ANNA UNIVERSITY, CHENNAI

NON-AUTONOMOUS COLLEGES AFFILIATED COLLEGES

REGULATIONS 2021

CHOICE BASED CREDIT SYSTEM

B. TECH. PLASTICS TECHNOLOGY

CURRICULUM FOR SEMESTERS I TO VIII AND SYLLABI FOR SEMESTERS III AND IV

SEMESTER I

S. No.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IP3151	Induction Programme	-	-	-	-	-	0
THEORY								
2.	HS3151	Professional English - I	HSMC	3	0	0	3	3
3.	MA3151	Matrices and Calculus	BSC	3	1	0	4	4
4.	PH3151	Engineering Physics	BSC	3	0	0	3	3
5.	CY3151	Engineering Chemistry	BSC	3	0	0	3	3
6.	GE3151	Problem Solving and Python Programming	ESC	3	0	0	3	3
7.	GE3172	அறிவியல் தமிழ் / Scientific Thoughts in Tamil	HSMC	1	0	0	1	1
PRACTICALS								
8.	GE3171	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
9.	BS3171	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
10.	GE3172	English Laboratory $^{\$}$	EEC	0	0	2	2	1
			TOTAL	**16**	**1**	**10**	**27**	**22**

$ Skill Based Course

SEMESTER II

S. No.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT	CREDITS
				L	T	P		
THEORY								
1.	HS3251	Professional English - II	HSMC	2	0	0	2	2
2.	MA3251	Statistics and Numerical Methods	BSC	3	1	0	4	4
3.	PH3258	Physics of Materials	BSC	3	0	0	3	3
4.	BE3252	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	0	0	3	3
5.	CY3201	Physical and Organic Chemistry	BSC	3	0	0	3	3
6.	GE3251	Engineering Graphics	ESC	2	0	4	6	4
7.	GE3252	தமிழர் மரபு / Heritage of Tamils	HSMC	1	0	0	1	1
8.		NCC Credit Course Level 1#	-	2	0	0	2	2
PRACTICALS								
9.	GE3271	Engineering Practices Laboratory	ESC	0	0	4	4	2
10.	BE3272	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	0	0	4	4	2
11.	GE3272	Communication Laboratory / Foreign Language $	EEC	0	0	4	4	2
			TOTAL	**17**	**1**	**16**	**34**	**26**

#NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.
$ Skill Based Course

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA3391	Probability and Statistics	BSC	3	1	0	4	4
2.	PT3301	Fundamentals of Chemical Engineering	PCC	3	0	0	3	3
3.	PT3302	Plastics Materials I	PCC	3	0	0	3	3
4.	PT3303	Polymer Chemistry	PCC	3	0	0	3	3
5.	PT3304	Polymer Physics	PCC	3	0	0	3	3
6.	PT3305	Solid Mechanics for Technologists	ESC	3	0	0	3	3
PRACTICALS								
7.	PT3311	Chemical Engineering Lab	ESC	0	0	4	4	2
8.	PT3312	Polymer Chemistry Lab	PCC	0	0	4	4	2
9.	GE33361	Professional Development[$]	EEC	0	0	2	2	1
			TOTAL	**18**	**1**	**10**	**29**	**24**

$ Skill Based Course

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PT3401	Additives and Compounding	PCC	3	0	0	3	3
2.	PT3402	Polymer Rheology and Fluid Mechanics	ESC	3	0	0	3	3
3.	PT3403	Plastics Materials II	PCC	3	0	0	3	3
4.	PT3404	Plastics Moulds and Dies Technology	PCC	3	0	0	3	3
5.	PT3405	Plastics Processing	PCC	3	0	0	3	3
6.	GE3451	Environmental Sciences and Sustainability	BSC	2	0	0	2	2
7.		NCC Credit Course Level 2[#]		3	0	0	3	3 #
PRACTICALS								
8.	PT3411	Polymer Science Lab	PCC	0	0	3	3	1.5
9.	PT3412	Plastics Processing Lab	PCC	0	0	3	3	1.5
10.	PT3512	Industrial Training/Internship I*	EEC	-	-	-	-	-
			TOTAL	**17**	**0**	**6**	**23**	**20**

NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

*Four weeks industrial training/internship carries two credits. Industrial training/internship during IV Semester Summer Vacation will be evaluated in V semester

SEMESTER V

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PT3501	Plastics Testing and Characterization	PCC	3	0	0	3	3
2.		Professional Elective I	PEC	3	0	0	3	3
3.		Professional Elective II	PEC	3	0	0	3	3
4.		Professional Elective III	PEC	3	0	0	3	3
5.		Professional Elective IV	PEC	3	0	0	3	3
6.		Mandatory Course-I*	MC	3	0	0	3	0
PRACTICALS								
7.	PT3511	Plastics Testing and Characterization lab	PCC	0	0	0	3	1.5
8.	PT3512	Industrial Training/Internship I**	EEC	0	0	0	0	2
			TOTAL	**18**	**0**	**0**	**21**	**18.5**

[&] Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under MC-I)

**Four weeks industrial training/internship carries two credits. Industrial training/internship during IV Semester Summer Vacation will be evaluated in V semester

SEMESTER VI

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PT3601	Plastics Product Testing	PCC	3	0	0	3	3
2.		Open Elective – I*	OEC	3	0	0	3	3
3.		Professional Elective V	PEC	3	0	0	3	3
4.		Professional Elective VI	PEC	3	0	0	3	3
5.		Professional Elective VII	PEC	3	0	0	3	3
6.		Professional Elective VIII	PEC	3	0	0	3	3
7.		Mandatory Course--II[&]	MC	3	0	0	3	0
8.		NCC Credit Course Level 3[#]		3	0	0	3	3 #
PRACTICALS								
9.	PT3611	Plastics Product Testing Lab	PCC	0	0	0	3	1.5
10.	PT3612	Seminar and Comprehension	EEC	0	0	4	4	2
11.	PT3712	Industrial Training/Internship II**	EEC	-	-	-	-	-
			TOTAL	**21**	**0**	**4**	**28**	**21.5**

*Open Elective – I shall be chosen from the emerging technologies.

**Two weeks industrial training/internship carries one credit. Industrial training/Internship during VI Semester Summer Vacation will be evaluated in VII semester

[&] Mandatory Course-II is a Non-credit Course (Student shall select one course from the list given under MC- II)

[#] NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

SEMESTER VII/VIII*

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PT3701	Plastics Product Design	PCC	3	0	0	3	3
2.	PT3702	Plastics Recycling and Waste Management	PCC	3	0	0	3	3
3.	GE3791	Human values and Ethics	HSMC	2	0	0	2	2
4.		Elective- Management #	HSMC	3	0	0	3	3
5.		Open Elective – II**	OEC	3	0	0	3	3
6.		Open Elective – III***	OEC	3	0	0	3	3
7.		Open Elective – IV***	OEC	3	0	0	3	3
PRACTICALS								
8.	PT3711	CAD/CAM/CAE Lab	PCC	0	0	4	4	2
9.	PT3712	Industrial Training/Internship II##	EEC	-	-	-	-	2
			TOTAL	**20**	**0**	**4**	**24**	**24**

***If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.**

****Open Elective – II shall be chosen from the emerging technologies.**

*****Open Elective III and IV (Shall be chosen from the list of open electives offered by other Programmes**

Elective- Management shall be chosen from the Elective Management courses

##Two weeks industrial training/internship carries one credit. Industrial training/Internship during VI Semester Summer Vacation will be evaluated in VII semester

SEMESTER VIII/VII*

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	PT3811	Internship#/ Project Work	EEC	0	0	20	20	10
			TOTAL	**0**	**0**	**20**	**20**	**10**

***If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.**

#15 weeks of continuous Internship in an organization carries 10 credits.

TOTAL CREDITS : 166

ELECTIVE – MANAGEMENT COURSES

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GE3751	Principles of Management	HSMC	3	0	0	3	3
2.	GE3752	Total Quality Management	HSMC	3	0	0	3	3
3.	GE3753	Engineering Economics and Financial Accounting	HSMC	3	0	0	3	3
4.	GE3754	Human Resource Management	HSMC	3	0	0	3	3
5.	GE3755	Knowledge Management	HSMC	3	0	0	3	3
6.	GE3792	Industrial Management	HSMC	3	0	0	3	3

MANDATORY COURSES I

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3081	Introduction to Women and Gender Studies	MC	3	0	0	3	0
2.	MX3082	Elements of Literature	MC	3	0	0	3	0
3.	MX3083	Film Appreciation	MC	3	0	0	3	0
4.	MX3084	Disaster Management	MC	3	0	0	3	0

MANDATORY COURSES II

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3085	Well Being with traditional practices (Yoga, Ayurveda and Siddha)	MC	3	0	0	3	0
2.	MX3086	History of Science and Technology in India	MC	3	0	0	3	0
3.	MX3087	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0
4.	MX3088	State, Nation Building and Politics in India	MC	3	0	0	3	0
5.	MX3089	Industrial Safety	MC	3	0	0	3	0

PROFESSIONAL ELECTIVE COURSES : VERTICALS

Vertical I **Advanced Polymeric Materials**	Vertical II **Design and Manufacturing**	Vertical III **Processing Technology**	Vertical IV **Management**
Composite Materials	Advanced Mould and Die Design	Advanced Extrusion Processing	Product Design and Cost Estimation
Plastics in Electronics	Additive Manufacturing	Advanced Injection Moulding	Engineering Statistics and Quality Control
Biodegradable Polymers	Fiber technology	Advanced Blow Moulding	Circular Economy and Extended Producer Responsibility
Polymers in Biomedical Engineering	Plastics Packaging Technology	Polyurethane Technology	Pollution, Regulatory Norms and Control equipment
Adhesives, Paints & Coatings	Rubber Technology	Instrumentation and Process Control	Fintech and Block Chain
Polymers in Transportation	Design and Manufacture of Composites	Automation in Polymer Processing	Entrepreneurship Development
Biopolymers and Green Composite	Finite Element Methods	Foam Technology	Intellectual Property Rights (IPR)
Polymer Blends and Alloys	PVC Technology	Machining and Joining of Plastics	Engineering Management

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V and VI. These courses are listed in groups called verticals that represent a particular area of specialisation. Students are permitted to choose all Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to Regulations 2021 Clause 4.10.

PROFESSIONAL ELECTIVE COURSES : VERTICALS

VERTICAL 1: ADVANCED POLYMERIC MATERIALS

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	PT3001	Composite Materials	PEC	3	0	0	3	3
2.	PT3002	Plastics in Electronics	PEC	3	0	0	3	3
3.	PT3003	Biodegradable Polymers	PEC	3	0	0	3	3
4.	PT3004	Polymers in Biomedical Engineering	PEC	3	0	0	3	3
5.	PT3005	Adhesives, Paints & Coatings	PEC	3	0	0	3	3
6.	PT3006	Polymers in Transportation	PEC	3	0	0	3	3
7.	PT3007	Biopolymers and Green Composite	PEC	3	0	0	3	3
8.	PT3008	Polymer Blends and Alloys	PEC	3	0	0	3	3

VERTICAL 2: DESIGN AND MANUFACTURING

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	PT3009	Advanced Mould and Die Design	PEC	3	0	0	3	3
2.	PT3010	Additive Manufacturing	PEC	3	0	0	3	3
3.	PT3011	Fiber technology	PEC	3	0	0	3	3
4.	PT3012	Plastics Packaging Technology	PEC	3	0	0	3	3
5.	PT3013	Rubber Technology	PEC	3	0	0	3	3
6.	PT3014	Design and Manufacture of Composites	PEC	3	0	0	3	3
7.	PT3015	Finite Element Methods	PEC	3	0	0	3	3
8.	PT3016	PVC Technology	PEC	3	0	0	3	3

VERTICAL 3: PROCESSING TECHNOLOGY

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	PT3017	Advanced Extrusion Processing	PEC	3	0	0	3	3
2.	PT3018	Advanced Injection Moulding	PEC	3	0	0	3	3
3.	PT3019	Advanced Blow Moulding	PEC	3	0	0	3	3
4.	PT3020	Polyurethane Technology	PEC	3	0	0	3	3
5.	PT3021	Instrumentation and Process Control	PEC	3	0	0	3	3
6.	PT3022	Automation in Polymer Processing	PEC	3	0	0	3	3
7.	PT3023	Foam Technology	PEC	3	0	0	3	3
8.	PT3024	Machining and Joining of Plastics	PEC	3	0	0	3	3

VERTICAL 4: MANAGEMENT

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	PT3025	Product Design and Cost Estimation	PEC	3	0	0	3	3
2.	PT3026	Engineering Statistics and Quality Control	PEC	3	0	0	3	3
3.	PT3027	Circular Economy and Extended Producer Responsibility	PEC	3	0	0	3	3
4.	PT3028	Pollution, Regulatory Norms and Control equipment	PEC	3	0	0	3	3
5.	PT3029	Fintech and Block Chain	PEC	3	0	0	3	3
6.	PT3030	Entrepreneurship Development	PEC	3	0	0	3	3
7.	PT3031	Intellectual Property Rights (IPR)	PEC	3	0	0	3	3
8.	PT3032	Engineering Management	PEC	3	0	0	3	3

OPEN ELECTIVES

Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories.

OPEN ELECTIVE I AND II
(EMERGING TECHNOLOGIES)

To be offered other than Faculty of Information and Communication Engineering

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OCS351	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2.	OCS352	IoT Concepts and Applications	OEC	2	0	2	4	3
3.	OCS353	Data Science Fundamentals	OEC	2	0	2	4	3
4.	OCS354	Augmented and Virtual Reality	OEC	2	0	2	4	3

OPEN ELECTIVES – III

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS351	English for Competitive Examinations	OEC	3	0	0	3	3
2.	OCE353	Lean Concepts, Tools And Practices	OEC	3	0	0	3	3
3.	OMG352	NGOs and Sustainable Development	OEC	3	0	0	3	3
4.	OMG353	Democracy and Good Governance	OEC	3	0	0	3	3
5.	OME353	Renewable Energy Technologies	OEC	3	0	0	3	3
6.	OME354	Applied Design Thinking	OEC	2	0	2	4	3
7.	OMF351	Reverse Engineering	OEC	3	0	0	3	3
8.	OMF353	Sustainable Manufacturing	OEC	3	0	0	3	3
9.	OAU351	Electric and Hybrid Vehicle	OEC	3	0	0	3	3
10.	OAS352	Space Engineering	OEC	3	0	0	3	3
11.	OIM351	Industrial Management	OEC	3	0	0	3	3
12.	OIE354	Quality Engineering	OEC	3	0	0	3	3
13.	OSF351	Fire Safety	OEC	3	0	0	3	3

		Engineering						
14.	OMR351	Mechatronics	OEC	3	0	0	3	3
15.	ORA351	Foundation of Robotics	OEC	3	0	0	3	3
16.	OAE352	Fundamentals of Aeronautical engineering	OEC	3	0	0	3	3
17.	OGI351	Remote Sensing Concepts	OEC	3	0	0	3	3
18.	OAI351	Urban Agriculture	OEC	3	0	0	3	3
19.	OEN351	Drinking Water Supply and Treatment	OEC	3	0	0	3	3
20.	OEE352	Electric Vehicle technology	OEC	3	0	0	3	3
21.	OEI353	Introduction to PLC Programming	OEC	3	0	0	3	3
22.	OBT352	Biomedical Instrumentation	OEC	3	0	0	3	3
23.	OFD352	Traditional Indian Foods	OEC	3	0	0	3	3
24.	OFD353	Introduction to food processing	OEC	3	0	0	3	3
25.	OPY352	IPR for Pharma Industry	OEC	3	0	0	3	3
26.	OTT351	Basics of Textile Finishing	OEC	3	0	0	3	3
27.	OTT352	Industrial Engineering for Garment Industry	OEC	3	0	0	3	3
28.	OTT353	Basics of Textile Manufacture	OEC	3	0	0	3	3
29.	OPE351	Introduction to Petroleum Refining and Petrochemicals	OEC	3	0	0	3	3
30.	OPE352	Energy Conservation and Management	OEC	3	0	0	3	3
31.	OCH351	Nano Technology	OEC	3	0	0	3	3
32.	OCH352	Functional Materials	OEC	3	0	0	3	3
33.	OEC351	Signals and Systems	OEC	3	0	0	3	3
34.	OEC352	Fundamentals of Electronic Devices and Circuits	OEC	3	0	0	3	3
35.	OBM351	Foundation Skills in integrated product Development	OEC	3	0	0	3	3
36.	OBM352	Assistive Technology	OEC	3	0	0	3	3
37.	OMA352	Operations Research	OEC	3	0	0	3	3
38.	OMA353	Algebra and Number Theory	OEC	3	0	0	3	3
39.	OMA354	Linear Algebra	OEC	3	0	0	3	3

OPEN ELECTIVES – IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS352	Project Report Writing	OEC	3	0	0	3	3
2.	OCE354	Basics of Integrated Water Resources Management	OEC	3	0	0	3	3
3.	OMA355	Advanced Numerical Methods	OEC	3	0	0	3	3
4.	OMA356	Random Processes	OEC	3	0	0	3	3
5.	OMA357	Queuing and Reliability Modelling	OEC	3	0	0	3	3
6.	OMG354	Production and Operations Management for Entrepreneurs	OEC	3	0	0	3	3
7.	OMG355	Multivariate Data Analysis	OEC	3	0	0	3	3
8.	OME353	New Product Development	OEC	3	0	0	3	3
9.	OME355	Industrial Design & Rapid Prototyping Techniques	OEC	2	0	2	4	3
10.	OMF352	Micro and Precision Engineering	OEC	3	0	0	3	3
11.	OMF354	Cost Management of Engineering Projects	OEC	3	0	0	3	3
12.	OAU352	Batteries and Management system	OEC	3	0	0	3	3
13.	OAU353	Sensors and Actuators	OEC	3	0	0	3	3
14.	OAS353	Space Vehicles	OEC	3	0	0	3	3
15.	OIM352	Management Science	OEC	3	0	0	3	3
16.	OIM353	Production Planning and Control	OEC	3	0	0	3	3
17.	OIE353	Operations Management	OEC	3	0	0	3	3
18.	OSF352	Industrial Hygiene	OEC	3	0	0	3	3
19.	OSF353	Chemical Process Safety	OEC	3	0	0	3	3
20.	OML352	Electrical, Electronic and Magnetic materials	OEC	3	0	0	3	3
21.	OML353	Nanomaterials and applications	OEC	3	0	0	3	3
22.	OMR352	Hydraulics and Pneumatics	OEC	3	0	0	3	3
23.	OMR353	Sensors	OEC	3	0	0	3	3
24.	ORA352	Foundation of Automation	OEC	3	0	0	3	3

25.	ORA353	Concepts in Mobile Robotics	OEC	3	0	0	3	3
26.	OMV351	Marine Propulsion	OEC	3	0	0	3	3
27.	OMV352	Marine Merchant Vehicles	OEC	3	0	0	3	3
28.	OMV353	Elements of Marine Engineering	OEC	3	0	0	3	3
29.	OAE353	Drone Technologies	OEC	3	0	0	3	3
30.	OGI352	Geographical Information System	OEC	3	0	0	3	3
31.	OAI352	Agriculture Entrepreneurship Development	OEC	3	0	0	3	3
32.	OEN352	Biodiversity Conservation	OEC	3	0	0	3	3
33.	OEE353	Introduction to control systems	OEC	3	0	0	3	3
34.	OEI354	Introduction to Industrial Automation Systems	OEC	3	0	0	3	3
35.	OBT353	Environment and Agriculture	OEC	3	0	0	3	3
36.	OFD354	Fundamentals of Food Engineering	OEC	3	0	0	3	3
37.	OFD355	Food safety and Quality Regulations	OEC	3	0	0	3	3
38.	OPY353	Nutraceuticals	OEC	3	0	0	3	3
39.	OTT354	Basics of Dyeing and Printing	OEC	3	0	0	3	3
40.	OTT355	Fibre Science	OEC	3	0	0	3	3
41.	OTT356	Garment Manufacturing Technology	OEC	3	0	0	3	3
42.	OCH353	Energy Technology	OEC	3	0	0	3	3
43.	OCH354	Surface Science	OEC	3	0	0	3	3
44.	OPE353	Industrial safety	OEC	3	0	0	3	3
45.	OPE354	Unit Operations in Petro Chemical Industries	OEC	3	0	0	3	3
46.	OEC353	VLSI Design	OEC	3	0	0	3	3
47.	OEC354	Industrial IoT and Industry 4.0	OEC	2	0	2	4	3
48.	OBM353	Wearable devices	OEC	3	0	0	3	3
49.	OBM354	Medical Informatics	OEC	3	0	0	3	3

SUMMARY

B.TECH. PLASTIC TECHNOLOGY										
S.No	Subject Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII/VIII	VIII/VII	
1	HSMC	4	3					5		12
2	BSC	12	10	4	2					28
3	ESC	5	13	5	3					27
4	PCC			14	15	4.5	4.5	8		46
5	PEC					12	12			24
6	OEC						3	9		12
7	EEC	1		1		2	2	2	10	17
8	Non-Credit /(Mandatory)					√	√			
Total		22	26	24	20	18.5	21.5	24	10	166

Enrollment for B.E. / B. Tech. (Honours) / Minor degree (Optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E./B.Tech. (Honours) Minor degree.

For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.

For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also.

Complete details are available in clause 4.10 of Regulations 2021.

VERTICALS FOR MINOR DEGREE (In additions to all the verticals of other programmes)

Vertical I Fintech and Block Chain	Vertical II Entrepreneurship	Vertical III Public Administration	Vertical IV Business Data Analytics	Vertical V Environment and Sustainability
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics For Management	Sustainable infrastructure Development
Fundamentals of Investment	Team Building & Leadership Management for Business	Constitution of India	Datamining For Business Intelligence	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity & Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials
Introduction to Blockchain and its Applications	Principles of Marketing Management For Business	Administrative Theories	Marketing And Social Media Web Analytics	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Indian Administrative System	Operation And Supply Chain Analytics	Green Technology
Introduction to Fintech	Financing New Business Ventures	Public Policy Administration	Financial Analytics	Environmental Quality Monitoring and Analysis
-	-	-	-	Integrated Energy Planning for Sustainable Development
-	-	-	-	Energy Efficiency for Sustainable Development

(Choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)

VERTICAL 1: FINTECH AND BLOCK CHAIN

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG331	Financial Management	PEC	3	0	0	3	3
2.	CMG332	Fundamentals of Investment	PEC	3	0	0	3	3
3.	CMG333	Banking, Financial Services and Insurance	PEC	3	0	0	3	3
4.	CMG334	Introduction to Blockchain and its Applications	PEC	3	0	0	3	3
5.	CMG335	Fintech Personal Finance and Payments	PEC	3	0	0	3	3
6.	CMG336	Introduction to Fintech	PEC	3	0	0	3	3

VERTICAL 2: ENTREPRENEURSHIP

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG337	Foundations of Entrepreneruship	PEC	3	0	0	3	3
2.	CMG338	Team Building & Leadership Management for Business	PEC	3	0	0	3	3
3.	CMG339	Creativity & Innovation in Entrepreneurship	PEC	3	0	0	3	3
4.	CMG340	Principles of Marketing Management For Business	PEC	3	0	0	3	3
5.	CMG341	Human Resource Management for Entrepreneurs	PEC	3	0	0	3	3
6.	CMG342	Financing New Business Ventures	PEC	3	0	0	3	3

VERTICAL 3: PUBLIC ADMINISTRATION

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG343	Principles of Public Administration	PEC	3	0	0	3	3
2.	CMG344	Constitution of India	PEC	3	0	0	3	3
3.	CMG345	Public Personnel Administration	PEC	3	0	0	3	3
4.	CMG346	Administrative Theories	PEC	3	0	0	3	3
5.	CMG347	Indian Administrative System	PEC	3	0	0	3	3
6.	CMG348	Public Policy Administration	PEC	3	0	0	3	3

VERTICAL 4: BUSINESS DATA ANALYTICS

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG349	Statistics For Management	PEC	3	0	0	3	3
2.	CMG350	Datamining For Business Intelligence	PEC	3	0	0	3	3
3.	CMG351	Human Resource Analytics	PEC	3	0	0	3	3
4.	CMG352	Marketing And Social Media Web Analytics	PEC	3	0	0	3	3
5.	CMG353	Operation And Supply Chain Analytics	PEC	3	0	0	3	3
6.	CMG354	Financial Analytics	PEC	3	0	0	3	3

VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CES331	Sustainable infrastructure Development	PEC	3	0	0	3	3
2.	CES332	Sustainable Agriculture and Environmental Management	PEC	3	0	0	3	3
3.	CES333	Sustainable Bio Materials	PEC	3	0	0	3	3
4.	CES334	Materials for Energy Sustainability	PEC	3	0	0	3	3
5.	CES335	Green Technology	PEC	3	0	0	3	3
6.	CES336	Environmental Quality Monitoring and Analysis	PEC	3	0	0	3	3
7.	CES337	Integrated Energy Planning for Sustainable Development	PEC	3	0	0	3	3
8.	CES338	Energy Efficiency for Sustainable Development	PEC	3	0	0	3	3

MA3391 **PROBABILITY AND STATISTICS** **L T P C**
3 1 0 4

OBJECTIVES

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

UNIT I PROBABILITY AND RANDOM VARIABLES **9 + 3**

Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions – Functions of a random variable.

UNIT II TWO- DIMENSIONAL RANDOM VARIABLES **9 + 3**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III ESTIMATION THEORY **9 + 3**

Unbiased estimators - Efficiency - Consistency - Sufficiency - Robustness - Method of moments - Method of maximum Likelihood - Interval estimation of Means - Differences between means, variations and ratio of two variances

UNIT IV NON- PARAMETRIC TESTS **9 + 3**

Introduction - The Sign test - The Signed - Rank test - Rank - sum tests - The U test - The H test - Tests based on Runs - Test of randomness - The Kolmogorov Tests .

UNIT V STATISTICAL QUALITY CONTROL **9 + 3**

Control charts for measurements ($\bar{X}$ and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL: 60 PERIODS

OUTCOMES:

Upon successful completion of the course, students will be able to:

- Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
- Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.
- Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

TEXT BOOKS

1. Johnson. R.A., Miller. I.R and Freund . J.E, " Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2016.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata Mc Graw Hill, 4th Edition, 2007.
3. John E. Freund, "Mathematical Statistics", Prentice Hall, 5th Edition, 1992.

REFERENCES:

1. Gupta. S.C. and Kapoor. V. K., “Fundamentals of Mathematical Statistics”, Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences”, Cengage Learning, New Delhi, 8th Edition, 2014.
3. Ross. S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 5thEdition, Elsevier, 2014.
4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum’s Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 4th Edition, 2012.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9th Edition, 2010.

PT3301 FUNDAMENTALS OF CHEMICAL ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To learn the fundamental operation involved in chemical engineering
- To attain the knowledge in the subject of fluid flow
- To gain the ideas in the field of heat transfer operation
- To learn the mass diffusion in polymers by the study or mass transfer operations
- To acquire knowledge about various unit operations

UNIT I FLUID FLOW 9

Fluid Flow: Newtonian and Non-Newtonian fluid - Bernoulli’s theorem-Hagen Poisuille equation, measurement of fluid flow- orifice meter, venturi meter and pitot tube.

UNIT II MECHANICAL OPERATIONS 9

Properties of solids - Sieve analysis; Laws of crushing, Crushers and grinders. Principle of separation and selection and details of equipment for screening, cyclones and hydro cyclones (Basic principles and equipment description only. Mathematical consideration not required)

UNIT III HEAT TRANSFER 9

Modes of heat transfer; Heat transfer by conduction - Fourier’s law, conduction across composite walls. Heat transfer by natural & forced convection. Co current, counter current, shell & tube heat exchangers (Basic principles and equipment description only. Mathematical consideration not required)

UNIT IV MASS TRANSFER 9

Principles of diffusion, theory of diffusion, Two film theory and mass transfer coefficients Humidification - operation, humidity chart, equipment’s - cooling towers and spray chambers Drying - Principles and definitions. Rate of batch drying- Equipment for drying (Basic principles and equipment description only. Mathematical consideration not required)

UNIT V UNIT OPERATIONS 9

Absorption - Principle and equipment (packed towers and plate columns). Distillation - flash distillation, and Binary distillation. Industrial equipment for distillation Adsorption - Principle and equipment for adsorption. (Basic principles and equipment description only. Mathematical consideration not required)

TOTAL: 45 PERIODS

OUTCOMES

On completion of the course, students

- Will attain the knowledge in fluid flow behaviors and mechanical separation.
- Will understand the conduction and convection modes of heat transfer.
- Will understand the concept of distillation equipment in the process industries.
- Will increase the ability of the student over the fundamentals of chemical engineering
- Will acquire knowledge in various Unit Operations for Polymer processing

TEXT BOOKS:

1. W.L .Mc Cabe, J.C. Smith, “Unit Operations of Chemical Engineering”, McGraw-Hill,7th edition 2014.
2. Shri. K.A. Gavhane, “Unit Operations I & II”, NiraliPrakashan Publication, 2015.
3. Ghosal, S.K., Sanyal, S.K., Datta, S., “Introduction to Chemical Engineering”, Tata McGraw-Hill Publishing Company Ltd., New Delhi(1997).

REFERENCES:

1. Richardson and Coulson, “Chemical Engineering”, Vol. 1, Elesvier , 6th Edition 2006.
2. Anderson, L.B., Wenzel, L.A., “Introduction to Chemical Engineering", McGraw-Hill Book Company, Inc., New York (1961).

PT3302 PLASTICS MATERIALS I L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To learn about the general methods of preparation of individual class of plastics Materials
- To study about the general properties, processing behavior and applications of different Class of plastics materials
- To understand about the structure- property relation of different class of plastics materials.
- To make the student familiar about properties and end application of different plastics materials
- To apply knowledge of thermoplastics for industrial applications.

UNIT I INTRODUCTION 9

Basic chemistry of polymers-nomenclature of polymers sources for raw materials. Methods of manufacturing –properties and applications of Natural Polymers - Shellac resin and natural rubber-Cellulosics-Cellulose nitrate, cellulose acetate, cellulose acetate butyrate, Ethyl cellulose and others.

UNIT II COMMODITY THERMOPLASTICS-I 9

Preparation- properties - and applications of Polyolefin-Polyethylene- LDPE -LLDPE- HDPE, HMWHDPE- UHMWHDPE–Cross-linked polyethylene- Chlorinated polyethylene –Polypropylene – Homo & Co polymer

UNIT III COMMODITY THERMOPLASTICS-II 9

Preparation - properties - and applications of Vinyl plastics - Polyvinyl chloride, C-PVC, Polyvinyl Acetate, Polyvinylidene chloride, polyvinyl alcohol. Polystyrene

UNIT IV GENERAL PURPOSE THERMOSETS 9

Preparation - properties - and applications of: Phenol formaldehyde (PF), Amino plastics: Urea50formaldehyde (UF) - Melamine formaldehyde (MF), unsaturated polyesters, Alkyd resins

UNIT V ENGINEERING PLASTICS & ITS APPLICATIONS - I 9

Preparation- properties - and applications: Styrene copolymers–High Impact Polystyrene (HIPS), Acrylonitrile Butadiene Styrene (ABS), Styrene acrylonitrile (SAN), Acrylic plastics–Polymethyl Methacrylate, Polyacrylonitrile , Ethylene Vinyl Acetate (EVA).

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will familiarize in natural polymer properties and its applications
- Will acquire skills in selecting additives for plastic materials for specific applications
- Will have knowledge of manufacturing, properties and applications of poly olefins.
- Will have knowledge of manufacturing, properties and applications of vinyl halogenated olefin based plastic materials
- Will have knowledge of manufacturing, properties and applications of special purpose plastics

TEXT BOOKS:

1. J. A. Brydson, “Plastics Materials”, Butterworth- Heinemann - Oxford, 7th Ed., 2001.
2. Feldman.D and Barbalata. A, “Synthetic Polymers”, Chapman Hall, 1996.

REFERENCES:

1. V.R. Gowariker, “Polymer Science” – New Age International (P) Ltd, Publishers
2. Olagoke Olabisi, “Hand Book of Thermoplastics”, Marcel Decker, inc., 1997
3. K.J. Saunders, “Organic Polymer chemistry”, Chapman & Hall, NY, 1988.
4. Irvin.I. Rubin, “Hand Book of Plastic Materials and Technology”, Wiley Interscience, NY, 1990.
5. Charles Gebelein, Biotechnological Polymers: Medical, pharmaceutical and industrial applications, CRC press, 1993.

PT3303 POLYMER CHEMISTRY L T P C
3 0 0 3

OBJECTIVES:

To make the student conversant with

- The basic concepts of polymers, classification of polymers, copolymer types and tactility.
- The kinetics & mechanism of different types addition polymerization and free radical copolymerization
- The kinetics & mechanism of two types of condensation polymerization and ring-opening polymerization
- the various types of polymerization techniques
- the molecular weight and its distribution and different methods of molecular weight determination.

UNIT I BASIC CONCEPTS OF POLYMERS 9

Basic concepts of polymers – - Monomers -degree of polymerization– significance of functionality – classification of polymers based on **:**source, structure, thermal processing behaviour, composition and structure, mechanism, intermolecular forces – nomenclature of polymers –tacticity – copolymers and its types **:**alternate, random, block and graft copolymers.

UNIT II ADDITIONPOLYMERISATION 9

Kinetics and mechanism of free radical polymerization: chain transfer, Inhibition and retardation– Kinetics and mechanism of cationic polymerisation and anionic polymerisation–livingpolymers– Ziegler-Nattacatalysts–coordinationpolymerisation–kineticsoffreeradicalcopolymerisation – copolymer equation – monomer reactivity ratio and its significance.

UNIT III CONDENSATIONPOLYMERISATION 9

Kinetics of poly-condensation reactions (acid catalysed and self-catalysed) – ring-opening polymerization – multi chain polymerization: branching, cross-linking–step-wisecopolymerization–methodsofsynthesizingcopolymers**:** statistical, alternate and block copolymers.

UNIT IV POLYMERISATIONTECHNIQUES 9

Classification of polymerisation techniques: homogenous and heterogeneous polymerisation – bulk or mass polymerisation – Tromms droff effect – solutionpolymerisation–suspensionpolymerisation–emulsionpolymerisation–interfacialpolymerisation–meltpolycondensation. Advanced Polymerization Techniques - Atom Transfer Radical Polymerization (ATRP), Group Transfer Polymerization (GTP), Reversible Addition Fragmentation Termination (RAFT).

UNIT V MOLECULARWEIGHTANDITSDISTRIBUTION 9

Molecular weight of polymer – number, weight and viscosity average molecular weights – molecular weight distribution (problems) – molecular weight determination: end-group analysis, colligative properties, osmometry, light scattering, gel permeation chromatography and viscometry.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Classify polymers based on various criteria and also name the polymers using proper nomenclature.
- Derive the rate equations and explain the mechanism of addition polymerisation reactions.
- Derive the rate equations and explainthe mechanism of condensation polymerisation reactions.
- Describe the various polymerisation techniques.
- Elaborate on methods of molecular weight determination and calculate molecular weight of polymers

TEXTBOOKS:

1. FredW.BillMeyer‘TextbookofPolymerScience’JohnWiley&Sons, 2008.
2. George Odian, Principles of Polymerisation, 3rdEdition,McGraw HillBook Company,NewYork,1991.
3. Ravve, Principles of PolymerChemistry,Springer-VerlagNewYork,2012.
4. V.R. Gowariker, —Polymer Science – New Age International (P) Ltd, Publishers
5. JoelR.Fried,“PolymerScienceandTechnology”,PrenticeHall,2014.
6. Premamoy Ghosh‘Polymer Science and Technology’TataMcGraw–Hill, 2011.
7. Charles E.Carraher Jr. Introduction to Polymer Chemistry, Fourth Edition, CRC Press,2017.

REFERENCES:

1. HermanF.Mark,“EncyclopediaofPolymerScienceandTechnology”,WileyInterscience;3rd Edition,2004.
2. R. J. Samuels, “Structured Polymer Properties”, John Wiley & Sons, NewYork, 1974.
3. Premamoy Ghosh, —Polymer Science and Technology of Plastics and Rubbers‖, Tata McGraw- Hill, New Delhi, 1990.
4. AndrewJ. Peacock and Allison Calhoun, Polymer Chemistry: Properties and Application,Carl Hanser VerlagGmbH&Company,2012.
5. RobertJ.Young, Peter A.Lovell, Introduction to Polymers,ThirdEditionCRCPress,2011.

PT3304	POLYMER PHYSICS	L T P C 3 0 0 3

OBJECTIVES:

- To make the students understand physical and conformational properties of polymeric materials.
- To know the molecular arrangement in polymers and their orientation under the influence of stress.
- To know the solubility behavior of polymers.

UNIT I FUNDAMENTALS OF POLYMER PHYSICS 9

Potential energy and conformational energy of molecules - conformations and configurations, Tacticity, isomeric states and isomerism in polymers, stereoisomerism, geometric isomerism - Random coils and average end to end distance - (Derivation only)

UNIT II THERMODYNAMIC PROPERTIES 9

Laws of Thermodynamics - Freely jointed and freely rotating chain models - Entropy and enthalpy Energy driven and entropy driven elasticity - Thermo elasticity -Thermodynamic treatment - entropic and energetic contributions (Derivation only).

UNIT III POLYMER CRYSTAL FORMATION 9

Amorphous State - Transition temperatures- Glass transition temperature Theory- Factors influencing glass transition Temperature- Crystalline State - polymorphism – Polymer single crystals, lamellae, spherulites – Crystallinity -factors affecting crystallinity -X-ray diffraction.

UNIT IV CHAIN ORIENTATION 9

Chain orientation - Concept of chain orientation - orientation in amorphous and crystalline polymers - Uniaxial and biaxial orientation practical significance – Orientation processes: spinning Process – Optical Properties of polymers – Birefringence, Haze, Transparency.

UNIT V POLYMER SOLUTIONS 9

Polymer solutions - Terms and definitions, types of solutions - Hildebrand approach, Flory Huggins theory - Thermodynamic view of miscibility, upper critical solution temperature (UCST), lower critical solution temperature (LCST) - solubility parameter, determination of solubility parameter of polymers - theta conditions.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will understand molecular arrangement in polymers.
- Will able to demonstrate the orientation processes in polymer.
- Will acquire the knowledge in solubility behavior of polymers.

TEXT BOOKS:

1. Ulf W. Gedde, Polymer Physics, Springer – Science +Business Media, B.V. 1st Edition, 43 2001.
2. S. Glasstone and D. Lewis, Elements of Physical Chemistry, Textbook Publishers, 2003.

REFERENCES:

1. Michael Rubinstein, R. H. Colby, Polymer Physics – Oxford University Press, 2003.
2. Ulrich Eisele, Introduction to Polymer Physics, Springer 1990.

PT3305 SOLID MECHANICS OF TECHNOLOGISTS L T P C
3 0 0 3

OBJECTIVES:

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.
- To apply the mathematical knowledge to calculate the deformation behavior of beams.
- To understand the effect of torsion on shafts and springs.
- To analyze a complete two dimensional state of stress.

UNIT I STATICS OF PARTICLES 9

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectorial representation of forces – Vector operations of forces - additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .

UNIT II EQUILIBRIUM OF RIGID BODIES 9

Free body diagram – Types of supports –Action and reaction forces – stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT III DEFLECTION OF BEAMS 9

Double integration method - Macaulay's methods - Area moment method - conjugate beam method for computation of slopes and deflections of determinant beams.

UNIT IV TORSION 9

Torsion of Circular and Hollow Shafts – Stresses and Deflection in Circular Solid and Hollow Shafts – strain energy due to torsion – Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – Springs in series and parallel.

UNIT V THIN CYLINDERS AND THEORIES OF FAILURE 9

Thin cylinders – Stresses in thin cylindrical shell due to internal pressure – circumferential and longitudinal stresses - Theories of failure - maximum Principal stress - maximum Principal strain - Shear stress - Total strain energy - Energy distortion theories.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the student will be able to

- Illustrate the vectorial and scalar representation of forces and moments
- Analyse the rigid body in equilibrium
- Ability to apply the mathematical knowledge in determining the deformation behavior of beams
- Thorough understanding of the effect of torsion on shafts and springs.
- Ability to analyze a complex two dimensional state of stress and to analyze the failure mode.

TEXT BOOK

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2007
2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2007

REFFERENCE BOOK

1. Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2001

2. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2007.
3. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2007
4. Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 2005.

PT3311 CHEMICAL ENGINEERING LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- To train on various techniques for reducing and separating of particles, flow properties of fluids.

LIST OF EXPERIMENTS:

1. To determine the pipe friction using Flow through rough and smooth pipes.
2. To determine the efficiency of pump using Centrifugal pump.
3. To determine the coefficient of discharge of orifice meter.
4. To find the efficiency of Air compressor
5. To Calibrate the rotameter
6. To find the Pressure drop in packed bed
7. To study the concept of Fluidization by using fluidized bed
8. To determine the coefficient of discharge of Venturi meter
9. To find the Thermal conductivity of solids.
10. To find overall heat transfer coefficient of the Heat exchanger
11. To find the Stefan-Boltzman constant
12. To find the new surface area created by Jaw crusher
13. To find the critical speed of Ball Mill
14. To find the Screening efficiency.
15. To separate the component by Simple distillation
16. To separate the component by using steam distillation
17. To find the Particle size and Surface area of filler particles.

(Any nine Experiments) **TOTAL: 60 PERIODS**

OUTCOMES:

Upon completing this course, the students

- Will be able to apply the different technique for size reduction
- Will attain skill in function of fluid pressure apparatus.

REFERENCES:

1. W.L .Mc Cabe, J.C. Smith, "Unit Operations of Chemical Engineering", McGraw-Hill,7th Edition, 2005. 2. W.L.Badger, J.T. Banchero. "Introduction to Chemical Engineering", McGraw-Hill, UK, 1st Edition, 2002.

PT3312 **POLYMER CHEMISTRY LAB** **L T P C**
0 0 4 2

COURSEOBJECTIVES:

- To develop an understanding on various methods of polymerization and its structure property relationship.
- To equip with the fundamental knowledge of mechanism of polymerization and various process parameters affecting the polymerisation technique

PRACTICALS

List of Experiments:

1. Preparation of phenol-formaldehyde (Novolac) resin.
2. Preparation of phenol-formaldehyde (Resol) resin.
3. Preparation of urea-formaldehyde resin.
4. Preparation of bisphenol–A epoxy resin.
5. Preparation of unsaturated polyester resin.
6. Preparation of polyester using diethylene glycol & adipic acid.
7. Bulk polymerization of styrene.
8. Emulsion polymerization of styrene.
9. Solution polymerization of acrylonitrile.
10. Solution polymerization of vinyl acetate.
11. Suspension polymerization of methylmethacrylate.
12. Copolymerization of styrene and methylmethacrylate

(Any nine Experiments) **TOTAL: 60 PERIODS**

OUTCOMES:

- Develop new polymers and chemically modify the existing polymers based on specific property requirements
- Select a suitable technique for synthesizing polymers for advance applications

TEXTBOOKS:

- Sabu Thomas, Deepalekshmi Ponnamma, Ajesh K. Zachariah,"Polymer Processing and Characterization: 1 (Advances in Materials Science)",Apple Academic Press;1edition,January31,2013.
- V. A. Bershtein, G. C. Berry, etal,"Polymer Analysis and Characterization (Advances in Polymer Science)",2013.
- T.R.Crompton,"PracticalPolymerAnalysis",2012.
- Joseph D. Menczel, R. Bruce Prime, "Thermal Analysis of Polymers", Fundamentals and Applications",Wiley; 1edition, April20,2009.
- Characterization and Analysis of Polymers, by Wiley,2008.

PT3401 ADDITIVES AND COMPOUNDING L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To know various draw backs of polymer materials and suitable remedies.
- To understand various additives used in polymers
- To understand the mechanism of degradation of polymers and chemistry of stabilizing additives
- To know the various compounding methodologies for plastics materials
- To learn the house keeping and maintenance of compounding machinery.

UNIT I FILLERS/ REINFORCEMENTS, STABILIZERS, PIGMENTS 9

Fillers and Reinforcement–Antioxidants-Thermal Stabilisers, Ultraviolet stabilizer– Impact Modifiers/ toughening agents. Colourants-Fire retardants-Coupling agents-blowing-agents

UNIT II ADDITIVES FOR PROCESSING 9

Plasticizers- Antistatic agents-Anti blocking agents-Slip and anti slip agents-processing aids - Lubricants- mould releasing agents Additives for recycling.

UNIT III FUNDAMENTALS OF COMPOUNDING 9

Compounding-Selection of polymers and compounding-ingredients-general objectives- Merits and demerits of additives in polymer matrices. Mixing and mixing equipments. Compounding by batch mixer-High speed mixer-Two roll mill - Banbury Mixer - Ribbon blender - Planetary mixers.

UNIT IV COMPOUNDING MECHANISMS 9

Compounding Machineries specifications - temperature control system – operating characteristics and working details of continuous mixers - - Single Screw extruder - Twin Screw extruder-housekeeping and maintenance of compounding machines.

UNIT V CASE STUDIES 9

Case studies on preference of one plastics to other and co-relation of properties of conventional materials and blends and alloys - case studies on application of blends and alloys.

TOTAL: 45 PERIODS

OUTCOMES:

- Students will have clear understanding of various types of additives for plastics and their merits and demerits.
- Students can learn about various compounding methods used in the manufacturing of compounded thermoplastics and thermosets.

TEXT BOOKS:

1. Al – Malaika; S. Golovoy; A and Wilkie (Eds), Chemistry and Technology of Polymer Additives, Black well Science Ltd, Oxford (1999).
2. Matthews; F.L. and Rawlings; R.D, Composite Materials, Engineering and Science Chairman and Hall, London (1994).
3. Plastics Testing Technology Hand Books by Vishu Shah, 1984.

REFERENCES:

1. Hand Book of Plastics Test Methods by Brown R.P, 1989.
2. Mascia; L., The Role of Additives in Plastics, Edward Arnold Publishers Ltd., U. K. (1974).
3. Murphy; John, Additives for Plastics Handbook, 2nd Edition, Elsevier Advanced Technology, Oxford, 2001.
4. R. Gachter and H. Muller, Plastics Additives Hand Book, Hanser Publishers, Munich, 1993.

PT3402 POLYMER RHEOLOGY AND FLUID MECHANICS L T P C
3 0 0 3

OBJECTIVES:

To understand the basic concepts of rheology

- To analyze the flow behavior of polymer melts and to carry out the experimental techniques for measuring the rheological properties.
- To understand the basics of fluid mechanism and to analyze behavior of Newtonian fluids.
- To experimental with instruments such as orifice meter, venturi meter and Pitot tube.

UNIT I INTRODUCTION 9

Introduction and Basic concepts of Rheology, classification of fluids, Newtonian and non Newtonian fluids, shear stress, shear strain and shear rate, shear modulus, bulk modulus, Zero shear viscosity, Dependence of viscosity with temp, shear stress , Viscoelasticity - effect of rate of strain, temperature and time on mechanical behaviour of polymeric materials

UNIT II POLYMER RHEOLOGY 9

Mechanical models - stress strain response of spring and dashpot - visco elastic models -Maxwell element - Voigt kelvin element - response to creep and stress relaxation -four parameter model - Boltzman principle - time temperature super position principle - WLF equation.

UNIT III MEASUREMENT OF POLYMER VISCOSITY 9

Viscosity of polymer melts – dieswell and melt fracture - Weissenberg effect - Elongational viscosity. Measurements of rheological properties - capillary rheometers – cone and plate viscometer - Oscillating disc rheometer - Mooney viscometer.

UNIT IV FLUID PROPERTIES 9

Units and dimensions-Properties of fluids-mass density, specific weight, specific volume, specific gravity, viscosity, surface tension and capillarity-Terminologies of fluid flow-Laminar and turbulent flow of Newtonian fluids-Power law-Reynolds number and its significance

UNIT V FLUID FRICTION AND FLOW MESUREMENT 9

Bernoulli's equation–kinetic energy correction factor; head loss; friction factor; major and Minor losses- Flow measurement: Introduction; Orifice meter; Venturi meter; concept of area meters: rotameter; Local velocity measurement: Pitot tube.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, students

- Will have thorough knowledge on the basic concepts of rheology.
- Will able to analyze the mechanical behavior of polymers under applied load.
- Will carry out the experimental techniques for measuring the rheological properties.
- Will understand the basics of fluid mechanics and to analyze the behavior of Newtonian fluids.
- Will be able to the instruments such as orifice meter, venturi meter & pitot tube.

TEXT BOOKS:

1. J.A.Brydson, Flow properties of polymer melts, life books, London, 1981.
2. R.J. Crawford, Plastics Engineering, Butterworth - Heinemann, Oxford, 2002, 3rd edition
3. Dr. R. K. Bansal, "A Textbook of Fluid mechanics and Hydraulic Machines", 9th edition, 2017

REFERENCES:

1. P.N.Cogswell, Polymer Melt Rheology, A guide for Industrial Practice, George Godwin,1981.

2. Richard C. Progelh of and James L. Throne, Polymer Engineering Principles, Hanser Publishers, New York, 1998.
3. John M. Dealy and Kurt F. Wissburn, Melt rheology and its role in plastics processing, Chapman, London, Oct 3rd, 2013.
4. R.S. Lenk, Polymer Rheology, Applied Science, London, 2012.
5. J.D. Ferry, Viscoelastic Properties of Polymers, john Wiley & Sons, New York, 1986.
6. Chang Dae Han. Rheology in Polymer Processing, Academic Press, New York, 1976

PT3403 PLASTICS MATERIALS II L T P C
3 0 0 3

OBJECTIVES:

- To learn about the general methods of preparation of individual class of plastic materials
- To study the general properties, processing behavior of plastics materials.
- To provide the knowledge in applications of different class of plastics materials.
- To make the student familiar about specialty polymers properties and end application.
- To understand the role of polymer blends & alloys in current scenario.

UNIT I ENGINEERING PLASTICS & ITS APPLICATIONS – II 9

Preparation-properties - and applications: Polyamides-Nylons 6, (6,6), (6,10), 11, 12, Polyesters–Polyethylene terephthalate, polybutylene terephthalate, Polycarbonate, Polyacetals.

UNIT II HIGH PERFORMANCE PLASTICS - I 9

Preparation -properties-and applications: Aromatic ether-Polypheneylene oxide (PPO), Aromatic thioether - Polyphenylenesulphide (PPS), Polysulfone, Aromatic polyamides

UNIT III HIGH PERFORMANCE PLASTICS - II 9

Preparation-properties-and applications: Polyimides (PI) Polyamideimide (PAI), Polyimidazoles, Fluoropolymers–Polyvinyl fluoride (PVF), Polyvinylidene fluoride (PVDF), Polytetrafluoroethylene (PTFE), Polychlorotrifluoroethylene (PCTFE).

UNIT IV WATER SOLUBLE POLYMERS AND BIO DEGRADABLE POLYMERS 9

Preparation- properties and applications of Biodegradable polymers-poly ξ–caprolactone - polylactic acid- Bacterial polyhydroxyalkonates.–polyvinylpyrrolidone–polyacrylic acid and its homolog's – polyacrylamide –polyethylene oxide – polyethylene amine-Polyvinyl alcohol

UNIT IV ENGINEERING AND SPECIALITY THERMOSETS 9

Preparation - properties - and applications of: Epoxy Plastics, Polyurethane (PU) Silicones

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will have the knowledge of manufacturing methods, properties of special purpose polymers applied in special application
- Will have knowledge of manufacturing methods and correlate the high performance polymer properties for special purpose
- Will acquire skills in selection of conducting polymer to suitable application
- Will have the knowledge of manufacturing methods, properties and applications of ionic polymers
- Will have the knowledge of manufacturing methods, properties and applications of watersoluble and bio degradable polymers

TEXT BOOKS:

1. Plastic Materials Ed 7 - By Brydson, J A,1999.
2. Hand Book of Plastics Materials & Technology - By Rubin, Irwin, J,1990.

3. Manas Chanda, Salil.K.Roy, “Plastics Technology Hand book”, 2nd edition, Marcel Dekker, New York, 1993.
4. Matrin.T.Goosey, “Plastics for Electronics”, Elsevier, Applied Science, 1985.
5. R.W. Dyson, “Specialty Polymers”, Chapman & Hall, 2nd edition, 1998.

REFERENCES:

1. Plastics Engineering Hand Book Ed. 5 & Society of the Plastic Industry Inc - By SPI,1994.
2. Plastics Materials and Processing - By Schwartz & Goodman,1982.
3. Plastics Materials (Properties & Application) - By Birley & Scott,1982.
4. Modern Plastics Hand Book - By Harper,2000..
5. Birley; Arthur W. and Scott; Martyn J., Plastics Materials: Properties and Applications, Leonard Hill, Blackie and Sons Ltd., 1982.
6. Biron; Michel, Thermoplastics and Thermoplastic Composites: Technical Information for Plastics Users, Elsevier, Amsterdam, 2007.
7. DuBois; P, Plastics in Agriculture, Applied Science Publishers Ltd., London 1978
8. H.F.Mark, (Ed), “Encyclopedia of polymer Science & Engineering”, John Wiley & Sons, New York, 1989.
9. Johannes Karl Fink, ‘Handbook of Engineering and SpecialityThermoplastics’, Volume 10, Water Soluble Polymers, John Wiley & Sons, New Jersy, 2011.
10. David Kaplan, “Biopolymers from renewable resources” ,Springer,1998.

PT3404 PLASTIC MOULD AND DIE TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge on various Molds types, Mold making and Material of mold selection.
- To develop the knowledge on elements of the mould and manufacturing processes.
- To learn the application of additive manufacturing in mould development
- To acquire skills in advanced measuring instruments for inspection of mold

UNIT I BASIC MOLD TYPES, TOOL MAKING PROCESSES AND MATERIALS 9

Introduction to Molds - Classification - Working Principle and Construction - Types and making processes – Materials for mold making - Injection molding machine, Compression mold, Continuous extrusion mold and Blow molding – General mold types – Other tools for plastics, Cut off Equipments – Metal Cutting process – Metal displacement process – Casting Process– Step in Mold Finishing & References –Steel & Steel forging – Machinability – Heat treatment – Annealing Stainless Steel Steels for machined molds- Tool steel castings

UNIT II INJECTION MOLDS 9

Introduction to Injection Molding - Classification - Working Principle and Construction – Materials for Transfer mold – Product design considerations – Runner systems, Gating Transfer mold – injection molds for thermoset materials – Transfer Pressure – Runnerless Injection-compression molds – Encapsulation. Injection equipment – Projected area press capacity – Hot manifold system for thermoplastics – Hot edge gating – Venting – Cooling – Sprue Bushings and pullers – Cavities - Stander mold Base – Types of operation

UNIT III BLOW MOLDING AND EXTRUTION MOLDS 9

Introduction - theory of Blow mold - Working Principle and Construction – Plastic blow molding processing – Extrusion Blow molding materials design and construction – Extrution Blow molding Fabrications – Design of Extrution Blow molding – Injection Blow molding Design and Construction – Bottle Finishing – Container Terminology - Manufacturing of mould elements.

UNIT IV COMPRESSION MOLDS 9

Introduction to Compression molds - Working Principle and Construction – Design of hand molds – Design of 12 cavity semiautomatic mold – Spring Box Mold – Loading Shoe and Stripper plate molds – Positive Molds – Semi-positive mold – Mold Assembly – Automatic Compression Molds – Special Design Features – Side Ram Molds.

UNIT V REACTION INJECTION AND MAINTENANCE MOLD 9

Introduction to Design mold, Care and Maintenance - Working Principle and Construction – Principles and rule of design for mold – Engineering and design procedure – Dimension and mold drawings – Mold stamping – Structural Foam Products – Steam Chests – Causes of wear and damage – Preventive maintenance of molds.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- will have the knowledge in Molds Tools and mould manufacturing
- will acquire skills Types of molds
- will acquire skills in advanced measuring equipment for inspection of mold

TEXT BOOKS:

1.DuBois J. Harry : Plastics Mold Engineering Handbook (English, Paperback, Springer-Verlag New York Inc.4th Edition November 2013

2.Klus S DuBois J. Harry, Plastics Mold Engineering Handbook (English, Paperback, , Hanser Publishers, NY, 3rd Edition 2013

REFRENCES:

1. Peter Jones, “The Mould Design Guide”, Smithers Rapra Technology Ltd., 2008
2. R.G.W.Pye, Injection Mold Design, East West Press Pvt. Ltd., New Delhi.,2000.
3. Hajra Chouldnary S.K and Hajra Choudhury. AK., "Elements of workshop Technology", volume II, Media promoters and Publishers Private Limited, Mumbai, 2010.
4. Peter Jones, “The Mould Design Guide”, Smithers Rapra Technology Ltd., 2008.
5. W.A.J Chapman, Workshop Technology, Vol I & II, ELBS.
6. Herbert Rees, Mold Engineering, Hanser Publishers, NY.,2002.
7. George Menges & Paul Mohren, How To Make Injection Molds, Hanser Publishers,2001.
8. Douglas M. Bryce, Plastic Injection Molding manufacturing process fundamentals, Society of Manufacturing Engineers, Dearborn, Michigan.,1996.
9. Jain R K ,” Engineering Metrology” , 19th Edition , Khanna Publishers , 2005.
10. Gaylor, Shotbolt and Sharp, Metrology for Engineers, Publisher: O.R.Cassel, London,1993.

PT3405 PLASTICS PROCESSING L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To understand the various processing techniques of plastic materials.
- To learn the fundamentals and compression molding and transfer molding of thermoset plastics.
- To learn the basic processing of thermoplastics by injection molding, extrusion and blow moulding.

UNIT I INTRODUCTION 5

Basic principles of processing - shape and size – Effect of polymer property on processing – Newtonion and Non-Newtonion fluids - Rheology of polymer melts.

UNIT II COMPRESSION MOULDING & TRANSFER MOULDING 10

Basic principles of compression and transfer moulding-Meaning of terms-Bulk factor and flow properties as applied to moulding materials-The methods adopted for estimating these properties and their limitations Process variables-Inter relation between flow properties-Curing time-Mould temperature and Pressure requirements-Preforms and preheating-Techniques of preheating-Machines used-Types of compression mould-Common moulding faults and their correction-Finishing of mouldings. Fundamental principles of transfer moulding-advantages over compression moulding- Equipment used-Press capacity-Integral moulds and auxiliary ram moulds-Moulding cycles-Tool costs-Moulding tolerances-Materials Theoretical calculation of pressures- Line pressures- Injection ram pressure-clamping-Heating requirements-Finishing of moulded parts—Moulding faults – causes and remedies.

UNIT III INJECTION MOULDING 10

Principles processing outline - Process variables - Mould cycle - Machinery used – Parts and functions –Specifications - Construction and maintenance - Start-up and shut down procedures - Cylinder nozzles - Press capacity projected area -Shot weight Basic theoretical concepts and their relationship to processing - Interaction of moulding process aspect effects in quoted variables - Introduction to trouble shooting.

UNIT IV EXTRUSION 10

Basic principles of extrusion – Types of extruders, general features of extruders viz. barrel, screw, types of screws, drive mechanism, specifications, heating & cooling systems, flow mechanism, die entry effects and exit instabilities. Melt fracture & Bam- booing. Factors affecting the output of an extruder, process variables in extrusion Extrusion processes and the downstream equipments for the production of films, blown film, cast film/slot film, BO film, coextruded film. Tube/pipe-sizing take off equipment, extrusion coating, wire & cable covering –pre treatment of conductor, cooling, takeoff equipment constructional features of dies for the above processes and trouble shooting. Applications of extrusion and new developments.

UNIT V BLOW MOULDING 10

Basic principles and definitions- Processer – viz, Injection Blow moulding, extrusion blow moulding, Accumulation blow moulding, Merits & Demerits - Development of blow moulding industry Processing Parameters-Temperature-Pressure and cycle time Components – Materials requirements related to process and product performance- Materials used-Limitations in product design presented by process characteristics- Design guide lines for optimum product performance and appearance-Equipment used- Hand and power operated equipment. Screw and Plunger Systems-Cross head and die design-Blow moulding machine features and operation including hydraulic and electrical control systems-faults, causes and remedies. Parison programming, blow mould construction, cooling methods, mould venting, blow moulding of difficult articles like fuel tanks, odd shaped containers with handles, limitation in blow moulding, decoration of blow moulding products, hot stamping-multi colour printing-faults, causes and remedies.

TOTAL: 45 PERIODS

OUTCOMES:

- On completing this course, the students would acquire the knowledge of processing of plastic materials by injection moulding, extrusion, and blow moulding.
- Students can will understand processing techniques like compression molding and transfer moulding of thermoset plastics.

TEXT BOOKS:

1. Allen; W. S. and Baker; P. N., Hand Book of Plastic Technology, Volume-1, PlasticProcessing Operations [Injection, Compression, Transfer, Blow Molding], CBS Publishers and Distributors, New Delhi (2004).Injection Molding Theory & Practice By Rubin, Irvin.
2. Injection Molding Hand Book By Rusto,D.V &Rosato, D.V Plastic Engineering Hand Book & D–5 By Society of Plastic Industry Inc.,2000.
3. Plastics Material & Processing By Strong, A, Brent ,Blow Molding Hand Book By Rosato, D.V & Rosato, D.V ,Plastic Extrusion Technology By Hensen.
4. Extrusion of Plastics By Fisher
5. Plastics Extrusion Technology By Grief
6. Plastic Engineering Hand Book By S P I,1991.
7. Plastics Extrusion Technology By Henson,1997.

REFERENCES:

1.A Guide to Injection Molding of Plastics By Bolur, P.C.,
2. Development in Injection Molding By Whelan, A & Craft, J.L.
3. Technician's Hand Book & Plastics By Grandilli, P.A.,1990.
4. Plastics Materials & Processing By Schwartz & Goodman.,1982.
5. Injection Molding By Athalye, A.S.,1997.
6. Injection Molding Technology By V.D.I.
7. Innovation in Polymer Processing By Stevenson.,1996.
8. Extrusion The definitive Processing Guide and Hand Book By Giles, H.H & Others., 2004.
9. Compression Molding By Iyesew, A.I.
10. Polymer Extrusion By Rauwedaal, Chris.,2014.

GE3451 ENVIRONMENTAL SCIENCE AND SUSTAINABILITY L T P C
2 0 0 2

UNIT I: ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II: ENVIRONMENTAL POLLUTION 6

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

UNIT III: RENEWABLE SOURCES OF ENERGY 6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV: SUSTAINABILITY AND MANAGEMENT 6

Development , GDP ,Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V: SUSTAINABILITY PRACTICES 6

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization-Socio-economical and technological change.

TOTAL: 30 PERIODS

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers , 2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCE BOOKS:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 .
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
5. ErachBharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient BlackswanPvt. Ltd. 2013.

PT3411 POLYMER SCIENCE LAB L T P C
0 0 3 1.5

OBJECTIVE:

- To prepare the students with Methodology for facing the Industrial and academic challenges in Identifying various polymers and Controlling the quality of incoming raw materials and processing
- To give an understanding of laboratory scale synthesis process of various types of thermoplastics and thermosets
- will help student to carry out Production, Research and development in the areas of polymer Synthesis, Polymer nanocomposites ,coating formulation development, Fiber reinforced composites, Polymer processing etc.
- To make them aware of Environmental concerns of Polymer Synthesis

- To understand and do calculations observations formulations involved team work and understanding practical problems related to the experiment.

LIST OF EXPERIMENTS

1. Preparation of phenol - formaldehyde (Novalac) resin.
2. Preparation of phenol - formaldehyde (Resol) resin.
3. Preparation of Urea formaldehyde resin.
4. Preparation of Bisphenol - An epoxy resin.
5. Bulk polymerization of styrene.
6. Emulsion Polymerization of styrene.
7. Solution Polymerization of acrylonitrile.
8. Bulk Polymerization of Methyl methacrylate.
9. Copolymerization of styrene and methyl methacrylate.
10. Ring opening polymerization of Caprolactone
11. Solution Polymerization of Vinyl acetate.
12. Depolymerization of waste thermoplastics such as polystyrene or polymethylmethacrylate
13. Determination of acid value in unsaturated polyester resin
14. Preparation of saturated polyester resin
15. Determination of acid value in saturated polyester resin

(Any Nine of the above) **TOTAL: 60 PERIODS**

OUTCOMES:

Upon completing this course, the students

- Will acquire skills in preparation of polymers using various polymerization techniques.
- Will develop the conversion of polymeric materials into product.
- Design and conduct experiments for synthesis of Resins and polymers and understand the practical problems related to the experiment
- Interpret data, process parameters within realistic constraints of the experiment.
- Communicate effectively in team work and understanding of professional and ethical responsibility.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

- Magnetic stirrer 10 Nos.
- Thermostatic Water bath 2 Nos.
- Vacuum Pump 1 No.
- Heating Mantle 8 Nos.
- Water distillation set up 1 No.
- Bunsen burner 15 Nos.
- Electronic balance 2 Nos.
- Air oven 1 No.
- Melting point apparatus 1 No.
- Retard stands 15 Nos.
- Burette
- Pipette
- Funnel

PT3412 **PLASTICS PROCESSING LAB** **L T P C**
0 0 3 1.5

OBJECTIVE:

- To practice the students in different types of moulding machines.

Sl. No	Name of M/c/ Equipment/ Mould	Description of Practical Exercise to be done
1	Hand operated Injection Moulding Machine	(i) Study of Machine in Idle-Run Observation (IRO), Parts & functions, operating principle, Free sketch of Machine-parts eg. Nozzle, Torpedo, Hopper, Rack & Pinion Barrel etc., shot capacity definition (ii) Operation practice to produce moulding on Different and injection moulds. Recording the observation and results in practical record books.
2	Injection Moulding Semi Automatic	(i) Study of Semi Automatic Injection Moulding M/cs of all types in IRO. Comparative study of Pneumatic type & Hydraulic type of M/cs, Operating Principle of M/cs. Line diagrams of M/cs with nomenclature of parts, M/cs specifications. (ii) Operation of Pneumatic & Hydraulic type of Semi automatic Injection moulding M/cs, to produce components in different moulds. Cycle-time analysis, observations of Process- Parameters & Procedure to be recorded
3	Extrusion Processes on Extruders	(i) Study of Extruders in IRO, Free sketch of machines, their parts and parts-function, List of products manufactured by Extrusion-Process. Study of different types of extrusion process. (ii) Operation-Practice by Trainee on setting up of Process parameter to produce Blown-Film on Film-plant, observations on extruder output, size of film produced and technical specifications of machines to be recorded
4	Compression moulding – Hand Operated	(i) Study of Hand compression M/c in IRO Free sketch of Parts & study of part-function, comparison of compression moulding M/c with Injection Moulding M/c. Compression moulding processes. (ii) Operating Principle of Hand Compression Press, mould setting procedure & parameter setting, operation practice on different compression moulds, M/c specification observations and recording
5	Blow Moulding and Recording Hand Operated	(i) Study of Hand Blow Moulding M/cs, Free-sketch of M/c with parts & study of part-function, Specification of M/c, Study of Parison-die with sketch. (ii) Die-centering practice by Trainees, operation of Hand Blow Machines, to produce components observations, cycle time analysis Procedure of operation and observations.
6	Scrap Grinding	(i) M/c Study in IRO, specification of M/c, study of parts & function, Line Diagram of M/c. (ii) Operation-practice with different materials and output study in Kg/hour for different materials.
7	Injection Moulding M/c.- Automatic	Study of M/c Parts & function, Study of clamping systems in M/cs, Technical spec. of M/c, study of process sequence in Machine, Study & definitions of terms

		related to M/c operation e.g. M/c Day light, Locating – Ring Dimensions, ejector-stroke, Tie-Bar distance, M/c Platen sizes & mould clamping arrangements. Definitions of all Processing Parameters & study of controls in M/cs.
8	Compression & Transfer Moulding- Semi Automatic	Technical specification of M/c, Mould clamping on M/c, Parameter setting, operation-practice on different compression & Transfer Moulds, Cycle-time analysis, observation & Procedure of start-up & shut down of M/c.
9	Blow-Moulding Semi Automatic	Technical specification of M/c, Mould clamping on M/c, operation Practice with different moulds, Familiarisation with control-switches/ valves on the M/c, cycle-time analysis & procedure of operation of M/c.
10	Introduction to Maintenance	Basic knowledge of Hydraulic & Pneumatic systems, Electrical system, Definition of terms- Hydraulic fluid, viscosity Directional Valves, Resistance, Current, Voltage, Power, Hydraulic Pumps -Types & function, electrical heaters, thermocouples and temp control parameters and timers, electrical Motors - Types & fn.
11	Introduction to Moulds, Tool Room M/ c & Drawing Practice	Study of Different Types of Moulds & its Parts and function, free hand drawing practice, exposure to tool room machines.

LIST OF EQUIPMENTs/MACHINERY FOR BATCH OF 30 STUDENTS

Sl. No.	Name of M/c/ Equipment/ Mould	No. of machine required
1	Hand operated Injection Moulding Machine	01
2	Injection Moulding Semi-Automatic	01
3	Extrusion Processes on Extruders	01
4	Compression moulding–Hand Operated	01
5	Blow Moulding and recording – Hand Operated	01
6	Scrap Grinding	01
7	Injection Moulding M/c.- Automatic	01
8	Compression& Transfer Moulding- Semi Automatic	01
9	Blow-Moulding Semi-Automatic	01
10	Introduction to Maintenance	--
11	Introduction to Moulds, Tool Room M/c &Drawing Practice	--

TOTAL: 60 PERIODS

OUTCOME:

Upon completing this practical course, the student will have hands on experience on different types of moulding machines.