits		0-0-24	12

Suggested Program Elective Courses

S. No.	Course Number	Course Title	Type	L-T-P	Credits
1	PTL711	Engineering Plastics and Speciality Polymers	PE	3-0-0	3
2	PTL712	Polymer Blends and Composites	PE	3-0-0	3
3	PTL716	Rubber Technology	PE	3-0-0	3
4	PTL718	Polymer Reaction Engineering	PE	3-0-0	3
5	PTL720	Polymer Product and Mould Design	PE	2-0-2	3
6	PTL722	Polymer Degradation and Stabilization	PE	3-0-0	3
7	PTL724	Polymeric Coatings	PE	3-0-0	3
8	PTL726	Polymeric Nanomaterials and Nanocomposites	PE	3-0-0	3
9	PTL714	Biodegradable Polymeric Materials	PE	3-0-0	3
10	JPD799	Minor Project	PE	0-0-6	3
11	JPS800	Independent Study	PE	0-3-0	3
12	PTV700	Special Lectures in Polymers	PE	1-0-0	1

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centre for Polymer Science and Engineering
2.	**Course Title** *(< 45 characters)*	SPECIAL LECTURES IN POLYMERS
3.	**L-T-P structure**	1-0-0
4.	**Credits**	1
5.	**Course number**	PTV700
6.	**Status** (*category* for *program*)	Program Elective

7.	**Pre-requisites** (course no./title)	None

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	NIL
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	No

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☐1st sem ☐2nd sem ☒Either sem

11.	**Faculty who will teach the course**	Prof. A. K. Ghosh/Dr. J. Jacob
12.	**Will the course require any visiting faculty?**	

13. Course objective *(about 50 words)***:**

The course aims to organize special lectures in various aspects of polymers from leading experts from industry, academia and R&D organizations to give students a glimpse into the latest technological aspects in polymer science, engineering and technology.

14. Course contents *(about 100 words) (Include laboratory/design activities)***:**

There will only be special lectures followed by a final assignment or quiz.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Recent advances in Polymer Technology	3
2	Trends in Polymer Rheology	2
3	Advances in Polymer Processing	3
4	Emerging techniques in Polymer Synthesis and characterization	2
5	Polymers in energy and environment	2
6	Polymers in healthcare	2
7		
8		
9		
10		
11		
12		
COURSE TOTAL *(14 times 'L')*		14

16. Brief description of tutorial activities

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
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COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Lecture handouts/notes will be provided by the speakers.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centre for Polymer Science and Engineering
2.	**Course Title** *(< 45 characters)*	POLYMER CHEMISTRY
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	PTL701
6.	**Status** (*category* for *program*)	Program Core

7.	**Pre-requisites** (course no./title)	None

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	None
8.2	Overlap with any UG/PG course of other Dept./Centre	None
8.3	Supercedes any existing course	No

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☒1st sem ☐2nd sem ☐Either sem

11.	**Faculty who will teach the course** Prof. Veena Choudhary	
12.	**Will the course require any visiting faculty?**	No

13.	**Course objective** *(about 50 words)***:** The course gives a detailed understanding of the principles of polymer chemistry

14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** Introduction to polymers, nomenclature, addition, condensation, chain growth and step growth polymerization, kinetics of polymerization, material classes, polymerization techniques: bulk, suspension and emulsion polymerization; cationic, anionic and free radical polymerization; copolymerization, reactivity ratios; atom transfer radical polymerization

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction to Polymers: An introduction to the history, recent developments, applications and processing of polymers	2
2	Classification of polymers,addition and condensation polymerization, chain growth and step polymerization, Nomenclature	2
3	Organic Polymer Chemistry I: Systematic study of polymers with emphasis centered on those synthesized by step-growth polymerization and their kinetics such as - polyesters, polycarbonates, polyamides , polyimides, epoxy, phenolic resins, amino plastics, polyurethanes etc	7
4	Organic Polymer Chemistry II: systematic study of polymers with emphasis centered on those synthesized by addition polymerization and their kinetics such as- ethers, acetals, lactones, lactams	7
5	Polymerisation techniques such as - bulk, solution, suspension and emulsion polymerisation	2
6	Cationic and anionic polymerisation mechanism of ionic polymerisation,effect of gegen ions,temperature and solvent on polymerization	6
7	Copolymerisation ,reactivity ratios,composition of copolymers,block and graft copolymers	6
8	Complex catalyst polymerisation,mechanism of reaction	3
9	ATRP and Ring opening metathisis polymerization and their kinetics	3
10	physical state and transitions,factors affecting glass transition and melting temperature	4
11		
12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
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COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. George Odian Principles of polymerization, 4th Edition, Wiley, 2004.
2. P. C. Heimenz, T. P. Lodge Polymer Chemistry, 2nd Edition, CRC press, 2007.
3. Seymour/Carraher's Polymer Chemistry, 6th Edition, Marcel Dekker, Inc., 2003.
4. Comprehensive Polymer Science 'The synthesis, characterization, reactions and applications of polymers' vol 3-5, Pergamon press, 1989.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centre for Polymer Science & Engineering
2.	**Course Title** *(< 45 characters)*	POLYMER PROCESSING
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	PTL702
6.	**Status** (*category* for *program*)	Program Core

7.	**Pre-requisites** (course no./title)	NIL

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	NIL
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	No

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☐1st sem ☒2nd sem ☐Either sem

11.	**Faculty who will teach the course** Prof. A.K. Ghosh	
12.	**Will the course require any visiting faculty?**	NO

13.	**Course objective** *(about 50 words)***:** To develop fundamental knowledge in the area of polymer processing covering basic principles and all shaping operations used in the polymer Industry.

14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** Course covers the classification of polymer processing operations , extrusion, molding based processes, compounding and mixing, thermoforming and other processing methods..

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Classification of Polymer processing operations	2
2	Simple model flows woth example	2
3	Extrusion; single screw extrusion, twin screw extrusion, film processing	14
4	Molding based processes ; injection molding, blow molding, compression molding and rotational moulding	10
5	compounding and mixing	4
6	Thermoforming, calendering, Reactive processing and reaction injection Molding	10
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12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
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COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1- Middleman S, Fundamentals of Polymer Processing, McGraw-Hill (1977).
2-James M. McKelvey, Polymer processing, Jhon Wiley & Sons, New York(1979).
3-Tadmor Z., Gagos C.G. , Principle of polymer processing, Jhon willey & Sons, New Jersey(2006).

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	

19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centre for Polymer Science and Engineering
2.	**Course Title** *(< 45 characters)*	POLYMER PHYSICS
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	PTL703
6.	**Status** (*category* for *program*)	Programme Core

7.	**Pre-requisites** (course no./title)	None

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	NIL
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	No

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☒1st sem ☐2nd sem ☐Either sem

11.	**Faculty who will teach the course** Dr. B.K.SATAPATHY	
12.	**Will the course require any visiting faculty?**	No

13. Course objective *(about 50 words)***:**

The course introduces the basic concepts relating to the crystaline and amorphous structure od polymers and their related properties vis-a-vis the basic understanding of rubber elasticity. The course also extends to two-phase morphology, spherulitic structre and concepts related to melting and crystallization kinetics.

14. Course contents *(about 100 words) (Include laboratory/design activities)***:**

The course content will include polymer molecules, their conformations, crystalline and two phase structures and their effeccts on various thermo-physical properties such as melting, glass transition and crystallization kinetics.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Polymer molecules, structure and conformations	4
2	Elasticity of isolated polymer chain and its network, rubber elasticity	8
3	Structure of amorphous phase in bulk polymers, glass transition and the factors affecting it	8
4	Two- phase structure of semi-crystalline polymers and correlation with properties	5
5	Crystal morpholgies:extended chain crystals,Chain folding, lamellae,spherulites	5
6	Concept of unit cell,crystallite size and long period	4
7	Crystallization and its kinetics:Avrami equation	5
8	Melting :determination of melting point and the effect of various parameters on melting	3
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12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
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10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. R. J. Young and PM Lovell, Introduction to Polymers, 2nd Edition, Viva Publishers, 2004.
2. U. Gedde, Polymer Physics, Springer, 1995.
3. M. Rubinstein and R H Colby, Polymer Physics, Oxford Publishers, 2003.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	No

19.2	Hardware	No
19.3	Teaching aides (videos, etc.)	No
19.4	Laboratory	No
19.5	Equipment	No
19.6	Classroom infrastructure	Yes
19.7	Site visits	No

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	No
20.2	Open-ended problems	No
20.3	Project-type activity	No
20.4	Open-ended laboratory work	No
20.5	Others (please specify)	No

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centre for Polymer Science and Engineering
2.	**Course Title** *(< 45 characters)*	POLYMER TECHNOLOGY
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	PTL704
6.	**Status** (*category* for *program*)	Program Core

7.	**Pre-requisites** (course no./title)	None

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	NIL
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	No

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐ Every sem ☐ 1st sem ☒ 2nd sem ☐ Either sem

11.	**Faculty who will teach the course**	Prof. A. K. Ghosh and Prof. S. N. Maiti
12.	**Will the course require any visiting faculty?**	No

13. Course objective *(about 50 words)***:**

This course will help develop knowledge about industrial manufacturing processes, structure-property relationships, general properties and technology and application of commodity plastics.

14. Course contents *(about 100 words) (Include laboratory/design activities)***:**

Polymers of commercial importance; additives for plastics; stabilizers, fillers, plasticizers and extenders, lubricants and flow promoters, flame retardants, blowing agents, colourants, cross-lnking agents and biodegradation additives; manufacture, properties and applications of major thermoplastic and thermosetting polymers: polyethylene, polypropylene, poly(vinylene chloride), polystyrene and other styrenics, pheonol-formaldehyde, urea-melamine formaldehyde and unsaturated polyester resings

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Additives for platics	12
2	Technology of polyethylene	7
3	Polypropylene technology	5
4	poly(vinylene chloride)	6
5	Styrenics	7
6	Thermosetting resins	5
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12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
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COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. J. A. Brydson 'Plastic Materials' Elsevier, 2005.
2. L. Mascia. 'Additives for Plastics'
3. P. D. Ritchie 'Plasticizers, Stabilizers and Fillers' 1972.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	

19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centre for Polymer Science and Engineering
2.	**Course Title** *(< 45 characters)*	POLYMER CHARACTERIZATION
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	PTL705
6.	**Status** (*category* for *program*)	Program Core

7.	**Pre-requisites** (course no./title)	None

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	NIL
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	No

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☒1st sem ☐2nd sem ☐Either sem

11.	**Faculty who will teach the course** Dr. Josemon Jacob/Dr. Leena Nebhani	
12.	**Will the course require any visiting faculty?**	No

13. Course objective *(about 50 words)***:**

The course aims to provide an understanding of the commonly used techniques for structural, morphological, thermal and spectroscopic characterization of polymeric materials.

14. Course contents *(about 100 words) (Include laboratory/design activities)***:**

Molecular weight and molecular dimensions by end-group analysis, osmometry, light scattering, viscometry, gel permeation chromatography, MALDI-TOF, Infra-red, NMR, UV-visible and Raman spectroscopic techniques. Thermal properties by differential scanning calorimetry, differential thermal analysis, thermogravimetry; Microscopy: optical and electron microscopy, X-ray scattering from polymers, small angle light scattering; crystallinity by density measurements. .

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Common techniques for molecular weight determination	8
2	FTIR spectroscopy	6
3	NMR spectroscopy	14
4	Thermal characterization	4
5	X-ray, optical and electron microscopy	5
6	Morphological characterization	5
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12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
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COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. D. Campbell and J. R. White 'Polymer Characterization, Physical Techniques' Chapman and Hall, 1989.
2. Arza Seidel 'Characterization and Analysis of Polymers', Wiley Interscience 2008.
3. Techniques for Polymer Organization and Morphology Characterization, by R. A. Pethrick and C. Viney, Wiley Interscience, 2003.
4. Peter A. Mirau 'A practical Guide to understanding the NMR of polymers', Wiley Interscience, 2005.
5. Edith A. Turi Thermal Characterization of Polymeric Materials, 2nd Edition, Vol. 1-2, 1982.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centre for Polymer Science & Engineering
2.	**Course Title** *(< 45 characters)*	POLYMER ENGINEERING AND RHEOLOGY
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	PTL707
6.	**Status** (*category* for *program*)	Program Core

7.	**Pre-requisites** (course no./title)	None

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	NIL
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	No

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☒1st sem ☐2nd sem ☐Either sem

11.	**Faculty who will teach the course** Prof. A.K. Ghosh	
12.	**Will the course require any visiting faculty?**	NO

13.	**Course objective** *(about 50 words)***:** To develop fundamental knowledge in the area of polymer rheology covering basic principles of flow behaviour, rheological models, equipments and the significance of rheology .

14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** Course covers Newtonian and non-Newtonian flow, simple shear flow and its significance, normal stresses, simple elongational flow and its significance, viscoelasticity, Rheometers, molecular, theoratical and related models.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction and types of fluid flow	2
2	Relationship describing continuity, dynamic & constitutive equations	3
3	Simple shear flow and its application for viscosity as well as normal stresses measurement.	6
4	Simple elongational flow and its significance	6
5	Dynamic flow behaviour	8
6	Rheometers	8
7	Viscoelastic behaviour	6
8	Molecular, theoratical and related models	3
9		
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11		
12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
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10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1-Middleman S, Flow of high polymers: McGraw-Hill, New York, 1977.
2-R.B. Bird, R.C. Armstrong, O. Hassager: Dynamics of polymeric liquids (Volume1), John Wiley & Sons, New York, 1977.
3-J.J. Aklonis, W.J. McKnight, M. Shen: Introduction to polymer viscosity, Wiley-interscience, New York, 1972.
4. John M. Dealy Melt rheology and its role in plastics processing, Kluwer Academic Publishers, 1999.
5. Montgomery T. Shaw Introduction to polymer rheology, John Wiley and sons Inc, 2012.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centre for Polymer Science and Engineering
2.	**Course Title** *(< 45 characters)*	POLYMER SYNTHESIS AND CHARACTERIZATION LABORATORY
3.	**L-T-P structure**	0-0-4
4.	**Credits**	2
5.	**Course number**	PTP709
6.	**Status** (*category* for *program*)	Program Core

7.	**Pre-requisites** (course no./title)	None

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	NIL
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	No

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐ Every sem ☒ 1st sem ☐ 2nd sem ☐ Either sem

11.	**Faculty who will teach the course**	Dr. Josemon Jacob/Prof. Veena Choudhary
12.	**Will the course require any visiting faculty?**	

13. Course objective *(about 50 words)***:**

The course gives hands on laboratory training into synthesis and characterization of polymeric materials

14. Course contents *(about 100 words) (Include laboratory/design activities)***:**

Experiments: identification of polymers; purification of monomers; suspension polymerization of styrene; emulsion polymerization of vinyl acetate and butyl acrylate; bulk and solution polymerization of methyl methacrylate; preparation and testing of epoxy resins; unsaturated polyester resin technology; preparation of nylon 6 and nylon 10 by interfacial polymerization; copolymerization and determination of reactivity ratios; epoxide equivalent; molecular weight determination by viscometry and end-group analysis; atom transfer radical polymerization of styrene; thermal characterization by DSC and TGA; GPC; FTIR and NMR

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
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COURSE TOTAL *(14 times 'L')*		

16. Brief description of tutorial activities

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Identification of polymers	6
2	Determination of viscosity average molecular weight	6
3	Purification of MMA	6
4	Bulk polymerization of MMA	6
5	Copolymerization of MMA and styrene	6
6	Preparation of phenol-formaldehyde resin	6
7	Emulsion polymerization	6
8	Atom transfer radical polymerization	6
9	Preparation of vinyl ester resin	4
10	Determination of epoxy equivalent	4
COURSE TOTAL *(14 times 'P')*		56

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

D. Braun, H. Cherdon, M. Rehahn, H. Ritter, B. Voit Polymer Synthesis: Theory and Practice, 4th Edition, Springer 2005

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	

19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centrer for Polymer Science and Engineering
2.	**Course Title** *(< 45 characters)*	POLYMER RHEOLOGY AND PROCESSING LAB
3.	**L-T-P structure**	0-0-2
4.	**Credits**	1
5.	**Course number**	PTP710
6.	**Status** (*category* for *program*)	Programme core

7.	**Pre-requisites** (course no./title)	

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	NIL
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	No

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☐1st sem ☒2nd sem ☐Either sem

11.	**Faculty who will teach the course** Dr. B. K. SATAPATHY	
12.	**Will the course require any visiting faculty?**	No

13.	**Course objective** *(about 50 words)***:** . The lab course essentially exposes the students to various processing equipments and to activities related to each processing machine. The course also includes the measurement of rheological properties using MFI apparatus and capillary rheometer.
14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** The course comprises of eight regular expreminets on various processing equipments and two experientys dealing with rheology of polymer melts.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
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COURSE TOTAL *(14 times 'L')*		

16. Brief description of tutorial activities

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Processing experiments:Compounding of additives on two roll mill	3
2	Twin screw extruder,compression moulding	5
3	Injection moulding	3
4	Single screw and twin screw extrusion	4
5	Thermoforming	2
6	Melt flow index measurement	2
7	Mixing in HAAKE rheomix	2
8	Melt rheology on rheometers	3
9	Mechanicla proportion of polymers,mould flow demonstartion	2
10	Industry visit or demonstartion of specific processing and testing operations	2
COURSE TOTAL *(14 times 'P')*		28

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

R. J. Crawford Polymer Engineering 2nd Edition, Pergamon, 1987.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	

19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centre for Polymer Science and Engineering
2.	**Course Title** *(< 45 characters)*	ENGINEERING AND SPECIALITY POLYMERS
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	PTL711
6.	**Status** (*category* for *program*)	Program Elective

7.	**Pre-requisites** (course no./title)	None

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	NIL
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	No

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☐1st sem ☐2nd sem ☒Either sem

11.	**Faculty who will teach the course**	Prof. Veena Choudhary
12.	**Will the course require any visiting faculty?**	No

13.	**Course objective** *(about 50 words)***:** The course gives broad knowledge about common engineering platics and polymers for specialized applications

14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** Introduction to engineering polymers, applications, processing, thermoplastic engineering plastics, polycarbonates, polyimides, polyphenylene oxide, liquid crystalline polymers, poly(ether ketone), thermosets, speciality polymers, hydrogels, conducting polymers, fluoropolymers

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction to Engineering Polymers: An introduction to the history, recent developments, applications and processing of polymers	1
2	Characteristics of thermoplastics engineering plastics such as - polycarbonates, polyamides, polyimides, Poly (benzimidazoles), polyphenylene oxide,	8
3	Liquid Crystalline Polymers	2
4	Poly(aryl ether ketone), Poly(ether ketone), Poly(aryl ether sulfone), poly(phenylene sulfides), Polyacetals	6
5	Processing and applications of thermoplastic and thermosets engineering plastics	5
6	Introduction to Speciality Polymers: An introduction to the history, recent developments, applications and processing of polymers	6
7	Characteristics of Speciality polymers such as - fluropolymer, silicone, conducting polymers and polymeric hydrogels	6
8	Processing and applications of Speciality polymers	8
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12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
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COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

John Brydson Plastic Materials Elsevier
Johannes Karl Fink -High Performance Polymers -Norwich , NY, USA

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centre for Polymer Science and Engineering
2.	**Course Title** *(< 45 characters)*	POLYMER BLENDS AND COMPOSITES
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	PTL712
6.	**Status** (*category* for *program*)	Program Elective

7.	**Pre-requisites** (course no./title)	None

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	NIL
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	No

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☐1st sem ☐2nd sem ☒Either sem

11.	**Faculty who will teach the course** Dr. B.K. SATAPATHY	
12.	**Will the course require any visiting faculty?**	No

13. Course objective *(about 50 words)***:**

The course deals with the basic concepts of blends and composites and their related issues such as the components, interface, interphase, factors responsible for designing such polymer based materials.

14. Course contents *(about 100 words) (Include laboratory/design activities)***:**

The course will cover definition and classification of blends and composites, miscibility, phase behaviour, nature of interface, nature of polymer matrices, reinforcements, basic theoretical models to predict mechanical properties and the role of fibre length, distribution, dispersion etc. on the performance properties of polymer based blends and composites .

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Definition of polymer blends and alloys, Miscibility of polymers,Immiscible blends and compatibilization, Morphology and dispersion of immiscible blends, Phase separation	8
2	Melt rheology of multiphase blends .IPN,Thermoplastic elastomers, Reaction blending, Specific polymer blends, their properties and applications	10
3	Definition and classification of composites Reinforcing fibers-natural fibers (cellulose,jute,coir etc.), carbon, ceramic, glass, aramids, polyethylene(UHMWPE); Matrix resins: Thermoplastic and thermosetting matrix resins	12
4	Coupling agents-surface treatment of fillers and fibers, Significance of interface and interfacial adhesion in composites, Particulate fillers: Importance of particle shape and size	5
5	Short and continuous fiber reinforced composites, Filled composites	3
6	Rule of mixture, Halpin-Tsai equation, Critical fiber length, anistropic behavoiur, Fabrication techniques	4
7		
8		
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10		
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COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

1. P. K. Mallick 'Fibre Reinforced Composites: Material, Manufacturing and Design' 3rd Edition, CRC press, 2007.
2. Shao Yun-Fu, Yiu-Wing Mai, Bernd Lauke, 'Science and Engineering of short fibre reinforced polymer composites', Woodhead publishers, 2009.
3. L. Uttracki 'Polymer Blends Handbook' 1st Edition, Springer, 2003.
4. D. R. Paul, S. Newman 'Polymer Blends' Academic Press, 1978.

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
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COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centre for Polymer Science and Engineering
2.	**Course Title** *(< 45 characters)*	POLYMER TESTING AND PROPERTIES
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	PTL713
6.	**Status** (*category* for *program*)	Program Core

7.	**Pre-requisites** (course no./title)	None

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	NIL
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	No

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☒1st sem ☐2nd sem ☐Either sem

11.	**Faculty who will teach the course**	Dr. B. K. Satapathy/Prof. S. N. maiti
12.	**Will the course require any visiting faculty?**	No

13. Course objective *(about 50 words)***:**

The course aims to develop a broad understanding of the mechanical, thermal, electrical and permeation properties of polymeric materials and their evaluation by various standard test methods.

14. Course contents *(about 100 words) (Include laboratory/design activities)***:**

Properties of polymers and their measurements by standard test methods; tensile, flexural and impact properties; hardness, abrasion resistance and long term fracture properties; softening point, heat distortion temperature, thermal expansion coefficient and thermal conductivity; electrical insulation and conductivity; sorption, diffusion and permeation of gases/liquids through polymer membranes; standards used are BIS, BS, ASTM, ISO and DIM; correlation of test with actual performance; statistical quality control in various tests.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Thermomechanical properties	4
2	Tensile properties of polymers	5
3	Impact properties, testing and impact materials	7
4	Flexural properties of plastics	3
5	Abrasion resistance of plastics	5
6	Hardness measurements	3
7	Thermal conductivity, HDT and melting temperature	3
8	Electrical properties of polymers	4
9	Permeation properties	4
10	Long term fracture properties	4
11		
12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
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10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. H.Mark. 'Encyclopedia of polymer science and technology' Wiley Interscience, 1965.
2. N. M. Bikales 'Mechanical properties of polymers' Wiley Interscience, 1966.
3. R. Brown. 'Testing of polymers', Wiley Interscience, 1985.
4. Roger Brown 'Handbook of Polymer Testing: Physical Methods' Marcel Dekker, 1999.
5. G. M. Swallowe 'Mechanical properties and testing of polymers: An A-Z reference' Springer, 2010.
6. Wolfgang Grellmann 'Polymer Testing' 2nd Edition, Hanser Publications, 2012.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	

19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centre for Polymer Science and Engineering
2.	**Course Title** *(< 45 characters)*	BIODEGRADABLE POLYMERIC MATERIALS
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	PTL714
6.	**Status** (*category* for *program*)	Program Elective

7.	**Pre-requisites** (course no./title)	None

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	NIL
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	No

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☐1st sem ☐2nd sem ☒Either sem

11.	**Faculty who will teach the course** Dr. J. Jacob and Prof. S. N. Maiti	
12.	**Will the course require any visiting faculty?**	No

13.	**Course objective** *(about 50 words)***:** The objective is to train the students to make polymeric materials degrade after their use by enzymes and microorganisms so that the polymers do not litter and pollute the environment.
14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** Concept of biodegradation; mechanism of biodegradaton; kinetics of biodegradation; methods to evaluate biodegradation; bioplastics, biodegradable polymers and their synthesis; biodegradable polymer blends and composites; technology and processing of biodegradable polymers; applications of biodegradable polymers

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Concept of biodegradation	2
2	Mechanism and kinetics of biodegradation	6
3	methods to evaluate biodegradation	3
4	Bioplastics	3
5	Biodegradable polymers and their synthesis	12
6	Biodegradable blends and composites	10
7	Technology and processing	4
8	Applications of biodegradable polymers	2
9		
10		
11		
12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
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COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. N. Grassie 'Development in Polymer Degradataion' Elsevier, NewYork, 1987.
2. Ray Smith 'Biodegradable polymers for industrial applications' CRC/Woodhead, Cambridge, NewYork, 2005.
3. Emo Chiellini, Roberto Solaro 'Biodegradable polymers and plastics' Kluver Academic/ Plenum NewYork, 2003
4. Long Yu. 'Biodegradable Polymer blends and composites from renewable resources' Wiley NewJersey, 2009.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	

19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centre for Polymer Science and Engineering
2.	**Course Title** *(< 45 characters)*	RUBBER TECHNOLOGY
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	PTL716
6.	**Status** (*category* for *program*)	Program Elective

7.	**Pre-requisites** (course no./title)	None

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	NIL
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	No

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☐1st sem ☐2nd sem ☒Either sem

11.	**Faculty who will teach the course**	Dr. Josemon Jacob/Dr. Leena Nebhani
12.	**Will the course require any visiting faculty?**	

13. Course objective *(about 50 words)***:**

The course gives a broad idea about rubbers and elastomers, their compounding, vulcanization, processing and product development.

14. Course contents *(about 100 words) (Include laboratory/design activities)***:**

Rubber and elastomers, compounding and vulcanization, mastication, fillers-reinforcing and non-black (loading type). Other compounding ingredients; peptizers, vulcanizing agents, accelerators, accelerator activator, softeners, anti aging additives, miscellaneous additives, colourant, flame retarders, blowing agents, deodorants, abrasive retarders etc. Processing and vulcanization tests, vulcanization theory and technology, natural and synthetic rubbers, stryene butadiene rubbers, polybutadiene and polyisoprene rubbers, ethylene-propylene rubber, butyl and halobutyl rubber, nitrile and silicone rubber, thermoplastic elastomers, acrylate and fluoro elastomers. .

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Compounding ingredients and vulcanization	6
2	Carbon black and non-black fillers	6
3	Processing and vulcanization tests	2
4	Natural Rubber	4
5	Butadiene and Isoprene rubber	4
6	Styrene-butadiene rubber	3
7	Ethylene-propylene rubbers	3
8	Silicone rubbers	3
9	Nitrile and acrylic rubbers	3
10	Thermoplastic elastomers	3
11	Polyurethane elastomers	3
12	Fluoro elastomers	2
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
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10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. James E. Mark, Burak Erman and Frederick R. Eirich 'The Science and Technology of Rubber' 3rd Edition, Elsevier Academic Press, New York, 2005.
2. Maurice Morton 'Rubber Technology' Van Nostrand Reinhold Company, New York, 1987.
3. Anil K. Bhowmick, Malcolm M. Hall, Henry A. Benarey 'Rubber Products Manufacturing Technology' Marcel Dekker, Inc., New York 1994

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	

19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centre for Polymer Science & Engineering
2.	**Course Title** *(< 45 characters)*	POLYMER REACTION ENGINEERING
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	PTL718
6.	**Status** (*category* for *program*)	Program Elective

7.	**Pre-requisites** (course no./title)	None

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	NIL
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	NO

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☐1st sem ☐2nd sem ☒Either sem

11.	**Faculty who will teach the course** Prof. A. K. Ghosh	
12.	**Will the course require any visiting faculty?**	NO

13.	**Course objective** *(about 50 words)***:** To develop fundamental knowledge in polymerisation reaction kinetics, batch and continuous processes, reactors and their design.

14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** Course covers reaction kinectics in condensation and all types of addition polymerisation reactions, prediction of molecular weight for polymerisation in different types of reactors, batch and continuous processes, the effect of mixing on kinetics and MWD, reactor design.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Classification of polymerization mechanism	2
2	Polymerization kinetics: Chain growth polymerization	8
3	Polymerization kinetics: Step growth polymerization	4
4	Mass transfer effects in step growth polymerization reactors	4
5	Types of reactors, reactor modeling, optimisation of reactors	8
6	Comparison between batch and continuous systems	2
7	The effect of mixing on kinetics and MWD	3
8	Prediction of molecular weight distribution for polymerisation conducted in batch reactors, continuous stirred tank reactors an dplug flow reactors	5
9	Some commercially important polymerization processes	6
10		
11		
12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
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10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1- Reaction Engg. of Step Growth Polymerization, 1987, S.K.Gupta and Anil Kumar, Plenum
2. Polymer Reactor Engineering, 1994, Ed. C. McGreavy, Blackie Acad.
3. Principles of Polymerization Engineering, 1983, J.A. Biesenberger and D.H. Sebestian, Wiley

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	

19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centre for Polymer Science & Engineering
2.	**Course Title** *(< 45 characters)*	POLYMER PRODUCT & MOULD DESIGN
3.	**L-T-P structure**	2-0-2
4.	**Credits**	3
5.	**Course number**	PTL720
6.	**Status** (*category* for *program*)	Program Elective

7.	**Pre-requisites** (course no./title)	None

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	NIL
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	No

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☐1st sem ☐2nd sem ☒Either sem

11.	**Faculty who will teach the course**	Prof. A. K. Ghosh and Prof. Naresh Bhatnagar
12.	**Will the course require any visiting faculty?**	NO

13.	**Course objective** *(about 50 words)***:** To develop fundamental knowledge in types of moulds and dies used in the polymer industry, their construction details, product and mould design.

14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** Course covers the types of moulds and dies, product and mould design, details of construction and manufacturing methods of tools, dies and moulds.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Fundamentals of moulding processes	4
2	Designing with Polymers	2
3	Types of moulds, tool making processes, equipment and methods	4
4	Materials in mold making, designing and drafting practice	4
5	Design details for compression moulds, transfer moulds, blow and extrusion dies	4
6	Typical exercises in mould design and production	4
7	Mouldflow Analysis concept	4
8	Sucessful moulding concepts	2
9		
10		
11		
12		
COURSE TOTAL *(14 times 'L')*		28

16. Brief description of tutorial activities

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Product design of plastics	4
2	Solid model of a part	4
3	Moldflow Analysis based on finite element	4
4	Mould core and cavity design	3
5	Mould construction	6
6	3-D rapid prototype of parts/moulds	4
7	CAD/CAM	3
8		
9		
10		
COURSE TOTAL *(14 times 'P')*		28

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1-D. V. Rosato 'Plastics Engineered Product Design' Elsevier, 2003.
2. R. G. W. Pie 'Injection Mould Design' Longman, 1986.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	

19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centre for Polymer Science and Engineering
2.	**Course Title** *(< 45 characters)*	POLYMER DEGRADATION AND STABILIZATION
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	PTL722
6.	**Status** (*category* for *program*)	Program Elective

7.	**Pre-requisites** (course no./title)	None

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	NIL
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	No

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☐1st sem ☐2nd sem ☒Either sem

11.	**Faculty who will teach the course**	Prof. Veena Choudhary
12.	**Will the course require any visiting faculty?**	No

13.	**Course objective** *(about 50 words)***:** The course aims to give a general understanding about the various degradation mechanisms for polymers and methods to stabilize them.

14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** Introduction to degradation, thermal and oxidative degradation; radiative, mechanical and chemical degradation; biological degradation; degradation pathways for common polymers; methods to monitor degradation; mechanical degradation, waste management

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction to degradation.Various types of polymer degradation such as:thermal degradation, oxidative degradation, degradation by radiation, mechanical degradation, chemical degradation, biological degradation	14
2	Mechanism of degradation of some specific polymers such as: Polyolefins (PE and PP), PVC , Natural Rubber , Polyamides, PMMA, Polyimide , Cellulose, SBR, Polyacrylonitrile (PAN), Polystyrene (PS), PET, PU	14
3	Methods /Equipment used for monitoring the degradation in polymers by DSC, TGA, DTA and DMA.	4
4	Mechanical degradation of polymers and its effect on properties	2
5	Thermal ageing of polymer under various conditions	2
6	Environmental stress cracking resistance	2
7	Biodegradation of polymers	2
8	Waste Management of polymers	2
9		
10		
11		
12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Developments in polymer degradation by N. Grassie Elsevier, vol. 7 1987
Thermal Characterization of polymeric Materials by E. A.Turi, Elsevier, vol 1-2, 1982.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centre for Polymer Science and Engineering
2.	**Course Title** *(< 45 characters)*	POLYMERIC COATINGS
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	PTL724
6.	**Status** (*category* for *program*)	Programme Elective

7.	**Pre-requisites** (course no./title)	Nil

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	Nil
8.2	Overlap with any UG/PG course of other Dept./Centre	Nil
8.3	Supercedes any existing course	Nil

9.	**Not allowed for** (indicate program names)	Nil

10.	**Frequency of offering**	☐Every sem ☒1st sem ☐2nd sem ☐Either sem

11.	**Faculty who will teach the course** Prof. Harpal Singh	
12.	**Will the course require any visiting faculty?**	No

13.	**Course objective** *(about 50 words)***:** Polymeric coatings on various substrate for corrosion inhibition, decoration, durability and specialized properties.

14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** Introduction and machanism of adsesion of polymeric coatings on various substrates. Solvent based polymeric coatings. Water based polymeric coatings. UV and EB curable coatings. 100% convertible coaings. Selection criteria of coatings for various substrates. Health, safety hazard and environmental aspects of coatings during manufavturing and applications.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction and machanism of adsesion of polymeric coatings on various substrates.	7
2	Solvent based polymeric coatings.	7
3	Water based polymeric coatings.	4
4	100% convertible coaings.	6
5	UV and EB curable coatings.	6
6	Selection criteria of coatings for various substrates.	6
7	Health, safety hazard and environmental aspects of coatings during manufavturing and applications.	6
8		
9		
10		
11		
12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

Nil

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Nil	Nil
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Text book Surface Coatings Science and Technology by Swaraj Pal, John Wiley & Sons, 1985.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	Nil
19.2	Hardware	Nil
19.3	Teaching aides (videos, etc.)	Nil
19.4	Laboratory	Nil

19.5	Equipment	Nil
19.6	Classroom infrastructure	Nil
19.7	Site visits	Nil

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	Nil
20.2	Open-ended problems	Nil
20.3	Project-type activity	Nil
20.4	Open-ended laboratory work	Nil
20.5	Others (please specify)	Nil

Date: 6.2.2015 (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centre for Polymer Science and Engineering
2.	**Course Title** *(< 45 characters)*	POLYMERIC NANOMATERIALS AND NANOCOMPOSITES
3.	**L-T-P structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	PTL726
6.	**Status** (*category* for *program*)	Program Elective

7.	**Pre-requisites** (course no./title)	None

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	NIL
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	No

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☐1st sem ☒2nd sem ☐Either sem

11.	**Faculty who will teach the course** Dr. B. K. SATAPATHY	
12.	**Will the course require any visiting faculty?**	No

13.	**Course objective** *(about 50 words)***:** The aim of the course is to introduce the relevance of nanotechnology in polymer science and engineering. The course broadly includes concepts of nanocomposites and phase behaviour and morphology of nanostructured polymers such as block coplymers
14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** The course content include the basic concepts and elements related to the understanding of nano structured polymer materials and nanocomposites.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction to general aspects of nanostructured materials	5
2	Nanocomposites and block copolymers	4
3	Interaction parameter,phase behaviour, morphology	5
4	Phase diagrams,microphase separation transition	4
5	Polymer nanocomposites: Technical challenges	4
6	Understanding of interfacial dynamics using LJ Potential and many body problems approach	3
7	Nanoreinforcements eg. Nanoclay,POSS, Carbon nanostructures and nanoparticles	5
8	Dispersion and percolation	5
9	Influence of size ,shape and diameter of nanotubes/nanofillers	4
10	Functionalisation of nanoparticles and nanoplatelets	3
11		
12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1.Y. W. Mai Polymer Nanocomposites, Woodhead Publishers, 2006.
2.J. H. Koo Polymer Nanocomposites, Mc-Graw Hill, 2006. .
3. I. W. Hamley, The Physics of Block Copoymers, Oxford University Press, 1999.
4. N. Hadjichristidis, S. Pispas, G. Floudas Block Copolymers, Synthetic strategies, Physical properties and Applications, Wiley, 2007.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	

19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centre for Polymer Science and Engineering
2.	**Course Title** *(< 45 characters)*	MINOR PROJECT
3.	**L-T-P structure**	0-0-6
4.	**Credits**	3
5.	**Course number**	JPD799
6.	**Status** (*category* for *program*)	Program Elective

7.	**Pre-requisites** (course no./title)	None

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	NIL
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☐1st sem ☐2nd sem ☒Either sem

11.	**Faculty who will teach the course** Dr.J. Jacob	
12.	**Will the course require any visiting faculty?**	

13.	**Course objective** *(about 50 words)***:** The student will work on a small project in any area of polymers. The topic of research need not be linked with JPD801 or JPD802

14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** A project in any area of polymers as decided by the supervisor

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
COURSE TOTAL *(14 times 'L')*		

16. Brief description of tutorial activities

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Project work	84
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL *(14 times 'P')*		84

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Based on topic of research

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centre for Polymer Science and Engineering
2.	**Course Title** *(< 45 characters)*	INDEPENDENT STUDY
3.	**L-T-P structure**	0-3-0
4.	**Credits**	3
5.	**Course number**	JPS800
6.	**Status** (*category* for *program*)	Program Elective

7.	**Pre-requisites** (course no./title)	None

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	NIL
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	NIL

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☐1st sem ☐2nd sem ☒Either sem

11.	**Faculty who will teach the course** Dr. J. Jacob	
12.	**Will the course require any visiting faculty?**	No

13.	**Course objective** *(about 50 words)***:** The student is expected to take a course from the PE category and will study the full course under the guidance of a course teacher.

14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** The course contents are as defined for the program elective courses offered by the Centre.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
COURSE TOTAL *(14 times 'L')*		

16. Brief description of tutorial activities

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Cenre for Polymer Science and Engineering
2.	**Course Title** *(< 45 characters)*	MAJOR PROJECT PART 1
3.	**L-T-P structure**	0-0-12
4.	**Credits**	6
5.	**Course number**	JPD801
6.	**Status** (*category* for *program*)	Program Core

7.	**Pre-requisites** (course no./title)	

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	
8.2	Overlap with any UG/PG course of other Dept./Centre	
8.3	Supercedes any existing course	

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☐1st sem ☐2nd sem ☒Either sem

11.	**Faculty who will teach the course** Dr. J. Jacob	
12.	**Will the course require any visiting faculty?**	

13.	**Course objective** *(about 50 words)***:** The student will select a topic on any area related with polymers and perform the research for one semester (IIIrd semester)

14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** A project in any area of polymer science and technology

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
COURSE TOTAL *(14 times 'L')*		42

16. Brief description of tutorial activities

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	**Department/Centre proposing the course**	Centre for Polymer Science and Engineering
2.	**Course Title** *(< 45 characters)*	MAJOR PROJECT PART-2
3.	**L-T-P structure**	0-0-24
4.	**Credits**	12
5.	**Course number**	JPD802
6.	**Status** (*category* for *program*)	Program Core

7.	**Pre-requisites** (course no./title)	

8.	**Status vis-à-vis other courses** *(give course number/title)*	
8.1	Overlap with any UG/PG course of the Dept./Centre	
8.2	Overlap with any UG/PG course of other Dept./Centre	
8.3	Supercedes any existing course	

9.	**Not allowed for** (indicate program names)	

10.	**Frequency of offering**	☐Every sem ☐1st sem ☐2nd sem ☐Either sem

11.	**Faculty who will teach the course** Dr. J. Jacob	
12.	**Will the course require any visiting faculty?**	

13.	**Course objective** *(about 50 words)***:** The student will continue to work on the topic selected in semester III, the work content will be further extended which will include additional studies, modifications/diversification of the broad research. The work will be done for the entire 4th semester.
14.	**Course contents** *(about 100 words) (Include laboratory/design activities)***:** A project in any area of polymer science and technology

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
COURSE TOTAL *(14 times 'L')*		

16. Brief description of tutorial activities

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL *(14 times 'P')*		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)