

NEW SYLLABUS

**SURFACE COATING
TECHNOLOGY**

SURFACE ENGINEERING AND TECHNOLOGY

Proposed Revised Syllabus

The Bachelor of Technology is now a four-year program, after 12th.

The structure consists of subjects common to all branches, and includes basic sciences, engineering and some humanities and management components.

In this document, the structure of the syllabus, divided into 8 semesters, is followed by the detailed syllabus for special subjects

Surface Engineering domain.

Syllabus Structure B. Tech. First Year

Semester I								
Subjects	Credits	Hrs/Week			Marks for various Exams			
		L	T	P	C. A.	M.S.	E. S.	Total
Physical Chemistry-I	3	2	1	0	10	15	25	50
Analytical Chemistry	3	2	1	0	10	15	25	50
Applied Mathematics-I	4	3	1	0	20	30	50	100
Applied Physics-I	4	3	1	0	20	30	50	100
Physical and Analytical Chemistry Lab	2	0	0	4	25	-	25	50
Engineering Graphics	4	2	0	6	50	-	50	100
Communication Skills	2	0	0	4	50	-	-	50
TOTAL:	22	12	4	14	-	-	-	500

Semester II								
Subjects	Credits	Hrs/week			Marks for various Exams			
		L	T	P	C. A.	M.S	E. S.	Total
Physical Chemistry-II	3	2	1	0	10	15	25	50
Organic Chemistry	4	3	1	0	20	30	50	100
Process Calculations	4	3	1	0	20	30	50	100
Applied Mathematics-II	4	3	1	0	20	30	50	100
Applied Physics-II	3	2	1	0	10	15	25	50
Physics Laboratory	2	0	0	4	25	-	25	50
Organic Chemistry Laboratory	2	0	0	4	25	-	25	50
Total	22	13	5	8	-	-	-	500

Syllabus Structure B. Tech. Second Year

Semester III									
Course Code	Subjects	Credits	Hrs /week			Marks for various Exams			
			L	T	P	C. A.	M.S	E.S.	Total
PST 1301	Spl 1: Polymer Science & Technology	4	3	1	0	20	30	50	100
PST 1302	Spl 2: Polymer Chemistry & Technology	4	3	1	0	20	30	50	100
PST 1301	Material Technology	3	2	1	0	10	15	25	50
CHT1133	Chemistry and Applications of Colorants	4	3	1	0	20	30	50	100
CHT1124	Industrial Inorganic Chemistry	4	3	1	0	20	30	50	100
PSP 1301	Pr 1:Raw Material Analysis for Resins and Polymers	2	0	0	4	25	-	25	50
MAP1201	Computer Application Lab	2	0	0	4	25	-	25	50
	Total	23	14	5	8	-	-	-	550

Semester IV									
Course Code	Subjects	Credits	Hrs/week			Marks for various Exams			
			L	T	P	C. A.	M.S.	E. S.	Total
GET1116	Engineering Mechanics & Strength of Materials	4	3	1	0	20	30	50	100
PYT1202	Color Physics and Color Harmony	3	2	1	0	10	15	25	50
CET 1105	Transport Phenomena	4	3	1	0	20	30	50	100
GET1105	Electrical Engineering and Electronics	3	2	1	0	10	15	25	50
PST1403	Spl3 : High Polymer Chemistry	4	3	1	0	20	30	50	100
GEP1106	Electrical Engineering and Electronics Lab	2	0	0	4	25	-	25	50
PYP120	Pr 2: Color Physics Lab	2	0	0	4	25	-	25	50
	Total	22	13	5	8	-	-	-	500

Syllabus Structure B. Tech. Third Year

Semester V									
Course Code	Subjects	Credits	Hrs/week			Marks for various Exams			
			L	T	P	C. A.	M.S	E. S.	Total
CET1401	Chemical Engineering Operations	3	2	1	0	10	15	25	50
CET1201	Chemical Reaction Engineering	3	2	1	0	10	15	25	50
PST1504	Spl 4:Technology of Thermoplastic Polymer (Common)	4	3	1	0	20	30	50	100
PST1505	Spl 5 Technology of Thermoset Polymers (Common)	4	3	1	0	20	30	50	100
SCT1506	Spl 6: Additives for Coating	4	3	1	0	20	30	50	100
PSP1503	Pr3 : Synthesis & Characterization of Resins & Polymers Lab (Common)	4	0	0	8	50	-	50	100
PSP1504	Pr4 : Analysis and characterization of Resins and polymers Lab (Common)	2	0	0	4	25	-	25	50
	Total	24	13	5	12	-	-	-	550

Semester VI									
Course Code C	Subjects	Credits	Hrs/week			Marks for various Exams			
			L	T	P	C. A.	M.S	E. S.	Total
SCT1607	Spl 7 : Paint Technology I	4	3	1	0	20	30	50	100
SCT1608	Spl 8: Paint Technology II	3	2	1	0	10	15	25	50
HUT1103	Industrial Psychology and Human Resource Management	3	2	1	0	10	15	25	50
HUT1104	Industrial Management – I	3	2	1	0	10	15	25	50
PST1609	Spl 9: Elective-I Structure property Relationship (Common)	3	2	1	0	10	15	25	50
SCP1605	Pr 5: Synthesis, processing and characterization of colorants.	4	0	0	8	50	-	50	100

SCP1606	Pr 6: Processing of Paints Lab-I	2	0	0	4	25	-	25	50
SCP1607	Pr 7: Processing of Paints Lab-II	2	0	0	4	25	-	25	50
	Environmental Science and Technology	3	2	0	0	10	15	25	50
	Total	27	13	6	16	-	-	-	550

Internship

- After the end of the sixth semester examination and before the start of the seventh semester, every student will have to undergo an internship. The Internship would be of 6 credits.
- The internship (preferably Industrial Internship) would be assigned to the student by the Departmental Internship Coordinator, with the approval of Head of the Department.
- The total duration of the internship would be for a period equivalent to 12 Calendar weeks. This period typically start from 1st May and end before 30th July every year. This means the end semester examination of T. Y. Tech (Semester VI) should be completed by 25th April every year. The Semester VII (4th Year B.Tech.) should commence w.e.f. 1st Aug every year. The internship may be completed in one or more organizations as described below.
- The internship could be of the following forms:
 - (i) Industrial internship in a company (within India or Abroad) involved in R&D / design / manufacturing (QA/QC/Plant Engineering/Stores and Purchase) / marketing / finance / consultancy / Technical services / Engineering / Projects, etc.
 - (ii) Research internship in reputed Institutes (within India or Abroad) like, ICT, IITs, NITs, IISC, NCL, IICT etc.
- At the end of the internship, each student will submit a written report based on the work carried out during the Internship. The report will be countersigned by the Supervisor from Industry / Institute as the case may be.
- Performance of the student will be assessed based on the written report and a presentation to a committee consisting of two faculty members from the Department.
- Students will be assigned a grade based on the written report and a presentation; evaluated by a committee of faculty members.

Syllabus Structure B.Tech.Final Year

Semester VII									
Course Code	Subjects	Credits	Hrs/week			Marks for various Exams			
			L	T	P	C. A.	M.S	E. S.	Total
CET1703	Chemical Process Control	3	2	1	0	10	15	25	50
PST1710	Spl 10: Environment Health and Safety of polymers and coating (Common)	4	3	1	0	20	30	50	100
PST1711	Spl 11: Evaluation and Testing of polymers and coatings (Common)	3	2	1	0	10	15	25	50
SCT1712	Spl 12: Elective II Radiation Curing Coatings	3	2	1	0	10	15	25	50
HUT1105	Industrial Management – II	3	2	1	0	10	15	25	50
MAT1106	Design and Analysis of Experiments	3	2	1	0	10	15	25	50
PSP1708	Seminar	2	0	0	4	-	-	50	50
PSP1709	Project I	4	0	0	8	-	-	100	100
CEP1714	Chem.Eng.Laboratory	2	0	0	4	25	-	25	50
PSP1710	In-Plant Training	3							50
	Total	30	13	65	16	-	-	-	600

Semester VIII

Course Code	Subjects	Credits	Hrs/week			Marks for various Exams			
			L	T	P	C. A.	M.S	E. S.	Total
CET1504	Chemical Project Engineering and Economics	3	2	1	0	10	15	25	50
SCT1813	Spl 13: Technology of printing inks	3	2	1	0	10	15	25	50
PST1814	Spl 14: Nano materials and their applications (Common)	3	2	1	0	10	15	25	50
SCT1815	Spl 15:Advanced Paint Technology	4	3	1	0	20	30	50	100
SCT1816	Spl 16: Elective III Corrosion Science and Corrosion prevention	3	2	1	0	10	15	25	50
HUT1107	Value Education	3	2	1	0	10	15	25	50
PSP1811	Project II	4	0	0	8	-	-	100	100
SCP1812	Pr 8: Analysis and Testing of Paints	4	0	0	8	50	-	50	100
Total	27	27	6	16	-	-	-	550	Total

SEMESTER

CourseCode:CET 1401	Course Title: Chemical Engineering Operations	Credits=3		
		L	T	P
Semester: IV	Total contact hours:45	2	1	0
List of Prerequisite				
	Material&EnergyBalance Calculations,PhysicalChemistry,OrganicChemistry, Transport Phenomena			
List of Courses where this course will be prerequisite				
	This is a basic Chem Engg. course. It is required in almost all the courses, such as, Chemical Engineering Laboratory, Chemical Technology Projects etc.			
Description of relevance of this course in the B.Tech. Program				

This is a basic Chem Engg. course. The principles learnt in this course are required in almost all the courses and throughout the

	Course Contents (Topics and subtopics)	Reqd. hours
1	Introduction to Unit Operations and Chemical Engineering Processes	1
2	Single Equilibrium Stage, Flash Calculations and Cascade systems: Binary vapor-liquid systems,	2
3	Absorption and Stripping of dilute mixtures: Fundamentals of absorption, equilibrium curves, Operating lines from material balances, Number of equilibrium stages, Kremser Equation, Stage efficiency and column performance, Trayed and packed columns, Rate based methods for packed columns (HTU, NTU), Design considerations: loading and flooding zones, pressure drop and column diameter	6
4	Distillation of binary mixtures: Differential distillation, Flash or equilibrium distillation, Fractionating column and multistage column, design and analysis factors, degrees of freedom, specifications, reflux, reflux ratio, need for reflux, McCabe-Thiele, Lewis-Sorel methods of estimation of number of plates, Operating lines, Efficiency, Murphree Efficiency, Tray efficiency, Packed Column Efficiency	6
5	Methods for multicomponent separations: Fenske-Underwood-Gilliland Method, selection of two key	1
6	Particulate solids: Particle characterization Shape, size, particle size measurement, Particle size analysis	2
7	Particle Size Reduction: Necessity for size reduction of solids, Mechanism for size reduction, Energy requirements for size reduction and scale-up considerations, Operational considerations Crushing and grinding equipment: impact and attrition	3
8	Liquid Filtration: Filtration theory: constant pressure, constant rate, and variable pressure-variable rate	4
9	Sedimentation, Classification and Centrifugal Separations: Design and scale up equations, Performance	2
10	Drying of solids: Mechanism of drying, drying rate curves, Estimation of drying time, Drying Equipment, operation, Process design of dryers, material and energy balances in indirect dryers, Drying	3
List of Text Books/ Reference		
1	Richardson, J.F., Coulson, J.M., Harker, J.H., Backhurst, J.R., 2002. Chemical engineering: Particle technology and separation processes. Butterworth-Heinemann, Woburn, MA.	
2	Seader, J.D., Henley, E.J., 2005. Separation Process Principles, 2 ed. Wiley, Hoboken, N.J.	

3	Svarovsky,L., 2000. Solid-LiquidSeparation.Butterworth-Heinemann, Woburn, MA.	
4	McCabe,W.,Smith,J.,Harriott,P.,2004.UnitOperationsofChemicalEngineering,7ed.McGraw-	
5	Green,D.,Perry,R.,2007.Perry’sChemicalEngineers’Handbook,EighthEdition,8ed.McGraw-Hill	
6	Dutta,B.K.,2007.PrinciplesofMassTransferandSeparationProcess.Prentice-HallofIndiaPvt.Ltd, New Delhi.	

CourseOutcomes(studentswill be able to.....)

1	Knowthesignificanceandusageofdifferentparticulatecharacterizationparameters,andequipmen tto	
2	DescribeSizeductionenergyrequirements,estimateperformanceofequipment,selectionandsi zing of equipment	
3	Analyzefiltrationdataandselectsystemsbasedonrequirements,estimatefiltrationareaforgiven	
4	Draw T-y-x diagrams, and y-x diagrams, operating lines, feed line, bubble point, dew point	

5	Describetwocommonmodes of drying,industrialdryingequipment	
6	Calculate masstransfer coefficient in various equipment, Calculateheight and diameter required,	

CourseCode:CET 1201	Course Title:Chemical ReactionEngineering	Credits= 3		
		L	T	P
Semester: V	Total contacthours: 45	2	1	0
List of Prerequisite				
Physical Chemistry, Material & Energy Balance Calculations, Applied Mathematics.				
List of Courses where this course will be prerequisite				
Biochemical Engineering, Environmental Engineering and Process Safety, Proc. Dev and Engg.,				
Description of relevance of this course in the B.Tech. Program				

Chemical Reaction Engineering is concerned with the utilisation of chemical reactions on a commercial scale. This course is very relevant but not limited to the following industries: Inorganic chemicals, organic chemicals, petroleum & petrochemicals, Pulp

	Course Contents (Topics and subtopics)	Reqd. hours
1	Batch reactor (BR), continuous stirred tank reactor (CSTR), plug flow reactor (PFR), packed-bed	1
2	Design equations for BR, CSTR, PFR, PBR, and applications of design equations to various series- and parallel- combinations of flow reactors	3
3	Rate laws and stoichiometry	2
4	Isothermal reactor design applied to BR, CSTR, PFR, PBR	3
5	Analysis of rate data: differential method, integral method	2
6	Multiple reactions	2
7	Reaction mechanisms, pathways, bioreactions	3
8	Catalysis and catalytic reactors, catalyst deactivation, external diffusion effects on heterogeneous	4
9	Introduction to non-isothermal reactor design	3
10	Residence time distribution in reactors; models for non-ideal reactors	4
11	Mass transfer with chemical reaction in fluid-fluid and fluid-fluid-solids systems; Model reactors, pilot plants, and collection of scale-up data	3
List of Text Books /Reference		
1	Elements of Chemical Reaction Engineering – H.Scott FOGLER	
2	Chemical Reaction Engineering – Octave LEVENSPIEL	
3	The Engineering of Chemical Reactions – Lanny D. SCHMIDT	
4	An introduction to Chemical Engineering Kinetics and Reactor Design – Charles HILL	
5	Heterogeneous Reactions, Vol. I and II – L.K. Doraiswamy, M.M. Sharma	
Course Outcomes (students will be able to ...)		
1	design chemical reactors optimally, using minimum amount of data	
2	design experiments in a judicious way to get the required data, if not available	
3	fix some problems related to operability and productivity	
4	maintain and operate a process in a safe manner	
5	increase capacity and/or selectivity and/or safety by improving/changing the reactor type/sequence	

Course Code: PST1504	Course Title: :Technology of Thermoplastic Polymers(100 marks)	Credits	
		T	P
Semester: V	Total contact hours: 60	1	0

List of Prerequisite Courses

Polymer science and Technology, Polymer chemistry and Technology Raw material Analysis of resins and polymers, Resins and polymer analysis.

List of Courses where this course will be prerequisite

Compounding and Polymer Processing Project ,Environment Health and Safety of Polymers and Coating ,Evolution and testing of Polymers and Coatings,Technology of Plastic Packaging.

Description of relevance of this course in the B. Tech. Program

To give understanding of industrial manufacturing processes, properties and applications, processing of various types of thermoplastic polymers. Knowledge of subject will help student to carry out research and development in the areas of polymer blends polymernanocomposites ,coating formulation developement,Fiber reinforce composites ,Polymer processing, Rheology of polymers etc. To make aware of Environmental concerns of Polymer products, Recycling of Polymers, Industrially produced different grades trade names of polymers.

Course Contents

**Reqd.
hours**

1	Industrial Manufacturing processes, properties and applications,processing environmental concerns of various types of polymers polyolefines like LDPE HDPE etc	5
2	Polypropylene and copolymer of PP Plastomers	5
3	Copolymer of polyolefineslike EVA LLDPE EAA etc	5
4	Polystyrene, HIPS, SAN	5
5	ABS ,important copolymers of styrene maleic anhydride and styrene acrylics copolymers, toughening mechanism of impact modified plastics	5
6	Saturated Polyesters such as PET, PBT, PTT	5
7	Polycarbonates, Polyacetals	5
8	Polymamides- Nylon 6, Nylon 6,6, Nylon 11 etc, aromatic polyamide such as Kevlar	5
9	Acrylic polymers & copolymers, Polyacrylamide, PMMA, ,Polyacrylonitrile etc	5
10	Polyvinyl chloride & its copolymers Compounding of PVC	5
11	Cellulose esters and ethers such as Ethyl cellulose, CMC, CN, cellulose acetates etc	5
12	Thermoplastic PU, Poly vinyl acetate, Polyvinyl alcohol etc	5

List of Text Books/ Reference Books

List of Text Books/ Reference Books

1. Plastics Materials, 7th Edition by John Brydson, Elsevier 1999
2. Text book of polymer Science by Billmeyer, John Wiley and Sons 1984
3. Principles of Polymer Science, by Bahadur and Sastry, Narosa Publishing House 2002.
4. Polymer Science by Gowariker, , John Wiley and Sons 1986.
5. Encyclopedia of Polymer Science and Technology, John Wiley and Sons, Inc. 1965.
6. Encyclopedia of Polymer Science and Engineering, John Wiley and Sons, Inc 1988.
7. Handbook of Thermoplastics, Second Edition Olagoke Olabisibiy CRC Press 2015
8. Thermoplastic Materials by Ibeh, Christopher C, Taylor Francis Inc 2013
9. Introduction to Polymer Science and Technology by H. S. Kaufman and J. J. Falchetta, Wiley – Interscience Publication, 1977
10. Handbook of Polyethylene, A. J. Peacock, Marcel Dekker Inc, 2000
11. PVC Technology, A. S. Athalye and Prakash Trivedi, Multi-Tech Publishing Co, 1994.
12. Engineering Thermoplastics Polycarbonates Polyacetals Cellulose Esters, L. Bottenbruch, Hanser Publishers, 1996.
13. Polymer and Resins; Their Chemistry and Chemical Engg, Brage Golding, D. VanNostrand Company Inc, 1959.
14. Structures of Cellulose, Atlla, American Chemical society, 2003.

Course Outcomes (students will be able to.....)

1	To study industrial manufacturing process advantages disadvantages, process parameters of the thermoplastics polymers and environmental concerns of their products	
2	To give understanding of properties like physical mechanical thermal rheological etc	
3	To make aware of practical applications of thermoplastics in real world and structure properties and relationship.	
4	To study basic processing methods related to of the thermoplastics polymers.	
5	To make aware of different grades of commodity and engineering plastics manufacturer suppliers of them in the market.	

Course Code: PST1505	Course Title: :Technology of Thermosets Polymers(100 marks)	Credits = 4		
		L	T	P
Semester: V	Total contact hours: 60	3	1	0

List of Prerequisite Courses

Polymer science and Technology, Polymer chemistry and Technology Raw material Analysis of resins and polymers, Resins and polymer analysis.

List of Courses where this course will be prerequisite

Paint Processing Project ,Environment Health and Safety of Polymers and Coating ,Evolution and testing of Polymers and Coatings,Technology of Plastic Packaging.

Description of relevance of this course in the B. Tech. Program

To give understanding of alkyd resins, types, synthesis, properties and modification of alkyd resins. Understanding of polyester resins, raw materials used and various curing systems. Basics of Phenolics, polyurethane, silicone and acrylics resins. Their synthesis, modification, processing, chemistry and applications.

	Course Contents	Reqd. hours
1	Alkyd resins Basic components like polyfunctional alcohols, poly-basic acids, vegetable oils/fatty acids. Different types of drying oils: drying, semi-drying and non-drying with examples. Influence of all these components in the synthesis and properties of the final alkyds obtained. Modification of alkyds: modifications with rosin, maleic anhydride, acrylics, vinyls, imides, etc.	10
2	Polyesters Resins – unsaturated polyesters resins: Raw material: poly-basic acids, polyfunctional glycols. Curing of resins through unsaturation of the resin/polymer backbone. Curing systems, catalysts and accelerators. Molding compositions, fibre and film forming compositions	5
3	Phenolics. Basic Components of the polymer. Different kinds of phenols to aldehyde on the nature and the property of the polymer. Theory of resinification and effect of pH on the reaction mechanism and the reaction product. Curing of Phenolics.	5
4	Modification of Phenolics such as oil soluble and oil reactive. Phenolic moulding compounds ingredients, compounding and applications	5
5	Polyurethanes – Thermoplastic and Thermoset: Basic components diisocyanates and diols, different diisocyanates and diols used Reactions of isocyanates with various other functional groups synthesis of polymers polyurethane foams, polyester and polyether foams.	5
6	Processes like one-shot process, Polyether pre-polymers, Quasi-pre-polymer polyether foams, etc. Flexible foams Polyurethanes in Coatings Polyisocyanates IPN using polyurethanes-acrylic blends.	5
7	Silicones Thermoplastic and Thermoset; Preparation of intermediates, Grignard's method, directs method, olefin addition method, sodium condensation method, rearrangement of	5
8	Nature and effect of Si-H, Si-O, Si-Si, and Si-C bond. Silicone fluids, resins, elastomers	5
9	Compounding, Processing and applications of Silicone resins. Modified silicone resins.	5

10	Thermosetting acrylics: Synthesis of acrylic polymers and co-polymers, different techniques.	5
11	Miscellaneous thermosetting polymers.	5
List of Text Books/ Reference Books		
	<p>Text book of Polymer Science by Billmeyer, John Wiley and Sons 1984.</p> <p>Encyclopedia of Polymer Science and Technology, John Wiley and Sons, Inc 1965.</p> <p>Encyclopedia of Polymer Science and Engineering, John Wiley and Sons, Inc 1988.</p> <p>Polymer Chemistry by Malcolm P. Stevens, Oxford University Press, Inc, 1990.</p> <p>Introduction to Polymer Science and Technology by H. S. Kaufman and J. J. Falcetta, Wiley – Interscience Publication, 1977</p> <p>Handbook of Polyethylene, A. J. Peacock, Marcel Dekker Inc, 2000</p> <p>PVC Technology, A. S. Athalye and Prakash Trivedi, Multi-Tech Publishing Co, 1994.</p> <p>Engineering Thermoplastics Polycarbonates Polyacetals Cellulose Esters, L. Bottenbruch, Hanser Publishers, 1996.</p> <p>Composite Polymeric Material, R. P. Sheldon, Applied Science Publishers, 1982.</p> <p>Composites: Design Guide, Industrial Press Inc, 1987.</p> <p>Composite Material Handbook, M. M. Schwartz, McGraw-Hill company, 1984.</p> <p>Biopolymers, Wiley, VCH Verlag, 2003</p> <p>Handbook of Thermoplastics, O. Olabisi, Marcel Dekker, 1997.</p> <p>Plastics Materials J. A. Brydson, Butterworth Scientific, 1990.</p> <p>Polymer chemistry, Seymour and Carraher, Marcel Dekker, 2003.</p> <p>Polymer and Resins; Their Chemistry and Chemical Engg, Brage Golding, D. VanNostrand Company Inc, 1959.</p> <p>Structures of Cellulose, Atlla, American Chemical society, 2003.</p> <p>Polymer Technology by Miles and Briston Falcetta, Wiley – Interscience Publication, 1977</p> <p>10. Handbook of Polyethylene, A. J. Peacock, Marcel Dekker Inc, 2000</p> <p>11. PVC Technology, A. S. Athalye and Prakash Trivedi, Multi-Tech Publishing Co, 1994.</p> <p>12. Engineering Thermoplastics Polycarbonates Polyacetals Cellulose Esters, L. Bottenbruch, Hanser Publishers, 1996.</p> <p>13. Polymer and Resins; Their Chemistry and Chemical Engg, Brage Golding, D. VanNostrand Company Inc, 1959.</p> <p>14. Structures of Cellulose, Atlla, American Chemical society, 2003.</p> <p>15. Styrene Based Plastics and their Modifications, Ellis Harwood, 1991.</p> <p>16. Polymer Technology by Miles and Briston</p>	

Course Outcomes (students will be able to.....)

1	To study the basics of alkyd resins and understand existence of various types of alkyds present. To understand the chemistry of alkyd resins and provide inputs for modification of alkyds.	
2	To study the chemistry of polyurethanes. To understand the reactivity of polyurethanes and provide inputs for modification	
3	To study the basics of silicones and understand its modification	
4	To study basics and chemistry of acrylic resins. To understand the various acrylics and study its modification.	
5	To study about chemistry of phenolics and polyester	

Course Code: SCT1506	Course Title: :Additives for coatings (100 marks)	Credits = 4		
		L	T	P
Semester: V	Total contact hours: 60	3	1	0
List of Prerequisite Courses				
Structure Property relationship, Paint Processing, Paint Technology. Polymer science and Technology, Polymer chemistry and Technology Raw material Analysis of resins and polymers, Resins and polymer analysis.				
List of Courses where this course will be prerequisite				
Compounding and Polymer Processing Project ,Environment Health and Safety of Polymers and Coating ,Evolution and testing of Polymers and Coatings,Technology of Plastic Packaging. Structure Property relationship.Paint Processing, Paint Technology.				
Description of relevance of this course in the B. Tech. Program				
<ol style="list-style-type: none"> 1. To study various properties of pigments and extenders 2. To understand the basics of pigment dispersion. 3. To study different inorganic and organic pigments and their different properties. 4. To study theory of color formation and effect of auxiliary groups on the shade andhue of the pigment 5. To study properties and application of various additives. 				
	Course Contents	Reqd. hours		
1	An overview of paint additives, types of Coating Additive and the Main Technical Trends, need and importance additives.	5		
2	Pigment wetting and dispersing additives, Rheological additives, Substrate wetting additives.	5		
3	Defoamers and dereactors, Antioxidants and formulation stabilizers, Surface control additives: flow. leveling. slip. scratch resistance.	5		
4	Flow and leveling additives, matting agents, Additives to improve adhesion.	5		
5	Colorants, Fillers, Thickeners, Surface Active agents, Additives for surface modification.	5		
6	Flow and Levelling Agents, Coalescing Agent,Catalytically Active additive.	5		
7	Fillers, Thickeners, Surface Active agents.	5		
8	Additives for surface Modification, Flow and Levelling Agents, Coalescing Agent	5		

9	Catalytically Active additive, Additives for Special Functions.	5
10	Hygienic Additives, In can stabilizer	5
11	Masking agent, Testing and Characterization	5
12	Special effect pigments (IR Reflective, anticorrosive, thermo chromic, pearlescent) mixing equipment compounding dosingHealth and safty	5

List of Text Books/ Reference Books

1. Polymer Chemistry: A Practical Approach (The Practical Approach in Chemistry Series) 1st Edition Fred J. Davis Oxford University Press 2004
2. A Practical Course in Polymer Chemistry S. H. Pinner, Borough Polytechnic, London, Pergamon Press, he., New York, 1961
3. PVC Technology, A. S. Athalye and Prakash Trivedi, Multi-Tech Publishing Co, 1994
4. Polymer Science by Gowariker, John Wiley and Sons 1986.
5. Encyclopedia of Polymer Science and Technology, Johan Wiley and Sons, Inc 1965.
6. Encyclopedia of Polymer Science and Engineering, Johan Wiley and Sons, Inc 1988.

Course Outcomes (students will be able to.....)

- CO 1: Ability to identify and choose various pigments and additives for a particular application
- CO 2: Understanding of basic ideas, properties, dosage, techniques of dispersion for wide variety of pigments (organic and inorganic)
- CO 3: Ability to understand the mechanism of color formation and effect of various factors on shade and hue of pigment.
- CO 4: Should be able to perform manufacturing and synthesis of various pigments
- CO 5: Ability to decide the dosage and selection criteria for various types of additives.

Course Code: PSP1503	Course Title : : Synthesis and Characterization of Resins and Polymers Common (100 marks)	Credits = 4		
		L	T	P
Semester: V	Total contact hours: 2x4hr/Week	0	0	8

List of Prerequisite Courses

Polymer science and Technology, Polymer chemistry and Technology, Technology of Thermoset, Technology of Thermoplastics, Raw material Analysis of resins and polymers, Resins and polymer analysis.

List of Courses where this course will be prerequisite

Compounding and Polymer Processing Project, Environment Health and Safety of Polymers and Coating , Evolution and testing of Polymers and Coatings, Structure Property relationship. Paint Processing, Paint Technology.

Description of relevance of this course in the B. Tech. Program

To give understanding of laboratory scale synthesis processes, properties and applications of various types of thermoplastic and thermoset polymers. Knowledge of subject will help student to carry out Production, Research and development in the areas of polymer Synthesis, Polymer nanocomposites ,coating formulation developement, Fiber reinforced composites, Polymer processing etc.To make them aware of Environmental concerns of Polymer Synthesis. Handling Hazards of raw materials monomers, Work ethics in group, Ability design and conduct experiments, Ability to analyze and interpret data, process parameters . To understand and do calculations observations formulations involved team work and understanding practical problems related to the experiment

	Course Contents	Reqd. hours
1	Bulk, Solution and Suspension polymerization of monomers like styrene, MMA etc. and to analyses % solids, %yield, melting range etc	2x4hr/Week
2	Emulsion polymerization of monomers like vinyl acetate, styrene etc and to analyse polymer content, %solids etc.	
3	Aqueous polymerization of monomers like AA, Acrylamide etc. and analyse %solids, %yield, melting range etc.	
4	Synthesis of phenolic resin such as novalac, resol and to analyse free formaline, free phenol content, %solids, curing charecterestics etc.	
5	Synthesis of epoxy resin and to find epoxy value, epoxy equivalent yield etc.	
6	Synthesis of Unsaturated polyesters and to analyse Acid value, yield etc.	
7	Synthesis of copolymer of styrene and acrylate and to analyse yield melting range	
8	Polymer nanocomposites via insitu polymerization	
9	To study kinetics of free radical polymerization	
10	To svnthesis superabsorbant. hvdrogels and its analysis	
11	Plastisol core and shell polymers and its analysis	
12	Synthesis of amino resins like Melamine formaldehyde and urea formaldehyde resin And its analysis and application.	

List of Text Books/ Reference Books

	<p>1.Polymer Chemistry: A Practical Approach (The Practical Approach in Chemistry Series)1st EditionFred J. DavisOxford University Press 2004</p> <p>2.A Practical Course in Polymer ChemistryS. H. Pinner, Borough Polytechnic,London, Pergamon Press,he., New York, 1961</p> <p>3. PVC Technology, A. S. Athalye and Prakash Trivedi, Multi-Tech Publishing Co, 1994</p> <p>4.Polymer Science by Gowarikar,John Wiley and Sons 1986.</p> <p>5.Encyclopedia of Polymer Science and Technology, Johan Wiley and Sons, Inc 1965.</p> <p>6.Encyclopedia of Polymer Science and Engineering, Johan Wiley and Sons, Inc 1988.</p> <p>7. PVC Technology, A. S. Athalye and Prakash Trivedi, Multi-Tech Publishing Co, 1994</p> <p>8. Principles of polymerization, G.Odian, Wiley – Interscience (1981)</p> <p>9. PVC Technology 4th edition by W.V.Titow Elsevier Applied Science Publishers, London, 1984</p> <p>10.Phenolic Resins chemistry, Applications, Standardization, Safety and Ecology by L.Knop,Springer-Verlag Berlin Heidelberg 2000</p> <p>11. Chemistry and Technology of Epoxy Resins by Eliss Brayn ,Springer Nethelands,1993</p> <p>12. Plastics Materials, 7th Edition by John Brydson, Elsevier 1999</p> <p>13.Experimental Plastics A practical course for students by C.A.Redfran, Interscience Bublisher Inc.NY 1971</p> <p>14.Testing of Paints by S.Patil, Current Awareness Service Publisher, 1993</p>
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Course Outcomes (students will be able to.....)

1	Do laboratory scale experiment for synthesis of polymers like PS PMMA polyacrylamide Epoxy Polyesters nanocomposites .etc	
2	Design and conduct experiments for synthesis of Resins and polymers and understand the practical problems related to the experiment	
3	Analyze and characterize polymers by finding yield melting point epoxy value acid value % solid etc	
4	Interpret data, process parameters within realistic constraints of the experiment	
5	Communicate effectively in team work and understanding of professional and ethical responsibility	

Course Code: PSP1504	Course Title: : Analysis and characterization of Resins and Polymers Lab (50 marks)	Credits =		
		L	T	P
Semester: V	Total contact hours: 1x4hr/Week	0	0	8
List of Prerequisite Courses				
Analytical Chemistry Lab, Polymer science and Technology, Polymer chemistry and Technology, Technology of Thermoset, Technology of Thermoplastics, Raw material Analysis of resins and polymers, Resins and polymer analysis.				
List of Courses where this course will be prerequisite				
Experimental Project, Research and Development in the area of Polymer Synthesis, analysis and characterization				
Description of relevance of this course in the B. Tech. Program				
To understand the laboratory scale quality control analysis. Research and Development of Polymer Synthesis. Ability to analyze and interpret data, process parameters. It helps to improve the ability to identify an unknown resin.				
	Course Contents	Req d. 1x4hr/Week		
1	To determine Acid value, amine value, iodine value, hydroxyl, epoxy, SAP value, ester value of polymers			
2	Refractive Index of resins			
3	Viscosity of resins by various analysis.			
4	K- Value of PVC			
5	Analysis of emulsion polymer			
6	End group analysis of polymers			
7	To determine the melting range and softening range of polymers like			
8	Determine the chlorine content of the chlorinated polymers			

Semester VI

	Course Code: SCT1607	Course Title: :Paint Technology I (100 marks)	Credits = 4		
			L	T	P
	Semester: VI	Total contact hours: 60	3	1	0
List of Prerequisite Courses					
	Polymer science and Technology, Polymer chemistry and Technology, Technology of Thermoset polymers, Analysis of resins and polymers				
List of Courses where this course will be prerequisite					
	Paint Technology II, Environment Health and Safety of Polymers and Coating, Evaluation and testing of Polymers and Coatings. Polymer science and Technology, Polymer chemistry and Technology, Technology of Thermoset polymers, Analysis of resins and polymers				
Description of relevance of this course in the B. Tech. Program					
To give understanding of industrial manufacturing processes, properties and applications, processing of various types of paints. Knowledge of subject will help student to carry out research and development in the areas of paints and coatings, coating formulation development, setting up a paint industry and plant, basics of research and development, etc. To make aware of Environmental concerns of paints and coatings eg., release of VOCs and the effect of VOCs on the environment.					
	Course Contents				Reqd. hours
1	Colloidal chemistry of coatings, surface chemistry of pigment				4
2	Pigment dispersion and wetting, flushing of pigments, effect of pigment volume concentration on paint properties				4
3	Paint additives (wetting and dispersing agents, rheology modifiers, etc.) and solvents				10
4	Basics of Paint formulations				5
5	Machinery for grinding of pigments and extender				2
6	Paint manufacturing machinery for pigment dispersion (Ball mill, Sand mill, Attritor mills, basket mill, kaddy mills, twin shaft dispenser, alpine mills, horizontal vs. vertical mills, etc)				8
7	Manufacture of Powder Coatings, dry distempers, cement paints, oil based distempers and paints, other stiff paints, putties, etc.				4
8	Manufacturing of alkyds, emulsions and hard resins, filtration of resins, paints; forming of hard resins, marking and labeling of packaged products				6
9	Utilities in paint plant (steam, hot oil, cooling water, chilled water, compressed air, etc.)				5
10	Plant layout, Inventory control, use of computers in paint industry, interphasing with R&D				6
11	Solvent emission, recovery and disposal, environmental, health and safety issues				6

List of Text Books/ Reference Books

1. Polymer Chemistry: A Practical Approach (The Practical Approach in Chemistry Series) 1st Edition Fred J. Davis Oxford University Press 2004
2. Basics of Paint Technology Part I, V. C. Malshe.
4. Polymer Science by Gowariker, John Wiley and Sons 1986.
5. Resins for Surface Coatings, Polyurethanes Polyamides Phenoplasts Aminoplasts Maleic Resins (Waterborne & Solvent Based Surface Coatings Resins & Applications) (Volume III) Volume III Edition
6. Resins for Surface Coatings, Volume 1 2nd Edition, Resins for Surface Coatings: Acrylics and Epoxies 2nd Edition by H. Coyard (Author), P. Deligny (Author), N. Tuck (Author), P. K. T. Oldring (Editor)
7. Basics of Paint Technology Part II, Part 2, V. C. Malshe, Prakash C. Malshe, 2008 - Coatings - 624 pages
8. Principles of polymerization, G. Odian, Wiley – Interscience (1981)
9. Outlines of Paint Technology Hardcover – December 1, 2000 by Morgan (Author)

Course Outcomes (students will be able to.....)

1)	Ability to understand various factors affecting the stability of paint	
2)	The student should be able to choose and decide the dosage of various additives in paints	
3)	To be able to decide basic criteria for paint recipe	
4)	Basic understanding of designing paint formulation considering various ingredients	
5)	Ability to handle various machineries and equipment used in laboratory	

Course Code:SCT1608	Course Title: :Paint Technology II (50 marks)	Credits = 3		
		L	T	P
Semester: VI	Total contact hours: 45	2	1	0

List of Prerequisite Courses

Polymer science and Technology, Polymer chemistry and Technology, Technology of Thermoset polymers, Analysis of resins and polymers, Paint Technology I

List of Courses where this course will be prerequisite

Environment Health and Safety of Polymers and Coating, Evaluation and testing of Polymers and Coatings. Polymer science and Technology, Polymer chemistry and Technology, Technology of Thermoset polymers, Analysis of resins and polymers

Description of relevance of this course in the B. Tech. Program

To give understanding of industrial manufacturing processes, properties and applications, processing of various types of high performance paints and coatings. Knowledge of subject will help student to carry out research and development in the areas of high performance paints and coatings, their formulation development, etc. To make aware of Environmental concerns of high performance paints and coatings eg., release of VOCs and the effect of VOCs on the environment.

	Course Contents	Reqd. hours
1	Paints industry overview, Problems and prospects	2
2	Formulation of Primers, zinc rich epoxy, Micaceous iron oxide, zinc chromate and tetraoxy and terraoxy chromate zinc phosphate based primers, wash primers	4
3	Anti-fouling coatings, Paints for marine environments, vinyl paints	4
4	Road marking paints, Cement paints	2
5	Automotive protection products, paints, finishing and refinishing, Electrodeposition coatings, UV curable coatings	4
6	Coatings for high temperature, Coatings for aerospace and aircrafts	4
7	Electrical insulation coatings, Electrical conducting coatings	4
8	Thermal sensitive paints, Thermal Insulating paints	4
9	Metallic paints, Powder coatings, Coil coatings, Wood finishing, Strippable coatings, lacquers	6
10	Treatment of air for paint application, Surface treatment and paint application methods, Treatment of over sprays	4
11	Reworking of painted products	2
12	Paint application and curing machinery	2
13	Formulation and application of sealants and adhesives	3

List of Text Books/ Reference Books		
<p>1. Polymer Chemistry: A Practical Approach (The Practical Approach in Chemistry Series) 1st Edition Fred J. Davis Oxford University Press 2004</p> <p>2. Basics of Paint Technology Part I, V. C. Malshe.</p> <p>4. Polymer Science by Gowariker, John Wiley and Sons 1986.</p> <p>5. Resins for Surface Coatings, Polyurethanes Polyamides Phenoplasts Aminoplasts Maleic Resins (Waterborne & Solvent Based Surface Coatings Resins & Applications) (Volume III) Volume III Edition</p> <p>6. Resins for Surface Coatings, Volume 1 2nd Edition, Resins for Surface Coatings: Acrylics and Epoxies 2nd Edition by H. Coyard (Author), P. Deligny (Author), N. Tuck (Author), P. K. T. Oldring (Editor)</p> <p>7. Basics of Paint Technology Part II, Part 2, V. C. Malshe, Prakash C. Malshe, 2008 - Coatings - 624 pages</p> <p>8. Principles of polymerization, G. Odian, Wiley – Interscience (1981)</p> <p>9. Outlines of Paint Technology Hardcover – December 1, 2000 by Morgan (Author)</p>		
Course Outcomes (students will be able to.....)		
1)	Ability to understand various factors affecting the stability of paint	
2)	The student should be able to choose and decide the dosage of various additives in paints	
3)	To be able to decide basic criteria for paint recipe	
4)	Basic understanding of designing paint formulation considering various ingredients	
5)	Ability to handle various machineries and equipment used in laboratory	
6)	Ability to understand various factors affecting the stability of paint	

Course Code: HUT1104	Course Title: Industrial Management – I	Credits= 3		
		L	T	P
Semester: VI	Total contact hours: 45	2	1	0
List of Prerequisite				
List of Courses where this course will be prerequisite				

Description of relevance of this course in the B.Tech. Program				
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This course is essential for effective functioning of students in their professional career

	Course Contents (Topics and subtopics)	Reqd. hours
1	Introduction: Principles, thoughts and contributions of FW Taylor, Henry Fayol and Elton Mayo. Responsibilities of management: society and development. Functions of Management: Planning, Motivating, Leading, Controlling; Business organization structures, limitations, relative merits & demerits.	10
2	Organisational Process and Behaviour: Introduction and Meaning of Organization, Organization as a process, Span of Control, Authority, Responsibility and Accountability, Delegation of authority, Decentralization of authority. Enhancing Managerial Effectiveness through self and others, Individual Personality & Behavior, Perception, Attitudes, Values and Aptitude, Frustration, Conflict, Organisational structure, Organisational culture, Organisational transformation, Organisational Effectiveness and Assessment;	10
3	Technology Management: Strategies & their applications in industry, Business specifications versus Technical specifications, Introduction to Strategic Innovation, Introduction to technology transfer	10
4	Marketing Management: Marketing vs sales, advertising, marketing research, supply chain management, Brand Management	10
5	Laws: Company Laws, Factory Laws, Labor Laws and Intellectual Property Rights (IPR)	10
6	Communication Skills: Communication process, media channels, written and verbal/presentation skills, barriers to effective communications, counseling and coaching,	5

List of Text Books/ Reference

Essentials of Management, Koontz	
Innovation and Entrepreneurship, Peter Drucker	
Industrial Management – I, Jhamb L.C. and Jhamb S.	
Essentials of Organizational Behavior, S. Robbins	
Organizational Behaviour, Luthans F	
Principles of Marketing, Kotler	
Research and Development Management, Bamfield P	
Industrial Management, Spriegel U.S.	

Course Outcomes (students will be able to.....)

1	Students should be able to explain the fundamental concepts of Industrial Management	
2	Students should be able to analyze practical situations and be able to	

	CourseCode:HUT1105	Course Title:IndustrialManagement– II	Credits= 3		
			L	T	P
	Semester: VII	Total contacthours: 45	2	1	0
List of Prerequisite					
List of Courses where this course will be prerequisite					
Description of relevance of this course in the B.Chem. Engg. Program					
This course is essential for effective functioning of students in their professional career					
	Course Contents (Topics and subtopics)				Reqd.
1	Production Operations Management: Production Management – Modern Approach, Manufacturing systems, Interfacemanagement. Manufacturing/ Operations Strategy – Principles & concept, Operations as competitive weapon --Investment strategy, Capacity strategy, Quality strategy, Technology strategy, Customer focus strategy, Facility location strategy, Product flexibility strategy, Short delivery process strategy, Quick time delivery strategy,				9
2	Financial Management: Investment decisions, Linking investment to Product Life Cycle, Investment risk analysis and risk control/mitigation, Accounting system, Step costing diagram, Balance sheet				9
3	Quality Management: Quality– concept/meaning, Modern approach to Quality Management, QA versus				9
4	Maintenance Management: Causes, costs, life profiles, Classifications, Organization, Equipment & plant reliability and availability, Management of shutdowns & turnarounds.				9
5	Materials Management: Definition, objectives, organization, stages, factors responsible, value analysis,				9
List of Text Books/ Reference					
Production & Operations Management – An Applied Modern Approach, J.S. Martinich					
Industrial Management – I, Jhamb L.C. and Jhamb S.					
Industrial Management, Spriegel U.S.					
Operations Management for Competitive Advantage, Richard B. Chase, F. Robert Jacobs, Nicholas					
World Class Manufacturing - A strategic Perspective, B.S. Sahay, K.B.C. Saxena, A Kumar					
Management Finance, Varanasay Murthy					
Financial Management, R.M. Srivastava					
Quality, John M. Nicholas					
Quality Planning and Analysis, Juran and Gryna					
Course Outcomes (students will be able to.....)					
1	Students should be able to explain the fundamental concepts of Industrial Management				
2	Students should be able to analyze practical situations and be able to provide applicable solutions.				

SCP 1605 Pr 5: Synthesis, processing and characterization of colorants.**100 marks****Contact hr 2x 4hr/week**

Course Contents		Reqd. hours	Course outcomes
1	Synthesis of pigments like 1. Iron oxide, Iron blue etc 2. Lemon chrome 3. Middle chrome 4. Zinc phosphate and Zinc Chromate 5. Para red 6. Toluidine red 7. Hansa Yellow 8. Lithol red 9. Pthalocyanine blue 10. Precipitated barium sulphate	2x4hr/Week	
2.	Characterization and testing of pigments like moisture content, hiding power, yield, bulk density etc.		
3.	Use of Muller and Pigment Flusher for dispersion		
4.	Qualitative analysis of Pigments & Pigment mixtures.		
CO 1	To be able to perform and analyze pigments quantitatively and qualitatively		
CO 2	Ability to conduct experiments to separate pigments from the mixture and the analysis		
CO 3	The student should be able to understand the process of dispersion, factors affecting on it and use the machineries to perform the same		
CO 4:	Ability to handle the equipments such as flusher, muller etc. used for processing in paint industry.		

List of Text Books/ Reference Books

Encyclopedia of Color Science and Technology, Editors: Luo, Ronnier (Ed.)

Modern colorants: synthesis and structure by A T Peters; H S Freeman

SYNTHESIS OF CHROMOTROPIC COLORANTS. By Ralph A Coleman; John Kazan; Mary Louise Vega; american cyanamid co bound brook nj.

Food Colorants: Chemical and Functional Properties by Carmen Socaciu

Course objectives:

1. To learn synthesis of industrially used pigments like Iron Oxide, Iron Blue, Lemon Chrome, Middle Chrome, Zinc Phosphate, Zinc Chromate, Para Red, Toluidine Red, Hansa Yellow, Lithol Red, Pthalocyanine Blue, Precipitated, Barium Sulphate
2. To learn the characterisation of the Pigments like Moisture Content, Bleeding etc.
3. To learn Pigment Dispersion using Muller Machine, Flusher and their quantitative analysis.

SCP 1606 Pr 6: Processing of Paints Lab-I(50 marks)**Contact hr 1x 4hr/week**

	Course Contents	Reqd. hours
1	1. Evaluation of paints as per IS 1012	1x4hr/Week
2.	Preparation of <ul style="list-style-type: none"> A. Alkyd resin and its evaluation (Long, Medium and short by different groups) B. Acrylic/vinyl acetate emulsion C. Plastic emulsion paint and evaluation (To include determination of surfactant demand by daniel flow point method and evaluation of final properties of the prepared paint. Scrub resistance, stain resistance, detergent and soap resistance to be evaluated) D. Polyester polyol from Aliphatic and aromatic dibasic acids, aliphatic diol, triols and its characterizations (A.V. and Hydroxyl value) E. Suspension polymer from MMA and Butyl methacrylate F. Cement paint and application on exterior surface G. Alkyd paint for base coat and top coat at different PVC H. High gloss coating from the polyol and evaluation of the coating properties I. Varnishes for wood finishing 	
3.	Flushing of a pigment cake and comparison of the colour properties of the flush with the dry pigment.	

SCP 1607

Pr 7: Processing of Paints Lab-I I

50 marks

Contact hr 1x 4hr/week

Course Contents:

Processing of Paints-II
Identification of pigment and determine Acidity and Alkalinity
To Determine Oil absorption value, bulk density, Bleeding tendency and Moisture Content of various Pigments.
Preparation of an Azo pigment.
Synthesis of whiting (CaCO ₃) and Iron Oxide Pigment
To synthesize various grades of lead chrome pigment.
Preparation of phthalocyanine pigments.

Semester VII

SYLLABUS: INSTRUMENTATION AND PROCESS CONTROL

Course Code: PST 1710	Course Title: : Environment Health and Safety of Polymers and Coating (100 marks)	Credits = 4		
		L	T	P
Semester: VII	Total contact hours: 60	3	1	0
List of Prerequisite Courses				
Polymer chemistry and Technology, Surface coating Chemistry, Plastic Material, High Polymer Chemistry, Paint Technology				
List of Courses where this course will be prerequisite				
Synthesis of Polymer and resins at laboratory scale and at industrial level. For recycling industry, plastic waste management				
Description of relevance of this course in the B. Tech. Program				
To give understanding of basics of care to be taken while handling polymer and resin. Safety and hazardous of their manufacturing processes. Knowledge of subject will help student to see the environmental impact by plastic and resin. Current understanding of the benefits and concerns surrounding the use of plastics and look to future priorities, challenges and opportunities. It is evident that plastics bring many societal benefits and offer future technological and medical advances. However, concerns about usage and disposal are diverse and include accumulation of waste in landfills and in natural habitats, physical problems for wildlife resulting from ingestion or entanglement in plastic, the leaching of chemicals from plastic products and the potential for plastics to transfer chemicals to wildlife and humans.				
	Course Contents	Reqd. hours		
1	Introduction to Health and safety	1		
2	Plastics and coatings in the society	1		
3	Plastics and coating in the environment	2		
4	Plastic waste and coating waste management	2		
5	Plastic waste in the marine and terrestrial environment	3		
6	Plastic and coating material degradation Regulations for hazardous chemicals in articles/plastic products, coated article.	4		
7	Plastic and coating composition and hazardous chemicals like phthalate base plasticizers and Release and release potential Degradation products Exposure	5		
8	Effects Hazard and risk assessment.	4		
9	Toxicity Product leaching tests	2		
10	Toxicity Identification Evaluations (TIEs)	2		
11	Hazard ranking and assessment of plastic and coating Chemicals in plastic and coating formulations	4		

12	Polymer Production, Paint production and hazard classifications	4
13	Toxicity of discarded electronic products	3
14	Recycling methods of plastic waste and coating waste and their environmental impact	5
15	Health safety and environment related to Solvent based coating UV coatings	5
16	Hygiene coatings Industrial coatings wood coatings, marine coatings etc	5
17	Cytotoxicity of nano particles	2
18	Environment Health and Safety Indian and world Policy of Polymers and Coating	3
19	A more sustainable use of plastics and coatings.	3

List of Text Books/ Reference Books

1.	Plastics Materials by <i>J.A. Brydson</i> , Butterworth-Heinemann, 1999 - <u>Technology & Engineering</u> - 920 pages
2.	Handbook of Industrial Chemistry: Organic Chemicals by Mohammad Farhat Ali, Ph.D., Bassam M. El Ali, Ph.D., James G. Speight, Ph.D. McGraw-Hill Education: New York, Chicago, San Francisco, Athens, London, Madrid, Mexico City, Milan, New Delhi, Singapore, Sydney, Toronto, 2005.
3.	SPI Plastics Engineering Handbook of the Society of the Plastics Industry, Inc. by Berins, Michael L., 1991.

Course Outcomes (students will be able to.....)

1	Understand basics of environmental and safety issues in chemical industry.
2	Understand safety in handling monomer and resins
3	Impact of final product of polymer and coating on environment after use and its waste management.
4	Identify, formulate and know Polymer & Resins
5	Understand safety rule and regulation for polymer and resins. Manufacturing process and application impact and health hazards study of polymer and resins.

Course Code: PST1711	Course Title: :Evaluation and testing of polymer and coatings(50 marks)	Credits = 4		
		L	T	P
Semester: VII	Total contact hours: 45	3	1	0
List of Prerequisite Courses				
Polymer science and Technology, Polymer chemistry and Technology, Technology of Thermoset polymers, Analysis of resins and polymers				
List of Courses where this course will be prerequisite				
Paint Technology II, Environment Health and Safety of Polymers and Coating,Evaluation and testing of Polymers and Coatings. Compounding and Polymer Processing Project ,Environment Health and Safety of Polymers and Coating				
Description of relevance of this course in the B. Tech. Program				
Student will able to design the product .Suggest the product for suitable applications.Subject will help student to carry out work in the area of material sciences.				
	Course Contents	Reqd. hours		
1	Glass transition temperature, melting temperature, heat distortion temperature, etc. Sample preparation, standardization, conditioning of sample, processability test, dynamic mechanical analysis, melt flow rate, Vicat softening temperature. Study of a dilatometer. Study of thermo-chemical analysis and differential scanning calorimeter, GPC.	5		
2	Fourier transform infrared spectrometry, Ultraviolet - visible spectrometry, Nuclear magnetic resonance spectrometry, Mass spectrometry, X-ray diffraction spectrometry, Gas chromatography. Scanning electron microscopy, travelling electron microscope Molecular weight determination Viscosity of polymer solutions and polymers: Their significance, application to polymers using different viscometers.	5		
3	Surface volume resistivity, Breakdown voltage, Arc resistance, Tan Delta,Tensile strength, flexural strength, impact resistance, percentage elongation, tear test, fatigue and wear, hardness, compressive strength time dependant properties like creep, stress, relaxation,etc.Refractive index, gloss, color matching, haze, limiting oxygen index, smoke density Tests for adhesives Identification of polymers using chemical methods ESCR.	5		
4	Analysis of Paints, Theory and practice in testing of paints ,Paint film defects and their remedies. Analytical instruments in paints technology, UV, IR, GCMS,X-Ray Diffraction, LCMS MS, Microscopy	5		
5	Partical size analysis of pigments, Accelerated weathering of paints Evaluation and testing of Synthetic Enamel, Primer, Emulsion paint, Intermediate Coat.	5		
6	NVM,Viscosity,WPL, Grind, Hiding, Drying Time, Scratch Hardness, Impact Test, Flexibility, Gloss Dry Film Thickness.	5		

7	Acid Alkali, and water Resistance, Adhesion As per IS101, Corrosion Resistance By Salt Spray And Humidity Cabinet	5
8	Accelerated Exposure of Paints In QUV And Atlas Apparatus, % Solids, Scrub Resistance, Stain Resistance	5
9	Rheology of Paint system, Colour Matching of Synthetic Enamel, Plastic Emulsion Paint And Distemper.	5
	<p>1.Polymer Chemistry: A Practical Approach (The Practical Approach in Chemistry Series)1st Edition Fred J. Davis Oxford University Press 2004</p> <p>2.A Practical Course in Polymer Chemistry S. H. Pinner, Borough Polytechnic, London, Pergamon Press, Inc., New York, 1961</p> <p>3. PVC Technology, A. S. Athalye and Prakash Trivedi, Multi-Tech Publishing Co, 1994</p> <p>4. Polymer Science by Gowariker, John Wiley and Sons 1986.</p> <p>5. Encyclopedia of Polymer Science and Technology, John Wiley and Sons, Inc 1965.</p> <p>6. Encyclopedia of Polymer Science and Engineering, John Wiley and Sons, Inc 1988.</p> <p>7. PVC Technology, A. S. Athalye and Prakash Trivedi, Multi-Tech Publishing Co, 1994</p> <p>8. Principles of polymerization, G. Odian, Wiley – Interscience (1981)</p> <p>9. PVC Technology 4th edition by W.V. Titov Elsevier Applied Science</p>	
Course Outcomes (students will be able to.....)		
	<p>1) Able to understand the significance and can suggest the techniques which are used for analysis of Polymers such as NMR</p> <p>2) Students get knowledge about various properties of polymers such as mechanical, electrical etc. hence they can suggest the various polymer depending upon specific application</p> <p>3) The significance of rheology is well understood by student and correlation of rheology and temperature is understood hence student can apply this knowledge while processing of polymer</p> <p>4) Student gets theoretically knowledgeable about FTIR, NMR etc hence in case of any hand on experiment with such equipment they can apply this knowledge.</p> <p>5) Student gets idea theoretically about how to identify any unknown sample.</p>	

	Course Code: SCT1712	Course Title: :Radiation Curing Coating (50 marks)	Credits = 4		
			L	T	P
	Semester: VII	Total contact hours: 45	3	1	0
List of Prerequisite Courses					
	Polymer science and Technology, Polymer chemistry and Technology, Technology of Thermoset polymers, Analysis of resins and polymers				
List of Courses where this course will be prerequisite					
	Paint Technology II, Environment Health and Safety of Polymers and Coating, Evaluation and testing of Polymers and Coatings.				
Description of relevance of this course in the B. Tech. Program					
<p>Able to understand the significance of Radiation Curing properties and applications of radiations.</p> <p>Awareness about new and emerging technology in Radiation Curing.</p> <p>Able to judge the property variation with different radiation curing method.</p> <p>Awareness about new and emerging technology in Radiation Curing.</p>					
	Course Contents				Reqd. hours
1	Introduction, Main differences compared to conventional coatings, Advantages and disadvantages, EB versus UV curing, Market figures and main applications, Basics of radiation curing technology, Unique features.				5
2	Cationic UV curing, Initiation – UV exposure, Propagation – curing mechanism, UV curing by photolent bases, Electron-beam technology (EB curing), Raw materials, Monomers and oligomers, General structure-properties relationships, Functional groups and functionality.				5
3	Epoxy acrylates, Urethane acrylates, Polyether acrylates, Acrylatedoligoacrylates, Silicone acrylates.				5
4	Self-initiating acrylate resins, Thiol-ene systems, Unsaturated polyesters, Saturated resins, Monomers for curing by free-radical polymerization, Monofunctional monomers, Difunctional monomers, Polyfunctional monomers.				5
5	Water-based radiation curable coatings, Radiation curable powder coatings, Dual cure technology, Radiation sources, Light sources, Mercury medium pressure lamps, Doped mercury medium pressure lamps, Mercury low pressure lamps, LED arrays.				5

6	Plasma curing, UV curing equipment, Power systems of mercury lamps, Reflectors, Inertization.	5
7	Equipment for curing on 3-dimensional substrates, Areas of application, Wood coatings, UV powder coatings, Other industrial and automotive coatings, Automotive coatings, Coil coatings.	5
8	Adhesives, Electronics and telecommunication, Radiation curable silicone release coatings, Radiation curing scratch-resistant coatings.	5
9	Environmental and occupational protection, Trouble shooting, Properties of the liquid coating/ink, Curing behaviour and mechanical properties of the cured coating/ink.	5

List of Text Books/ Reference Books

	<p>1. Radiation Curing of Coatings, Koleske, Joseph V. Charleston, WV, DOI: 10.1520/MNL12258M</p> <p>2. Paint Technology Handbook Hardcover – Import, 4 Oct 2007 by Rodger Talbert</p> <p>3. Radiation Technology for Polymers, Second Edition, By Jiri George Drobny</p> <p>4. Outlines of Paint Technology Hardcover – December 1, 2000 by Morgan (Author)</p>	
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Course Outcomes (students will be able to.....)

1	Able to understand the significance of Radiation Curing.	
2	Able to judge the property variation with different radiation curing method.	
3	Awareness about new and emerging technology in Radiation Curing.	

Syllabus: Humanities/Management Subject I

Syllabus: Chem. Eng. Laboratory

PSP 1701S Seminar 50 marks 4hr/week

Student will do literature survey on given problem.

PSP 1701P Project I 100 Marks 8 hrs/week

Student will find theoretical solution on given problem by collaborative work

Inplant Training 50 marks

Student will in industries on the industry topics for 45 days.

SEMESTER VIII

CourseCode:CET 1504	Course Title:Chemical ProjectEngg andEconomics	Credits= 3		
		L	T	P
Semester: VIII	Total contacthours: 45	2	1	0
List of Prerequisite Courses				
Material and Energy BalanceCalculations, Equip Desand Dwg I, Energy Engineering, Ind Eng Chem.				
List ofCourses where this coursewill be prerequisite				
Home Paperland II				
Descriptionof relevanceof this course in the B Tech.Program				
This course is required for thefutureprofessional career				
CourseContents(Topics and subtopics)				Reqd. hours
1	Introductiontogreenfieldprojectsandglobalnatureofprojects;Impactofcurrencyfluctuationson Project justificationandcashflowsandConceptsof“Quality byDesign”includingtypical design deliverablesandunderstandingconstructability,operabilityandmaintainability duringallstages of Relationshipbetweenpriceofaproductandprojectcostandcostofproduction,EVAanalysis.			6
2	Elements ofcost of production, monitoring of the same in a plant, Meaning of Administrative expenses,sales expenses etc. Introductiontovarious components ofprojectcost andtheirsignificance.			8
4	Projectfinancing: debt:Equityratio,Promoters’ contribution,Shareholders’ contribution,sourceof finance, timevalue of money. Concept ofinterest, time value of money, selection of various alternativeequipmentorsystem basedonthisconcept. Indiannorms,EMIcalculations.Depreciation			7
5	Estimateofworkingresultsofproposedproject. Capacityutilization,Grossprofit,operatingprofit, profit beforetax,Corporate tax, dividend, Netcashaccruals.Projectevaluation: Cumulativecashflow analysis Break-Even analysis incremental analysis various ratios analysis.			7
6	Process Selection, Site Selection, Feasibility Report			4
7	Project:ConceptiontoCommissioning:milestones,Projectexecutionasconglomerationoftechnical and nontechnical activities, contractual details. Contract:Meaning,contents, Types ofcontract. Lump-sum Turnkey			6
8	ReadingofBalanceSheetsandevaluationof Techno-commercial ProjectReports.			3
9	PERT, CPM,barcharts and network diagrams			4
List of Text Books/ Reference Books				
Chemical Project Economics,MahajaniV.V.andMokashi SM.				
Plant Designand EconomicsforChemical Engineers,Peters M.S.,TimmerhausK.D.				
ProcessPlant and Equipment Cost Estimation, KharbandaO.P.				
CourseOutcomes(studentswill be able to.....)				
1	Calculate workingcapital requirementfor agivenproject			
2	Calculate costof equipment usedinaplant total project cost			
3	Calculate cashflow froma given project			
4	Select a site for the projectfromgivenalternatives			
5	List outvarious milestonesrelatedto project concept tocommissioning			

Course Code: SCT1813	Course Title: Technology of printing inks (50 marks)	Credits = 4		
		L	T	P
Semester: VIII	Total contact hours: 45	3	1	0
List of Prerequisite Courses				
Polymer science and Technology, Polymer chemistry and Technology, Technology of Thermoset polymers, Analysis of resins and polymers.				
List of Courses where this course will be prerequisite				
Paint Technology II, Environment Health and Safety of Polymers and Coating, Evaluation and testing of Polymers and Coatings.				
Description of relevance of this course in the B. Tech. Program				
To understand the basic printing inks and its various formulations.				
To study about various testing and analysis methods for printing inks.				
To understand the basic concept behind the ink-substrate interactions like adhesion, smudging, water resistance, etc.				
To study about various printing inks application methods like flexographic printing, lithographic printing, screen printing, ink-jet printing, UV curable printing, etc.				
	Course Contents	Reqd. hours		
1	Manufacture of paper: qualities and properties of paper .	5		
2	Letterpress printing: Process- characteristics- raw materials- formulations for different substrates- ink related problem and their solution, latest developments	6		
3	Screen printing: Process- characteristics- raw materials- formulations for different substrates- ink related problem and their solution, latest developments	6		
4	Flexography: Process- characteristics- raw materials- formulations for different substrates- ink related problem and their solution, latest developments	6		
5	Gravure: Process- characteristics- raw materials- formulations for different substrates- ink related problem and their solution, latest developments	6		
6	Lithography: Process- characteristics- raw materials- formulations for different substrates- ink related problem and their solution, latest developments	6		
7	Non impact printing	5		
8	Other than above printing method: pad printing, transfer printing and latest development	5		

List of Text Books/ Reference Books	
<ol style="list-style-type: none"> 1. MODERN TECHNOLOGY OF PRINTING INKS 2. The Printing Ink Manual, R. H. Leach, Springer Science & Business Media, 30-Sep-1993 - Art - 993 pages 3. Printing Ink Technology Books Industrial Technologies, India Nai Sarak, New Delhi, Delhi 4. Gravure: Process and Technology Hardcover – Import, Dec 1997by Gravure Association of America (Author) 5. GRAVURE Process and Technology Hardcover – 2003by Gravure Education Foundation (Author) 	
Course Outcomes (students will be able to.....)	
<ol style="list-style-type: none"> 1) Ability to understand testing methods for printing Inks 2) Student should able to understand printing ink properties 3) Ability to understand the surface preparation methods for printings 	

	Course Code: PST1814	Course Title:Nanomaterial and their applications(50 marks)	Credits = 4		
			L	T	P
	Semester: VIII	Total contact hours: 45	3	1	0
List of Prerequisite Courses					
	Polymer science and Technology, Polymer chemistry and Technology, Technology of Thermoset polymers, Analysis of resins and polymers, Environment Health and Safety of Polymers and Coating,Evaluation and testing of Polymers and Coatings.				
List of Courses where this course will be prerequisite					
	Paint Technology II, Environment Health and Safety of Polymers and Coating,Evaluation and testing of Polymers and Coatings.				
Description of relevance of this course in the B. Tech. Program					
. Able to understand the significance of nanosize. Able to synthesized various nanomaterials and nanocomposites Gets aware about new and emerging technology in Polymer and Coating industry such as carbon nanotubes and anticorrosive coating with the use of same					
	Course Contents				Reqd. hours
1	Definition,Classificationofnanomaterialand its uniqueproperties.				5
2	Synthesis, propertiesandapplicationsofCarbonnanotubes.				6
3	Synthesis, propertiesandapplicationsfulleneres.				6
4	Synthesis, propertiesandapplicationsinorganicnanomaterialsliketitaniumdioxide, zinc oxide etc.				6
5	Synthesis, propertiesandapplicationsofnanoparticlesofgold, silvercellulosics etc.				6
6	Dendrimers, Nanoclaysand its differnttreatment.				6
7	Polymernanocompositesand its processingproperties,applicationsandcharecterization				5
8	Nanocoatings,safetyregulatinsofnanomaterials.				5

List of Text Books/ Reference Books	
<p>1. Structural Nanocomposites: Perspectives for Future Applications (Engineering Materials) Hardcover – Import, 16 Dec 2013 by James Njuguna</p> <p>2. Multifunctional Polymer Nanocomposites, ISBN13 : 9781439816820 ISBN10 : 1439816824 Publisher : Taylor & Francis Inc Pages : 466.</p> <p>3. Nanocomposites Organiques a Matrice de Silicium Poreux (French, Paperback, Diyana Badeva)</p> <p>4. Thermoset Nanocomposites for Engineering Applications, Author : Kotsilkova, R.</p>	
Course Outcomes (students will be able to.....)	
<p>1) Able to understand the significance of nanosize.</p> <p>2) Able to synthesized various nanomaterials and nanocomposites</p> <p>3) Able to take care of safety measurements and to deal with any emergency when working with nanoparticles</p> <p>4) Able to judge the property variation with differentiation of particle size of any filler, pigment etc. in polymer composite, coating etc.</p> <p>5) Gets aware about new and emerging technology in Polymer and Coating industry such as carbon nanotubes and anticorrosive coating with the use of same.</p>	

	Course Code: SCT1815	Course Title: Advance paint technology (100 marks)	Credits = 4		
			L	T	P
	Semester: VIII	Total contact hours: 60	3	1	0
List of Prerequisite Courses					
	Polymer science and Technology, Polymer chemistry and Technology, Technology of Thermoset polymers, Analysis of resins and polymers				
List of Courses where this course will be prerequisite					
	Paint Technology II, Environment Health and Safety of Polymers and Coating, Evaluation and testing of Polymers and Coatings.				
Description of relevance of this course in the B. Tech. Program					
To understand in detail the paint rheology and the different additives, called rheology modifiers, used for adjustment of viscosity as per the need. To study in detail surface pretreatment methods and application methods used along with their working principles, advantages and limitations.					
	Course Contents				Reqd. hours
1	Industry overview, problems and prospects, Surface pretreatments for metallic substrates like zinc chromate and tetraoxy chromate, zinc phosphate.				5
2	Primers for Metallic substrates like shop primers and wash primers consisting of zinc rich epoxy, Micaceous iron oxide, Electrodeposition primer.				5
3	Primer surface and sealer coat for metallic substrates. Metallic and solid colour top coat and clear coat. Refinishing of automotive paints. Coatings for aerospace and aircrafts.				5
4	Coil coatings Anti-fouling coatings Electrical conducting coatings Thermal sensitive paints Insulating paints				5
5	Coatings for high temperature Road marking paints				5
6	Paint film defects causes & remedies, Architectural coatings				5
7	Anti-carbonation coating Heat reflective coatings Wood Finishing				5
8	Strippable coatings, lacquers Treatment of air for paint application				5
9	Paint application methods Treatment of over sprays				5
10	Paint application and curing machinery Formulation and application of sealants and adhesives				5
11	Radiation Curing coatings Metallic Coatings				5
12	Paint rheology & different rheology modifiers, Analysis & testing of paints & Paint film				5

List of Text Books/ Reference Books	
	<p>1.Polymer Chemistry: A Practical Approach (The Practical Approach in Chemistry Series)1st EditionFred J. DavisOxford University Press 2004</p> <p>2.A Practical Course in Polymer ChemistryS. H. Pinner, Borough Polytechnic,London, PergamonPress,he., New York, 1961</p> <p>3.Polymer Science by Gowarikar,John Wiley and Sons 1986.</p> <p>4.Encyclopedia of Polymer Science and Technology, Johan Wiley and Sons, Inc 1965.</p> <p>5.Principles of polymerization, G.Odian, Wiley – Interscience (1981)</p> <p>9. PVC Technology 4th edition by W.V.Titow Elsevier Applied Science</p>
Course Outcomes (students will be able to.....)	
1)	Student Should able to understand in detail the paint rheology
2)	Ability to understand Paint properties and their defects
3)	Student should able to understand testing methods and Instruments
4)	Ability to understands the surface preparation methods for coating

Course Code:SCT1816	Course Title:Corrosion science and Corrosion prevention(50 marks)	Credits = 4		
		L	T	P
Semester: VIII	Total contact hours: 45	3	1	0
List of Prerequisite Courses				
Polymer science and Technology, Polymer chemistry and Technology, Technology of Thermoset polymers, Analysis of resins and polymers				
List of Courses where this course will be prerequisite				
Paint Technology II, Environment Health and Safety of Polymers and Coating,Evaluation and testing of Polymers and Coatings.				
Description of relevance of this course in the B. Tech. Program				
. To understand the basics of corrosion- theory, causes, mechanism of corrosion To study how corrosion can be detected and prevented				
	Course Contents	Reqd. hours		
1	Introduction to corrosion	5		
2	Mechanism of corrosion Types of corrosion	5		
3	Detection of corrosion	5		
4	Methods of preventing corrosions	5		
5	Pigments used in corrosion prevention	5		
6	Binders used in corrosion prevention.	5		
7	Formulations of primers for Industrial and non-industrial environment.	5		
8	Best methods and practices followed before and during application of paints.	5		
9	Different characterization and test methods for prevention of corrosion of metallic substrates.	5		

List of Text Books/ Reference Books	
<p>1.Polymer Chemistry: A Practical Approach (The Practical Approach in Chemistry Series)1st Edition<u>Fred J. Davis</u>Oxford University Press 2004</p> <p>2.A Practical Course in Polymer ChemistryS. H. Pinner, Borough Polytechnic,London, PergamonPress,he., New York, 1961</p> <p>3. PVC Technology, A. S. Athalye and PrakashTrivedi, Multi-Tech Publishing Co,1994</p> <p>4.Polymer Science by Gowarikar,John Wiley and Sons 1986.</p> <p>5.Encyclopedia of Polymer Science and Technology, Johan Wiley and Sons, Inc 1965.</p> <p>6.Encyclopedia of Polymer Science and Engineering, Johan Wiley and Sons, Inc 1988.</p> <p>7. PVC Technology, A. S. Athalye and PrakashTrivedi, Multi-Tech Publishing Co,1994</p>	
Course Outcomes (students will be able to.....)	
<p>CO1 To understand the basics of corrosion- theory, causes, mechanism of corrosion</p> <p>CO2 To study various factors/environments that facilitate corrosion.</p> <p>CO3 To study how corrosion can be detected and prevented</p> <p>CO4 To study the role of pigments, binders and additives for corrosion prevention</p> <p>CO5 To study the recent developments in corrosion protection materials etc.</p>	

PSP 1802P Project II 100 marks 8hr/week

Student will do experimental work on the given Problem

	Course Code: SCP1808	Course Title: Analysis and Testing of Paints (100 marks)	Credits = 4		
			L	T	P
	Semester: VIII	Total contact hours: 60	3	1	0
List of Prerequisite Courses					
	Polymer science and Technology, Polymer chemistry and Technology, Technology of Thermoset polymers, Analysis of resins and polymers				
List of Courses where this course will be prerequisite					
	Paint Technology II, Environment Health and Safety of Polymers and Coating, Evaluation and testing of Polymers and Coatings.				
Description of relevance of this course in the B. Tech. Program					
To give understanding of industrial manufacturing processes, properties and applications, processing of various types of paints. Knowledge of subject will help student to carry out research and development in the areas of paints and coatings, coating formulation development, setting up a paint industry and plant, basics of research and development, etc. To make aware of Environmental concerns of paints and coatings eg., release of VOCs and the effect of VOCs on the environment.					
	Course Contents				Reqd. hours
1	Analysis of Linseed Oil (IV, Sap Value, color, Refractive Index, Viscosity)				2x4h/week
2	Analysis of A Synthetic Enamel (Black, Red, White)				
3	Zinc Chrome Primer, Red Oxide , Primer, Intermediate Coat, (NVM, Viscosity, WPL, Grind, Hiding, Drying Time, Scratch Hardness, Impact Test, Flexibility, Gloss, Dry Film Thickness, Acid , Alkali, and Water Resistance, Adhesion, Corrosion Resistance By Salt Spray Humidity Cabinet, Accelerated Exposure Of Paints In QUV And Atlas Apparatus				
4	Analysis of Emulsion Paint (NVM, % Solids, Scrub Resistance, Stain Resistance) Analysis of Architectural Paints, Plastic Emulsion Paint and Distemper				
5	Color Matching Of Synthetic Enamel.				
6	Analysis of Pigments (Solvent Bleed in about 10 Different Solvents, Resistance to acids, alkalis, light)				

List of Text Books/ Reference Books	
	<p>1.Polymer Chemistry: A Practical Approach (The Practical Approach in Chemistry Series)1st EditionFred J. DavisOxford University Press 2004</p> <p>2.A Practical Course in Polymer ChemistryS. H. Pinner, Borough Polytechnic, London, Pergamon Press,he., New York, 1961</p> <p>3. PVC Technology, A. S. Athalye and Prakash Trivedi, Multi-Tech Publishing Co,1994</p> <p>4.Polymer Science by Gowarikar, John Wiley and Sons 1986.</p> <p>5.Encyclopedia of Polymer Science and Technology, Johan Wiley and Sons, Inc 1965.</p> <p>6.Encyclopedia of Polymer Science and Engineering, Johan Wiley and Sons, Inc 1988.</p> <p>7. PVC Technology, A. S. Athalye and Prakash Trivedi, Multi-Tech Publishing Co,1994</p>
Course Outcomes (students will be able to.....)	
1	To know all the properties of Linseed Oil and to have the ability to analyze other sample of Oil given.
2	To be able to characterize the given paint for its properties such as Mechanical, Liquid Properties etc.
3	To be able to characterize given emulsion paint.
4	To have the ability to analyze different Pigments' Properties.