Institute of Chemical Technology

Nathalal Parekh Marg, Matunga
Mumbai - 400019

Category I Deemed to be University (MHRD/UGC)
Elite Status and Centre of Excellence, Govt. of Maharashtra
"National Rank 1 in Atal Innovation Ranking (ARIIA)"
World Renowned for Quality of Education, Research
and Connectivity with Industry

Department of Fibres and Textile Processing Technology

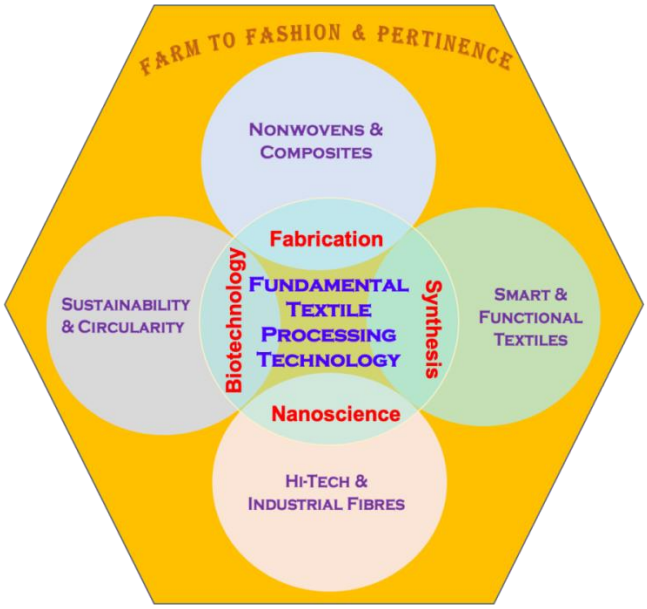
Curriculum
(Instruction, Evaluation and Course content)
(Revision 2021)
For the Four year course leading to the
Bachelor of Technology (B.Tech.) degree program

Implemented from the batch admitted in Academic Year 2021-22

Department of Fibres and Textile Processing Technology

The Institute of Chemical Technology (ICT), was established in1933 and earlier known as a University Department of Chemical Technology (UDCT). Inaugurated by then Chairman of the Textile Mill Owner's Association, with an objective to provide Education and develop Capabilities in the area of Textile Processing and to fulfil the needs of blooming Textile Industry in India.

Initially, it offered two courses; one in Textile Chemistry and the other in Chemical Engineering. The Textiles department is now completing glorious journey of 88 years. This is the first and only premium institute specifically dedicated to study various aspects of Textile wet processing and conduct in-depth research to provide feasible techno-commercial solutions to the ever evolving industrial needs.



The educational curriculum of the department encompasses various segments of Textile value chain and covers components from the 'Farm to Fashion'. The strong technical foundation is laid based on the topics covered, theoretical fundamentals clarified and the hands-on practical know-how provided to the budding technologists. It has helped the alumnus of the department demonstrate industrial excellence and entrepreneurial ability. The alumni of the department are able to provide value added differentiation, achieve leadership positions in different facets of Textile manufacturing and allied industries as well as shine in academic and research institutes across the world.

The department is closely working with various industries involved in fibre and yarn manufacturing, fabric processing and garment making, colourant and auxiliary chemical producing, instrument and equipment making, fashion designing and branding. It also has strong linkage and signed Memorandum of Understanding (MOU) with many national and

international renowned universities. It is well known for the translational research and technology transfer and is often cited as a role model for academic institutes.

The department has the unique distinction of being the first discipline with which this academic institute started and has the highest student intake capacity among the technology courses within the institute. The course involves study of chemistry and manufacture of fibres, their chemical processing such as bleaching, dyeing, printing and finishing. It further encompasses the study of chemistry as well as application of various kinds of chemicals, dyes, thickeners, and finishing auxiliaries which are used in chemical processing of apparel, home furnishing and technical textiles. It also involves knowledge of green chemistry, biotechnology and nanotechnology with special reference to chemical processing of textiles.

Preamble:

The undergraduate programmes at the Institute of Chemical Technology are reputed worldwide. Alumni from these programmes have found a place of pride in the Indian chemical industry including some top names and many as entrepreneurs, in Universities/ Institutes and Research Organisations throughout India and the world. The B.Tech. programmes in the then Department of Chemical Technology, University of Mumbai started in 1934 as post B.Sc., second graduation as B.Sc.(Tech.). Keeping national, societal needs in focus, post-independence, the programme grew into multiple branches keeping connection with chemical engineering content. Once the Institute became a University in 2009, these became independent B. Tech. Programmes retaining their dual core nature. The Institute of Chemical Technology is committed to keeping its syllabi updated and globally relevant for the industry. We have revamped the syllabi of all the B. Tech. programmes now in 2021. The 205 credit programmes each have around 6% humanities, 23% basic sciences, 8% engineering sciences, 12% chemical engineering plus 51% special subjects..

All the courses are credit based and the evaluation are grade based. The credit system is a systematic way of describing an educational programme by attaching credits to its components. The definition of credits is based on student workload, learning outcomes and contact hours. This system is described in detail in Regulation No.9 of the Institute. Each theory course consists of Lectures and tutorials. During tutorial session, it is expected that the problem solving / case studies / relevant real life applications / student presentations / home assignments/individual or group projects are discussed in the presence of the teacher. Teacher can have the freedom to interchange lectures / tutorials depending upon the topic. Institute gives emphasis on continuous evaluation with considerable freedom to the teacher in deciding the mode of evaluation.

Programme Outcomes (POs) for B. Tech. (Fibres & Textile Processing Technology)

PO1	Textile Technology knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and knowledge in specialized field of Fibres and Textile Processing Technology to the solution of complex Textile and apparel industrial problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyze complex Textile and Apparel chemical technological problems reaching substantiated conclusions using first principles of mathematics, natural sciences, engineering sciences including Fibres and Textile Processing technology.
PO3	Design/Development of Solutions: Design solutions for complex Fibres and Textile Processing technology related problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions which can be used for constructing solutions to the problems.
PO5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex Fibres and Textile Processing technology related activities with an understanding of the limitations.
PO6	The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the Fibres and Textile Processing technology practice.
PO7	Environment and Sustainability: Understand the impact of the professional engineering solutions with respect to Fibres and Textile Processing technology, in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex Pharmaceutical technology activities with the Pharmaceutical community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11	Project Management and Finance: Demonstrate knowledge and understanding of the Pharmaceutical technology and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
(B) Programme Specific Outcomes (PSOs)	
PSO1	Develop a confident graduate who can offer solutions to the shop floor complex problems in fibre to garment textile processing field.
PSO2	Instill fundamental knowledge and motivation to go for advance studies and research so that they could develop themselves into Academician and Research scientists making positive contribution to generation and dissemination of new knowledge.
PSO3	Introduce the diverse industry and emerging Textile Technologies to create a thirst among the students for innovative start- up or career options taking advantage of the fast developing Indian economy.

Semester I									
Course Code	**Subjects**	**Credits**	**Hrs/Week**			**Marks for various Exams**			
			L	**T**	**P**	**C.A.**	**M.S.**	**E.S.**	**Total**
CHT1137	Organic Chemistry - I	3	2	1	0	10	15	25	50
CHT1341	Physical Chemistry - I	3	2	1	0	10	15	25	50
CHT1139	Industrial Inorganic Chemistry	3	2	1	0	10	15	25	50
MAT1101	Applied Mathematics - I	4	3	1	0	20	30	50	100
PYT1101	Applied Physics - I	4	3	1	0	20	30	50	100
GEP1113	Engineering Graphics and Elementary Autocad	4	2	0	4	50	-	50	100
CHP1343	Physical and Analytical Chemistry Laboratory	2	0	0	4	25	-	25	50
	TOTAL:	23	14	5	8				500
Semester II									
Subject Code	**Subjects**	**Credits**	**Hrs/week**			**Marks for various Exams**			
			L	**T**	**P**	**C.A.**	**M.S.**	**E.S.**	**Total**
CHT1401	Analytical Chemistry	3	2	1	0	10	15	25	50
CHT1342	Physical Chemistry - II	3	2	1	0	10	15	25	50
CHT1138	Organic Chemistry - II	3	2	1	0	10	15	25	50
PYT1103	Applied Physics - II	3	2	1	0	10	15	25	50
MAT1102	Applied Mathematics - II	4	3	1	0	20	30	50	100
CET1507	Process Calculations	4	3	1	0	20	30	50	100
PYP1101	Physics Laboratory	2	0	0	4	25	-	25	50
CHP1132	Organic Chemistry Laboratory	2	0	0	4	25	-	25	50
HUP1101	Communication Skills	2	0	0	4	50	-	-	50
	TOTAL:	26	14	6	12				550
Syllabus Structure B. Tech. Second Year									
Semester III									
Subject Code	**Subjects**	**Credits**	**Hrs /week**			**Marks for various Exams**			
			L	**T**	**P**	**C.A.**	**M.S.**	**E.S.**	**Total**
BST1110	Basics of Biology and Applications to Technology	3	2	1	0	10	15	25	50
GET1110	Basic Mechanical Engineering	3	2	1	0	10	15	25	50
TXT1106	**SPL1:**Technology of Fibres and Polymers	4	3	1	0	10	15	50	100
CET1704	Material Technology	3	2	1	0	10	15	25	50
CHT1133	**Chemistry of Colorants and It's Application**	4	3	1	0	20	30	50	100
PYT1202	**Colour Physics & Colour Harmony**	3	2	1	0	10	15	25	50
TXP1015	**Pr 1:** Analysis of Textile Chemicals and Fibres	2	0	0	4	25		25	50
PYP1203	**Pr 2:** Colour Physics Lab	2	0	0	4	25		25	50

	TOTAL:	24	14	6	8				500
Semester IV									
Subject Code	**Subjects**	**Credits**	**Hrs/week**			**Marks for various Exams**			
			L	**T**	**P**	**C. A.**	**M.S.**	**E. S.**	**Total**
GET1117	Engineering Mechanics and Strength of Materials	3	2	1	0	10	15	25	50
CET1105	Transport Phenomena	4	3	1	0	20	30	50	100
GET1105	Electrical Engineering and Electronics	3	2	1	0	10	15	25	50
TXT1101	**SPL2:**Technology of Yarn and Fabric Manufacturing	4	3	1	0	20	30	50	100
TXT1209	**SPL3:** Technology of Textile Pretreatment	3	2	1	0	10	15	25	50
TXT1213	**SPL4:** Theory of Textile Colouration	3	2	1	0	10	15	25	50
GEP1106	Electrical Engineering and Electronics Laboratory	2	0	0	4			25	50
MAP1201	Computer Applications Laboratory	2	0	0	4			25	50
	TOTAL:	24	14	6	8				500
Syllabus Structure B. Tech. Third Year									
Semester V									
Subject 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
CET1212	Chemical Reaction Engineering	3	2	1	0	10	15	25	50
TXT1210	**SPL5:** Technology of Textile Dyeing	4	3	1	0	20	30	50	100
TXT1212	**SPL6:** Technology of Textile Printing	3	2	1	0	10	15	25	50
TXT1215	**SPL7:** Chemistry and Applications of Specialty Chemicals	3	2	1	0	10	15	25	50
MAT1106	Design and Analysis of Experiments	4	2	2	0	20	30	50	100
TXP1020	**Pr 3:** Experimental Dyeing and Printing	4	0	0	8			50	100
TXP1002	**Pr 4:** Pretreatment of Textiles	2	0	0	4			25	50
	TOTAL:	26	13	7	12				550
Semester VI									
Subject Code	**Subjects**	**Credits**	**Hrs/week**			**Marks for various Exams**			
			L	**T**	**P**	**C.A.**	**M.S.**	**E. S.**	**Total**
TXT1211	**SPL8:** Technology of Finishing	4	3	1	0	20	30	50	100
TXT1301	**SPL9:** Testing of Textile Materials	4	3	1	0	20	30	50	100
TXT1803	**SPL10:** Effluent characterisation and Treatment	3	2	1	0	10	15	25	50

HUT1103	Industrial Psychology & Human Resource Management	3	2	1	0	10	15	25	50
HUT1106	Environmental Science and Technology	3	2	1	0	10	15	25	50
	Institute Elective – I (Annexure A)	3	2	1	0	10	15	25	50
TXP1010	Seminar	3	0	0	6				50
TXP1011	**Pr 5:** Finishing and Evaluation of Textiles	2	0	0	4	25		25	50
TXP1005	**Pr 6:** Evaluation of Dyes and Specialty Chemicals	2	0	0	4	25		25	50
	TOTAL:	27	14	6	14				550
TXP1014	In-plant Training of 8 to 10 weeks after end of semester								

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 the 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

Subject 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
TXT1501	**SPL11:** High-tech and Industrial Fibres	3	3	1	0	10	15	25	50
TXT1901	**SPL12:** Textile Process House Management	3	2	1	0	10	15	25	50
	Institute Elective- II (Annexure B)	3	2	1	0	10	15	25	50
TXP1014	In-Plant Training	6	0	0	0	10	15	25	50
HUT1203	Industrial Management	4	3	1	0	20	30	50	100
CEP1714	Chemical Engineering Laboratory	2	0	0	4	25		25	50

TXP1021	**Pr 7:** Evaluation of Effluent Parameters	2	0	0	4	25		25	50
TXP1013	Project I	2	0	0	4				50
	TOTAL:	28	12	6	12				500

Semester VIII

Subject 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
TXT1504	**SPL13:** Nonwoven and Technical Textiles	4	3	1	0	20	30	50	100
TXT1207	**SPL14:** Emerging Textile Technology	3	2	1	0	10	15	25	50
TXT1403	**SPL15:** Technology of Garment Processing	3	2	1	0	10	15	25	50
	Programme Elective (Annexure C)	3	2	1	0	10	15	25	50
	Pre-approved Open Electives from MOOOCs/NPTEL	3	2	1	0	10	15	25	50
TXP1017	Project II	4	0	0	8				100
TXP1019	**Pr 8:** Shade Matching and Bulk Colouration	4	0	0	8	50		50	100
	Total	27	13	6	16				550

Semester I

	Course Code: CHT1137	Course Title: Organic Chemistry – I	Credits = 3		
			L	T	P
	Semester: I	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

This is a Basic Organic Chemistry course. The Organic Chemistry studied at HSC is the basis for building up Advanced Organic Chemistry knowledge.

List of Courses where this course will be Prerequisite

Organic Chemistry – II (CHT1138), Biochemistry (BST1102) and several Special Subjects of Pharmaceutical Sciences and Technology Department

Description of relevance of this course in the B. Tech. (Pharm. Chem. Tech.) Programme

To acquaint the students with IUPAC and other types of Nomenclature of organic compounds, fundamentals of Organic Chemistry including reaction mechanisms, organic transformations, types of reactions, selectivity of chemical transformations, etc., stereochemical implications of organic reactions, functional group identification and reactions

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**a. IUPAC Nomenclature of Organic Compounds**	3
	b. Reactive intermediates Carbocations, Carbanions, Carbon radicals and Carbenes – Generation, Structure, Stability and Reactions	5
2	**Stereochemistry of Organic Compounds** containing one and two asymmetric carbon atoms, Stereo descriptors – R/S, E/Z, erythro and thero, Conformation – Ethane and butane Enantiomers and Diastereomers, meso compounds, different representations of stereoisomers – Saw-horse, Newmann, Wedge and dash and Fischer and their interconversions	8
3	**Haloalkanes** Aliphatic Nucleophilic Substitution Reactions: S_N1, S_N2 Elimination Reactions: E1, E2	7
4	**Chemistry of Carbonyl Compounds** Concept of acidity and tautomerism of carbonyl compounds, General methods of preparation and Nucleophilic Addition reactions Enolate chemistry, Aldol and related condensation reactions, Michael reaction, Robinson annulation, Claisen condensation, Dieckmann condensation, Mannich reaction	9
5	**Chemistry of Aromatic Compounds** Hückel rules, Aromatic, Non-aromatic and Anti-aromatic compounds, Benzenoid and non-benzenoid aromatic compounds	3
6	**Electrophilic Aromatic Substitution Reactions** Nitration, Halogenation, Alkylation, Acylation and Sulfonation Activating, deactivating and orienting effects of functional groups in mono- and poly-substituted benzenes Friedel-Crafts alkylation, Acylation, Gattermann, Gattermann-Koch, Riemer-Tiemann reactions	10
	Total	**45**

List of Text Books/Reference Books

1	Clayden, J., Greeves, N., Warren, S.; Organic Chemsitry; 2nd ed.; Oxford University Press (2012)
2	Graham Solomons, T. W.; Fryhle, Craig B.; Snyder, Scott A. Organic Chemistry; 12th Ed.; John Wiley & Sons. Inc. (2016)
3	Smith, M. B.; March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure; 7th ed.; Wiley, India (2015)
4	Carey F. A., Sundberg, R. J. Advanced Organic Chemistry: Part A: Structure and Mechanisms; 5th ed.; Springer (2005)
5	Carey F. A., Sundberg, R. J.; Advanced Organic Chemistry: Part B: Reaction and Synthesis; 5th ed.; Springer (2007)
6	Wade, L. G.; Simek, J. W.; Singh, M. S. Organic Chemistry; 9th ed.; Pearson Education (2019)

7	Eliel, E. L. Stereochemistry of Carbon Compounds; Mcgraw-Hill (2001)
8	Bruice, Paula, Y. Organic Chemistry; 8th Ed.; Pearson Education (2020)

Course Outcomes (Students will be able to…..)	
CO1	draw structures of organic compounds and write their IUPAC names correctly.(K2)
CO2	appreciate the stereochemical implications of organic compounds and visualize and appreciate chirality concept.(K2)
CO3	understand organic chemistry reactions related to aliphatic as well as aromatic compounds as well as decipher the outcome of a given organic transformation.(K3)
CO4	interpret and analyse reactions having different functionalities, deduce and solve problems related to the reactions as well as apply them, if need be.(K4)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	2	0	2	1	3	3	2	3	3	3	1	3	2
CO2	K2	3	2	0	1	0	3	3	1	2	3	2	0	3	2
CO3	K3	3	3	1	2	2	3	1	3	3	2	3	2	3	3
CO4	K4	3	3	1	3	2	3	2	3	2	3	3	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

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

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

	Course Code: CHT1341	Course Title: Physical Chemistry – I	Credits = 3		
			L	T	P
	Semester: I	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

Standard XII Chemistry

List of Courses where this course will be Prerequisite

Physical and Analytical Chemistry Laboratory (CHP1343), Physical Chemistry - II (CHT1342)

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

The course will enable the students to understand and apply the principles of thermodynamics to real-world systems. The students would be able to apply the insights to understand the stability of solutions, spontaneity of physical/chemical processes, effect of thermodynamics parameters on phase and chemical equilibria, etc.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Introduction -** Thermodynamic systems, Work, Heat and Energy, State and Path functions, Intensive and Extensive variables	3
2	**First Law of Thermodynamics -** Enthalpy and heat capacities, Application of First Law to gases, Standard states, Enthalpy changes of chemical and physical conversions, Thermochemistry – Hess's Law	6
3	**Second and Third Laws of Thermodynamics -** Statements and applications of Second Law of thermodynamics, Clausius inequality, Entropy as a state function, Entropy changes for reversible and irreversible processes, Entropy and probability Third Law of Thermodynamics, Absolute entropies, Verification of Third Law	6
4	**Spontaneous Process and Equilibrium -** Combined statement of First and Second Laws of thermodynamics, Helmholtz and Gibbs free energy, Spontaneity and Free energy, Maxwell's relations, Effect of T and P on free energy, Van't Hoff equation, Free energy and equilibrium constant, Ellingham diagrams	7
5	**Multicomponent Systems -** Free energy and entropy of mixing, Partial molar quantities and chemical potential, Gibbs Duhem equation	5
6	**Phase Equilibria -** Gibbs Phase rule, Clausius- Clapeyron equation, Stability of phases, First and second order phase transitions, Phase diagrams of one and two two-component systems, l-L systems - TC, PC phase diagrams, distillation and azeotropes, L/S systems, S/S – eutectics and deep eutectics, Phase diagram of three-component systems	3
7	**Equilibrium in Solutions –** Ideal and non-ideal solutions, Henry's law and Raoult's law, Colligative properties Solubility Equilibria – Solubility constant, Common ion effect, Effect of added salts on solubility, pH, Weak and strong acids and bases, Buffer solutions, Ionic solutions, Activity and activity coefficients, Thermodynamic properties of electrolytes in solutions	6
8	Chemical Equilibria - Equilibrium constants, Le Chaterlier's principle, Effect of temperature, pressure and composition on equilibrium	6
9	Electrochemistry – Thermodynamics of electrochemical systems - Types of electrochemical cells, Determination of electrode potentials, Activity and activity coefficients, Dissociation of electrolytes, Ionic equilibria	3
	Total	**45**

List of Text Books/Reference Books

1	Atkins, Peter W.; Paula, Julio de; Keeler, James. Atkin's Physical Chemistry; 11th ed.; Oxford University Press (2018)
2	Atkins, Peter W.; Paula, Julio de. Elements of Physical Chemistry; 7th ed.; Oxford University Press (2017)
3	Levine, Ira. Physical Chemistry; 6th ed.; McGraw-Hill Education (2009)

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

CO1	comprehend the laws of thermodynamics and related concepts and to explain the molecular basis for the same. (K2)

CO2	apply the concepts of partial molar quantities to explain the behaviour of pure substances and solutions.(K3)
CO3	understand principles of phase equilibria in two- and three-component systems.(K3)
CO4	elucidate the effect of thermodynamic quantities on chemical equilibria and relate it to properties of chemical systems.(K2)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K3	3	3	2	2	2	3	1	3	0	3	2	2	2	3
CO3	K3	3	3	1	2	2	0	3	3	2	3	3	2	3	3
CO4	K2	2	2	0	2	0	3	3	3	3	3	3	1	2	2
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

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

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

	Course Code: CHT1139	Course Title: Industrial Inorganic Chemistry	Credits = 3		
			L	T	P
	Semester: I	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

Standard XII Inorganic Chemistry

List of Courses where this course will be Prerequisite

Material Technology (PCB1302), Engineering Mechanics and Strength of Materials (GET117), Environment Science and Technology (HUT1106)

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

To acquaint the students with synthesis, properties and applications of various industrial inorganic chemicals

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Primary Inorganic Materials:** Water, Hydrogen, Hydrogen Peroxide and Inorganic Peroxo Compounds, Nitrogen, Ammonia, Nitric acid, and Nitrogen Compounds, Phosphorus, Phosphoric acid and its Compounds, Sulfur, Sulfuric acid and Sulfur Compounds, Halogens, Chloralkali and Halogen Compounds	12
2	**Metals and Their Compounds:** Alkali and Alkaline Earth Metals and their Compounds, Aluminum and its Compounds, Chromium Compounds and Chromium, Silicon and its Inorganic Compounds, Manganese Compounds and Manganese, Metallurgy of Iron	10
3	**Organo-Silicon Compounds:** Industrially Important Organo-silicon Compounds, Industrially Important Silanes, Silicones, Industrial Silicone Products	7
4	**Inorganic Solids:** Silicate Products, Inorganic Fibers, Construction Materials, Enamel, Ceramics, Metallic Hard Materials, Carbon Modifications, Fillers, Inorganic Pigments, Cement, Glass	8
5	**Nuclear Cycle:** Economic Importance of Nuclear Energy, General Information about the Nuclear Fuel Cycle, Availability of Uranium, Nuclear Reactor Types, Nuclear Fuel Production Disposal of Waste from Nuclear Power Stations	8
	Total	**45**

List of Text Books/ Reference Books

1	Büchel, Karl Heinz; Moretto, Hans-Heinrich; Woditsch, Peter. Industrial Inorganic Chemistry, Second, Completely Revised Edition; Wiley-VCH (2008)
2	Benvenuto, Mark Anthony. Industrial Inorganic Chemistry; de Gruyter (2015)
3	Swaddle, T. W. Inorganic Chemistry – An Industrial and Environmental Perspective; 1st ed.; Academic Press (1997)
4	House, James, E. Inorganic Chemistry; 3rd ed.; Academic Press, Inc. (2019)

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

CO1	understand various industrial chemicals of nitrogen, sulfur, hydrogen, phosphorus and halogens.(K2)
CO2	understand alkali and alkaline-earth metal based industrial chemicals, iron metallurgy.(K3)
CO3	understand inorganic solid materials like glass, silicone, cement, ceramics, etc.(K2)
CO4	understand nuclear fuel and power industry.(K2)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	2	1	2	0	3	2	3	3	3	3	1	3	2
CO2	K3	3	3	2	2	2	3	3	1	3	3	2	2	3	3
CO3	K2	3	2	0	2	1	3	3	3	3	0	3	1	2	1
CO4	K2	3	2	1	2	1	2	3	3	3	3	1	1	3	2
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

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

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

	Course Code: MAT1101	Course Title: Applied Mathematics – I	Credits = 4		
			L	T	P
	Semester: I	Total Contact Hours: 60	3	1	0

List of Prerequisite Courses

HSC Standard Mathematics

List of Courses where this course will be prerequisite

This is a basic Mathematics course. This knowledge will be required in almost all subjects later.

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

Applied Mathematics is beyond crunching numbers. It is useful for solving real-life problems and make an impact in the world, technology being one of those fields. The knowledge gained is required for solving various mathematical equations in several Chemical Engineering courses such as MEBC, Momentum Transfer, Reaction Engineering, Separation Processes, Thermodynamics, and several others.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Linear Algebra:** Vectors in IR^n, Notion of linear independence and dependence. Vector subspaces of IR^n, Basis of a vector subspace, Row space, Null space, and Column space, Rank of a matrix, Determinants and rank of matrices Abstract vector spaces, Linear transformations in IR^n, Matrix of a linear transformation, Change of basis and similarity, Rank-nullity theorem, and its applications Inner product spaces, Orthonormal bases, Gram-Schmidt orthogonalization process, Eigenvalues and eigenvectors, Characteristic polynomials, Eigenvalues of special orthogonal projection and its application to least methods Diagonalization of matrices and its applications stochastic matrices, Solving initial value system of linear ordinary differential equations	15
2	**Differential Calculus:** Higher order differentiation and Leibnitz Rule for the derivative, Taylor's and Maclaurin's theorems, Maxima/Minima, Convexity of functions, Radius of Curvature. Functions of two or more variables, Limit and continuity, Partial differentiation, Total derivatives, Taylor's theorem for multivariable functions and its application to error calculations, Maxima/Minima	15
3	**Integral Calculus:** Beta and Gamma functions, Differentiation under the integral sign, Multiple integrals, Line and surface integrals, Applications of Green's, Gauss-Divergence and Stokes theorems	15
4	**Probability & Statistics:** Random variables and cumulative distribution function, Probability mass function and probability density function, Some common univariate distributions: Binomial, Poisson, Uniform, exponential, Normal, Expectation and Moments, Moment generating function, Multiple random variables and Joint distribution, Marginal distributions, Covariance and Correlation Concept of parameter estimation: Maximum likelihood estimation, Method of least squares and Simple linear regression, Nonlinear regression	15
	Total	**60**

List of Textbooks/Reference Books

1	Stang, G. Linear Algebra and its Applications; 4th ed.; Thomson (2006)
2	Anton, Howard; Kaul, Anton. Elementary Linear Algebra; 12th ed.; Wiley (2019)
3	Friedberg, Stephen H.; Insel, Arnold J.; Spence, Lawrence E. Linear Algebra; 5th ed.; Pearson Education (2019).
4	Hughes-Hallett, Deborah; Gleason, Andrew M.; McCallum, William G. Calculus: Single and Multivariable; 6th ed.; John Wiley & Sons, Inc. (2012)
5	Kreyszig, E.; Advanced Engineering Mathematics; 10th ed.; Wiley Global Education (2010) (Officially Prescribed)
6	Iyengar, S. R. K.; Jain, R. K. Advanced Engineering Mathematics; 4th ed.; Alpha Science (2014)
7	Ross, Sheldon M. A First Course in Probability; 10th ed.; Pearson Education (2018)
8	Hines, William W.; Montgomery, Douglas C.; Goldsman, David M.; Borror, Connie M. Probability and Statistics in Engineering; 4th ed.; John Wiley & Sons, Inc. (2003)

9	Boes, Duane C.; Graybill, Franklin A.; Mood, Alexander McFarlane. Introduction To the Theory of Statistics; 3rd ed.; McGraw Hill Education (India) (2013)
Course Outcomes (Students will be able to…..)	
CO1	understand the notion of differentiability and be able to find maxima and minima of functions of one and several variables.(K3)
CO2	compute surface and volume integrals.(K3)
CO3	understand the notion of vectors and vector spaces.(K2)
CO4	solve systems of linear equations and eigenvalue problems analytically and numerically.(K3)
CO5	fit relationship between two data sets using linear, non-linear regression.(K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	0	2	3	3	2	3	3	3	2	3	3
CO2	K3	3	3	2	2	2	3	1	1	3	3	2	1	3	3
CO3	K2	3	2	1	2	1	2	3	3	3	3	3	0	3	2
CO4	K3	3	3	2	1	2	3	2	0	0	0	3	2	3	3
CO5	K3	3	3	1	2	2	3	3	2	3	3	1	2	3	3
Course	K3	3	3	2	2	2	3	3	2	3	3	3	2	3	3

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

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

	Course Code: PYT1101	Course Title: Applied Physics – I	Credits = 4		
			L	T	P
	Semester: I	Total Contact Hours: 60	3	1	0

List of Prerequisite Courses

Standard XIIth Physics

List of Courses where this course will be prerequisite

Applied Physics – II (PYT1103), Physics Laboratory (PYP1101), Chemical Process Control (CET1703), Chemical Reaction Engineering (CET1212), Transport Phenomena (CET1105)

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

This is a basic physics course. This knowledge will be required in almost all subjects later on. This knowledge is also required for understanding various chemical engineering concepts that will be introduced in courses such as momentum transfer, reaction engineering, separation processes, thermodynamics, heat transfer, etc.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Solid State Physics** Crystal Structure of Solids: unit cell, space lattices and Bravais lattice, Miller indices, directions and crystallographic planes, Cubic crystals: SSC, BCC, FCC, Hexagonal crystals: HCP, atomic radius, packing fraction, Bragg's law of x-ray diffraction, determination of crystal structure using Bragg spectrometer Semiconductor Physics: Formation of energy bands in solids, concept of Fermi level, classification of solids: conductor, semiconductor and insulator, intrinsic and extrinsic semiconductors, effect of doping, mobility of charge carriers, conductivity, Hall effect	15
2	**Fluid Mechanics** Basic concepts of density and pressure in a fluid, ideal and real fluids, Pascal's law, absolute pressure and pressure gauges, basic concepts of surface tension and buoyancy, fluid flow, equation of continuity, Bernoulli's equation, streamlined and turbulent flow, concept of viscosity, Newton's law of viscosity, brief introduction to non-Newtonian behaviour	15
3	**Optics and Fibre Optics** Diffraction: Introduction to interference and example; concept of diffraction, Fraunhofer and Fresnel diffraction, Fraunhofer diffraction at single slit, double slit, and multiple slits; diffraction grating, characteristics of diffraction grating and its applications Polarisation: Introduction, polarisation by reflection, polarisation by double refraction, scattering of light, circular and elliptical polarisation, optical activity Fibre Optics: Introduction, optical fibre as a dielectric wave guide: total internal reflection, numerical aperture and various fibre parameters, losses associated with optical fibres, step and graded index fibres, application of optical fibres	10
4	**Lasers** Introduction to interaction of radiation with matter, principles and working of laser: population inversion, pumping, various modes, threshold population inversion, types of laser: solid state, semiconductor, gas; application of lasers least squares and Simple linear regression, Nonlinear regression	10
5	**Ultrasound** Generation of ultrasound: mechanical, electromechanical transducers; propagation of ultrasound, attenuation, velocity of ultrasound and parameters affecting it, measurement of velocity, cavitation, applications of ultrasound	10
	Total	**60**

List of Textbooks/Reference Books

1	Physics: Vols. I and II – D. Halliday and R. Resnick, Wiley Eastern
2	Lectures on Physics: Vols. I, II and III – R. P. Feynman, R. B. Leighton and M. Sands, Narosa.
3	Concepts of Modern Physics – A. Beiser, McGraw-Hill.
4	Introduction to Modern Optics – G. R. Fowles ,Dover Publications
5	A Course of Experiments with LASERs – R. S. Sirohi, Wiley Eastern.
6	Optical Fibre Communication – G. Keiser, McGraw-Hill
7	Optoelectronics – J. Wilson and J. F. B. Hawkes, 2nd ed, Prentice-Hall India

8	Ultrasonics: Methods and Applications – J. Blitz, Butterworth
9	Applied Sonochemistry – T. J. Mason and J. P. Lorimer, Wiley VCH.
Course Outcomes (Students will be able to…..)	
CO1	apply acoustic cavitation of Chemical Engineering Processes. (K3)
CO2	apply Bernoulli equation in simple pipe flows. (K3)
CO3	introduced to the principles of lasers, types of lasers and applications. (K2)
CO4	calculate resolving power of instruments.(K3)
CO5	describe principles of optical fibre communication.(K2)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	1	1	3	3	3	3	2	3	3
CO2	K3	3	1	2	1	2	3	3	3	3	3	0	2	1	3
CO3	K2	3	2	1	2	0	3	3	3	3	2	3	1	3	2
CO4	K3	2	3	2	1	2	2	0	2	3	3	3	2	0	3
CO5	K2	3	2	1	2	0	0	3	3	1	3	1	1	3	2
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

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

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

	Course Code: GEP1113	Course Title: Engineering Graphics and Elementary AUTOCAD	Credits = 4		
			L	T	P
	Semester: I	Total Contact Hours: 90	2	0	4

List of Prerequisite Courses

Basic Geometry

List of Courses where this course will be prerequisite

Basic Mechanical Engineering (GET1110), Engineering Mechanics and Strength of Materials (GET1117), Chemical Engineering Operations (CET1401), Chemical Process Control (CET1703)

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

A Chemical Engineering student is required to know various processes and equipments used in the processes. Some of the elementary processes such as filtration, size reduction, evaporation, condensation, crystallization etc., are very common to all the branches of Technology. These and several other processes require machines and equipments. One should be familiar with the design, manufacturing, working, and maintenance of such machines and equipments. The subject of 'Drawing' is a medium through which, one can learn all such matters, because the drawings are used to represent the objects and the processes on paper. With the help of the drawings, a lot of accurate information is conveyed, which otherwise will not be practicable through spoken words or written text. Drawing is a language used by Engineers and Technologists. This course is required in many subjects as well as later on in the professional career.

	Course Contents (Topics and Subtopics)	Required Hours
1	**Orthographic Projections:** Conversion of 3D object or pictorial view into front view, top view and side views using first angle method of projection Sectional views draw sectional front view, top view, and side view Problems with section plane cutting object exactly at centre or off centre Orthographic views of at least 15 machine parts using mini drafter and drawing board	20
2	**Isometric Projections and Isometric Views:** Isometric scale, draw pictorial view or 3D view using front and top view or front view and any one side view Machine parts with circle, semicircle in the orthographic views and slots on inclined planes At least 10 isometric drawings using mini drafter and drawing board	12
3	**Missing Views:** Draw top view when front and any one side view is given Draw any one side view or both the side views when front view and top view is given. Problems involving sectional views. At least 6 machine parts using mini drafter and drawing board.	12
4	**Assembly Drawing**: Draw front view and top view or side view of assembly after assembling all the details of machine parts Convert assembly into details Assembly drawing of Nut and bolt, footstep bearings, Plummer block, etc.	20
5	**Introduction to Computer-Aided Drawing:** Role of CAD in design and development of new products, Advantages of CAD. Creating two-dimensional drawing with dimensions using suitable software (Minimum 2 exercises mandatory) Introduction to Solid Modelling: Creating 3D models of various components using suitable modelling software (Minimum 2 exercises mandatory)	26
	Total	**90**

List of Textbooks/Reference Books

1	Bright, Steven. AutoCAD Fundamentals: A Comprehensive Guide on Engineering Drawing and Modeling (2020)
2	Rathnam, K. A First Course in Engineering Drawing; Springer (2017)
3	Agrawal, Basant. Engineering Drawing; McGraw-Hill Education (2015)
4	Bhatt, N. D. Engineering Drawing by N. D. Bhatt.; 11th ed.; C. Publishing House Pvt. Ltd. (2011)
5	Shah, M. B.; Rana, B. C. Engineering Drawing; 2nd ed.; Pearson Education (2014)
6	Giesecke, Frederick E.; Lockhart, Shawna; Goodman, Marla; Johnson, Cindy M. Technical Drawing with Engineering Graphics; 15th ed.; Pearson Prentice Hall (2016)
7	Dubey, N. H. Engineering Drawing; 15th ed.; Nandu (2015)

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

CO1	prepare multi view orthographic projections of objects by visualizing them in different positions. (K3)
CO2	draw sectional views and develop surfaces of a given object. (K3)

CO3	prepare pictorial drawings using the principles of isometric projections to visualize objects in three dimensions. (K3)
CO4	prepare assembly drawing. (K3)
CO5	obtain Multiview projections and solid models of objects using CAD tools (K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K3	3	2	2	2	2	3	3	3	1	2	3	2	3	1
CO3	K3	3	3	2	2	1	1	3	3	3	3	3	2	2	3
CO4	K3	3	3	2	2	2	3	0	2	3	3	3	2	3	1
CO5	K3	3	2	2	0	2	3	3	3	1	3	0	2	3	3
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

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

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

	Course Code: CHP1343	Course Title: Physical and Analytical Chemistry Laboratory	Credits = 2		
			L	T	P
	Semester: I	Total Contact Hours: 60	0	0	4

List of Prerequisite Courses
Standard XIIth Chemistry Laboratory courses
List of Courses where this course will be prerequisite
This is a basic Course. This knowledge will be required in Applied Chemistry subjects later.
Description of relevance of this course in the B. Tech. Program
Students will become familiar with laboratory experimental skills, plan and interpretation of experimental tasks, understand the relevance of principles of physical chemistry in chemical processes

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	Experiments based on chemical reaction kinetics, phase equilibria and electrolyte systems, surface and interfacial phenomena such as surface tension and CMC measurements	4 hrs/session X 15 sessions
	Total	**60**

List of Text Books/ Reference Books	
1	Practical physical Chemistry – B. Viswanthan and P. S. Raghavan
2	Practical physical Chemistry- Alexander Findlay
Course Outcomes (students will be able to…..)	
CO1	identify and determine physicochemical parameters using simple tools.(K3)
CO2	interpretation of data and drawing scientific conclusions, dryers, etc.(K4)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	2	3	3	2	3	3
CO2	K4	3	3	1	3	1	2	3	1	3	3	0	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

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

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

Semester II

	Course Code: CHT1401	Course Title: Analytical Chemistry	Credits = 3		
			L	T	P
	Semester: II	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

Standard XII Chemistry

List of Courses where this course will be prerequisite

Physical and Analytical Chemistry Laboratory (CHP1343), SPL4: Pharmaceutical Analysis and Green Chemistry (PHT1052), other Chemistry Courses

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

The course introduces the students to key concepts of chemical analysis – sampling, selection of analytical method and data analysis. It presents basic techniques like spectroscopy and chromatography. The students should be able to select an appropriate analytical technique and apply it in accordance with its strengths and limitations.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	Introduction to Chemical Analysis, Terminology (technique/method/procedure /protocol), Broad classification of analytical techniques, Good Laboratory Practices (GLP)	5
2	Sampling: Basics and procedures, preparation of laboratory samples Criteria for selecting analytical methods – accuracy, precision, sensitivity, selectivity, and detection limit Calibration and validation	8
3	Data Analysis: Errors – Systematic and random errors, statistical treatment of experimental results (F, Q and t tests, rejection of data, and confidence intervals), least square method, correlation coefficients	6
4	Spectroscopic Methods: General principles, instrumentation and applications of - UV-visible spectroscopy - Fluorescence spectroscopy	8
5	Electrochemical Methods: General principles, instrumentation and applications of – Conductometry, Potentiometry, Coulometry, Voltammetry	8
6	Chromatographic Methods: General principle, instrumentation and applications of - Gas chromatography (GC), High-performance liquid chromatography (HPLC), Ion-exchange chromatography, Size-exclusion chromatography	10
	Total	**45**

List of Textbooks/Reference Books

1. David Harvey. Modern Analytical Chemistry; McGraw-Hill (1999)
2. R. A. Day and A. L. Underwood. Quantitative Analysis, Prentice Hall of India (2001)
3. H. H. Willard, L. L. Merritt, J. A. Dean and F. A. Settle. Instrumental Methods of Analysis, 7th ed.; Wadsworth Publishing, USA (2004)
4. D. A. Skoog, D. M. West, F. James Holler and S. R. Crouch. Fundamentals of Analytical Chemistry; 9th ed.; Cengage Learning (2013)
5. D. A. Skoog, F. James Holler and S. R. Crouch. Principles of Instrumental Analysis; 6th ed.; Cengage Learning (2016)

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

CO1	apply the knowledge of sampling, data analysis and select proper analytical method. (K3)
CO2	explain the principles of UV Visible and Fluorescence spectroscopic methods. (K2)
CO3	explain the principles of electrochemical methods. (K2)
CO4	Understand the principles of chromatographic separations. (K2)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	0	3	3	0	2	3	3
CO2	K2	3	1	0	1	1	0	3	3	2	3	3	0	2	2
CO3	K2	3	2	1	2	0	3	3	3	3	2	3	1	3	2
CO4	K2	3	2	1	1	1	3	2	3	3	3	3	1	1	2
Course	K3	3	2	2	2	2	3	3	3	3	3	3	2	3	3

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

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

	Course Code: CHT1342	Course Title: Physical Chemistry – II	Credits = 3		
			L	T	P
	Semester: II	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

Standard XIIth Chemistry, Physical Chemistry - I (CHT1341)

List of Courses where this course will be prerequisite

Other Chemistry and Applied Chemistry courses

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

Students should learn to appreciate the relevance of kinetic studies and parameters affecting the same. The understanding of kinetic principles should be applied towards understanding complex reaction pathways and their mechanistic studies. The concept of interfaces and surfaces are instrumental in conveying the applications and importance of disperse systems.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Introduction** – concept of reaction rates and order, experimental methods in kinetic studies, differential and integral methods to formulate rate equations of zero, first and second order reactions Experimental methods of kinetic studies	3
2	**Kinetics and Reaction Mechanism** – Rate-determining step, steady state approximation Complex reactions- parallel, consecutive and reversible reactions Mechanism of thermal, photochemical chain reactions, polymerization reactions Fast reactions – experimental techniques	6
3	**Homogenous Catalysis** – homogeneous acid / base catalysis (specific and general acid catalysis), enzyme catalysis (Michalis-Menten kinetics)	4
4	**Reactions at Interface** – Adsorption isotherms, kinetics of surface reactions- Hishelwood and Rideal models of surface reactions	4
5	**Theories of Reaction Rates** - Theory of unimolecular reactions, collision theory and transition state theory, Effect of temperature, Solvent effects on reaction rates	6
6	**Surface and Interfacial Chemistry** – introduction, surface tension and surface free energy, methods of determining surface and interfacial tensions	10
7	**Thermodynamics of Surfaces** – surface excess, Gibbs adsorption equation, curved surfaces- bubbles, droplets and foams, Kelvin, Young Laplace and Thomson equations, homogeneous nucleation	4
8	**Liquid-Liquid and Solid-Liquid Interfaces** – contact angle, wetting and spreading, adhesion and cohesion, contact angle measurements and hysteresis	4
9	**Surfactants** – Types, adsorption at surfaces and interfaces, surfactant aggregates, factors affecting aggregation phenomena, applications of surfactants and mixed surfactant systems	4
10	**Colloids** – Preparation, stability, characterization, surface charges and electrical double layer Emulsions: Thermodynamics and stability of emulsions, microemulsions and foams, HLB values	5
	Total	**45**

List of Textbooks/Reference Books

1	P. W. Atkins, J. de Paula and J. Keeler. Physical Chemistry; 11th ed.; Oxford University Press (2017)
2	Keith J. Laidler. Chemical Kinetics; 3rd ed.; Harper & Row, New York (1987)
3	Duncan Shaw. Introduction to Colloid and Surface Chemistry; 4th ed.; Butterworth-Heinemann (2013)
4	Drew Myers. Surfaces, Interfaces, and Colloids: Principles and Applications; 2nd ed.; John Wiley & Sons, Inc. (1999)
5	M. J. Rosen. Surfactants and Interfacial Phenomena; 4th ed.; John Wiley & Sons, Inc. (2012)

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

CO1	comprehend fundamental knowledge in chemical kinetics with basics of order, molecularity and temperature effect.(K2)
CO2	examine kinetics for complex, fast as well as surface reactions and comprehend different theories in kinetics.(K4)

CO3	comprehend fundamental knowledge and thermodynamics in surface and interfacial chemistry.(K2)
CO4	evaluate the behavior of surface active agents and disperse systems based on the knowledge of interfacial phenomena.(K4)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	2	1	2	0	3	3	3	3	3	3	0	3	2
CO2	K4	3	1	2	3	2	3	3	3	3	1	3	2	3	3
CO3	K3	3	3	0	2	2	3	3	2	2	3	3	1	3	2
CO4	K4	3	2	2	3	2	0	3	3	3	3	2	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

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

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

	Course Code: CHT1138	Course Title: Organic Chemistry – II	Credits = 3		
			L	T	P
	Semester: II	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

Organic Chemistry – I (CHT1137)

List of Courses where this course will be prerequisite

Other Chemistry and Applied Chemistry courses

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

To acquaint the students with concepts related to aromatic, heteroaromatic and pericyclic reactions so that they are perfectly aligned to apply the same for the future courses and in their professional career

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Nitro and Amino Arenes** Reactions, basicity of aminoarenes, diazotization reactions	5
2	**Aromatic Nucleophilic Substitution Reactions** Addition, elimination mechanism; elimination – addition mechanism (benzyne), Sandmeyer reaction	5
3	**Pericyclic Reactions** Symmetry of molecular orbitals, frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system, classification of pericyclic reactions; Woodward-Hoffmann correlation diagrams, FMO and PMO approaches; electrocyclic reaction -conrotatory and disrotatory motions of 4n, 4n+2 and allyl systems; cycloaddition -antara facial and suprafacial addition, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheleotropic reactions; sigmatropic rearrangements - suprafacial and antarafacial shifts of hydrohen, sigmatropic shifts involving carbon moieties, 3,3- and 5,5-sigmatropic rearrangements, Claisen, Cope and Aza-Cope rearrangements, ene reaction.	13
4	**Heteroaromatic Compounds** IUPAC nomenclature, structures and common names, comparison with benzenoid compounds, reactivity and synthesis – pyrroles, furans, thiophenes and pyridines	10
5	**Named Organic Reactions** Perkin reaction (Mauvine synthesis-dyes), Fischer indole synthesis, (dyes), Jacobson Corey epoxide synthesis (Pharmaceutical), Ziegler Natta polymerisation (polymer), Multicomponent reactions, Mailard reaction (foods), Strecker amino acid synthesis (Pharmaceuticals & Food), Wittig reactions, Prilezhaev reaction	12
	Total	**45**

List of Textbooks/Reference Books

1	Clayden, J., Greeves, N., Warren, S.; Organic Chemsitry; 2nd ed.; Oxford University Press (2012)
2	Graham Solomons, T. W.; Fryhle, Craig B.; Snyder, Scott A. Organic Chemistry; 12th Ed.; John Wiley & Sons. Inc. (2016)
3	Smith, M. B.; March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure; 7th ed.; Wiley, India (2015)
4	Carey F. A., Sundberg, R. J. Advanced Organic Chemistry: Part A: Structure and Mechanisms; 5th ed.; Springer (2005)
5	Carey F. A., Sundberg, R. J.; Advanced Organic Chemistry: Part B: Reaction and Synthesis; 5th ed.; Springer (2007)
6	Wade, L. G.; Simek, J. W.; Singh, M. S. Organic Chemistry; 9th Ed.; Pearson Education (2019)
7	Eliel, E. L. Stereochemistry of Carbon Compounds; Mcgraw-Hill (2001)
8	Bruice, Paula, Y. Organic Chemistry; 8th Ed.; Pearson Education (2020)

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

CO1	be well versed with aromatic chemistry and interpret the outcome of general transformations.(K3)
CO2	appreciate and visualize the reactions involving radicals such as cyclizations, pericyclic reactions in synthesis.(K3)

CO3	understand the importance of heterocycles, learn the properties and synthetic routes, interpret IUPAC of compounds and decipher outcomes of various transformations involving heterocycles.(K3)
CO4	apply the knowledge obtained through the course to predict the outcome of reactions and devise solutions to unknown problems.(K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	0	3	3	2	3	3
CO2	K3	3	3	2	2	1	3	3	3	3	3	3	2	0	3
CO3	K3	3	3	2	1	2	2	1	3	2	3	3	2	3	3
CO4	K3	3	2	0	2	2	3	3	3	3	3	3	1	3	3
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

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

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

	Course Code: PYT1103	Course Title: Applied Physics – II	Credits = 3		
			L	T	P
	Semester: II	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses
Standard XIIth Physics, Applied Physics – I (PYT1101)
List of Courses where this course will be prerequisite
This is a basic Physics course. This knowledge will be required in almost all subjects later on.
Description of relevance of this course in the B. Tech. Program
The knowledge gained from this course is required for understanding various chemical engineering concepts that will be introduced in courses such as momentum transfer, reaction engineering, separation processes, thermodynamics, heat transfer, etc.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Quantum Mechanics** Introduction to quantum physics, black body radiation, explanation using the photon concept, photoelectric effect, Compton effect, de Broglie hypothesis, wave-particle duality, Born's interpretation of the wave function, verification of matter waves, uncertainty principle, Schrodinger wave equation, particle in box, quantum harmonic oscillator, hydrogen atom (no detailed derivation)	25
2	**Dielectric and Magnetic Properties of Materials** Introduction to the 'del' operator and vector calculus, revision of the laws of electrostatics, electric current and the continuity equation, revision of the laws of magnetism. Polarisation, permeability and dielectric constant, polar and non-polar dielectrics, internal fields in a solid, Clausius-Mossotti equation, applications of dielectrics. Magnetisation, permeability and susceptibility, classification of magnetic materials, ferromagnetism, magnetic domains and hysteresis, applications.	20
	Total	**45**

List of Textbooks/Reference Books	
1	Physics: Vols. I and II – D. Halliday and R. Resnick, Wiley Eastern
2	Lectures on Physics: Vols. I, II and III – R. P. Feynman, R. B. Leighton and M. Sands, Narosa.
3	Concepts of Modern Physics – A. Beiser, McGraw-Hill.
4	Solid State Physics – A. J. Dekker, 1957, MacMillan India.
5	Perspectives of Modern Physics – A. Beiser, McGraw-Hill (1969)
Course Outcomes (Students will be able to…..)	
CO1	do simple quantum mechanics calculations.
CO2	define various terms related to properties of materials such as, permeability, polarization, etc.
CO3	state some of the basic laws related to quantum mechanics as well as magnetic and dielectric properties of materials.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K2	3	2	1	2	1	3	2	3	3	3	3	0	3	2
CO3	K2	3	2	1	2	0	3	3	3	0	3	3	1	3	2
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

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

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

	Course Code: MAT1102	Course Title: Applied Mathematics – II	Credits = 4		
			L	T	P
	Semester: II	Total Contact Hours: 60	3	1	0

List of Prerequisite Courses
HSC Standard Mathematics, Applied Mathematics – I (MAT1101)
List of Courses where this course will be prerequisite
This is a basic Mathematics course. This knowledge will be required in almost all subjects later.
Description of relevance of this course in the B. Tech. Program
Applied Mathematics is beyond crunching numbers. It is useful for solving real-life problems and make an impact in the world, technology being one of those fields. The knowledge gained is required for solving various mathematical equations in several Chemical Engineering courses such as MEBC, Momentum Transfer, Reaction Engineering, Separation Processes, Thermodynamics, and several others.

	Course Contents (Topics and Subtopics)	Required Hours
1	**Numerical Methods I:** Solutions of system of linear equations (Gauss-elimination, LU-decomposition, and others) Numerical methods for solving non-linear algebraic/transcendental, Newton's method, Secant, Regula Falsi methods Numerical solution set of linear algebraic equations: Jacobi, Gauss Siedel, and under /over relaxation methods	15
2	**Numerical Methods II:** Interpolation and extrapolation for equal and non-equal spaced data (Newtons Forward, Newtons backward and Lagrange) Numerical integration (trapezoidal rule, Simpson's Rule) Numerical methods for solution of initial values problems using RK method, Euler's method and Taylor series method	15
3	**Differential Equations I:** Differential Equations: Solution of Higher order ODE with constant and variable coefficients and its applications to boundary and initial value problems, Series solution of differential equations, Bessel functions, Legendre Polynomials, Error function	15
4	**Differential Equations II:** Fourier series, Laplace Transforms and their application in differential equation (both ODEs PDEs) Partial Differential Equations, Classification of higher order PDEs, Solution of parabolic equation using separation of variables	15
	Total	**60**

List of Textbooks/ Reference books	
1	Kreyszig, E.; Advanced Engineering Mathematics; 10th ed.; Wiley Global Education (2010) (Officially Prescribed)
2	Iyengar, S. R. K.; Jain, R. K. Advanced Engineering Mathematics; 4th ed.; Alpha Science (2014)
3	Jain, M. K.; Iyengar, S. R. K.; Jain, R. K. Numerical Methods for Scientific and Engineering Computation; 4th Ed.; New Age International (P) Ltd. (2004)
4	Boyce, W. E.; DiPrima R. C. Elementary Differential Equations; 10th ed.; John Wiley & Sons (2012)
5	Brown, J. W.; Churchill, R. V. Fourier Series and Boundary Value Problems; 8th ed.; McGraw-Hill Higher Education (2011)

Course Outcomes (Students will be able to…..)	
CO1	solve system of linear algebraic equations.(K3)
CO2	do numerical integrations of functions.(K3)
CO3	solve higher order ODE by analytical methods.(K4)
CO4	solve initial value problems using numerical methods.(K3)
CO5	apply Fourier series and Laplace transform techniques to solve ODE and PDE.(K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K3	3	3	2	3	2	3	3	3	0	3	1	2	3	2
CO3	K4	3	2	1	2	0	3	3	1	3	3	3	1	3	3
CO4	K3	3	3	3	2	2	2	2	3	3	3	2	2	3	2
CO5	K3	3	2	2	1	2	3	3	3	2	3	3	2	3	3
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

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

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

	Course Code: CET1507	Course Title: Process Calculations	Credits = 4		
			L	T	P
	Semester: II	Total Contact Hours: 60	3	1	0

List of Prerequisite Courses

Standard XIIth Mathematics, Chemistry, Physics

List of Courses where this course will be prerequisite

This is a basic Course. This knowledge will be required in ALL subjects later.

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

The course introduces various concepts used in Chemical Engineering to the students. The knowledge of this course is required for in ALL B. Tech. courses in the subsequent semesters including the project work. It can be applied in various situations such as process selection, economics, sustainability, environmental impacts and others.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	Introduction to chemical process calculations, Overview of single- and multistage operations, Concept of process flow sheets	2
2	Revision of Units and Dimensions, Dimensional analysis of equations, Mathematical techniques	4
3	Mole concept, Composition relationship, Types of flow rates	2
4	Material balance in non-reacting systems: Application to single- and multistage processes	8
5	Stoichiometry	2
6	Material balance in reacting systems: Application to single- and multistage processes	6
7	Behavior of gases and vapors	4
8	Introduction to Psychrometry, Humidity and air-conditioning calculations.	6
9	Calculation of X-Y diagrams based on Raoult's law.	2
10	Applications of material balances to multiphase systems	6
11	Basic concepts of types of energy and calculations	2
12	Application of energy balance to non-reacting systems	6
13	Application of energy balance to reacting systems	6
14	Fuels and combustion	4
	Total	**60**

List of Text Books/ Reference Books

1	Elementary Principles of Chemical Processes, Felder, R. M. and Rousseau
2	Chemical Process Principles, Hougen O. A., Watson K. M.
3	Basic Principles and Calculations in Chemical Engineering, Himmelblau,
4	Stoichiometry, Bhatt B. I. and Vora S. M.

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

CO1	convert units of simple quantities from one set of units to another set of units.(K2)
CO2	calculate quantities and /or compositions, energy usages, etc. in various processes and process equipment such as reactors, filters, dryers, etc.(K3)
CO3	apply material balances in multiphase systems.(K3)
CO4	apply energy balance to various systems.(K3)

Mapping of Course Outcomes (Cos) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	2	0	2	1	3	3	3	3	3	3	1	3	2
CO2	K3	3	3	2	2	2	3	3	3	3	3	2	2	3	3
CO3	K3	3	1	2	2	1	3	3	3	2	3	3	1	3	3
CO4	K3	3	3	2	0	2	3	3	3	3	3	3	2	2	3
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

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

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

	Course Code: PYP1101	Course Title: Physics Laboratory	Credits = 2		
			L	T	P
	Semester: II	Total Contact Hours: 60	0	0	4

List of Prerequisite Courses

Applied Physics – I (PYT1101)

List of Courses where this course will be prerequisite

This is a basic Physics Laboratory course. This knowledge will be required in almost all subjects later on.

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

Students will be able to learn various concepts by doing experiments on different topics. This knowledge will be required in almost all subjects later on. This knowledge is also required for understanding various chemical engineering concepts that will be introduced in courses such as momentum transfer, reaction engineering, separation processes, thermodynamics, heat transfer, etc.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	Viscosity	5
2	Thermistor	6
3	Thermal conductivity	5
4	Ultrasonic interferometer	6
5	Photoelectric effect	5
6	Hall effect	6
7	Newton's rings	5
8	Dispersive power of prism	8
9	Laser diffraction	8
10	Resolving power of grating	6
	Total	**60**

List of Text Books/ Reference Books

1	Physics : Vols. I and II – D. Halliday and R. Resnick, Wiley Eastern
2	Lectures on Physics: Vols. I, II and III – R. P. Feynman, R. B. Leighton and M. Sands, Narosa
3	Concepts of Modern Physics – A. Beiser, McGraw-Hill.
4	Introduction to Modern Optics – G. R. Fowles ,Dover Publications.
5	Optical Fibre Communication – G. Keiser, McGraw-Hill.
6	A Course of Experiments with LASERs – R. S. Sirohi, Wiley Eastern
7	Optoelectronics – J. Wilson and J. F. B. Hawkes, 2nd ed, Prentice-Hall India.
8	Ultrasonics: Methods and Applications – J. Blitz, Butterworth
9	Applied Sonochemistry – T. J. Mason and J. P. Lorimer, Wiley VCH.

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

CO1	Apply various laws which they have studied through experiments (K3)
CO2	Measure transport properties like viscosity, conductivity, etc.(K4)
CO3	Explain the application of acoustic cavitation (K2)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	1	3	3	3	3	3	3	2	3	3
CO2	K4	3	3	2	3	2	3	3	2	3	3	3	0	2	3
CO3	K2	3	2	1	2	0	3	3	3	3	1	3	1	3	2
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

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

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

	Course Code: CHP1132	Course Title: Organic Chemistry Laboratory	Credits = 2		
			L	T	P
	Semester: II	Total Contact Hours: 60	0	0	4

List of Prerequisite Courses

Standard XIIth Organic Chemistry Laboratory

List of Courses where this course will be prerequisite

All the Applied Chemistry Practicals

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

The course is relevant for training the students for working with binary mixtures. The students are exposed to basics of organic separations and identification of organic compounds based on their physicochemical properties. The laboratory training is crucial for the students to carry out work-up of organic reactions leading to separation of crude products followed by purification using recrystallization and/or distillation or related methods.

	Course Contents (Topics and Subtopics)	Required Hours
1	a) Principles of qualitative separation of organic mixtures using physical properties, chemical properties and their combination b) Principles of quantitative separation of organic mixtures using physical properties, chemical properties and their combination	4 4
2	a) Separation of solid-solid water insoluble binary organic mixtures b) Separation of solid-solid partly water soluble binary organic mixtures c) Separation of solid-solid mixtures by fractional crystallization d) Separation of liquid-liquid mixtures by distillation e) Separation of liquid-liquid mixtures by solvent extraction	5X4 2X4 2X4 2X4 2X4
	Total	**60**

List of Textbooks/Reference Books

1	Arthur, Vogel. Textbook of Practical Organic Chemistry, 5th edition, publishers Longman group Ltd, 1989
2	F.G. Mann and B.C. Saunders, Practical Organic Chemistry, 4th edition published by Orient Longman
3	Keese, R, Martin P. B, and Trevor P. Toube. Practical Organic Synthesis: A Student's Guide. John Wiley & Sons, 2006.

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

CO1	work safely in the organic chemistry laboratory.(K3)
CO2	separate binary organic mixtures by multiple techniques.(K4)
CO3	understand basic principles for separation of binary organic mixtures qualitatively and quantitatively.(K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	0	3	3
CO2	K4	3	3	2	3	2	3	3	0	3	3	3	2	2	3
CO3	K3	3	1	2	1	2	2	3	3	3	3	1	2	3	1
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

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

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

	Course Code: HUP1101	Course Title: Communication Skills	Credits = 2		
			L	T	P
	Semester: II	Total Contact Hours: 60	0	0	4

List of Prerequisite Courses

Standard XIIth English

List of Courses where this course will be prerequisite

All courses in this and subsequent semesters

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

This is an important course for the effective functioning of an Engineer and a Technologist. Communication skills are required in all courses and professional career.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	Development of communication skills in oral as well as writing	10
2	The writing skills should emphasize technical report writing, scientific paper writing, letter drafting, etc.	14
3	The oral communication skills should emphasize presentation skills.	10
4	Use of audio-visual facilities like powerpoint, LCD. for making effective oral presentation	14
5	Group Discussions	12
	Total	**60**

List of Text Books/ Reference Books

1	Elements of Style – Strunk and White

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

CO1	write grammar error free technical reports in MS Word or equivalent software.(K3)
CO2	make power point slides in MS PowerPoint or equivalent software.(K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	1	2	3	3
CO2	K3	3	3	2	0	2	3	1	3	3	2	3	2	3	3
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

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

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

Semester III

	Course Code: BST1110	Course Title: Basics of Biology and Applications to Technology	Credits = 3		
			L	T	P
	Semester: III	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses
Standard XIIth Biology
List of Courses where this course will be prerequisite
Safety studies pertaining to Chemicals, Pharmaceuticals, Polymers, cosmetics, Lubricants, Textiles, etc.
Description of relevance of this course in the B. Tech. Program
This interdisciplinary course will help a student understand basics of Human biology along with certain terminologies to enable them to read contemporary research pertaining to important technological developments. The course will help a student to understand the safety evaluation of materials as per regulatory guidelines

	Course Contents (Topics and Subtopics)	Required Hours
1	**Overview of Basics of Human Anatomy and Physiology**, the terminologies used etc. Definitions of Anatomy, Physiology, Histology, Biochemistry, Homoeostasis, Health, Disease, Toxicity, Safety, Genotoxicity, etc. Systems that make the human body, the rationale behind introducing the subject to the technology students of Pharma, foods, Polymers, Surface coatings, Oils, Textiles, Dyes	9
2	**Overview of the Cell Functioning** as a whole unit and its organelles with their functions and its applications to technology. An overview of normal cell division, cell death by apoptosis, necrosis , Cancerous growth, metabolites/ energy production , cellular secretions, different types of cells, cell repair, biomarkers, etc.	9
3	**Overview of Biomaterials:** Biodegradable, Biocompatible and their technological applications	6
4	**Practical Applications:** Design some simple experiments to evaluate toxicity using cellular experiments, organisms, animals etc. OECD guidelines. Concept of Safety studies and industrial relevance. (oral, dermal, inhalation)	6
5	**Toxicity Evaluation** in terms of mortality, Genotoxicity, hypersensitivity (allergy), biocompatibility as per various international guidelines namely, ICH, OECD, ISO to name a few.	10
6	Irritation potential evaluation of lubricants, surfactants, excipients, etc.	5
	Total	**45**

List of Textbooks/Reference Books	
1	R. K. Goyal. Human Anatomy and Physiology, Ahmedabad, India.
2	H. P. Rang, M. M. Dale, J. M. Ritter, Pharmacology
3	Ross and Wilson's Anatomy and Physiology in Health and Illness Anne Waugh and All
4	Online guidelines of OECD, ISO, ICH
Course Outcomes (Students will be able to…..)	
CO1	understand basic concepts and terminologies of Biology.(K2)
CO2	appreciate interdisciplinary nature of biology and will be able to design and execute simple experiments.(K3)
CO3	understand about the concept of toxicity/safety and its relevance to technology and its applications in everyday life.(K2)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	2	1	2	0	3	3	3	3	3	3	1	3	2
CO2	K3	3	3	2	2	2	3	1	3	3	2	1	2	2	3
CO3	K2	3	1	0	2	1	3	3	3	0	3	3	1	3	2
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

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

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

	Course Code: GET1110	Course Title: Basic Mechanical Engineering	Credits = 3		
			L	T	P
	Semester: III	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

None

List of Courses where this course will be Prerequisite

Material Technology (PCB1302), Engineering Mechanics and Strength of Materials (GET1117), Environmental Science and Technology (HUT1106)

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

To acquaint the students with synthesis, properties and applications of various industrial inorganic chemicals

Sr. No.	Course Contents (Topics and subtopics)	Required Hours
1	**Introduction to Thermodynamics:** First Law of Thermodynamics, Steady-flow energy equation, Second Law of Thermodynamics	3
2	**Properties of Steam and Boilers:** Steam formation, Types of steam, Steam Properties – Enthalpy, Simple numerical for finding enthalpy and dryness fraction Steam Boilers: Classification, Working principle of Cochran, Babcock & Wilcox, etc. boilers	6
3	**I. C. Engines:** Classification, Working of 2-stroke, 4-stroke C.I. and S.I. Engines with P-V diagrams, Definitions and simple numerical for determining indicated power, Brake power, Mechanical efficiency, Indicated thermal efficiency, and Brake thermal efficiency	6
4	**Prime Movers:** Classification of Prime movers, Working principle of steam, gas and water turbines, Concept of impulse and reaction steam turbines	4
5	**Compressors:** Classification of compressors, Reciprocating compressors, Single-stage and multistage compressors, P-V diagram, Rotary compressors, Fan, Blower & Compressors, Centrifugal and axial compressors, Application of compressors	4
6	**Pumps:** Classification of pumps, Reciprocating pumps, Centrifugal pumps, Axial pumps, Gear pumps, Maintenance of pumps	4
7	**Refrigeration:** COP of refrigerator and heat pumps, Classification of refrigerants, Nomenclature, Properties desired by refrigerants, Vapour compression refrigeration cycle, Methods of increasing COP of VCRS, Vapour absorption refrigeration systems	5
8	**Renewable Energy:** Role and importance of nonconventional and alternate energy sources such as solar, wind, ocean, bio-mass and geothermal	4
9	**Transmission of Power:** Introduction to various drives such as belt, rope, chain and gear drives, Introduction to mechanical elements such as keys, couplings and bearings in power transmission (No numericals)	5
10	**Properties and Applications of Engineering Materials:** Metals –ferrous, cast-iron, tool steels and stainless steels and non-ferrous aluminium, brass, bronze Polymers – Thermoplastic and thermosetting polymers Ceramics – Glass, optical fibre, glass, cermets Composites – fibre-reinforced composites, metal-matrix composites	4
	Total	**45**

List of Text Books/ Reference Books

1	Nag, P. K. Engineering Thermodynamics; 5th ed.; McGraw Hill Education (2013)
2	Morse, Frederick T. Power Plant Engineering; 3rd ed.; Van Nostrand Reinhold Inc. (1953)
3	Ballaney, P. L. Thermal Engineering: Engineering Thermodynamics & Energy Conversion Techniques; 5th ed.; Khanna Publishers (1966)
4	Lal, J. Hydraulic Machines Including Fluidics; 6th ed.; Metropolitan Book Co. Pvt. Ltd. (2016)
5	Twidell, John; Weir, Tony. Renewable Energy Resources; 3rd ed.; Routledge (2015)
6	Rai, G. D. Non-conventional Energy Sources; Khanna (1988)
7	Arora, C. P. Refrigeration and Air Conditioning; 4th ed.; McGraw Hill (2021)
8	Rattan, S. S. Theory of Machines; 5th ed.; McGraw Hill (2019)

Course Outcomes (Students will be able to…..)	
CO1	discuss the steam formation process and its properties. (K2)
CO2	understand basics of heat transfer, refrigeration and I. C. Engines. (K2)
CO3	understand mechanism of power transfer through belt, rope and gear drives and understand the properties of common engineering materials and their applications in engineering industry. (K3)
CO4	explain the working principles of power-absorbing devices such as pumps and compressors and explain need and importance of various renewable energy sources. (K2)

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K2	3	1	0	2	1	3	1	3	3	3	3	1	3	2
CO3	K3	3	3	2	2	2	3	3	3	3	2	3	2	2	3
CO4	K2	3	2	1	2	0	3	3	2	3	3	3	1	3	2
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

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

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

Course Code: TXT1106	Course Title: SPL1 Technology of Fibres and Polymers	Credits = 4		
		L	T	P
Semester: III	Total contact hours: 60	3	1	0

List of Prerequisite Courses

H. S. C. Science

List of Courses where this course will be prerequisite

Chemistry and Application of Colorants, Technology of Textile Dyeing, High Tech and Industrial Fibres

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

Students will have better understanding of different natural and synthetic fibres, their properties as well as important concept of polymer chemistry which will help in manufacturing as well as designing processing parameters.

Sr No.	Course Contents (Topics and subtopics)	Reqd. hrs
1	Introduction to textile fibre as polymer, Fibre forming characteristics of polymers, Definition of various basic textile terms, Introduction to Fibre, Yarn, Fabric,Classification of fibres based on sources of origin and on chemical constitution.	5
2	Natural fibres of plant, animal and mineral origin, chemistry, morphology, physical and chemical properties, structure property relationship with application, commercially important fibres like cotton, jute, linen, bamboo, wool, silk etc., Fibre to fabric conversion steps.	12
3	Semi-synthetic fibres such as viscose rayon, cuprammonium rayon, acetate rayon, bamboo rayon and lyocell with respect to chemistry, manufacturing process, morphology, physical and chemical properties and structure property relationship with applications.	8
4	Synthetic fibres such as polyester and its variants, polyamides, acrylic, polypropylene, etc with respect to their raw materials, synthesis, manufacturing processes including LOY, FOY, POY, FDY, draw ratio, physical and chemical properties and applications.	15
5	General polymer chemistry; Classification of polymers, synthesis and mechanism, Techniques of polymerization.	8
6	Types of polymeric Molecular weight and its determination.	4
7	Microstructure of polymers, Fibre modification through texturization, TiO2 and chemical modification (using co monomer, other monomers and grafting), Brief idea about polymer composites; Polymer waste and techniques of utilization.	8

List of Text Books/ Reference Books

1	Textile Fibres-I, Mathews, J.M, 4th edition, 1924.
2	Textile Chemistry, Peters R.H, Vol-1, Elsevier Publishing Company, London, 1963.
3	Man-made Fibres, Moncriff, R.W., Newnes Butterworth, London, 6th edition, 1965.
4	Man-made Fibres, Moncriff, R.W., Butterworth Science, London, 6th edition, 1975.
5	Textile Fibres, Shenai V.A., Vol-1, Sevak Publications, Bombay, 3rd edition, 1991.
6	Joseph's Introductory Textile Science, Joseph, M.L., Hudson P.B., Clapp A. C., Fortworth: Harcourt Brace Jovanovich College Publication, 6th edition, 1993.
7	Microscopy of Textile Fibres, Greaves, P.H., Saville B.P.Oxford : BIOS Scientific Publishers Ltd., 1995.
8	Modern Textile Characterization Methods, Raheel, M. Marcel Dekker Inc., New York, 1996.
9	Handbook of Fibre Chemistry, Lewin Menachem, Eli M. Pearce, Marcel Dekker Inc., New York, 2nd edition, 1998.

10	Mishra, S. P. A Text Book of Fibre Science and Technology. India: New Age International, 2000
11	Ghosh, P. . Fibre Science and Technology. United States: McGraw Hill Education (India) Private Limited, 2004
11	Kothari, V. Manufactured Fibre Technology. Netherlands: Springer Netherland, 2012
13	Natural Polymer man-made Fibres, Carrol and Porczynski C.Z., National Trade Press Ltd., London,1965
14	Visco-Elastic Properties of Polymers, Ferry, J.D., John Wiley and Sons, New York, 3rd edition, 1980
15	Textbook of Polymer Science, Billmeyer F.W., John Wiley and Sons, New York, 3rd edition, 1984.
16	Polymer Science, V R Gowarikar, New Age international (P) Ltd Publications, New Delhi,1986

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

1	**Understand** fibre forming properties with different textile terms as well as their classification (K4).
2	**Acquire** deeper understanding and insights in basic chemistry, production processes and physical and chemical properties of Natural and Synthetic fibers. (K2).
3	**Understand** different areas of applications of these fibres vis a vis their properties. (K4).
4	C**omprehend** fundamental knowledge of polymers, their classifications, as well as techniques and mechanism of polymerization(K2).
5	D**escribe** chemical and physical methods used for fibre modification and recycling. (K2)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	3	2	2	2	3	3	3	3	1	3	2	3	3
CO2	K4	3	2	2	3	3	2	3	3	2	3	2	2	3	2
CO3	K4	3	1	0	2	1	3	2	2	3	3	3	1	2	3
CO4	K3	3	3	2	1	1	2	3	3	3	2	0	2	1	2
CO5	K2	3	2	2	3	2	3	3	2	2	3	3	2	3	3
Course	K3	3	3	3	2	2	3	3	3	3	3	3	2	3	3

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

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

	Course Code: CET1704	Course Title: Material Technology	Credits = 3		
			L	T	P
	Semester: III	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

Applied Physics – I (PYT1101), Applied Physics – I (PYT1103)

List of Courses where this course will be prerequisite

Equipment design, Final Year Project, Process Development and Engineering, Project Engineering and Economics

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

Selection of Material of Construction for a given application, Maintenance and corrective measures for various Engineering materials, Troubleshooting

Sr. No.	Course Contents (Topics and subtopics)	Required Hours
1	**Engineering Materials:** Classification, Fundamentals of Engineering properties of materials, Phase diagrams, Study of ferrous and nonferrous materials	12
2	**Composite and Smart Materials**	3
3	**Structure-Property Relationship:** Subatomic to macroscopic level, Modification and control of material properties	10
4	**Theory of Failure of Materials:** Fracture, creep and fatigue	8
5	**Corrosion Engineering:** Electrochemical principles, different types of corrosion, Polarization, Mechanisms of corrosion control and prevention, Preventive coatings. Corrosion behavior of industrial materials	8
6.	**Criteria for Selection of Materials** in Chemical Process industry	4
	Total	**45**

List of Textbooks

1	The Essence of Materials for Engineers, Robert W. Messler, Jr.
2	Materials Science and Engineering, Raghavan V.
3	Materials Science and Engineering, Van Vlack L.H.
4	Engineering Materials and Applications, Flin R.A., Trojan P.K.

List of Additional Reading Material/Reference Books

1	Material Science and Engg, Callister
2	Mechanical Metallurgy, Dieter

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

CO1	resolve the issues related to mechanical failure.(K3)
CO2	troubleshoot corrosion-related industrial problems.(K2)
CO3	learn from incidences (LFI).(K2)

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	1	3	2	3	3
CO2	K3	3	3	2	0	2	3	3	2	3	3	0	2	2	3
CO3	K2	3	2	1	2	1	2	3	3	3	2	3	1	3	2
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

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

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

Course Code: CHT1133	Course Title: Chemistry of Colorants and It's Application	Credits = 4		
		L	T	P
Semester: III	Total contact hours: 60	3	1	0

List of Prerequisite Courses

HSC (Science), Organic Chemistry

List of Courses where this course will be prerequisite

Technology of Textile Dyeing, Additives for polymers, Additives for Coatings Compounding and polymer Processing Analysis of Paints Pigment synthesis Lab Experimental Dyeing, Theory of Textile Coloration

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

Students will understand the chemistry behind the colorants.

They will be able to explain the its applications in various field according to the chemistry involved..

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	Introduction of Pigments ,Colour Index Generic Names of Pigments, Colour Constitution Number ,Polymorphism, Properties required in a pigment and extender, Pigment dispersion basics Classification of inorganic and organic pigments with examples, additive and substractivecolour mixing. Definitions of pigment, extenders, dyes, pigment dyestuffs, toner and lakes	5
2	Theory of color formation in organic compounds, effect of auxiliary groups on the shade and hue of the pigment (Bathochromic and hyper chromic shift) Practices and requirement of Pigments	5
3	Inorganic pigments such as titanium dioxide, zinc oxide, carbon black, chromate pigments, molybdate orange, chrome green. General methods of processing and synthesis of inorganic pigments: Crushing and grinding, vaporization, co precipitation, filtration, drying, flushing, calcinations/roasting, vapour phase oxidation etc. Raw materials for organic pigments: A brief study of coal tar distillation and the role of distillation products in the manufacture of synthetic dyes: bases and precipitants used in the colour striking, toners and lake formation.	5
4	Ultramarine blue, iron blue, cadmium red, pearlescent and other effect pigments Ceramic pigments, metal flake pigments, extenders	5
5	Organic pigments such as Antraquinone, Benzimidazolonedioxazines, Diazo lakes	5
6	Litholrubones, Monoazo lakes, Napthol AS lakes, Napthol AS, Perylenes, Phthalocyanines, Quinacridones effect pigments	5
7	Pigments for Plastics, Textiles, Paints, Resins,PrintingInk,Cosmetics, Rubbers,Special Application fields.	5
8	Spectral properties of colorants, Jablonski diagram, classification of dyes according to application/constitution, empirical treatment of colour and constitution	5
9	Azo dyes: Diazotisation and coupling reactions, azoic colours, acid dyes, mono azo dye; diasazo, nitro, diphenylamine and anthraquinone dyes; acid mordant dyes, azo metal complex dyes, direct dyes	5

10	Basic dyes: Diphenylmethane and triphenylmethane dyes and heterocyclic analogues thereof, triphenodioxazine dyes. Disperse dyes: azo, anthraquinone, dinitrophenylamine, methine dyes; properties in relation to constitution	5
11	Vat dyes: Indigoid, anthraquinonoid and polycyclic quinonoid dyes; solubilised vat dyes. Sulphur dyes and sulphurised vat dyes	5
12	Reactive dyes: Chlorotriazine and other halo heterocyclic compounds, vinyl sulphone based dyes, high fixation, highly substantive, neutral fixing bifunctional reactive dyes.	5

List of Text Books/ Reference Books

1	Color Chemistry, 3rd Edition, Heinrich Zollinger, Wiley – VCH 2003
2	Colorants and Auxiliaries: Colorants v. 1: Organic Chemistry and Application Properties, John Shore, Society of Dyers &Colourists; 2nd edition edition (Jan. 2002)
3	The Chemistry of Synthetic dyes, K. Venkataraman, Academic Press (1 January 1971)
4	Industrial Inorganic Pigments, Gunter Buxbaum, Wiley-VCH; 1 edition (March 11, 2005)
5.	Industrial Organic Pigments: Production, Properties, Applications, 3rd, Completely Revised Edition by Herbst, Klaus HungerWilly March 2006
6.	Application Properties of Pigments By A.Karnik, First Edition Thane1999

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

1	Understand fundamental knowledge on basics of chemistry involved in the colorants. (K2)
2	Describe the types of pigments and their applications (K2)
3	Compare the physical properties of Pigments and dyes to differentiate them (K4)
4	Illustrate synthetic methods used for azo dyes and their properties. (K3)
5	Identify types of dyes on the basis of application, properties and functional groups. (K2)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

POs		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
K level		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K5	K4	K3
CO1	**K2**	3	2	2	3	2	2	3	3	2	1	2	3	3	2	3
CO2	**K2**	2	1	3	2	2	2	2	2	2	2	2	2	3	2	3
CO3	**K4**	3	3	2	3	3	3	3	2	1	2	2	3	2	2	2
CO4	**K3**	3	2	2	3	3	2	3	1	2	2	2	3	3	3	3
CO5	**K2**	2	2	3	2	2	2	3	2	2	1	3	3	3	2	3
Course	**K4**	3	2	3	3	3	2	3	2	2	2	2	3	3	2	3

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

Course Code: PYT1202	Course Title: Colour Physics & Colour Harmony	Credits = 3		
		L	T	P
Semester: III	Total contact hours: 45	2	1	0

List of Prerequisite Courses

H. S. C. Science

List of Courses where this course will be prerequisite

Chemistry and Application of Colorants

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

This subject will be useful for understanding choice of material for dyeing and printing for specific requirement of color or shade.

Sr. No.	Course contents(topics/subtopics)	Required hrs
1	**Introduction:** Colour as a concept, its definition, geometric and chromatic attributes	3
2	**Radiation and illumination:** SPD, CT andCCT; Sources and illuminants; Need for artificial sources – various ways of producing light and different artificial sources; efficacy and colour rendering properties of sources.	6
3	**Interaction of radiation with matter** : gloss and diffused reflectance, travel, flip and flop colour,polar diagrams; absorption of light in sample-various transitions in dye molecule, Beer – Lambert law and its verification, deviation from Beer – Lambert law, Additivity of absorbances, mixture analysis, various instruments used for the purpose; absorbance and scattering in the sample – Kubelka Munk theory	8
4	**Perception of colour** in **eye \ brain**: various colour coding processes at retina and beyond it, colour constancy, colour theories, anomalous colour visions, metamerism	6
5	**Colour specification**: Additive-substractive mixing, Grassmann's law,1931 and1964CIE system-XYZ and L*a*b*colour spaces, colour difference formulae, Munsell colour order system	8
6	**Recipe match prediction**: Single constant Kubelka – Munk theory of colourant formulation and recepie prediction; Modern computerised methods of colour matching	6
7	**Colour Harmony**: Definition, colour associations, colour harmony theories; colour contrasts-successive and simultaneous contrast, contrast of proportion, intensity, value, hue etc.(Itten's contrasts);colour wheel and various colour schemes, dominant, subdominant and accent colours; visual weight and balance in colour schemes	8

List of Text Books/ Reference Books

1	Colour Physics for Industry, R. McDonald, West Yorkshire, 1997.
2	Color: A Multidisciplinary Approach; Zollinger Heinrich Zurich, Verlag Helvetica Chemica Acta, 1999
3	The Colour Science of Dyes and Pigments, R. McLaren Bristol, Adam Hilger Ltd., 1983
4	Industrial Colour Technology, Johnson R. M., Sartzman M, American Chemical Society, Washington D.C., 1971.
5	Coloring of Plastics: Fundamentals by Robert A. Charvat John Wiley & Sons, 11-Mar-2005
6	Coloring of plastics: theory and practice by M.Ahmad Van Nostrand Reinhold, 1979

	Course Outcomes (students will be able to.....)
1	Understand the colour perception and the effect of various parameters on it. (K2)
2	Understand various visual and colour processes in human beings. (K2)
3	Understand various systems to specify uniquely a colour stimulus and use them to do so. (K3)
4	Use knowledge of such colour systems to predict recipe (K3)
5	Understand various colour harmony theories and the use of colour wheel. (K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)																
POs		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
K level		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K5	K4	K3
CO1	**K2**	2	1	1	1	1	1	1	2	2	2	2	2	2	2	3
CO2	**K2**	2	1	1	1	1	1	1	2	2	2	2	3	2	2	2
CO3	**K3**	3	2	2	2	2	2	2	3	2	3	2	2	3	3	2
CO4	**K3**	3	2	2	2	2	2	2	3	3	3	2	3	2	3	3
CO5	**K3**	3	2	1	1	1	2	2	3	2	2	3	3	3	3	2
Course	**K3**	3	2	2	1	2	2	2	3	2	2	2	3	2	3	2

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

	Course Code: TXP1015	Course Title: PR1 Analysis of Textile Chemicals and Fibres	Credits = 2		
			L	T	P
	Semester: III	Total contact hours: 60	0	0	4

List of Prerequisite Courses

H. S. C. Science, Organic Chemistry

List of Courses where this course will be prerequisite

Chemistry, Applications and Evaluation of Specialty Chemicals

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

It will provide scientific background to students which will help them to understand requirements, evaluation and standardisation of basic chemicals used during textile processing

Sr. No.	Course contents (topics/subtopics)	Reqd. hrs
1	Estimation of bleaching powder, Hydrogen peroxide and sodium chlorite	4
2	Estimation of sodium silicate and sodium carbonate, Glauber's salt and sodium chloride	4
3	Estimation of composition of alkali mixture and barium hydroxide	4
4	Estimation hardness of water, acid value and Iodine value of fatty acids	4
5	Estimation of sodium hydrosulphite and Rangolite C	4
6	Estimation of formaldehyde, oxalic acid, sodium alginate and Chelating agents	4
7	Estimation of efficiency of Sizing chemicals	4
8	Identification of single fibres and binary/tertiary blends by microscopic and chemical method	4
9	Quantitative analysis of blends	4
10	Determination of count of yarn and fibre maturity	4
11	To measure Yarn Appearance, twist/Count , Hairiness/yarn imperfections(Zwellager) , and single yarn strength and elongation at break of the yarns	4
12	To determine Types of weave (Weave Diagram) of the fabric	4
13	To measure the GSM and Fabric Count (Ends/pick, Wales/course) of the fabric	4
14	To measure the Fibre fineness by Cut-Weight Method and airflow instrument	4
15	To measure twist in double and single yarn	4

List of Text Books/ Reference Books

1	Technology of Bleaching and Mercerizing, Shenai V.A., Sevak Publication, Bombay, Vol. - 3, 3rd
2	Textile Bleaching, Steven A.B., Pitman and Sons, London.
3	Technology of Scouring and Bleaching, Trotman E.R., Griffin, London, 1968.
4	Technology of Bleaching and Dyeing, Chakraverty, R.R., Trivedi S.S., Vol. 1, Mahajan Publishers Private Ltd., Ahmedabad, 1979.

5	Textile Chemistry, Peters R.H, Vol-2, Elsevier Publishing Company, London, 1967.
6	Sizing by D.B.Ajgaonkar, M.K.Talukdar and V.R.Wadekar
7	Mercerizing by J.T.Marsh
8	Chemical Technology in the Pre-treatment Processes of Textiles by S.R.Karmakar
Course Outcomes (students will be able to.....)	
1	Able to estimate the purity of the different acids, alkali, reducing agents, oxidizing agents used in the textile processing. (K4)
2	Able to find the efficiency e.g. of Sizing chemicals, blend analysis, fibre identification by microscopic and by chemical methods . (K5)
3	Able to describe, carry out and use yarn twist/count, Appearance, Hairiness/yarn imperfections, fabric GSM. (K2)
4	Able to describe, interpret, examine and determine twist in double and single yarn, strength and elongation at break.(K3)
5	Able to carry out and use measurement of maturity and fineness of fibres by airflow instrument.(K3)

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K4	3	2	1	2	0	3	3	3	3	3	3	1	3	2
CO2	K4	3	2	1	3	1	3	3	2	2	1	3	0	3	3
CO3	K4	3	3	3	2	1	2	3	0	3	2	3	2	2	3
CO4	K3	3	2	1	2	0	3	3	3	3	3	2	1	3	2
Course	K4	3	3	2	2	2	3	3	3	3	3	3	2	3	3

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

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

Course Code: PYP1203	Course Title: PR2 Colour Physics Lab (Marks50)	Credits = 2		
		L	T	P
Semester: III	Total contact hours: 40	0	0	4

List of Prerequisite Courses

H. S. C. Science

List of Courses where this course will be prerequisite

Theory of Textile colouration, Computer Colour Matching Laboratory, Experimental Dyeing

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

This course will help student to study and understand photophysical properties of colorants.

	Course contents(topics/subtopics)	Required hrs
1	Determination of unknown concentration of a dye in solution by Dubosque colorimeter.	4
2	Verification of B-L law (dependence of absorbance on concentration) by spectrophotometer.	4
3	Mixture analysis using spectrophotometer.	4
4	Determination of gloss of various samples using gloss meter	4
5	Determination of color of various textile samples in terms of Lovibond primaries and chromaticity co-ordinates using Lovibond tintometer	4
6	Specification of color of a textile sample in terms of 'Lab' at using color computer.	4
7	Finding color differences (ΔE) between set of samples vis a vis dye solution concentration	4
8	Finding color differences (ΔE) between set of samples vis a vis time of exposure.	4
9	Determination of colors of samples in terms of Munsell color system using Munsell Color Tree	4
10	Recipe prediction and matching of colored samples using CCM.	4

List of Text Books/ Reference Books

Colour Physics for Industry, R McDonald, SDC Publ., 1997

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

1	To understand colour specifying systems and schemes of quantification of colour.
2	To measure the intensity of the transmitted light and correlate it with concept of chromophore and colour
3	To use instruments to uniquely specify a colour in terms of nos.
4	To explain various concepts of colour mixing, sources etc.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
K Level	K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K5	K4	K3

CO1	**K3**	3	2	2	3	2	2	2	1	2	1	1	2	2	2	3
CO2	**K4**	2	3	3	3	2	2	1	2	3	2	2	3	3	3	3
CO3	**K4**	3	3	3	2	1	2	1	2	3	1	2	3	3	3	2
CO4	**K3**	3	2	2	3	1	1	2	1	2	2	1	2	2	2	3
Course	**K4**	3	3	3	3	2	2	1	2	3	1	1	2	3	2	3

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

Semester IV

	Course Code: GET1117	Course Title: Engineering Mechanics and Strength of Materials	Credits = 3		
			L	T	P
	Semester: IV	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

Standard XII Physics and Mathematics, Applied Mathematics - I and - II, Applied Physics - I

List of Courses where this course will be Prerequisite

Material Technology, Strength of Materials, Environment Science and Technology

Description of relevance of this course in the B. Tech. (Pharm. Chem. Tech.) Programme

This subject will help students to understand use of basics of Applied Mechanics and Strength of Materials. As a practicing Engineer and Technologist, the students will relate different types of forces to be considered along with their quantification during design of equipments. It will also help in understanding the conditions of equilibrium and their application for analysing the problems, importance of centre of gravity and moment of inertia in Engineering Design, study of different types of stresses and strains occurring in various components of the structure including in thin cylindrical shells., advantages and disadvantages of various geometric sections available for Engineering design. In addition, the students will be acquainted with different advance fibre polymer composite materials used in industry for various applications and several performance- enhancing construction chemicals. In summary, this is a foundation course for a proficient Design Engineer and Technologist.

Sr. No.	Course Contents (Topics and subtopics)	Required Hours
1	**Concepts of Forces**, their types, Resolution of forces, Composition of forces, Steps in Engineering Design, Different types supports and free body diagram	4
2	**Equilibrium of Rigid Bodies** - Conditions of equilibrium Determinant and indeterminate structures Equilibrium of beams, trusses and frames Problems on analysis of beams and truss.	6
3	**Concept of Centroid and Moment of Inertia** (Second moment of area) its use Parallel axis theorem Problems of finding centroid and moment of Inertia of single figures, composite figures Perpendicular axis theorem, Polar M.I., Radius of gyration.	5
4	**Shear Force and Bending Moment** - Basic concept, S.F. and B.M. diagram for cantilever, simply supported beams (with or without overhang) Problems with concentrated and U.D. loads.	4
5	**Stresses and Strains** - Tensile and compressive stresses, Strains, Modulus of elasticity, Modulus of rigidity, Bulk modulus Thermal stresses and strains Problems based on stresses and strains Basics of Engineering Design - Steps in the engineering design, Importance of analysis, 1-D, 2-D and 3-D analysis and interpretation of results. Design philosophies	6
6	**Theory of Bending** - Assumptions in derivation of basic equation, Basic equation, Section modulus, Bending stress distribution	3
7	**Problems on Shear Stress** - Concept, Derivation of basic formula Shear stress distribution for standard shapes Problems of Shear stress distribution	3
8	**Slope and Deflection of Beams** - Basic concept, Slope and Deflection of cantilever and simply supported beams under standard loading Macaulay's method	4
9	**Thick and Thin Cylinders** - Concept of radial, longitudinal stresses, behaviour of thin cylinders Problems on thin cylindrical and spherical shells Behaviour of thick cylinders (Theory only)	4
10	**Natural Materials**, Manmade Materials Composite Materials – Types of composite materials and their uses in various industrial applications Different types of performance enhancing and special purpose construction chemicals; Plasticizers and super-plasticizers; Recycling of waste – value addition; Testing of Materials and its relevance	6
	Total	**45**

List of Text Books/ Reference Books	
1	Thadani, B. N. Engineering Mechanics; Asia Publishing House (1966)
2	Popov, Egor P. Introduction to Mechanics of Solids; Macdonald (1968)
3	Beer. Mechanics of Materials; 7th ed.; Mc Graw-Hill India (2016)
4	Dadhe, V. G.; Jamdar, M. G.; Walavlkar, Y. N. Fundamentals of Applied Mechanics; Sarita Prakashan (1989)
5	Timoshenko, S.; Young, D. H.; Rao, J. V.; Pati, Sukumar. Engineering Mechanics; 5th ed.; McGraw Hill Education (2017)
6	Singer, Ferdinand L.; Pytel, Andrew. Strength of Materials; 4th ed.; Harper Colins Publishers (2012)
7	Kaw, Autar K. Mechanics of Composite Materials; 2nd ed.; CRC Press (2006)
8	Shetty, M. S.; Concrete Technology: Theory and Practice; S. Chand & Co. Ltd. (2005)
Course Outcomes (Students will be able to…..)	
CO1	quantify the actions and able to find reactions by applying conditions of equilibrium, find out the Centroid and Moment of Inertia for various cross sections used in engineering structures and for plane areas and be able to draw the Shear Force and Bending Moment diagram for different types of beams under simple and complex loading.(K3)
CO2	calculate the forces, reactions, stresses, strains in components of the bodies of a complex engineering structure.(K3)
CO3	find out the Bending Stresses at different positions and Shear Stress distribution across the cross section at various points and calculate the Slope and Deflection at different points under simple and complex loading.(K3)
CO4	know various materials used in various applications in engineering. cement composite – Concrete, Chemicals used to alter the properties of concrete.(K2)

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	1	3	2	3	3
CO2	K3	3	3	1	2	1	3	3	2	3	3	3	2	1	3
CO3	K3	3	2	2	2	2	3	2	3	3	3	0	2	3	3
CO4	K2	3	2	0	2	1	3	3	3	3	3	3	1	3	2
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

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

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

	Course Code: CET1105	Course Title: Transport Phenomena	Credits = 4		
			L	T	P
	Semester: IV	Total Contact Hours: 60	3	1	0

List of Prerequisite Courses

XIIth Standard Physics and Mathematics

List of Courses where this course will be prerequisite

This is a basic course required in special subjects that deal with flow offluids, heat and mass transfer, etc.

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

This basic course introduces concepts of momentum, heat and mass transfer to students. Various other concepts such as pressure, momentum, energy are introduced as well. Laws related to conservation of momentum, energy, mass are taught. Applications of these laws to various engineering and technological situations and process equipments are explained with the help of several problems.

Sr. No.	Course Contents (Topics and subtopics)	Required Hours
1	**Fluid Statics and Applications** to Engineering importance	4
2	**Applications of Bernoulli's Equation**, Pressure-drop in pipes and Fittings, Meters, Fluid moving machinery such as pumps	10
3	**Particle Dynamics**, Flow through fixed and fluidized Beds	4
4	**Equations of Continuity and Motion** in laminar flows and its applicationsfor simple Couette flow and Poiseuille flow applications	6
5	**Heat Conduction**, Convective heat transfer and concept of heat transfer coefficient	4
6	**Design and Constructional Aspects of Exchangers:** Types of flows - Concurrent, counter-current and cross flows, Log mean temperature difference, Double-pipe and Shell and tube heat exchangers. Introduction to other heat exchangers like, PHE, finned tube heat exchangers, graphite block, etc.	10
7	**Heat Transfer** aspects in agitated tanks, Condensers, Reboilers and evaporators	6
8	**Fundamentals of Mass Transfer:** Molecular diffusion in fluids, concept of mass transfer coefficients, and interface mass transfer	4
9	**Theories of Mass Transfer**, Analogies for heat and mass transfer, Empirical correlations	4
10	**Mass Transfer** applications in simple 1-D situations	8
	Total	**60**

List of Text Books/ Reference Books

1	Transport Phenomena, Bird R.B., Stewart W.E., Lightfoot E. N.
2	Fluid Mechanics, Kundu Pijush K.
3	Fluid Mechanics, F. W. White
4	Unit Operations of Chemical Engineering, McCabe, Smith

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

CO1	calculate friction factor, pressure drop, power.(K3)
CO2	calculate flow and power required for pumps.(K3)
CO3	calculate heat transfer coefficients and do basicsizing of double pipe and shell and tube heat exchangers.(K3)
CO4	calculate mass transfer coefficients and estimatemass transfer rates in simple situations.(K3)

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K3	3	3	1	2	1	3	1	3	3	3	1	2	3	3
CO3	K3	3	1	2	2	2	2	3	2	3	3	3	2	2	3
CO4	K3	3	3	2	0	2	3	3	3	3	2	3	0	3	3
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

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

K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

	Course Code: GET1105	Course Title: Electrical Engineering and Electronics	Credits = 3		
			L	T	P
	Semester: IV	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

Standard XII Physics and Mathematics courses

List of Courses where this course will be prerequisite

Various Technology Courses and Professional Career

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

In this course, students will get an insight to the importance of Electrical Energy in Chemical Plants. The students will understand basics of electricity alongside basic knowledge about Transformer and selection of different types of drives for a given application process. They will get basic knowledge of electronic devices and their applications in Power supplies, amplifiers and other circuits.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Basic Laws:** Kirchoff's current and voltage law, Simple series and parallel connections, star and delta transformation. Mesh and nodal analysis, Basic elements R, L and C. Concept of self and mutual inductance	6
2	**Network Theorems:** super position, Thevenin's theorems	3
3	**A.C. Fundamentals:** Equations of alternating voltages and currents, cycle, frequency. Time period, amplitude, peak value average value, R.M.S. value, A.C. through resistance, inductance and capacitance, simple RL, RC and RLC circuits. Resonance in series RLC circuits, Power, power factor, series and parallel circuits	5
4	**Three-Phase Systems:** Star and delta connections, relationship between line and phase voltages and currents, Power in three phase circuits	5
5	**Transformer:** Introduction, principle of operation, e.m.f. equation, phasor diagrams. Ideal transformer, transformer on no load, Transformer under load, Transformer losses, efficiency, regulation	5
6	Introduction to dc and ac drives	5
7	**Diodes and Rectifiers:** P-N junction diode characteristics, Zener diode, Half wave and full wave rectifiers, their waveforms, brief introduction to filters	4
8	**Bi-polar Junction Transistor:** Current components. Modes of operation, Input and output characteristics, Regions of operation, Transistor as an amplifier, classification of amplifiers	6
9	**Introduction to Uni junction transistor**, Characteristics, UJT relaxation oscillator	3
10	**Silicon-controlled Rectifier:** Controlled rectification, characteristics, methods of turning-on. Applications	3
	Total	**45**

List of Textbooks/Reference Books

1	Electrical Engineering Fundamentals by Vincent Deltoro
2	Electronic devices and circuits by Boylstead, Nashelsky
3	Electrical Machines by Nagrath, Kothari
4	Electrical Machines by P.S. Bhimbra
5	Electrical Technology by B. L. Theraja, A. K.Therajavol I, II, IV
6	Thyristors and their applications by M. Ramamurthy
7	Power Electronics by P.S. Bhimbra

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

CO1	understand the basic concepts of D.C circuits. Solve basic electrical circuit problems.(K3)
CO2	understand the basic concepts of single phase and three phase AC supply and circuits.(K2)
CO3	understand the basic concepts of transformers and motors used as various industrial drives.(K2)
CO4	understand the basic concepts of electronic devices and their applications.(K2)

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K2	3	2	0	2	1	3	3	3	3	2	3	0	3	2
CO3	K2	3	2	1	2	0	3	3	2	3	3	3	1	3	2
CO4	K2	3	0	1	2	1	2	3	3	1	3	1	1	2	2
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

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

K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: TXT1101	Course Title: SPL2 Technology of Yarn and Fabric Manufacturing	Credits = 4		
		L	T	P
Semester: IV	Total contact hours: 60	3	1	0

List of Prerequisite Courses

H. S. C. Science

List of Courses where this course will be prerequisite

Technology of Fibres

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

This course will help students understand structure of fibres based on which choice material and method for processing can be determined.

Sr No	Course Contents (Topics and subtopics)	Reqd. hrs
1	Introduction of spinning, Primary properties of textile fibres, Physical properties of Cotton, Silk, Wool. Fineness measurement of Filament and Yarn. Process comparison of staple spinning and filament spinning.	8
2	Cotton spinning system – Ring spinning process	4
3	Wool spinning – difference between worsted and common spinning	4
4	Testing of yarn, Factors affecting spinning, Types of yarn, Basic defects of yarn, spin-finish chemicals and its usefulness	8
5	Introduction to Fabric formation, types of fabric - weaving, knitting, non-woven.	4
6	Weaving – steps, details of shuttle loom process, modification of primary motions, Including towel, carpet, tapes and ribbons, blanket	12
7	Knitting – Types of knitting, process and machine overview	2
8	Non-woven - Types of non-woven, process and machine overview	2
9	Fabric design – basic structures, Testing of fabric – basic parameters, cover factor, Basic defects of fabric	6
10	Different type of yarn and fabric. Yarn - Slub, amseler, core spun, hollow, loop, chenille, etc Fabric - Poplin, cambric, fleece, etc	2
11	Developments – Electrospinning, 3d fabric, warp knit, auxetic fabric, lycra incorporated fabric	2
12	Numerical – Fineness, Moisture percentage, Motion transfer in gears and rollers, Drafting and doubling, Twist, Fabric production, Cover factor, statistical analysis	6

List of Text Books/ Reference Books

1	Handbook of Textile Fibres - 1st Edition – Elsevier J Gordon Cook, 6th edition, 1983.
2	Manual of Textile Technology, Klein, W., The Textile Institute, Manchester, Vol. 1-6, 1987.
3	Spun Yarn Technology, Eric Oxtoby, Butterworth-Heinemann, 2013
4	The Practical Spinner's Guide – Wool, Kate Larson, 2015

5	Advances in Yarn Spinning Technology, C A Lawrence, Elsevier Science - 2010
6	Fancy Yarns: Their Manufacture and Application, R H Gong, R M Wright, Elsevier, 2002
7	Weaving: Machines, mechanisms, management, Talukdar, M.K., Sriramulu P.K., Ajgaonkar D.B., Mahajan Publishers Private Ltd., Ahmedabad, 1998
8	Weaving- Conversion of Yarn to Fabric, Peter R. Lord, M H Mohamed, Elsevier, 2014
9	Watson's Textile Design and Colour, Z Grosicki, Elsevier, 2014
10	Knitting Technology, D. Spenser, Elsevier, 2014
11	Knitting technology, D. B. Ajgaonkar, Universal Pub, 1998
12	Nonwovens - Process, Structure, Properties and Applications; T Karthik, 2017
13	A Practical Guide to Textile Testing, Amutha K., Woodhead Publishing India, 2016.
14	Statistics for Textile Engineers, J. R. Nagla, Woodhead Publishing, 2015
Course Outcomes (students will be able to…..)	
1	**Jnderstand** different spinning processes and the types of yarns made thereof. (K2)
2	**Describe** process of fabric manufacture via different routes and their properties. (K2)
3	**Calculate** yarn and fabric production related numericals. (K3)
4	**Analyze** designs of various type of fabrics and different types of defects in fabric. (K4)
5	**Differentiate** types of textile substrates and the fabric structures (K4)

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	2	3	2	3	3
CO2	K2	3	2	0	2	1	3	3	3	2	3	3	1	2	2
CO3	K3	3	1	1	3	1	2	2	3	2	3	2	1	3	2
CO4	K4	3	2	1	2	0	3	3	2	3	3	3	0	3	2
Course	K4	3	3	2	2	2	3	3	3	2	3	3	2	3	3

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

K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: TXT1209	Course Title: SPL3 Technology of Textile Pretreatment	Credits = 3		
		L	T	P
Semester: IV	Total contact hours: 45	2	1	0

List of Prerequisite Courses

Technology of Fibres and Polymers

List of Courses where this course will be prerequisite

Technology of Textile Dyeing, Technology of Printing and Technology of Finishing

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

Being the initial stage of wet processing the knowledge of pretreatment is important to understand further processing stages such as dyeing, printing and finishing.

Sr No.	Course Contents (Topics and subtopics)	Reqd. hours
1.	Basic operations in textile wet processing – overall sequence, overview of textile types and chemicals used	4
2.	Purpose of yarn Sizing and chemicals used for sizing of different type of textile substrates	6
3.	Shearing and Cropping; Singeing – plate, roller, gas singeing, latest technologies in singeing	4
4.	Desizing of cotton; different methods – hydrolytic and oxidative, types of enzymes used and determination of desizing efficiency, machinery used.	6
5.	Techniques of demineralisation, machinery used for discontinuous and continuous operations.	4
6.	Scouring and bleaching of different forms of textiles, material and energy balance, reduction in liquor ratios and savings in water and energy. Batch, semi and continuous processing, Enzymatic (Bio)scouring, determination of scouring and bleaching efficiency.	6
7.	Mercerization, material and energy balance; caustic recovery, its importance and efficiency, Ammonia mercerization, its significance and benefits, machinery for mercerization, Mercerization of Knits, mercerisation efficiency determination	4
8.	Silk degumming and bleaching, Scouring and bleaching of wool; Bioscouring, Carbonization of wool, Scouring and bleaching of synthetics and their blends with natural fibres	6
9.	Application of optical brightening agents in bleaching of natural and synthetic fabrics and determination of whiteness index	2
10.	Washing principles and methods used different types of continuous washers for textiles. Environmental load of conventional pre-treatment	3

List of Text Books/ Reference Books

1	Textile Bleaching, Steven A.B., Pitman and Sons, London, 1947
2	Mercerizing by J.T.Marsh; 1951
3	Textile Chemistry, Peters R.H, Vol-2, Elsevier Publishing Company, London, 1967.
4	Technology of Scouring and Bleaching, Trotman E.R., Griffin, London, 1968.
5	Sizing by D.B.Ajgaonkar, M.K.Talukdar and V.R.Wadekar; December 1969
6	Technology of Bleaching and Dyeing, Chakraverty, R.R., Trivedi S.S., Vol. 1, Mahajan Publishers Private Ltd., Ahmedabad, 1979.

7	Chemical Technology in the Pre-treatment Processes of Textiles by S.R.Karmakar, 1999
8	Technology of Bleaching and Mercerizing, Shenai V.A., Sevak Publication, Bombay, Vol.3, 3rd edition, 2003.
Course Outcomes (students will be able to..)	
1	**Comprehend** the need for singeing of loom state fabric and use of latest technologies for open width woven and knit fabrics. (K2)
2	**Explain** the need for sizing of yarns and desizing of fabric; sizing chemicals and different desizing methods. (K2)
3	**Elaborate** the different bleaching recipes for natural and synthetics textiles and their blends (K3)
4	**Describe** the concept of mercerization and the techniques and machinery employed for the same (K2)
5	**Illustrate** methods for the pretreatments of wool and silk (K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	3	2	1	2	3	3	3	3	3	3	2	1	3
CO2	K2	3	2	2	3	0	3	1	3	2	3	1	2	3	2
CO3	K3	3	1	0	2	1	2	2	2	3	3	3	0	3	3
CO4	K4	3	3	2	2	2	1	3	3	1	2	2	2	2	2
CO5	K2	3	2	1	3	2	3	3	3	2	3	3	2	3	3
Course	K3	3	3	3	2	2	3	3	3	3	3	3	2	3	3

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

K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Course Code: TXT1213	Course Title: SPL4 Theory of Textile Coloration	Credits = 3		
		L	T	P
Semester: IV	Total contact hours: 45	2	1	0

List of Prerequisite Courses

Technology of Fibres, Yarn and Fabric Formation, Technology of Textile Pretreatment

List of Courses where this course will be prerequisite

Environmental Aspects in Textile Processing; Technology of Textile Dyeing and Printing

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

Provide in-depth knowledge of the chemistry and mechanism of natural and synthetic colourants, dye-fibre interaction from the point of view of uniform dyeing with desirable depths and tone. Physicochemical aspects of dyeing and the expectations of textile consumer in terms of colour fastness properties.

Sr No	Course contents (topics/subtopics)	Reqd Hrs
1.	Perception of colour, Major characteristics of dyes and pigments, Classification of colouring matters according to their application to the textile fibres, Colour Index, Nomenclature of commercial dyes, Molecular structures of dyes, Dye standardisation, Dye Selection, Fastness properties, standard depth concept, evaluation of fastness properties of dyed materials and their acceptability limits, Important properties of dyestuffs and their evaluation.	10
2.	Common terms used in textile wet processing; substantivity and affinity, % shade, % exhaustion, % expression, MLR, standing bath, cross dyeing, reserve dyeing, tailing effect, stripping etc., Dyeing assistants, mechanism for exhausting agents, levelling agents.	4
3.	Mechanism of dyeing, Dye fibre interactions, General theory of dyeing. Brief introduction to dyeing of different dyestuffs onto various natural and synthetic textile fibres.	6
4.	Thermodynamics of dyeing process; Kinetics of dyeing; Affinity of dyes towards the fibres; Adsorption isotherms; Equilibrium adsorption and factors influencing the same; Saturation value; Diffusion coefficient; Glass transition temperature and its effect on dyeability; Electro-kinetic properties of dye-fibre systems.	10
5.	Compatibility of dyes in mixtures; Dyeing of fibre blends and shade matching. Novel dyeing techniques, Theories behind different techniques such as, Rapid dyeing concept solvent dyeing, mass colouration, heat transfer coloration, etc.	12
6.	Concept of eco-friendliness in dyestuffs and dyeing techniques.	3

List of Text Books/ Reference Books

1. Textile Chemistry, Peters R.H, Vol-3, Elsevier Publishing Company, London, 1975
2. Chemical Processing of Synthetic Fibres and Blends, Datye K.V. and Vaidya A.A., John Wiley and Sons, New York, 1984
3. Theory of Colouration of Textiles, Johnson A., SDC Publ., Bradford, 2nd edition, 1989
4. Handbook of textile and industrial dyeing, Clark M., Woodhead Publishing Limited, 2011
5. Physico-Chemical Aspects of Textile Colouration, Burkinshaw S.M., Wiley, 2016

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

1	**Comprehend** fundamentals of fibres and colour science in relation to dyeing (K2)

2	**Describe** basic physicochemical aspects of dyeing on fibres (K3)
3	**Write**, compile and elaborate on dyeing procedures (K2)
4	**Use** different dyeing techniques and compare them (K4)
5	**Correlate** the theory and procedures of dyeing (K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	3	2	2	0	3	3	3	3	3	3	2	3	3
CO2	K3	3	2	2	0	3	3	3	0	2	3	2	0	3	2
CO3	K4	3	2	1	2	1	2	2	2	3	3	3	1	2	3
CO4	K2	3	1	2	2	2	3	1	3	2	1	3	2	3	2
CO5	K3	3	2	1	3	2	3	3	3	2	3	3	2	1	3
Course	K4	3	3	3	2	3	3	3	3	2	3	3	2	3	3

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

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

	Course Code: GEP1106	Course Title: Electrical Engineering and Electronics Laboratory	Credits = 2		
			L	T	P
	Semester: IV	Total Contact Hours: 60	0	0	4

List of Prerequisite Courses

Standard XII Physics and Mathematics courses

List of Courses where this course will be prerequisite

Various Technology Courses and Professional career

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

In this course, students will get an insight to the importance of Electrical Energy in Chemical Plants. The students will understand basics of electricity alongside basic knowledge about Transformer and selection of different types of drives for a given application process. They will get basic knowledge of electronic devices and their applications in Power supplies, amplifiers and other circuits.

	Course Contents (Topics and Subtopics)	Required Hours
	Suitable no of experiments out of the following will be conducted -	
1	Superposition Theorem	5
2	Thevenin's Theorem	5
3	Series RL circuit	4
4	Resonance in Series RLC circuit	5
5	H.W. and F.W. Rectifiers	4
6	Cathode Ray Oscilloscope	5
7	Input and output characteristic of npn transistor in CE mode	4
8	Load Test on Transformer	4
9	Three phase star connection	4
10	Three phase delta connection	4
11	Study of UJT relaxation oscillator	4
12	Design of UJT relaxation oscillator	4
13	Load Test on 3 phase induction motor	4
14	Study of Thermocouple	4
	Total	**60**

List of Textbooks/Reference Books

1	Electrical Engineering Fundamentals by Vincent Deltoro
2	Electronic devices and circuits by Boylstead, Nashelsky
3	Electrical Machines by Nagrath, Kothari
4	Electrical Machines by P.S. Bhimbra
5	Electrical Technology by B. L. Theraja, A. K. Therajavol I, II, IV
6	Thyristors and their applications by M. Ramamurthy
7	Power Electronics by P.S. Bhimbra

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

CO1	understand concepts of basic working of D.C circuits.(K2)
CO2	understand the basic applications of single phase and three phase AC supply and circuits.(K2)
CO3	understand the working and utility of transformers and motors used as various industrial drives.(K2)
CO4	understand the basic working and applications of electronic devices and circuits.(K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	2	1	2	0	3	3	3	3	3	3	1	3	2
CO2	K2	3	2	1	1	1	3	3	3	3	3	3	0	2	2
CO3	K2	3	2	0	2	1	3	3	3	2	2	3	1	3	2
CO4	K3	3	3	2	2	2	3	3	2	3	3	3	2	3	3
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

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

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

	Course Code: MAP1201	Course Title: Computer Applications Laboratory	Credits = 2		
			L	T	P
	Semester: IV	Total Contact Hours: 60	0	0	4

List of Prerequisite Courses

HSC Standard Mathematics, Applied Mathematics – I (MAT1101)

List of Courses where this course will be prerequisite

This is a basic Mathematics course. This practical knowledge will be required in several subjects later.

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

Students will understand the basics of Python programming and get exposure to the use of spreadsheet programme and Excel for numerical computations and statistical analysis for engineering applications. The students will also explore R-programming for Regression Analysis, Testing of Hypothesis using of standard statistical inference. B. Tech programme requires students to analyze data and develop computer programmes to solve various problems in Engineering and Technology fields.

	Course Contents (Topics and subtopics)	Hours
1	Introduction to Spreadsheet Programmes, Use of formulae and Plotting Graphs of Function and Data Plotting in Excel	4
2	Exploring Basic Statistics and Hypothesis Testing with Spreadsheet	4
3	Numerical Solution of Linear and Non-Linear Equations in Excel	4
4	Basic Introduction to R and R Studio, Data Management in R	4
5	Plotting Graphs in R, Exploring Probability Distribution Function in R	3
6	Hypothesis Testing in R	4
7	Basic Regression Analysis in R	4
8	Introduction to Python, Installation of Python and jupyter notebook through Anaconda. Variables in Python, Exploring math and cmath modules	3
9	List, Tuples and Dictionaries in Python, if else and elif statements, Creating functions (using def and lambda functions)	4
10	For loops and while loops in Python, Use of break and continue statements with loops, Developing Python programmes using loops	4
11	Writing Python Programme to solve problems in basic numerical analysis such root finding, Numerical solutions of linear equations, Numerical integration, etc.	4
12	Use of Numpy and Scipy to deal with vectors, matrices and their operations	4
13	Use of Numpy and SciPy continued	3
14	Plotting graphs using matplotlib	4
15	Use of Pandas for data processing and analysis	4
16	Linear and multilinear regression using Python	3
	Total	**60**

List of Textbooks/ Reference Books

1	Carlberg, Conrad George. Statistical analysis: Microsoft Excel 2016; Que (2018).
2	Langtangen, Hans Petter. A Primer on Scientific Programming with Python; 5th ed.; Springer-Verlag Berlin Heidelberg (2016)
3	Thareja, Reema; Python Programming - Using Problem Solving Approach; Oxford University Press (2017)
4	Beazley, David; Jones, Brian K. Python Cookbook: Recipes for Mastering Python 3; O'Reilly Media (2013)
5	VanderPlas, Jack; Python Data Science Handbook: Essential Tools for Working with Data; 1st ed.; O'Reilly Media (2016)
6	Dalgaard, Peter; Introductory Statistics with R; 2nd ed.; Springer (2008)
7	Navarro, Daniel; Learning Statistics with R (2013)
8	Dennis, Brian; The R Student Companion; CRC Press (2012)
9	Verzani, John; Using R for Introductory Statistics; 2nd ed.; CRC Press (2014)

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

CO1	perform descriptive statistical analysis using Excel.(K3)
CO2	perform basic statistical tests using R.(K3)
CO3	perform linear regression using R.(K3)
CO4	write Python programs to implement basic numerical methods.(K4)
CO5	perform data processing and regression analysis using Python.(K4)

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	0	3	3	3	3	3	3	2	3	3
CO2	K3	3	3	2	1	2	3	3	3	3	3	1	2	0	3
CO3	K3	3	1	2	2	2	2	3	0	3	2	3	2	3	3
CO4	K4	3	3	0	3	2	3	3	3	3	3	3	0	3	3
CO5	K4	3	3	2	3	2	3	3	2	3	3	3	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

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

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

Semester V

	Course Code: CET1401	Course Title: Chemical Engineering Operations	Credits = 3		
			L	T	P
	Semester: V	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

Process Calculations (CET1507), Transport Phenomena (CET1105)

List of Courses where this course will be prerequisite

This is a basic course. It is required in many other courses that involve physical processes

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

This is a basic Chemical Engineering course. The principles learnt in this course are required in almost all the forthcoming courses and throughout the professional career of students.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Distillation:** Fundamentals of flash-, batch- and continuous distillation, Distillation columns internals, Steam and azeotropic distillation	12 – 15
2	**Liquid-Liquid Extraction:** Solvent selection, Construction of ternary diagrams, Staged calculations, Types of extraction equipment	6
3	**Crystallization:** Phase diagram (temp/solubility relationship), Evapo-rative and cooling crystallization, Introduction to different types of crystallizers	5
4	**Filtration:** Mechanism of filtration, Basic equation, Constant volume, Constant pressure filtration, Rate expressions with cake and filter cloth resistances, Compressible and incompressible cakes, Introduction to various types of filters	5
5	**Drying:** Drying mechanism, Drying rate curves, Estimation of drying time, ypes of dryers	5
6	**Introduction to Other Aspects of Unit Operations:** Content will be aimed towards understanding practical and safety aspects of unit operations and/or introducing other separation processes like: adsorption/ion exchange, membrane processes and gas absorption, etc.	9 – 6
7	**Industrial Case Studies:** Interactive discussion with experienced professionals from industry or equipment vendors with emphasis on applicability, importance and challenges of different unit operations	3
	Total	**45**

List of Text Books/ Reference Books

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-Liquid Separation. Butterworth-Heinemann, Woburn, MA.
4	McCabe, W., Smith, J., Harriott, P., 2004. Unit Operations of Chemical Engineering, 7 ed. McGraw-Hill Science/Engineering/Math, Boston.
5	Green, D., Perry, R., 2007. Perry's Chemical Engineers' Handbook, Eighth Edition, 8 ed. McGraw-Hill Professional, Edinburgh.
6	Dutta, B.K., 2007. Principles of Mass Transfer and Separation Process. Prentice-Hall of India Pvt. Ltd, New Delhi.

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

1	perform basic sizing of continuous and batch distillation columns.(K3)
2	analyze filtration data and select systems based on requirements, estimate filtration area for given requirements, understand filter aids and their usage.(K4)
3	describe few industrial crystallization, filtration and drying equipment.(K2)
4	describe the need and importance of other separation processes like adsorption, ion exchange and membrane.(K2)
5	gain a practical perspective of unit operation in chemical industries.(K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	1	3	3	3	3	3	0	2	3	3
CO2	K4	3	3	2	3	2	3	2	3	3	2	3	2	3	3
CO3	K2	3	2	0	2	1	3	3	2	3	3	3	1	3	2
CO4	K2	3	2	1	2	0	3	3	3	3	1	3	1	2	2
CO5	K3	3	3	2	2	2	1	3	3	1	3	3	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

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

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

	Course Code: CET1212	Course Title: Chemical Reaction Engineering	Credits = 3		
			L	T	P
	Semester: V	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

Physical Chemistry – I (CHT1341), Physical Chemistry – II (CHT1342), Transport Phenomena (CET1105)

List of Courses where this course will be prerequisite

Environmental Science and Technology (HUT1106), Chemical Project Engineering and Economics (CET1504)

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

The course is concerned with the utilization 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 & paper, Pigments & paints, rubber, plastics, synthetic fibres, Foods, Dyes and intermediates, Oils, oleo chemicals, and surfactants, Minerals, clean sing agents, Polymers and textiles, Biochemicals and biotechnology, Pharmaceuticals and drugs, Microelectronics, energy from conventional and non-conventional resources, Metals

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	Kinetics of homogeneous reactions, Interpretation of batch reactor data, Single ideal reactors including design aspects	10
2	Multiple reactions, Temperature and pressure effects	5
3	Introduction to Non-ideal flow, RTD measurements, Models to predict conversions	5
4	Homogeneous and Heterogeneous Catalysis, Kinetics of Solid Catalyzed Reactions. Design of gas – solid catalytic reactors	15
5	Introduction to multiphase reactors	5
6	Mass Transfer with Chemical Reactions: Regimes of operation and Model contactors	5
	Total	**45**

List of Textbooks

1	Elements of Chemical Reaction Engineering – H. Scott Fogler

List of Additional Reading Material / Reference Books

1	Heterogeneous Reactions, Vol.I and II –L.K. Doraiswamy, M.M.Sharma

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

CO1	describe and apply the principles of various types of reactors (K3)
CO2	calculate rates of reactions based on given reaction scheme (K3)
CO3	design various components of reactors used in industrial practice (K3)
CO4	compare various reactors and select an appropriate reactor for a given situation (K4)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	1	3	3	3	3	3	3	2	3	3
CO2	K3	3	2	2	2	2	1	3	0	3	3	2	0	3	3
CO3	K3	3	3	2	1	2	3	3	3	3	3	3	2	3	3
CO4	K4	3	3	2	3	0	2	3	3	1	3	3	1	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

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

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

Course Code: TXT1210	Course Title: SPL5 Technology of Textile Dyeing	Credits = 4		
		L	T	P
Semester: V	Total contact hours: 60	3	1	0

List of Prerequisite Courses

Technology of Fibres; Technology of Textile Pretreatment, Theory of Textile Colouration

List of Courses where this course will be prerequisite

Technology of Printing, Technology of Textile Finishing, Environmental Aspects and Advances in Textile Processing

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

Student will understand the importance and relevance of textile coloration, the problems and remedies to solve them, the developments in machinery with respect to growth of industry, the quality of dyed textiles and environmental relevance of dyeing processes

Sr.No.	Course contents (topics/subtopics)	Required hrs
SECTION I		
1	Physical and chemical characteristics of textile fibres in relation to dyeing, Pretreatments of textiles and quality of water in relation to dyeing	4
2	Parameters of quality dyeing, machines used and terms used; Classification of dyes based on application, Performance characteristics of dyed textiles	2
3	Earlier developments in processes and machinery for dyeing of textiles in various forms such as fibres, yarns, woven and knitted fabric	4
4	Dyeing of cellulosic fibres with Direct, Azoic, Vat, Solubilized Vat, Sulphur, Oxidation colours and OBA's	8
5	Dyeing of polyamide fibres with Acid, Mordant and Metal Complex dyes	4
6	Dyeing of Acrylic with Basic and modified cationic dyes	2
7	Dyeing of Indigo and Natural dyes	2
8	Dyeing of Polyester with Disperse dyes	6
9	Dyeing of Cellulosics with Reactive dyes	4
10	Dyeing of blends, Dyeing of union fabrics; Dyeing of micro fibre fabrics	2
11	Batch, semi-continuous and continuous type dyeing machinery for all forms of textiles.	6
12	Dosing systems for dyeing, automatic colour and chemical dispensing systems, automated inventory management systems for dyes and chemicals	3
13	Right First Time approach, Faults in dyed materials and their correction. (4)	4
14	Machinery used for washing and soaping of dyed materials, Recent developments in machinery and dyeing techniques	6
15	Concept of conservation of chemicals and water in dyeing	3

List of Text Books/ Reference Books

1	The Theory and Practice of Wool Dyeing, Bird, C.L., SDC Publ., Bradford, 1972
2	Chemical Processing of Synthetic Fibres and Blends by K V Datye and A A Vaidya, John Wiley and Sons, New York, 1984
3	Wool Dyeing by D M Lewis, SDC Publication, 1992

4	Batchwise Dyeing of Woven Cellulose Fabric by John Shore, SDC Publ., 1993
5	Colour for Textiles-User's Handbook, W. Ingamells, SDC Publ., 1993
6	Technology of Dyeing, Shenai V.A., Vol. 6, Sevak Publication, Bombay, 1994.
7	Cellulosic Dyeing by John Shore, SDC Publ., 1995
8	Blends Dyeing by John Shore, 1998
9	Handbook of Synthetic Dyes and Pigments, K.M.Shah, Multitech Publishing, 1998.
10	Reactive Dyes for Textile Fibres, A. Hunter and M. Renfrew, SDC Publ., 1999.
11	Basic Principles of Textile Coloration by A D Broadbent, SDC Publ., 2001
12	Synthetic Fibre Dyeing by C Hawkyard, SDC Publ., 2004
	Course Outcomes (students will be able to.....)
1	Understand the importance of various textile processing parameters for quality dyeing. (K1)
2	Identify the correct process to be carried out based on type and form of the substrate (K2)
3	Explain the developments in dyes, machinery and processes in tune with constantly changing requirements of the industry (K2)
4	Analyse the quality of dyeing and suggest corrective measures. (K4)
5	Design the process for dyeing of novel fibres and blends based on its physico-chemical characteristics. (K4)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	2	1	2	1	3	3	1	3	3	0	1	3	2
CO2	K2	3	3	2	2	0	2	3	3	3	2	3	2	2	3
CO3	K3	3	2	2	3	3	2	1	3	3	3	2	2	3	3
CO4	K4	3	3	1	3	2	3	0	3	2	3	3	3	2	3
Course	K4	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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

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

Course Code: TXT1212	Course Title: SPL6 Technology of Textile Printing	Credits = 3		
		L	T	P
Semester: V	Total contact hours: 45	2	1	0

List of Prerequisite Courses
Technology of Fibres, Theory of dyeing
List of Courses where this course will be prerequisite
Experiments in Printing
Description of relevance of this course in the B.Tech. Program
The course will make student to understand printing as one of the most versatile method of colouration of textiles and its significance in value addition of textiles.

Sr. No.	Course contents (topics/subtopics)	Req. hrs.
	SECTION I	
1	Introduction to various colouration technics, Stages in printing of textiles, History of textile printing.	4
2	Preparation of print paste, functions of various ingredients of print paste, Various Natural, modified and synthetic thickeners, classification of thickeners, Preparation of stock thickening, Selection of thickening agents based on dye class, style and method, Rheology of printing pastes	6
3	Three Basic styles of Printing and various special styles of printing	6
4	Methods of Printing, Block, stencil, Screen; hand screen, flat bed, rotary, Roller, Transfer and digital printing, Defects and remedial actions in various methods of printing, Machines used for printing, Brief idea about preparation of block, stencil, flat and rotary screens, rollers for printing.	8
5	Various methods of fixation, Selection of fixation method, Machines for fixation and its working; various after treatment of printed materials.	6
6	Printing of Cellulosics, polyamides, polyester and acrylic with different dyes. Printing of blended fibre/fabrics Special printing techniques; Printing of velvet, carpets and knits	10
7	Evaluation of printed fabrics, Ecological aspects in printing of textiles; Recent developments in printing machinery and techniques;	5

List of Text Books/ Reference Books	
1	Dyeing and Printing, Cockett S.R., Hilton K.A., Leonard Hill Books Ltd., London, 1961.
2	Introduction to Textile Printing, W. Clarke, Newness Butterworths, London, 4th edition, 1977.
3	Guide to Printing Techniques, Naoharu Oyabu, Mahajan Brothers Publish Ltd., Ahmedabad, 1978.
4	Technology of Printing, V. A. Shenai, Sevak Publications, Bombay, Vol. 4, 1990.
5	Textile Printing by L. W. C. Miles, revised second edition published by SDC, 2003
6	Design and Printing Textiles by June Fish, 2005
7	Digital Printing of Textiles by H. Ujiiye, Woodhead Publishing Series in Textiles, 2006
8	Dyeing and Screen-Printing on Textiles by Joanna-Kinnersly Taylor, Revised and Updated, 2012.

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

1	**Comprehend** fundamental knowledge on stages of printing (K2)
2	**Describe and use** different types of printing methods and styles, fixation conditions, after treatments used for printing. (K3)
3	**Identify and evaluate** thickening agents, chemicals and dyestuffs for printing; Formulation and rheological properties of printing pastes(K4)
4	**Evaluate** quality of printed goods and suggest remedial actions to overcome faults in printing (K4)
5	**Comprehend and apply** the recent developments in the machinery techniques and special printing techniques. (K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K3	3	3	2	2	2	2	3	1	3	3	1	2	2	3
CO3	K4	3	3	0	3	2	3	3	2	3	3	2	3	3	3
CO4	K3	3	3	3	1	3	2	3	3	3	0	3	3	2	3
CO5	K3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Course	K4	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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

Course Code: TXT1215	Course Title: SPL7 Chemistry & Applications of Specialty Chemicals	Credits = 3		
		L	T	P
Semester: V	Total contact hours: 45	2	1	0

List of Prerequisite Courses

Technology of Fibres and Polymers, Technology of Textile Pretreatment

List of Courses where this course will be prerequisite

Testing of Textile Materials

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

The course will provide student deep understanding about the role of different functional groups on the properties of various specialty chemicals used in different industries.

Sr. No.	Course contents (topics/subtopics)	Reqd Hrs
1	Nomenclature, functions and classification of textile auxiliaries	2
2	Surface activity phenomenon, Surfactants and their chemistry and applications.	3
3	Anionic Surfactants: Properties and uses of anionics from carboxylic acids, alkylaryl sulphonates, alkyl sulphates, alkane sulphonates and phosphate esters, etc.	5
4	Cationic Surfactants: Chemistry, Properties and applications	2
5	Nonionic Surfactants: Chemistry, Properties and applications	2
6	Processing Aids: The structure property relationships of Antimigrants, Defoamers, Dyeing Assistants, Enzymes in Preparation, Lubricants, Peroxide Stabilizers, Printing Binders, Surfactants (Scouring and Wetting Agents), Thickeners Warp Sizes	8
7	Performance Enhancers: The structure property relationships of Antimicrobial Finishes, Antipilling Agents, Antistatic Agents, Durable Press Agents, Dye Fixatives, Elastomeric Finishes, Enzymes in Finishing, Flame Retardants, Hand Modifiers (Softeners and Hand Builders), Repellent Finishes, Soil Release Agents, Stain blockers and Ultraviolet Absorbers	8
8	Qualitative and quantitative evaluation of auxiliaries; Testing of surfactants, detergency, identification of ionic nature.	5
9	Biodegradability of surfactants	2
10	Banned chemicals in pretreatments, Natural textile auxiliaries	4
11	Recent developments in textile auxiliaries	4

List of Text Books/ Reference Books

1	Textile Chemicals and Auxiliaries, Speel H.C., Reinhold Processing Corporation, New York, 1952
2	Textile Auxiliaries, Batty, J.W., Dergamon Press, Oxford, 1967.
3	Colourants and Auxiliaries: Organic Chemistry and Application Properties, Shore, J., SDC, Bradford, 1990.
4	Laundry Detergents, Smulders, E., Wiley VCH, Weinheim, 2002.
5	Chemistry and Textile Auxiliaries, Shenai V.A., Vol. 65, Sevak Publication, Bombay, 2nd edition, 2002.
6	Textile finishing, D. Heywood, ed., Society of Dyers and Colourists, Bradford, England, 2003
7	Chemical finishing of textiles, W.D. Schindler and P.J. Hauser, Woodhead Publishing, Cambridge, England, 2004

	Course Outcomes (students will be able to.....)
1	**Understand** fundamental of textile auxiliaries. (K1)
2	**Describe** the role of surfactants in textile and their different types (K2)
3	**Write** synthesis of important textile auxiliaries (K2)
4	**Evaluate** surfactants and identify the ionic nature. (K3)
5	**Explain** biodegradability of surfactants and eco-friendly textile auxiliaries. (K2)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K4	3	2	1	2	1	3	1	3	3	1	3	1	3	2
CO2	K3	3	3	2	2	2	1	3	3	3	3	2	2	3	3
CO3	K4	3	3	1	3	2	2	3	2	0	3	3	0	3	3
CO4	K4	3	0	3	3	3	3	2	3	3	2	3	3	2	3
Course	K6	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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

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

	Course Code: MAT1106	Course Title: Design and Analysis of Experiments	Credits = 4		
			L	T	P
	Semester: V	Total Contact Hours: 60	3	1	0

List of Prerequisite Courses

HSC Standard Mathematics, Applied Mathematics – I (MAT1101), Computer Applications Laboratory (MAP1201)

List of Courses where this course will be prerequisite

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

This course is required for graduating technocrats to function effectively and efficiently in Industry, Academia and other Professional Spheres.

Sr. No.	Course Contents (Topics and subtopics)	Required Hours
	Module I (Statistical Theory of Design of Experiments)	
1	**Fundamental Principles of Classical Design of Experiments:** Strategy of Experimentation, Typical applications of experimental design, Basic principles, Guidelines for designing experiments	2
2	**Review of Probability and Basic Statistical Inference:** Concepts of random variable, Probability, Density function cumulative distribution function, Sample and population, Measure of central tendency, Mean, median and mode, Measures of variability, Concept of confidence level, Statistical Distributions: Normal, Log Normal & Weibull distributions, Hypothesis testing	4
3	**Experiments with a Single Factor: Analysis of Variance -** Fixed effect model and Random effect model, Model adequacy checking, Contrasts, Orthogonal contrasts, Regression Models and ANOVA, Violation of normality assumption: Kruskal-Wallis test Randomized block designs, Latin square designs, Balanced incomplete block designs	8
4	**Factorial Designs:** Definition, Estimating model parameters, Fitting response curves and surfaces	4
	Module II (Data Analysis using Software (R/Python))	
5	The 2^k Factorial design, Blocking and confounding in the 2^k Factorial design, Focus of 2^2 and 2^3 designs, Blocking and confounding in the 2k Factorial Design	8
6	Plackett Burman methods, Central Composite Design (CCD)	4
7	Descriptive Statistics, Probability Distribution and Testing of Hypothesis using R	6
8	Regression techniques, Diagnostic checks, ANOVA using R and implementation of contrasts	6
9	Construction of Balanced Incomplete Block Designs and data analysis using R	6
10	Analysis of factorial designs using R, Understanding output and interpretation	6
11	Factorial designs, Data analysis and interpretation.	6
	Total	**60**
	List of Textbooks/ Reference Books	
1	Montgomery, Douglas C. Design and Analysis of Experiments; 9th Ed.; John Wiley & Sons, Inc. (2017)	
2	Box, G. E.; Hunter, J. S.; Hunter, W. G. Statistics for Experimenters: Design, Innovation, and Discovery; 2nd Ed.; Wiley (2005)	
3	Lawson, John. Design and Analysis of Experiments with R; 1st Ed.; CRC Press (2015)	
4	Rasch, D.; Pilz, J.; Verdooren, R.; Gebhardt, A. Optimal Experimental Design with R; 1st Ed.; CRC Press (2011)	
5	Unpingco, J. Python for Probability, Statistics, and Machine Learning; 2nd Ed.; Springer (2019)	
6	Anderson-Cook, Christine M.; Montgomery, Douglas C.; Myers, Raymond H. Response Surface Methodology: Process and Product Optimization using Designed Experiments; 4th Ed.; Wiley (2016)	
7	Montgomery, Douglas C. Introduction to Statistical Quality Control; 7th Ed.; Wiley (2009)	
8	Lazić, Živorad R. Design of Experiments in Chemical Engineering: A Practical Guide; 1st Ed.; Wiley-VCH (2005)	

Course Outcomes (Students will be able to…..)	
CO1	understand basic principles of design of experiments.(K2)
CO2	perform statistical analysis of single experiments and do post hoc analysis.(K3)
CO3	conduct experiment and analyse the data using statistical methods.(K4)
CO4	choose an appropriate design given the research problem.(K5)
CO5	perform statistical analysis of different designs using R and interpret the results.(K5)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	2	1	2	0	3	3	3	3	3	1	1	3	2
CO2	K3	3	3	2	2	2	3	3	3	0	3	3	2	3	3
CO3	K4	3	2	2	3	2	3	1	3	3	2	3	2	2	3
CO4	K5	3	3	3	3	3	3	3	3	3	3	0	3	3	3
CO5	K5	3	1	3	3	3	3	3	2	3	3	3	3	0	3
Course	K5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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

Course Code: TXP1020	Course Title: PR3 Experimental Dyeing and Printing	Credits = 4		
		L	T	P
Semester: V	Total contact hours: 120	0	0	4

List of Prerequisite Courses

Theory of Textile Colouration, Technology of Textile Dyeing, Technology of Textile Printing

List of Courses where this course will be prerequisite

Technology of Finishing, Testing of Textile Materials

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

The practical will enable students to perform dyeing and printing on different textile substrates using various classes of dyes by different methods of application.

Sr No	Course contents (topics/subtopics)	Reqd Hrs
1	To study the effect of liquor ratio, percentage shade and salt concentration on exhaust dyeing of direct dyes on cotton yarn	12
2	To study dyeing of different types of reactive dyes (exhaust-HE, HBF)on cotton knit fabric, viscose, jute and linen woven fabric	8
3	To study dyeing and after treatments of sulphur black dye on cotton yarn	4
4	To study the dyeing of vat dyes on cotton yarn by vatting and pigmentation methods	4
5	To study dyeing of azoic colors on cotton fabric by tie and dye method	4
6	To study dyeing of acid dyes (Levelling and 1:2 metal complex)on wool and silk	8
7	To study dyeing of polyesters and Nylon using disperse dyes by HTHP and carrier method	4
8	To study dyeing of Nylon with acid, reactive and direct dyes	4
9	To study dyeing of acrylic fabric with modified cationic dyes	4
10	Dyeing of cotton fabric with reactive dyes by Cold-pad-batch and vat dye by pad-jig method	8
11	Dyeing of Polyester/cotton fabric with disperse + vat dyes and disperse +reactive dyes by Pad-dry-thermosol -pad-steam method	6
12	Dyeing of Polyester/cotton fabric with vat dyes by Pad-dry-cure method	4
13	Print paste preparation, viscosity measurement, Screen making,	4
14	Methods of printing – block, screen, stencil, roller	4
15	Direct style of printing of Reactive Dyes on cotton (H/P) class – various fixation methods (steamer, silicate and baking)	6
16	Direct style printing on Polyester with Disperse dyes	4
17	Direct style printing on Nylon Acid, Direct and reactive dyes	4
18	Direct style of printing on acrylic with Basic Dyes, Pigments on cotton, polyester and PC blend	8

19	Discharge style of printing – white discharge under Reactive dyed ground, reactive (ND) under reactive (D) dyed ground	4
20	Discharge style of printing – Vat discharge under reactive dyed ground, pigment under reactive dyed ground	4
21	Resist style of printing – White resist under reactive dyed ground, pigment under reactive dyed ground	4
22	Special print effects – Tie and Dye, batik, crimp, brasso, spray, marble, transfer, digital	8

List of Text Books/ Reference Books

Gile's Laboratory Course in Dyeing, D G Duff and R S Sinclair, SDC Publ.

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

1	**Analyze** effect of various parameters on dyeing and printing of cotton with different class of dyes (K4).
2	**Carry out** different dyeing and printing effects on polyester using disperse dyes (K6).
3	**Demonstrate** colouration of natural and synthetic polyamide fibres using different class of Acid dyes (K3).
4	**Achieve** different printing effects by varying fibres, application methods and machinery (K4).
5	**Evaluate** performance effect of different class of dyes on fibres (K4).

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K4	3	2	1	2	1	3	1	1	3	3	3	1	3	2
CO2	K5	3	3	2	2	1	3	3	3	3	3	3	3	3	1
CO3	K5	3	3	2	0	2	3	3	2	3	3	3	2	2	3
CO4	K4	3	3	3	2	3	3	0	3	3	2	2	3	3	3
Course	K6	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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

Course Code: TXP1002	Course Title: PR4 Pretreatment of Textiles	Credits = 2		
		L	T	P
Semester: V	Total contact hours: 60	0	0	4

List of Prerequisite Courses

Technology of Textile Pre-treatment

List of Courses where this course will be prerequisite

Technology of Finishing, Testing of Textile Materials

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

Being initial stage of wet processing the knowledge on pre-treatment is important to understand further processing and testing

Sr No	Course Contents (Topics and subtopics)	Reqd. Hrs
1	Stain removal by spotting, chemicals used and methods of stain removing.	4
2	Methods of Desizing of cotton woven fabric – acidic, enzymatic, and oxidative, qualitative and quantitative evaluation of desizing efficiency- TEGEWA scale staining, loss in weight, water absorbency.	4
3	Scouring of cotton-open boil, pressure boil; Scouring of knitted cotton fabric – conventional and bio-scouring; Evaluation of scouring efficiency-Drave's test, sinking time, wicking property, loss in weight, core alkali determination – boil fabric and check pH, phenolphthalein.	8
4	Bleaching of cotton with oxidative and reductive bleaching agent, Scouring and bleaching of polyester/cotton blends.	4
5	Scouring and bleaching of wool, Degumming and Bleaching of Silk	4
6	Drumming and weight reduction of polyester fabric, Bleaching of polyester with hydrogen peroxide and nylon with sodium chlorite.	4
7	Evaluation of bleaching efficiency – whiteness index and bleach clean-up (peroxide killer – enzymatic and reducing agent).	8
8	Mercerisation of cotton with and without tension, Evaluation of mercerization – Shrinkage, Barium Activity no., dye uptake, strength and elongation; microscopic observation.	4
9	Assessment of cotton for degradation by Methylene Blue Absorption.	4
10	Application of OBA/FBA on natural and synthetic fabrics and evaluation of fabric for whiteness index – exhaust and pad application	4
11	Pre-treatment by semi-continuous process – combined desizing, scouring, bleaching; Pre-treatment by continuous process – separate and combined scouring, bleaching	8
12	To study effect of heat setting on dye uptake, dimensional stability and strength	4

List of Text Books/ Reference Books

1	Textile Bleaching, Steven A.B., Pitman and Sons, London, 1947
2	Mercerizing by J.T.Marsh; 1951

3	Textile Chemistry, Peters R.H, Vol-2, Elsevier Publishing Company, London, 1967.
4	Technology of Scouring and Bleaching, Trotman E.R., Griffin, London, 1968.
5	Sizing by D.B.Ajgaonkar, M.K.Talukdar and V.R.Wadekar; December 1969
6	Technology of Bleaching and Dyeing, Chakraverty, R.R., Trivedi S.S., Vol. 1, Mahajan Publishers Private Ltd., Ahmedabad, 1979.
Course Outcomes (students will be able to…..)	
1	**Carry out** desizing, scouring and bleaching of cotton by different methods and its evaluation by suitable methods (K3)
2	**Perform** mercerisation of cotton and measurement of its efficiency by shrinkage, Barium Activity Number (BAN), dye uptake, strength (K4)
3	**Prepare** textile material by scouring and bleaching of wool, degumming, and bleaching of Silk (K3)
4	**Evaluate** efficiency pf pretreatment and associated impact on fibre degradation (K4)
5	**Apply** OBA/FBA on natural and synthetic fabrics and evaluate improvement in whiteness. (K5)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K3	K4
CO1	K3	3	1	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K4	3	3	2	3	2	2	1	2	3	0	3	2	3	3
CO3	K4	3	3	3	0	3	3	2	3	1	3	2	3	2	2
CO4	K5	3	3	2	2	2	3	3	2	2	3	3	1	3	3
Course	K5	3	3	2	3	2	3	3	3	3	3	3	2	3	3

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

Semester VI

Course Code: TXT1211	Course Title: SPL8 Technology of Finishing	Credits = 4		
		L	T	P
Semester: VI	Total contact hours: 60	3	1	0

List of Prerequisite Courses

Technology of Fibres, Textile Pretreatment, Technology of Textile Dyeing and Printing

List of Courses where this course will be prerequisite

Testing of Textile materials, Garment manufacturing

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

This course will help students understand effect of various mechanical and chemical finishes in terms of imparting desired functionality to meet the end use application.

	Course contents (topics/subtopics)	Required hrs
1	Objective of textile Finishing and type of finishing techniques.	2
2	Mechanical finishes like Calendaring, raising, sueding, crabbing, potting, compacting, sanforising, pressing, etc and machinery involved.	8
3	Heat setting of synthetic fabrics; Machinery used and principle involved.	4
4	Drying equipment; stenters, vertical drying ranges, curing ranges. Process control systems to enhance efficiency of drying.	4
5	Evaluation and durability of mechanical finishes	2
6	Chemical finishing – conventional softeners, stiffeners, binders, weighting agents, silicone finishes. Machinery involved in finishing of Yarn, Knit, Woven, Denim, Terry towel, Garments	10
7	Effect finishes - wrinkle resistance, wash and wear, and durable press properties of fabrics; different technologies for resin finishing- Pad-dry cure and Moist cross linking, machinery involved.	4
8	Functional finishes - antibacterial, flame retarding, water/oil repelling, soil release, antistatic finishes, Moisture management, UV Protection, Cellulase Bio Polishing etc.	20
9	Performance evaluation of conventional and effect finishes.	6

List of Text Books/ Reference Books

1	Textile Finishing, Hall A.J., Heywood book, London, 1966.
2	An Introduction to Textile Finishing, Marsh J.T., B.I. Publication, Bombay, 1979.
3	Technology of Finishing, Shenai V.A., Vol. 10, Sevak Publication, Bombay, 1990.
4	Handbook of Fibre Finish Technology, Slade, P.E., Marcel, New York, 1998.
5	Encyclopedia of Textile Finishing, Rouette, H.K., Springer Verlag, New York, 2001.
6	Chemical Finishing of Textiles, Schindler, W.D and Hauser P.J., Woodhead, 2004
7	Principles of Textile Finishing, Choudhury A. R, Woodhead Publishing, 2017
8	Textile Finishing; Recent Developments and Future Trends, Mittal K.L., Scrivener Publishing, 2017

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

1	**Explain** different methods and machineries available for application of finish and calculate finish add on onto fabric (K2)

2	**Describe** different types of softeners, fastness improving agents , antimicrobial, antistatic, flame retardant, their chemistry, application on fabric and evaluation tests (K2)
3	**Determine** use of appropriate machine and process parameters for finishing(K3)
4	**Compare and choose** various mechanical and thermal process control systems to enhance efficiency of drying and heat setting (K4)
5	**Explain** different methods for evaluation and durability of finishes. (K2)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K3	K4
CO1	K4	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K3	3	2	2	2	2	0	3	2	2	3	3	1	3	3
CO3	K5	3	2	3	3	3	3	2	3	3	0	2	3	3	2
CO4	K4	3	3	2	1	2	3	3	2	1	3	1	2	2	3
CO5	K5	3	3	2	3	2	3	3	2	3	3	2	2	3	3
Course	K6	3	3	2	3	2	3	3	3	3	3	3	2	3	3

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

Course Code: TXT1301	Course Title: SPL9 Testing of Textile Materials	Credits = 4		
		L	T	P
Semester: VI	Total contact hours: 60	3	1	0

List of Prerequisite Courses

Technology of Fibres and Polymers ,Tech. of Textile Pretreatment ,Technology of Textile Dyeing, Technology of Textile Printing, Technology of Finishing

List of Courses where this course will be prerequisite

Technology of Garment Processing

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

This course will help student to understand and apply different analytical methods for testing textile, measurement of colour fastness and assessment of performance properties of textile.

Sr. No.	Course contents (topics/subtopics)	Req. Hrs
1.	Objects of testing; Introduction to textile testing, Selection of samples for testing, Random and biased samples, Testing equipments and their use; Analysis of results, Quality, statistical analysis of results, t-test	5
2.	Analytical (Advanced) equipments and their role in Textile analysis, Identification, and testing of fibres by different methods like density, burning behavior, stain test, melting point, dissolution test etc.	4
3.	Need for testing, Various testing standards such as BIS, AATCC, ISO along with their format for measurement and reporting of colour fastness to various agencies, standard depth of shade	18
4.	Tensile testing of fibres, yarns and fabrics. Tearing, bursting, Pilling and abrasion resistance tests for fabrics. Bending, shear and compressional properties of fabrics. Fabric drape and handle. Crease and wrinkle behavior. Air, water and water-vapour transmission through fabrics. Thermal resistance of fabrics. Testing of interlaced and textured yarns.	18
5.	Flame retardancy, antimicrobial, Hydrophilic and hydrophobic testing of fabrics along with special tests for carpets.	10
6.	Care labelling, Testing of lycra blended fabric material	5

List of Text Books/ Reference Books

1.	Textile Analysis, Trotman E.R., Trotman S.R., Charles Griffin and Co., London, 1932.
2.	Principles of Textile Testing : An introduction to Physical methods and Testing textile fibres, yarn and fabric, Booth J.E., Heywood Books, London, 3rd edition, 1968.
3.	Microscopic and Chemical Testing of Textiles, Koch, P.H., Chapman and Hall, London, 1963
4.	Physical Properties of Textile Fibres, Morton, W.E. and Hearle, J.W.S., Textile Institute, Manchester, 2nd edition, 1975.
5.	Society of Dyers and Colourists : standard methods for the determination of the colour fastness of Textiles and Leather.1980
6.	Handbook of Textile Testing and Quality Control, Grover, B. and Hemby, P.S., Wiley Eastern Ltd., New Delhi, 2nd edition, 1988.
7.	Textile Testing and Analysis, Collier, B.J. and Hellen H., Upper Saddle River: Pentice Hall Inc., 1999.
8.	Principles of Textile Testing, 3e (PB) India: CBS Publishers and Distributors, 1996
9.	Saville, B. P. Physical Testing of Textiles. United Kingdom: Elsevier Science, 1999
10.	Raul, J. Textile Testing. India: APH Publishing Corporation, 2005

11.	Izquierdo, V., Vermeersch, O., Dolez, P. I. Advanced Characterization and Testing of Textiles. United Kingdom: Elsevier Science, 2017
Course Outcomes (students will be able to.....)	
1	**Comprehend** the objects of testing and its reasons stages at which testing is to be done (K2)
2	**Explain** different physical testing's performed on the fibres, yarn as well as fabric for their mechanical, aesthetic and performance behaviour (K2)
3	I**nterpret and examine** different fastness tests of the coloured goods (K4)
4	**Understand** testing principles and operation of different analytical testing instruments (K2)
5	**Identify** different testing standards and their importance (K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K3	K4
CO1	K3	3	3	2	2	3	3	3	3	3	3	3	1	3	3
CO2	K3	3	3	1	0	2	3	3	1	3	3	3	2	2	3
CO3	K3	3	3	2	3	2	3	2	3	3	3	2	2	3	2
CO4	K3	3	3	2	2	2	2	3	3	2	0	3	2	2	3
CO5	K4	3	2	2	3	2	3	3	3	3	3	2	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

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

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

Course Code: TXT1803	Course Title: SPL10 Effluent Characterisation and Treatment	Credits = 3		
		L	T	P
Semester: VI	Total contact hours: 45	2	1	0

List of Prerequisite Courses

Technology of pretreatment, dyeing, printing, and finishing

List of Courses where this course will be prerequisite

Process house management

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

Understand importance and relevant of environmental aspects related to sustainability in textile wet processing and the effluent parameters

Sr No.	Course contents (topics/subtopics)	Reqd Hrs
1.	Water requirement by textile wet processing industry, quality of incoming process water, standard norms for process water, overview of methods used to test incoming water	10
2.	Methods to treat incoming water such as, screening, filtration, clarification, disinfection etc.,	10
3.	Design of effluent treatment plant, primary, secondary and tertiary treatments	15
4.	Activated sludge and its modification, trickling filters, rotating biological contractors, suspended and attached growth anaerobic systems. Stabilisation ponds, aerated lagoons, etc. Sludge treatment and disposal. Treated effluent disposal in inland waters and marine environment.	10

List of Text Books/ Reference Books

1	Economy Energy & Environment in textile Wet Processing - ACT, Edited by S.S. Trivedi.
2	Environmental Issues - Technology option for Textile Industry Edited by R. B. Chavan, Indian Journal
3	Eco-friendly Textiles Challenges to Textile Industry - Textile Committee.
4	Environmental Success - America Textile Industry, AATCC Symposium - 1996.

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

1	**Comprehend** requirements of water and energy conservations during textile processing (K2)
2	**Explain** methods to determine presence of metal or other impurities in the effluent. (K2).
3	**Demonstrate** fundamentals about environment and its charactertics (K3).
4	**Describe** various ecosystems and ecolables. (K2)
5	**Explain** effluent treatment procedures and their application to textile processing waste-water(K2)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K2	3	3	2	3	2	0	3	2	3	1	3	3	2	3
CO3	K3	3	2	3	1	3	2	3	2	3	3	2	2	3	3
CO4	K4	3	3	2	2	2	3	3	3	3	3	3	0	2	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

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

	Course Code: HUT1103	Course Title: Industrial Psychology and Human Resource Management	Credits = 3		
			L	T	P
	Semester: VI	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses
None

List of Courses where this course will be prerequisite
Technology Courses in the forthcoming semesters

Description of relevance of this course in the B. Tech. Program
This course equips students with human resource management skills to be able to function effectively in their professional careers.

	Course Contents (Topics and Subtopics)	Required Hours
1	Introduction and Overview	2
2	Management Theories Taylor, Fayol, Weber, Hawthorne; Basic types of structures; Span of Control, Delegation, Authority, Responsibility	4
3	Recruitment Philosophies, Different methods of attracting candidates	3
4	Selection Application blanks, Interviews, Induction	2
5	Performance Management Goal setting process, Performance appraisal methods, Appraisal interviews, Rating errors	3
6	Training & Development Identifying training needs, Training methods (on the job and off the job techniques), Evaluation of training	3
7	Change Management Types of change, Theories of change management, Hurdles to change, Olmosk change strategies	3
8	Knowledge Management Innovation, Importance and benefits of Knowledge Management, Framework	3
9	Motivation Theories Classification of motives, Various theories (Maslow, Herzberg, ERG, Vroom, Equity and Nohria's 4 drive model)	4
10	Leadership Theories Blake Mouton model, Hersey Blanchard Model, Michigan Model	3
11	Organizational Culture Types of cultures, Understanding and influencing cultures	3
12	Conflict Management Stages of conflict, Types of conflict and sources of conflicts, Conflict resolution	3
13	Power &Politics Bases of power, Politicking strategies	3
14	Personality Theories of personality, Behaviour and personality styles	3
15	Perception Persception versus sensation, Perceptual process, Perceptual errors	3
	Total	**45**

List of Textbooks/Reference Books	
1	Innovation and Entrepreneurship, Peter Drucker
2	Essentials of organizational Behaviour, Srephen Robbins
3	Organizational Behaviour, Luthans
4	Select HBR cases and articles for review
5	Innovation and Entrepreneurship, Peter Drucker

Course Outcomes (Students will be able to…..)	
CO1	explain the fundamental concepts of industrial psychology and human resource management.(K2)
CO2	analyze practical solutions.(K4)
CO3	provide applicable solutions.(K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	2	1	2	0	3	3	3	3	3	3	1	3	2
CO2	K4	3	3	1	3	2	3	2	3	3	3	1	2	3	3
CO3	K3	3	3	2	2	2	3	3	3	2	3	3	2	1	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

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

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

	Course Code: HUT1106	Course Title: Environmental Science and Technology	Credits = 3		
			L	T	P
	Semester: VI	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

Various Technology Courses in previous semesters

List of Courses where this course will be prerequisite

Various Technology Courses in the forthcoming semesters

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

The course is very useful for the future Chemical Engineers and Technologists for assessing and appreciating impact of chemical processes and technologies on the Environment. The students will be exposed to the nitty-gritties of the impact of design principles on the Environment. Thorough understanding of these technology aspects is going to help in innovative solutions with positive impact on the environment.

	Course Contents (Topics and Subtopics)	Required Hours
1	Introduction to all prevailing international standards of Health, Safety, and Environment (HSE); Environmental laws and regulations; Standards (air quality, noise, water), ISO14000+	3
2	Environmental impact assessment, Life cycle assessment (LCA)	3
3	Pollution prevention in chemical manufacturing, effluent valorization	2
4	Air pollution; Air pollutants: sources (specific pollutants), effects, and dispersion modelling, air pollution, air quality, pollutants minimisation and control, fugitive emissions (source and control), Noise pollution	4
5	Wastewater treatment; Groundwater and surface water pollution, removal of specific water contaminants; Solid waste; Hazardous waste	4
6	Inherent safety; Major disasters (e.g. Flixborough, UK; Bhopal, India; Seveso, Italy; Pasadena, Texas; Texas City, Texas; Jacksonville, Florida; Port Wentworth, Georgia)	5
7	Toxicology; Industrial hygiene	2
8	Source models; Toxic release and dispersion models	5
9	Fires and explosions; Concepts to prevent fires and explosions	3
10	Chemical reactivity	2
11	Reliefs and reliefs sizing; Hazard identification; Risk assessment	4
12	Safety procedures and designs	4
13	Some case histories	4
	Total	**45**

List of Textbooks/Reference Books

1	Environmental Studies by R. Rajagopalan, Oxford University Press.
2	Essentials of Environmental Studies by Kurian Joseph & Nagendran, Pearson
3	Education Renewable Energy by Godfrey Boyle, Oxford Publications
4	Perspective of Environmental Studies, by Kaushik and Kaushik, New Age
5	International Environmental Studies by. Anandita Basak, Pearson Education
6	Textbook of Environmental Studies by Dave and Katewa, Cengage Learning
7	Environmental Studies by Benny Joseph, Tata McGraw Hill
8	Textbook of Environmental studies by Erach Books Bharucha, University Press.

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

CO1	calculate BOD / COD for a given composition of effluent stream, estimation of biokinetics.(K3)
CO2	calculate adiabatic lapse rate and determine conditions for suitability of atmospheric dispersion, effective stack height, chimney design.(K3)
CO3	calculate concentrative of pollutant at any point in the neighbourhood of emission given atmospheric conditions like wind, dispersion, environmental factors, etc.(K3)
CO4	calculate size/time/power required for primary clarifier, secondary treatment, tertiary treatment, sizing of different types of Biological treatments etc.(K3)
CO5	identify hazards in a given process and assess the same and provide solutions for operating safely.(K4)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K3	K4
CO1	K3	3	3	2	2	2	3	3	2	3	3	3	2	3	3
CO2	K3	3	3	2	2	0	3	3	3	3	3	3	1	3	3
CO3	K3	3	3	0	2	2	3	1	3	3	1	3	2	2	3
CO4	K3	3	1	2	2	2	3	3	3	3	3	0	2	3	3
CO5	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

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

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

Course Code: TXP1010	Course Title: Seminar	Credits = 3		
		L	T	P
Semester: VI	Total contact hours: 60	0	0	6

List of Prerequisite Courses

None

List of Courses where this course will be Prerequisite

Project I (TXP1013), Project II (TXP1017)

Description of relevance of this course in the B. Tech. (Fibres & Textile Processing Technology) Programme

Course objectives

1. Develop a systematic thinking about a topic related to textile wet processing and other allied areas
2. Develop skills for presenting a topic in textile processing effectively

Sr. No.	Course Contents (Topics and subtopics)	Required Hours
1	Each Student will conduct literature survey, collect full papers, reviews, book chapters etc. and prepare presentation and written review report on the given seminar topic. Oral presentation & written report of the seminar will be evaluated.	60
	Total	60

Course Outcomes (Students will be able to…..)	
CO1	Develop a protocol for literature survey about a certain topic (K4)
CO2	Evaluate the literatures and interpret the scientific content (K5)
CO3	Apply the concept of food technology on a selected topic (K3)
CO4	Develop skills for presenting a scientific topic in textile processing (K6)
CO5	Develop skills for writing a scientific document (K6)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K3	K4
CO1	K4	3	3	1	3	2	3	3	3	3	3	3	2	3	3
CO2	K5	3	2	3	3	3	0	3	3	3	3	2	3	3	3
CO3	K3	3	3	2	2	2	3	3	2	3	3	3	1	3	3
CO4	K6	3	1	3	3	0	3	3	3	1	3	0	3	3	3
CO5	K6	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Course	K6	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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

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

Course Code: TXP1011	Course Title: PR5 Finishing and Evaluation of Textiles	Credits = 2		
		L	T	P
Semester: VI	Total contact hours: 60	0	0	4

List of Prerequisite Courses
Technology of Textile Pretreatment, Technology of Dyeing, Technology of Finishing
List of Courses where this course will be prerequisite
Non-woven and Technical Textile
Description of relevance of this course in the B.Tech. Program
This will help students to understand the properties of textile substrate used in different applications.

Sr No	Course contents (topics/subtopics)	Reqd Hrs
1.	Objective and requirement of finishing, machinery used, mechanical operations involved, methods of finish evaluation	4
2.	Application of softeners of varying ionic nature– Cationic, Anionic, Nonionic, Amphoteric and different physical aspects – flakes, paste, liquid – evaluation of finished fabric for its feel, effect on absorbency, yellowing	4
3.	Finishing of cotton and Polyester using Silicone softeners of varying particle size – Macro, Micro, Nano (particle size analysis) and performance effect – amino, amido, quaternary to evaluate effect on hand feel and absorbency.	4
4.	Application of Elastomeric finish on cotton and polyester fabric – evaluation of hand feel, bulk/bounce, stretch and elastic recovery	2
5.	Application of stiffener and weight-gain agents on cotton woven– Starch, PVA. Evaluation in terms of hand feel, drape, bending length, tear strength	2
6.	Application of antistatic on polyester and hydrophilic on terry towel - testing of finished fabric for static charge, absorbency, wicking property, water retention	4
7.	Application of Anti-pilling agent on polyester cotton and polyester Viscose blend - testing of pilling behavior by Martindale	4
8.	Application of flame retarding agent and testing of finished fabric by measurement of char length, rate of burning and Limiting Oxygen Index.	4
9.	Application Resin cross linking agent and testing of finished fabric for crease recovery angle, tear strength, bending length	4
10.	Application of Oil and water repellent and evaluation of fabric for water repellency by spray/shower test and water penetration test and oil repellency by spotting.	4
11.	Application of colour enhancer on Navy and Red dyed Cotton and Polyester fabric – evaluate depth enhancement, shade change, hand-feel	4
12.	Application of Rub fastness improver on Navy and Red dyed Cotton and Polyester fabric – evaluate rubbing fastness, shade change, hand feel	4
13.	Application of antibacterial agents and testing of finished fabric for antibacterial property, methylene blue test.	4
14.	Application of soil release agent and testing of finished fabric for anti-soiling property, stain spotting and wash off behaviour	4
15.	Application of Aroma and microencapsulated fragrance finish – Mint, Lavender, Rose, Vanilla – evaluation of fragrance release by rubbing	4
16.	One step dyeing and finishing on cotton, polyester and P/C blend fabric by pad-dry-cure method	4

List of Textbooks/Reference Books	
1.	Textile Finishing, Hall A.J., Heywood book, London, 1966.
2.	An Introduction to Textile Finishing, Marsh J.T., B.I. Publication, Bombay, 1979.
3.	Technology of Finishing, Shenai V.A., Vol. 10, Sevak Publication, Bombay, 1990.
4.	Handbook of Fibre Finish Technology, Slade, P.E., Marcel, New York, 1998.
5.	Encyclopedia of Textile Finishing, Rouette, H.K., Springer Verlag, New York, 2001.
Course Outcomes (students will be able to.....)	
1	**Carry out** application of conventional textile finishing agents (K3).
2	**Evaluate** various finish parameters and testing procedure (K3).
3	**Perform** application techniques for specialty functional finishes (K3)
4	**Evaluate** effect of finishing on the comfort feel properties of textile (K4)
5	**Formulate** compatible mixture recipes for intended end use application (K6)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO2	K4	3	3	2	3	0	3	3	1	3	3	3	3	3	3
CO3	K5	3	3	3	1	3	3	3	3	3	2	0	1	3	3
CO4	K3	3	3	3	3	3	1	3	3	3	1	3	3	3	3
Course	K6	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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

Course Code: TXP1005	Course Title: PR6 Evaluation of Dyes and Specialty Chemicals	Credits = 2		
		L	T	P
Semester: VI	Total contact hours: 60	0	0	4

List of Prerequisite Courses

Pretreatment of Textiles, Technology of Dyeing and Printing

List of Courses where this course will be prerequisite

Textile Process House Management

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

Understand requirements, application methods and performance evaluation criteria of colourants and chemicals used during textile processing

Sr No	Course contents (topics/subtopics)	Reqd Hrs
1.	Analysis of given water soluble dye sample – appearance, pH (1%), solubility (water, salt, alkali), O.D. against std., TLC, paper chromatography - direct and reactive dyes	4
2.	Analysis of given disperse dye sample – appearance, pH (1%), dispersion stability (electrolyte, with and without dispersing agent), O.D. against std., TLC, paper chromatography, filter test for disperse and vat dyes	4
3.	To test given pigment dispersion for appearance, pH, solid content	4
4.	Substantivity, primary and secondary exhaustion, build-up study	4
5.	Identification of dye on fiber	4
6.	Determination of colour fastness to various agencies like washing, light and rubbing	4
7.	Determination of colour fastness to perspiration and bleaching agents	4
8.	Determination of colour fastness to sublimation and hot pressing.	4
9.	To test given sample of textile auxiliary for appearance, pH, solid content, solubility, ionic nature, specific gravity, viscosity, cloud point determination, surface tension determination, chelation value, active content of anionic	4
10.	Testing of wetting agent – wetting and foaming; mercerization shrinkage test	4
11.	Testing of desizing agent, Testing of hydrogen peroxide stabilizer and killer	4
12.	Testing of levelling and dispersing agent – disperse, reactive	4
13.	Testing of dye fixing agent, Testin of washing off agent	4
14.	Qualitative and quantitative analysis of printing binders	4
15.	Determination of Amylase, catalase and cellulase activity	4

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

1	**Analyze** various properties of dyes (K3)
2	**Evaluate** various properties of auxiliaries and specialty chemicals used in textile processing.(K4)
3	**Assess** qualitative and quantitative analysis of auxiliaries and specialty chemicals. (K4)
4	**Evaluate** performance properties of processed fabric. (K4)
5	**Analyze** the various chemical performance chriteria. (K4)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	1	2	3	3	3	3	3	3	1	3	3
CO2	K4	3	3	2	3	2	3	3	1	3	2	3	2	3	3
CO3	K4	3	3	3	3	3	0	2	3	3	3	2	3	3	3
Course	K4	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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

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

Semester VII

	Course Code: CET1703	Course Title: Chemical Process Control	Credits = 3		
			L	T	P
	Semester: VII	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

Material and Energy Balance Calculations, Applied Mathematics, Chemical Engineering Operations, Chemical Reaction Engineering

List of Courses where this course will be prerequisite

Chemical Engineering Laboratory, Projects

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

Process control plays a very critical role in the context of actual operation of a process plant. Most of the core chemical engineering courses focus on the steady state operation. In the real life environment, process is continuously subjected to various disturbances which deviates the operation from the designed steady state. This course specifically prepares students to assess the impact of such disturbances and equip them with the tools available to tackle these situations.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Instrumentation:** Principles of measurement; Pressure, Temperature, Level, Flow and composition measuring devices; Introduction to controllers (PLC, digital control, DCS), Introduction to control valves, Types of control valves, Control valve characteristics	9
2	**Introduction to System Dynamics**, Concept of dynamic response, Linear systems, First, second and higher order system, Systems with dead-time, Definition of terms such as transfer function, Time constant, Gain of the process with practical examples Response of processes to standard inputs	9
3	**Introduction to Process Control:** Set point, disturbance, closed loop and open loop control, Feedback and feed-forward configurations, Poles and zeros of the transfer functions Basic control actions (ON/OFF, P, I and D), Effects of controller action on process response: Offset, closed-loop gain, controller gain effect of controller parameters	6
4	**Stability Analysis** of feedback systems, Notion of stability, Criteria for stability	6
5	**Control System Design:** Introduction to controller design Identification of controlled, manipulated and disturbance variables, Pairing of inputs and outputs Controller selection for pressure, flow, temperature, level and composition control Criteria-based controller design, heuristic controller design, controller tuning	9
6	**Multiple Loop and Traditional Advanced Control Systems:** Cascade control, Ratio control, Feed-forward control, Selective control, Split-range control, Inferential control	6
	Total	**45**

List of Text Books/ Reference Books

1	Chemical Process Control: An Introduction to Theory and Practice, Stephanopolous G.
2	Process Modeling, Simulation, and Control for Chemical Engineers, Luyben W.L.
3	Process Dynamics and Control, Seborg, D. E. and Mellichamp, D. A. and Edgar, T. F. and Doyle, F. J.
4	Process Control: Modeling, Design, and Simulation, Bequette, B. W.
5	Process Control Instrumentation Technology, Johnson, C. D.

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

1	specify the required instrumentation and control elements for a particular process (K3)
2	develop input-output transfer function models for dynamics of processes (K4)
3	characterize the dynamics and stability of processes based on mathematical analysis (K5)
4	design and tune process controllers (K6)
5	specify the required instrumentation and control elements for a particular process (K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	0	3	3	3	2	3	3
CO2	K4	3	3	2	0	2	3	3	3	3	3	0	2	3	2
CO3	K5	3	2	3	3	1	3	1	3	3	1	3	3	3	3
CO4	K6	3	3	1	3	3	2	3	3	2	3	3	1	2	3
CO5	K3	3	1	2	2	2	3	3	3	3	3	3	2	3	3
Course	K6	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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

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

Course Code: TXT1501	Course Title: SPL11 High-tech and Industrial Fibres	Credits = 3		
		L	T	P
Semester: VII	Total contact hours: 45	2	1	0

List of Prerequisite Courses

Technology of Fibres and Polymers

List of Courses where this course will be prerequisite

Non-woven and Technical Textile

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

The course will be helpful to understand manufacturing, properties and applications of the most commonly used high tech fibres

Sr No	Course contents (topics/subtopics)	Reqd. Hrs.
1.	Introduction to fibres and their manufacturing techniques, terminology, Definition of High Tech fibres, Differences between conventional and High Tech fibres	5
2.	Manufacturing of carbon fibres from PAN precursors, viscose and pitch fibres. Differences between them wrt properties and Application of each type in different areas/fields	7
3.	Aramide Fibres, Synthesis of polymer, manufacturing, Discussion on Liquid crystals, Difference between regular aliphatic and aramid fibre, Application in different areas/fields	7
4.	Ultra High Molecular weight Polyethylene Fibres, Synthesis, manufacturing, Special focus on its structure, Discussion on Sheesh Kebab structure , Gel spinning, Super drawing, , Difference between regular olefin and UHMW fibre, Application in different areas/fields	7
5.	Polyurethane/Elastomeric Fibres, Synthesis of polymer along with precursors, manufacturing, Discussion on block/segmented structure, comparison with rubber, stretchability, Application in different areas/fields	6
6.	Glass fibres including optical glass fibres , their manufacturing, Rotary jet spinning technique , different types like C,E and S, Sizing and its reasons. Properties vis a vis Aramide and Carbon and other High Tech fibres, Application in different areas/fields	7
7.	Brief discussion about different biodegradable fibres, monomers used, polymers synthesis, nano fibres, application in medical field	6

List of Text Books/ Reference Books

1	Natural and man-made Textile fibres,G.E Linton, New York duell,sloan and pearce 1966
2	Turbak, A. F., Vigo, T. L. High-tech Fibrous Materials: Composites, Biomedical Materials, Protective Clothing, and Geotextiles. United States: American Chemical Society, 1991
3	Bicomponent fires.,Jeffries,Merrow publishing,1996
4	Hongu, T., Phillips, G. O. New Fibers. United Kingdom: Elsevier Science, 1997
5	High Performance Fibers, J.W.S. Hearle, Wood head Publishing,2001
6	Advanced fiber spinning Technology,T.Nakajima,Wood head publication,2002
7	New millennium fiber ,Thongu,CRC press,2005
8	Phillips, G. O., Takigami, M., Hongu, T. New Millennium Fibers. United Kingdom: Elsevier Science, 2005

9	Medical Textiles and biomaterial for healthcare,Anand S.C. Wood head publishing,2006
10	High-Performance and Specialty Fibers: Concepts, Technology and Modern Applications of Man-Made Fibers for the Future. (n.d.). Japan: Springer Japan
11	High Performance Technical Textiles. United Kingdom: Wiley, 2019

	Course Outcomes (students will be able to.....)
1	**Recognise** the need, technology and difference between conventional and High Tech fibres (K2)
2	**Describe** manufacturing of Carbon fibres using different precursors, their applications and properties (K2)
3	**Understand** manufacturing of Glass and Aramide fibres, their applications including optical fibres and properties (K1)
4	**Explain** manufacturing of Ultra high molecular weight Polyethylene and Poly urethane fibres, their applications and properties (K2)
5	**Predict** end use applications and performance evaluation criteria of hi-tech fibres (K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K3	K4
CO1	K3	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO2	K4	3	2	3	3	1	3	3	2	3	3	3	1	3	3
CO3	K4	3	3	2	3	3	2	0	3	3	1	0	3	2	3
Course	K4	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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

Course Code: TXT1901	Course Title: SPL12 Textile Process House Management	Credits = 3		
		L	T	P
Semester: VII	Total contact hours: 45	2	1	0

List of Prerequisite Courses		
	Technology of Textile Pretreatment, Technology of Dyeing, Printing and Finishing	

List of Courses where this course will be prerequisite		
	Technology of Garment Processing	

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

This course is essential for effective functioning of students in their professional career

Sr No	Course Contents (Topics and subtopics)	Req. Hrs
1	Responsibilities of management: society and development. Functions of Management: Planning, Motivating, Leading, Controlling; Business organization structures, limitations, relative merits and demerits.	5
2	Organisational Process and Behaviour: Span of Control, Authority, Responsibility and Accountability, Delegation of authority, Decentralization of authority. Enhancing Managerial Effectiveness through self and others, Individual Personality and Behaviour, Perception, Attitudes, Values and Aptitude, Frustration, Conflict, Organisational structure, Organisational culture, Organisational transformation, Organisational Effectiveness and Assessment	10
3	Technology Management: Strategies and 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)	5
6	Communication Skills: Communication process, media channels, written and verbal/ presentation skills, barriers to effective communications. counselling and coaching,	5

List of Text Books/ Reference Books

1	Essentials of Management, Harold Koontz, Heinz Weihrich; Tata McGraw Hill Education Pvt. Ltd., 2012
2	Industrial Management, Richard Lansburgh, William Spriegel; J. Wiley, New York, 1947
3	Innovation and Entrepreneurship, Peter Drucker; Harper Business, 1993
4	Industrial Management– I, Jhamb L. C. and Jhamb S.; Everest Publishing house, 2015
5	Essentials of Organizational Behavior, S. Robbins, Timothy Judge; Pearson, 2017
6	Organizational Behaviour, Luthans F; McGraw-Hill/Irwin, 2011
7	Principles of Marketing, Philip Kotler, Gary Armstrong, Prafulla Agnihotri; Pearson, 2018
8	Research and Development Management, Bamfield Peter; Wiely VCH, 1996

Course Outcomes (students will be able to…..)	
1	**Understand** fundamental concepts of Industrial Management (K1)
2	**Analyze** practical situations and be able to provide applicable solutions (K4)
3	**Demonstrate** human resource requirements and their management (K3)
4	**Identify** importance and significance of role of management and its function in smooth running of production operations (K4)
5	**Exercise** control over check points and product quality control at various stages of textile manufacturing (K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K3	K4
CO1	K2	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO2	K3	3	2	3	3	0	3	3	2	2	3	0	3	2	3
CO3	K3	3	3	1	2	3	2	2	3	1	3	3	3	3	3
CO4	K4	3	2	3	3	2	1	3	3	3	2	3	0	3	3
Course	K3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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

Course Code: TXP1014	Course Title: In-plant Training	Credits = 6		
		L	T	P
Semester: VI	Total duration: 12 weeks	0	0	0

List of Prerequisite Courses

None

List of Courses where this course will be Prerequisite

Project I (TXP1013), Project II (TXP1017)

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

Course objectives

1. Develop a systematic thinking about an industrial problem
2. Develop skills for communication, networking, personal grooming & professional conduct within an industrial environment
3. Develop the attitude for individual and teamwork

Sr. No.	Course Contents (Topics and subtopics)	Required weeks
1	-Each Student will be involved in R & D/ manufacturing (QA / QC / Plant Engineering /Stores and Purchase)/ marketing / finance/ consultancy/ Technical services/ Engineering / Projects, etc. -Oral presentation & written report of the in-plant training will be evaluated along with industry feedback.	**12**
	Total	**12**

Course Outcomes (Students will be able to…..)	
CO1	Apply the concept of project & production management in further planning (K3)
CO2	Develop critical thinking regarding the various operations involved in textile industry (K4)
CO3	Solve certain industrial challenges in textile processing (K6)
CO4	Present and communicate an industrial problem effectively (K6)
CO5	Write a scientific report on the training (K6)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	2
CO3	K6	3	3	3	3	3	3	2	3	1	3	2	3	3	3
CO4	K6	3	3	2	3	3	3	3	0	3	3	3	3	2	3
CO5	K6	3	3	3	3	1	3	3	3	3	2	3	3	3	3
Course	K6	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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

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

	Course Code: HUT1203	Course Title: Industrial Management	Credits = 4		
			L	T	P
	Semester: VII	Total Contact Hours: 60	3	1	0

List of Prerequisite Courses
None

List of Courses where this course will be prerequisite
None

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

	Course Contents (Topics and Subtopics)	Required Hours
1	Greiner's Model of Organization Life Cycle Organic and mechanistic structures	3
2	Marketing Management Introduction, Porter's value chain, Porter's five forces, Porter's generic strategies	7
3	Introduction to the 4Ps of Marketing Product, Price, Place, Promotion	11
4	Production and Operations Management Concept of productivity, World class manufacturing, Business process reengineering, Kanban, JIT, Poka Yoke system, Maintenance practices	10
5	Quality Management The concept of quality, Quality control ,acceptance sampling and SQC Deing's 14 points, TQM, Insights into ISO-9000, ISO -14000,ISO-50000	6
6	Financial Management Accounting system, Balance-sheet evaluation, Fund-flow analysis, Financial ratios an insight, Costing	15
7	Materials Management Value analysis, Purchasing and vendor development, Warehousing and inventory control methods	4
8	Maintenance Management Classifications, Equipment and plant reliability and availability, Management of shut downs and turnarounds	4
	Total	**60**

List of Textbooks/Reference Books	
1	Industrial Management–I, Jhamb L. C. and Jhamb S.
2	Industrial Management, Spriegel U.S.
3	Operations Management for Competitive Advantage, Richard B. Chase, F. Robert Jacobs, Nicholas Acquilano
4	World Class Manufacturing - A strategic Perspective, B.S. Sahay, K.B.C. Saxena, Ashish Kumar
5	Management Finance, Varanasay Murthy
6	Essentials of Management,Koontz
7	Principles of Marketing, Kotler
8	Quality Planning and Analysis, Juran
9	Financial Management, Prasanna Chandra
10	Financial Management, R. M. Srivastava
11	Select HBR cases and articles for review

Course Outcomes (Students will be able to…..)	
CO1	explain the fundamental concepts of Marketing management and the various aspects therein.(K2)
CO2	understand the fundamental concepts of Finance and analyse the balance sheet.(K4)
CO3	understand various productivity techniques that when combined with engineering knowledge can be applied successfully in the industry.(K2)
CO4	study real life practical problems , constraints and will be able to think in terms of various alternative solutions.(K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K4	3	3	2	3	2	1	3	3	3	3	3	2	3	3
CO3	K2	3	2	0	2	1	3	3	2	3	3	0	1	3	2
CO4	K3	3	3	2	0	2	3	3	3	3	3	3	2	2	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

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

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

	Course Code: CEP1714	Course Title: Chemical Engineering Laboratory	Credits = 2		
			L	T	P
	Semester: VII	Total Contact Hours: 60	0	0	4

List of Prerequisite Courses

Process Calculations (CET1507), Transport Phenomena (CET1105), Chemical Engineering Operations (CET1401), Chemical Reaction Engineering (CET1212)

List of Courses where this course will be prerequisite

Other B. Tech. courses in this and the last semester

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

This course provides students the first-hand experience of verifying various theoretical concepts learnt in theory courses. It also exposes them to practical versions of typical chemical engineering equipments and servers as a bridge between theory and practice. This particular lab focuses on fluid dynamics, distillation, filtration, drying and sedimentation.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	4 - 6 Experiments on fluid dynamics and heat transfer	24
2	3 - 5 Experiments on Chemical Engineering Operations	16
3	2 – 4 Experiments on Reaction Engineering	12
4	1 – 3 Experiments on process dynamics and control	8
	Total	**60**

List of Text Books/ Reference Books

1	McCabe W.L., Smith J.C., and Harriott P. Unit Operations in Chemical Engineering (2014)
2	Bird R.B., Stewart W.E., and Lightfoot, E.N. Transport Phenomena (2007)
3	Coulson J.M., Richardson J.F., and Sinnott, R.K. Coulson & Richardson's Chemical Engineering: Chemical engineering design (1996)
4	Green D. and Perry R. Perry's Chemical Engineers' Handbook, Eighth Edition (2007)

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

CO1	learn how to experimentally verify various theoretical principles.(K3)
CO2	visualize practical implementation of chemical engineering equipments.(K4)
CO3	develop experimental skills.(K4)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K4	3	3	2	1	2	3	3	0	3	3	3	2	2	3
CO3	K4	3	3	2	3	2	2	3	3	3	3	2	2	3	2
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

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

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

Course Code: TXP1021	Course Title: PR7 Evaluation of Effluent Parameters	Credits = 2		
		L	T	P
Semester: VII	Total contact hours: 60	0	0	4

List of Prerequisite Courses

Technology of pretreatment, dyeing, printing, and finishing

List of Courses where this course will be prerequisite

Textile Process house management

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

The course will be helpful to understand properties and evaluation criteria of the textile process house effluent

Sr No	Course contents (topics/subtopics)	Reqd Hrs
1	To analyse given sample of effluent for pH using pH meter, dissolved oxygen	4
2	To analyse given sample of effluent for colour (hazen value)	4
3	To analyse given sample of effluent for biological oxygen demand (BOD)	4
4	To analyse given sample of effluent for chemical oxygen demand (COD)	4
5	To determine biodegradability based on BOD and COD	4
6	To analyse given sample of effluent for total chromium and other heavy metal ions	4
7	To analyse given sample of effluent for total sulfide content	4
8	To analyse given sample of effluent for total dissolved solids (TDS), hardness	4
9	To analyse given sample of effluent for sodium absorption ratio	4
10	To analyse given sample of effluent for ammoniacal nitrogen	4
11	To analyze TAN (Total Ammonical Nitrogen)	4
12	To analyze basic parameters of sludge including calorific value	4
13	To understand Treatability study	4
14	To understand MLSS and MLVSS , microscopic study of Bio-mass health.	8

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

1	**Analyze** the textile effluents. (K4)
2	**Determine** presence of metal or other impurities in the effluent. (K5).
3	**Comprehend** various stages of primary, secondary and tertiary effluent treatment processes (K2)
4	**Understand** and describe various effluent treatment procedures and their application to textile processing wastewater.(K2)
5	**Operate** various instruments required for effluent characterization (K4)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K3	K4
CO1	K4	3	0	3	3	3	3	3	3	3	3	3	3	3	3
CO2	K4	3	3	3	3	2	3	3	3	3	1	2	3	2	2
CO3	K4	3	3	3	1	3	3	2	3	0	3	3	0	3	3
CO4	K3	3	3	2	3	3	3	1	3	3	3	3	2	3	3
Course	K4	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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

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

	Course Code: TXP1013	Course Title: Project I	Credits = 2		
			L	T	P
	Semester: VII	Total Contact Hours: 60	0	0	4

List of Prerequisite Courses
TXP1010
List of Courses where this course will be prerequisite
TXP1017
Description of relevance of this course in the B. Tech. Program

Sr. No.	Course Contents (Topics and subtopics)	Required Hours
1	-Teachers will communicate various research project topics to all the students based on interest and facilities available and relevance to the area of Textile Processing Technology and allied areas. - Each student based on his/her interest and merit selects the research topic and is allotted a supervisor. - Review of literature, formulation of research project, hypothesis, objectives, methodology, possible expected outcomes, planning for experimentation, experimental trials, data generation and analysis. - Oral presentation & written report of the seminar will be evaluated.	**60**
	Total	**60**

Course Outcomes (Students will be able to…..)	
CO1	Develop critical thinking to identify the research gap for the project (K5)
CO2	Formulate a scientific question and approach to solve it (K6)
CO3	Plan the experimental methodology for the project (K5)
CO4	Develop skills to communicate the research plan effectively (K6)
CO5	Develop skills for writing a scientific document on the research work (K6)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K3	K4
CO1	K5	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	K6	3	3	3	3	3	3	3	3	3	3	2	3	3	1
CO3	K5	3	2	3	3	3	3	3	1	3	3	3	3	3	3
CO4	K6	3	3	3	3	3	2	3	3	3	0	3	3	2	3
CO5	K6	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Course	K6	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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

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

Semester VIII

	Course Code: CET1504	Course Title: Chemical Project Engineering and Economics	Credits = 3		
			L	T	P
	Semester: VIII	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

All Chemical and General Engineering Courses in previous semesters.

List of Courses where this course will be prerequisite

Project – II (PHP1075) and Professional career

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

This course is required for the future professional career.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Introduction to the Green Field Projects** and global nature of the projects Impact of currency fluctuations on Project justification and cash flows Concepts of 'Quality by Design' including typical design deliverables Understanding constructability, operability and maintainability during all stages of project execution Meaning of Project Engineering, various stages of project implementation	6
2	**Relationship between Price of a Product and Project Cost** and cost of production, EV Analysis. Elements of cost of production, monitoring of the same in a plant Meaning of Administrative expenses, sales expenses, etc. Introduction to various components of project cost and their estimation Introduction to concept of inflation, location index and their use in estimating plant and machinery cost Various cost indices	8
4	**Project Financing**, debt:equity ratio, promoters, contributors, shareholders contribution, source of finance, time value of money Concept of interest, time value of money, selection of various alternative equipment or system based on this concept, Indian norms, EMI calculations Depreciation concept, Indian norms and their utility in estimate of working results of project. Working capital concept and its relevance to project	7
5	Estimate of working results of proposed project. Capacity utilization, Gross profit, operating profit, profit before tax, Corporate tax, dividend, Net cash accruals. Project evaluation: Cumulative cash flow analysis Break-Even analysis, incremental analysis, various ratios analysis, Discounted cash flow analysis	7
6	Process Selection, Site Selection, Feasibility Report	4
7	**Project Conception to Commissioning:** milestones, Project execution as conglomeration of technical and nontechnical activities, contractual details. Contract: Meaning, contents, Types of contract. Lump- sum Turnkey (LSTK),Eng, Procurement and Construction(EPC),Eng, Procurement and Construction Management (EPCM).Mergers and Acquisitions	6
8	Reading of balance sheets and evaluation of techno-commercial project reports	3
9	PERT, CPM, Bar-charts and network diagrams	4
	Total	**45**

List of Text Books/ Reference Books

1	Chemical Project Economics,MahajaniV.V.andMokashi SM.
2	Plant Designand Economics for Chemical Engineers,Peters M.S.,TimmerhausK.D.
3	Process Plant and Equipment Cost Estimation, Kharbanda O.P.

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

CO1	calculate working capital requirement for a given project.(K3)
CO2	calculate cost of equipment used in a plant total project cost.(K3)
CO3	calculate cash-flow from a given project.(K3)
CO4	select a site for the project from given alternatives.(K4)
CO5	list out various milestones related to project concept to commissioning.(K2)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K3	3	3	2	2	2	3	3	3	3	3	2	2	2	3
CO3	K3	3	3	1	0	2	3	1	3	3	3	3	2	3	2
CO4	K4	3	3	2	3	2	2	3	3	3	3	3	2	3	3
CO5	K2	3	2	1	2	1	3	3	3	3	0	3	1	3	2
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

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

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

Course Code: TXT1504	Course: SPL13 Nonwovens and Technical Textiles	Credits = 4		
		L	T	P
Semester: VIII	Total contact hours: 60	3	1	0

List of Prerequisite Courses

Technology of Textile Dyeing and Finishing

List of Courses where this course will be prerequisite

Nil

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

The students will understand various non-apparel applications of textiles and the vast and fast growing field of technical textiles

Sr. No.	Course contents (topics/subtopics)	Reqd Hrs
1.	Importance and relevance of Nonwoven textiles, fibres used and various manufacturing techniques	6
2.	Different web formation techniques like carding, air laid, wet laid, spun laid, melt blowing, film splitting methods along with process flow machinery and testing of nonwovensused and end use applications	8
3.	Coating, Laminating, interlining and composite textile – manufacturing techniques and application usages	6
4.	Introduction to Technical Textiles, Difference between Technical textiles and other sects of textiles. Classification of various Technical Textiles and their end use applications	6
5.	Medical textiles– materials used, classification, extra corporeal (biomedical) – Health care and hygiene products	6
6.	Geotech, Agrotech, Indutech, Packtech - products and applications	6
7.	Sports and recreation textiles, Water proof breathable fabrics –camping and hiking – base ball – tennis –foot ball – golf and hockey – bikes – marine products – textiles in sports surfaces –hot air ballooning	6
8.	Safety protective textiles and transportation textiles. Introduction, high temp. textiles – flame resistant protective clothing, chemical, protective clothing's radiation protection, thermal insulation, camouflage textiles	4
9.	Mobiltech - Transportation textiles – airbags – seat belts – automotive interior and exterior trim – truck and car covers, for aircrafts	6
10.	Smart Textiles – Concept of phase change materials like temperature sensitive, pH Sensitive, photo sensitive etc., Applications of phase change materials in textiles. Concept of shape memory polymers and their applications in textiles. Use of electronics in clothing.	6

List of Text Books/ Reference Books

1.	Hand book of Industrial textiles, Adanur S., CRC Press, 1995
2.	Introduction to Nonwovens, Turbak, A.F, TAPPI, 1998
3.	Automotive Textiles, Mukhopadhyay S.K., Partridge J.F., CRC Press, 1999
4.	Hand book of Technical Textiles, Horrock A. R.and Anand S.C., Woodhead Publ.,2000
5.	Coated textiles Principles and applications, Sen A.K., Technomic Publishing, 2001
6.	Medical textiles, Anand S.C., Woodhead Publishing, 2001
7.	Nonwoven Fabrics, Wilhelm A., Fuchs H., Kittelmann W., WILEY Verlag GmbH,2003
8.	Handbook of Nonwovens. United Kingdom: Elsevier Science, S. J. Russell, 2007

9.	Applications of Nonwovens in Technical Textiles. United Kingdom: Elsevier Science, R. Chapman, 2010
10.	Pourdeyhimi, B., Batra, S. K. Introduction to Nonwovens Technology. United States: Destech Publications, 2012
11.	Das, D., Pourdeyhimi, B. Composite Nonwoven Materials: Structure, Properties and Applications. United Kingdom: Elsevier Science, 2014
Course Outcomes (students will be able to.....)	
1	**Comprehend** difference between woven, knitted and nonwoven fabrics along with the areas of application depending on the properties desired(K1)
2	**Explain** methods of web formation, web bonding and finishing of nonwovens as per the intended end use (K3)
3	**Differentiate** areas of technical textile and specific fibre properties (K4)
4	**Describe** properties related to different type of technical textiles (K2)
5	**Apply** knowledge of textile processing in areas of technical textiles (K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	3	3	3	3	3	3	3	3	3	1	3	3	3
CO2	K3	3	3	2	1	2	3	3	2	3	2	3	3	3	3
CO3	K4	3	1	3	3	3	3	3	2	3	3	3	2	2	3
CO4	K3	3	3	3	2	3	0	3	3	3	3	2	0	3	3
Course	K3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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

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

Course Code: TXT1207	Course: SPL14 Emerging Textile Technologies	Credits = 3		
		L	T	P
Semester: VIII	Total contact hours: 45	2	1	0

List of Prerequisite Courses

Technology of Textile Dyeing, Printing, Finishing and Testing

List of Courses where this course will be prerequisite

Nil

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

Sr. No.	Course contents (topics/subtopics)	Reqd Hrs
1	Brief idea about nano technology and its importance in Textiles. Different routes/Methods used for Synthesis of different Nano Particles, Nanoclays and their treatments, Carbon Nano tubes and its application in textiles, Different methods of application of Nano particles onto the textile with examples	10
2	Introduction to biotechnology in Textiles, Enzyme synthesis and characterization, Various biotechnological application in textile wet processing e.g. Microbial colorants, Enzyme catalyzed dye synthesis	8
3	Plasma technology, E-Control processing; Supercritical carbon dioxide dyeing of textiles; Layer by Layer coloration of textiles, Air Dye technique, Electrochemical dyeing, Digital printing and finishing; Structural colouration	12
4	Water and energy conservation, Application of nonconventional energy and water resources in textile wet processing	8
5	Introduction to Industry 4.0 - Internet of Things, Artificial Intelligence, Data Analytics, Robotics	7

List of Text Books/ Reference Books

1	Ecotextiles, BTRA,1996
2	Coated and laminated textiles, Fung walter , CRS Press,2002
3	The textile book,Colin Gale and Jasbir Kaur,Berg Publisher New York,2002
4	Digital printing of textiles, Ujiie.H.,Woodhead publishing,2006
5	Nano fibers and Nano technology in textiles, Brown P.J,Woodhead publishing,2007
6	Plasma Technologies for Textiles,Woodhead Publishing Ltd.,R. Shishoo, 2007
7	Advances in Textile Biotechnology. , United Kingdom: Elsevier Science, 2010
8	Plasma Technologies for Textile and Apparel,Dr. S.K. Nema, Prof. P.B. Jhala, Woodhead Publishing Ltd.,2015
9	Militky, J., Mishra, R. Nanotechnology in Textiles: Theory and Application. United Kingdom: Elsevier Science, 2018
10	Frontiers of Textile Materials: Polymers, Nanomaterials, Enzymes, and Advanced Modification Techniques. ,United States: Wiley, 2020
11	Energy Conservation in Textile Industry, S. C. Bhatia, Woodhead Publishing Ltd.2020

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

1	**Understand** and apply different synthesis routes for nano particles its application on textiles by various techniques to get enhanced performance (K2)
2	**Grasp** the concept of enzyme, their synthesis and applications in different textile wet processing treatment. (K3)
3	**Recognise** the use of modern technology like plasma, e control, super critical carbon dioxide, digital printing in textiles.(K3)
4	**Relate** different ways for Water and energy conservation and utilization of nonconventional energy and water resources in textile wet processing (K3)
5	**Understand** the concept of modern IT tools in the textile wet processing like Iot, Artificial intelligence, robotics, data analytics etc.(K2)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	3	3	3	3	3	3	0	3	3	3	3	3	3
CO2	K3	3	3	2	3	3	1	3	3	3	2	3	2	3	2
CO3	K3	3	3	3	2	2	3	3	3	3	3	3	1	2	3
CO4	K4	3	3	3	2	3	3	3	3	3	2	2	3	3	2
Course	K3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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

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

Course Code: TXT1403	Course Title: SPL15 Technology of Garment Processing	Credits = 3		
		L	T	P
Semester: VIII	Total contact hours: 45	3	1	0

List of Prerequisite Courses

Technology of Textile Dyeing, Technology of Textile Finishing,

List of Courses where this course will be prerequisite

Nil

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

The course will help student to understand applications of the textile products and requirements of markets.

Garment processing

Sr No	Course contents (topics/subtopics)	Reqs Hrs
1	**Introduction:** Aim and scope of readymade garment field with special reference to textile wet processing. Brief introduction to various departments in a garment export house. General overview of various fabric materials used in garment making depending on type of garment. Accessories used	5
2	**Garment processing:** Concept of pre garment stage and garment stage processing. Concept of garment finishing, general precaution to be taken during finishing of cotton, wool, silk, rayon, woven and knitted materials, Process Sequence, Flow chart, pigment dyeing, reactive, direct, sulfur dyeing	8
3	**Garment processing machines-** Pedal dyeing machines, tumble dryers, chest printing with no. of printing stations, washing, machines, rotary drum washing, tumble drying	4
4	**Specialty Finishes on Garments** - Finishing of woven / knitted garments -Stoneless stone wash effects - mud wash, Ion wash, chalk wash etc., various softening treatments, water resistant breathable finish, Bio polishing, Leathery Finish, Protective Finishes - Antimicrobial, Deodorizing etc., Functional Finishes -Cool finish, Wrinkle free finishes, Use of various types of enzymes in garment processing, spray techniques	5
5	**Wash down effects on Denim** - Stone Wash, Enzyme Wash, Combined enzyme and stone wash, acid wash, antique wash, ball blast, whiskering, Sand blast, Ice wash.	4
6	**Laundering-** Objective, Laundering procedures for various fibre fabrics i.e. cotton and linen, woolen, silks and synthetics, various laundry equipments used in commercial laundering.	4
7	Anti-yellowing finish for garment, anti – ozone (finishes specially for garments)	3
8	**Stain Removal** - Object (with reference to garment processing), general procedure of stain removal. Classification of stains, Principles of stain removing. Classification of stain removers. Application techniques for stain removers, i) Local Application II) Bulk Application	2
9	**Dry Cleaning** - General introduction, objective and principle of the dry cleaning process, dry cleaning chemicals, detailed description of dry cleaning operations (sequential steps)	2
10	**Printing** - Special print recipes for fashion and garments; Khadi, Metallic, Floe, Plastizol, Reflective, Pearl, Fluorescent Printing, High Density Printing, Puff Printing, Foil Printing, Plastic Printing, transfer printing, digital printing	4
11	Dyeing in Garment form with pigment / reactive / sulphur Colour	4

List of Text Books/ Reference Books

1	Introduction to textile finishing by J.T. Marsh.
2	Technology of finishing - Vol. X by Dr. V.A. Shenai.

3	Chemical processing of polyester/cellulosic blends by R.M. Mittal and S.S. Trivedi.
4	Silk dyeing, printing and finishing by Prof. M.L. Gulrajani.
5	Garment Finishing and Care Labelling by S.S.Satsangi, Usha Publishers,53-B/AC-IV, Shalimar Bagh, New Delhi.
6	Stain Removing Techniques by by S. S. Satsangi, Usha Publishers, 53-B/AC-IV, Shalimar Bagh, New Delhi.
7	Fabric Care by Noemia D'SOUZA, New Age International Publishers, Daryagang, New Delhi
8	Garment Processing, Mittal, R.M.
Course Outcomes (students will be able to.....)	
1	**Understand** the aim and scope of readymade garment field with special reference to textile wet processing. (K2)
2	**Understand** the concept of various stages of garment processing, (pretreatment dyeing printing finishing) its problems and remedies.(K2)
3	**Comprehend** fundamental knowledge of the garment industry and the stages at which garments are manufactured (K2)
4	**Describe** different manufacturing processes and various equipment which are related to the fabric cutting, sewing, fusing, pressing technology of garment manufacturing (K2)
5	**Interpret** different trims and components used in the garment industry, analyze the federal classification of seams and stitches which are widely used in the garment industry**.** (K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	2	3	3	3	3	3	3	3	3	3	3	3	3
CO2	K3	3	3	2	1	2	3	3	2	3	2	0	2	2	3
CO3	K4	3	3	3	3	3	2	3	3	3	3	3	3	3	3
CO4	K3	3	3	0	2	3	3	3	3	3	1	2	3	3	2
Course	K3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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

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

	Course Code:	Course Title: Pre-approved Open Electives from MOOCs / NPTEL	Credits = 3		
			L	T	P
	Semester: VIII	Total Contact Hours: 45	2	1	0
List of Prerequisite Courses					
-					
List of Courses where this course will be prerequisite					
-					
Description of relevance of this course in the B. Tech. Program					
-					

	Course Contents (Topics and Subtopics)	Required Hours
1	-	-
2	-	-
3	-	-
4	-	-
5	-	-
	Total	45
List of Textbooks/Reference Books		
1	As prescribed by the Course Instructor(s)	
Course Outcomes (Students will be able to…..)		
CO1	As prescribed by the Course Instructor(s)	
CO2	As prescribed by the Course Instructor(s)	
CO3	As prescribed by the Course Instructor(s)	
CO4	As prescribed by the Course Instructor(s)	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-

	Course Code: TXP1017	Course Title: Project II	Credits = 4		
			L	T	P
	Semester: VIII	Total Contact Hours: 120	0	0	8

List of Prerequisite Courses
TXP1013
List of Courses where this course will be prerequisite
Non
Description of relevance of this course in the B. Tech. Program
1. Develop a skill to execute & solve a research problem in textile processing 2. Develop skills for presenting a research outcome effectively

Sr. No.	Course Contents (Topics and subtopics)	Required Hours
1	The topic of the research with defined objectives and hypothesis should be explored by scientifically planned rational experiments. Students should have actual experimental data collected on the chosen research topic.	**80**
2	-Oral presentation of proposed research work with data generated during actual trial targeted towards the objectives -Submission of report of research proposal	**40**
	Total	**120**

Course Outcomes (Students will be able to…..)	
CO1	Perform experiments & troubleshoot to generate reliable data (K5)
CO2	Apply different statistical tools for scientific data analysis (K4)
CO3	Evaluate critically the experimental data and draw meaningful inferences (K5)
CO4	Develop skills to communicate the research outcome effectively (K6)
CO5	Develop skills for writing a complete document on the project work (K6)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K5	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	K4	3	3	2	3	2	3	3	3	2	3	3	2	3	3
CO3	K5	3	3	3	3	3	0	3	3	3	3	3	3	3	3
CO4	K6	3	3	3	3	3	3	1	3	3	3	3	2	3	3
CO5	K6	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Course	K6	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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

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

Course Code: TXP1019	Course Title: PR8 Shade Matching and Bulk Colouration	Credits = 4		
		L	T	P
Semester: VIII	Total contact hours: 120	0	0	8

List of Prerequisite Courses

Technology of Textile Dyeing, Experimental Dyeing and Printing

List of Courses where this course will be pre-requisite

Nil

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

The course will help student understand the criticality and importance of accurate colour matching and the lab to bulk reproducibility expectations to achieve optimum productivity

Sr. No.	Course contents (topics/subtopics)	Reqd Hrs
1.	Pretreatment and dyeing of cotton yarn with reactive dyes	4
2.	Pretreatment and dyeing of polyester yarn with disperse dyes	4
3.	Pre-treatment and dyeing of cotton knitted and woven fabric using reactive dyes	4
4.	Dyeing of cotton woven fabric using vat dyes with vat pigment method	4
5.	Pre-treatment and dyeing of cotton/lycra blended knitted fabric	4
6.	Pre-treatment and dyeing of polyester woven/knitted fabric	4
7.	Dyeing of cotton woven fabric with reactive dyes – cold pad batch method	4
8.	Dyeing of cotton woven fabric with vat dyes – pad jigger method	4
9.	Dyeing of cotton woven fabric by pad-dry-pad-steam method	4
10.	Dyeing of polyester cotton blended fabric by one bath process using reactive and disperse dye system	4
11.	Reactive direct style of printing and development by steaming	4
12.	Polyester cotton blended fabric printing with pigment dispersions	4
13.	Pre-treatment and dyeing of garment using reactive dyes	4
14.	Effect of bio fading enzyme on denim garments	4
15.	Shade correction of reactive dyed cotton woven fabric	4
16.	Shade correction of disperse dyed polyester woven fabric	4
17.	Dyeing of cotton woven fabric with three basic reactive dyes – yellow, blue and red for self, binary and tertiary shades starting from 0.1 upto 4%	12
18.	Dyeing of polyester woven fabric with three basic disperse dyes – yellow brown, navy blue and red for self, binary and tertiary shades starting from 0.1 upto 4%	12
19.	Building data bank on computer colour matching system	12

20.	Getting recipe for a given shade from computer colour matching system	4
21.	Carry out dyeing using the computer-generated recipe and checking the same on CCM	4
22.	Getting exact match by fine tuning recipe derived from computer	12
Course Outcomes (students will be able to.....)		
1	Perform dyeing of various types of fabrics and blends using different methods on continuous dyeing range (K4)	
2	Prepare screen design and print using Flat bed, rotary and block printing methods (K4)	
3	Perform combined and separate Desizing, Scouring, Bleaching of cotton knit, processing of Cotton/Elastane blends on soft flow machine (K4)	
4	Process Polyester/Viscose, Polyester/Wool blends on pilot Jet dyeing machine (K4)	
5	Develop shade matching of cotton fabric using vat and reactive dyes (K5)	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	2	1	2	1	3	3	3	3	3	3	2	3	3
CO2	K4	3	2	0	2	1	3	3	3	1	3	3	1	3	3
CO3	K2	3	1	1	2	1	3	2	3	3	3	3	0	3	2
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

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

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

Institute Electives (By The Department)	Program Elective
1. Laboratory Management Systems 2. Sustainability aspects of Textile Processing	1. Ayurvastra- Natural Textiles 2. Textile 4.0