Syllabus for Bachelor of Technology
In
Fibres and Textile Processing Technology

(Under the National Education Policy, NEP 2020)
(2023-2024)

DEPARTMENT OF FIBRES AND TEXTILE PROCESSING TECHNOLOGY

INSTITUTE OF CHEMICAL TECHNOLOGY
(University Under Section-3 of UGC Act, 1956)
Elite Status and Center for Excellence
Government of Maharashtra

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A. Preamble

The Institute of Chemical Technology (ICT) was established in 1933 and was earlier known as the 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 the 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 the 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 ever-evolving industrial needs.

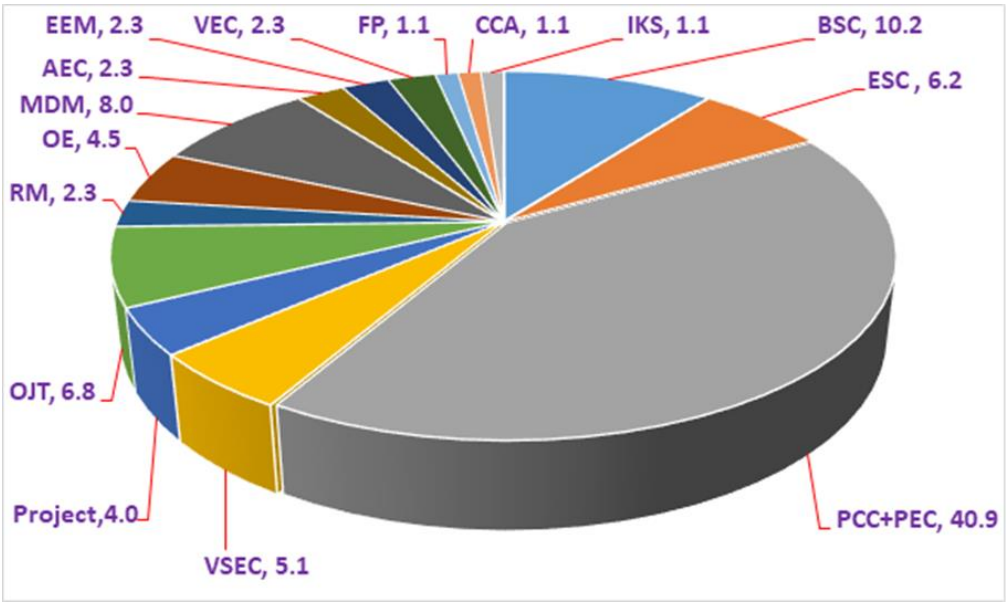

Figure 1 Distribution of various course types (in percentage) for the programme as per the guidelines of NEP 2020. This distribution does not include Honours courses having 18 credits in total.

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.

B. Program Educational Objectives (PEOs)

PEO1	To prepare a professional in Textile technology along with the knowledge of recent developments to be absorbed in Academia, Research Institutes in India and abroad along with Entrepreneurship skills.
PEO2	To encourage students to understand, create and progress in their profession and create inquisitiveness to achieve greater goals in life in the form of higher education or impart public awareness at grass root levels.
PEO3	To promote research, technology and products related to fibres and textile science and engineering, thus providing technological intelligence to the society at large.
PEO4	To profess social and environmental awareness of textile technology which will have a great impact on job availability, industrial research and global scientific environment.

C. Program Outcomes (POs) as defined by the National Board of Accreditation (NBA): 12 Graduate Attributes

PO1	**Engineering 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**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the

	complex problems	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 teamwork**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication**	Communicate effectively on complex technological activities with reference to Fibres and Textile Processing Technology, with the engineering 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 engineering 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.

D. Program Specific Outcomes (PSOs) for B. Tech. (Fibres and Textile Processing Technology)

The graduates will be able to:

PSO1	Understand basic concepts and terminology of science, mathematics, and fundamentals of engineering and technology particularly in Fibres and Textile Processing Technology.
PSO2	Instil essential knowledge and concept of textile fibres, physicochemical aspect of textile materials, and wet processing of textile to meet the specified needs considering basic needs, safety, societal, economic, and environmental or sustainability factors making positive contribution to generation and dissemination of new knowledge.
PSO3	Probe and investigate to conduct experiments, research, or model as per standards, collect and analyse information based on field visits, analysis, and interpretation of data to create a thirst among the students for innovative start-ups or career options taking advantage of the fast-developing Indian economy.
PSO4	Imparting advanced technical education, emerging Textile Technologies and upskilling in different fields of technical textiles, catering to the manufacture, processing and the application areas of technical textiles to promote 'Make in India'.
PSO5	Aware of the environmental and societal impact of textile industry and work within the periphery for the good of society and the scientific world. Set-up their own ventures and generate employment, promote awareness in society about Textile technology profession.

EXIT Policy

Based on the National Education Policy guidelines (NEP-2020), the following rules and regulations shall be applicable for the exit from the Degree program where the candidate is currently registered, after the First year, Second Year, and Third Year of the students can exit at each level of their four-year B. Tech (Fibres and Textile Processing Technology) program.

a) A candidate who has earned a total of 44 credits after the First year of the Degree Course AND completed eight weeks of practical training can exit the degree course with a Certificate in a relevant degree program.

b) A candidate who has earned a total of 88 credits after the Second year of the Degree Course AND has completed eight weeks of practical training/Internship can exit the degree course with Diploma in a relevant degree program.

c) A candidate who has earned a total of 132 credits after the Third year of the Degree course AND has completed eight weeks of practical training/ Internship can exit the degree with B.Sc. (Tech) in a relevant degree program.

d) The candidate shall apply for the exit from the program by this exit policy in a standard format. The letter will be addressed to The Dean, Academic Program. The exit will be permitted only on completion of the training program as prescribed by the Regulations.

Sr. no.	Exit Year	Mandatory Activity	Credits	Duration (No of Weeks)
1	1st Year (After Semester II)	8 credit course workshop/chemistry lab (after semester II)	8	8 weeks
2	2nd Year (After Semester IV)	Certificate Course in Practice of Chemical Technology of ICT (CCPCT)	8	8 weeks
3	3rd Year (After Semester VI)	In-plant training for 3 months	8	8 weeks

Syllabus Structure
for
Bachelor of Technology in Fibres and Textile Processing Technology
(Under NEP 2020)
Institute of Chemical Technology, Mumbai

Semester I										
Subject Code	**Subject**	**Course**	**Credits**	**Hrs./Week**			**Marks for various Exams**			
				L	**T**	**P**	**CA**	**MS**	**ES**	**Total**
CHT1405	Physical Chemistry	BSC	3	2	1	0	20	30	50	100
CHT1406	Analytic Chemistry	BSC	3	2	1	0	20	30	50	100
MAT 1301	Engineering Mathematics	ESC	3	2	1	0	20	30	50	100
GET1129	Engineering Drawing and Computer Aided Drafting	VSEC	3	1	0	4	0	50	50	100
PYT1205	Applied Physics	BSC	2	1	1	0	20	30	50	100
TXT1107	**SPL1:** Introduction to Textile Substrates	ESC	2	1	1	0	20	30	50	100
HUT1110B	Communication Skills	AEC-01	2	0	0	4	0	50	50	100
PYP1101	Physics Laboratory	BSC	2	0	0	4	0	50	50	100
XXXX	OPEN Activity - Sports/ Fine arts/Yoga/ Music/NSS**	CCA	2	0	0	4	0	50	50	100
	TOTAL		**22**	**9**	**5**	**16**				**900**

Semester II										
Subject Code	**Subject**	**Course**	**Credits**	**Hrs./Week**			**Marks for various Exams**			
				L	**T**	**P**	**CA**	**MS**	**ES**	**Total**
CHT1407	Organic Chemistry	BSC	3	2	1	0	20	30	50	100
CHT1408	Industrial Chemistry	BSC	3	2	1	0	20	30	50	100
TXT1218	**SPL-2** Introduction to Textile Wet Processing	PCC	2	1	1	0	20	30	50	100
GET 1306	Basic Mechanical Engineering	ESC	2	1	1	0	20	30	50	100
GET 1125	Electrical Engineering and Electronics	ESC	2	1	1	0	20	30	50	100
CEP1720	Process Calculations	ESC	2	0	0	4	0	50	50	100
CHP1343	Physical and Analytical Chemistry Lab	BSC	2	0	0	4	00	50	50	100
CHP1132	Organic Chemistry Laboratory	VSEC	2	0	0	4	00	50	50	100
HUPXXXX	OPEN Activity- Sports/ Fine Arts/Yoga/ Music/NSS**	CCA	2	0	0	4	00	50	50	100

HUT1117	**MOOC**- Indian Knowledge System (NPTEL - Traditional Indian Chemical Technology)	IKS	2	2	0	0	20	30	50	100
	TOTAL		**22**	**7**	**5**	**20**				**1000**
Note: Universal Human Values (UHV) an audit course to be taken in inter-semester break after Semester-II to be taken as MOOC course. ** Students will undertake these co-curricular activities such as sports / Fine Arts / Yoga / Music / Literature etc administered through various clubs under Technological Association approved by Dean, Students Affairs.										

Semester-III										
Subject Code	**Subject**	**Course**	**Credits**	**Hrs./Week**			**Marks for various Exams**			
				L	**T**	**P**	**CA**	**MS**	**ES**	**Total**
TXT1219	**SPL-3:** Textile Wet Processing Machinery	PCC	4	3	1	0	20	30	50	100
TXT1216	**SPL-4:** Chemistry and Application of Speciality Chemicals	PCC	2	1	1	0	20	30	50	100
HUTXXXX	Basic Sciences (Chemistry/ Physics/Biology / Maths / Humanities)	OE	4	3	1	0	20	30	50	100
HUPXXXX	Modern Indian Language – (Marathi / Hindi or Any other language)	AEC-02	2	2	1	0	00	50	50	100
HUT1205	Basic Economics and Finance	EEM	2	2	1	0	00	50	50	100
XXXX	Value Enhancement Courses in Emerging Areas (NPTEL)	VEC	2	1	1	0	20	30	50	100
XXXX	**MDM-I**	MDM	2	1	1	0	20	30	50	100
TXP1015	**PR 1:** Analysis of Textile Chemicals and Fibers	PCC	2	0	0	4	0	50	50	100
TXP1022	**PR 2:** Textile Wet Processing Lab 1 (Pretreatment, Dyeing, Printing)	PCC	2	0	0	4	0	50	50	100
	TOTAL		**22**	**11**	**7**	**8**				**900**

Semester-IV										
Subject Code	**Subject**	**Course**	**Credits**	**Hrs./Week**			**Marks for various Exams**			
				L	**T**	**P**	**CA**	**MS**	**ES**	**Total**
CET1105	Transport Phenomena	PCC	4	3	1	0	20	30	50	100

TXT 1301	**SPL-5:** Testing of Textile Materials	PCC	3	2	1	0	20	30	50	100
TXT1405	**SPL-6:** Garment Manufacturing and Merchandising	PCC	3	2	1	0	20	30	50	100
XXXX	Basic Sciences (Chemistry/ Physics/ Biology / Maths) or Humanities Discipline (Biochemistry and Micro)	OE	2	1	1	0	20	30	50	100
CET1805	Chemical Process Economics	EEM	2	1	1	0	20	30	50	100
TXP1023	**PR3:** Textile Wet Processing Lab 2 (Finishing, Testing)	VSEC	2	0	0	4	0	50	50	100
HUT1206	Environmental Sciences and Technology	VEC	2	1	1	0	20	30	50	100
XXXX	**MDM II**	MDM	2	1	1	0	20	30	50	100
HUPXXXX	Community Engagement Project	CEP/FP	2	0	0	4	0	50	50	100
	TOTAL		**22**	**11**	**7**	**8**				**900**
# During summer vacation, students will undertake community projects as individual or group related to study of societal technological activities through various organization such as Lions club, Teach India, Marathi Vidnyan Parishad, CSR projects outsourced by various industries, ISR activities administered through Technological Association approved by the Dean, Student Affairs.										

Third Year Semester-V										
Subject Code	**Subject**	**Course**	**Credits**	**Hrs./Week**			**Marks for various Exams**			
				L	**T**	**P**	**CA**	**MS**	**ES**	**Total**
CET1806	Chemical Reaction Engineering	PCC	2	1	1	0	20	30	50	100
CET1807	Chemical Engineering Operations	PCC	2	1	1	0	20	30	50	100
TXT 1201	**SPL-7:** Technology of Textile Pretreatment	PCC	4	3	1	0	20	30	50	100
XXXX	Department Elective Cource-1 Offered by department **(SPL 8)**	PEC-1	4	3	1	0	20	30	50	100
TXP 1002	**PR4:** Pretreatment Lab	PCC	2	0	0	4	0	50	50	100
TXP 1004	**PR5:** Experimental Dyeing Lab	PCC	2	0	0	4	0	50	50	100
XXXX	From Basic Sciences (Chemistry/ Physics/ Biology / Maths) or Humanities Discipline	OE	2	1	1	0	20	30	50	100
XXXX	**MDM III**	MDM	4	2	0	4	20	30	50	100
TXT1701	Honors Course -I: Chemistry of Colorants	PCC	4	3	1	0	20	30	50	100
	TOTAL		**26**	**14**	**6**	**12**				**900**

Third Year Semester-VI

Subject Code	Subject	Course	Credits	Hrs./Week			Marks for various Exams			
				L	T	P	CA	MS	ES	Total
TXT1106	**SPL-9:** Technology of Fibers and Polymers	PCC	3	2	1	0	20	30	50	100
TXT 1101	**SPL-10:** Manufacturing of Yarn and Fabrics	PCC	3	2	1	0	20	30	50	100
XXXX	Department Elective Course-2 Offered by department **(SPL-11)**	PEC-2	4	3	1	0	20	30	50	100
TXT1211	**SPL-12:** Technology of Textile Finishing	PCC	4	3	1	0	20	30	50	100
CEP1714	Chemical Engineering Laboratory	VSEC	2	0	0	4	0	50	50	100
TXP 1006	**PR6:** Printing Lab	PCC	2	0	0	4	0	50	50	100
TXP 1011	Department Elective Course-3 Offered by department **(PR7)**	PEC-3	2	0	0	4	0	50	50	100
XXXX	**MDM IV**	MDM	2	1	1	0	20	30	50	100
TXT1213	Honors Course-II: Theory of Dyeing	PCC	4	3	1	0	20	30	50	100
	TOTAL		**26**	**14**	**5**	**12**				**900**

Fourth Year Semester-VII										
Subject Code	**Subject**	**Course**	**Credits**	**Hrs./Week**			**Marks for various Exams**			
				L	**T**	**P**	**CA**	**MS**	**ES**	**Total**
TXT1504	**SPL-13:** Non-Woven and High-Tech Fibres in Technical Textiles	PCC	3	2	1	0	20	30	50	100
TXT 1803	**SPL-14:** Effluent Characterisation and Treatment	PCC	2	2	0	0	20	30	50	100
XXXX	Department Elective Course-4 Offered by department	PEC-4	3	2	1	0	20	30	50	100
XXXX	Department Elective Course-5 Offered by department	PEC-5	2	1	1	0	20	30	50	100
TXT1207	Honors-III: Emerging Textile Technologies	PCC	4	3	1	0	20	30	50	100
XXXX	**MDM V**	MDM	2	1	1	0	20	30	50	100
TXP1019	**PR8:** Shade Matching and Bulk Coloration	PCC	2	0	0	4	0	50	50	100
TXP1027	Literature Review (Research Methodology - I)	RM-1	2	1	0	2	20	30	50	100
TXP1028	Design and Analysis of Experiments (Research Methodology - II)	RM-2	2	1	0	2	20	30	50	100
TXP1013	Project -I	Project	4	0	0	8	0	50	50	100
	TOTAL		**26**	13	5	16				**1000**

Fourth Year Semester-VIII (10 weeks)										
Subject Code	**Subject**	**Course**	**Credits**	**Hrs./Week**			**Marks for various Exams**			
				L	**T**	**P**	**CA**	**MS**	**ES**	**Total**
TXT 1502	**SPL-15:** Technical Textiles and its Applications	PCC	3	2	1	0	20	30	50	100
TXT1702	Honors Course-IV: Textile Physics	PCC	3	2	1	0	20	30	50	100
TXT1217	Honors Course-V: Continuous Processing of Textiles	PCC	3	2	1	0	20	30	50	100
XXXX	**MDM VI**	MDM	2	2	1	0	20	30	50	100
XXXX	Department Elective Course-6 Offered by department	PEC-6	2	0	0	4	0	50	50	100
TXP1017	Project-II	PCC	3	0	0	12	0	50	50	100
TXP1014	Internship with Industry **(12-16 weeks)**	OJT	12	0	0	0				100
	TOTAL		**28**	**8**	**4**	**16**				**700**

BSC: Basic Science Course,
ESC: Engineering Science Course
PCC: Program Core Course,
PEC: Program Elective Course
MDM: Multi-disciplinary Minor: Different discipline of engineering or different faculty altogether
OE: Open Elective: To be chosen Compulsorily from faculty other than major discipline
VSEC: Vocational and Skill Enhancement Course: Hands on training corresponding to major/minor
AEC: Ability Enhancement Course: English 2 credit, Modern Indian Language 2 credit
IKS: Indian Knowledge System: Indian Architecture/Maths/Medicine
VEC: Value Enhancement Course: e.g. Understanding India, Environmental Science / Education / Digital and Tech solutions.
RM: Research Methodology
CCA: Co-curricular activities: Health and wellness / Yoga / Sports / Cultural activities / NSS/NCC/Applied visual performing arts

F. Detailed syllabus:

SEMESTER-I

BSC	Course Code: CHT1405	Course Title: Physical Chemistry	Credits = 3		
			L	T	P
	Semester: I	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

Std. XII Chemistry

List of Courses where this course will be Prerequisite

Physical and Analytical Chemistry laboratory (CHP1343), Transport Phenomena (CET1105)

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)	Reqd Hrs
1	**Laws of thermodynamics** – Enthalpy and heat capacities, application of first law to gases, thermochemistry-Hess law 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
2	**Spontaneous process and equilibrium** –Helmholtz and Gibbs free energy, spontaneity and free energy, Maxwell's relations, effect of T and P on free energy,	3
3	**Multicomponent system –** free energy and entropy of mixing, partial molar quantities and chemical potential, Gibbs Duhem equation	6
4	**Equilibrium in solutions –** ideal and non-ideal solutions, Henry's law and Raoult's law, colligative properties, activity and activity coefficients, thermodynamic properties of electrolytes in solution	7
5	**Solubility equilibria** – solubility constant, common ion effect, effect of added salts on solubility pH, weak and strong acids and bases, buffer solutions, ionic solutions **Chemical Equilibria –** le Chaterlier's principle, Effect of temperature, pressure and composition on equilibrium	5
6	**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
7	**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
8	**Homogenous catalysis** – homogeneous acid / base catalysis (specific and general acid catalysis), enzyme catalysis (Michelis Menten kinetics)	6

9	**Reactions at interface –** Adsorption isotherms, kinetics of surface reactions- Hishelwood and Rideal models of surface reactions	3
Total		**45**
List of Textbooks/ Reference Books		
1	Atkins, Peter W.; Paula, Julio de; Keeler, James. Atkin's Physical Chemistry; 11th ed.; Oxford University Press (2018).	
2	Elements of Physical Chemistry (7th edition) by P. W. Atkins and J. de Paula, Oxford University Press, 2016.	
3	Chemical Kinetics (3rd edition) by Keith J. Laidler, New York : Harper & -Row, 1987.	
Course Outcomes (Students will be able to…..)		
CO1	Understand the concepts of thermodynamics and relate them to measurable quantities	K2
CO2	Elucidate the effect of thermodynamic quantities on physical and chemical equilibria	K4
CO3	Correlate the thermodynamic properties of chemical systems with the observed outcomes and predict the optimum conditions	K3
CO4	Comprehend fundamental knowledge in chemical kinetics with basics of order, molecularity and temperature effect	K2
CO5	Examine kinetics for complex, fast and interfacial reactions	K3
CO6	Comprehend different theories in kinetics to explain the molecular origin of kinetic phenomena	K4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	3	2	1	2	0	0	1	0	2
CO2	2	3	2	3	2	2	2	1	1	1	1	1
CO3	2	3	2	3	2	2	2	1	1	1	1	1
CO4	2	3	1	2	2	1	2	0	0	1	0	2
CO5	3	3	2	3	2	2	2	1	0	1	0	1
CO6	2	2	3	3	2	1	1	1	0	1	1	1

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

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	1	1
CO2	2	3	2	1	2
CO3	2	3	2	1	1
CO4	3	2	1	1	1
CO5	2	2	1	0	1
CO6	2	1	1	1	1

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

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

BSC	Course Code: CHT1406	Course Title: Analytical Chemistry	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
(CHP1343) Physical and Analytical Chemistry Laboratory, (TXT1216) Chemistry and Application of Speciality Chemicals
Description of relevance of this course in the B. Tech. Programme
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)	Reqd Hrs
1	Introduction to chemical analysis, terminology (technique / method / procedure / protocol), broad classification of analytical techniques, good laboratory practices	5
2	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 principle, instrumentation, and applications of - UV-visible spectroscopy - Infrared spectroscopy - fluorescence spectroscopy	8
5	**Electrochemical methods:** General principle, instrumentation, and applications of - conductometry - potentiometry	8
6	**Chromatographic methods:** General principle, instrumentation, and applications of - gas chromatography (GC) - HPLC	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	Explain the principles of UV-visible and fluorescence spectroscopic methods	K3
CO2	Explain the principles of electrochemical methods	K3
CO3	Understand the principles of chromatographic separations	K3
CO4	Evaluate the results of chemical analysis in terms of accuracy and precision	K4
CO5	Apply the principles of sampling to design an optimum analytical protocol	K4
CO6	Identify conditions to minimize the error and increase the sensitivity of analysis	K5
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	3	3	2	2	1	1	0	1
CO2	2	3	2	3	3	2	2	1	1	1	0	1
CO3	2	3	2	3	3	2	2	0	1	1	0	1
CO4	2	3	2	3	3	2	2	1	1	1	0	1
CO5	2	2	2	1	2	1	1	1	0	1	1	0
CO6	2	2	1	1	2	1	2	1	0	0	0	0

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	2	2	1	1	2
CO2	2	2	2	1	1
CO3	2	2	1	0	0
CO4	1	2	1	0	0
CO5	1	2	1	1	1
CO6	1	1	1	0	0

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

ESC	**Course Code: MAT 1301**	**Course Title: Engineering Mathematics**	**Credits = 3**		
			L	**T**	**P**
	Semester: I	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
XII Standard Mathematics					
List of Courses where this course will be prerequisite					
(CEP1714) Chemical Engineering Laboratory, (CEP1720) Process Calculations, (TXP1028) Design and Analysis of Experiments (Research Methodology - II)					
Description of relevance of this course in the B. Tech. Program					

This is a basic Mathematics course which will give the students the required foundations of mathematics to understand engineering concepts in the later part of the technology programs in ICT Mumbai. This course will also introduce probability distributions and basic statistics will be helpful to understand various data science studies in different engineering disciplines.		
Sr. no.	**Course Contents (Topics and subtopics)**	**Reqd Hrs**
1	**Linear Algebra:** Vectors in $\mathbb{R}^n$, notion of linear independence and dependence. $\mathbb{R}^n$ as a vector space, vector subspaces of $\mathbb{R}^n$, basis of a vector subspace, row space, null space, and column space, rank of a matrix. Determinants and rank of matrices. Linear transformations in $\mathbb{R}^n$, 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 square methods, Diagonalization of matrices and its applications to stochastic matrices	15
2	**Differential Calculus:** Higher order differentiation and Leibnitz Rule for the derivative, Taylor's and Maclaurin's theorems, Maxima/Minima, convexity of functions and applications. 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, Method of Lagrange Multipliers, Introduction to double and triple integrals.	15
3	**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		**45**
List of Textbooks/ Reference Books		
1	G. Strang, Linear Algebra and its Applications (4th Edition), Thomson (2006).	
2	Howard Anton, Elementary Linear Algebra, John Wiley & Sons (2016)	
3	Stewart, James, Single Variable Calculus, 6th Edition, Cenage learning (2016)	
4	Hughes-Hallett et al., Calculus - Single and Multivariable (3rd Edition), John-Wiley and Sons (2003).	
5	E. Kreyszig, Advanced Engineering Mathematics (8th Edition), John Wiley (1999). (Officially prescribed)	
6	S. R. K. Iyengar, R. K. Jain, Advanced Engineering Mathematics Narosa, (2020)	
7	A First Course in Probability, Sheldon Ross, Pearson Prentice Hall, 9th Edition (2018)	
8	W.W. Hines, D. C. Montgomery, D.M. Goldsman, John-Wiely, Probability and Statistics in Engineering, John Wiley & Sons (2008)	
9	Alexander M. Mood, Duane C. Boes, and Franklin A. Graybill, Introduction to the Theory of Statistics, Mc GrawHill, (1973)	
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	Understand the notion of integrability and be able to compute multiple integrals and apply them in engineering applications.	K3
CO3	Understand the computational and geometrical concepts related to linear transformations, eigenvalues and eigenvectors and apply them to solve computational problems.	K3
CO4	Demonstrate understanding of different concepts in linear algebra in solving computational problems related to vectors and matrices and apply them to solve problems arising the Engineering especially in AI and ML.	K4
CO5	Understand the concepts of various probability distributions and apply them to analyze various engineering problems and make inference about the system.	K3
CO6	Understand the method of linear and nonlinear least squares method and apply it to choose appropriate mathematical functions for modelling real data sets, arising from engineering disciplines.	K3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	1	1	1	0	0	0	0	0	0	3
CO2	2	2	1	1	1	0	0	0	0	0	0	3
CO3	2	2	1	1	1	0	0	0	0	0	0	3
CO4	2	2	1	1	2	0	0	0	0	1	0	3
CO5	2	2	1	1	1	0	0	0	0	0	0	3
CO6	2	3	3	1	2	1	0	0	3	1	0	3

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	1	0	1	1	0
CO2	1	1	1	0	1
CO3	2	2	0	2	0
CO4	2	2	2	2	1
CO5	2	2	2	2	1
CO6	2	1	2	1	0

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

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

VSEC	**Course Code: GEP1129**	**Course Title: Engineering Drawing and Computer Aided Drafting**	**Credits = 3**		
	Semester: I		**L**	**T**	**P**
		Total contact hours: 75	**1**	**0**	**4**
List of Prerequisite Courses					
Standard XII Mathematics					

List of Courses where this course will be prerequisite		
(GET1306) Basic Mechanical Engineering, (TXT1405) Garment Manufacturing and Merchandising, (TXT1702) Textile Physics		
Description of relevance of this course in the B. Tech. Program		
Drawing is a language used by engineers and technologists. A student is required to know the various processes and the equipment used to carry out the processes. Some of the elementary areas like product sizing, manufacturing etc., are very common to all the branches of technology. These and many other processes require machines and equipment's. One should be familiar with the design, manufacturing, working, maintenance of such machines and equipments. The subject of "drawing" is a medium through which, one can learn all such matter, because the "drawings" are used to represent objects and various processes on the paper. Through the drawings, a lot of accurate information is conveyed which will not be practicable through a spoken word or a written text. This course is required in many subjects as well as later in the professional career.		
Sr. no.	**Course Contents (Topics and subtopics)**	**Reqd. hrs**
1.	**Orthographic projections:** Introduction, Principles of Projection, Methods of Projection, Planes of projection, Quadrants, First-angle method of projection, Third-angle method of projection, and concept of orthographic projections.	15(3L+12P)
2.	**Sectional Projections and Missing Views:** Need for the drawing sectional views, concept of sectioning and section lines, Sectional drawings of different solids and machine components, Auxiliary planes, and views. **Missing Views**: Concept of recognizing missing views and their interpretation, drawing of missing views from given orthographic drawings.	15 (3L+12P)
3.	**Isometric projections:** Concept of isometric views, isometric projections and isometric scale, Iso metric projections of different solids and machine components.	10 (2L+8P)
4.	**Computer Aided Drafting and Assembly drawing:** Basic introduction to CAD software, Design and Development of new products, Application of CAD, 2D, 3D part modelling on software, drawing modification and dimensioning, modelling of different machine components. Basics of Assembly drawing, preparation of 2D, 3D components and assembling on CAD software, conversions, labelling and table creation for bill of materials.	25(5L+20P)
Total		**75**
List of Textbooks/ Reference Books		
1.	Engineering Drawing by N.D. Bhat	
2.	Engineering Drawing by N.H. Dubey	
3.	CAD/CAM: Theory and Practice by Ibrahim Zeid and R Sivasubramanian	
Course Outcomes (students will be able to….)		
CO1	Draw Orthographic Projections of Solid objects.	K4+P2
CO2	Draw Third view of solid object when two views are given	K4+P2
CO3	Draw isometric Projections of Solid objects.	K4+P2
CO4	Draw assembly of various machine components	K4+P2
CO5	Understand basic commands of CAD software	K2+P2
CO6	Use CAD software for drafting and editing 2 dimensional drawings	K3+P2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating P1 – Imitate, P2 – Manipulate, P3 – Perfect, P4 – Articulate, P5 – Embody		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	0	0	0	0	0	0	0	1	0	0	0	3	0
CO2	3	0	0	0	0	0	0	0	1	0	0	0	3	0
CO3	3	0	0	0	0	0	0	0	1	0	0	0	3	0
CO4	3	0	0	0	0	0	0	0	1	0	0	0	3	0
CO5	3	0	0	0	3	0	0	0	2	0	0	3	3	0
CO6	3	0	0	0	3	0	0	0	2	0	0	3	3	0

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	2	2	2	1	1
CO2	1	1	1	2	0
CO3	0	0	1	1	0
CO4	2	2	2	2	1
CO5	1	1	1	1	0
CO6	2	0	1	1	0

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

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

BSC	**Course Code:** **PYT1205**	**Course Title:** **Applied Physics**	**Credits = 2**		
			L	**T**	**P**
	Semester: I	**Total contact hours: 30**	**1**	**1**	**0**

List of Prerequisite Courses

Standard XII Science

List of Courses where this course will be prerequisite

Project-II(TXP1017), Transport Phenomena (CET1105)

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

Materials and their properties play a key role in chemical engineering and technology. The Applied Physics course will provide the students with the necessary fundamentals to develop a broad understanding of various aspects related to materials, thereby equipping them with the ability to apply it wherever required in their course of study.

Sr. no.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
	Solid State Physics	
1.	Crystal Structure of Solids: A revision of concepts of a lattice, a basis, unit cell, different crystal systems (SC, BCC, FCC, HCP), co-ordination number and packing fractions. Single crystalline, Polycrystalline, and Amorphous materials.	**3**
2.	Crystallographic planes and directions: concept of Miller indices and its determination, examples; calculation of inter-planar spacing in terms of Miller indices.	**3**
3.	Determination of crystal structure using X-rays: Bragg's law of X-ray diffraction, types of diffractometers, Indexing diffraction peaks and calculation of various lattice parameters and crystallite size.	**4**

4.	Energy band in solids and classification of solids, the concept of Fermi level and Fermi distribution function, Intrinsic and extrinsic semiconductors, Transport properties of semiconductors: Conductivity in semiconductors and its dependence of carrier concentration and mobility.	**5**
	Physics of Fluids	
5.	A revision of the basic concepts of hydrostatics and ideal fluid flow: Equation of continuity and Bernoulli's equation.	**4**
6.	The concept of viscosity, Newton's law of viscosity, Reynold's number, Poiseuille's equation for streamline flows	**4**
7.	An introduction to Rheology: Parameters of viscous flows, Newtonian and non-Newtonian behaviour, Variation of viscosity with shear rate, shear time, temperature, and pressure (qualitative ideas with illustrative examples), measuring properties of viscous flows. The concept of viscoelasticity, Maxwell and Kelvin models of relaxation, relaxation spectrum, creep testing.	**7**
Total		**30**
List of Textbooks/ Reference Books		
1.	Fundamentals of Physics – Halliday, Resnick, Walker – 6th Edition - John Wiley	
2.	Sears and Zeemansky's University Physics – Young and Freedman – 12th Edition - Pearson Education	
3.	A Textbook of Engineering Physics - M N Avadhanulu, P G Kshirsagar, TVS Arun Murthy - 11th Edition -S. Chand Publishers	
4.	Solid State Physics – S. O. Pillai – 10th Edition - New Age Publishers	
5.	Solid State Physics – A. J. Dekker - MacMillan India.	
6.	Engineering Physics – V Rajendran – 6th Edition - McGraw Hill Publishers	
7.	Introduction to Rheology – H. A. Barnes, J. F. Hutton and K. Walters - 4th Edition - Elsevier Science.	
8.	Viscoelastic Properties of Polymers – J. D. Ferry - 3rd Edition - Wiley	
Course Outcomes (students will be able to…..)		
CO1	Assign Miller indices to various crystallographic planes and directions in a crystal lattice, thereby understand periodicity in the crystal lattice.	K4
CO2	Analyse a given x-ray diffraction pattern to deduce the crystal structure of the material and calculate the values of the basic structural parameters.	K4
CO3	Classify solids, and in turn semiconductors, and calculate basic quantities related to charge transport in them.	K3
CO4	Analyse simple ideal fluid flows by applying the continuity equation and Bernoulli's equation.	K3
CO5	Describe the basic behaviour of viscous flows and the relationships between various flow parameters.	K4
CO6	Understand simple models that are used to describe viscoelastic flows.	K4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	3	2	1	1	1	1	1	1	3
CO2	3	3	3	2	2	1	1	1	1	1	1	3
CO3	3	3	2	2	2	2	1	1	1	1	1	3
CO4	3	2	3	3	2	1	1	1	1	1	1	3

CO5	2	2	2	3	2	1	1	2	1	1	1	3
CO6	2	2	3	2	2	1	1	1	1	1	1	3

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	2	3	2	1
CO2	3	3	3	2	0
CO3	2	2	2	2	1
CO4	3	3	2	2	0
CO5	2	3	3	2	1
CO6	1	2	2	1	1

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

ESC	**Course Code: TXT1107**	**Course Title: SPL1 Introduction to Textile Substrates**	**Credits = 2**		
			L	**T**	**P**
	Semester: I	**Total contact hours: 30**	**1**	**1**	**0**

List of Prerequisite Courses

Standard XII Science

List of Courses where this course will be prerequisite

(TXT1210) Technology of Textile Dyeing, (TXT1301) Testing of Textile Materials, (TXT1106) Technology of Fibres and Polymers, (TXT1101) Manufacturing of Yarn and Fabric

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 concepts 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.	4
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.	7
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.	5

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.	5
5.	Manufacturing of yarn: 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.	3
6.	Manufacturing of Fabric: Introduction to fabric manufacturing, types of manufacturing, weaving, knitting and non-woven.	3
7.	Numerical – Fineness, Moisture percentage, Motion transfer in gears and rollers, Drafting and doubling, Twist, Fabric production, Cover factor, statistical analysis.	3
Total		**30**

List of Textbooks/ Reference Books

1.	Textile Fibres, Shenai V.A., Vol-1, Sevak Publications, Bombay, 3rd edition, 1991.
2.	Mishra, S. P. A Textbook of Fibre Science and Technology. India: New Age International,
3.	Ghosh, P. Fibre Science and Technology. United States: McGraw Hill Education (India) Private Limited, 2004
4.	Kothari, V. Manufactured Fibre Technology. Netherlands: Springer Netherland, 2012
5.	Visco-Elastic Properties of Polymers, Ferry, J.D., John Wiley and Sons, New York, 3rd
6.	Polymer Science, V R Gowarikar, New Age international (P) Ltd Publications, New
7.	Weaving: Machines, mechanisms, management, Talukdar, M.K., Sriramulu P.K., Ajgaonkar D.B., Mahajan Publishers Private Ltd., Ahmedabad, 1998
8.	Knitting technology, D. B. Ajgaonkar, Universal Pub, 1998
9.	Nonwovens - Process, Structure, Properties and Applications; T Karthik, 2017

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

CO1	Understand fibre-forming properties with different textile terms and their classification.	K1
CO2	Acquire deeper understanding and insights into basic chemistry, production processes and physical and chemical properties of Natural and Synthetic fibers.	K2
CO3	Comprehend fundamental knowledge of polymers, their classifications, as well as techniques and mechanism of polymerization.	K2
CO4	Understand different areas of applications of these fibres vis a vis their	K2
CO5	Analyze designs of various type of fabrics and different types of defects in	K2
CO6	Calculate yarn and fabric production related numerical.	K3

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	3	3	2	1	2	1	1	2	3	3
CO2	3	3	3	3	3	3	3	1	2	2	2	3
CO3	3	3	3	3	3	2	2	1	2	1	3	3
CO4	3	3	3	3	3	2	3	2	1	2	2	3
CO5	3	3	3	3	3	2	2	1	2	1	3	3
CO6	3	3	3	3	3	2	3	2	1	2	2	3

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	2	2	3
CO4	3	3	3	2	3
CO5	3	3	2	2	1
CO6	3	3	3	2	1

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

AEC	**Course Code:** **HUT1110B**	**Course Title:** **Communication Skills**	**Credits = 2**		
			L	**T**	**P**
	Semester: I	**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)**	**Reqd Hrs**
1	Communication as a way of life Process of communication and its elements Functions of communication and importance in future careers Essentials of good communication	6
2	The communication cycle The 5-step communication cycle: Idea formation Message encoding Message transmission Decoding	4

	Feedback	
3	Factors affecting effective communication Planning for effective communication Modes of communication	3
4	Nonverbal communication Gestures Facial expressions Posture and movement Paralinguistics Eye contact Image management	4
5	Presentation skills What makes good presentation Prsenting the message Presenting oneself Visual Communication	8
6	Introduction to research study Introduction to databases Introduction to citation and referencing styles How to conduct literature review Preparation of a report based on literature review	5
Total		**60**
List of Textbooks/ Reference Books		
1	Elements of Style – Strunk and White	
Course Outcomes (students will be able to…..)		
CO1	Student would be able to illustrate the 5 step communication process	K2
CO2	Student would be able to explain the end goal of communication	K2
CO3	Student would be able to explain barriers to clear communication	K2
CO4	Student would be able to articulate the role of visual communication within society and implement the creative process to express himself/herself.	K2
CO5	Student would be able to identify the most relevant textbooks, reviews, papers and journals	K2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	0	0	0	0	0	0	1	1	3	3	2	3
CO2	0	0	0	0	0	0	1	1	3	3	2	3
CO3	0	0	0	0	0	0	1	1	3	3	2	3
CO4	0	0	0	0	0	0	1	1	3	3	2	3
CO5	0	0	0	0	0	0	1	1	3	3	2	3

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	0	0	0	0	0
CO2	0	0	0	0	0
CO3	0	0	0	0	0
CO4	0	0	0	0	0
CO5	0	0	0	0	0

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

BSC	**Course code: PYP1101**	**Course Title: Physics Laboratory**	**Credits = 2**		
			L	**T**	**P**
	Semester: I	**Total Contact Hours: 60**	**0**	**0**	**4**

List of Prerequisite Courses

Standard XII Physics course, (PYT1205) Applied Physics

List of Courses where this course will be prerequisite

(CET1105) Transport Phenomena, (CET1807) Chemical Engineering Operations, (TXT1702) Textile Physics

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

The hands-on experience gained by the students in the Applied Physics laboratory course will equip them with basic experimental skills related to measurement of various important physical quantities. These skills will act as a useful foundation for other laboratory and theory courses in their area of specializations.

Sr. No.	**Course Contents (Topics and Subtopics)**	**Reqd Hrs**
1	Determination of Co-efficient of Viscosity by Poiseuille's method	04
2	Thermistor characteristics: Determination of Bandgap of a semiconductor	04
3	Determination of compressibility of liquids using an Ultrasonic Interferometer	04
4	Measurement of thermal conductivity of a solid: Lee's disc method	04
5	Photoelectric effect: Determination of h/e	04
6	Hall effect-I (sample current variation) Determination of carrier type and concentration in a semiconductor	04
7	Hall effect-II (magnetic field variation) Determination of carrier type and concentration in a semiconductor	04
8	Newton's rings: Determination of wavelength of light	04
9	Laser Diffraction: Determination of particle size	04
10	Studying variation of compressibility of liquid as function of temperature	04
11	Estimating resistivity of semiconductor using four probe metho	04
12	Determination of magnetic susceptibility of paramagnetic liquid using Quincke's method	04
Total		**60**

List of Textbooks/ Reference Books		
1	Fundamentals of Physics - Halliday, Resnick, Walker - 6th Edition - John Wiley	
2	Sears and Zeemansky's University Physics - Young and Freedman - Pearson Education	
3	Engineering Physics - V Rajendran - 6th Edition - McGraw Hill Publishers	
4	Fundamentals of Optics - F. Jenkins and H. White - 4th Edition McGraw Hill	
5	ICT Physics Laboratory Manual (supplied to students)	
Course Outcomes (students will be able to…..)		
CO1	Independently set up, handle, and use basic setups to measure and obtain various physical quantities.	K4+P2
CO2	Use basic instruments like vernier-caliper, screw-gauge, travelling microscope, thermometer, etc. to make accurate measurements.	K4+P2
CO3	Correlate and use directly measured quantities to obtain the relevant parameters through appropriate formulae, calculations, and/or graphical plotting, thereby understand the measurement principle involved in the experimental setups.	K3+P2
CO4	Preliminarily treat the obtained datasets statistically to obtain errors in the experiments.	K5+P2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating P1 – Imitate, P2 – Manipulate, P3 – Perfect, P4 – Articulate, P5 – Embody		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	1	1	2	1	1	1	3	1	1	3
CO2	2	3	1	1	2	1	1	1	3	1	1	3
CO3	2	3	1	1	2	1	1	1	1	1	1	3
CO4	2	3	1	1	2	1	1	1	1	1	1	3

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	2	2	1
CO2	3	3	2	1	0
CO3	1	3	2	1	1
CO4	2	2	2	1	0

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

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

CCA	**Course Code: XXXX**	**Course Title: Fine Arts and Performing Arts**	**Credits = 2**		
			L	**T**	**P**
	Semester: I	**Total contact hours: 30**	**2**	**0**	**0**
List of Prerequisite Courses					
No					
List of Courses where this course will be prerequisite					
NA					
Description of relevance of this course in the B. Tech. Program					

Cultivation of arts is an integral part of the development of human beings since the arts are what make us most human, most complete as people. They offer us the experience of wholeness because they touch us at the deepest levels of mind and personality. They come into being not when we move beyond necessity but when we move to a deeper necessity, to the deeper human need to create order, beauty and meaning out of chaos. They are the expressions of deepest human urges, imperatives and aspirations		
	Course Contents (Topics and subtopics)	**Reqd. hours**
1	The Institute offers a range of courses in different art forms: music, dance, theatre, painting, and other art forms. Students will be given an option to choose a particular art form, and learn and practice it under an artist-instructor. At the end of the course, a student should be able to demonstrate basic proficiency in that particular art form.	30
	Total	**30**
Course Outcomes (students will be able to…..)		
CO1	Enhance perceptual and cognitive skills	
CO2	Develop self-esteem, motivation, aesthetic awareness, cultural exposure	
CO3	Be creative with improved emotional expression	
CO4	Develop social harmony and appreciation of diversity.	
CO5	Develop an understanding and sharing of culture, with social skills that enhance the awareness and respect of others	
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	0	0	1	0	2	1	1	2	2	2	1	2
CO2	0	0	1	0	2	1	1	2	2	2	1	2
CO3	0	0	1	0	2	1	1	2	2	2	1	2
CO4	0	0	2	0	1	1	1	2	2	1	1	2
CO5	0	0	2	0	1	1	1	2	2	1	1	2

<table>
<tr><td rowspan="2">CCA</td><td>Course Code: XXXX</td><td>Course Title: Yoga and Self Development</td><td colspan="3">Credits = 2</td></tr>
<tr><td></td><td></td><td>L</td><td>T</td><td>P</td></tr>
<tr><td></td><td>Semester: I</td><td>Total Contact Hours: 60</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td colspan="6">List of Prerequisite Courses</td></tr>
<tr><td colspan="6">It may be necessary to gather some basic information about the students, such as their age, marital status, academic schedules, and recreational activities, whether they have any sleep issues and stress because of any situation. It shall be better to know how the students deal with stress, and whether they have proper nutrition. We also might need information about any injuries past or current and any other medical condition that may interfere in the program.</td></tr>
<tr><td colspan="6">List of Courses where this course will be prerequisite</td></tr>
<tr><td colspan="6">Applicable throughout professional and personal lives</td></tr>
<tr><td colspan="6">Description of relevance of this course in the B. Tech. Program</td></tr>
<tr><td colspan="6">Yoga is not course but a journey. The benefits of Yoga are many. It brings in calmness of mind besides the physical fitness by doing Yoga Aasanas. Apart from flexibility developed by regular physical activities, it makes one aware of his own potential. Professional and personal lives are full of situations that can be stressful. Yoga helps the students to withstand the stress coming from the expectations and demands of their own lives.</td></tr>
<tr><td>Sr. No.</td><td colspan="4">Course Contents (Topics and Subtopics)</td><td>Reqd Hrs</td></tr>
<tr><td>1</td><td colspan="4">Yoga
The principles and foundations of yoga. Both concentrative and insight meditation techniques may be practiced for each session. Behavioural techniques of self-monitoring should also be practiced observing the stream of consciousness from the perspective of a vigilant but detached observer.
The students shall be trained to practice different models of mindfulness and meditation so as to elicit a state of deep physical and behavioural relaxation. They may work on selectively influencing or changing the symmetry in hemispheric brain activity. Positive addiction, meta-cognitive practices etc. are exercised to make the students experience the universal human capacity through spiritual experiences. The students may learn to turn-off or bypass the cognitive processing of usual daily preoccupations and concerns, allowing access to mindful, spiritual and meditative state of self-realization
The students shall keep a small journal to write down their own journey/progress on physical flexibility, strength building and most importantly, how they deal with stressful conditions. This record will form the paper assessment of the student.
Yoga helps to develop many mental skills like mindfulness, self-control, focus, and even self-compassion. It’s mainly a physical practice. The students are taken through different movements and poses during the yoga sessions.</td><td>40</td></tr>
<tr><td>2</td><td colspan="4">Assessment: The following assessments are recommended:
Regular attendance
Paper Assessment: A paper assessment may include assessing student’s understanding of the basic philosophy of yoga
Verbal Assessment on the basis of his/her ability to assimilate the philosophy of yoga and practicing in daily life.
Mobility & Flexibility assessment is to assess the strength and flexibility, like twist.</td><td>20</td></tr>
<tr><td colspan="5">Total</td><td>60</td></tr>
<tr><td colspan="6">List of Textbooks/ Reference Books</td></tr>
</table>

1	Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata
2	RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakashan, Delhi 2016

Course Outcomes (students will be able to…..)		
CO1	Keep physically fit and mentally agile	K2
CO2	Manage stress in studies and later in life	K2
CO3	Coordinate body and mind together	K2
CO4	Understand own emotions and maintain healthy daily routine	K2

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	0	1	2	0	1	0	1	2	2	1	0	2
CO2	0	1	2	0	1	0	1	2	2	1	0	2
CO3	0	1	2	0	1	0	1	2	2	1	0	2
CO4	0	1	2	0	1	0	1	2	2	1	0	2

Semester II

BSC	**Course Code: CHT1407**	**Course Title: Organic Chemistry**	**Credits = 3**		
			L	**T**	**P**
	Semester: II	**Total Contact Hours: 45**	**2**	**1**	**0**

List of Prerequisite Courses

Std. XII Chemistry

List of Courses where this course will be Prerequisite

(CHP1132) Organic Chemistry Laboratory, (TXT1216) Chemistry and Application of Speciality Chemicals

Description of relevance of this course in the B. 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)**	**Reqd Hrs**
1	**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
2	**Aromatic Substitution Reactions** **A) Electrophilic Substitution Reactions** Nitration, Halogenation, Alkylation, Acylation and Sulfonation	10

	Activating, deactivating and orienting effects of functional groups in mono- and poly-substituted benzenes Friedel-Crafts alkylation, Acylation, Gattermann, Gattermann-Koch, Riemer-Tiemann reactions. **B) Nucleophilic Substitution Reactions** Addition and elimination mechanism, Benzyne mechanism, Sandmeyer reaction.	
3	**Heteroaromatic Compounds** IUPAC nomenclature, structures and common names, comparison with benzenoid compounds, reactivity and synthesis – pyrroles, furans, thiophenes and pyridines	8
4	**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	10
5	**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
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	Draw structures of organic compounds and write their IUPAC names correctly.	K2
CO2	Understand aromatic chemistry and interpret the outcome of general transformations.	K3
CO3	Understand the importance of heterocycles, learn the properties and synthetic routes, interpret the 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.	K4

CO5	Appreciate the stereo-chemical implications of organic compounds and visualize and appreciate the chirality concept.	K4
CO6	Understand organic chemistry reactions related to aliphatic as well as aromatic compounds as well as decipher the outcome of a given organic transformation.	K4
CO7	Interpret and analyze reactions having different functionalities, deduce and solve problems related to the reactions as well as apply them, if need be.	K5
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	2	1	1	1	0	2	1	0	2	0	2
CO2	2	2	2	2	2	1	3	1	1	1	0	2
CO3	1	2	2	1	1	1	3	2	0	1	1	2
CO4	3	3	2	3	2	1	2	1	0	2	1	1
CO5	2	3	3	1	2	1	3	1	0	1	0	1
CO6	2	3	2	1	1	2	2	0	1	1	0	1
CO7	2	3	3	3	2	2	2	2	1	1	1	1

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	2	1	1
CO2	2	1	3	2	1
CO3	3	2	3	1	1
CO4	3	3	2	2	1
CO5	3	3	1	2	1
CO6	3	3	2	1	1
CO7	3	3	3	3	2

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

BSC	**Course Code:** CHT1408	**Course Title:** Industrial Chemistry	**Credits = 3**		
	Semester: II	**Total contact hours: 45**	**L**	**T**	**P**
			2	**1**	**0**
List of Prerequisite Courses					
Standard XII Chemistry					
List of Courses where this course will be Prerequisite					
(TXT 1216) Chemistry and Application of Speciality Chemicals, (CET 1807) Chemical Engineering Operations, (CEP1714) Chemical Engineering Laboratory, (TXT1803) Effluent Characterization and Treatment					
Description of relevance of this course in the B. Tech. Program					

It is important for engineering graduates to be familiar with the industrial scale-up of basic organic and inorganic reactions. The course aims to acquaint the students with synthesis, properties and applications of various industrial inorganic chemicals of commercial importance. The economic and ecological factors to be considered while selection and execution of such processes will also be discussed.

Sr. no	Course Contents (Theory)	Reqd. hours
1	**Introduction to Chemical Industry:** Bulk chemicals, fine chemicals, intermediates, active pharmaceutical ingredients (API), etc.	**3**
2	Petrochemical Industry: operations and processes in manufacture of ethers, hydrocarbons, aromatic compounds, etc.	**6**
3	**PRIMARY INORGANIC MATERIALS:** Water, Hydrogen, Hydrogen Peroxide and Inorganic Peroxo Compounds, Nitrogen and Nitrogen Compounds, Phosphorus and its Compounds, Sulfur and Sulfur Compounds, Halogens and Halogen Compounds,	**8**
4	**MINERAL FERTILIZERS:** Phosphorus-Containing Fertilizers, Nitrogen-Containing Fertilizers, Potassium-Containing Fertilizers	**4**
5	**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	**8**
6	**ORGANIC BULK CHEMICALS:** Manufacture of methanol, acetic acid, ethanol, ethylene, propylene, butadiene, acetaldehyde, acetylene, BTX, alkyl benzenes, acetone, phenol, styrene, esters, ethylene oxide, phthalic acid, Vinyl-Halogen and Vinyl-Oxygen Compounds, azo dyes, Polyamides, Propene Conversion Products, Aromatics - Production and Oxidation Products of Xylene and Naphthalene	**8**
7	Important pharmaceutically active ingredients, agrochemicals, insecticides, pesticides, perfumery chemicals.	**8**
	Total	**45**

List of Textbooks/ Reference Books

1. Inorganic Chemistry – an industrial and environmental perspective, T.W. Swaddle, ISBN 0-12- 678550-3, 482 pages, Academic Press
2. Industrial Organic Chemistry, 3rd, Completely Revised Edition, Klaus Weissermel, Hans-Jürgen Arpe ISBN: 978-3-527-61459-2 July 2008
3. Industrial Inorganic Chemistry, 2nd Completely Revised Edition, Karl Heinz Buchel, Hans-Heinrich Moretto, Dietmar Werner, ISBN: 978-3-527-61333-5, 667 pages, November 2008, Wiley-VCH

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

CO1	Understand the important chemical principles applied to various industrial processes	K2
CO2	Describe the fundamental processes underlying manufacture of important organic chemicals	K2
CO3	Describe the fundamental processes underlying manufacture of important inorganic chemicals	K2
CO4	Review and assess the impact of the chemical factors on the efficiency of industries and feedstock manufacturing	K3

CO5	Modify existing applications for improving the efficiencies in terms of yields, energy requirement and environmental impact	K4
CO6	Evaluate the modifications in terms of long-term environmental implications	K5
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	3	2	2	1	3	1	1	3	0	2
CO2	3	2	3	2	2	2	3	1	2	2	1	2
CO3	3	3	3	2	1	2	3	2	2	2	2	2
CO4	3	3	3	2	1	3	3	2	2	2	2	2
CO5	2	1	3	1	1	2	2	1	1	1	0	0
CO6	2	2	1	1	1	1	2	1	1	1	0	0

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	1	2	2	2	1
CO2	2	2	2	2	2
CO3	2	2	2	2	2
CO4	2	2	1	1	2
CO5	1	2	2	1	1
CO6	2	2	2	2	2

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

PCC	**Course Code: TXT 1218**	**Course Title: SPL2 Introduction to Textile Wet Processing**	**Credits = 2**		
			L	**T**	**P**
	Semester: II	**Total contact hours: 30**	**1**	**1**	**0**

List of Prerequisite Courses

H. S. C. Science

List of Courses where this course will be prerequisite

(TXT1210) Technology of Textile Dyeing, (TXT1212) Technology of Textile Printing, (TXT1201) Technology of Textile Pretreatment, (1211) Technology of Finishing

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

Students will have better understanding of various stages of textile wet processing and gain a basic idea about the wet processing operations.

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hrs**
1.	Pretreatment: Basic operations in textile wet processing – overall sequence, an overview of textile types and chemicals used, Singeing, Desizing, Scouring and Bleaching, Mercerization, Pretreatment of Blends.	5

2.	Dyeing: Parameters of quality dyeing, Classification of dyes based on application, Performance characteristics of dyed textiles. Machinery for dyeing of textiles in various forms such as fibres, yarns, woven and knitted fabric.	10
3.	Printing: Introduction to various colouration technics, Stages in the printing of textiles, and History of textile printing. Preparation of print paste, functions of various ingredients of print paste, classification of thickeners, Preparation of stock thickening, Selection of thickening agents based on dye class, style and method, Styles of Printing and various special styles of printing	10
4.	Finishing of Textile: Objective of textile Finishing and type of finishing techniques, Mechanical finishes like Calendaring, sanforising. Chemical finishing – conventional softeners, stiffeners, binders, weighting agents, silicone finishes, speciality finishes.	5
Total		**30**
List of Textbooks/ Reference Books		
1.	Chemical Technology in the Pre-treatment Processes of Textiles by S.R.Karmakar, 1999	
2.	Technology of Bleaching and Mercerizing, Shenai V.A., Sevak Publication, Bombay, Vol.3, 3rd edition, 2003.	
3.	Technology of Dyeing, Shenai V.A., Vol. 6, Sevak Publication, Bombay, 1994.	
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.	Technology of Finishing, Shenai V.A., Vol. 10, Sevak Publication, Bombay, 1990.	
Course Outcomes (students will be able to…..)		
CO1	Explain the need for sizing yarns and desizing of fabric; effect of scouring and bleaching agent on fabric pretreatment, mercerization of yarn and fabric.	K2
CO2	Applying various dyes on textile coloration and understanding the importance of various textile processing parameters for quality dyeing.	K2
CO3	Analyse the quality of dyeing and suggest corrective measures.	K2
CO4	Comprehend fundamental knowledge thickener selection for printing and stages of printing.	K3
CO5	Select between different types of softeners, fastness-improving agents, antimicrobial, antistatic, flame retardant, their chemistry, application on fabric and evaluation tests.	K3
CO6	Explain different methods for evaluation and durability of finishes.	K2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	3	2	2	3	2	1	2	2	3
CO2	3	3	2	3	2	2	3	2	1	2	2	3
CO3	3	3	3	3	2	2	3	2	1	2	2	3
CO4	3	3	2	3	2	2	3	2	1	2	2	3
CO5	3	3	2	3	2	2	3	2	1	2	2	2

CO6	3	3	3	2	2	2	3	2	1	2	2	3

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	2	2	2
CO4	3	3	3	3	2
CO5	3	3	2	3	3
CO6	3	2	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

ESC	**Course Code: GET 1306**	**Course Title: Basic Mechanical Engineering**	**Credits = 2**		
			L	**T**	**P**
	Semester: II	**Total contact hours: 30**	**1**	**1**	**0**

List of Prerequisite Courses

(PYT1205) Applied Physics, (MAT1301) Engineering Mathematics

List of Courses where this course will be prerequisite

This is a basic Course. Professional Career.

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

Students will be able to understand various equipments like steam turbine, gas turbine, pumps, compressors, and power transmission system.

Sr. no	**Course Contents (Topics and subtopics)**	**Reqd. hrs**
1.	**Introduction- Concept of Stress** Condition of Equilibrium for concurrent coplaner and non-concurrent coplaner forces.Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses, Stress Strain Diagram, elastic constants and their relations volumetric, linear and shear strains.	6
2.	**Introduction to Thermodynamics** First Law of Thermodynamics, Steady-flow energy equation, Second Law of Thermodynamics	4
3.	**Basics of Power Station** **-Steam Generators** Fire tube and Water tube boiler, Low pressure, and high-pressure boilers, Mountings and accessories, Boiler efficiency **-Steam Turbines** Working principle of steam, gas and water turbines, Concept of impulse and reaction steam turbines. **-Compressors/Pumps** Different Types of Compressors and their applications, Different Types of Pumps, and their applications	8
4.	**Transmission of Power**	4

	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 numerical)	
5.	**Refrigeration and Air-conditioning** Vapour compression refrigeration cycle, Vapour absorption refrigeration systems, Properties of air such as DBT. WBT. DPT, relative humidity, Psychometric chart.	4
6.	**Renewable Energy** Role and importance of non-conventional and alternate energy sources such as solar, wind, ocean, bio-mass and geothermal, hydrogen energy.	4
Total		**30**
List of Textbooks/ Reference Books		
1.	Strength of Materials by S. Ramamrutham, Dhanpat Rai Pvt. Ltd	
2.	Thermodynamics by P.K. Nag	
3.	Power plant by Morse	
4.	Hydraulic Machines by Jagdish Lal	
5.	Renewable Energy resources by Tiwari and ghosal, Narosa publication.	
6.	Non-conventional energy sources, Khanna publications	
7.	Gas turbine theory by HiH Saravanamutoo.	
8.	Refrigeration and air conditioning by C.P. Arora	
9.	Thermodynamics by P.K. Nag	
Course Outcomes (students will be able to….)		
CO1	Understand different types of stresses and their effects on bodies.	K2
CO2	Understand and apply the physics of laws of thermodynamics and mass-balancing.	K3
CO3	Analyze the working of steam boilers, boiler mountings, and accessories, gas turbines, types of pumps, types of compressors and its working process.	K4
CO4	Discuss different types of power transmission systems and their typical applications.	K5
CO5	Understand the working principle of vapor compression and vapor absorption refrigeration systems.	K2
CO6	Understand the importance of non-conventional energy sources as an alternative source of fuels.	K2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	1	2	1	3	3	3	3	3	3	1
CO2	3	1	0	2	1	3	1	3	3	3	3	1
CO3	3	3	2	2	2	3	3	3	3	2	3	2
CO4	3	2	1	2	0	3	3	2	3	3	3	1
CO5	3	2	1	2	0	3	3	2	3	3	3	1
CO6	3	2	1	2	0	3	3	2	3	3	3	1

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	2	2
CO4	3	3	2	3	3
CO5	3	3	2	2	2
CO6	3	3	2	2	2

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

ESC	**Course Code:** GET1125	**Course Title:** Electrical Engineering and Electronics	**Credits = 2**		
			L	**T**	**P**
	Semester: II	**Total Contact Hours: 30**	**1**	**1**	**0**

List of Prerequisite Courses

XIIth Standard Physics and Mathematics courses, Applied Physics((PYT1101), Engineering Mathematics (MAT1301)

List of Courses where this course will be prerequisite

(TXT1219) Textile Wet Processing Machinery, (CET1806) Chemical Reaction Engineering

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

Students will get an insight to the importance of Electrical Energy in Chemical Plants. The students will understand the basics of electricity, selection of different types of drives for a given application process. They will get basic knowledge as regards to Power supplies, instrumentation amplifiers and thyristor application in industries.

Sr. No.	**Course Contents (Topics and Subtopics)**	**Reqd Hrs**
1	**Fundamentals of DC Circuits** Voltage and Current Sources, Basic Laws, Network Theorems, Superposition Theorem and Thevenin's Theorem,	4
2	**AC Fundamentals:** A.C. through resistance, inductance and capacitance, simple RL, RC and RLC circuits. Power, power factor	4
3	**Three Phase Systems**: Three phase system of emfs and currents, Star and Delta connections, three phase power	3
4	**Single phase transformers**: Principle of working, Efficiency, regulation.	3
5	**Electrical drives**: Basic concepts of different types of Electrical motors as drives, Their suitability for various applications.	2
6	**Regulated power supplies**, Diodes as rectifiers, Half wave and Full wave rectifier, Filters and Regulators	3
7	**Bipolar junction transistors**: Different configurations, Characteristics, Concept of basic amplifier circuits, Amplifier gain, Transistor as switch	3
8	**Introduction to Integrated circuits:** Basic concepts of ICs	2
9	**Introduction to data acquisition and signal conditioning,** Basic concept and Block diagram, Concept of conversion of physical quantity to electrical signal, signal conditioning, Introduction to A/D and D/A converters	3

10	**Introduction to instrumentation amplifiers and their applications** Operational Amplifier – Notation, Pin diagram, Differential and common mode gain, CMRR, Introduction to various applications such as Non-inverting, inverting amplifiers, adder, subtractor, integrator, differentiator.	3
	Total	**30**
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 Technology by B.L.Theraja, A.K.Theraja vol I,II,IV	
Course Outcomes (Students will be able to…..)		
CO1	Understand the basic concepts of D.C. supply and circuits, Solve basic electrical circuit problems	K3
CO2	Understand the basic concepts single phase and three phase AC supply and circuits, Solve basic electrical circuit problems	K3
CO3	Understand the basic concepts of transformers, evaluate, and calculate efficiency at various load condition.	K5
CO4	Understand the concept of motors and their uses as various industrial drives.	K5
CO5	Understand the basic concepts of electronic devices and their applications in power supplies, amplification and instrumentation	K4
CO6	Understand the basic concepts of operational amplifiers and their applications, Understand the concept of Data acquisition, signal conditioning	K4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	0	0	0	0	0	2	3	2	0	0	3	3
CO2	3	3	0	0	0	0	0	2	3	2	0	0	3	3
CO3	3	3	0	0	0	0	0	2	3	2	0	0	3	3
CO4	3	3	0	0	0	0	0	2	3	2	0	0	3	3
CO5	3	3	0	0	0	0	0	2	3	2	0	0	3	3
CO6	3	3	0	0	0	0	0	2	3	2	0	0	3	3

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

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	3	1	1	0
CO2	1	3	1	0	0
CO3	1	3	0	1	1
CO4	0	3	1	1	1
CO5	1	2	1	2	1
CO6	1	3	2	1	1

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

ESC	Course Code: CEP1720	Course Title: Process Calculations	Credits = 2		
			L	T	P
	Semester: II	Total contact hours: 60	0	0	4

List of Prerequisite Courses

XIIth Standard Mathematics, Chemistry, Physics, (PYT1205) Applied Physics

List of Courses where this course will be prerequisite

(TXP1013) Project I, (TXP1017) Project II, (TXP1014) Internship with industry

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

This is a basic course. This knowledge will be required in almost all subjects later. This subject introduces the various concepts used in Chemical Engineering to the students. Knowledge of this subject is required for ALL B. Tech. courses, etc. It can be applied in various situations such as process selection, economics, sustainability, environmental impacts.

Sr. No.	Course Contents (Topics and subtopics)	Reqd. Hrs
1	Introduction to Chemical process calculations, overview of single stage 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 Textbooks/ 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	Students should be able to calculate friction factor, pressure drop, power requirements of singe phase flow in a circular pipe	K2+P2
CO2	Students will be able to select an appropriate pump based on flow and head requirements	K3+P2
CO3	Students should be able to calculate heat transfer coefficients and do basic sizing of double pipe and shell and tube heat exchangers	K3+P2
CO4	Students should be able to perform preliminary sizing of phase change equipment such as reboilers and condensers	K3+P2

CO5	Students should be able to calculate mass transfer coefficients and estimate mass transfer rates in simple situations	K3
CO6	Students should be able to understand empirical correlations and solve various equations analytically or numerically	K4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating P1 – Imitate, P2 – Manipulate, P3 – Perfect, P4 – Articulate, P5 – Embody		

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	1	1	1	1	1	1	3
CO2	3	3	2	3	2	1	2	1	1	1	1	3
CO3	3	3	3	3	3	1	2	2	2	1	1	3
CO4	3	3	3	3	3	1	1	1	2	1	1	3
CO5	3	3	2	3	2	1	1	1	1	1	1	3
CO6	3	3	2	3	3	1	1	1	1	1	1	3

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

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	1	1
CO2	3	3	2	1	1
CO3	3	3	2	3	1
CO4	3	3	2	3	2
CO5	3	2	1	3	1
CO6	2	2	1	2	1

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

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

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

List of Prerequisite Courses

Standard XIIth Chemistry Laboratory courses, Physical Chemistry (CHT1405) and Analytical Chemistry (CHT1406)

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

The laboratory course is mainly focused on imparting critical experimental skills in Physical and Analytical Chemistry to the undergraduate students. It is expected that they will not only become familiar with laboratory experimental skills but also planning experiments and interpretation of experimental tasks. The course will help them to understand the relevance of chemical principles in real-life applications.

Sr. No.	**Course Contents (Topics and Subtopics)**	**Reqd. Hrs.**

1	The experiments will focus on the following key concepts / skills: **Physical Chemistry:** • determination of dissociation constants of a polybasic acid • determination of critical micelle concentration (CMC) of the given surfactant • study of kinetics of reaction – order of reaction, activation energy • study of weak and strong electrolytes • characterization of polymers using MW / viscosity determination **Analytical Chemistry:** • determination of water quality (hardness / BOD / COD) • determination of composition in a mixture of acids • verification of Beer-Lambert's law • quality analysis (determination of Vitamin C, for example)	4h per practical
Total		**60**

List of Textbooks/ 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	perform quantitative analysis of samples to determine purity / composition	K3+P2
CO2	use common laboratory instruments with appropriate calibration and safety protocols	K3+P2
CO3	apply concepts of equilibria and kinetics to determine properties of molecules / processes	K4+P2
CO4	design experiments for acquiring physicochemical data and to interpret results for addressing specific queries / requirements	K4+P2
CO5	Evaluate the results in terms of accuracy and estimated precision	K4+P2
CO6	Identify the sources of errors and design steps to minimise the same	K5+P2

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating, P1 – Imitate, P2 – Manipulate, P3 – Perfect, P4 – Articulate, P5 – Embody

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	2	1	3	1	1	3	0	2	3	2
CO2	3	2	3	2	2	2	3	1	2	2	1	2	3	2
CO3	3	3	3	2	1	2	3	2	2	2	2	2	3	3
CO4	3	3	3	2	1	2	2	2	2	2	2	2	3	3
CO5	3	2	3	2	2	2	3	1	2	2	1	2	3	2
CO6	3	3	3	2	1	2	3	2	2	2	2	2	3	3

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

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	1	2
CO2	2	3	2	1	1
CO3	2	3	2	1	0
CO4	1	2	1	1	1
CO5	2	2	2	1	2

CO6	1	2	2	2	2

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

VSEC	**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 Chemistry, Organic Chemistry (CHT1407)

List of Courses where this course will be prerequisite

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

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

Students are introduced to basics of organic separations and identification of organic compounds based on their physicochemical properties. The course is relevant for training the students for working with binary mixtures. 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.

Sr. no.	**Course Contents (Topics and Subtopics)**	**Reqd Hrs**
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	4h/ Practical
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	
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	understand basic principles for separation of binary organic mixtures qualitatively and quantitatively	K3+P2
CO2	Estimate the components of binary mixtures quantitatively	K3+P2
CO3	Separate binary organic mixtures by multiple techniques and test the purity	K3+P2
CO4	Determine the purity of the individual components through quantitative analysis	K4+P2
CO5	Design experimental protocols to improve the purity of isolated components	K5+P2
CO6	Follow GLP protocols and work safely in the organic chemistry laboratory	K4+P2

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating, P1 – Imitate, P2 – Manipulate, P3 – Perfect, P4 – Articulate, P5 – Embody

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	2	2	1	1	2	1	1	2	2	1
CO2	2	2	2	3	1	1	2	1	1	2	2	2
CO3	1	2	3	3	1	2	2	2	1	1	1	2
CO4	2	2	3	2	1	2	2	3	3	3	2	2
CO5	3	3	3	2	1	2	3	2	2	2	2	2
CO6	3	3	3	2	1	2	2	2	2	2	2	2

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	2	3	2	2	1
CO2	2	3	2	2	1
CO3	2	3	2	2	0
CO4	2	2	1	2	2
CO5	2	2	2	2	2
CO6	2	1	2	3	2

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

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

CCA	**Course Code:** XXXX	**Course Title:** Physical Activities (Sports & games)	**Credits = 2**		
			L	**T**	**P**
	Semester: II	**Total contact hours: 60**	0	**0**	4

List of Prerequisite Courses

None

List of Courses where this course will be prerequisite

Not Applicable

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

Games and sports are necessary and useful for all. Games play an important part in life. Education is incomplete without games. Games are necessary to keep the body fit and trim. Moreover, they provide recreation. As a result, one feels smart and cheerful throughout the day. If one is cheerful and healthy, he or she is able to get the best out of life. A player really enjoys life. For him, life is a song and a beauty. Games teach us the lesson of discipline, team-work, patience and punctuality. In the playground, the players obey the captain and abide by the rules of the games. Games also teach us that we should play a game for game's sake, not for victory or defeat. A healthy man is always hopeful and cheerful.

Sr. no	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1	The students shall select participating a specific sports/game/physical activity of their choice in morning/evening or at other suitable times according to the local climate. This would involve a routine of physical activity with games and sports. Physical activity means any bodily movement produced by skeletal muscles requiring energy expenditure, for example, Walking, gardening, climbing the stairs, playing soccer.	60

	Activities can be considered vigorous, moderate, or light in intensity. Activity makes one breathe harder and one's heart beat faster. **Moderate physical activities** include: · Walking briskly (about 3½ miles per hour) · Bicycling (less than 10 miles per hour) · General gardening (raking, trimming shrubs) · Dancing · Golf (walking and carrying clubs) · Water aerobics · Canoeing · Tennis (doubles) **Vigorous physical activities** include: · Running/jogging (5 miles per hour) · Walking very fast (4½ miles per hour) · Bicycling (more than 10 miles per hour) · Heavy yard work, such as chopping wood · Swimming (freestyle laps) · Aerobics · Basketball (competitive) · Tennis (singles)	
Total		**60**
Course Outcomes (students will be able to…..)		
CO1	Keep physically fit and mentally agile.	K2
CO2	Manage stress in studies and later in life.	K2
CO3	Coordinate body and mind together.	K2
CO4	Understand own emotions and maintain healthy daily routine.	K2
CO5	Develop teamwork and an ability to work with others for a common goal.	K3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	0	1	0	0	0	1	1	1	1	1	0	1
CO2	0	1	0	0	0	1	1	1	1	1	0	1
CO3	0	1	0	0	0	1	1	1	1	1	0	1
CO4	0	1	0	0	0	1	1	1	1	1	0	1
CO5	0	1	0	0	0	1	1	1	1	1	0	1

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

IKS	**Course Code:** **HUT1117**	**Course Title:** **Traditional Indian Chemical Technology**	**Credits = 2**		
			L	**T**	**P**
	Semester: II	**Total Contact Hours: 30**	**2**	**0**	**0**

List of Prerequisite Courses		
NIL		
List of Courses where this course will be prerequisite		
NIL		
Description of relevance of this course in the B. Tech. Program		
To acquaint the students with major chronological developments in Indian science and technology. · To review the ancient discoveries and research related to chemicals in Pharmaceuticals, flavours and fragrances, metallurgy, architecture, textile, agriculture and Ayurveda etc. To know the fundamental principles of Indian health systems such as Ayurveda, which is useful in maintaining well-being. To facilitate the students to identify and develop interest in the ancient knowledge systems to make meaningful contributions to the development of science today. To develop respect and pride about Indigenous Knowledge thereby to assist the learners' understanding about conclusions/products from ancient Indian knowledge system for verifying them on modern scientific and technological footings.		
Sr. no.	**Course Contents (Topics and subtopics)**	**Reqd Hrs**
1	**Introduction to Indian Knowledge System (IKS):** - Introduction, Definition and History - Need to study it in current times Chemists and texts of the ancient era	2
2	**Traditional Indian Pharmaceutical Sciences and Technology:** Alternative systems of Medicine/ Welfare of the society: Principles of Ayurveda - Medicinal plants and crude drugs - Reappraisal of Ayurvedic Phytochemistry - Ayurvedic Dosage forms and similarity to that of modern dosage forms - Extraction of herbs in Ayurvedic System and comparison to that of modern extraction process - Detoxification of poisonous plants (*Shodhan Prakriya*) Ancient perspective of Adulterants and Substitutes	6
3	**Traditional Indian Knowledge on Oils, Perfumery and Flavoring agents** - Essential oils and fixed oils Applications in perfumery and flavoring-fragrance industry	3
4	**Traditional Indian Knowledge on Textile and Fibres** - Types of fibers - Textile patterns across the country Methods and Techniques	2
5	**Traditional Indian Knowledge on Dyes, Pigments, mordents and specialty chemicals** - Natural dyes and pigments Sources, Methods of dying	2
6	**Traditional Indian Knowledge on Polymers and surface coatings** Waxes, Gums, Carbohydrates	2
7	**Traditional Indian Food Technology**	2
8	Traditional Indian Knowledge about Metallurgy and Materials Science	3
9	**Traditional Indian Preservation Technology**	3

	- Methods of preservation: Food, monuments and artifacts Materials used in Preservation	
10	Science associated with traditional Indian practices during festivals	2
11	Connecting The traditional Indian Knowledge with Modern Science	3
Total		**60**
List of Textbooks/ Reference Books		
1	Acharya Prafulla Chandra Ray, A History of Hindu Chemistry, 1902, republ., Shaibya Prakashan Bibhag, centenary edition, Kolkata, 2002	
2	B. Mahadevan and Vinayak Rajat Bhat, INTRODUCTION TO INDIAN KNOWLEDGE SYSTEM: CONCEPTS AND APPLICATIONS, PHI Learning publication, 2022	
3	The Positive Sciences of the Ancient Hindus; Brijendra Nath Seal; 4th Edition; 2016	
4	Fine Arts & Technical Sciences in Ancient India with special reference to Someśvara's Mānasollāsa; Dr. Shiv Shekhar Mishra, Krishnadas Academy, Varanasi 1982	
5	A Concise History of Science in India, ed. D M Bose, S N Sen and B V Subbarayappa; INSA; 2009	
6	Science and Technology in Medieval India - A Bibliography of Source Materials in Sanskrit, Arabic and Persian by A Rahman, M A Alvi, S A Khan Ghori and K V Samba Murthy; 1982.	
7	Vaidya Navnitlal B. Pandya, Fundamental principles of ayurveda part – 1. October 1982 Ancient Science of Life.	
8	Vasant Lad, Textbook of Ayurveda: Fundamental Principle, reprint 2010	
9	Lakshmi chandra Mishra (Editor), Scientific Basis for Ayurvedic Therapies, CRC Press LLC 2003	
10	H.Panda, Handbook on Speciality Gums, Adhesives , Oils, Rosin & Derivatives, Resins, Oleoresins, Katha, Chemicals with other Natural Products, Asia Pacific Business Press Inc., 2022	
11	Achyut Godbole, Anna, Madhushree Publication, 2022, Marathi edition	
12	BHOJANAKUTUHALAM, RAGHUNATHA SURI (Author), FRLHT (Contributor), DR.M.A.ALWAR (Editor), DR.PADMA VENKAT, THE MEDPLAN CONSERVATORY SOCIETY 2019	
13	R.M. Pujari, Pradeep Kolhe, N. R. Kumar, 'Pride of India: A Glimpse into India's Scientific Heritage', Samskrita Bharati Publication.	
14	'Indian Contribution to science', compiled by Vijnana Bharati.	
15	'Knowledge traditions and practices of India',Kapil Kapoor, Michel Danino, CBSE, India	
Course Outcomes (students will be able to….)		
CO1	List the key achievements of Ancient India in different areas of Chemical Technology	K3
CO2	Describe the various features of traditional Indian knowledge in different areas of Chemical Technology	K2
CO3	Describe Key Principles of Traditional Indian Health Systems	K2
CO4	Describe the various products and key technology aspects based on traditional Indian Knowledge in context of Modern science	K2
CO5	Understanding the applications of IKS in current practices.	K3

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	1	1	3	0	1	3	3	1	0
CO2	3	2	2	1	1	3	0	1	3	3	1	0
CO3	3	2	2	1	1	3	0	1	3	3	1	0
CO4	3	2	2	1	1	3	0	1	3	3	1	0
CO5	2	1	1	3	1	1	0	1	1	3	1	1

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

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

	Course Code: XXXX	**Course Title:** Universal Human Values-I	**Credits = 3**		
			L	**T**	**P**
	Semester: II	**Total contact hours: 45**	**2**	**1**	**0**

List of Prerequisite Courses
NA
List of Courses where this course will be prerequisite
NA
Description of relevance of this course in the B.Tech. Program
This course gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting staff in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base of character building. The objective of the course is four fold: 1. Sensitization of student towards self, family (relationship), society and nature. 2. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals. 3. Strengthening of self reflection. 4. Development of commitment and courage to act..

Sr.no.	**Course Contents (Topics and subtopics)**	**Reqd Hrs**
1	Purpose and motivation for the course	

2	Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration 3. Continuous Happiness and Prosperity- A look at basic Human Aspirations	
3	Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority	
4	Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario	
5	Method to fulfil the above human aspirations: understanding and living in harmony at various levels.	
6	**Methodology of this Course:** Methodology of teaching this content must not be through do's and dont's, but get the students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values. The teachers must come from all the departments rather than only one department like HSS or from outside of the Institute. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking	
Total		**45**

List of Textbooks	
1	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999
3	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
4	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

Course Outcomes (students will be able to….)		
CO1	Become more aware of their surroundings, society, social problems and their sustainable solutions, while keeping human relationships and human nature in mind.	K2
CO2	Develop better critical ability.	K2
CO3	Become sensitive to their commitment towards what they believe in (humane values. humane relationships and humane society).	K3
CO4	Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction	K3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	0	1	0	0	0	1	1	1	1	1	0	1
CO2	0	1	0	0	0	1	1	1	1	1	0	1

CO3	0	1	0	0	0	1	1	1	1	1	0	1
CO4	0	1	0	0	0	1	1	1	1	1	0	1

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

Semester III

PCC	Course Code: TXT1219	Course Title: SPL3 Textile wet processing machinery	Credits = 4		
			L	T	P
	Semester: III	Total contact hours: 60	3	1	0

List of Prerequisite Courses

(TXT1107) Introduction to Textile Substrates, (TXT1218) Introduction to Textile Wet Processing

List of Courses where this course will be prerequisite

(TXT1213) Technology of Textile Dyeing, (TXT1212) Technology of Textile Printing, (TXT1201) Technology of Textile Pretreatment, (TXT1211) Technology of Textile Finishing

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

Students will better understand various stages of textile wet processing, and types of machinery used and gain a basic idea about wet processing operations.

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hrs
1	Shearing, Cropping, and Singeing types of machinery, machine specifications for gas singeing, latest developments in gas-based singeing machines	6
2	Machinery used for these preparatory processes in batch-wise, semi-continuous, and continuous operations for different forms of textiles such as loose fibres, yarn, and fabric	18
4	Developments in machinery for pretreatment, dyeing, printing, and finishing	16
5	Automation in computer applications in textile wet processing and microprocessor applications in processing.	8
6	Modifications for energy and water conservation in textile wet processing	6
7	Effluent treatment plant organization in textile	6
	Total	**60**

List of Textbooks/ Reference Books

1	Chemical Technology in the Pre-treatment Processes of Textiles by S.R.Karmakar, 1999
2	Technology of Bleaching and Mercerizing, Shenai V.A., Sevak Publication, Bombay, Vol.3, 3rd edition, 2003.
3	Technology of Dyeing, Shenai V.A., Vol. 6, Sevak Publication, Bombay, 1994.
4	Technology of Printing, V. A. Shenai, Sevak Publications, Bombay, Vol. 4, 1990.

5	Technology of Bleaching and Dyeing, Chakraverty, R.R., Trivedi S.S., Vol. 1, Mahajan	
6	Textile Printing by L. W. C. Miles, revised second edition published by SDC, 2003.	
7	Technology of Finishing, Shenai V.A., Vol. 10, Sevak Publication, Bombay, 1990.	
8	Principles of Textile Finishing, Choudhury A. R, Woodhead Publishing, 2017	
Course Outcomes (students will be able to…..)		
CO1	Justify the improvisation in the textile processing machinery according to the efficiency and ease of operation.	K2
CO2	Examine the various parts and segments of textile processing machinery and differentiate them according to their functions.	K2
CO3	Demonstrate the new developments in the textile processing types of machinery with respect to their utility.	K2
CO4	Design processing machinery setup and effluent treatment plant according to the prerequisites.	K3
CO5	Explain effluent treatment procedures and their application to textile processing wastewater.	K2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

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

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	2	3	3	3	2	2	1	1	2	3
CO2	2	3	3	2	3	2	2	2	2	1	3	2
CO3	3	2	3	2	3	3	3	2	1	2	2	3
CO4	3	2	3	3	2	2	3	1	2	2	3	3
CO5	3	2	2	2	2	2	3	3	1	1	2	3

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

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2
CO2	2	2	3	3	2
CO3	2	2	2	3	1
CO4	3	2	2	3	3
CO5	3	3	1	1	3

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

PCC	**Course Code: TXT1216**	**Course Title: SPL4 Chemistry & Applications of Specialty Chemicals**	**Credits = 2**		
			L	**T**	**P**
	Semester: III	**Total contact hours: 30**	**1**	**1**	**0**

List of Prerequisite Courses		
(TXT1107) Introduction to Textile Substrates, (TXT1218) Introduction to Textile Wet Processing		
List of Courses where this course will be prerequisite		
(TXT1213) Technology of Textile Dyeing, (TXT1212) Technology of Textile Printing, (TXT1201) Technology of Textile Pretreatment, (TXT1211) Technology of Textile Finishing		
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.	2
3	Anionic Surfactants: Properties and uses of anionics from carboxylic acids, alkylaryl sulphonates, alkyl sulphates, alkane sulphonates and phosphate esters, etc.	3
4	Cationic Surfactants: Chemistry, Properties, and applications	2
5	Nonionic Surfactants: Chemistry, Properties, and applications	2
6	Processing Aids: The structure-property relationships of Antimigrant, Defoamers, Dyeing Assistants, Enzymes in Preparation, Lubricants, Peroxide Stabilizers, Printing Binders, Surfactants (Scouring and Wetting Agents), Thickeners Warp Sizes	5
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	5
8	Qualitative and quantitative evaluation of auxiliaries; Testing of surfactants, detergency, identification of ionic nature.	3
9	Biodegradability of surfactants	2
10	Banned chemicals in pre-treatments, Natural textile auxiliaries	2
11	Recent developments in textile auxiliaries	2
Total		**30**
List of Textbooks/ Reference Books		
1	Textile Chemicals and Auxiliaries, Speel H.C., Reinhold Processing Corporation, New York,	
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.....)		
CO1	Understand fundamentals of textile auxiliaries.	K1
CO2	Describe the role of surfactants in textiles and their different types.	K2
CO3	Write synthesis of important textile auxiliaries.	K2
CO4	Evaluate surfactants and identify the ionic nature.	K3
CO5	Explain biodegradability of surfactants and eco-friendly textile auxiliaries.	K2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	1	2	1	3	1	3	3	1	3	1
CO2	3	3	2	2	2	1	3	3	3	3	2	2
CO3	3	3	1	3	2	2	3	2	0	3	3	0
CO4	3	0	3	3	3	3	2	3	3	2	3	3
CO5	3	2	2	2	2	2	3	3	0	0	3	3

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

AEC Course to be added (Modern Indian Languages)

AEC-02	**Course Code:**	**Course Title: AEC-02** Modern Indian Language – (Marathi / Hindi or Any other language will be chosen using MOOCS) To be uploaded	**Credits = 2**		
			L	**T**	**P**
	Semester: III	**Total Contact Hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
List of Courses where this course will be prerequisite					
Description of relevance of this course in the B. Tech. Program					

Sr.no.	Course Contents (Topics and Subtopics)	Reqd Hrs
	Total	**60**
List of Textbooks/ Reference Books		
Course Outcomes (Students will be able to…..)		
CO1		
CO2		
CO3		
CO4		
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

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

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

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

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1					
CO2					
CO3					
CO4					

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

EEM	Course Code: HUT1205	Course Title: Basic Economics and Finance	Credits = 2		
			L	T	P
	Semester: III	Total Contact Hours: 30	2	0	0

List of Prerequisite Courses

NIL

List of Courses where this course will be prerequisite

(CET1805) Chemical Process Economics, (TXP1013) Project I, (TXP1017) Project II

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

The course will provide student understanding about the importance of Basic Economics and Finance in various processes.

	Course Contents (Topics and Subtopics)	Reqd Hrs
1	**INTRODUCTION** Explaining the Economy The Supply and Demand Model Using the Supply and Demand Model	3
2	**THE COMPETITIVE EQUILIBRIUM MODEL** Deriving Demand Deriving Supply Market Equilibrium and Efficiency	5
3	**DEVIATIONS FROM COMPETITION** Monopoly and Market Power Between Monopoly and Competition Antitrust Policy and Regulation	5
4	MACRO FACTS AND MEASURES Getting Started with Macroeconomic Ideas Measuring Production, Income and Spending of Nations	5
5	**ACCOUNTING TRANSACTIONS** Journal entries Debit credit rules Compound journal entry Journal and ledger Rules of posting entries Trial balance	5
6	**CAPITAL AND REVENUE** Income and expenditure Expired costs and income Final accounts Manufacturing accounts Trading accounts Profit and Loss account Suspense account Balance sheet	5
7	CONCEPT OF DEPRECIATION	2
	Total	**30**

List of Textbooks/Reference Books

1	William G. Droms and Jay O. Wright Finance and Accounting for Nonfinancial Managers: All the Basics You Need to Know
2	E. Case Karl, C. Fair Ray, et al, PRINCIPLES OF ECONOMICS(12e)
3	A A Temu, D W Ndyetabula, et al Microeconomics: Basic Principles and Applications
4	Basic Finance for Nonfinancial Managers: A Guide to Finance and Accounting Principles for Nonfinancial Managers- Kendrick Fernandez
5	Microeconomic Theory: Basic Principles and Extensions- Walter Nicholson and Christopher Snyder
6	Macroeconomics(10e) Part of: Pearson Series in Economics (23 books) - by Froyen

Course Outcomes (Students will be able to…..)		
CO1	Know and apply accounting and finance theory.	K3
CO2	Understand the mechanics of preparation of financial statements, their analysis and interpretation	K2
CO3	Explain basic economic terms, concepts, and theories	K2
CO4	Able to identify key macroeconomic indicators	K3
CO5	Applying during the project cost calculation	K3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	2	2	3	3	3	3	3	3	2
CO2	3	2	2	2	2	3	3	3	1	2	3	2
CO3	3	3	2	2	1	1	3	3	3	3	3	2
CO4	3	3	2	2	2	3	0	2	3	3	3	2

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	0	2	3	1	0
CO2	0	2	2	2	1
CO3	0	1	2	2	1
CO4	0	2	2	1	0

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

VEC Course (NPTEL) to be added

VEC	**Course Code:**	**Course Title:** Courses in Emerging Areas	**Credits = 2**		
			L	**T**	**P**
	Semester: III	**Total Contact Hours: 30**	**1**	**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					

Sr. no.	Course Contents (Topics and Subtopics)	Reqd Hrs
Total		**60**

List of Textbooks/ Reference Books	

Course Outcomes (Students will be able to…..)	
CO1	
CO2	

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2														
CO3														
CO4														

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

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1					
CO2					
CO3					
CO4					

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

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

PCC	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

(TXT1107) Introduction to Textile Substrates, (TXT1218) Introduction to Textile Wet Processing

List of Courses where this course will be prerequisite

(TXT1213) Technology of Textile Dyeing, (TXT1212) Technology of Textile Printing, (TXT1201) Technology of Textile Pretreatment, (TXT1211) Technology of Textile Finishing, (TXT1301) Testing of Textile Materials

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

It will provide scientific background to students which will help them to understand relation between processing chemicals and fibre substrate.

Sr. No.	Course contents (topics/subtopics)	Reqd hrs
1	Estimation of bleaching powder and sodium chlorite	4
2	Estimation of sodium silicate and sodium carbonate	4
3	Estimation of composition of alkali mixture and barium hydroxide	2
4	Estimation of Glauber's salt and sodium chloride	2
5	Estimation of chrome alum and hardness of water	2
6	Estimation of sodium hydrosulphite and Rangolite C	2
7	Estimation of formaldehyde and oxalic acid	2
8	Estimation of sodium alginate	2
9	Estimation of acid value and Iodine value of fatty acids	2
10	Estimation of efficiency of Sizing chemicals	2
11	Estimation of Chelating agents	2
12	Estimation of bleaching powder and sodium chlorite	2
13	Identification of fibres by microscopic method	2
14	Identification of fibres by chemical methods	2
15	Identification of fibres from binary blends by chemical methods	2
16	Identification of fibres from tertiary blends by chemical methods	2
17	Quantitative analysis of blends	2
18	Determination of count of yarn	2
19	Fibre maturity measurements	2
20	Fibre fineness by Cut-Weight Method	2
21	Measurement of maturity and fineness by airflow instrument	2
22	Determination of twist in double and single yarn	2

23	To measure Yarn Appearance, Hairiness/yarn imperfections (Zwellager)	2
24	To measure Yarn twist/Count	2
25	To determine Types of weave (Weave Diagram)	2
26	To measure Fabric weight (GSM)	2
27	To measure Fabric Count (Ends/pick, Wales/course)	2
28	Determination of the single yarn strength and elongation at break of the yarns	2
Total		**60**

List of Textbooks/ Reference Books

1	Technology of Bleaching and Mercerizing, Shenai V.A., Sevak Publication, Bombay, Vol. - 3, 3rd edition, 2003.
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…..)

CO1	Estimate the purity of the different acids, alkali, reducing agents, oxidizing agents used in the textile processing.	K4+P2
CO2	Find the efficiency e.g. of Sizing chemicals, blend analysis, fibre identification by microscopic and by chemical methods.	K4+P2
CO3	Describe, carry out and use yarn twist/count, Appearance, Hairiness/yarn imperfections, fabric GSM.	K2+P2
CO4	Describe, interpret, examine and determine twist in double and single yarn, strength and elongation at break.	K3+P2
CO5	Carry out and use measurement of maturity and fineness of fibres by airflow instrument.	K3+P2

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating, P1 – Imitate, P2 – Manipulate, P3 – Perfect, P4 – Articulate, P5 – Embody

	Mapping of Course Outcomes (COs) with Programme Outcomes (POs)											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	1	2	0	3	3	3	3	3	3	1
CO2	3	2	1	3	1	3	3	2	2	1	3	0
CO3	3	3	3	2	1	2	3	0	3	2	3	2
CO4	3	2	1	2	0	3	3	3	3	3	2	1
CO5	3	3	2	2	2	3	3	3	3	3	3	2

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

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

PCC	**Course Code: TXP1022**	**Course Title: PR 2 Textile wet processing lab 1 (Pretreatment, Dyeing, Printing)**	**Credits = 2**		
			L	**T**	**P**
	Semester: III	**Total contact hours: 60**	**0**	**0**	**4**

List of Prerequisite Courses

(TXT1107) Introduction to Textile Substrates, (TXT1218) Introduction to Textile Wet Processing

List of Courses where this course will be prerequisite

(TXT1213) Technology of Textile Dyeing, (TXT1212) Technology of Textile Printing, (TXT1201) Technology of Textile Pretreatment, (TXT1211) Technology of Textile Finishing

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 and subtopics)**	**Reqd. hrs**
1.	Desizing cotton-acid desizing, enzyme desizing, oxidative desizing of cotton and Evaluation of desizing efficiency-staining with iodine, loss in weight and estimation of residual starch	4
2.	Scouring of cotton-open boil, pressure boil, pad-steam process and Evaluation of scouring efficiency-wetting time, sinking time, loss in weight	4
3.	Bleaching of Cotton by bleaching powder, hydrogen peroxide and Evaluation of bleaching efficiency -whiteness index and % reflectance	4
4.	To study dyeing of cotton and Viscose with Direct and Reactive dyes	4
5.	To study dyeing of cotton with Vat and Sulpher dyes	4
6.	To study dyeing of cotton with azoic colors	4
7.	To study dyeing of Wool and silk with Acid dyes	4
8.	To study dyeing of Polyester with Disperse dyes	4
9.	Direct style of printing of Direct and Reactive Dyes on cotton	4
10.	Direct style of printing of Vat Dyes and cotton	4
11.	Direct style printing on Wool and Silk with Acid dyes	4
12.	Direct style printing on Polyester and Nylon with Disperse dyes	4
13.	Discharge style of printing – white discharge under Reactive dyed ground	4
14.	Resist style of printing – White resist under reactive dyed ground	4
15.	Special print effect – Batik and Tie & Dye style of printing	4
Total		**60**

List of Textbooks/ Reference Books

1.	Gile's Laboratory Course in Dyeing, D G Duff and R S Sinclair, SDC Publ.	
Course Outcomes (students will be able to…..)		
CO1	Perform desizing, scouring and bleaching of cotton along with its evaluation.	K4+P2
CO2	Demonstrate colouration of natural and synthetic fibres using different class of dyes.	K4+P2
CO3	Achieve different printing effects by varying fibres, application methods and machinery.	K4+P2
CO4	Evaluate performance effect of different class of dyes on fibres.	K4+P2
CO5	Analyse the quality of dyeing and suggest corrective measures.	K4+P2
CO6	Comprehend and apply the recent developments in the machinery techniques and special printing techniques.	K3+P2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating, P1 – Imitate, P2 – Manipulate, P3 – Perfect, P4 – Articulate, P5 – Embody		

	Mapping of Course Outcomes (COs) with Programme Outcomes (POs)											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	2	2	3	3	3	3	3	3
CO2	3	3	3	3	3	2	2	1	2	2	2	3
CO3	2	2	2	2	2	3	2	1	3	1	3	1
CO4	3	3	3	3	3	2	2	2	2	3	2	2
CO5	3	3	3	3	2	2	3	2	1	1	2	3
CO6	3	3	3	3	3	2	2	1	1	1	2	2

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	2	2	2
CO4	3	1	3	3	2
CO5	3	2	2	3	3
CO6	3	2	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

Semester IV

PCC	**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					
Applied Physics (PYT1205), Engineering Mathematics (MAT1301), Process Calculations (CEP1720)					
List of Courses where this course will be prerequisite					
(CET1807) Chemical Engineering Operations, (CET1806) Chemical Reaction Engineering, (CEP1714) Chemical Engineering Laboratory					
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, and energy are introduced as well. Laws related to conservation of momentum, energy, and 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)**	**Reqd Hrs**
1	Fluid Statics and applications to engineering importance.	4
2	Applications of Bernoulli's Equation, Pressure drop in pipes and Fittings,meters, and fluid moving machinery such as pumps.	10
3	Particle Dynamics, Flow through Fixed and Fluidised 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 ofmass 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 Textbooks/ 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	Students should be able to calculate friction factor, pressure drop, power requirements of singe phase flow in a circular pipe	K2
CO2	Students will be able to select appropriate pump based on flow and head requirements	K3
CO3	Students should be able to calculate heat transfer coefficients and do basic sizing of double pipe and shell and tube heat exchangers	K3
CO4	Students should be able to perform preliminary sizing of phase change equipment such as reboilers and condensers	K3
CO5	Students should be able to calculate mass transfer coefficients and estimate mass transfer rates in simple situations	K3
CO6	Students should be able to understand empirical correlations and solve various equations analytically or numerically	K4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**

CO1	3	2	2	2	2	1	1	1	1	1	1	3
CO2	3	3	2	3	2	1	2	1	1	1	1	3
CO3	3	3	3	3	3	1	2	2	2	1	1	3
CO4	3	3	3	3	3	1	1	1	2	1	1	3
CO5	3	3	2	3	2	1	1	1	1	1	1	3
CO6	3	3	2	3	3	1	1	1	1	1	1	3

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	2	3	2	2	2
CO4	3	3	3	3	2
CO5	3	2	2	1	2
CO6	3	3	2	2	1

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

PCC	**Course Code: TXT1301**	**Course Title: SPL5 Testing of Textile Materials**	**Credits = 3**		
			L	**T**	**P**
	Semester: IV	**Total contact hours: 45**	**2**	**1**	**0**

List of Prerequisite Courses

(TXT1107) Introduction to Textile Substrates, (TXT1218) Introduction to Textile Wet Processing

List of Courses where this course will be prerequisite

(TXT1405) Garment Manufacturing and Merchandising, (TXT1502) Technical Textiles and its Applications.

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

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

Sr. No.	**Course contents (topics/subtopics)**	**Reqd. hrs**
1.	Objects of testing; Introduction to textile testing, Selection of samples for testing, Random and biased samples, Testing equipment and their use; Analysis of results, Quality, statistical analysis of results, t-test	4
2.	Analytical (Advanced) equipment's 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.	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	14
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.	14
5.	Flame retardancy, antimicrobial, hydrophilic and hydrophobic testing of fabrics along with special tests for carpets.	7
6.	Care labelling, Testing of lycra blended fabric material	2
Total		**45**

List of Textbooks/ 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.....)

CO1	Comprehend the objects of testing and its reasons stages at which testing is to be done.	K2
CO2	Explain different physical testings performed on the fibres, yarn as well as fabric for their mechanical, aesthetic and performance behaviour.	K3
CO3	Interpret and examine different fastness tests of the coloured goods.	K4
CO4	Understand testing principles and operation of different analytical testing instruments.	K2
CO5	Identify different testing standards and their importance.	K3

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	3	2	3	2	3	2	2	2	1
CO2	2	2	3	2	3	2	3	2	3	2	2	2
CO3	3	3	2	3	3	2	3	3	3	3	3	2
CO4	3	2	3	1	3	2	1	2	3	2	2	3
CO5	3	3	3	2	2	3	3	3	3	3	3	2

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

PCC	**Course Code:** TXT1405	**Course Title:** SPL6 Garment manufacturing and merchandising	**Credits = 3**		
			L	**T**	**P**
	Semester: IV	**Total contact hours: 45**	**2**	**1**	**0**

List of Prerequisite Courses

(TXT1107) Introduction to Textile Substrates, (TXT1218) Introduction to Textile Wet Processing

List of Courses where this course will be prerequisite

(TXT1101) Manufacturing of Yarn and Fabrics

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

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

Sr. No	**Course contents (topics/subtopics)**	**Reqd Hrs**
	Garment Manufacturing:	
1.	The Garment Industry: Structure of the garment industry, sectors of Industry, product types and organization. Apparel industry in India, Domestic industry: size of the industry, nature, and developments in recent years. Export industry: Size and nature of the industry.	3
2.	Manufacturing Technology: Types of Fabric Packages, Types of Fabrics - One Way - Two Way Fabrics - Their effect on spreading -Methods of Fabric spreading - Spreading	3

	equipments - Computerized spreaders - Marker making –Marker efficiency - Factors affecting marker efficiency - Marker duplicating methods-Computer aided marker making.	
3.	Introduction to cutting machines -Types and functions of cutting machines - straight knife, round knife, band knife, cutting machines - Notches, drills, die cutting machines - Computerized cutting machines -maintenance of cutting machines - common defects in cutting & their remedies.	3
4.	Types of needles - Parts of needles and their function - Needle size -sewing thread - properties of sewing threads - ticket number - fabric sewability. Seam quality - effect of stitch type on seam quality; Selection of seam and stitch	3
5.	Federal classification of seam and stitches - Basic parts of sewing machine	2
6.	Needle - Bobbin case /Bobbin hook, Loopers - Loop spreader - Threading fingers - Throat plate - Tongue chaining plates - Take-up devices.	2
7.	Sewing Technology: feed systems, , machinery and equipment, basic sewing machines, like general sewing, over locking, safety stitching, blind stitching, button holes, bartacking, & button sewing, special sewing machines like three thread over lock with a microprocessor, Sewing.	2
8.	Problems, slipped stitches, staggered stitches, etc.	2
9.	Fusing Technology: Construction of Fusible, Fusing process, Fusing machinery, quality control	2
10.	Pressing Technology: Classification, components of Pressing, machinery and equipments viz. Hand irons, dry iron, electric steam iron, under pressing, top pressing, scissors press, Carousel machines, Steam dolly, tunnel finishing, controls, handling systems, boiler room.	2
11.	Garment Finishing and Inspections: Attaching buttons, marking, sewing labels, cleaning, final touch, fitting quality, live models, measurements, viewing the garments, quality standards.	2
12.	Production Technology: Manual systems, making through, section system, progressive bundle system, straight line system, mechanical transport systems, selective conveyor belt system, unit production system, quick response sewing system. Ware Housing: Handling equipment, storage equipment, packing equipment. Basic Pattern Making: Measurement Taking - Size chart and Measuring of Sizes. Definition of various garments parts & positions. Methods: Bespoke method & Industrial method (Using Blocks) - Basic block construction - Block preparation & correction. Figure analysis: Body ideals, body proportion, height, weight distribution, body parts, individual figure analysis, study of body measurement of all age groups. Preparation of basic blocks, muslin pattern, commercial pattern, sizes and its understanding, fabric preparation for garment construction. CAD/CAM in Garment Manufacturing	3
	Merchandising:	
13.	Sourcing of textiles materials; Inventory planning and marketing of final products; Techniques and principles of merchandising; Merchandising according to domestic and international demand, requirements and supply; Application of information technology in merchandising; Costing with respect to export and domestic market	15

Total		**45**
List of Textbooks/ 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 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.....)		
CO1	Understand the Aim and scope of readymade garment field with special reference to textile wet processing.	K1
CO2	Understand the concept of various stages of garment processing, (pretreatment dyeing printing finishing) its problems and remedies.	K2
CO3	Comprehend fundamental knowledge of the garment industry and the stages at which garments are manufactured.	K2
CO4	Classify different manufacturing processes and various equipment which are related to the fabric cutting, sewing, fusing, pressing technology of garment manufacturing.	K3
CO5	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
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	3	3	1	2	3	2	2	2
CO2	3	2	3	3	2	3	2	2	2	1	3	3
CO3	3	2	3	2	2	2	2	2	2	1	2	2
CO4	3	2	2	3	3	2	1	2	3	0	3	2
CO5	3	2	3	2	2	1	1	2	3	0	2	3

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	2	2	1	1
CO2	3	3	2	3	1
CO3	2	2	2	3	2

CO4	2	1	2	2	2
CO5	2	2	2	2	1

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

EEM	**Course Code: CET1805**	**Course Title: Chemical Process Economics**	**Credits=2**		
			L	**T**	**P**
	Semester: IV	**Total contact hours: 30**	**2**	**0**	**0**

List of Prerequisite Courses

(CEP1720) Process calculations

List of Courses where this course will be prerequisite

(TXP1013) Project I, (TXP1017) Project II, (TXP1014) Internship with industry

Description of the 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)**	**Reqd. Hrs.**
1	Estimation of Plant and Machinery cost, Capacity Index, Cost Indices	8
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. Project financing, debt: equity ratio, promoters, contributors, shareholders	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.	8
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	6
	Total	**30**

List of Text Books/ Reference Books

1	Chemical Project Economics, MahajaniV.V.andMokashi SM.
2	Plant Design and 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
CO6	Calculate overall profitability and rate of return for a given project	K5

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	3	3	2	2	2	3	3	3	3	3	2	2	2	3
CO3	3	3	1	0	2	3	1	3	3	3	3	2	3	2
CO4	3	3	2	3	2	2	3	3	3	3	3	2	3	3
CO5	3	2	1	2	1	3	3	3	3	0	3	1	3	2

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

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

VSEC	**Course Code: TXP1023**	**Course Title: PR 3 Textile wet processing lab 2 (Finishing and Testing)**	**Credits = 2**		
	Semester: IV		**L**	**T**	**P**
		Total contact hours:60	**0**	**0**	**4**

List of Prerequisite Courses

(TXT1107) Introduction to Textile Substrates, (TXT1218) Introduction to Textile Wet Processing

List of Courses where this course will be prerequisite

(TXT1211) Technology of Textile Finishing, (TXP1011) Finishing and Evaluation of Textiles

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

This will help students to understand the properties and applications of textile substrate used in different end-uses.

Sr. no.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1.	Application of cross-linking agent on cotton fabric and testing of finished fabric for crease recovery angle, tensile and tear strength.	6
2.	Application of flame retarding agent on cotton fabric and testing of finished fabric by measurement of char length, rate of burning and Limiting Oxygen Index	6
3.	Application of softeners on cotton fabric and testing of finished fabric for its feel, drapability, effect on absorbency, yellowing, shade change, sewability testing, Handlometer /surface friction assessment.	6
4.	Application of water repellent/waterproof agent on cotton fabric and evaluation of fabric for water repellence by spray/shower test and water penetration test.	6
5.	Application of Optical brightening agent on cotton & Polyester fabric and evaluation of fabric for its whiteness.	6

6.	Application of stiffening agent and evaluation of fabric for its feel and bending length	6
7.	To measure the Tensile strength and % elongation of cotton & polyester yarn and fabric	6
8.	To measure the Tearing and bursting strength of cotton & polyester fabric	6
9.	To measure the % crimp of texturized yarn and fabric, ,	4
10.	To measure the GSM, drapability and bending length of finished fabrics	4
11.	To measure the count and denier of the yarn	4
Total		**60**
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…..)		
CO1	Apply crosslinking, flame retarding agent and softener on cotton fabric along with its evaluation.	K4+P2
CO2	Apply water & oil repellent agents on cotton fabric along with its evaluation.	K4+P2
CO3	Apply optical brightener on cotton & polyester fabric along with its evaluation.	K4+P2
CO4	Measure tensile, tearing and bursting strength, & % elongation of cotton & polyester fabric and/ yarn.	K3+P2
CO5	Evaluate effect of finishing on the comfort feel properties of textile	K4+P2
CO6	Formulate compatible mixture recipes for intended end use application	K6+P2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating, P1 – Imitate, P2 – Manipulate, P3 – Perfect, P4 – Articulate, P5 – Embody		

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

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	1	2	2	1	1	1	2	3
CO2	3	3	3	2	2	1	3	1	1	1	2	2
CO3	3	3	2	2	1	1	2	1	1	1	2	3
CO4	3	3	2	3	3	2	2	1	2	1	2	3
CO5	3	3	2	3	1	1	1	1	0	0	2	2
CO6	3	3	3	2	2	2	1	1	0	0	1	2

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

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2
CO2	3	3	2	2	2
CO3	3	3	2	2	1
CO4	3	3	2	3	1
CO5	3	3	1	2	1
CO6	3	3	1	2	1

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

VEC	Course Code: HUT1206	Course Title: Environmental Science and Technology	Credits = 2		
			L	T	P
	Semester: IV	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

(TXT1218) Introduction to Textile Wet Processing

List of Courses where this course will be prerequisite

(TXP1013) Project I, (TXP1017) Project II, (TXP1014) Internship with industry

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

The course is very useful for future Chemical Engineers and Technologists for assessing and appreciating the 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 technological aspects is going to help in innovative solutions with positive impact on the environment.

Sr. no.	Course Contents (Topics and Subtopics)	Reqd Hrs
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 concentration of pollutant at any point in the neighborhood 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
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	3	3	2	3	3	3	2
CO2	3	3	2	2	0	3	3	3	3	3	3	1
CO3	3	3	0	2	2	3	1	3	3	1	3	2
CO4	3	1	2	2	2	3	3	3	3	3	0	2
CO5	3	3	2	3	2	3	3	3	3	3	3	2

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

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

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

CEP/FP	**Course Code: XXXX**	**Course Title: Community Engagement Projects**	**Credits = 2**		
			L	**T**	**P**
	Semester: IV	**Total Contact Hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
NA					
List of Courses where this course will be prerequisite					
NA					
Description of relevance of this course in the B. Tech. Program					
Students will explore the various community projects as individual, or group related to study of societal technological activities through various organizations.					

Sr. no	Course Contents (Topics and Subtopics)	Reqd Hrs
1	Chemical Technology have the main objective of making the knowledge useful for the benefit of society. In the first step, students, individually or in a group not more than 5, shall identify the problems faced by the society in their neighborhood or city, or the state. They shall collect necessary data, collate relevant information and identify a problem that can be solved using the knowledge of own field or general sciences and propose an affordable solution. The team shall then execute the project with support from Institute, Local Society groups, NGOs, Industry. OR Community service: Helping students in studies, Making colorful charts, short notes, providing coloring books and colors , Activity games ,Teaching street children ,Helping in school assignments, Visiting old age homes and child care Centre etc.	60
Total		**60**
List of Textbooks/ Reference Books		
1	General Books, Newspaper etc	
Course Outcomes (Students will be able to….)		
CO1	This course will help students to contribute of social networking as a bridge between the various government schemes and the people of India. The course also outlines the benefits of community engagement through research and innovation.	K2
CO2	Sensitivity towards the environment and education, safety and energy, enthusiasm towards physical, mental and spiritual health along with simple living and high thinking have been explained for better understanding of the students.	K2
CO3	Students will be able to understand the various problems of any community and the possible ways to address the same.	K3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	2	1	1	2	1	1	2	1	2	2
CO2	1	1	2	1	1	2	1	1	2	1	2	2
CO3	1	1	2	1	1	2	1	1	2	1	2	2

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

Semester V

PCC	**Course Code: CET1806**	**Course Title: Chemical Reaction Engineering**	**Credits = 2**		
			L	**T**	**P**
	Semester: V	**Total contact hours: 30**	**1**	**1**	**0**
List of Prerequisite Courses					

(CHT1405) Physical Chemistry, (CET1105) Transport Phenomena, (CEP1720) Process Calculations		
List of Courses where this course will be prerequisite		
(CEP1714) Chemical Engineering Laboratory, (TXP1017) Project II		
Description of relevance of this course in the B.Tech. Program		
Chemical Reaction Engineering 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)**	**Reqd. hrs**
1	Kinetics of homogeneous reactions, Interpretation of batch reactor data, Single ideal reactors including design aspects	8
2	Multiple reactions, Temperature, and pressure effects	3
3	Introduction to Non ideal flow, RTD measurements, Models to predict conversions	2
4	Homogeneous and Heterogeneous Catalysis, Kinetics of Solid Catalyzed Reactions. Design of gas – solid catalytic reactors	8
5	Introduction to Multiphase reactors	4
6	Mass transfer with chemical Reactions: Regimes of operation and Model contactors	5
Total		**30**
List of Textbooks		
1	Elements of Chemical Reaction Engineering – H.Scott Fogler	
2	Heterogeneous Reactions, Vol.I and II –L.K. Doraiswamy, M. M. Sharma	
Course Outcomes (students will be able to…..)		
CO1	Estimate kinetics of chemical reaction based on laboratory data	K3
CO2	Derive design expressions for ideal reactor systems such as batch, plug flow and continuous stirred tank reactor	K3
CO3	Estimate conversion, yield and selectivity for different chemical reactions	K3
CO4	Compare various reactors and select an appropriate reactor for a given situation	K4
CO5	Select appropriate multiphase reactor based on reaction chemistry, heat and mass transfer aspects	K4
CO6	Identify rate controlling mechanism of a given reaction system involving mass transfer	K4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	3	1	1	1	2	1	1	3
CO2	3	3	3	3	3	1	1	1	2	1	1	3
CO3	3	3	3	2	2	1	1	1	1	1	1	3
CO4	3	3	3	3	2	1	3	1	1	1	1	3
CO5	3	3	3	3	1	2	1	1	2	1	1	3
CO6	3	3	3	3	2	1	1	1	2	1	1	3

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	2	2	1
CO2	3	3	2	1	1
CO3	3	3	2	2	1
CO4	3	3	2	2	1
CO5	2	2	1	1	1
CO6	3	3	2	1	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

PCC	**Course Code:** CET1807	**Course Title:** Chemical Engineering Operations	**Credits = 2**		
			L	**T**	**P**
	Semester: V	**Total contact hours:30**	**1**	**1**	**0**

List of Prerequisite Courses

(CEP1720) Process Calculations, (CET1105) Transport Phenomena

List of Courses where this course will be prerequisite

(TXP1013) Project I, (TXP1017) Project II

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

The principles learnt in this course are required in almost all the courses and throughout the professional career of student

Sr. no	**Course Contents (Topics and subtopics)**	**Reqd. hrs**
1	Distillation: Fundamentals of flash, batch and continuous distillation, distillation columns internals, steam and azeotropic distillation	10
2	Liquid-Liquid Extraction: Solvent selection, construction of ternary diagrams, staged calculations, types of extraction equipment.	5
3	Crystallization: Phase diagram (temp/solubility relationship), evaporative 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 and types of dryers	5
	Total	**30**

List of Textbooks/ 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…..)		
CO1	Understand and compare various unit operations used in the chemical and allied industries	K3
CO2	Perform preliminary sizing of continuous and batch distillation columns	K3
CO3	Analyze filtration data and select systems based on requirements, estimate filtration area for given requirements, understand filter aids and their usage	K4
CO4	Construct ternary equilibrium diagram based on laboratory scale experimental data	K3
CO5	Understand the working principle of various industrial extraction, crystallization, filtration and drying equipment	K2
CO6	Select and carry out preliminary sizing of various industrial extraction, crystallization, filtration and drying equipment	K3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	1	2	1	1	1	1	2	1	1	3
CO2	3	2	3	3	2	2	1	2	2	1	1	3
CO3	3	3	3	2	2	1	1	2	2	1	1	3
CO4	3	3	2	2	3	1	1	2	2	1	1	3
CO5	3	2	2	2	1	1	1	1	2	1	1	3
CO6	3	3	2	2	3	2	2	2	2	1	1	3

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	2	2	2
CO2	3	3	2	1	2
CO3	3	2	2	2	1
CO4	2	2	3	2	2
CO5	3	3	1	2	3
CO6	3	3	2	2	3

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

PCC	Course Code: TXT1201	Course Title: SPL7 Technology of Textile Pretreatment	Credits = 4		
			L	**T**	**P**
	Semester: V	**Total contact hours: 60**	**3**	**1**	**0**
List of Prerequisite Courses					
(TXT1107) Introduction to Textile Substrates, (TXT1218) Introduction to Textile Wet Processing					
List of Courses where this course will be prerequisite					
(TXT1210) Technology of Textile Dyeing, (TXT1212) Technology of Textile Printing, (TXT1211) 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 significant to understand further processing stages such as dyeing, printing, and finishing.		
Sr No.	**Course Contents (Topics and subtopics)**	**Reqd. hrs**
1.	Basic operations in textile wet processing – overall sequence, an overview of textile types and chemicals used	4
2.	Purpose of yarn Sizing and chemicals used for sizing of different types of textile substrates	8
3.	Shearing and Cropping; Singeing – plate, roller, gas singeing, latest technologies in singeing	5
4.	Desizing of cotton; different methods – hydrolytic and oxidative, types of enzymes used and determination of desizing efficiency, machinery used.	8
5.	Techniques of demineralization, machinery used for discontinuous and continuous operations.	5
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.	8
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	6
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	8
9.	Application of optical brightening agents in bleaching of natural and synthetic fabrics and determination of whiteness index	4
10.	Washing principles and methods used different types of continuous washers for textiles. Environmental load of conventional pre-treatment	4
Total		**60**

List of Textbooks/ 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..)

CO1	Comprehend the need for singeing of loom state fabric and use of latest technologies for open width woven and knit fabrics.	K1
CO2	Explain the need for sizing of yarns and desizing of fabric; sizing chemicals and different desizing methods.	K1
C03	Elaborate the different scouring and bleaching recipes for natural and synthetics textiles and their blends.	K2
C04	Describe the concept of mercerization and the techniques and machinery employed for the same (K2)	K2
CO5	Illustrate methods for the pretreatments of wool and silk.	K2
CO6	Elaborate the different washing processing used for textiles and their blends	K2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	3	2	3	2	2	1	2	2
CO2	3	3	2	2	2	3	3	1	1	2	2	1
CO3	3	3	2	3	2	3	3	2	2	2	1	2
CO4	3	2	3	2	3	1	2	1	2	1	2	2
CO5	3	2	3	3	3	2	3	2	2	2	2	3
CO6	3	2	3	2	3	2	2	1	2	1	2	2

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	1	2
CO2	2	2	2	2	1
CO3	2	2	3	1	2
CO4	3	2	1	2	2
CO5	3	3	2	1	2
CO6	3	2	2	1	2

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

PCC	**Course Code: TXP1002**	**Course Title: PR4 Pretreatment Lab**	**Credits = 2**		
			L	**T**	**P**
	Semester: V	**Total contact hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
(TXT1218) Introduction to Textile Wet Processing, (TXP 1022) Textile Wet Processing Lab 1, (TXT1201) Technology of Textile Pretreatment,					
List of Courses where this course will be prerequisite					
(TXT1210) Technology of Textile Dyeing, (TXP 1004) Experimental Dyeing Lab, (TXT1212) Technology of Textile Printing, (TXP 1006) Printing Lab					

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
Total		**60**
List of Textbooks/ 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…..)		
CO1	Carry out desizing, scouring and bleaching of cotton by different methods and its evaluation by suitable methods.	K3+P2

CO2	Perform mercerisation of cotton and measurement of its efficiency by shrinkage, Barium Activity Number (BAN), dye uptake, strength.	K4+P3
CO3	Prepare textile material by scouring and bleaching of wool, degumming, and bleaching of Silk.	K3+P2
CO4	Evaluate efficiency of pretreatment and associated impact on fibre degradation.	K4+P3
CO5	Apply OBA/FBA on natural and synthetic fabrics and evaluate improvement in whiteness.	K5+P4
CO6	Illustrate methods for the continuous and semi-continuous pretreatment processes.	K4+P3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating, P1 – Imitate, P2 – Manipulate, P3 – Perfect, P4 – Articulate, P5 – Embody		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	3	2	3	3	3	2	3	3
CO2	3	3	3	2	3	2	2	2	3	2	3	3
CO3	3	2	2	2	2	2	2	3	3	1	2	2
CO4	2	3	3	3	3	1	3	3	2	2	3	3
CO5	3	3	3	2	2	2	1	1	2	0	0	3
CO6	3	3	2	3	3	2	1	1	0	0	2	3

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	2	1	2
CO2	3	2	3	1	2
CO3	3	2	3	2	2
CO4	2	3	2	2	2
CO5	3	2	2	1	0
CO6	3	3	2	2	1

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

PCC	**Course Code: TXP1004**	**Course Title: PR5 Experimental Dyeing Lab**	**Credits = 2**		
			L	**T**	**P**
	Semester: V	**Total contact hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
(TXT1107) Introduction to Textile Substrates, (TXT1218) Introduction to Textile Wet Processing, (TXT1210) Technology of Textile Dyeing					
List of Courses where this course will be prerequisite					
(TXT1213) Theory of Dyeing, (TXP1019) Shade matching and Bulk coloration, (TXT1217) Continuous Processing of Textile					
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 application methods.		
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	4
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	4
11	Dyeing of Polyester/cotton fabric with disperse + vat dyes and disperse +reactive dyes by Pad-dry-thermosol -pad-steam method	8
12	Dyeing of Polyester/cotton fabric with vat dyes by Pad-dry-cure method	4
Total		**60**
List of Textbooks/ Reference Books		
1.	Gile's Laboratory Course in Dyeing, D G Duff and R S Sinclair, SDC Publ.	
Course Outcomes (students will be able to.....)		
1.	Analyze the effect of various parameters on the dyeing and printing textiles with different dyes classes.	K4+P3
2.	Demonstrate colouration of natural and synthetic fibres using different classes of dyes.	K3+P2
3.	Carry out different printing effects by varying fibres and application methods.	K4+P3
4.	Evaluate the performance effect of the different classes of dyes on fibres.	K4+P3
5.	Achieve different dyeing effects by varying fibres, application methods, and machinery.	K4+P3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating, P1 – Imitate, P2 – Manipulate, P3 – Perfect, P4 – Articulate, P5 – Embody		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	3	3	2	2	3	1	3
CO2	3	2	2	2	3	2	2	2	3	3	2	3

CO3	3	3	3	2	3	2	3	3	3	2	1	3
CO4	2	2	3	3	3	3	3	2	2	2	2	2
CO5	3	3	2	3	2	3	2	2	2	3	2	2

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

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

Semester VI

PCC	**Course Code: TXT1106**	**Course Title: SPL9 Technology of Fibres and Polymers**	**Credits = 3**		
			L	**T**	**P**
	Semester: VI	**Total contact hours: 45**	**2**	**1**	**0**

List of Prerequisite Courses

(TXT1107) Introduction to Textile substrates

List of Courses where this course will be prerequisite

(TXT1504) Nonwoven and High-Tech Fibres in Technical Textiles, (TXT1502) Technical textiles and its applications

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 concepts 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.	10

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 property relationship with applications.	6
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.	10
5	General polymer chemistry; Classification of polymers, synthesis and mechanism, Techniques of polymerization.	5
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	5
Total		**45**

List of Textbooks/ Reference Books

1.	Textile Fibres, Shenai V.A., Vol-1, Sevak Publications, Bombay, 3rd edition, 1991.
2.	Joseph's Introductory Textile Science, Joseph, M.L., Hudson P.B., Clapp A. C., Fortworth: Harcourt Brace Jovanovich College Publication, 6th edition, 1993.
3.	Microscopy of Textile Fibres, Greaves, P.H., Saville B.P.Oxford : BIOS Scientific Publishers Ltd., 1995.
4.	Modern Textile Characterization Methods, Raheel, M. Marcel Dekker Inc., New York, 1996.
5.	Handbook of Fibre Chemistry, Lewin Menachem, Eli M. Pearce, Marcel Dekker Inc., New York, 2nd edition, 1998.
6.	Mishra, S. P. A Text Book of Fibre Science and Technology. India: New Age International, 2000
7.	Ghosh, P. . Fibre Science and Technology. United States: McGraw Hill Education (India) Private Limited, 2004
8.	Kothari, V. Manufactured Fibre Technology. Netherlands: Springer Netherland, 2012
9.	Natural Polymer man-made Fibres, Carrol and Porczynski C.Z., National Trade Press Ltd., London,1965
10.	Visco-Elastic Properties of Polymers, Ferry, J.D., John Wiley and Sons, New York, 3rd edition, 1980
11.	Textbook of Polymer Science, Billmeyer F.W., John Wiley and Sons, New York, 3rd edition, 1984.
12.	Polymer Science, V R Gowarikar, New Age international (P) Ltd Publications, New

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

CO1	Understand fibre forming properties with different textile terms as well as their classification.	K1

CO2	Acquire deeper understanding and insights in basic chemistry, production processes and physical and chemical properties of Natural and Synthetic fibers.	K2
CO3	Understand different areas of applications of these fibres vis a vis their properties.	K2
CO4	Comprehend fundamental knowledge of polymers, their classifications, as well as techniques and mechanism of polymerization.	K2
CO5	Describe chemical and physical methods used for fibre modification and recycling.	K2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	2	2	3	3	3	3	1	3	2
CO2	3	2	2	3	3	2	3	3	2	3	2	2
CO3	3	1	0	2	1	3	2	2	3	3	3	1
CO4	3	3	2	1	1	2	3	3	3	2	0	2
CO5	3	2	2	3	2	3	3	2	2	3	3	2

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

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

PCC	**Course Code: TXT1101**	**Course Title: SPL10 Manufacturing of Yarn and Fabric**	**Credits = 3**		
			L	**T**	**P**
	Semester: VI	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
(TXT1107) Introduction to Textile substrates					
List of Courses where this course will be prerequisite					
(TXT1504) Nonwoven and High-Tech Fibres in Technical Textiles, (TXT1502) Technical textiles and its applications					
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.	5
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	5
5	Introduction to Fabric formation, types of fabric - weaving, knitting, non-woven.	3
6	Weaving – steps, details of shuttle loom process, modification of primary motions, Including towel, carpet, tapes and ribbons, blanket.	6
7	Knitting – Types of knitting, process, and machine overview	3
8	Non-woven - Types of non-woven, process and machine overview	3
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, core spun, hollow, loop, chenille, etc, Fabric - Poplin, cambric, fleece, etc, Developments – Electrospinning, 3D fabric	3
11	Numerical – Fineness, Moisture percentage, Motion transfer in gears and rollers, Drafting and doubling, Twist, Fabric production, Cover factor, statistical analysis	3
Total		**45**

List of Textbooks/ 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…..)		
CO1	Understand different spinning processes and the types of yarns made thereof.	K1
CO2	Describe process of fabric manufacture via different routes and their properties.	K2
CO3	Calculate yarn and fabric production related numerical.	K3
CO4	Analyze designs of various type of fabrics and different types of defects in fabric.	K2
CO5	Differentiate types of textile substrates and the fabric structures.	K2

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

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

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	3	3	3	3	2	3	2
CO2	3	2	0	2	1	3	3	3	2	3	3	1
CO3	3	1	1	3	1	2	2	3	2	3	2	1
CO4	3	2	1	2	0	3	3	2	3	3	3	0
CO5	3	3	2	2	2	3	3	3	2	3	3	2

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

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	1	1	1
CO2	2	2	1	2	1
CO3	3	3	2	2	2
CO4	3	2	2	2	1
CO5	2	2	1	2	1

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

PCC	Course Code: TXT1211	Course Title: SPL12 Technology of Textile Finishing	Credits = 4		
			L	T	P
	Semester: VI	Total contact hours: 60	3	1	0

List of Prerequisite Courses

(TXT1107) Introduction to Textile Substrates, (TXT1218) Introduction to Textile Wet Processing, (TXT1201) Technology of Textile Pretreatment, (TXT1210) Technology of Textile Dyeing

List of Courses where this course will be prerequisite

(TXP1011) Finishing and Evaluation of Textiles,		
Description of relevance of this course in the B.Tech. Program		
This course will help students understand the effect of various mechanical and chemical finishes in terms of imparting desired functionality to meet the end use application.		
Sr. no	**Course contents (topics/subtopics)**	**Reqd 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, Bio Polishing etc.	20
9	Performance evaluation of conventional and effect finishes.	6
Total		**60**
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.	
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.....)		
CO1	Explain different methods and machineries available for application of finish and calculate finish add on onto fabric.	K2
CO2	Describe different types of softeners, fastness improving agents, antimicrobial, antistatic, flame retardant, their chemistry, application on fabric and evaluation tests.	K2

CO3	Determine use of appropriate machine and process parameters for finishing.	K2
CO4	Compare and choose various mechanical and thermal process control systems to enhance efficiency of drying and heat setting.	K3
CO5	Explain different methods for evaluation and durability of finishes.	K2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	1	1	3	2	2	1	3	2
CO2	2	2	2	2	2	2	3	1	1	2	3	3
CO3	3	3	3	3	1	3	2	2	2	3	3	3
CO4	3	3	3	3	2	2	3	2	1	2	3	3
CO5	3	2	2	3	1	1	3	1	1	1	2	2

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

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

VSEC	**Course Code:** CEP1714	**Course Title:** Chemical Engineering Laboratory	**Credits= 2**		
			L	**T**	**P**
	Semester: VI	**Total contact hours: 60**	**0**	**0**	**4**

List of Prerequisite Courses

(CEP1720) Process Calculations, (CET1807) Chemical Engineering Operations, (1806) Chemical Reaction Engineering

List of Courses where this course will be prerequisite

(TXP1013) Project I, (TXP1017) Project II, (TXP1014) Internship with Industry

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

Chemical Engineering lab provides students the firsthand 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)**	**Reqd. hrs**
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 Textbooks/ 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+P2
CO2	Visualize practical implementation of chemical engineering equipment	K4+P3
CO3	Perform statistical analysis of experimental data	K4+P3
CO4	Get hands on experience with various measurement devices	K2+P2
CO5	Develop empirical correlations based on the experimental data generated	K5+P3
CO6	Generate meaningful tables and graphs	K3+P2

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating
Imitate, P2 – Manipulate, P3 – Perfect, P4 – Articulate, P5 – Embody

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	2	1	3	3	2	1	3
CO2	3	3	3	2	1	1	1	2	3	1	1	3
CO3	3	3	2	3	3	1	1	3	3	1	1	3
CO4	3	3	2	2	3	1	1	2	3	1	1	3
CO5	3	3	3	3	3	1	1	1	3	1	1	3
CO6	3	3	3	2	3	1	1	2	3	1	1	3

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

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	2
CO2	2	3	2	1	3
CO3	3	2	2	2	2
CO4	3	2	2	2	2
CO5	2	2	1	2	2
CO6	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

PCC	**Course Code: TXP1006**	**Course Title: PR6 Printing Lab**	**Credits = 2**		
			L	**T**	**P**
	Semester: VI	**Total Contact Hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					

(TXT1107) Introduction to Textile Substrates, (TXT1218) Introduction to Textile Wet Processing, (TXT1201) Technology of Textile Pretreatment, (TXT1212) Technology of Textile Printing		
List of Courses where this course will be prerequisite		
(TXT1901) Textile Process House Management		
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	Direct style of printing of Direct Dyes on cotton	2
2	Direct style of printing of Reactive Dyes on cotton	2
3	Direct style of printing of Reactive Dyes on cotton with various types of thickeners	4
4	Direct style of printing of Vat Dyes cotton	4
5	Direct style of printing of Azoic colors on cotton	4
6	Direct style printing on Polyester with Disperse dyes	4
7	Direct style printing on Nylon with disperse dyes	2
8	Direct style printing on Nylon Acid and Direct dyes	2
9	Direct style printing on Wool with Acid and Direct dyes	2
10	Direct style of printing on Jute, wool and acrylic with Basic Dyes	2
11	Direct style of printing of Pigments on cotton and polyester	2
12	Discharge style of printing – white discharge under direct dyed ground	4
13	Discharge style of printing – white discharge under Reactive dyed ground	4
14	Discharge style of printing – white and yellow discharge under azoic ground	4
15	Discharge style of printing – Vat discharge under direct dyed ground	2
16	Discharge style of printing – pigment under reactive dyed ground	4
17	Resist style of printing – White resist under reactive dyed ground	4
18	Resist style of printing – white resist and colour resist under Phthalogen Blue	4
19	Special print effect – Tie and Dye style of printing, Batik style of printing	2
20	Special print effect – crimp style of printing, burnt out/brasso style of printing	2
Total		**60**
List of Textbooks/ Reference Books		
1.	Gile's Laboratory Course in Dyeing, D G Duff and R S Sinclair, SDC Publ.	
Course Outcomes (students will be able to.....)		
CO1	Analyze the effect of various parameters on printing cotton with different class of dyes.	K4+P3
CO2	Carry out different printing styles on textile materials.	K4+P3
CO3	Demonstrate colouration of natural and synthetic polyamide fibres.	K5+P4

CO4	Achieve different printing effects on varying fibres, application methods and machinery.	K4+P3
CO5	Demonstrate different special printing effects on textile materials.	K5+P4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating, Imitate, P2 – Manipulate, P3 – Perfect, P4 – Articulate, P5 – Embody		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	2	3	3	2	2	3	1	3
CO2	3	2	2	2	3	2	2	2	3	3	2	3
CO3	3	3	3	2	3	2	3	3	3	2	1	3
CO4	2	2	3	3	3	3	3	2	2	2	2	2
CO5	3	3	2	2	2	1	2	0	0	2	2	2

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

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

Semester VII

PCC	**Course Code: TXT1504**	**Course Title: SPL13 Non-Woven and High-Tech Fibres in Technical Textiles**	**Credits = 3**		
			L	**T**	**P**
	Semester: VII	**Total contact hours: 45**	**2**	**1**	**0**

List of Prerequisite Courses

(TXT1301) Testing of Textile Materials, (TXT1106) Technology of Fibres and Polymers

List of Courses where this course will be prerequisite

(TXT 1502) Technical Textiles and its Applications

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 used high-tech fibres

Sr No	**Course contents (topics/subtopics)**	**Reqd. hrs.**
1.	Importance and relevance of Nonwoven textiles, fibres used and various manufacturing techniques.	3

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 nonwoven used and end use applications.	5
3.	Introduction to fibres and their manufacturing techniques, terminology, Definition of High-Tech fibres, Differences between conventional and High Tech fibres.	5
4.	Manufacturing of carbon fibres from PAN precursors, viscose and pitch fibres. Differences between them wrt properties and Application of each type in different	5
5.	Aramide Fibres, Synthesis of polymer, manufacturing, Discussion on Liquid crystals, Difference between regular aliphatic and aramid fibre, Application in different	5
6.	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	5
7.	Polyurethane/Elastomeric Fibres, Synthesis of polymer along with precursors, manufacturing, Discussion on block/segmented structure, comparison with rubber, stretchability, Application in different areas/fields.	5
8.	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.	5
9.	Brief discussion about different biodegradable fibres, monomers used, polymers synthesis, nano fibres, application in medical field.	5
	Total	**45**

List of Textbooks/ 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 fibres, Jeffries, Merrow publishing,1996
4.	High Performance Fibers, J.W.S. Hearle, Wood head Publishing,2001
5.	Advanced fiber spinning Technology,T.Nakajima,Wood head publication,2002
6.	Medical Textiles and biomaterial for healthcare, Anand S.C. Wood head publishing,2006
7.	High-Performance and Specialty Fibers: Concepts, Technology and Modern Applications of Man-Made Fibers for the Future. (n.d.). Japan: Springer Japan
8.	High Performance Technical Textiles. United Kingdom: Wiley, 2019

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

CO1	Recognize the need, technology, and difference between conventional and High-Tech fibres.	K2
CO2	Understand manufacturing of Glass and Aramide fibres, their applications including optical fibres and properties	K1
CO3	Describe the manufacturing of Carbon fibres, aramid, PU, Glass, Ultra-high Mol weight PE fibres using different precursors, their applications, and properties.	K1

CO4	Explain the manufacturing of non-woven by different web formation and bonding techniques.	K2
CO5	Predict end-use applications of hi-tech fibres and non-woven materials.	K2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	3	3	2	2	3	3	2	3	3	3
CO2	2	3	2	1	3	2	2	1	1	1	2	2
CO3	3	3	2	3	3	3	3	3	2	3	2	3
CO4	3	3	3	2	3	2	2	2	3	3	2	3
CO5	3	3	3	3	2	2	3	3	3	2	3	3

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

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

PCC	**Course Code: TXT1803**	**Course Title: SPL14 Effluent Characterisation and Treatment**	**Credits = 2**		
			L	**T**	**P**
	Semester: VII	**Total contact hours: 30**	**2**	**0**	**0**

List of Prerequisite Courses

(TXT1218) Introduction to Textile Wet Processing, (TXT1201) Technology of Textile Pretreatment, (TXT1212) Technology of Textile Printing

List of Courses where this course will be prerequisite

(TXT1901) Textile 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	7
2.	Methods to treat incoming water such as, screening, filtration, clarification, disinfection etc.,	7
3.	Design of effluent treatment plant, primary, secondary and tertiary treatments	9

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.	7
Total		**30**

List of Textbooks/ 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 of Fibre & Textile Research Special Issue - March, 2001.
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.....)

CO1	Comprehend requirements of water and energy conservations during textile processing.	K2
CO2	Explain methods to determine presence of metal or other impurities in the effluent.	K2
CO3	Demonstrate fundamentals about the environment and its characteristics.	K3
CO4	Describe various ecosystems and ecolabels.	K2
CO5	Explain effluent treatment procedures and their application to textile processing wastewater.	K2

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

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

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	3	3	3	3	3	3	2
CO2	3	3	2	3	2	0	3	2	3	1	3	3
CO3	3	2	3	1	3	2	3	2	3	3	2	2
CO4	3	3	2	2	2	3	3	3	3	3	3	0
CO5	3	3	2	3	2	3	3	3	3	3	3	2

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

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	3	2	3
CO2	2	2	3	1	3
CO3	3	3	2	1	3
CO4	2	3	2	1	3
CO5	3	2	2	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

PCC	Course Code: TXP1019	Course Title: PR8 Shade Matching and Bulk Colouration	Credits = 2		
			L	T	P

	Semester: VII	Total contact hours: 60	0	0	4
List of Prerequisite Courses					
(TXT1218) Introduction to Textile Wet Processing, (TXT1210) Technology of Textile Dyeing					
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	2
2	Pretreatment and dyeing of polyester yarn with disperse dyes	2
3	Pre-treatment and dyeing of cotton knitted fabric using reactive dyes	2
4	Pre-treatment and dyeing of cotton woven fabric using reactive dyes	2
5	Dyeing of cotton woven fabric using vat dyes with vat pigment method	4
6	Dyeing of cotton woven fabric using reactive dyes	4
7	Pre-treatment and dyeing of cotton/lycra blended knitted fabric	2
8	Pre-treatment and dyeing of polyester woven/knitted fabric	2
9	Dyeing of cotton woven fabric with reactive dyes – cold pad batch method	2
10	Dyeing of cotton woven fabric with vat dyes – pad jigger method	4
11	Dyeing of cotton woven fabric by pad-dry-pad-steam method	4
12	Dyeing of polyester cotton blended fabric by one bath process using reactive and disperse dye system	4
13	Reactive direct style of printing and development by steaming	2
14	Polyester cotton blended fabric printing with pigment dispersions	2
15	Pre-treatment and dyeing of garment using reactive dyes	2
16	Effect of bio fading enzyme on denim garments	2
17	Shade correction of reactive dyed cotton woven fabric	2
18	Shade correction of disperse dyed polyester woven fabric	2
19	Dyeing of cotton woven fabric with three basic reactive dyes – yellow, blue and red for self, binary and tertiary shades starting from 0.1-4%	4
20	Dyeing of polyester woven fabric with three basic disperse dyes – yellow brown, navy blue and red for self, binary and tertiary shades starting from 0.1-4%	2
21	Building data bank on computer colour matching system	2
22	Getting recipe for a give shade from computer colour matching system	2
23	Carry out dyeing using the computer-generated recipe and checking the same on CCM	2

24	Getting exact match by fine tuning recipe derived from computer	2
Total		**60**
Course Outcomes (students will be able to.....)		
CO1	Perform dyeing of various types of fabrics and blends using different methods on continuous dyeing range.	K4+P3
CO2	Prepare screen design and print using Flat bed, rotary and block printing methods.	K4+P3
CO3	Perform combined and separate Desizing, Scouring, Bleaching of cotton knit, processing of Cotton/Elastane blends on soft flow machine.	K4+P3
CO4	Process Polyester/Viscose, Polyester/Wool blends on pilot Jet dyeing machine.	K5+P4
CO5	Develop shade matching cotton fabric using vat and reactive dyes.	K5+P4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating, Imitate, P2 – Manipulate, P3 – Perfect, P4 – Articulate, P5 – Embody		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	3	2	2	2	2	2	1	3	2
CO2	2	3	3	3	2	2	1	3	3	2	2	3
CO3	3	3	3	2	1	2	1	3	3	1	2	3
CO4	3	2	2	3	1	1	2	2	2	2	3	2
CO5	3	3	2	2	2	2	3	2	3	2	2	3

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

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

RM-1	**Course Code: TXP1027**	**Course Title: Literature Review (Research Methodology-I)**	**Credits = 2**		
			L	**T**	**P**
	Semester: VII	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
(HUT1110B) Communication Skills					
List of Courses where this course will be prerequisite					
Project-I (TXP 1013) and Project-II (TXP1017)					
Description of relevance of this course in the B. Tech. Program					

The formal exposure to various elements of research methods such as problem formulation, literature search, planning of various activities, documentation, budgeting, purchase, report/thesis compilation, manuscript writing, patent drafting, is critical for polishing the naïve research attitude and aptitude in the UG students of the programme. The course is designed to formally introduce various concepts of research methodology in stepwise manner to the students.		
Sr. no.	**Course Contents (Topics and subtopics)**	**Reqd Hrs**
1	Introduction of Course Academic Honesty Practices General philosophy of science & Arguing About Knowledge Case studies in science history	3
2	Motivation and Background Motivation/Demotivation for Research, Building Background for Research and How to read research papers	3
3	Time Management (Academic and Non-academic time), Effort Management, Plan execution, Energy Management Issue, Role and expectation of research supervisor and student	4
4	Finding and Solving Research Problems What is Research, How to start? Approaches to find research problems and psychological experiments Literature survey, Textbooks, Review and research papers How to ask Questions What is worthwhile research problem, Analytical and synthetic research approach	4
5	Finding and Solving Research Problems What is Research, How to start? Approaches to find research problems and psychological experiments Literature survey, Textbooks, Review and research papers, critical review of research papers, how to write literature survey report, How to ask Questions, formulating research questions,	4
6	What is worthwhile research problem, Analytical and synthetic research approaches How to solve research problems, designing work plan, importance of objectives, activity and strategizing research work. Design of timeline for work plan (Gnatt Chart etc), Grant Writing Guidelines	4
7	Experimental Research Inventory Management, Material Management Learning required skills for research, Documentation and lab notebook guidelines, Safety aspects in chemical/biological research	4
8	Methods and Tools used in Research: Qualitative studies; Quantitative studies; Simple data organization; Descriptive data analysis; Limitations and sources of error; Inquiries in form of Questionnaire, Opinionnaire or by interview; Statistical analysis of data including Variance, Standard deviation, Students ‘t’ test and Analysis of variance (ANOVA), Correlation data and its interpretation, Computer data analysis	6
9	Scientific Writing Skeleton of research paper, author guidelines, good writing skills, importance of discussion, Macro-level discussion. Structure of the documents. General issues of presentability. Micro-level discussion.	6

	Stylistic issues. Examples of bad and good writings.	
10	Publishing and Reviewing Publication process, How to publish papers, where to submit, Review process and reacting to a review report Reviewing scientific papers	4
11	Scientific Norms and Conventions Authorship. Plagiarism. Simultaneous submissions. Reviewing norms. Referring to other papers. Use of data. Collaborative Research Work	3
Total		**45**

List of Textbooks/ Reference Books	
1	Menzel, D.; Writing a Technical Paper; McGraw-Hill, United States (1961).
2	Best, J. W., Kahn, J. V., Jha, A. K.; Research in Education; 10th ed.; Pearson, New Delhi, India (2005)
3	Davis R. M.; Thesis Projects in Science and Engineering: A Complete Guide from Problem Selection to Final Presentation; St. Martin's Press, (1980).
4	Anderson, J., Durston, B. H., Poole, M. E.; Thesis and Assignment Writing; John Wiley, United States (1970).
5	Menzel, D.; Writing a Technical Paper; McGraw-Hill, United States (1961).
6	Brown, L.; Effective Business Report Writing; Prentice-Hall, United States (1973).
7	WIPO Intellectual Property Handbook; WIPO Publication (2004).
8	Carter, M.; Designing Science Presentations: A Visual Guide to Figures, Papers, Slides, Posters, and More; Academic Press, London (2013).
9	Ranganathan, S. R.; Documentation: Genesis and Development; Ess Publications, India (2006).

Course Outcomes (students will be able to….)		
CO1	Understand the basic concepts of research and the components therein, formally	K2+P2
CO2	Understand and appreciate the significance of statistics in Chemical Technology, Pharmacy and Chemical Engineering	K3+P2
CO3	Understand and apply importance of literature survey in research design	K4+P3
CO4	Understand an in-depth knowledge on the documentation in research	K5+P3
CO5	Evaluate importance of various parts of a research report/paper/thesis in presentation of research results	K4+P3
CO6	Prepare and deliver a model research presentation	K5+P3
CO7	Understand the significance of various types of IPRs in research	K3+P3
CO8	Create a model research project	K6+P4

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating, P1 – Imitate, P2 – Manipulate, P3 – Perfect, P4 – Articulate, P5 – Embody

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	2	2	2	2	2	2	2	2	2	3

CO2	2	2	2	2	2	2	2	2	2	2	1	3
CO3	2	3	1	3	2	2	3	2	2	2	2	2
CO4	3	2	2	3	2	2	3	3	2	2	2	2
CO5	2	2	2	3	2	2	3	2	2	2	1	2
CO6	2	2	2	3	2	2	3	2	2	2	2	3
CO7	3	2	3	3	2	2	3	2	2	2	2	2
CO8	2	2	2	3	2	2	3	2	2	2	2	2

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	2	2	2	2	2
CO2	2	1	2	2	1
CO3	2	2	3	2	2
CO4	2	2	2	2	2
CO5	2	1	2	2	1
CO6	2	3	2	3	2
CO7	2	3	2	3	2
CO8	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

RM-II	**Course Code: TXP1028**	**Course Title: Design and Analysis of Experiments (Research Methodology – II)**	**Credits =2**		
			L	**T**	**P**
	Semester: VII	**Total contact hours: 45**	**2**	**1**	**0**

List of Prerequisite Courses

(MAT1301) Engineering Mathematics, (CEP1720) Process Calculations

List of Courses where this course will be prerequisite

This course is required for graduating students to function effectively in Industry, Academia and other professional spheres. (TXP1017) Project II

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

Modern day manufacturing activities and R&D activities need decisions taken with a scientific rigor and should be well-supported by 'statistics.' Chemical Technologist graduates who will serve industry as well as postgraduate research students who will serve industry, R&D organizations, or academic research should have a reasonably good background of statistical decision making. This also involves extraction of meaningful data from well-designed minimal number of experiments at the lowest possible material costs. This course will also help the students in all domains of their life by imparting them a vision for critical appraisal and analysis of data.

Sr. no	**Course Contents (Topics and subtopics)**	**Reqd Hrs**
1	Fundamental principles of classical design of experiments	4

	Strategy of Experimentation, Typical applications of Experimental design, Basic Principles, Guidelines for Designing Experiments.	
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.	3
3	Experiments with a Single Factor: The 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	6
4	Factorial designs: Definition, Estimating model parameters, Fitting response curves and surfaces.	3
5	The 2^k Factorial Design, Blocking and Confounding in the 2k Factorial Design; Focus of 2^2 and 2^3 designs, Blocking and Confounding in the 2^k Factorial Design.	6
6	Plackett Burman methods, Central Composite Design (CCD)	3
7	Descriptive Statistics, Probability Distribution and testing of Hypothesis using R	4
8	Regression techniques, diagnostic checks, ANOVA using R and implementation of contrasts.	4
9	Construction of Balanced Incomplete Block Designs and data analysis using R	4
10	Analysis of factorial designs using R, understanding output and interpretation.	4
11	Factorial designs, Data analysis and interpretation.	4
	Total	**45**
List of Textbooks/ Reference Books		
1	Douglas C. Montgomery, Design and Analysis of Experiments, 8th Edition, John Wiley & Sons, Inc. 2013	
2	Box, G. E., Hunter, W.G., Hunter, J.S., Hunter, W.G., Statistics for Experimenters: Design, Innovation, and Discovery, 2nd Edition, Wiley, 2005.	
3	John Lawson, Design and Analysis of Experiments with R, CRC Press, 2015	
4	Dieter Rasch, Jürgen Pilz, Rob Verdooren, Albrecht GebhardtOptimal Experimental Designs with R. CRC Press, 2011.	
5	José Unpingco, Python for Probability, Statistics, and Machine Learning, Springer, 2019	
6	Response Surface Methodology: Process and Product Optimization using Designed Experiments: R. H. Myers, D. C. Montgomery.	
7	Introduction to Statistical Quality Control: D. C. Montgomery.	
8	Design of Experiments in Chemical Engineering: Živorad R. Lazić.	
Course Outcomes (students will be able to….)		
CO1	Students should be able to understand basic principles of design of experiments.	K3
CO2	Students should be able to perform statistical analysis of single experiments and do post hoc analysis.	K4

CO3	Students should be able to conduct experiment and analyse the data using statistical methods.	K5
CO4	Students should be able to choose an appropriate design given the research problem.	K4
CO5	Students should be able to perform statistical analysis of different designs using R and interpret the results.	K5
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	1	2	0	3	3	3	3	3	3	1
CO2	3	2	2	2	2	3	3	3	1	2	3	2
CO3	3	3	2	2	1	1	3	3	3	3	3	2
CO4	3	3	2	2	2	3	0	2	3	3	3	2
CO5	3	2	2	0	2	3	3	3	1	3	0	2

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

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

Project	**Course Code: TXP1013**	**Course Title: Project I**	**Credits = 4**		
			L	**T**	**P**
	Semester: VII	**Total Contact Hours: 60**	**0**	**0**	**8**

List of Prerequisite Courses

All Technology Courses in previous semesters.

List of Courses where this course will be prerequisite

(TXP1017) Project II

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

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.

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd hrs**

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 Project-I will be evaluated.	120
Total		**120**

Course Outcomes (Students will be able to…..)		
CO1	Develop critical thinking to identify the research gap for the project.	K5+P4
CO2	Formulate a scientific question and approach to solve it.	K5+P4
CO3	Plan the experimental methodology for the project.	K5+P4
CO4	Develop skills to communicate the research plan effectively.	K6+P4
CO5	Develop skills for writing a scientific document on the research work.	K6+P4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating, P1 – Imitate, P2 – Manipulate, P3 – Perfect, P4 – Articulate, P5 – Embody		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	2	3	2	3	3	3	3	3	3	2
CO3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3

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

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

Semester VIII

PCC	**Course Code: TXT1502**	**Course: SPL15 Technical Textiles and its Applications**	**Credits = 3**		
			L	**T**	**P**
	Semester: VIII	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					

(TXT1107) Introduction of Textile Substrates, (TXT1106) Technology of Fibres and Polymers, (TXT1301) Testing of Textile Materials		
List of Courses where this course will be prerequisite		
Professional Career and future academic research		
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.	Introduction to Technical Textiles, Difference between Technical textiles and other aspects of textiles. Classification of various Technical Textiles and their enduse applications	6
2.	Medical textiles– materials used, classification, extracorporeal (biomedical) – Health care and hygiene products	6
3.	Geotech, Agrotech, Indutech, Packtech - products and applications	12
4.	Sports and recreation textiles, Waterproof breathable fabrics –camping and hiking – baseball – tennis –foot ball – golf and hockey – bikes – marine products – textiles in sports surfaces –hot air ballooning	5
5.	Safety protective textiles and transportation textiles. Introduction, high temp. textiles – flame resistant protective clothing, chemical, protective clothing's radiation protection, thermal insulation, camouflage textiles	5
6.	Mobiltech - Transportation textiles – airbags – seat belts – automotive interior and exterior trim – truck and car covers, for aircrafts	5
7.	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
Total		**45**
List of Textbooks/ Reference Books		
1.	Handbook of Industrial textiles, Adanur S., CRC Press, 1995	
2.	Automotive Textiles, Mukhopadhyay S.K., Partridge J.F., CRC Press, 1999	
3.	Handbook of Technical Textiles, Horrock A. R.and Anand S.C., Woodhead Publ.,2000	
4.	Coated textiles Principles and applications, Sen A.K., Technomic Publishing, 2001	
5.	Medical textiles, Anand S.C., Woodhead Publishing, 2001	
6.	Handbook of Nonwovens. United Kingdom: Elsevier Science, S. J. Russell, 2007	
7.	Applications of Nonwovens in Technical Textiles. United Kingdom: Elsevier Science, R. Chapman, 2010	
Course Outcomes (students will be able to.....)		
CO1	Comprehend the difference between woven, knitted, and nonwoven fabrics along with the areas of application depending on the properties desired.	K1

CO2	Explain methods of web formation, web bonding and finishing of nonwovens as per the intended end use.	K3
CO3	Differentiate areas of technical textile and specific fibre properties.	K3
CO4	Describe properties related to different type of technical textiles	K2
CO5	Apply knowledge of textile processing in areas of technical textiles.	K3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	3	2	2	3	3	2	3	3	3
CO2	3	3	2	3	3	3	3	3	2	3	2	3
CO3	3	3	3	2	3	2	2	2	3	3	2	3
CO4	3	3	3	3	2	2	3	3	3	2	3	3
CO5	3	2	3	3	5	2	2	1	2	2	3	1

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	2	3	2	2	0
CO2	3	2	3	2	1
CO3	3	2	3	3	0
CO4	3	2	3	3	1
CO5	3	3	2	1	0

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

PCC	**Course Code:** **TXP1017**	**Course Title:** **Project II**	**Credits = 3**		
	Semester: **VIII**		**L**	**T**	**P**
		Total Contact Hours: 120	**0**	**0**	**12**

List of Prerequisite Courses
All Technology Courses in previous semesters.
List of Courses where this course will be prerequisite
Professional Career and future academic research
Description of relevance of this course in the B. Tech. Program
Develop a skill to execute & solve a research problem in textile processing. The course presents an opportunity to the students for fine-tuning their scientific communication skills, oral as well as written.

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd Hrs**
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.	90

2	-Oral presentation of proposed research work with data generated during actual trial targeted towards the objectives - The outcome is submitted in the form of a report and Viva-voce examination will be conducted and will be evaluated by both internal and external subject experts.	30
Total		**120**

List of Textbooks/ Reference Books	
1	Relevant review articles, research papers, patents, book chapter, books, etc.

Course Outcomes (Students will be able to…..)		
CO1	Develop critical thinking to identify the research gap for the project	K4+P5
CO2	Formulate a scientific question and approach to solve it	K5+P5
CO3	Plan the experimental methodology for the project	K6+P5
CO4	Develop skills to communicate the research plan effectively	K6+P5
CO5	Develop skills for writing a scientific document on the research work	K6+P5
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating, P1 – Imitate, P2 – Manipulate, P3 – Perfect, P4 – Articulate, P5 – Embody		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	3	3	2	2	2	2	3	3
CO2	3	3	2	3	2	3	2	2	2	2	3	2
CO3	3	3	3	3	3	3	1	1	0	1	2	3
CO4	3	3	3	3	1	2	0	0	1	1	2	3
CO5	3	3	3	2	3	3	1	3	0	2	1	3

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	2
CO2	3	3	3	2	1
CO3	3	3	2	1	0
CO4	2	1	2	1	1
CO5	1	2	1	1	0

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

OJT	**Course Code:** **TXP1014**	**Course Title:** **Internship with Industry**	**Credits = 12**		
			L	**T**	**P**
	Semester: **VIII**	**Total duration: 12-16 weeks**	**0**	**0**	**0**
List of Prerequisite Courses					
All the subjects related to textile wet processing technology and technical textiles					
List of Courses where this course will be Prerequisite					
Professional Career and future academic research					
Description of relevance of this course in the B. Tech. Programme					

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

Sr. No.	Course Contents (Topics and subtopics)	Reqd weeks
1	**Scheme of Evaluation of Internship with Industry (SEMESTER – VIII)** i. After the end of the VIII semester examination, every student will have to undergo an internship. The Internship would be of 12 credits. ii. 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. iii. The total duration of the internship would be for a period equivalent to 12-16 Calendar weeks. This period typically start from 1st May and end before 30th July every year. This means the end semester examination of Final. Year. Tech (Semester VIII) should be completed by 25th April every year. The internship may be completed in one or more organizations as described below. iv. 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. v. 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. vi. 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. vii. Students will be assigned a grade based on the written report and a presentation; evaluated by a committee of faculty members.	**12**

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

CO1	Apply the concept of project & production management in further planning.	K4+P4
CO2	Develop critical thinking regarding the various operations involved in textile industry.	K5+P4
CO3	Solve certain industrial challenges in textile processing.	K6+P5
CO4	Present and communicate an industrial problem effectively.	K6+P5
CO5	Write a scientific report on the training.	K6+P5

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating, P1 – Imitate, P2 – Manipulate, P3 – Perfect, P4 – Articulate, P5 – Embody

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	3	3	3	3	3	3	2
CO2	3	3	2	3	2	3	3	3	3	3	3	2
CO3	3	3	3	3	3	3	2	3	1	3	2	3
CO4	3	3	2	3	3	3	3	0	3	3	3	3
CO5	3	3	2	2	3	3	2	3	1	2	3	3

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

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	3	3	2
CO2	3	2	3	3	3
CO3	3	3	3	3	3
CO4	3	2	3	2	1
CO5	3	2	3	2	2

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

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

PROGRAM ELECTIVES

Semester V										
Subject Code	Subject	Course	Credits	Hrs./Week			Marks for various Exams			
				L	T	P	CA	MS	ES	Total
TXT1210	Electives will be offered and one of the electives can be **SPL-8:** Technology of Textile Dyeing	PEC-1	4	3	1	0	20	30	50	100

Semester VI										
Subject Code	Subject	Course	Credits	Hrs./Week			Marks for various Exams			
				L	T	P	CA	MS	ES	Total
TXT1212	Electives will be offered and one of the electives can be **SPL-11:** Technology of Textile Printing	PEC-2	4	3	1	0	20	30	50	100
TXP 1011	Electives will be offered and one of the electives can be **PR7:** Finishing and Evaluation of Textiles	PEC-3	2	0	0	4	0	50	50	100

Semester VII										
Subject Code	Subject	Course	Credits	Hrs./Week			Marks for various Exams			
				L	T	P	CA	MS	ES	Total
TXT1804	Electives will be offered and one of the electives can be Eco Compliance and Certification	PEC-4	3	2	1	0	20	30	50	100
TXT1506	Electives will be offered and one of the electives can be Functional Textile Materials									
TXT1901	Electives will be offered and one of the electives can be Textile Process House Management	PEC-5	2	1	1	0	20	30	50	100

Semester VIII					
Subject Code	Subject	Course	Credits	Hrs./Week	Marks for various Exams

				L	T	P	CA	MS	ES	Total
TXP1024	Electives will be offered and one of the electives can be Advanced Characterisation Techniques	PEC-6	2	0	0	4	0	50	50	100

PEC	Course Code: TXT1210	Course Title: SPL8 Technology of Textile Dyeing	Credits = 4		
			L	T	P
	Semester: V	Total contact hours: 60	3	1	0

List of Prerequisite Courses

(TXT1107) Introduction to Textile Substrates, (TXT1218) Introduction to Textile Wet Processing

List of Courses where this course will be prerequisite

(TXT1212) Technology of Textile printing, (TXT1004) Experimental dyeing lab

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

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

Sr. No.	Course contents (topics/subtopics)	Reqd. hrs
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
14	Machinery used for washing and soaping of dyed materials, Recent developments in machinery and dyeing techniques	4
15	Concept of conservation of chemicals and water in dyeing	3
Total		**60**

List of Textbooks/ 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.....)

CO1	Understand the importance of various textile processing parameters for quality dyeing.	K1
CO2	Identify the correct process to be carried out based on type and form of the substrate.	K2
CO3	Explain the developments in dyes, machinery and processes in tune with constantly changing requirements of the industry.	K2
CO4	Analyse the quality of dyeing and suggest corrective measures.	K2
CO5	Design the process for dyeing of novel fibres and blends based on its physico-chemical characteristics.	K3
CO6	Correlate types of dyes used for various fibres and machineries used for dyeing.	K3

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

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

Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	3	3	1	3	3	0	1
CO2	3	3	2	2	0	2	3	3	3	2	3	2
CO3	3	2	2	3	3	2	1	3	3	3	2	2
CO4	3	3	1	3	2	3	0	3	2	3	3	3

CO5	3	2	3	2	3	2	3	1	0	1	2	1
CO6	3	3	3	3	2	2	2	0	0	1	2	3

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	2	2	2	3
CO2	2	2	3	2	3
CO3	2	3	2	3	3
CO4	3	3	2	3	3
CO5	3	3	2	3	2
CO6	3	2	2	1	1

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

PEC	**Course Code: TXT1212**	**Course Title: SPL11 Technology of Textile Printing**	**Credits = 4**		
			L	**T**	**P**
	Semester: VI	**Total contact hours: 60**	**3**	**1**	**0**

List of Prerequisite Courses

(TXT1107) Introduction to Textile Substrates, (TXT1218) Introduction to Textile Wet Processing, (TXT1201) Technology of Textile Pretreatment

List of Courses where this course will be prerequisite

(TXP1006) Printing Lab

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 methods of colouration of textiles and its significance in value addition of textiles.

Sr. No.	**Course contents (topics/subtopics)**	**Reqd. hrs.**
1	Introduction to various colouration techniques, Stages in the printing of textiles, History of textile printing.	6
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	8
3	Three Basic styles of printing and various special styles of printing	8
4	Methods of Printing, Block, stencil, Screen; hand screen, flatbed, rotary, Roller, Transfer and digital printing, Defects, and remedial actions in various methods of printing, Machines used for printing, Brief idea about the preparation of the block, stencil, flat and rotary screens, rollers for printing.	10

5	Various methods of fixation, Selection of fixation method, Machines for fixation and its working; various after treatment of printed materials.	8
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	12
7	Evaluation of printed fabrics, Ecological aspects in printing of textiles; Recent developments in printing machinery and techniques.	6
Total		**60**

List of Textbooks/ 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.....)

CO1	Comprehend fundamental knowledge on stages of printing.	K1
CO2	Describe and use different types of printing methods and styles, fixation conditions, after treatments used for printing.	K2
CO3	Identify and evaluate thickening agents, chemicals and dyestuffs for printing; Formulation and rheological properties of printing pastes.	K3
CO4	Evaluate quality of printed goods and suggest remedial actions to overcome faults in printing.	K3
CO5	Comprehend and apply the recent developments in the machinery techniques and special printing techniques.	K3

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

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

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	3	3	3	3	3	3	1
CO2	3	3	2	2	2	2	3	1	3	3	1	2
CO3	3	3	0	3	2	3	3	2	3	3	2	3
CO4	3	3	3	1	3	2	3	3	3	0	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3

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

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

PEC	**Course Code: TXP1011**	**Course Title: PR7 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 Finishing

List of Courses where this course will be prerequisite

Non-woven and Hi-Tech Fibres, Technical Textile

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

This will help students to understand the properties of textile substrates 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
Total		**60**

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.

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

CO1	Carry out application of conventional textile finishing agents.	K3+P2
CO2	Evaluate various finish parameters and testing procedure.	K3+P3
CO3	Perform application techniques for specialty functional finishes.	K4+P4
CO4	Evaluate the effect of finishing on the comfort feel properties of textile.	K4+P4
CO5	Formulate compatible mixture recipes for intended end use application.	K6+P4

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating, P1 – Imitate, P2 – Manipulate, P3 – Perfect, P4 – Articulate, P5 – Embody

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

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	3	3	3	3	3	3	2
CO2	3	3	2	3	0	3	3	1	3	3	3	3
CO3	3	3	3	1	3	3	3	3	3	2	0	1
CO4	3	3	3	3	3	1	3	3	3	1	3	3
CO5	3	3	2	3	2	1	3	1	1	0	2	3

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

PEC	**Course Code:** TXT1804	**Course Title:** Eco Compliance and Certification	**Credits = 3**		
	Semester: VII		**L**	**T**	**P**
		Total contact hours: 45	**2**	**1**	**0**

List of Prerequisite Courses

(TXT1218) Introduction to Textile Wet Processing, (TXT1210) Technology of Textile Dyeing, (TXT1212) Technology of Textile Printing

List of Courses where this course will be prerequisite

(TXT1901) Textile Process House Management, (TXT1217) Continuous Processing of Textile

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

This course is required for the future professional career. The course will help student to understand eco-balance in the textile products and their requirements.

Sr no.	**Course Contents (Topics and subtopics)**	**Reqd. hrs**
1.	Textile Exchange Certification-GOTS, OCS, RCS, OCS, RAS, RWS, RDS, EU flower, Nordic Swan	5
2.	Concept of Chemical Management (CM) and its importance in Textiles Preparation of Safety Data Sheet and its interpretation	5
3.	Better cotton initiative (BCI), Fair Trade Cotton, Egyptian cotton	5
4.	Oeko tex-Standard 100, Sustainable textile Production (STeP), Made in Green, Clean By Design-Apparel Impact Institute, Other compliance-Bluesign	5
5.	Zero Discharge of Hazardous Chemicals (ZDHC)-Supplier to zero, brands to zero, wastewater sampling, Detox to zero, Incheck, Chemchek, ZDHC-MRSL and RSL	5
6.	REACH Certification-Registration, Evaluation, Authorization and Restriction of chemicals	5
7.	Leadership in energy and environmental design (LEED)	3
8.	Fair Wear foundation, Leather Working Group (LWG), Alliance for responsible denim, Sustainable Fibre alliance	3
9.	Cradle to cradle certification, ISO certification:9001-QMS,14001-EMS,45001-OHSAS.	3
10.	Environment Audit program-Higg Facility Environment Module, Amfori BEPI-Environment & chemical audit, Security Audit-Customs Trade Partnership against Terrorism (CT-PAT), Technical Audits- SQP, Product safety audit programs based on client requirement	3

11.	Social Certification-FSLM, WRAP, BSCI, SEDEX-SMETA, SA8000, Client -code of conduct audits, Ethical trading initiative, International Labor organization standard, Forest stewardship council (FSC) certification	3
Total		**45**
List of Textbooks/ Reference Books		
1.	Textile Exchange: Accreditation and Certification Procedures for Textile Exchange Standards 2.0	
2.	Roadmap to Sustainable Textiles and Clothing, Subramanian Senthilkannan Muthu, Springer Science, 2014.	
3.	Ecology and textiles, V. A. Shenai, Sevak publication	
4.	Textile effluent, Padma Vankar, Ncute publication	
5.	Handbook of chemical and environmental engineering calculations, J.P. Reynolds, John S. Jeris, Louis Theoore	
6.	Environmental chemistry, John Wright	
Course Outcomes (students will be able to…..)		
CO1	Understand the concept of Chemical Management and its importance, different global regulations and testing protocols of the hazardous chemicals.	K2
CO2	Interpret and preparation of safety data sheet of the chemicals.	K3
CO3	Identify hazardous chemical, RSL and MRSL substances in the Textile value chain.	K3
CO4	Evaluate different auditing systems used for textile field.	K3
CO5	Evaluate various certifications used in textile industries	K3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	3	2	2	3	3	2	2	1	3	3
CO2	2	2	3	2	3	3	3	2	1	1	2	3
CO3	2	3	3	2	3	3	3	2	1	2	3	3
CO4	3	3	3	2	3	3	3	2	2	3	2	3
CO5	3	3	2	2	2	3	3	3	2	3	2	3

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

PEC	**Course Code: TXT1506**	**Course Title: Functional Textile Materials**	**Credits = 3**		
			L	**T**	**P**
	Semester: VII	**Total Contact Hours: 45**	**2**	**1**	**0**

List of Prerequisite Courses		
(TXT1107) Introduction of Textile Substrates, (TXT1106) Technology of Fibres and Polymers, (TXT1301) Testing of Textile Materials		
List of Courses where this course will be prerequisite		
(TXT1502) Technical textile and its applications		
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 and subtopics)**	**Reqd. hrs**
1	**Introduction:** Need for smart textiles, difference between passive, smart and active smart textiles, human aspects, technology aspects, applications.	4
2	**Electrically active polymers:** Polymer gel as actuators, non-ionic polymer gel, applications, electroactive elastomer	4
3	**Thermally sensitive textiles:** Basics of heat storage, manufacture of thermally sensitive fibres and clothing by using phase change materials etc, properties	5
4	**Polymeric membranes:** PVA and PAAc network, polymers prepared by plasma and radiation grafting, polymers for gas separation	5
5	**Fibre Bragg gratings:** Fabrication of grating, mechanical properties of FBG, optical response under various deformations, polymeric optical fibres, integration of optical fibres in textiles, applications	5
6	**Shape m e m o r y materials:** Polymers and gel, effect of temperature, applications	4
7	**Designing Technology for smart clothing:** Design process for smart clothing, wearable motherboard manufacture, properties and applications like snow clothing, army uniforms.	5
9	**Medical textiles:** Polymers for biomedical applications, drug release textiles, textile sensors for healthcare, applications for children, patients	5
10	**Tissue engineering:** Ideal scaffold system, scaffold materials, scaffold making, use of embroidery and its applications, nanofibres by electrospinning	5
11	**Standardization for smart clothing technology:** Methods, effects of standardization, evaluation for wearable computing.	3
	Total	**45**
List of Textbooks/Reference Books		
1	Smart fibers, fabrics and clothing, Edited by Xiaomiag Tao, The Textile Institute, published by Woodhead publishing Ltd.	
2	Textiles for protection Edited by Richard A. Scott, The Textile Institute, published by Woodhead publishing Ltd.	
3	Smart clothing technology and applications, Edited by Gilsoo Cho, published by CRC press	

4	Intelligent textiles and clothing, Edited by H. R. Mattila, published by Woodhead publishing Ltd.
5	Smart textiles for medicine and healthcare Edited by L. Van Langenhove, published by Woodhead publishing Ltd.
6	Bioprocessing of textiles Edited by C. Vigneswaran M. Ananthasubramanian and P. Kandhavadivu, published by Woodhead publishing Ltd.
7	Medical textiles and biomaterials for healthcare Edited by S. C. Anand, J. F. Kennedy, M. Miraftab and S. Rajendran, published by Woodhead publishing Ltd.
8	Nanofibers and nanotechnology in textiles Edited by P. J. Brown and K. Stevens, published by Woodhead publishing Ltd.
9	Plasma technologies for textile and apparel, Edited by S. K. Nema and P. B. Jhala, published by Woodhead publishing Ltd.
10	Smart textiles and their applications, Edited by Vladan Koncar, published by Woodhead publishing Ltd.
11	Handbook of smart textiles, Edited by Xiaomiag Tao, published by Springer

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

CO1	Understand and explain types of smart textiles and their applications.	K1
CO2	Explain different types of materials used for fabrication of smart textile.	K2
CO3	Discuss various methods of fabrication processes required in smart textiles.	K2
CO4	Explain extensive applications of smart textile in defense and medical sector.	K2
CO5	Discuss designing and standardization of textile smart clothing	K2

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

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

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	1	2	2	0	2	1	1	2	2
CO2	3	2	2	1	1	2	1	1	2	0	2	2
CO3	3	2	1	1	2	2	1	0	1	0	1	1
CO4	3	1	1	1	1	2	1	0	1	1	1	1
CO5	3	1	1	1	2	2	2	1	2	1	1	2

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

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	0
CO2	3	2	3	2	1
CO3	3	3	3	3	0
CO4	3	3	3	2	1
CO5	2	2	3	2	1

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

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

PEC	Course Code: TXT1901	Course Title: Textile Process House Management	Credits = 2		
			L	T	P
	Semester: VII	Total contact hours: 30	1	1	0

List of Prerequisite Courses

(TXT1218) Introduction to Textile Wet Processing, (TXT1210) Technology of Textile Dyeing, (TXT1212) Technology of Textile Printing

List of Courses where this course will be prerequisite

Nil

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

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

Sr No	Course Contents (Topics and subtopics)	Reqd. Hrs
1	**Responsibility of management:** Business Organization, Typical management structure in the mill, Organizational goals, Top management strategies, management functions, Leading, controlling, motivation, limitation, relative merits and demerits.	3
2	**Organizational processes and behavior: -** Different sections of the typical textile process house/ organization, manpower/Resources, section to section communications, Authority, responsibility, accountability, work delegation, individual personality and behaviors, perception, attitude, values, l o g i c a l thinking, frustration, conflict, and decision making through various related demonstrative examples, role play.	7
3	**Technology Management: -** Various product mix and value chain in the textile market, change in the product demand, Process house requirements and its designing , Existing Machine set up capabilities, gaps against business specification, resource planning for quality production, Process and quality control, Productivity and machine utilization control, quality control, production data and trend analysis, expansion requirements, new machine and processes setup requirements to achieve the management goals, adoption and techno economic feasibility of the new innovations and research in textile industry, cost saving approach.	10
4	**Marketing Management: -** Market and customer requirements, Production planning and control, a tool for marketing support, Brands compliances, specification and sustainability, customer complaints and satisfaction.	6

5	**Laws: -** Company laws, labor laws, environment related requirements of regulatory bodies and organization responsibility and intellectual property rights.	2
6	**Communication and communication skills: -** Section to section communication and their levels, ways of communication, written, verbal and presentation communications, barriers to the effective communication, counseling and coaching, demonstration and role play	2
Total		**30**

List of Textbooks/ 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…..)

CO1	Understand fundamental concepts of Industrial Management.	K1
CO2	Analyze practical situations and be able to provide applicable solutions.	K2
CO3	Demonstrate human resource requirements and their management.	K3
CO4	Identify importance and significance of role of management and its function in smooth running of production operations.	K3
CO5	Exercise control over check points and product quality control at various stages of textile manufacturing.	K3

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

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

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	3	3	3	3	3	3	2
CO2	3	2	3	3	0	3	3	2	2	3	0	3
CO3	3	3	1	2	3	2	2	3	1	3	3	3
CO4	3	2	3	3	2	1	3	3	3	2	3	0
CO5	3	2	2	3	2	2	3	3	3	3	2	2

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

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	3	2	1
CO2	3	3	2	1	1
CO3	2	3	3	1	2

CO4	2	3	3	1	3
CO5	3	3	2	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

PEC	**Course Code: TXP1024**	**Course: PR 9 Advanced Characterization Techniques**	**Credits = 2**		
	Semester: VIII	**Total contact hours: 60**	**L**	**T**	**P**
			0	**0**	**4**

List of Prerequisite Courses

(TXT1107) Introduction of Textile Substrates, (TXT1106) Technology of Fibres and Polymers, (TXT1301) Testing of Textile Materials

List of Courses where this course will be prerequisite

Future academic research

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

Students will have better understanding of the structure of textile fibres, yarns and fabrics, their properties as well as important concept of textile physics and testing which will help to measure different properties of textile materials.

Sr. no.	**Course Contents (Topics and subtopics)**	**Reqd. hrs**
1.	FTIR analysis of natural and synthetic untreated and finished fabrics on FTIR	6
2.	Structure analysis with respect to crystallinity, orientation and crystal size of neat and modified polyester, Nylon and polypropelene fibres on XRD machine	6
3.	DSC Analysis of neat and modified polyester, Nylon and polypropelene fibres on Differential Scanning Calorimeter	6
4.	Analysis of neat and modified polyester, Nylon and polypropelene fibres on TGA and LOI tester	6
5.	Determination of zeta potential of untreated and surface modified cotton material on Electrokinetic Analyzer	6
6.	To measure particle size of nano TiO2 on nano particle size analyzer	6
7.	To study the morphology of different treated and untreated fibres using Image Analyzer	6
8.	To measure static charge decay time, bulk, and surface resistivity of untreated and conducing polyester fabric	6
9.	Measurement of contact Angle on untreated, finished, and coated fabric on Contact Angle Analyzer	6
10.	Measurement of surface energy of untreated and finished fabric on Tensiometer	6
	Total	**60**

List of Textbooks/ Reference Books

1.	Fundamentals of Molecular Spectroscopy - C. Banwell and E. McCash
2.	Instrumental Methods of Analysis - H. H. Willard, 1.1. Merritt and J. A. Dean

3.	Fundamentals of Surface and Thin Film Analysis - L. C. Feldman and J. Mayer
4.	Advances in Electrochemical Science and Engineering -1.1. Gerischer and C. W. Tobnia (eds.)

Course Outcomes (students will be able to…..)		
CO1	Calibrate instruments required for textile material characterizations.	K3+P2
CO2	Understand the working principle behind various materials characterization techniques.	K1+P2
CO3	Measure contact angle, particle size, and zeta potential as a surface characterization technique.	K4+P2
CO4	Demonstrate different experiments for the characterisation of textile materials.	K4+P2
CO5	Measure and analyse the thermal properties of the fibres and correlate them to its structural properties.	K4+P2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating, P1 – Imitate, P2 – Manipulate, P3 – Perfect, P4 – Articulate, P5 – Embody		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	3	2	2	3	3	2	3	3	3
CO2	3	2	1	2	3	2	0	1	0	2	2	1
CO3	3	3	2	3	3	3	3	3	2	3	2	3
CO4	3	3	3	2	3	2	2	2	3	3	2	3
CO5	3	2	3	2	2	1	1	1	2	2	2	1

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	2	3	3	1	0
CO2	3	2	2	2	1
CO3	3	2	3	1	1
CO4	3	3	3	1	2
CO5	3	2	1	1	0

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

HONORS COURSE

Honors Course										
Subject Code	**Subject**	**Course**	**Credits**	**Hrs./Week**			**Marks for various Exams**			
				L	**T**	**P**	**CA**	**MS**	**ES**	**Total**
TXT1701	Honors Course -I: Chemistry of Colorants	PCC	4	3	1	0	20	30	50	100
TXT1213	Honors Course-II: Theory of Dyeing	PCC	4	3	1	0	20	30	50	100
TXT1207	Honors-III: Emerging Textile Technologies	PCC	4	3	1	0	20	30	50	100
TXT1702	Honors Course-IV: Textile Physics	PCC	3	2	1	0	20	30	50	100
TXT1217	Honors Course-V: Continuous Processing of Textiles	PCC	3	2	1	0	20	30	50	100

PCC	Course Code: TXT1701	Course Title: Honors Course-I Chemistry of Colorants	Credits = 4		
			L	T	P
	Semester: V	Total contact hours: 60	3	1	0

List of Prerequisite Courses

HSC (Science), (CHT1407) Organic Chemistry, (TXT1216) Chemistry and Application of Specialty Chemicals

List of Courses where this course will be prerequisite

(TXT1210) Technology of Textile Dyeing, (TXP) Experimental Dyeing Lab, (TXT1212) Technology of Textile Printing, (TXP1006) Printing Lab

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 its applications in various fields according to the chemistry involved.

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hrs
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 subtractive colour 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	3
6	Litholrubones, Monoazo lakes, Napthol AS lakes, Napthol AS, Perylenes, Phthalocyanines, Quinacridones effect pigments	5
7	Pigments for Plastics, Textiles, Paints, Resins, Printing Ink, Cosmetics, Rubbers, Special Application fields.	3
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.	3
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
13	Disperse dyes: azo, anthraquinone, dinitrophenylamine, methine dyes; properties in relation to constitution	6
Total		**60**

List of Textbooks/ 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…..)

CO1	Understand fundamental knowledge on basics of chemistry involved in the colorants.	K1
CO2	Describe the types of pigments and their applications.	K2
CO3	Compare the physical properties of pigments and dyes to differentiate them.	K2
CO4	Illustrate synthetic methods used for azo dyes and their properties.	K2
CO5	Identify types of dyes on the basis of application, properties and functional groups.	K3

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

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

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	2	2	3	3	2	1	2	3
CO2	2	1	3	2	2	2	2	2	2	2	2	2
CO3	3	3	2	3	3	3	3	2	1	2	2	3
CO4	3	2	2	3	3	2	3	1	2	2	2	3
CO5	2	2	3	2	2	2	3	2	2	1	3	3

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

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	1
CO2	3	2	3	2	2
CO3	2	2	2	2	1
CO4	3	3	3	2	2
CO5	3	2	2	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

PCC	**Course Code: TXT1213**	**Course Title: Honors Course-II Theory of Dyeing**	**Credits = 4**		
			L	**T**	**P**
	Semester: VI	**Total contact hours: 60**	**3**	**1**	**0**

List of Prerequisite Courses

(TXT1107) Introduction to Textile Substrates, (TXT1218) Introduction to Textile Wet Processing

List of Courses where this course will be prerequisite

(TXT1212) Technology of Textile Printing, (TXT1211) Technology of Textile Finishing

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

Students 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)	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, Mechanism of dyeing, Dye fibre interactions	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.	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
4.	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.	8

5.	Dyeing of cellulosic fibres with Direct, Reactive, Azoic, Vat, Solubilized Vat, Sulphur, Oxidation colours and OBA's	8
6.	Dyeing of polyamide fibres with Acid, Mordant and Metal Complex dyes, Acrylic with Basic and modified cationic dyes, Indigo and Natural dyes, Polyester with Disperse dyes	8
7.	Dyeing of blends, Dyeing of union fabrics; Dyeing of micro fibre fabrics	2
8.	Batch, semi-continuous and continuous type dyeing machinery for all forms of textiles. Dosing systems for dyeing, automatic colour and chemical dispensing systems, automated inventory management systems for dyes and chemicals	8
9.	Right First-Time approach, Faults in dyed materials and their correction, Concept of conservation of chemicals and water in dyeing	2
Total		**60**

List of Textbooks/ 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.....)

CO1	Explain the developments in dyes, machinery, and processes in tune with constantly changing requirements of the industry.	K1
CO2	Estimate the correct process to be carried out based on type and form of the substrate.	K2
CO3	Analyse the quality of dyeing and suggest corrective measures.	K2
CO4	Design the process for dyeing of novel fibres and blends based on its physico-chemical characteristics.	K3
CO5	Correlate the theory and procedures of dyeing.	K3

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	3	2	3	3	3	2	2	1	1	2	3
CO2	2	3	3	2	3	2	2	2	2	1	3	2
CO3	3	2	3	2	3	3	3	2	1	2	2	3
CO4	3	2	3	3	2	2	3	1	2	2	3	3
CO5	3	3	3	2	2	1	1	1	1	0	2	3

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

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

PCC	**Course Code: TXT 1207**	**Course Title: Honors Course-III Emerging Textile Technologies**	**Credits = 4**		
			L	**T**	**P**
	Semester: VII	**Total contact hours: 60**	**3**	**1**	**0**

List of Prerequisite Courses

(TXT1218) Introduction to Textile Wet Processing, (TXT1210) Technology of Textile Dyeing, (TXT1212) Technology of Textile Printing

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 nanotechnology and its importance in Textiles. Different routes/methods used for the synthesis of different nano particles, Nanoclays and their treatments, carbon Nanotubes and its application in textiles, and different methods of application of nanoparticles onto the textile with examples.	12
2	Introduction to biotechnology in textiles, enzyme synthesis and characterization, Various biotechnological applications in textile wet processing e.g. Microbial colorants, Enzyme catalyzed dye synthesis.	12
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	12
5	Introduction to Industry 4.0 - Internet of Things, Artificial Intelligence, Data Analytics, Robotics	12
Total		**60**

List of Textbooks/ Reference Books

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

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

CO1	Understand and apply different synthesis routes for nano particles its application on textiles by various techniques to get enhanced performance.	K2
CO2	Grasp the concept of enzyme, their synthesis and applications in different textile wet processing treatment.	K3
CO3	Recognise the use of modern technology-like plasma, e control, super critical carbon dioxide, digital printing in textiles.	K3
CO4	Relate different ways for Water and energy conservation and utilization of nonconventional energy and water resources in textile wet processing.	K3
CO5	Understand the concept of modern IT tools in the textile wet processing like Iot, Artificial intelligence, robotics, data analytics etc.	K2

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

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

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	3	0	3	3	3	3
CO2	3	3	2	3	3	1	3	3	3	2	3	2
CO3	3	3	3	2	2	3	3	3	3	3	3	1
CO4	3	3	3	2	3	3	3	3	3	2	2	3
CO5	3	3	3	2	3	3	2	2	2	2	2	2

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

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

PCC	**Course Code:** TXT1702	**Course Title:** Honors Course-IV Textile Physics	Credits = 3		
			L	**T**	**P**
	Semester: VIII	**Total contact hours: 45**	**2**	**1**	**0**

List of Prerequisite Courses

(TXT1107) Introduction of Textile Substrates, (TXT1106) Technology of Fibres and Polymers, (TXT1301) Testing of Textile Materials, (TXT1101) Manufacturing of Yarn and Fabrics

List of Courses where this course will be prerequisite

Nil

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

Students will have a better understanding of the structure of textile fibres, yarns and fabrics, their properties as well as the important concept of textile physics and testing, which will help to measure different properties of textile materials.

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hrs**
1	Fine Structure of fibre; molecular chain properties, crystallinity, the orientation of molecular chains and their effect on fibre properties. Fibre length and its distribution, technical importance of fibre length, methods of measurement of fibre length and associated parameters, Baer-Sorter diagram, HVI, span length and effective length, mean length, uniformity ratio and index and Fibre Quality Index. Definition of fibre fineness, technical significance of fibre fineness, principles of measurement of fibre fineness, maturity of cotton.	10
2	Yarn linear density - direct and indirect system, conversion from one system to another measurement of yarn count, linear density of ply and cable structure, yarn diameter and packing density. Definition of twist, twist direction, twist contraction and retraction, measurement of twist, twist factor, effect of twist on strength of yarn (both continuous and staple), effect of twist on yarn diameter and packing density.	9
3	Open packing and hexagonal close packing; Fibre migration in yarn. Various types of irregularities in yarn, limit irregularity, irregularity index, causes of irregularity, short- and long-term irregularity, variance - length curves, hairiness index, Classimat faults.	7

4	Length, width, thickness, areal density of fabrics, porter, shots, thread density, cover factor - definition and measurement. Fabric stiffness, drape-definitions, measurement, factors affecting these properties. Air permeability, water permeability and thermal transmission property of fabrics, factors affecting those properties.	7
5	Woven cloth setting theories, elements of woven fabric geometry; cover factor, ends and picks, count, crimp and weight relationship of similar fabrics. Pierce simple geometry of plain weaves, derivation of basic equations, practical application of cloth geometry crimp	7
6	Optical properties of textiles; colour, lustre, birefringence, dichroic ratio, fibre friction - its role and measurement; Static Electricity - its generation, measurement, effect in processing. New methods of measuring fabric hands (KES, FAST etc.).	5
Total		**45**

List of Textbooks/ Reference Books	
1	Principles of Textile Testing by J.E. Booth,1961
2	Physical Properties of Textile Fibers by W. E. Morton and J. W. S. Hearle, 1962
3	Structural Mechanics of Fibres, Yarns and Fabrics; Vol. 1 by J. W. S. Hearle, P. Grosberg and S. Backer, 1969
4	Textile Yarns (Technology, Structure and Applications) by B. C. Goswami, J. G. Martindale, F. L. Scardino, 1977
5	Textile Fibres, Yarns and Fabrics by E. R. Kaswell, 1953
6	Structural mechanics of woven fabrics by J. Hu, 2004

Course Outcomes (students will be able to…..)		
CO1	Understand fibre structure and properties as well as their significance in yarn properties.	K2
CO2	Calculate fibre, yarn and fabric properties related numerical.	K3
CO3	Analyze fabric structure and properties.	K2
CO4	Understand the importance of fabric properties and their correlation with yarn structures.	K2
CO5	Analyze optical properties of fibres and corelates it with yarn and fabric properties.	K2

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	3	2	2	3	3	2	3	3	3
CO2	3	3	2	3	3	3	3	3	2	3	2	3
CO3	3	3	3	2	3	2	2	2	3	3	2	3
CO4	3	3	3	3	2	2	3	3	3	2	3	3
CO5	3	2	1	2	1	3	2	0	0	1	2	2

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	2	3	3	2	0

CO2	3	2	3	3	1
CO3	3	3	3	2	0
CO4	3	2	3	2	1
CO5	3	2	3	2	1

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

PCC	**Course Code: TXT1217**	**Course Title: Honors Course-V Continuous Processing of Textile**	**Credits = 3**		
			L	**T**	**P**
	Semester: VIII	**Total contact hours: 45**	**2**	**1**	**0**

List of Prerequisite Courses

(TXT1210) Technology of Textile Dyeing, (TXT1201) Technology of Textile Pretreatment, (TXT1212) Technology of Textile Printing, (TXT1211) Technology of Textile Finishing

List of Courses where this course will be prerequisite

Nil

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

Students will better understand various stages of textile wet processing, and types of machinery used and gain a basic idea about wet processing operations.

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hrs**
1	Continuous pretreatment of textiles-Processes & Machinery	10
2	Combined pretreatment of different textiles.	8
3	Continuous dyeing of natural & synthetic and blended fabrics-various dyeing processes.	12
4	Different classes of dyes used, dyeing machinery.	8
5	Recent advances in continuous processing.	7
	Total	**45**

List of Textbooks/ Reference Books

1	Principles of Textile Testing by J.E. Booth,1961
2	Physical Properties of Textile Fibers by W. E. Morton and J. W. S. Hearle, 1962
3	Structural Mechanics of Fibres, Yarns and Fabrics; Vol. 1 by J. W. S. Hearle, P. Grosberg and S. Backer, 1969
4	Textile Yarns (Technology, Structure and Applications) by B. C. Goswami, J. G. Martindale, F. L. Scardino, 1977
5	Textile Fibres, Yarns and Fabrics by E. R. Kaswell, 1953
6	Structural mechanics of woven fabrics by J. Hu, 2004

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

CO1	Elaborate the different scouring and bleaching recipes and machinery for natural and synthetic textiles and their blends.	K2
CO2	Analyze the types of machinery for each type of fibre form, dyeing parameters, and dyeing methods.	K2
CO3	Demonstrate the advancements in textile processing types of machinery with respect to their utility.	K2
CO4	Examine the various parts and segments of textile processing machinery and differentiate them according to their functions.	K3
CO5	Demonstrate recent developments in continuous wet processing of textiles	K2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

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

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	3	2	3	2	2	1	2	2
CO2	3	3	2	2	2	3	3	1	1	2	2	1
CO3	3	3	2	3	2	3	3	2	2	2	1	2
CO4	2	2	3	3	3	2	3	2	2	2	2	3
CO5	3	2	3	3	2	3	1	2	1	2	2	1

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

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	1
CO2	3	2	3	1	1
CO3	3	3	2	2	2
CO4	3	2	3	3	2
CO5	3	2	1	2	1

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