KUMARAGURU COLLEGE OF TECHNOLOGY,

An autonomous Institution affiliated to Anna University, Chennai

COIMBATORE – 641 049.

B. Tech TEXTILE TECHNOLOGY

REGULATION 2024

I to VIII Semesters

Department of Textile Technology

VISION

To be a Centre of Excellence in textile technology and management with basic and applied research for the fulfilment of societal needs.

MISSION

- **Develop industry relevant curriculum,** innovative teaching and project-based learning methods that enables students to be efficient professionals.
- **Motivate Faculty** to update their knowledge and skills through continuous learning.
- **Provide holistic student development** by creating opportunities for lifelong learning and to develop entrepreneurship skills.
- **Undertake inter-disciplinary research** and development/Internship/Consultancy in the field of Textile Technology to support the industry and society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of the B. Tech - Textile Technology Programme will be able to:

- PEO: 1 Hold leadership responsibilities in Textile and related segments such as product development, production, technical services, quality assurance and marketing.
- PEO: 2 Become successful entrepreneur in Textile and related field and contributing to societal, technological and industry development.
- PEO: 3 Partake professional qualifications/ certifications in Textile Technology related areas by pursuing specialized studies in engineering and business.

PROGRAM SPECIFIC OBJECTIVES (PSOs)

Graduates of the Textile Technology Undergraduate Program will have the ability to:

PSO1: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization for Process Optimization, Cost and Value analysis, Productivity improvement, Solutions to quality issues and Product development in textile and related fields.

PSO2: Demonstrate learned techniques, experiments, modern engineering tools and software to estimate the optimum utilization of resources such as raw materials, machineries, manpower and to predict the properties of fibre, yarn, fabric and garments as per the end uses.

PROGRAM OUTCOMES (POs) (as per New NBA document)

Graduates of the Textile Technology Undergraduate Program should have the ability to:

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WKS)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, ma ke effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

KUMARAGURU COLLEGE OF TECHNOLOGY

DEPARTMENT OF TEXTILE TECHNOLOGY
REGULATION 2024
B.Tech Textile Technology Curriculum

Semester I

S. No	Course code	Course Title	Course Mode	Course Category	L	T	P	J	C
1	24HST101	Heritage of Tamils	Theory	HS	1	0	0	0	1
2	24EET104	Foundations of Electrical and Electronics Engineering	Theory	ES	3	0	0	0	3
3	24MAI112	Computational Linear Algebra and Calculus	Embedded	BS	3	0	2	0	4
4	24CYI105	Textile and Apparel Chemistry	Embedded	BS	3	0	2	0	4
5	24MEI101	Engineering Graphics	Embedded	ES	2	0	2	0	3
6	24INP102	Innovation Practicum - 1	Practical	ES	0	0	2	0	1
7	24ADP001	Basics of Artificial Intelligence	Practical	ES	0	0	2	0	1
8	24HSP111	Holistic Wellness- 1	Practical	HS	0	0	2	0	1
9	24INP101	Design Thinking	Practical	HS	0	0	2	0	1
10	24INO1-	FCLF General Stack - 1	Practical	OE	0	0	2	0	1
								Total Credits	20
								Total Contact Hours / Week	28

Semester II

S. No	Course code	Course Title	Course Mode	Course Category	L	T	P	J	C
1	24HST102	Tamils and Technology	Theory	HS	1	0	0	0	1
2	24HST103	Effective Communication	Theory	HS	2	0	0	0	2
3	24HST104	Professional Communication	Theory	HS	2	0	0	0	
4	24HSJ102	Fluency through Practice	Project	HS	0	0	0	4	
5	24MET106	Basics of Mechanical Engineering	Theory	ES	3	0	0	0	3
6	24TTT101	Introduction to Textiles	Theory	PC	1	0	0	0	1
7	24MAI122	Advanced Computational Calculus	Embedded	BS	3	0	2	0	4
8	24PHI103	Applied Physics for Textile Technology	Embedded	BS	3	0	2	0	4
9	24INP103	Innovation Practicum - 2	Practical	ES	0	0	2	0	1
10	24CSI101	Logical thinking and Problem Solving	Embedded	ES	3	0	2	0	4
11	24HSP112	Holistic Wellness- 2	Practical	HS	0	0	2	0	1
12	24INO1--	FCLF General Stack - 2	Practical	OE	0	0	2	0	1
								Total Credits	**22**
								Total Contact Hours / Week	**30**

Semester III

S. No	Course code	Course Title	Course Mode	Course Category	L	T	P	J	C
1	24TTI201	Textile Fibres	Embedded	PC	3	0	2	0	4

2	24TTI202	Yarn Manufacturing Technology - I	Embedded	PC	3	0	2	0	4
3	24TTI203	Weaving Technology - I	Embedded	PC	3	0	2	0	4
4	24TTJ204	Internships Camp / Mini Project -1	Project	PRJ	0	0	0	0	1
5	24MAI232	Applied Statistics for Engineers	Embedded	BS	**3**	**0**	**2**	**0**	**4**
6	24HSP005	Mastering Conversations	Practical	HS	**0**	0	2	0	1
7	24INM201	Universal Human Values – II; Understanding Harmony	Theory	HS	1	0	0	0	1
8	24INO2--	FCLF – General Stack - 3	Practical	OE	0	0	2	0	1
9	24INP201	Innovation Practicum - 3	Practical	ES	0	0	2	0	1
10	24EII225	Measurements and Instrumentation for Textile Industries	Embedded	ES	3	0	2	0	4
								Total Credits	**25**
								Total Contact Hours / Week	**32**

Semester IV									
S. No	**Course code**	**Course Title**	**Course Mode**	**Course Category**	**L**	**T**	**P**	**J**	**C**
1	24HSP006	Group Discussions and Presentation Skills	Practical	HS	**0**	**0**	**2**	**0**	**1**
2	24TTT205	Characteristics of Textile Fibres	Theory	PC	3	0	0	0	3
3	24TTI206	Yarn Manufacturing Technology - II	Embedded	PC	3	0	2	0	4
4	24TTI207	Weaving Technology - II	Embedded	PC	3	0	2	0	4
5	24TTl208	Textile Design and Structures	Embedded	PC	2	0	2	0	3
6	24TTI209	Knitting Technology	Embedded	PC	3	0	2	0	4
7	24INM202	Environmental Science & Sustainability	Embedded	HS	1	0	2	0	2
8	24TTO---	FCLF – Technical Stack – 1	Theory	OE	0	0	2	0	1
9	24TTO---	FCLF – Emerging Stack - 1	Theory	OE	0	0	2	0	1
10	24INP202	Innovation Practicumm - 4	Practical	ES	0	0	2	0	1
								Total Credits	**24**
								Total Contact Hours / Week	**33**

Semester V									
S.No	**Course code**	**Course Title**	**Course Mode**	**Course Category**	**L**	**T**	**P**	**J**	**C**
1		Interview Strategies for Career Opportunities	Embedded	HS	**0**	**0**	**2**	**0**	**1**
2	24TTI301	Garment Manufacturing Technology	Embedded	PC	3	0	2	0	4
3	24TTI302	Textile Wet Processing - I	Embedded	PC	3	0	2	0	4
4	24TTI303	Textile Testing	Embedded	PC	3	0	2	0	4
5	24TTE--	Professional Elective - 1	Theory	PE	3	0	0	0	3
6	24TTE--	Professional Elective - 2	Theory	PE	3	0	0	0	3
7	24TTO---	FCLF – Technical Stack – 2	Theory	OE	1	0	0	0	1
8	24TTO---	FCLF – Emerging Stack – 2	Theory	OE	1	0	0	0	1
9	24TTJ301	Internship Camp / Mini Project - 2	Project	PRJ	0	0	0	0	2
Total Credits									**23**
Total Contact Hours/week									**28**

Semester VI									
S.No	**Course code**	**Course Title**	**Course Mode**	**Course Category**	**L**	**T**	**P**	**J**	**C**
1		Indian / Foreign Languages	Practical	HS	**0**	**0**	**4**	**0**	**2**
2	24TTT304	Technical Textile	Theory	PC	3	0	0	0	3
3	24TTI305	Textile Wet Processing - II	Embedded	PC	3	0	2	0	4
4	24TTT306	Nonwoven Technology	Theory	PC	3	0	0	0	3
5	24TTT307	Protective Textile	Theory	PC	3	0	0	0	3
6	24TTT308	Textile Costing	Theory	PC	3	0	0	0	3
7	24TTE--	Professional Elective – 3	Theory	PE	3	0	0	0	3
8	24TTO---	FCLF – Technical Stack – 3	Theory	OE	1	0	0	0	1
9	24TTO---	FCLF – Emerging Stack - 3	Theory	OE	1	0	0	0	1
Total Credits									**23**
Total Contact Hours/week									**24**

Semester VII									
S.No	**Course code**	**Course Title**	**Course Mode**	**Course Category**	**L**	**T**	**P**	**J**	**C**
1	24TTT401	Textile Business Management	Theory	Mgmt / Fin	3	0	0	0	3
2	24TTE--	Professional elective -4	Theory	PE	3	0	0	0	3
3	24TTE--	Professional elective -5	Theory	PE	3	0	0	0	3
4	24TTE--	Professional elective -6	Theory	PE	3	0	0	0	3
5	24TTJ401	Project Phase I	Project	PR	0	0	0	3	3
6		Indian Knowledge Systems (IKS)	Theory	HS	1	0	0	0	1
								Total Credits	**16**
								Total Contact Hours/week	**16**

Semester VIII									
S.No	**Course code**	**Course Title**	**Course Mode**	**Course Category**	**L**	**T**	**P**	**J**	**C**
1	24TTJ402	**Project Phase II**	**Project**	**PR**	**0**	**0**	**0**	**12**	**12**
								Total Credits	**12**
								Total Contact Hours/week	**12**

Total Credits	**165**

List of Mandatory Courses										
S.No	**Course code**	**Course Title**	**Course Mode**	**Course Category**	**L**	**T**	**P**	**J**	**C**	**Sem**
1	24______	Indian Constitution	Theory	HS	1	0	0	0	1	4

Professional Electives									
S.No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**
TRACK -I- Technical									
1	24TTE011	Manufactured Fiber Technology	Theory	PE	3	0	0	0	3
2	24TTE012	High-Performance Fibers	Theory	PE	3	0	0	0	3
3	24TTE013	Process control in spinning and weaving	Theory	PE	3	0	0	0	3
4	24TTE014	Sustainability in Textile Manufacturing and Material	Theory	PE	3	0	0	0	3
5	24TTE015	Garment Processing	Theory	PE	3	0	0	0	3
6	24TTE016	Garment Machinery	Theory	PE	3	0	0	0	3
7	24TTE017	Clothing Science	Theory	PE	3	0	0	0	3
8	24TTE018	Advances in Textile Finishing	Theory	PE	3	0	0	0	3
9	24TTE019	Textile Composites	Theory	PE	3	0	0	0	3
10	24TTE020	Sports Textiles	Theory	PE	3	0	0	0	3
11	24TTE021	Home Textiles	Theory	PE	3	0	0	0	3
12	24TTE022	Filtration Textiles	Theory	PE	3	0	0	0	3
13	24TTE023	Medical Textiles	Theory	PE	3	0	0	0	3
14	24TTE024	Geotextiles	Theory	PE	3	0	0	0	3
15	24TTE025	Testing of Functional and Technical Textiles	Theory	PE	3	0	0	0	3
TRACK -II– Entrepreneurship and Business									
1	24TTE041	New Product Development and Strategy	Theory	PE	3	0	0	0	3
2	24TTE042	Market Research and Portfolio Management	Theory	PE	3	0	0	0	3
3	24TTE043	Supply Chain Management	Theory	PE	3	0	0	0	3
4	24TTE044	Textile Project Management and Finance	Theory	PE	3	0	0	0	3
5	24TTE045	Export Documentation and Business Strategy	Theory	PE	3	0	0	0	3
6	24TTE046	Principles of Management	Theory	PE	3	0	0	0	3
7	24TTE047	Apparel Quality Management	Theory	PE	3	0	0	0	3
8	24TTE048	Apparel Production Planning and Control	Theory	PE	3	0	0	0	3
9	24TTE049	Fashion Marketing Management	Theory	PE	3	0	0	0	3
10	24TTE050	Industrial Engineering	Theory	PE	3	0	0	0	3
11	24TTE051	Sustainable Textile Manufacturing and strategy	Embedded	PE	2	0	2	0	3
12	24TTE052	Textile Robotics and Automation	Embedded	PE	2	0	2	0	3
TRACK -III– Advanced Research in Textile Engineering									
1	24TTE071	Digital Printing in Textiles	Theor	PE	3	0	0	0	3

2	24TTE072	3-D Printing in Textiles	Theory	PE	3	0	0	0	3
3	24TTE073	Smart Textiles and Wearable Technology	Theory	PE	3	0	0	0	3
4	24TTE074	Biomimetic and Bio-inspired Textiles	Theory	PE	3	0	0	0	3
5	24TTE075	Textile Robotics and Automation	Theory	PE	3	0	0	0	3
6	24TTE076	Computational Textiles	Theory	PE	3	0	0	0	3
7	24TTE077	Manufacture of Specialty Yarns and Fabrics	Theory	PE	3	0	0	0	3
8	24TTE078	Specialty Knits	Theory	PE	3	0	0	0	3
9	24TTE079	Mechanics of Textile Machinery	Theory	PE	3	0	0	0	3
10	24TTE080	Nano and smart materials in Textiles	Theory	PE	3	0	0	0	3
11	24TTE081	Smart Textile Manufacturing	Embedded	PE	2	0	2	0	3
12	24TTE082	Applied Artificial Intelligence in Textiles	Embedded	PE	2	0	2	0	3
13	24TTE083	Digital Twins & Industry 5.0 in Textiles	Embedded	PE	2	0	2	0	3

List of FCLF One credit Courses

Technical Stack				
S. No.	Shopfloor operations		Insights into machinery	
	Course code	Course title	Course code	Course title
1	24TTO002	Value Stream mapping	24TTO006	Erection & Commissioning of Textile Machinery
2	24TTO003	Quality Control and Statistical Tools in Textile Manufacturing	24TTO007	Maintenance Practices in Textile Machinery
3	24TTO004	Lean Management	24TTO008	Energy Management in Textile Mills
4	24TTO005	Workload and Work Assignments	24TTO009	Automation and Sensor Applications in Textile Machinery
Emerging Stack				
S. No.	Computing in textiles		Green textiles	
	Course code	Course title	Course code	Course title
1	24TTO301	ERP in Textiles	24TTO305	Sustainability concepts in textile manufacturing
2	24TTO302	IoT and Application in Textile Mill	24TTO306	Sustainability certifications and economic impact
3	24TTO303	Data analytics and AI application in textile process optimization	24TTO307	Circularity in textiles
4	**24TTO304**	Smart manufacturing in textiles	**24TTO308**	Micro-pollution from textiles

Note – One course each from emerging and technical stacks will be offered to students over three semesters. Once a set (under each stack) is chosen, it cannot be changed.

Open Electives (OFFERED TO STUDENTS OF OTHER DEPARTMENTS)									
S.No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**
1	24TTO001	Smart Textiles and Wearable Technology	Theory	1	1	0	0	0	1
2	24TTO002	Textiles and its applications	Theory	1	1	0	0	0	1
3	24TTO003	Textile Composites for Engineering Applications	Theory	1	1	0	0	0	1
4	24TTO004	Sustainable Textile Engineering	Theory	1	1	0	0	0	1
5	24TTO005	Textile Materials for Defense and Protective Applications	Theory	1	1	0	0	0	1
6	24TTO006	Medical Textiles and Healthcare Applications	Theory	1	1	0	0	0	1
7	24TTO007	Nonwoven Fabrics and Their Applications	Theory	1	1	0	0	0	1
8	24TTO008	Automotive Textiles	Theory	1	1	0	0	0	1
9	24TTO009	Geotextiles and Their Applications	Theory	1	1	0	0	0	1
10	24TTO010	Textile Recycling and Waste Management	Theory	1	1	0	0	0	1

Minor Specialization (OFFERED TO STUDENTS OF OTHER DEPARTMENTS)									
S.No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**
1	24TTO051	Basics of Technical Textiles	Theory	3	3	0	0	0	3
2	24TTO052	Composites and Reinforced Fabrics	Theory	3	3	0	0	0	3
3	24TTO053	Industrial Textiles	Theory	3	3	0	0	0	3
4	24TTO054	Automotive Textiles	Theory	3	3	0	0	0	3
5	24TTO055	Defense Textiles	Theory	3	3	0	0	0	3
6	24TTI1056	Aerospace Textiles	Theory	3	3	0	0	0	3
7	24TTJ051	Project	Project	3	3	0	0	0	3

SEMESTER I

24HST101	தமிழர் மரபு / HERITAGE OF TAMILS	L	T	P	J	C
		1	0	0	0	1
HS	(Common to all Departments)	SDG	4, 11, 16			

Pre-requisite courses	-	**Data Book / Code book (If any)**	-

Course Objectives:	
The purpose of taking this course is to:	
1	தமிழ் மமமமொழி மற்றும் இலக்கியத்தின் அடிப்படை அம் சங்கடை அறிமுகப்படுதது தல், அதன் மமதொன்மைமக்மகாலம் முதல் நவீனமகாலம் வடையிமலான டவரச்சி யைவிட க்கம் மசய்யுதல். Introduce students to the foundational aspects of Tamil language and literature, tracing its evolution from ancient to modern times.
2	தமிழகத்தின் மசழுமமயான கலொசம் ொர பொரமப்பரியத்மத அறிமுகப்படுத்துதல், பொமற ஓவியகக் கமலயிலிருந்து நவீன ம ிறப்ப கமலயின்படி அதன் கமல சவளிப்பொடுகமள ஆரொய்தல். Familiarize students with the rich cultural heritage of Tamil Nadu, exploring its artistic expressions from rock art paintings to contemporary sculptures.
3	தமிழகத்தின் நொட்டுப்புறக் கமலகள் மற்றும் வீரவிமளயொட்டுகமள அறிதல் - தினணக்கமகொைம் பொடுகடை டமஆொய்தல் - இந்திய கதசிய இயக்கத்தில் தமிழர்கின் பங்கினை அறிதல். To know the folk arts and heroic ames of Tamilnadu-explore the concept of thinai -to know the role of Tamils in Indian National movement.

Course Outcomes		
After successful completion of this course, the students shall be able to		**Revised Bloom's Taxonomy Levels (RBT)**
CO1	தமிழ் சமொழி மற்றும் இலக்கியத்தின் அடிப்படம அறிமவ மமம்படுத்துதல். மமமொழி பண்மபொட்டில் எவ்மவொறு இடைந்துள்ட து என்பைத டைரத் லல். Enhance the fundamental knowledge of Tamil language and literature	U
CO2	பழங்மகொல மபொறை ஓவியங்கள், ம ிறப்பம் என கைலகள் நவீன மகொலமவ்வடை	U

	எவ்மவறெு படயிக்கிறது என்பைத புரிந்துசகளொ்ளுதல். Understand the heritage, rock art paintings to modern art sculpture	
CO3	நொைடப்புறக் கைலகள் தற்கொப்பகக் கமலடமகொகவும், டைல் ஆடமகொக்கியத்ைத கமம்படுத்தும் விதமமொகவும் ைஅமைவத அறிந்து கைலகள் மீமதொன ஆரவ்த்ைத அதிகரிக்கச் மசய்தல் - தமிழரக் ளின் அகத்திடைம, புறத்திடைம கமகொைம் பொைைட்டிைன புரிந்து மமகளொ்ளுதல். இந்திய பண் மபொைைட்டில் தமிழரக் கின் பங் டகிப்ைப அறிதல். Acquire essential knowledge in the folk and martial arts-understanding the Agam and puram concept- to know the contribution of Tamils in Indian culture.	Ap

	Program Outcomes (PO) **(Strong-3, Medium – 2, Weak-1)**										**Program Specific**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Outcomes (PSO)**

Course Outcomes (CO)	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1							3	2	2		2		
2							3	3	2		2		
3							3	2	2		2		

Course Content

மமமொழி மற்ற ும் இலக்கியம்

இந்திய சமொழிக் க ுடும்பங்களஂ – திட ம ொவிட சமொழிகள் – தமிழ் ஒரு மசம்சமொழி – தம ிழ் மசவ்வ ிலக்கியங் கள் - சங் க இலக்கியத்தின் சமய மசொரபற்ற தன் ைம – சங் க இலக்கியத்தில் பக ிரதல் அறம் – திருக்குறள ில் கமமலொண் ைமக் கருத்துக்கள் – தமிழ் க் மகொப்ப ியங் கள் , தமிழகத்தில் சமண சமபௌத்த சமயங் கள ின் சதொட க்கம் -பக்தி இலக்க ியம், ஆழ் மவொரக்ள் மற்றும் மநொயன் மமொரக் ள் –

ம ிற்ற ிலக்க ியங்கள் – தமிழ ில் நவீன இலக்க ியத்தின் வளரச் ம ி – தமிழ் இலக்க ிய வளரச் ம் ியில் மபொரத ிமயொர் மற்றும் மபொட திமதொசன் ஆகிகமயொர ின் பங்கள ிப்பு.

LANGUAGE AND LITERATURE

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

3 Hours

மரபு – பொறற ஓவியங்கள் முதல் நவீன ஓவியங் கள் வறர – சிற்பக்கறற

நடுகல் முதல் நவீன ம ிற்பங்கள் வடை – ஐம்சபொன் ம ிைலகள் – பழங் குட ியினர் மற்ற ும் அவரக் ள் தமயொர ிக்கும் ைகவ ிைனப் மமபொருைக்கள், சபொம் ைமகள் – கதர் மசய் யும் கைல – சுடுமண் ம ிற்பங் கள் – மநொைடீப்புற மதய் வங் கள் – க ுமரிமுைனயில் திருவள்ளுவர் ம ிைல – ைஇசக் கர ுவிகள் – மிருதங்கம், ைபற, வீடைை, மயொழ், மநொதஸ் வரம் – தமிழரக் ள ின் சமூக சபொருட ம ொமதொர மவொழ் வில் கமகொவ ில்கள ின் பங்கு.

HERITAGE – ROCK ART PAINTINGS TO MODERN ART SCULPTURES

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar

3 Hours

Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.	
நொடடுு ப்புறக் கறறகள் மறற்றும் வீ விறறயொடடூகள் மதருகக்கூதது, கரமகொைட மம், வில் லுபம்மபொைடு, கணிமயொண் கூததது, ஒயிமலொைட மம், கமதொல் மபொைவகக்கூதது, ம ிலமம் மபொைட மம், வளரி, புலிமயொைட மம், தமிழரக் ளின் விடைமயொைடூகள். **FOLK AND MARTIAL ARTS**	**3 Hours**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Ciabatta, Valari, Tiger dance - Sports and Games of Tami	
தம◌ிழரக் ள◌ின் த◌ிறறக◌்க&◌ாம◌ொட◌்ப◌ொடுகள◌் தமிழகத்தின் மதம◌ொவரங◌்களும◌், வ◌ிலங◌்குகளும◌் – சதம◌ொல◌்மகம◌ொப◌்பியம◌் மற◌்றும◌் சங◌்க இலக◌்கியத்தில◌் அகம◌் மற◌்றும◌் புறக◌்கமகம◌ொம◌ை◌்சப◌ொடுகள◌் – தமிழரக் ள◌் கமப◌ொற◌்ற◌ிய அறக◌்கமகம◌ொம◌ைம் ப◌ொடு – சங◌்கமகம◌ொலத்தில◌் தமிழகத்தில◌் எழுத்தறிவும◌், கல◌்வ◌ியும◌் – சங◌் கமகம◌ொல நகரங◌் களும◌் து◌ைறமுகங◌்களும◌்–சங◌்கமகம◌ொலத்தில◌் ஏற◌்ற◌ுமதி மற◌்ற◌ும◌் இறக◌்குமதி – டகல◌்டகந◌்த மநம◌ொடுகள◌ில◌் தமிழரக் ளின் மவற◌்றி. **THINAI CONCEPTS OF TAMIL** Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.	**3 Hours**
இந◌்த◌ிய கதச◌ிய இயக◌்கம◌் மற◌்ற◌ும◌் இந◌்த◌ிய பண◌் ப◌ொட◌்ட◌ிற◌்குத◌் **தம◌ிழரக் ள◌ின் பங◌்கள◌ிப◌்பு** இந◌்திய வ◌ிடுதம◌ைலப◌் கமப◌ொரில◌் தமிழரக் ள◌ின் பங◌்கு – இந◌்திமய◌ொவ◌ின் பிறப◌்பகுதிகளில◌் தமிழ◌்ப◌் பண◌்மப◌ொம◌ை◌்ட◌ின் மதம◌ொக◌்கம◌் – சுயமரிமய◌ொம◌ைத இயக◌்கம◌் – இந◌்திய மருத◌்துவத்தில◌், ம◌ித்த மருதது◌் வத்தின◌்பங◌்கு – கல◌்மவம◌ை◌்டுகள◌் , ◌ைகமயழுத்துப◌்பட◌ிகள◌் - தமிழ◌்ப◌் புத்தகங◌்கள◌ின் அசசு◌் வரமலம◌ொற◌ு. **CONTRIBUTIONS OF TAMIL TO INDIAN NATIONAL MOMENT AND INDIAN CULTURE** Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.	**3 Hours**

Theory Hours:	**15**	**Tutorial Hours:**	**0**	**Practical Hours:**	**0**	**Project Hours:**	**0**	**Total Hours:**	**15**

Learning Resources

Reference books:

1. தமிழக வரமலம◌ொறு – மக◌்களும◌் பண◌்மப◌ொடும◌் – கக.கக. ப◌ிள◌்டம◌ை (மடவியீடு: தம◌ிழ◌் மநம◌ொடு மப◌ொட நூல◌் மற◌்றும◌் கல◌்வ◌ிய◌ியல◌் பண◌ிகள◌் கழகம◌்).

2. கணினித்தமிழ் – முைனவர் இல. சுந்தரம். (விடகன் பிரசுரம்).

3. கீழடி – ைவைக நதிக்கடைையில் சங் கமகொல நகர மநொகரிகம் (சதொல்லியல் துைற மவளியீடு)

4. சபொரூைந – ஆற்றங்கடை மநொகரிகம். (சதொல்லியல் தூ மவளியீடூ)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Textbook and Educational Services Corporation, Tamil Nadu)

1. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
2. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
3. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL)

Online Educational Resources:

4. https://www.youtube.com/watch?v=IKPwEmsmuZc&list=PLMMrJE4pHZmc0iJZIE6l BpFoPK_9Y325e
5. https://www.youtube.com/watch?v=j6_ddjn_gLc&list=PLMMrJE4pHZmc0iJZIE6lBp FoPK_9Y325e&index=2
6. https://docs.google.com/presentation/d/1pf0jbyuDTNdvlcKMnOfoPjbqha7JqdOc/edit# slide=id.p1
7. https://www.youtube.com/watch?v=IKPwEmsmuZc&list=PLMMrJE4pHZmc0iJZIE6l BpFoPK_9Y325e&index=1

Assessment (Theory course)
CAT, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), Assignments, Quiz, Library Record

Course Curated by

Expert from Industry	Expert(s) from Higher Education Institutions	Internal Expert	
Mr.Vijayan Ramanathan, Project manager, Toppan Merrill. Technologies, Coimbatore	Dr. Aninditha Sahoo, IIT, Madras Dr.P.R.Sujatha Priyadharshini, Anna University, Chennai Dr. E. Justin Ruben, CIT, Coimbatore	Suriya Prakash Department of Language	
Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

24EET104	FOUNDATIONS OF ELECTRICAL AND ELECTRONICS ENGINEERING (Common to CE & TT)	L	T	P	J	C
		3	0	0	0	3
ES		SDG	7, 9, 12			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:

The purpose of taking this course is to:

1	impart knowledge on power system structure, apparatus and its operation
2	familiarize the students about the operation of Electrical and Electronic circuits
3	provide significance of energy conservation and safety in Electrical Installations

Course Outcomes

	After successful completion of this course, the students shall be able to	Revised Bloom's Taxonomy Levels (RBT)
CO1	analyse the components of electrical power system and interconnections.	An
CO2	apply Ohm's Law and Kirchhoff's Laws to solve basic problems in electrical circuits.	Ap
CO3	compare the structure and principle of operation of Electrical motors and choose the motor for suitable applications.	Ap
CO4	analyse the operation of electronic devices, circuits and instrumentation systems.	An
CO5	apply Electrical safety and energy conservation measures.	An

	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											**Program Specific Outcomes (PSO)**	
	1	2	3	4	5	6	7	8	9	10	11		
Course Outcomes (CO)	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	2	2											

2	2	2											
3	2	2	1										
4	1	1	1										
5				1	1	1							

Course Content

ELECTRIC POWER SYSTEM Structure of Power system: Single line diagram, Generation of power: Layouts of Hydro power station, Thermal power station, Solar power plant, Wind energy conversion system. Types of substations -Types of wires and cables, Domestic wiring.	**9 Hours**

ELECTRIC CIRCUITS Basic circuit elements and sources, Ohms law, Kirchhoff's laws, Series and Parallel connection of circuit elements (simple problems), Single phase AC series circuit: Voltage, Current, Power, Energy, Power factor in R-L series circuit.	**9 Hours**
ELECTRICAL MACHINES (Qualitative treatment Only) Single phase Transformers - Separately Excited DC motor - PM DC motor - Single phase Capacitor start and run induction motor - Three phase squirrel cage induction motor - PM Stepper motor - BLDC motor drive.	**9 Hours**
ELECTRONIC CIRCUITS PN junction diode - Full wave rectifier – Bipolar Junction transistors – Single phase bridge inverter (VSI) - Block diagrams of Online UPS, Digital Energy meter - Types of transducers- Introduction to smart sensors and automation systems.	**9 Hours**
ELECTRICAL SAFETY AND ENERGY CONSERVATION Earthing, Protective devices: Switch fuse unit - Miniature circuit breaker - Earth leakage circuit breaker-Lightning arrester - Safety precautions - PPE and First Aid - Energy conservation measures in domestic and industrial facilities.	**9 Hours**

Theory Hours:	**45**	**Tutorial Hours:**	**0**	**Practical Hours:**	**0**	**Project Hours:**	**0**	**Total Hours:**	**45**

Learning Resources

Textbooks

1. S. Salivahanan, N. Suresh Kumar, A. Vallavaraj - Basic Electrical and Electronics Engineering, 3rd Edition, McGraw Hill Education, 2021
2. S.L. Uppal, G.C. Garg - Electrical Wiring, Estimating and Costing, 6th Edition, Khanna Publishers, 2022

Reference books

2. P.S. Bimbhra - Electrical Machinery, 8th Edition, Khanna Publishers, 2023
3. V.K. Mehta, Rohit Mehta - Principles of Electrical Engineering, 2nd Edition, S. Chand Publishing, 2022
4. B.L. Theraja, A.K. Theraja - A Textbook of Electrical Technology - Vol. 2: AC & DC Machines, 25th Edition, S. Chand Publishing, 2023
5. Adel S. Sedra, Kenneth C. Smith - Microelectronic Circuits, 8th Edition, Oxford University Press, 2023
5. Robert L. Boylestad, Louis Nashelsky - Electronic Devices and Circuit Theory, 12th Edition, Pearson, 2023

Online Resources (Web Links)

6. https://www.coursera.org/learn/electronics
7. https://archive.nptel.ac.in/courses/108/105/108105053/

Assessment (Theory course)
CAT, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE)

<table>
<tr><th colspan="4">Course Curated by</th></tr>
<tr><th>Expert(s) from Industry</th><th>Expert(s) from Higher Education Institution</th><th colspan="2">Internal Expert(s)</th></tr>
<tr><td>Mr. S. Jaya kumar</td><td>Dr.N.Senthilnathan</td><td colspan="2">Dr. P. Thirumoorthi</td></tr>
<tr><td>Swagat Industries Ltd, CBE
Mr. Lakshmiprasad
Bosch Global Software Technologies, CBE</td><td>Professor/EEE
Kongu Engineering College
Dr. S. Balamurugan
Professor - EEE
Amrita Vishwa Vidyapeetham</td><td colspan="2">Professor
Department of EEE</td></tr>
<tr><td>Recommended by BoS on</td><td colspan="3">14.08.2024</td></tr>
<tr><td>Academic Council Approval</td><td>27</td><td>Date</td><td>24.08.2024</td></tr>
</table>

24MAI112	COMPUTATIONAL LINEAR ALGEBRA AND CALCULUS	L	T	P	J	C
		3	0	2	0	4
BS	(Common to BT, FT, TT)	SDG	4, 7, 9			
Pre-requisite courses	-	Data Book / Code book (If any)	-			

Course Objectives:

The purpose of taking this course is to:

1	develop and understanding of the solution techniques for systems of linear equations and their applications in engineering problems.
2	familiarize students with the concept of eigenvalues and eigenvectors, and their significance in transforming real-world systems.
3	apply differential calculus to solve real-life optimization problems involving rate changes and extrema.
4	enhance proficiency in evaluating integrals using analytical and numerical methods for solving area and volume problems in engineering.
5	introduce ordinary differential equations and their numerical solutions for modelling dynamic systems in various engineering disciplines.

Course Outcomes

After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO1	apply matrix operations (Gauss Jordan, Gauss Seidel) to solve systems of linear equations in textile manufacturing and material composition problems.	Ap
CO2	apply eigenvalues and eigenvectors to simplify textile stress-strain matrices and design systems in fashion technology.	Ap
CO3	apply differential calculus to optimize garment fitting, fabric draping, and bio-responses in biotechnological textiles by analysing changes in variables.	Ap
CO4	analyse and estimate changes in textile production processes and biological systems with variable data points by utilizing numerical differentiation techniques (Newton's, Lagrange's methods).	An
CO5	solve integration problems using analytical and numerical methods (Trapezoidal, Simpson's rule) for calculating fabric area or volume in garment design and textile engineering.	Ap
CO6	apply numerical methods (Euler's method, Taylor series, Runge Kuta) to solve first-order ordinary differential equations in dynamic biotechnological processes such as enzyme kinetics or fluid flow in textile materials.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	3	3	2		3	2		2	1	2			
2	3	3	2		3	2		2	1				
3	3	2	3		3	2		2	1				
4	3	3	2		3	2		2	1				
5	3	2	2		3	2		2	2	2			
6	3	3	2		3	2		2	1				

Course Content:

SYSTEM OF LINEAR EQUATIONS

Rank of a matrix – Consistency of a system of linear equations - Rouche’s theorem - Linearly dependent and independent vectors – Solution of a system of linear equations - Row Echelon form method

Numerical Method - Solution of a system of linear equations by Gauss Jordan and Gauss Seidel Method.

9 Hours

Practical Component

Solve a system of linear equations using Gauss Jordan and Gauss Seidel methods and interpret the results for a circuit analysis problem.

Use MATLAB to find the rank of a matrix and check the consistency of a system of linear equations, applying the results to a mechanical structure problem.

6 Hours

EIGENVALUES AND EIGENVECTORS Eigenvalues and Eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors –Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation. Numerical Method - Dominant Eigen value by Power Method.	**9 Hours**
Practical Component Implement the Power Method in MATLAB to find the dominant eigenvalue of a matrix representing a dynamic system (e.g., vibration analysis of a mechanical structure). Use MATLAB to perform orthogonal transformations and diagonalize a symmetric matrix in a physical system (e.g., stress-strain analysis).	**6 Hours**

DIFFERENTIAL CALCULUS Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable - Numerical Method - Numerical differentiation by Newton's Forward and Backward Method (Equal intervals), Lagrange's Method (Unequal Intervals).	**9 Hours**
Practical Component Use MATLAB to compute numerical differentiation using Newton's Forward and Backward methods for a data set representing temperature changes over time. Apply Lagrange's method for numerical differentiation to an unequal interval data set, such as population growth data.	**6 Hours**
INTEGRAL CALCULUS Definite and Indefinite integrals - Techniques of Integration: Substitution rule, Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction. Numerical Method - Numerical integration by Trapezoidal and Simpson's rule. **Practical Component**	**9 Hours**
Implement MATLAB to numerically integrate a function using the Trapezoidal rule, solving for areas under curves in engineering problems (e.g., fluid flow). Use Simpson's rule in MATLAB for numerical integration, applied to solve real-world volume problems in physics or engineering.	**6 Hours**
FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS Leibnitz's equation – Bernoulli's equation – Numerical Methods - Solving first ODE by Euler's formula, Taylor series and Runge Kutta method of 4th order.	**9 Hours**
Practical Component Solve a first-order ODE using Euler's method in MATLAB and apply it to model the cooling process of an object. Implement the Runge Kutta method of the 4th order in MATLAB to solve a dynamic system, such as the motion of a pendulum or a mass-spring system.	**6 Hours**

Theory Hours: 45	**Tutorial Hours: 0**	**Practical Hours: 30**	**Project Hours: 0**	**Total Hours: 75**

Learning Resources

Textbooks

1. James Stewart, “Calculus: Early Transcendentals”, Cengage Learning, 9th Edition, New Delhi, 2023.
2. Grewal B.S., “Numerical Methods in Engineering and Science”, Khanna Publishers, 2013.

Reference books

1. Kreyzig E., “Advanced Engineering Mathematics”, 10th Edition, John Wiley and sons, 2011.
2. Weir, MD, Hass J, Giordano FR, “Thomas’ Calculus”, Pearson education 15th Edition, 2023.
3. Steven.C.Chapra, "Applied Numerical Methods with Matlab for Engineers and Scientists",4th Edition, Tata McGraw Hill Co. Ltd, 2017.
4. Dennis G. Zill and Michael R Cullen, “Differential equations with boundary value problems”, 7th Editon, Brooks/Cole Cengage Learning.2009.
5. Ron Larson and Bruce H. Edwards, “Calculus”, 12th Edition Brooks/Cole Cengage Learning.2022.
6. James W. Demmel Applied Numerical Linear Algebra" 9th Edition, SIAM, 1997

Online Resources (Web Links)

1. MIT Open Courseware: Linear Algebra (Free) https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/
2. Coursera: Numerical Methods for Engineers https://www.coursera.org/learn/numerical-methods-engineers
3. Khan Academy: Differential Calculus (Free) https://www.khanacademy.org/math/calculus-1
4. MIT OpenCourseWare: Differential Equations (Free) https://ocw.mit.edu/courses/mathematics/18-03sc-differential-equations-fall-2011/

Assessment (Embedded course)
CAT, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by

<table>
<tr><th>Expert(s) from Industry</th><th colspan="2">Expert(s) from Higher Education Institution</th><th colspan="2">Internal Expert(s)</th></tr>
<tr><td>Mr. Ramesh V.S.,
STEPS Knowledge Services Private Limited, Coimbatore.
Mr.Jayakumar Venkatesan,
Valles Marineris International Private Limited- Chennai.
Mr. Imran Khan,
GE Transportation Company, Bangalore.</td><td colspan="2">Dr.T.Govindan,
Government College of Engineering, Srirangam, Trichy.
Dr.C.Porkodi,
PSG College of Technology, Coimbatore.
Dr.P.Paramanathan,
Amrita Vishwa Vidyapeetham, Coimbatore.</td><td colspan="2">Dr. R.Marudhachalam
Dr. Vijitha Iyer
Dr. A.Ezhilarasi,
Department of Maths</td></tr>
<tr><td>Recommended by BoS on</td><td colspan="4">16.08.2024</td></tr>
<tr><td>Academic Council Approval</td><td>No: 27</td><td colspan="2">Date</td><td>24.08.2024</td></tr>
</table>

24CYI105	TEXTILE AND APPAREL CHEMISTRY (Common to TT & FT)	L	T	P	J	C
		3	0	2	0	4
BS		SDG	6, 9, 12			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	provide a deep understanding of chemical principles in polymer science, dyeing, and textile finishing for sustainable production.
2	equip students with advanced polymerization techniques and chemical additives knowledge for engineering high-performance, eco-friendly textiles.
3	develop analytical skills in water treatment and waste management for resource conservation and minimizing environmental impact in textiles.
4	introduce emerging technologies such as nanotechnology and bio-based polymers, preparing students for innovation in smart textiles and sustainable fashion.
5	promote the application of green chemistry principles, enabling students to contribute to sustainable and ethical practices in the textile industry.

Course Outcomes		
After successful completion of this course, the students shall be able to		**Revised Bloom's Taxonomy Levels (RBT)**
CO1	apply polymerization mechanisms to solve challenges in developing novel polymers for textile applications	Ap
CO2	analyse the effects of polymer structures on material properties to distinguish between various polymer-based textile products	An
CO3	apply different polymer processing techniques to solve challenges in textile manufacturing processes	Ap
CO4	apply sustainable materials and chemical additives in textile production processes to develop eco-friendly textile products	Ap
CO5	interpret the interaction between dyes and fibers to optimize dyeing processes for various fabric types, ensuring efficiency and sustainability	An
CO6	evaluate and recommend water treatment processes and recycling strategies to address the environmental challenges of the textile industry	E

	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)	Program Specific

	1	2	3	4	5	6	7	8	9	10	11	Outcomes (PSO)	
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	3	2						2			3		
2		3	2		2								

3	2			2				2			2		
4			2				2						
5						2	2						
6	2			3		1	3			2	2		

<table>
<tr><th colspan="2">Course Content</th></tr>
<tr><td>POLYMER CHEMISTRY

Introduction – Functionality - Degree of polymerisation - classification - Mechanism - (Free Radical Mechanism, coordination polymerisation - Ziegler-Natta Polymerization)
Effect of polymer structure on properties- Degradations - chemical, thermal, mechanical and photo degradations. Polymer characterization techniques (GPC, DSC, TGA, FTIR).
Practical Component:
Determination of Polymer Melting Points and Moulding Characteristics
Determination of Polymer Solution Viscosity at Different Concentrations</td><td>9 Hours

4 Hours</td></tr>
<tr><td>POLYMER PROCESSING

Polymer Processing: Calendaring - compression – injection - extrusion - blow moulding

- foaming - fibre spinning (melt, dry and wet spinning) - 3D printing of polymers and textiles

Speciality chemicals: plasticizers - anti-aging additives - antioxidants - UV stabilizers - blow agents - crosslinking agents - Applications: Smart Textiles (Conducting polymers), Biopolymers and Biodegradable polymers</td><td>9 Hours</td></tr>
<tr><td>DYE AND FIBER INTERACTIONS

Bonding: Ionic - covalent - co-ordinate covalent bonds - hydrogen bonding - Vanderwaal’s forces - Interaction of proteins and enzymes with fibres.

Dyes: Introduction - Chromophore and auxochromes - Hypochromic and Bathochromic effects - Classification of dyes based on different parameters - Significance and limitations of natural and synthetic dyes - Interaction between Fibers and dyes - Dyes substrate affinity (dyes for cellulose fibres, silk).

Practical Component:
Preparation of Standard solution - Sodium Carbonate
Preparation of Standard Dye Solutions
Synthesis of Methyl orange
Estimation of Dye Concentration Using Spectrophotometry
Determination of Dye Nature Through pH Analysis
Determination of Dyeing Effectiveness on Fabric using Synthetic dyes
Determination of Natural Dye Extraction Efficiency from Various Sources</td><td>9 Hours</td></tr>
</table>

• Determination of Dye Solubility in Various Solvents	**16 Hours**
WATER TECHNOLOGY Introduction - Hardness of water - Disadvantages of hard water in textile industry Softening Processes: External treatment (Demineralisation process) - Internal treatment (colloidal, carbonate, phosphate and calgon conditioning) - Desalination (Reverse osmosis, Electrodialysis) - Advanced oxidation processes for wastewater treatment - Water recycling and reuse in textile industry **Practical Component:** • Determination of total, temporary and permanent hardness by EDTA method	**9 Hours**

• Estimation of DO by Winkler's method • Estimation of Alkalinity by Indicator method • Estimation of Chloride by Argentometric method	**8 Hours**
EMERGING TECHNOLOGIES IN SUSTAINABLE TEXTILES Introduction to sustainable textiles - Green Chemistry in Textile Production (Principles and Solvent - free and Water-free textile processing) - Bio-based and Sustainable Polymers (Polylactic acid (PLA) - Nanotech in Sustainable Textiles (Carbon nanotubes and graphene in textiles, Nanofibers and their production methods) - Sustainable Raw Materials (Natural Fibers, Recycled – Pet fibres, Textile waste and Bio-Based Fibers) - Eco-Friendly Dyeing and Finishing. **Practical Component**: • Determination of Decolourisation of Dyeing Effluent	**9 Hours** **2 Hours**

Theory Hours:	**45**	**Tutorial Hours:**	**0**	**Practical Hours:**	**30**	**Project Hours:**	**0**	**Total Hours:**	**75**

Learning Resources

Textbooks:

1. Gowariker, V. R., Viswanathan, N. V., & Sreedhar, J. Polymer Science., New Age International Publishers, New Delhi (2016).
2. Dara, S. S., & Umare, S. S. A Textbook of Engineering Chemistry., S. Chand and Company Limited, New Delhi (2014).
3. Jain, P. C., & Jain, M. Engineering Chemistry (17th ed.)., Dhanpat Rai and Sons, New Delhi (2018).
4. Singh, A., Vairam, S., & Suba Ramesh. Chemistry for Engineers., Wiley India Ltd, New Delhi (2010).

References:

4. Seymour, R. B., & Carraher, C. E. Jr. Polymer Chemistry (6th ed.)., Plenum Publishing Corporation, New York (2003).
5. Finar, I. L. Organic Chemistry., Pearson Publishers, London (2012).
6. Hungar, K. Industrial Dyes: Chemistry, Properties and Applications., Wiley-VCH Verlag GmbH
& Co. KGaA, Weinheim (2004).

4. Khan, M. M. J., Ng, B. K. S., & Goh, S. C. K. The Handbook of Sustainable Textiles., Springer, Singapore (2022).

Online Resources (Weblinks)

7. NPTEL - Polymer Chemistry
https://nptel.ac.in/courses/104/105/104105039/
8. NPTEL - Polymer Reaction Engineering
https://nptel.ac.in/courses/103/105/103105110/
9. NPTEL - Processing of Polymers and Polymer Composites
https://nptel.ac.in/courses/112/104/112104221/
10. SWAYAM - Polymer Processing and Moulding Techniques
https://onlinecourses.swayam2.ac.in/cec21_mg15/preview
11. NPTEL - Chemistry of Dyes and Pigments
https://nptel.ac.in/courses/104/104/104104123/

6. SWAYAM - Textile Chemistry
   https://swayam.gov.in/nd2_cec20_he03/preview
7. NPTEL - Water and Wastewater Treatment
   https://nptel.ac.in/courses/103/106/103106118/
8. SWAYAM - Water Quality and Wastewater Management
   https://onlinecourses.swayam2.ac.in/cec21_ge11/preview
9. NPTEL - Sustainable Materials and Green Buildings
   https://nptel.ac.in/courses/124/105/124105016/

Assessment (Embedded course)
CAT, Activity and Learning Task(s), One-minute paper, Think-pair-share, MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert(s)**
Dr. Muthuraja Perumal General Manager - Research & Development Rohith Industries, APIIC Industrial Park, Andhra Pradesh	Dr. Venkatakrishnan Professor, School of Chemical Sciences Indian Institute of Technology (Mandi), Himachal Pradesh, India		Dr K Kalapriya, AP- III, Mr. K Karthik, AP- II, Department of Chemistry
Recommended by BoS on	16.08.2024		
Academic Council Approval	No.27	**Date**	24.08.2024

24MEI101	ENGINEERING GRAPHICS (Common to AE, AU, CE, FT, ME, MR, TT)	L	T	P	J	C
		2	0	2	0	3
ES		SDG		4, 9, 11		

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	understand the importance of graphics in the design process, including visualization, communication, and documentation.
2	develop proficiency in constructing various curves, orthographic projections, and using drafting tools.
3	gain the ability to project and section simple solids and develop lateral surfaces and isometric projections.
4	learn to use AutoCAD for sketching, editing objects, and creating detailed engineering drawings.

Course Outcomes		
After successful completion of this course, the students shall be able to		**Revised Bloom's Taxonomy Levels (RBT)**
CO 1	apply the construction of curves such as ellipses, parabolas, and hyperbolas to accurately visualize and communicate design ideas using drafting tools.	Ap
CO 2	analyze the projections of points, lines, and planes to determine true lengths and inclinations for effective representation of objects in design.	An
CO 3	evaluate the projections and sections of solids like prisms, pyramids, cylinders, and cones to create accurate sectional views and true shapes in engineering drawings.	An
CO 4	create developments of surfaces for simple solids and construct isometric projections to enhance the design process with three-dimensional visualizations.	An
CO 5	design free-hand sketches of orthographic views using AutoCAD.	Ap
CO 6	apply AutoCAD commands to demonstrate object selection and editing techniques, enabling precise modifications in engineering drawings.	Ap

	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											**Program Specific Outcomes (PSO)**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	

Course Outcomes (CO)	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	2	2			2								
2		2		2						2			
3		2	2				2						
4	2		2		2								
5	2				2					2			
6	2				2					2			

Course Content	
PLANE CURVES, PROJECTION OF POINTS, LINES AND PLANES • Importance of graphics in design process, visualization, communication, documentation and drafting tools, Construction of curves - ellipse, parabola, and hyperbola by eccentricity method only. Orthographic projection of points. • Construction of cycloid — Construction of spirals - Construction of involutes of square and circle. • Drawing of tangents and normal to the above curves. • Projections of straight lines located in first quadrant - determination of true length and true inclinations. • Projections of plane surfaces - polygonal lamina and circular lamina, located in the first quadrant and inclined to one reference plane.	**6 Hours** **6 Hours**
PROJECTION AND SECTION OF SOLIDS • Projection of simple solids - prism, pyramid, cylinder and cone. Drawing views when the axis of the solid is inclined to one reference plane. • Sectioning of simple solids - prisms, pyramids, cylinder and cone. Obtaining sectional views and true shape when the axis of the solid is vertical and cutting plane inclined to one reference plane.	**6 Hours** **6 Hours**
DEVELOPMENT OF SURFACES, ISOMETRIC PROJECTIONS • Development of lateral surfaces of truncated prisms, pyramids, cylinders and cones. • Isometric projection, Isometric scale, Isometric views of simple solids, truncated prisms, pyramids, cylinders and cones.	**6 Hours** **6 Hours**
FREE-HAND SKETCHING AND INTRODUCTION TO AUTOCAD • Free hand sketching techniques, sketching of orthographic views from given pictorial views of objects, including free-hand dimensioning. Free hand sketching of isometric views from orthographic views. • Introduction to Drafting Software (AutoCAD) & its Basic Commands. Introduction to coordinate systems, object selection methods, selection of units and precession. Annotation and dimensions, Object properties.	**6 Hours** **6 Hours**
DRAWING ORGANIZATION AND HOUSE PROJECT AutoCAD - Sketching – line, circle, arc, polygon, rectangle and ellipse. Working with object snaps, layers and object properties. Editing the objects – copy, move, trim, extend, working with arrays, mirror, scale, hatch, fillet and chamfer. Isometric views of simple solid blocks.	**6 Hours** **6 Hours**

Theory Hours:	**30**	**Tutorial Hours:**	**0**	**Practical Hours:**	**30**	**Project Hours:**	**0**	**Total Hours:**	**60**

Learning Resources

Textbooks:

1. Basant Agrawal and CM Agrawal, Engineering Drawing, McGraw-Hill, New Delhi, First Edition, 2008.
2. Venugopal K. and Prabhu Raja V., Engineering Graphics, New Age International (P) Limited, New Delhi, 2008.

References:

- Nataraajan K.V., Engineering Drawing and Graphics, Dhanalakshmi Publisher, Chennai, 2005.
- Warren J. Luzadder and Jon. M. Duff, Fundamentals of Engineering Drawing, Prentice Hall of India Pvt. Ltd., New Delhi, Eleventh Edition, 2005.

3. Gopalakirishna K.R., Engineering Drawing (Vol. I & II), Subhas Publications, 2001.
4. James Leach, AutoCAD 2017 Instructor, SDC Publications, 2016.

Online Resources (Open sources):

1. https://www.khanacademy.org/math/differential-calculus
2. https://nptel.ac.in/courses/106105171
3. https://swayam.gov.in/nd1_noc19_cs42/preview

Assessment (Embedded course)
CAT, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by			
Expert from Industry	**Expert from Higher Education Institutions**		**Internal Expert**
Mr. G. Vergin Vino Design Engineer TANCAM, Chennai	Dr. V. Prabhuraja Professor Department of Mechanical Engineering PSG College of Technology, Coimbatore		Dr. K. M Senthil Kumar Associate Professor Department of Mechanical Engineering
Recommended by BoS on	17.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

24INP102	INNOVATION PRACTICUM – 1 (Common to all Departments)	L	T	P	J	C
		0	0	2	0	1
ES		SDG	9, 11, 12			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:

The purpose of taking this course is to:

1	analyse the effectiveness of systems thinking and problem-solving methodologies in applying data-driven insights for innovative solution design.
2	evaluate the impact of transdisciplinary collaboration on creating functional hardware prototypes through fabrication techniques.
3	understand the future trends and implications of technology in developing innovative products.

Course Outcomes:

After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO1	recall the fundamental principles of custom hardware design.	R
CO2	understand the appropriate tools and their applications for solving hardware-related problems.	U
CO3	apply systems engineering concepts to real-world hardware design challenges.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	2		1										
2	2				1								

3		2	2	1									

Course Content

Engineering Fundamentals and Innovation Why engineering? The concept of street fight engineering - Real-world design process and problem-solving methodology - Data-driven insights and concept generation - Case studies of successful engineering innovations.	**3 Hours**
Transdisciplinary Systems and Manu’Futuring Transdisciplinary systems to accelerate innovation - Manu’Futuring: Technology in hardware manufacturing and manufacturing of hardware technologies - Future scopes with product case studies.	**6 Hours**

Building Custom Hardware How to build a basic custom hardware - Electronics fundamentals and components - Software for hardware control - Fabrication techniques.	**6 Hours**
System Thinking and Engineering Introduction to system thinking - Real world as a system - Concept of system engineering and its application – iLenSys.	**7 Hours**
Creativity Time and Tech Teardown Creativity exercise: Apply system thinking to a real-world problem - Tech teardown: Analyse a product or system to understand its engineering principles - Presentation: Present your creative project and tech teardown with an engaging title	**8 Hours**

Theory Hours:	0	Tutorial Hours:	0	Practical Hours:	30	Project Hours:	0	Total Hours:	30

Learning Resources

Textbooks:

1. Sanjoy Mahajan - Street Fighting Mathematics
2. Donald Knuth - The Art of Computer Programming
3. Think like a programmer: An introduction to creative problem solving
4. Thinking in Systems: A Primer

References:

4. Learning to code: How to think like a programmer
5. How to find innovative ideas: Ramesh Raskar's note
6. Case study: How Tesla changed the auto industry
4. Ultimate Guide: How to develop a new electronic hardware product

Online Resources (Weblinks)

7. https://www.ifixit.com/Teardown?srsltid=AfmBOorwzDG9RhJoL3L5tlZ_Dr4sVce y-vPC-_pkKTj2E0mWJWtFYlikY
8. https://www.symmetryelectronics.com/technology-teardowns/

Assessment (Practical course)
Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by

Expert from Industry	Expert from Higher Education Institutions	Internal Expert

<table>
<tr><td>Dr. Mahesh Veezhinathan
Director - Innovation Practicum
Associate VP - Forge.

Innovation</td><td colspan="2">-</td><td>Dr. Samuel Ratna Kumar P S
Assistant Professor – III
Department Mechanical Engineering</td></tr>
<tr><td>Recommended by BoS on</td><td colspan="3">17.08.2024</td></tr>
<tr><td>Academic Council Approval</td><td>No: 27</td><td>Date</td><td>24.08.2024</td></tr>
</table>

24ADP001	BASICS OF ARTIFICIAL INTELLIGENCE (Common to all Departments except CS, IT, AD)	L	T	P	J	C
		0	0	2	0	1
ES		SDG	8, 9, 16			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	introduce students to the fundamentals of Artificial Intelligence (AI) and Generative AI, and its key concepts
2	enable students to explore and experiment with common generative AI models and tools for generating text, images, audio, video, and code
3	equip students with the techniques and best practices for crafting effective prompts for AI models

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	understand the fundamentals of AI and generative AI, including its potential impact, issues, limitations, and ethical concerns and its practical use cases in real-world scenarios.	U
CO 2	explore common generative AI models and tools for text, code, image, audio, and video generation.	E
CO 3	apply common prompt engineering techniques and approaches for writing effective prompts.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	2						2						

2	2		2										
3					2					2			

Course Content

Introduction to Artificial Intelligence (AI) **Practical Component** Introduction to Artificial Intelligence (AI) - Generative AI Overview and Use Cases - Impact and Examples of AI - Application Domains for AI - Generative AI Applications. AI Concepts, Terminology - Cognitive Computing (Perception, Learning, Reasoning) -	**8 Hours**

Terminology and Related Concepts of AI- Machine Learning Techniques and Training - Deep Learning - Neural Networks - Natural Language Processing, Speech, Computer Vision - Self Driving Cars. AI: Issues, Concerns and Ethical Considerations - AI Ethics, Regulations, Governance, and ESG. The evolution and future of AI - The AI Ladder - The Journey for Adopting AI Successfully - Hotbeds of AI Innovation.	
Generative AI: Introduction and Applications **Practical Component** Introduction and Capabilities of Generative AI - Applications of Generative AI - Tools for Text Generation - Tools for Image Generation - Tools for Audio and Video Generation - Tools for Code Generation	**6 Hours**
Generative AI: Prompt Engineering Basics **Practical Component** Introduction to Prompt and Prompt Engineering - Best Practices for Prompt Creation - Common Prompt Engineering Tools - Hands on Lab: Getting to Know Our AI Prompting - Experimenting with Prompts - Naive Prompting and Persona Pattern. Prompt Engineering Techniques and Approaches - Text-to-Text Prompt Techniques - Interview Pattern Approach - Chain-of-Thought Approach - Tree-of-Thought Approach - Future of Human-Crafted Prompts - Text-to-Image Prompt Techniques - Hands-on Lab: Effective Text Prompts for Image Generation.	**7 Hours**
Project and Wrap Up **Practical Component** Graded Quiz Final Project: Generating Text, Images, and Code.	**9 Hours**

Theory Hours:	**0**	**Tutorial Hours:**	**0**	**Practical Hours:**	**30**	**Project Hours:**	**0**	**Total Hours:**	**30**

Learning Resources

Textbooks:

1. George F. Luger "Artificial Intelligence: Structures and Strategies for Complex Problem Solving" (6th Edition), Pearson, 2021.
2. Anna Jordan, Robert S. Menzies, Kristine P. Schwab, "AI-Powered Creativity: Generative AI and the Future of Content Creation" Routledge, 2023.

References:

1. https://platform.openai.com/docs/overview
2. https://towardsdatascience.com/
3. https://gemini.google.com/

Online Resource (Weblinks)

3. Introduction to Artificial Intelligence (AI) | Coursera
4. Generative AI: Introduction and Applications | Coursera
3. Generative AI: Prompt Engineering Basics | Coursera

Assessment (Practical course)		
MCQ, Mini project and viva-voce		
Course Curated by		
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**
-	-	Dr. S. Sangeetha, Associate Professor

			Department of AI&DS	
Recommended by BoS on	16.08.2024			
Academic Council Approval	No: 27		**Date**	24.08.2024

24HSP111	HOLISTIC WELLNESS-1 (Common to all Department)	L	T	P	J	C
		0	0	2	0	1
HS		SDG	2,3			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	introduce first-year students to the foundational concepts of holistic wellness, emphasizing the integration of physical, mental, emotional, and Internal well-being.
2	create a balanced lifestyle that promotes overall health and happiness through practical activities.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	understand the basic principles of holistic wellness.	U
CO 2	apply strategies for maintaining physical health, including nutrition and exercise	Ap
CO 3	practice mindfulness techniques to enhance mental and emotional well- being.	Ap
CO 4	develop a personal wellness plan incorporating various aspects of holistic health.	C

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	G	10	11		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1						2		1					
2						2							
3						1							

4						2							

Course Content

INTRODUCTION TO HOLISTIC WELLNESS: • Overview of holistic wellness: physical, mental, emotional, and internal health. • The importance of balance in overall well-being.	**4 Hour**

• Hands-on activity: Self-assessment of current wellness status.	
PHYSICAL WELLNESS: • Importance of physical activity and exercise. • Understanding nutrition and its role in health. • Sleep hygiene and its impact on well-being. • Hands-on activity: Designing a personalized fitness and nutrition plan.	**14 Hours**
MENTAL AND EMOTIONAL WELLNESS: • Stress management techniques. • The role of Yoga, mindfulness and meditation in mental health. • Emotional intelligence and its impact on relationships. • Hands-on activity: Practicing Yoga, mindfulness and emotional regulation exercises.	**6 Hours**
INTERNAL WELLNESS: • Exploring the concept of Internal wellness. • The role of purpose and meaning in life. • Introduction to meditation and reflective practices. • Hands-on activity: Developing a personal reflection, Yoga and meditation routine.	**4 Hours**
INTEGRATING WELLNESS PRACTICES: • Combining physical, mental, emotional, and Internal wellness practices into daily life. • Developing a balanced wellness plan. • Hands-on activity: Creating a comprehensive personal wellness plan.	**2 Hours**
Theory 0 Tutorial Hours: 0 Practical Hours: 30 Project Hours: Hours: 0	**Total Hours: 30**

Learning Resources
Textbooks:
1. Jayanna, Krishnamurthy., Science C Practice of Integrative Health C Wellbeing Lifestyle., White Falcon Publishing (2020). 2. Rosenberg, Marshall Bertram., Nonviolent Communication: A Language of Life., Puddle Dancer Press, Encinitas, CA (2015).
References:

1. B.K.S Iyengar., Yoga: The Path to Holistic Health., Dorling Kindersley Limited, City of Publication (2001)
2. Goleman Daniel., Emotional Intelligence., Bloomsbury India, India, (2021).
3. James Allen., As a Man Thinketh., Maple Press, Noida, (2010)
4. Swami Budhanandha., Will power and its development., Advaita Ashrama Mayavati, Pithoragarh, Himalayas from its Publication Department, Calcutta. (2001)
5. Kalderdon Adizes Ichak., What Matters in Life: Lessons I Learned from Opening My Heart ., WS Press, Newtown, PA (2023)

Online Resources (Weblinks)

1. Learning Suryanamskar
2. Yoga for well-being
3. Nutritional Educational contents
4. Introduction to Psychology
5. Guided Meditation
5. Simplified physical exercises instructions
6. Simplified Physical Exercises

Assessment (Practical course)
Participation, Practical activities and assignments, personal wellness plan and reflection.

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert(s)**
			Dr. Ezhilarasi Principal- KCT
Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

24INP101	DESIGN THINKING (Common to all Department)	L	T	P	J	C
		0	0	2	0	1
ES		SDG	9			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	introduces first-year engineering students to Design Thinking, focusing on practical, user-centered problem-solving techniques
2	empathize with users, generate ideas, and create models to test and refine their solutions
3	understand iteration, empathy, and critical reflection to cultivate a creative mindset

Course Outcomes		
After successful completion of this course, the students shall be able to		**Revised Bloom's Taxonomy Levels (RBT)**
CO 1	apply problem-solving techniques and the Design Thinking process to engineering problems using simple models	Ap
CO 2	understand user needs through various empathy techniques and develop/refine models iteratively based on user insights.	U
CO 3	reflect critically on their learning journeys and the emotional demands of problem-solving. Collaborate effectively in teams to develop innovative solutions	Ap

	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											**Program Specific Outcomes (PSO)**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**		
Course Outcomes (CO)	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	1		2			2		2			1		
2	1							2			1		
3	1		2			2		1			1		

Course Content	
Introduction to Problem Solving and Ground Rules Introduction to problem-solving strategies without mentioning Design Thinking-Emphasize problem-solving attitudes, mindsets, and behaviours necessary for iterative problem solving (e.g., openness to failure, patience, empathy)-Set ground rules for the course, including incentives for creative risk-taking and penalties for non-participation or lack of reflection-Overview of the Design Thinking process and its importance.	**6 Hours**
Empathy and Problem Definition	

Techniques for understanding user needs, including observation, interviews, **surveys** and **focus groups-**Importance of secondary research as a complement for the above-mentioned methods-Introduction to empathy cycles: involve students in two empathy cycles before and after problem definition-Finetuning problem definition based on user insights.	**6 Hours**
Ideation and Concept Modelling Brainstorming ideas and selecting feasible solution-Creating concept modelling to visualize ideas-Include an empathy cycle after students propose solutions, allowing them to revisit and reshape their solutions based on further insights from users.	**6 Hours**
Prototyping and Testing with Models Building basic prototypes using simple materials (e.g., cardboard, clay)- Introduction to different prototyping methods (e.g., **low-fidelity** vs **high-fidelity models**) for different contexts: product design, space design, policy, and digital/e-commerce solutions-Conduct an empathy cycle after the prototype is developed to gather user feedback and refine the prototype.	**6 Hours**
Iteration and Final Modelling Project Students refine their prototypes based on feedback from the empathy cycle-Finalize prototypes for presentation based on consistent feedback loops.	**6 Hours**
Presentation, Reflection, and Learning Summaries Students present their final projects and reflect on their learning journeys, including how their understanding of problem-solving and empathy evolved during the course-**Learning Summary Activity:** Each student presents their individual journey and learning outcomes from the empathy cycles and iterations-Peer review and group discussions.	**6 Hours**

Theory Hours:	0	Tutorial Hours:	0	Practical Hours:	30	Project Hours:	0	Total Hours:	30

Learning Resources

Textbooks:

6. Handbook of Design Thinking, Christian Muller – Roterberg, Kindly Direct Publishing
7. The Art of Innovation, Tom Kalley
8. **E Balaguruswamy (2022), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company**

Online Resources (Weblinks)

9. Survey and focus group design guides
10. Guidance on Designing, Administering and Analyzing Focus Groups and Interviews
3. Empathy mapping tools

11. How to Make a Concept Model
12. Brainstorming Techniques: 15 Creative Activities
13. 10 Brainstorming Techniques for Developing New Ideas
14. Brainstorming templates
8. 5 Common Low-Fidelity Prototypes and Their Best Practices

9. UX Prototypes: Low Fidelity vs. High Fidelity

10. Low-fidelity vs. High-fidelity Design Prototypes (and when to use which)
Case study 1: Iterative Design and Prototype Testing of the NN/g Homepage
Case study 2: Using iterative design to optimise the user flow of a product

11. Reflective practice toolkit

Assessment
Formative: Assignments, Mini project

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institutions**	**Internal Expert(s)**	
		Dr. Padhmanand Sudhagar R Department of Bio-Tech Dr. Arul H Department of Physics	
Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

SEMESTER II

24HST102	தம ிழரும ் தமதத ொழ ில ் நுட ்பமும ்/ TAMILS AND TECHNOLOGY	L	T	P	J	C
		1	0	0	0	1
HS		SDG	4, 8			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:

The purpose of taking this course is to:

1	தம ிழரக்ள ின ் மதசவு மற ்ற ும ் மபத ொடனத் தமதத ொழ ில ் ந ுை ைப்பத்னத அற ிமுகப ்படுத்த ுதல ், சங ் க மகத ொல கை ை ட ில ை தமதத ொழில ் ந ுை ை பத ்னத விளக ்குதல ், கமகத ொயில ்கள ் மற ்ற ும ் சிற ்பக்கனலகனள ஆமரத ொய ்தல ். introducing weaving and pottery technology of Tamils -Explaining the building technology of the Sangam Period-Explore temples and sculptures.
2	கப ்பல ், இர ும ்ப ு, ம ம ொணயங ்கள ், மணி ை ர ுமவத ொக ்க ும ் தமதத ொழிற ்மசத ொனலகள ், ஆகியவற்னற விளக ்கம ் தசய்தல், தம ிழகத்த ின ் தமதத ொல ் ல ியல ் மசத ொன ்றுகள ின ் பழனமனய ை ணரத்த ுதல ். explain Ship, Iron, Coins, Beads Making Factories. Realizing the Antiquity of Archaeological Evidence of Tamil Nadu
3	கவமளத ொண ்னம மற ்ற ும ் அற ிவியல ் தம ினழப ் பற ் றி அற ிதல ், இனணயத்த ில ் தம ிழ ின ் கதனவனய ை ணரத ்துதல ் ,தம ிழ ் தமன ்தமபத ொருள ்கனள அற ிமுகம ்தசய ் தல ். knowledge of Agricultural and Scientific Tamil, Realizing the need for Tamil on the Internet, Introducing Tamil software.

Course Outcomes:

After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	தம ிழரக் ள ின ் மதசவு மற ்ற ும ் மபத ொடனத் தமதத ொழ ில ் ந ுை ை பத்தின ் முக ்க ியத்த ுவத்திடன அறிந ்து தமகத ொள ் ளுதல ் . சங ் கமகத ொல தமிழர ் வளரத் ்த அழகுக ் கனலகனளத ் தமதெரிந ்து தமகத ொள ் ளுதல ் . know the importance of weaving and pottery technology of Tamils-To know the Aesthetics arts developed by Sangam Tamils	U

CO 2	கபப்பல் கைடு் மம் கனல, இருமப்பூத் தமதொழிற்மசொனல, ம ம ொணயங்கள் அசச் டித்தல் ,மணி ைரூமவொகக்கூமம் தமதொழிற்மசொனலகள், சிலபப்பதிமகொரத்தில் ைளள மணிகளின் வனகனய அறிதல். knowledge of ship building, ironworks, coinage, minting, and beads making factories,Knowing the types of beads in Silapathikaram.	U
CO 3	கவமளொண்னம மறறும் ம ரப் மபொடச தமதொழில்நுைபதனத அறிநது தமகொளளல். அறிவியல் தமிழ் மறறூமம் கணிட ித் தமினழப் மபுரிந்து தமகொளளூதல். know agriculture and irrigation technology. Understanding Scientific Tamil and Computer Tamil.	Ap

	Program Outcomes (PO) **(Strong-3, Medium – 2, Weak-1)**	

	1	2	3	4	5	6	7	8	9	10	11	Program Specific Outcomes (PSO)	
Course Outcomes (CO)	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	2		2				3	2	2		2		
2	2		2				3	2	2		2		
3	2		2				3	2	2		2		

Course Content

மதசவு மற்ும் மபொறனத் தமதொழில்நூட்பம்: சங்க மகொலத்தில் மதசவூத் தமதொழில் - மபொடனத் தமதொழில்நுைப்பம் - கருப்பு சிவப்பு மபொண் ைங்கள் - மபொண் ைங்களில் கீறல் குறிPடூகள். Weaving Industry during Sangam Age - Ceramic technology - Black and Red Ware Potteries (BRW)-Graffiti on Potteries.	**3 Hours**
வடிவனமப்பு மற்ும் கடடி் டத் தமதொழில்நுட்பம்: சங்க மகொலத்திலை வடிவனமப்பு மற்றூம் கைட்டூமமொட ஙகள் ரூ சங்க மகொலத்தில் வீைட்டூப் தமபொரூைகளில் வடிவனமப்பு - சங்க மகொலத்தில் கைட்டூமமொட தமபொரூைகளூம் ம டூகல்லூம் -சிலப்பதிமகொரத்தில் கமனை அனமப்பு பற்றிய விவரங்கள் - மமொமல்லபுரச் சிறப்பங்களூம், கமகொவில்களூம் - கமசொழர் மகொலத்தூப் தபருங்கமகொயில்கள் மற்றும் பி வழிமபொைடூதத் தலங்கள் - ம மொயக்கர் மகொலக் கமகொயில்கள் - மமொமதிரிகைக்ைனமப்புகள் பற்றி அறிதல், மதூனர மீ ட ம ொைைசி அம்மன் ஆலயம் மற்றூம் திருமனல மம ொயக்கர் மமொல் - தசைட்டிமமொைடு வீடுகள் - மபிரிைட்டிஷ் மகொலத்தில் தசன்டனயில் இந்கமதொ-மசொகமரொதடசிக் கைடிைக் கனல. Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.	**3 Hours**

<table>
<tr>
<td>
உற்பத்திதத் தமதெொழில் நுடட்பம்:

கபப்பல் கடை்டும் கனல - ைகமலதெொகவியல் - இரும்புத் தமதெொழிற்மசனல - இரும்மனப ைருக்குதல், எஃகு -

வரமலதெொற்றுச் மசனெ்றுகமளதெொக தசம்பு மற்றும் தங்க ம மதெொணயங்கள் - ம மதெொணயங்கள் அசச் டித்தல் - மணி

ைரும்மவதெொகக்கும் தமதெொழிற்மசனலகள் - கல் மணிகள், கண் மணதெொடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் -எலும்புத்துண் டுகள் -தமதெொல்லியல் மசனெ்றுகள் - சிலப்பதிமகதெொரத்தில் மணிகளின் வனககள்.

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel-Copper and gold- Coins as source of history - Minting of Coins - Beads
</td>
<td>3 Hours</td>
</tr>
</table>

making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidence - Gem stone types described in Silappathikaram.	
கவமளணொண் னம மற்றும் மாாரப்மபறொசத் தமதொழில் நுட்பம்: அனண, மஏொி, குளஙக்ளக், மதகு - கமசொழரமகொலக் கூமுழித்தூம்பின் முக்கியதத்துவம் - மகொல் ம னை பமரொமமொிபப்பு - மகொல்ம னைகளுக்மகொக வடிவனமக்கப்பை்ை கிணறுகள் - கவமளணொண் னம மற்றும் கவமளணொண் னமச் மசொரந்்த தசயல் மபொடுகள் - கைல் மசொர் அறிவு - மீ ன்வளம் - முத்து மறற்ும் முத்துக்கூளித்தல் - தபருஙக்ைல் குறித்த பண் னைய அறிவு - அறிவுமசொர்சமூகம். Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries - Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.	**3 Hours**
அறிவியல் தமிழ் மற்றூம் கணித்தமிழ்: அறிவியல் தமிழின் வளரச் சி - கணித்தமிழ் வளரச் சி - தமிழ் நூல்கனள மின் பதிப்பு தசய்தல் - தமிழ் தமன்தமபொருைக்ள் ைருமவொக்கம் - தமிழ் இனணயக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இனணயத்தில் தமிழ் அகமரொதிகள்- தமசொறக்ூனவத் திை்ைம். Development of Scientific Tamil - Tamil computing- Digitalization of Tamil Books-Development of Tamil Software - Tamil Virtual Academy - Tamil Digital Library - Online Tamil Dictionaries - Sorkuvai Project.	**3 Hours**

Theory Hours:	**15**	**Tutorial Hours:**	**0**	**Practical Hours:**	**0**	**Project Hours:**	**0**	**Total Hours:**	**15**

Reference books

1. தமிழக வரலாறு மக்களும் பண்பாடும் கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு).
4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL- (in print)
6. Social Life of the Tamils the Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tarnils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Textbook and Educational Services Corporation> Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation> Tamil Nadu) 12. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) - Reference Book.
Online Resources
13. https://www.youtube.com/watch?v=Gp1ratX2sOE&list=PLtyn2o7hocf40PtPibRqJTf_dQL3eOtLl 14. https://www.youtube.com/watch?v=jteRvnNiD6w

Assessment (Theory course)
CAT, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), Assignments, Quiz, Library Record

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	-	
Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

24HST103	EFFECTIVE COMMUNICATION	L	T	P	J	C
		2	0	0	0	2
HS		SDG	4, 8			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:

The purpose of taking this course is to

1	enhance students' abilities to communicate ideas effectively, both orally and in writing, by developing skills in organizing thoughts clearly and logically and expressing them through well-structured paragraphs and concise summaries.
2	enable students to critically evaluate and synthesize information from multiple sources and utilize suitable writing techniques and formats to produce professional-quality content tailored to various contexts.
3	foster active listening, critical reading, and reflective thinking, empowering students to create engaging, relevant, and informative content by applying effective communication strategies across diverse platforms.

Course Outcomes

After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO1	demonstrate proficiency in delivering ideas effectively, both in speaking and writing, with a deeper understanding of the content and the ability to convey complex ideas through well-structured paragraphs and summaries.	Ap
CO2	create and present original content by evaluating information from multiple sources and employing appropriate formats and writing strategies across various professional contexts.	C
CO3	produce engaging and informative content through active listening, reading, reflection, and effective communication skills.	E

Course	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)										Program Specific Outcomes (PSO)
	1	2	3	4	5	6	7	8	9	10	11

	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1							2	2	3		3		
2							2	2	3		3		
3							2	2	3		3		

Course Content

Text Analysis	

Composition of Coherent Paragraphs (Expository, Descriptive, Narrative, Evaluative) - Loud Reading (Reading Extracts will be given were students identify the main idea of paragraphs or sections and debrief)	**6 Hours**
Visual & Written Analysis Process writing (Drafting effective introduction, process and conclusion using appropriate transition words and phrases) - Describing Visuals (Line graph, Bar Chart, Flow Chart, Pie Chart, Table, Tree diagram) - Note Making & Summarizing	**6 Hours**
Professional Correspondence Crafting Professional Emails - Writing Instruction for Manuals - Reading technical documents (Reading extracts will be given to construct sentences from the new words found in the document)	**6 Hours**
Research and Documentation Library Reading (Identify at least three sources and extract information, Summarize the main ideas and key findings from each source, compile them findings into a brief report that includes the main points, sources, and relevance to the topic)- Report Writing (Title Page, Abstract, Introduction, Methodology, Results, Discussion, Conclusion and recommendation)	**6 Hours**
Talk Analysis and Podcast Skills Listening to and analyzing TED talks – Preparing Podcast-PRISM (Professional Rhetoric Improvement and Speech Mastery) to share facts, opinions and experiences - Writing Reviews on products.	**6 Hours**

Theory Hours:	30	Tutorial Hours:	0	Practical Hours:	0	Project Hours:	0	Total Hours:	30

Learning Resources

References:

1. Swamy, V. R. Narayana. Strengthen Your Writing. Orient Longman, 2003.
2. Sasikumar, V., and P. V. Dhamija. Spoken English: A Self-Learning Guide to Conversation Practice. Tata McGraw Hill, New Delhi (1993).
3. Maison, Margaret M. Examine Your English. Orient Longman, 1999.
4. Rizwi, Ashraf. Effective Technical Communication. Tata McGraw Hill, 2005.
5. Pickett, Nell Ann, and Ann A. Laster. Technical English: Writing, Reading, and Speaking.
6. Harpercollins College Div, 1993.

Online Resources (Weblinks)

6. https://owl.purdue.edu/owl/general_writing/academic_writing/paragraphs_and_paragraphing/ind ex.html
7. https://learnenglish.britishcouncil.org/skills/writing/upper-intermediate b2/describing-trends
8. https://hbr.org/2016/07/how-to-write-email-with-military-precision
4. https://owl.purdue.edu/owl/subject_specific_writing/professional_technical_writing/reports and_memos/index.html

Assessment (Theory course)
CAT, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE)

Course Curated by

<table>
<tr><th>Expert from Industry</th><th colspan="2">Expert(s) from Higher Education Institution</th><th colspan="2">Internal Expert(s)</th></tr>
<tr><td>Mr.Vijayan Ramanathan ,
Project manager,
Toppan Merrill. Technologies, Coimbatore</td><td colspan="2">Dr. Aninditha Sahoo,
IIT, Madras
Dr.P.R.Sujatha Priyadharshini,
Anna University, Chennai
Dr. E. Justin Ruben,
CIT, Coimbatore</td><td colspan="2">Dr. Arokia Lawrence Vijay
Dr. Sreejana
Dr. Tissaa
Department of English</td></tr>
<tr><td>Recommended by BoS on</td><td colspan="4">16.08.2024</td></tr>
<tr><td>Academic Council Approval</td><td>No:27</td><td colspan="2">Date</td><td>24.08.2024</td></tr>
</table>

24HST104	PROFESSIONAL COMMUNICATION (Common to all Departments)	L	T	P	J	C
		2	0	0	0	2
HS		SDG	4, 8			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to	
1	develop students' abilities to craft clear, concise, and well-structured technical content and professional communications
2	enhance students' communication skills in team settings
3	equip students with cross-cultural communication skills and effective listening techniques

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO1	demonstrate proficiency in crafting clear, concise, and well-structured technical content and professional communications, including emails that meet industry standards.	Ap
CO2	communicate effectively in team settings, showcasing collaboration, conflict resolution, and leadership skills, while employing creative writing techniques to convey complex ideas.	An
CO3	apply principles of cross-cultural communication and effective listening techniques to engage successfully in diverse, globalized professional environments.	Ap

	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11		
Course Outcomes (CO)	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1						2	1	3	1		3		

2						2	3	3	2		3		
3						1	1	3	1		3		

Course Content

Mastering Professional Communication Industry-specific terminology (Business / Technical Register) - Crafting professional emails - Essential elements of an effective email (subject line, salutation, body, closing) - reading and responding to email communication – Networking Emails - Analyzing and interpreting technical texts (Loud Reading).	**6 Hours**
Navigating Digital Media	

Introduction to Digital media and online communication tools (instant messaging, video conferencing, social media, blogs, forums) - Listening and analyzing advanced audio materials - Creative & Blog Writing (General & Technical).	**6 Hours**
Technical Writing Techniques Writing Reflective Essays / Experience Sharing, Process writing, Transcoding graphics (interpreting technical texts), Writing Reviews (Research Articles & Books).	**6 Hours**
Building a Professional Digital Presence Creating Digital Profile - Overview of different digital platforms (LinkedIn, GitHub, personal websites) - Setting Up a LinkedIn Profile – Crafting a Video Resume – Digital Etiquette and Professionalism - Cross-cultural communication and diversity awareness.	**6 Hours**
Social Responsibility in Practice Environmental and social responsibilities - Case studies and real-world applications - Project Work - Writing Project reports.	**6 Hours**

Theory Hours:	**30**	**Tutorial Hours:**	**0**	**Practical Hours:**	**0**	**Project Hours:**	**0**	**Total Hours:**	**30**

Learning Resources

Reference books

1. Baker, W., & Ishikawa, T. Transcultural Communication Through Global Englishes: An Advanced Textbook for Students. Routledge, 2021.
2. Bodnar, O., Fedak, S., Hinsirovska, I., Denysiuk, N., Perenchuk, O., Plavutska, I., ... & Shchur, N. English for Study and Work: A Coursebook In-class Activities. 2017.
3. Doff, A., Thaine, C., Puchta, H., Stranks, J., & Lewis-Jones, P. Cambridge English Empower Advanced Student's Book. Cambridge University Press, 2016.
4. Hewings, M., Thaine, C., & McCarthy, M. Cambridge Academic English C1 Advanced Student's Book: An Integrated Skills Course for EAP. Cambridge University Press, 2012.
5. Beer, D. F., & McMurrey, D. A. A Guide to Writing as an Engineer. John Wiley & Sons, 2019.

Online Resources (Web Links)

6. https://hbr.org/2016/07/how-to-write-email-with-military-precision
7. https://ocw.mit.edu/courses/comparative-media-studies-writing/21w-732-scientific-and- technical-communication-spring-2015/
8. https://www.coursera.org/learn/digital-media
9. https://owl.purdue.edu/owl/subject_specific_writing/professional_technical_writing/reports_an d_memos/index.html

Assessment (Theory course)
CAT, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE)

Course Curated by		
Expert from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**
Mr.Vijayan Ramanathan , Project manager, Toppan Merrill. Technologies, Coimbatore	Dr. Aninditha Sahoo, IIT, Madras Dr.P.R.Sujatha Priyadharshini, Anna University, Chennai Dr. E. Justin Ruben,	Dr. Arokia Lawrence Vijay Dr. Hema Department of English

	CIT, Coimbatore		
Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

24HSJ102	FLUENCY THROUGH PRACTICE (Common to all Programmes)	L	T	P	J	C
		0	0	0	4	2
HS		SDG	4, 9, 12			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	develop professional communication skills, including technical writing, public speaking, and collaborative discourse.
2	foster creativity and critical thinking by producing real-world academic and professional outputs such as book chapters, journal articles, and intellectual property.
3	instil awareness of global and ethical communication practices, contributing to sustainability and social impact.
4	enhance students' language fluency through project-based learning relevant to engineering

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO1	analyse and apply effective communication techniques in professional contexts.	An
CO2	collaborate in teams to design and execute language-based projects with real-world applications.	Ap
CO3	develop critical thinking and problem-solving skills through research, analysis, and presentation of technical content.	An
CO4	produce publishable-quality written and spoken outputs, such as book chapters, journal articles, and copyrighted content.	C

	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)
	1	2	3	4	5	6	7	8	9	10	11	

Course Outcomes (CO)	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1		2	2	1			3	2	2	1	2		
2		3	2	1			3	2	2	1	2		
3		2	2	2			3	2	2	1	2		
4		3	1	1			3	2	2	1	1		

Course Content	
1. Introduction to Activity Based Learning 2. Research and Initial Project Planning 3. Technical Writing and Documentation 4. Creative Writing 5. Drafting and Editing Techniques 6. Teamwork and Peer Collaboration 7. Public Speaking and Presentation Skills 8. Challenges to Opportunities 9. Cross-Cultural Communication and Global Ethics Intellectual Property and Copyrighting Publication – English for research Writing Digital Communication & Social Responsibility	**60 Hours**

Theory Hours:	**0**	**Tutorial Hours:**	**0**	**Practical Hours:**	**0**	**Project Hours:**	**60**	**Total Hours:**	**60**

Learning Resources

Reference books

10. Mahesh Kumar, Dr.Soma. Soft Skills: Enhancing Personal and Professional Success, McGraw Hill,2023.
11. Maxwell, John C. Developing the leader within you, Harper Collins, 2018.
12. Ansarian, Loughman, and Teoh, Mei Lin. Problem-based Language Learning and Teaching: An Innovative Approach to Learn a New Language. Singapore, Springer Nature Singapore, 2018.
13. Savin Baden, M., Major, C. H. (2004). Foundations of Problem Based Learning. United Kingdom: McGraw-Hill Companies, Incorporated.

Online Resources (Weblinks)

14. https://www.sciencedirect.com/science/article/pii/S2590291123002735
15. https://www.cal.org/adultesl/pdfs/problem-based-learning-and-adult-english-language-learners.pdf
16. https://www.apu.ac.jp/rcaps/uploads/fckeditor/publications/polyglossia/Polyglossia_V16_Ng.pdf

Course Curated by

Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**
Mr.Vijayan Ramanathan , Project Manager, Toppan Merrill. Technologies, Coimbatore	Dr. Aninditha Sahoo, IIT, Madras Dr.P.R.Sujatha Priyadharshini, Anna University Chennai Dr. E. Justin Ruben, CIT, Coimbatore	Dr. Arokia Lawrence Vijay Dr. SG Mohanraj Department of English

Recommended by BoS on	16.08.2024		
Academic Council Approval	No:27	**Date**	24.08.2024

24MET106	BASICS OF MECHANICAL ENGINEERING (Common to TT and FT)	L	T	P	J	C
		3	0	0	0	3
BS		SDG	8,G			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	provide students with foundational knowledge in key areas of Mechanical Engineering, which is essential for understanding and applying mechanical principles across various engineering fields.
2	apply principles in practical scenarios and Analyzing systems like engines, refrigeration units, and mechanical forces to solve real-world engineering problems.
3	develop problem-solving skills and learn to apply mechanical concepts to design, analyze, and optimize engineering systems.
4	equips them with the knowledge to understand how mechanical systems operate and lays the groundwork for more advanced courses and professional work in industries like manufacturing, energy, and automation.
5	understanding the basics of mechanical systems and processes, students are better prepared for internships, industrial projects, and professional careers.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO1	apply the fundamental concepts in developing various mechanisms	Ap
CO2	analyze the laws of thermodynamics to solve problems related to energy transfer and evaluate the performance of thermodynamic processes.	An
CO3	demonstrate the working principles of IC engines, VCR C VAR systems.	Ap
CO4	evaluate the various manufacturing processes to select the appropriate technique for producing textile-related components.	An
CO5	design power transmission systems by integrating suitable drives and gears to ensure optimal mechanical performance	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	G	10	11		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2

1	2	3	2										
2	2			2									
3	2		1										
4		2			3								
5	2		3										

Course Content

BASICS OF MECHANISMS Terminology and definitions- degree of freedom-Kutzbach criterion-Grashoff's law- Kinematic inversions of 4-bar chain and slider crank chains-Description of common mechanisms-single,double and offset slider mechanisms- Quick return mechanisms	**G Hours**
LAWS OF THERMODYNAMICS First law of thermodynamics – statement and application, steady flow of energy equation, Second law of thermodynamics. Heating and Expansion of Gases, Expression for work done, internal energy, hyperbolic and polytropic processes. Properties of Steam, Dryness fraction, latent heat, total heat of wet steam.	**G Hours**
INTERNAL COMBUSTION ENGINES Classification of IC engines, Main components of IC engines, working of a 4 stroke and 2 stroke petrol and diesel engine, differences between 4 stroke and 2 stroke engines. Refrigeration and Air Conditioning: principle of vapour compression and vapour absorption refrigeration systems. Air conditioning, terminology and classifications. Humidification and Air conditioning	**G Hours**
MANUFACTURING PROCESSES Basic principles of Arc and Gas Welding, Soldering and Brazing, Extrusion, Forging, Rolling, and Drawing Processes. Milling – Types, Operations and Equipment's	**G Hours**
POWER TRANSMISSION Types of drives, belt drives – flat and V belts, rope drives, chain drive, gear drives – spur, helical, bevel and worm gears (Descriptive treatment only) – gear trains, simple and compound.	**G Hours**

Theory Hours:	**45**	**Tutorial Hours:**	**0**	**Practical Hours:**	**0**	**Project Hours:**	**0**	**Total Hours:**	**45**

Learning Resources

Textbooks:

3. Venugopal. K. and Prabu Raja, "Basic Mechanical Engineering", Anuradha Publications, Chennai, 2011.
4. A Textbook of Engineering Thermodynamics. PK Nag. Tata McGraw-Hill Education, 2017.

References:
6. Rao N., “Manufacturing Technology: Foundry, Forming and Welding”, Tata McGraw Hill Co., New Delhi, Paperback Edition. 2019 James Brown, “Advanced Machining Technology Handbook”, McGraw Hill, New York,2019. 7. Rattan S.S, “Theory of machines”, Tata MC Graw-Hill publishing company Ltd., New Delhi, 2019.

1. Shigley J.E and Uicker J.J. “Theory of machines and mechanisms”, McGraw- Hill, Inc. 2017.
2. Shanmugam G, Palanichamy M S, “Basic Civil and Mechanical Engineering”, Tata McGraw Hill Company, New Delhi, 2nd Edition, 2018.
10. Pravin Kumar - Basic Mechanical Engineering -Pearson Education 2017.

Online Resources (Weblinks)

3. https://archive.nptel.ac.in/courses/112/107/112107144/
4. https://onlinecourses.nptel.ac.in/noc22_me28/preview
3. https://archive.nptel.ac.in/courses/112/105/112105123/

Assessment (Theory course)
CAT, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE)

Course Curated by

Expert from Industry	Expert from Higher Education Institution		Internal Expert
Mr. Fazil, Lead Engineer, CAE Optimization, Ford Motors Private Limited, Chennai 600096.	Dr. M.Balasubramanian, Assistant Professor Department of Mechanical Engineering, Anna University Regional Campus Coimbatore – 641 046		Mr. P.Pradeep, Assistant Professor – II, Department of Mechanical Engineering,
Recommended by BoS on	17.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

24TTT101	INTRODUCTION TO TEXTILES	L	T	P	J	C
		1	0	0	0	1
PC		SDG	12			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	introduce students to textiles they encounter daily and break down their components.
2	explore the creation of yarns and fabrics from fibers and their everyday applications.
3	introduce textile coloration and finishing techniques that enhance the properties of fabrics in everyday products.
4	break down the apparel manufacturing process and quality considerations.
5	introduce students to technical textiles and their specialized applications in various industries.

Course Outcomes		
After successful completion of this course, the students shall be able to		**Revised Bloom's Taxonomy Levels (RBT)**
CO 1	analyze everyday textile products by identifying their fiber composition, fabric structure, and finishing techniques through reverse engineering.	A
CO 2	demonstrate an understanding of textile formation (spinning, weaving, coloration, and garmenting) processes, and their application in creating common textile products.	An
CO 3	explain the role and significance of technical textiles in various industries and evaluate their specialized functions in enhancing product performance.	An

Course Outcome	**Program Outcomes (PO)** (Strong-3, Medium – 2, Weak-1)											**Program Specific Outcomes (PSO)**
	1	2	3	4	5	6	7	8	G	10	11	

	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	2					2				1		1	
2	2			1						1			2
3	2		1							1		1	

Course Content

UNDERSTANDING EVERYDAY TEXTILES	3 Hours

• Introduction to Textiles in Daily Life: Fabrics in clothing, home textiles (e.g., bedsheets, curtains), accessories (e.g., bags). • Materials and Fibers: Overview of natural (cotton, wool) vs. synthetic (polyester, nylon) fibers. • Reverse Engineering Task: Students will bring an item of clothing or home textile and analyze its composition. • Correlating with Personal Experience: Discussions on why certain fabrics are used in different products (e.g., comfort, durability).	
YARN AND FABRIC FORMATION • Yarn Types and Properties: Spun vs. filament yarns; importance of yarn count and twist. • Basic Fabric Structures: Woven, knitted, and non-woven fabrics. • Reverse Engineering Task: Students will examine the structure of a fabric they own (e.g., T-shirt, jeans) to identify its weave/knit pattern. • Correlating with Usage: Discuss the role of fabric structure in functionality (e.g., strength in jeans, stretch in T-shirts).	**3 Hours**
TEXTILE COLORATION AND TREATMENTS • **Introduction**: Pre-treatment, dyeing, printing, finishing • **Reverse Engineering Task**: Students will investigate how dyeing processes affect an item they own (e.g., dyed fabrics, printed fabrics). • **Correlating with Experience**: Discuss why certain dyes are applied to specific textiles (e.g., Vat dyes, Disperse dyes)	**3 Hours**
APPAREL MANUFACTURING AND QUALITY CONTROL • **Introduction to Apparel Manufacturing**: From fabric to finished product (cutting, sewing, assembly). • **Quality Control Measures**: Inspection techniques, comfort and fit tests, durability tests. • **Reverse Engineering Task**: Students will trace the steps involved in making a garment they wear, from fabric to final stitching. • **Correlating with Day-to-Day Use**: Understanding how quality control affects the durability and comfort of clothing.	**3 Hours**
TECHNICAL TEXTILES • **Introduction and classification -** Protective textiles, medical textiles, geotextiles, automotive textiles, sports textiles, and more. • **Reverse Engineering Task**: Students will examine an example of a technical textile product and identify its specific requirements (e.g., sportswear - moisture-wicking, medical bandages - antimicrobial, etc). • **Correlating with Real-World Use**: Discuss the functional role of technical textiles in enhancing performance, safety, and durability in specific applications.	**3 Hours**

Theory 15	Tutorial Hours: 0	Practical Hours: 0	Project Hours: 0	Total Hours: 15

Learning Resources
Textbooks:
1. Murthy, H.S., 2016. Introduction to textile fibres. CRC Press. 2. Kozłowski, R.M. and Mackiewicz-Talarczyk, M., 2020. Introduction to natural textile fibres. In Handbook of natural fibres (pp. 1-13). Woodhead Publishing. 3. Burns, E.J., 2004. Introduction: Why Textiles make a difference. In Medieval Fabrications: dress, textiles, clothwork, and other cultural imaginings (pp. 1-18). New York: Palgrave Macmillan US. 4. Mahadevan, M.G., 2005. Textile Spinning, Weaving C Designing. Abhishek Publications. 5. Hamdani, S.T.A., 2017. Introduction to weaving. In Structural Textile Design (pp. 31-46). CRC Press. 6. Wardman, R.H., 2017. An introduction to textile coloration: principles and practice. John Wiley C Sons. 7. Broadbent, A.D., 2001. Basic Principles of Textile Coloration. Society of Dyers and Colorists.
References:
1. Shishoo, R., 2015. Introduction to textiles in sport. In Textiles for sportswear (pp. 3-16). Woodhead Publishing. 2. Shishoo, R., 2012. Introduction: trends in the global textile industry. In The global textile and clothing industry (pp. 1-7). Woodhead Publishing.
Online Resources (Weblinks)
7. https://www.textileschool.com/119/textile-an-introduction/#google_vignette 8. https://www.britannica.com/topic/textile 9. https://gphisar.ac.in/wp-content/uploads/2022/09/TEXTILE-FUNDAMENTALS.pdf 4. https://sj-mqt.org/makerspace-blog/introduction-to-textiles

Assessment (Theory course)
CAT, Activity and Learning Task(s), MCQ

Course Curated by		
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert**
M. Balaji General Manager, Poppy's Tiruppur	Dr. M. Senthil Kumar Associate Professor PSG College of Technology	Dr Saminathan R, Department of Textile
Recommended by BoS on	14.08.2024	

Academic Council Approval	No.27	**Date**	24.09.2024

24MAI122	ADVANCED COMPUTATIONAL CALCULUS	L	T	P	J	C
		3	0	2	0	4
BS	(Common to BT, FT, TT)	SDG	3, 9, 12			

Pre-requisite courses	-	Data Book / Codes books (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	apply Taylor's series expansion to approximate functions of two variables and use Lagrange's method of undetermined multipliers for optimizing such functions.
2	develop proficiency in solving higher-order linear differential equations with constant coefficients using numerical techniques such as Taylor's series and Runge-Kutta methods.
3	set up and evaluate double and triple integrals in cartesian coordinates for calculating areas and volumes of various two- and three-dimensionl regions.
4	attain expertise in using numerical methods such as Trapezoidal and Simpson's rules to evaluate double and triple integrals for areas and volumes when analytical solutions are difficult.
5	examine and apply Laplace transforms to solve differential Equations to represent dynamic systems across different engineering fields.

Course Outcomes		
After successful completion of this course, the students shall be able to		**Revised Bloom's Taxonomy Levels (RBT)**
CO 1	apply Taylor's series expansion to approximate stress distribution in textile materials under varying load conditions.	Ap
CO 2	use Lagrange's method to optimize dyeing processes in fashion industry to minimize cost while meeting color consistency constraints.	Ap
CO 3	apply Runge-Kutta methods to model and predict the growth rates of microbial populations in biotechnology applications.	Ap
CO 4	use Euler's method to solve heat conduction problems in textile manufacturing processes for better thermal management.	Ap
CO 5	evaluate the volume of fabric needed for complex garment patterns using triple integrals to ensure accurate material estimation.	E
CO 6	solve differential equations for the response of biosensors to varying stimuli using Laplace transforms to improve sensor design.	Ap

	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)	**Program Specific**

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Outcomes (PSO)**	
Course Outcomes (CO)	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	3	3	2	1	2	1	1	2					

2	2	3	3	1	2	2	1	2					
3	2	3	2	3	2	1	1	2					
4	2	3	2	2	2	1	1	2					
5	2	2	3	1	2	1	1	2					
6	2	3	2	3	3	2	1	2					

Course Content	
FUNCTIONS OF SEVERAL VARIABLES Total derivatives – Differentiation of composite functions – Taylor's series expansion – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers **Practical Component** • Taylor's series expansion of function of two variables. • Maxima and Minima of a function of two variables.	**9 Hours** **6 Hours**
HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS Linear equations of second and higher order with constant coefficients – Rules and Problems for finding the particular integral – Initial value problems - Single step methods: Taylor's series method – Truncation error – Euler and Improved Euler methods • Fourth order Runge–Kutta method **Practical Component** • Solution of second order ordinary differential equations by Euler and improved Euler method. • Solution of second order ordinary differential equations by Runge Kutta method of 4th order.	**9 Hours** **6 Hours**
MULTIPLE INTEGRALS Double integration in Cartesian coordinates – Area as double integrals-Triple integration in Cartesian coordinates – Volume as triple integrals – Numerical double integration – Trapezoidal rule – Simpson's rule. **Practical Component** • Area and volume using multiple integrals. • Numerical double integration by Trapezoidal and Simpson's rule	**9 Hours** **6 Hours**
LAPLACE TRANSFORMS Definition - Properties: Superposition, Shift in t or Time Delay, Shift in s, Time Derivatives, Time Integral- Initial Value Theorem - Final Value Theorem. **Practical Component** • Solution of transcendental functions using Laplace transforms.	**9 Hours**

• Heaviside functions	**6 Hours**
INVERSE LAPLACE TRANSFORMS Definition - Properties -Inverse transforms using convolution method and partial fractions method -Solution of linear ordinary differential equations of second order with constant coefficients. **Practical Component** • Inverse Laplace Transforms. • Solution of differential equations using inverse Laplace transform.	**9 Hours** **6 Hours**

Theory Hours:	**45**	**Tutorial Hours:**	**0**	**Practical Hours:**	**30**	**Project Hours:**	**0**	**Total Hours:**	**75**

Learning Resources

Textbooks
1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 44th Edition, 2014. 2. Ramana B.V., “Higher Engineering Mathematics”, Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010. 3. Sastry S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015. 4. Grewal B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science, Khanna Publishers, 10th Edition, New Delhi, 2015.
Reference books
4. Veerarajan T., “Engineering Mathematics (for First Year)”, Tata McGraw Hill Pub. Co. Ltd., New Delhi, Third Edition, 2011. 5. Kandasamy P., Thilagavathy K., and Gunavathy K., “Engineering Mathematics”, S. Chand & Co., New Delhi, (Reprint) 2014. 3. Kandasamy P., Thilagavathy K. and Gunavathy K., “Numerical Methods”, S. Chand Co. Ltd., New Delhi, 2007.
Online Resources (Weblinks)
1. https://www.khanacademy.org/math/integral-calculus

Assessment
CAT, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert(s)**
Mr. Ramesh V.S., STEPS Knowledge Services Private Limited, Coimbatore. Mr. Jayakumar Venkatesan, Valles Marineris International Private Limited- Chennai. Mr. Imran Khan, GE Transportation Company, Bangalore.	Dr. T. Govindan, Government College of Engineering, Srirangam, Trichy. Dr. C. Porkodi, PSG College of Technology, Coimbatore. Dr. P. Paramanathan, Amrita Vishwa Vidyapeetham, Coimbatore.		Dr. R.Maruthachalam Dr.S.Sathiyapriya Ms. S.Arunadevi Department of Mathematics
Recommended by BoS on	16.08.2024		
Academic Council Approval	27	**Date**	24.08.2024

24PHI103	**APPLIED PHYSICS FOR TEXTILE TECHNOLOGY**	**L**	**T**	**P**	**J**	**C**
		3	**0**	**2**	**0**	**4**
BS	**(Common to TT & FT)**	**SDG**	**7, 9**			

Pre-requisite courses	**High School Education**	**Data Book / Code book (If any)**	-

Course Objectives:	
The purpose of taking this course is to:	
1	introduce fundamental principles of light-matter interaction, quantum mechanics, and heat transfer, emphasizing their applications in laser technology, energy systems, and material science.
2	provide hands-on experience through experiments related to laser optics, quantum mechanics, and energy efficiency, reinforcing theoretical concepts with practical applications.
3	develop analytical skills in evaluating and solving problems in green energy, dielectric materials, and nanomaterials using advanced experimental techniques.

Course Outcomes		
After successful completion of this course, the students shall be able to		**Revised Bloom's Taxonomy Levels (RBT)**
CO 1	apply principles of light-matter interaction and laser technology to solve problems in laser systems, such as imaging gyroscopes and material characterization.	Ap
CO 2	analyse and Interpret quantum concepts like wave-particle duality, Schrödinger's equation, and quantum tunnelling, and demonstrate their applications through experiments like determining Planck's constant.	An
CO 3	evaluate the performance of green energy systems, such as solar cells and wind devices, and measure solar cell efficiency experimentally.	E
u CO 4	analyse the properties and preparation of dielectric and nanomaterials, and apply this knowledge in experiments to determine band gaps and magnetic susceptibility	An
CO 5	apply by investigate principles related to heat transfer, thermal expansion, and plasma characteristics, in experiments to determine the thermal conductivity of poor conductors.	Ap
CO 6	analyse and draw results by performing hands-on application of skills in experiments (data analysis, and result interpretation) in quantum mechanics, laser optics, and material properties, reinforcing theory through lab practice.	An

Co	**Program Outcomes (PO)** **(Strong-3, Medium – 2, Weak-1)**	**Program Specific**

	1	2	3	4	5	6	7	8	9	10	11	Outcomes (PSO)

	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	3	2											
2	3												
3	3										2		
4	3										2		
5	3	2											
6	3	2											

Course Content

APPLIED OPTICS

Interaction of light and matter - Quantization of electromagnetic radiation – Absorption, Spontaneous emission and Stimulated emission - Einstein's theory of stimulated emission- Population inversion - Sources of excitation - Active medium -Laser beam output- Nd-YAG laser - CO_2 laser - Applications – Laser Imaging and Holography- Laser gyroscopes

9 Hours

Practical Component

Semiconductor laser:

a. Determination of wavelength of laser
b. Determination acceptance angle and numerical aperture of an optical fibre.
c. Determination of particle size

Spectrometer – Determination of wavelength of mercury source using grating

6 Hours

QUANTUM PHYSICS

Necessity of quantum mechanical picture- Planck’s concept (hypothesis) - Wave-particle duality - de-Broglie waves - Physical significance of wave function - Schrodinger equation- Time independent and time dependent equation - Particle in a box- Eigen values and Eigen function-

Superposition Principle- Quantum mechanical tunnelling through a barrier.

9 Hours

Practical Component

Determination of Planck’s constant – Electroluminescence method.

4 Hours

Compound pendulum – Determination of acceleration due to gravity	
GREEN ENERGY Introduction to Green energy – Solar energy: Energy conversion by photovoltaic principle – Solar cells – Efficiency measurements – Types (First, Second and Third Generation) of Solar Cells - Wind energy: Basic components and principle of wind energy conversion systems – Ocean energy: Wave energy – Wave energy conversion devices. Futuristic Energy: Hydrogen – Methane Hydrates – Carbon capture and storage (CCS).	**9 Hours** **6 Hours**

Practical Component Determination of efficiency of solar cell	
DIELECTRIC AND NANO MATERIALS: Basic definitions -Electronic, ionic, orientation and space charge polarization - Frequency and temperature dependence of polarization – Dielectric loss – Dielectric breakdown – different types of break down mechanism. Nanomaterials-Preparation of Nanomaterials -Top- down, Bottom-up, Ball milling, Laser ablation techniques, Thermal evaporation technique and applications **Practical Component** Determination of band gap of a semiconductor Determination of magnetic susceptibility of a solid material – B-H curve apparatus Non-uniform bending – Determination of Young's modulus Melde's string – Determination of frequency of a tuning fork	**9 Hours** **8 Hours**
HEAT AND PLASMA Treatment: Introduction - Transfer of heat energy- Thermal expansion of solids and liquids – expansion joints- Bimetallic strips- Theory of heat conduction in solids- rectilinear flow of heat- Determination of thermal conductivity of a bad conductor - Lee's & Charlton's disc method- Properties of plasma- types of plasma- thermal and non-thermal plasma- Production of glow discharge plasma-Cold plasma- applications. **Practical Component** Determination of thermal conductivity of a bad conductor – Lee's Disc method	**9 Hours** **6 Hours**
Theory Hours: 45 **Tutorial Hours: 0** **Practical Hours: 30** **Project Hours: 0**	**Total Hours: 75**

Learning Resources
Textbooks:

1. Avadhanulu, M. N., Kshirsagar, P. G., and Murthy, T. V. S. Arun., A Textbook of Engineering Physics., S. Chand Publications, New Delhi (2018).
2. Gaur, R. K., and Gupta, S. L., Engineering Physics., Dhanpat Rai Publishing Co Pvt Ltd, New Delhi.
3. Beiser, Arthur., Mahajan, Shobhit., and Choudhury, S. Rai., Concepts of Modern Physics., McGraw Hill Education, New Delhi (2017).
4. Rajendran, V., Applied Physics., Tata McGraw Hill Publishing, New Delhi (2017).

References:

4. Lal, Brij., and Subrahmanyam., Properties of Matter., S. Chand & Co Ltd, New Delhi (2014).
5. Prakash, Satya., Quantum Mechanics., Pragati Prakashan Publishers, Meerut (2015).
6. Thiagarajan, K., and Ghatak, Ajoy., Lasers: Fundamentals and Applications., Springer Science & Business Media, Berlin (2010).
7. Ultrasonics: Fundamentals, Technology, Applications, Second Edition., Marcel Dekker, New York (1988).
8. Silfvast, William., Laser Fundamentals., Cambridge University Press, Cambridge (2018).
9. Çengel, Yunus A., and Ghajar, Afshin J., Heat and Mass Transfer: Fundamentals and Applications., McGraw-Hill Education, New York (2014).
7. Chen, Francis F., Introduction to Plasma Physics and Controlled Fusion., Springer, Cham (2016).

Online Resources (Weblinks)
1. https://nptel.ac.in/courses/115105104 2. https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2013/

Assessment (Embedded course)
CAT, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert(s)**
-	-		Dr.E.Shobhana Dr.S.Inbakumar, Department of Physics
Recommended by BoS on	16.08.2024		
Academic Council Approval	No:27	**Date**	24.08.2024

24INP103	INNOVATION PRACTICUM – II (Common to All branches)	L	T	P	J	C
		0	0	2	0	1
ES		SDG	G,11,12			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	equip students with essential tools and techniques for leveraging open-source technologies to develop proof-of-concepts and prototypes
2	provide hands-on experience and participants will gain a comprehensive understanding of the entire product development process
3	final prototyping, empowering them to transform their ideas into tangible outcomes

Course Outcomes		
After successful completion of this course, the students shall be able to		**Revised Bloom's Taxonomy Levels (RBT)**
CO 1	analyse the effectiveness of various electronic tools and techniques in product development processes	An
CO 2	develop and implement functional software prototypes using open-source tools	Ap
CO 3	design and fabricate 3D models using digital fabrication techniques	Ap

Course Outcomes (CO)	**Program Outcomes (PO)** (Strong-3, Medium – 2, Weak-1)											**Program Specific Outcomes (PSO)**	
	1	2	3	4	5	6	7	8	G	10	11		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	3	2	2	2	2								
2	2	2	2		2								
3	2	2	3	2	2								

Course Content	
INTRODUCTION TO OPEN-SOURCE TOOLS AND TECHNIQUES Explore the concept of open-source, its underlying principles and its contrast with proprietary software, Discuss the advantages of using open-source tools, such as lower costs, increased innovation, educational value, and community support, walk through to the commonly used open-source tools for electronics design (KiCad, FreeCAD), software development (Python, Eclipse), and fabrication (Cura, LinuxCNC).	**3 Hours**

ELECTRONICS FUNDAMENTALS AND TOOLS Introduction to basic electronic components (resistors, capacitors, transistors, etc.), Understanding of electronic circuits and their functions, Hands-on practice with CircuitJS and Falstad, Simulating and analysing electronic circuits, Introduction to Arduino and Raspberry Pi, exploring their capabilities and applications, Designing PCBs using KiCad and EasyEDA, Understanding PCB fabrication processes	**6 Hours**
SOFTWARE PROTOTYPING AND TOOLS Benefits of rapid prototyping in product development, Iterative design and testing, Wireframing tools (Balsamiq, Figma), UI design tools (Sketch, Figma), Programming languages (Python, JavaScript), Testing frameworks (Selenium), No-code platforms (Bubble, Adalo, Wix, AppGyver), Building functional prototypes without extensive coding	**6 Hours**
FABRICATION AND PROTOTYPING Overview of fabrication techniques (3D printing, laser cutting, CNC machining), Prototyping methods for physical products, using tools like Blender, TinkerCAD, or Fusion 360, Creating 3D models for physical prototypes, Hands-on experience with laser cutting and engraving, Understanding their applications and limitations	**7 Hours**
SIMULATION s DEMONSTRATION Integrated project demonstration, explaining the design process, technical choices, and outcomes, simulation showcase to demonstrate their understanding of various technical tools and prototyping techniques	**8 Hours**
Theory 0 Tutorial Hours: 0 Practical Hours: 30 Project Hours: 0	**Total Hours: 30**

Learning Resources
Textbooks:
1. Damir Godec, Joamin Gonzalez-Gutierrez, Axel Nordin, Eujin Pei, Julia Ureña Alcázar, A guide to additive manufacturing, Springer – 2022. https://doi.org/10.1007/978-3-031- 05863-9 2. Introducing SolidWorks, Dassault Systems.
References:
1. Insight into Electronics 2. Microcontroller Programming with Arduino and Python 3. Fundamentals of 3D modelling
Online Resources (Weblinks)
1. Google Play store apps: a. https://play.google.com/store/apps/details?id=com.electronicslab b. https://play.google.com/store/apps/details?id=it.android.demi.elettronica 2. https://engservices-ece.sites.olt.ubc.ca/files/2020/01/SolidWorks-3D-Printing-Tutorial-R2.pdf

Assessment (Practical course)
Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by

<table>
<tr><th>Expert from Industry</th><th colspan="2">Expert(s) from Higher Education Institution</th><th colspan="2">Internal Expert</th></tr>
<tr><td>Dr. Mahesh Veezhinathan
Director - Innovation Practicum

Associate VP - Forge. Innovation</td><td colspan="2">-</td><td colspan="2">Dr. Samuel Ratna Kumar P S
Assistant Professor – III
Department Mechanical Engineering</td></tr>
<tr><td>Recommended by BoS on</td><td colspan="4">17.08.2024</td></tr>
<tr><td>Academic Council Approval</td><td>No: 27</td><td colspan="2">Date</td><td>24.08.2024</td></tr>
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24CSI101	LOGICAL THINKING AND PROBLEM SOLVING	L	T	P	J	C
		3	0	2	0	4
ES	(Common to all Programmes)	SDG	8, 9			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:

The purpose of taking this course is to:

1	gain a comprehensive understanding of computing systems, including their classification, processing units, memory structures, storage hierarchies, and the essential functions and types of operating systems
2	develop strong logical and analytical thinking skills, enabling the systematic analysis and solution of computational problems using reasoning techniques, algorithms, and flowcharts.
3	acquire a solid foundation in C programming, mastering the use of data types, operators, control structures, and input/output operations to create efficient and effective programs.
4	apply advanced programming techniques, including the use of arrays, structures, pointers, and functions, to solve complex real-world problems with a focus on modular and efficient coding practices.

Course Outcomes

After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO1	understand the basic concepts of hardware, software, Operating systems, and the logic behind the functioning of the Computing systems.	U
CO2	apply logical thinking and reasoning to solve computing problems using tools like algorithms and flowcharts.	Ap
CO3	understand the structured programming paradigms, memory organization and how the language can be used as a tool to solve problems.	U
CO4	develop simple programs using data types, operators, control structures, pointers, and functions as appropriate in real world applications.	Ap

Course Outcome	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)
	1	2	3	4	5	6	7	8	9	10	11	

	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	2												
2	3	2	1								3		
3		1									2		
4	3	2	1								3		

Course Content	
FUNDAMENTALS OF COMPUTERS AND COMPUTING Generations of computers, and classification of computers (supercomputers, mainframes, minicomputers, microcomputers). Processing Units (CPU, GPU, TPU), memory (RAM, ROM), storage devices and hierarchy, input / output and peripheral devices. System software, application software. Operating Systems - Functions (process management, memory management, file system management, device management, security), types of operating systems (desktop, mobile, networking, distributed, real-time, embedded). **Number Systems**: Introduction to different number systems (binary, octal, decimal, hexadecimal), conversions between number systems, and binary arithmetic (addition, subtraction, multiplication, division). **Practical Component** Exploring hardware and software components	**6 Hours** **4 Hours**
LOGICAL THINKING, REASONING AND TOOLS Problem Analysis – Logical Thinking vs Critical Thinking vs Design Thinking - Inference – Inductive Reasoning – Deductive Reasoning **– Logical Thinking Tools: Algorithms**: Definition and importance, characteristics of algorithms (finite, clear and unambiguous, well-defined inputs and outputs, feasible). Algorithm representation Techniques: Pseudocode, stepwise refinement, and top-down design. **Flowcharts**: Symbols used in flowcharts, creating flowcharts, and examples of flowchart-based problem-solving. **Practical Component** Algorithm writing and Flowcharts,	**8 Hours** **4 Hours**
PROGRAMMING PARADIGMS AND INTRODUCTION TO C PROGRAMMING **Programming Paradigms**: Structured programming - functional programming - object-oriented programming. **Introduction to C Programming**: History of C - features of C - structure of a C program – input / output statements. **Data Types**: Primitive data types (int, char, float, double) - derived data types, typecast. **Operators**: Arithmetic operators - relational operators - logical operators - bitwise operators - assignment operators - operator precedence. **Conditional Statements**: If - if-else - nested if - switch-case. **Looping Statements**: For loop - while loop - do-while loop. Pre-processor Directives and Command line arguments, Storage Classes.	**11 Hours**

Practical Component Programs on Operator precedence, Decision Making, Iterations	**10 Hours**
ARRAYS AND STRUCTURES **Collections**: Arrays – 2D Arrays – String Manipulation. **Structures and Unions**: Definition - declaration - accessing members - differences between structures and unions - applications. **Practical Component** Programs on Arrays, Structures, Union,	**10 Hours** **6 Hours**
POINTERS AND FUNCTIONS **Pointers**: Definition - declaration - pointer arithmetic - pointers and arrays. **Functions**: Definition - declaration - types of functions (user-defined, library functions) - parameter passing (by value, by reference) pointers and functions, recursion. **Practical Component**	**10 Hours**

Pointers and Functions. Additional programs on Files to be discussed.	**6 Hours**

Theory Hours:	**45**	**Tutorial Hours:**	**0**	**Practical Hours:**	**30**	**Project Hours:**	**0**	**Total Hours:**	**75**

Learning Resources

Textbooks:

1. Kanetkar, Yashavant. Let Us C. BPB Publications, New Delhi (2023).
2. Rajaraman, V. Fundamentals of Computers. PHI Learning, New Delhi (2020).
3. Dromey, R.G. How to Solve it by Computer. Prentice Hall International, New York (2008).

Reference

1. Cormen, Thomas H., Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. Introduction to Algorithms. MIT Press, Cambridge (2022).
2. Balagurusamy, E. Programming in ANSI C. McGraw Hill Education, New York (2021).
3. Kernighan, Brian W., and Dennis M. Ritchie. The C Programming Language. Prentice Hall, New York (2017).
4. Patterson, David A., and John L. Hennessy. Computer Organization and Design: The Hardware/Software Interface. Morgan Kaufmann, San Francisco (2017).

Online Resources (Weblinks)

4. https://nptel.ac.in/courses/106105214
5. https://www.coursera.org/learn/computer-fundamentals
6. https://www.khanacademy.org/computing/computer-science/algorithms
7. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-006-introduction- to-algorithms-fall-2011/

5. https://www.geeksforgeeks.org/c-programming-language/

Assessment (Embedded course)
CAT, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by

Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**
-	-	Dr. S. Kavitha, Department of Information Technology

Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

24HSP112	HOLISTIC WELLNESS-II (Common to all Department)	L	T	P	J	C
		0	0	2	0	1
HS		SDG	3,4			

Pre-requisite courses	Holistic Wellness-I	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	build on the foundation laid in Holistic Wellness -I and deepening into the practices and principles of holistic wellness.
2	explore advanced techniques in mental, emotional, and spiritual well-being, with an emphasis on creating sustainable wellness habits.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	apply advanced techniques in mindfulness, meditation, and stress management.	Ap
CO 2	understand the role of community and social connections in wellness.	U
CO 3	develop resilience and adaptability in maintaining wellness.	E
CO 4	refine and sustain a personalized holistic wellness plan.	E

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	G	10	11		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1						2		2					
2						2							
3						2				3			

4						2				3			

Course Content

ADVANCED MINDFULLNESS AND MEDITATION: • Deepening mindfulness practices for enhanced mental clarity. • Exploring different forms of meditation (e.g., guided, transcendental, movement-based). • Hands-on activity: Daily meditation practice and journaling reflections.	**6Hours**
EMOTIONAL RESILIENCE AND MENTAL HEALTH:	**6Hours**

• Building emotional resilience through positive psychology practices. • Cognitive-behavioural strategies for managing stress and anxiety. • Hands-on activity: Developing and practicing a resilience toolkit.	
SOCIAL AND ENVIRONMENTAL WELLNESS: • The impact of social connections and community on wellness. • Creating a supportive environment for personal growth. • Hands-on activity: Building a community wellness project or group activity.	**6Hours**
INTERNAL GROWTH AND PURPOSE: • Exploring the deeper aspects of internal wellness and self-actualization. • Reflective practices for discovering life purpose and meaning. • Hands-on activity: Creating a vision board or personal mission statement.	**6Hours**
SUSTAINING WELLNESS PRACTICES: • Strategies for maintaining wellness habits over the long term. • Adapting wellness plans to life changes and challenges. • Hands-on activity: Revising and finalizing a long-term personal wellness plan.	**6Hours**

Theory Hours:	Tutorial Hours:	Practical Hours:	Project Hours:	Total Hours:
0	**0**	**30**		**30**

Learning Resources

Textbooks:

1. Hanh, Thich Nhat. The Miracle of Mindfulness: An Introduction to the Practice of Meditation. Beacon Press, Boston (1975).
2. Tolle, Eckhart. The Power of Now: A Guide to Spiritual Enlightenment. New World Library, Novato (1997).
3. Patel, Kamlesh. Heartfulness Way: Heart-Based Meditations for Spiritual Transformation, Kamlesh Patel, 2018.

References:

3. Goleman Daniel., Emotional Intelligence., Bloomsbury India, India, (2021).
4. James Allen., As a Man Thinketh., Maple Press, Noida, (2010)
5. Swami Budhanandha., Will power and its development., Advaita Ashrama Mayavati, Pithoragarh, Himalayas from its Publication Department, Calcutta. (2001)
6. Rosenberg, Marshall Bertram., Nonviolent Communication: A Language of Life., Puddle Dancer Press, Encinitas, CA (2015).
7. Jayanna, Krishnamurthy., Science C Practice of Integrative Health C Wellbeing Lifestyle., White Falcon Publishing (2020).
8. Lipton, Bruce., The Biology of Belief 10th Anniversary Edition: Unleashing the Power of Consciousness, Matter C Miracles, Hay House, Carlsbad (2015).
9. Kalderdon Adizes Ichak., What Matters in Life: Lessons I Learned from Opening My Heart
10. ., WS Press, Newtown, PA(2023).
11. Murphy, Joseph., The Power of Your Subconscious Mind [Original Edition (Complete)], Prentice-Hall, Englewood Cliffs (1963).

10. Kamlesh D. Patel., Designing Destiny: The Heartfulness Way, Heartfulness Institute, Chennai (2021)
Online Resources (Weblinks)
1. Introduction to Psychology 2. Guided Meditation 3. Life skills and value education 4. James Allen Library

Assessment (Practical course)
Participation, Practical activities and assignments, personal wellness plan and reflection.

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert(s)**
			Dr. Ezhilarasi Principal- KCT
Recommended by BoS on			
Academic Council Approval	No: 27	**Date**	24.08.2024

SEMESTER III

24TTI201	TEXTILE FIBRES	L	T	P	J	C
		3	0	2	0	4
PC		SDG	9, 12			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Introduce the classification of textile fibres and the essential properties of fibre-forming polymers and explore how polymer structure influences key fibre properties.
2	Provide knowledge on the structure, manufacturing, properties, and applications of natural, regenerated, synthetic, and high-performance fibres.
3	Familiarize students with the types of specialty fibres and their applications, and to explain post-spinning processes and their impact on fibre performance and characteristics.
4	Develop skills for fibre identification using standard techniques such as microscopy, solubility, moisture absorption, flammability, and chemical testing.

Course Outcomes		
After successful completion of this course, the students shall be able to		**Revised Bloom's Taxonomy Levels (RBT)**
CO 1	Classify different types of fibers, structure and properties. Spinning systems	U
CO 2	Identify and classify different types of natural fibers based on their origin and basic properties.	Ap
CO 3	Describe the manufacturing processes, properties, and applications of regenerated fibers.	Ap
CO 4	Illustrate the production methods, characteristics, and uses of synthetic fibers.	Ap
CO 5	Summarize the features of specialty fibers and Outline the various post-spinning operations	U

CO 6	Identify the different types of fibres, evaluate their properties	An

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	3	2									2		
2	3	3	2	2	3						2	2	

3	3	3	2	3	2						2	3	
4	3	2		3	3						2		
5	3	2	2	2	3			2	2		2		
6	3	2	3	2	3			2	2		2		2

Course Content

INTRODUCTION — **9 Hours**

Classification of fibres, essential properties of fibre forming polymers- molecular structure and orientation, degree of polymerisation. Relationship between polymer structure and fibre properties - moisture absorption, mechanical, chemical and thermal properties. Polymer extrusion techniques – melt, dry, wet, gel spinning.

Practical Component: — **6 Hours**

- Identify the density of polymers
- Determination of molecular weight of the polymers using viscometry

NATURAL FIBRES — **9 Hours**

Cellulosic fibres – Cotton, Jute, Linen, Coir – morphology, chemical and physical structure, properties, applications

Protein fibres – Wool, Silk - morphology, chemical and physical structure, properties, applications

Practical Component: — **6 Hours**

- Identification of cellulosic and protein fibres by microscopy, solubility, moisture absorption, flammability
- Analyse the Maturity Ratio and content of cotton fibre

REGENERATED FIBRES — **9 Hours**

Regenerated Cellulosic fibres – Viscose Rayon, Cellulose Acetate - Manufacturing process, structure, properties, applications

Regenerated Protein fibres – Soyabean and Caesin Manufacturing process, structure properties, applications

Practical Component: — **4 Hours**

- Identification of fibres by microscopy, solubility, moisture absorption, flammability

SYNTHETICFIBRES Melt Spinning – Polyester, Polyamides, Polyolefins – Rawmaterial, polymerization, spinning process, structure, properties and applications Solution Spinning – Poly Acrylonitrile, polyurethane - Rawmaterial, polymerization, spinning process, structure, properties and applications High performance fibres – Aramid, Carbon, Glass - Rawmaterial, polymerization, spinning process, structure, properties and applications	**9 Hours**
PracticalComponent: • Identification of fibres by microscopy, solubility, moisture absorption, flammability • Effect of acid on polymers under various factors (Temperature/ time/ Concentration). • Effect of alkali on polymers under various factors (Temperature/ time/ Concentration).	**8 Hours**

SPECIALITY FIBRES AND POST SPINNING PROCESS	9 Hours
Bicomponent fibres, SAP fibres – properties and application Drawing - Structural changes in polymer, Heat setting - methods and applications Texturizing : Airjet, Draw and False twist texturing, Spin finish applications	

Theory	Tutorial	Practical	Project	Total
Hours:	--	-- - -	--	Hours

Learning Resources
Textbooks:
1. Bunsell, Anthony R., ed. *Handbook of properties of textile and technical fibres*. Woodhead Publishing, 2018. 2. Mather, R. R., Wardman, R. H., & Rana, S. Chemistry of textile fibres. Royal Society of Chemistry, Royal society of Chemistry, 2023
References:
3. Eichhorn, Stephen, John WS Hearle, Michael Jaffe, and Takeshi Kikutani, eds. "Handbook of textile fibre structure: volume 2: Natural, regenerated, inorganic and specialist fibres." (2009). 4. Gupta V. B. and Kothari V. K. (Editors), "Manufactured Fibre Technology", Kluwer Academic Publishers, 1997. 5. Kozłowski, Ryszard M., and Maria Mackiewicz-Talarczyk. "Introduction to natural textile fibres." In *Handbook of natural fibres*, pp. 1-13. Woodhead Publishing, 2020.
Online Educational Resources:
1. https://onlinecourses.swayam2.ac.in/cec19_te01/preview

Assessment (Embedded course)
SA, Activity and Learning Task(s)* , Mini project, MCQ, End Semester Examination (ESE)

Course Curated by		
Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)

R. SENTHIL KUMAR General Manager M/s.Reliance Industried Ltd Tirupur	Dr. N. Gobi Associate Professor Department of Textile Technology Anna University Chennai	R. Sukanya Devi, Assistant Professor

Recommended by BoS on	07.05.2025		
Academic Council Approval	No. 28	**Date**	26.06.2025

24TTI202	**YARN MANUFACTURING TECHNOLOGY-I**	**L**	**T**	**P**	**J**	**C**
		3	**0**	**2**	**0**	**4**
PC		**SDG**	**7, 8, 9**			

Pre-requisite courses	-	**Data Book / Code book (If any)**	-

Course Objectives:	
The purpose of taking this course is to:	
1	Understand modern ginning process and machinery including contamination removal. Study the principles of opening and cleaning of natural textile fibres.
2	Comprehend the carding principles and operations: Study the fiber individualization and cleaning process in Carding
3	Analyze the operation of combing process of cotton fibres. Study the fiber parellelisation in Combing
4	Analyze the operation of drawing and study the fiber parellelisation
5	Explore the importance and mechanism of roving process.

Course Outcomes		
After successful completion of this course, the students shall be able to		**Revised Bloom's Taxonomy Levels (RBT)**
CO 1	Discuss the concepts and mechanism of ginning, opening and cleaning of blow room machines.	An
CO 2	Evaluate the principle and mechanism of fibre individualization in carding.	E
CO 3	Discuss the impact of parallelization of fibers concept & mechanism in comber process.	E
CO 4	Analyse the concept of fibre parallelization in draw frame.	An
CO 5	Explain the principle and working of speed frame.	An
CO6	Demonstrate the various parameters from blow room to roving frame such as speed, draft, setting,	E

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	2						2	2			3		
2		3			2		2					2	2
3	2		1					2			2		
4	3	3										2	
5	3			1		2							2
6		3	3	3				2		2	2	3	

Course Content

GINNING AND BLOW ROOM **Theory** Introduction to Short-staple Spinning. Study of different types of gins – saw gin, roller gin and double roller gin. Effect of ginning performance on fibre quality. Modern ginning plant arrangement includes contamination cleaners. Raw material storage (warehouse). Concept of mixing, effect of fibre quality on yarn quality including recycled fibres, bale management- Objectives of blow room –Opening, Cleaning, Blending. Arrangement of an opener and beater- feeding, opening, grid and their interaction. Ideal Blow Room Arrangement- Opening (Manual and Automatic Bale Openers, Waste and Sliver), Precleaners (new generation Precleaners). Blending, Fine cleaning Intermediate cleaning, Fine cleaners)- Concepts of opening intensity and cleaning efficiency -Storing, Condensation and Chute feed. Safety systems- Metal, heavy particle, fire prevention. Contamination types and detectors. Waste Collection and Removal, Dust Removal. Machinery configuration for various levels of trashy and contaminated raw material. Factors influencing opening and cleaning-intensity of opening-fibre loss, fibre damage and their control.	**12 Hours**

Practical . Determination of opening intensity & Arriving Mixing Plan . Determination of cleaning efficiency and nep generation.	**6 Hours**
CARDING **Theory** Objectives of carding – opening, cleaning, short fibre removal, and dust removal, nep removal, fibre individualization, hooks theory. Operating Principle of a modern card (from chute feed to coiling). Geometry, Types and Selection of card clothing for cotton& synthetics blends. Auto levelling- need, types and its impact on sliver quality. Salient features of new generation cards-integrated draw frame, modular arrangement, maximum carding area, automatic grinding. Maintenance of cards. Speeds and draft distribution, settings & production calculation.	**9 Hours**
Practical 3.Analysis of Working mechanism and calculation of draft distribution & production calculation in carding machine. 4.Demonstrate the setting between various zones of carding machine & evaluate the nep content in the drafted web.	**6 Hours**
COMBING **Theory** Objectives and need of Comber-comber preparatory, Positioning of combing. Working Principle of Comber Preparatory- modern Lap formers. Working Principle of modern comber- combing sequence-Timing Diagram. Operations in detail- Feed, Nipper Assembly, Circular and Top Comb, Detaching, Sliver formation and coiling. Noil Extraction Theory- forward and backward feed- factors influencing combing-fractionating efficiency. Modern developments in comber-Automatic feeding and lap transport system. Speeds, Settings and Production Calculation.	**10 Hours**

Practical 5. Determination of speed, draft, production & combing cycle of comber. 6. Estimation of variation in comber noil between heads & machines and Nep removal efficiency.	**6 Hours**

DRAWFRAME **Theory** Objectives - Principle of doubling and drafting, Improving Evenness. Drafting system - draft theory – drafting force-drafting wave - actual and perfect draft-roller slip and eccentricity. Operating Principle of modern draw frames- creel (feed), drafting zone, condensing and coiling. Autolevelling (short-term levelling)- Blending. Modern Developments in Draw Frame (single and double delivery, Improvements in functioning)-Speeds, Settings and Production Calculation.	**6 Hours**
Practical . Determination of speed, draft distribution and A%. 2. Demonstrate the roller setting in draw frame.	**6 Hours**
ROVING FRAME **Theory** Objectives of Roving - Principle and working, flyer twisting. Operation in detail-Drafting- Rollers, Aprons, Spacers. Operation in detail- Winding- Flyer & Types, Bobbin lead Vs Flyer lead, Bobbin build. Machine Drive Mechanism- Bobbin Building Mechanism, Electronic (Independent) Drive System. Accessories-Creel Stop Motion, Roving Stop Motion, Roving Tension Monitoring, Over Head Clearers-Package faults. Automation- Doffing and Bobbin Transport system. Draft, twist and production calculations.	**8 Hours**
Practical 3. Study of drafting systems (rollers, spacers) of a roving frame and determination of cots shore hardness. 4. Determination of Roving Tension and study of material variation in roving.	**6 Hours**

Theory Hours:	45	**Tutorial Hours:**	**0**	**Practical Hours:**	**30**	**Project Hours:**	**0**	**Total Hours:**	**75**

Learning Resources
Textbooks:
1. Oxtoby E, “Spun Yarn Technology”, Butter worth’s, London, New Edition 2002. 2. Carl A Lawrence, “Fundamentals of Spun Yarn Technology”, CRC Press, 2023.

References:

1. Klein. W, Manual of Textile Technology, Short Staple Spinning Series, Vol 1-3, The Textile Institute 2014
2. Handbook of Yarn Production: Technology, Science and Economics, Woodhead Publishing, 2003.
3. Textile and Fashion-Materials, Design and Technology, Woodhead Publishing, 2015
4. Chattopadhyay R., Technology of Carding, NCUTE, IIT Delhi, 2003.
5. Chattopadhyay R. (Ed), Advances in Technology of Yarn Production, NCUTE, IIT Delhi, 2002
6. Salhotra K. R. & Chattopadhyay R., Book of papers on "Blow room and Carding", IIT Delhi 1998.
7. Duraiswamy I, Chellamani P &Pavendhan A., "Cotton Ginning" Textile Progress, The Textile Institute, Manchester, U.K., 1993.
8. Lord P. R., Yarn Production: Science, Technology and Economics", The Textile Institute, Manchester, U.K., 1999.
9. Arkady Cherakassky, Two-dimensional mathematical model of the carding process, Textile research journal P. 169 – 175, March 1994
10. Manufacturing Excellence in Spinning Mills, A, Kanthimathinathan, Taylor and Francis publications 2022

Assessment (Theory course)
SA, Activity and Learning Task: Quiz, Case study, MCQ, End Semester Examination (ESE)

Course Curated by		
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**
Mr. Gopalakrishnan P Chief General Manager-Quality Control Sri Shanmugavel Group of Mills, Thadicombu-624 709 Dindigul	Dr. J. C. Sakthivel Associate Professor Department of Textile Technology PSG College of Technology Peelamedu Coimbatore - 641004	Prof. A. Pavendhan, Associate Dean-Textile Cluster & Dr. Sivakumar.P, Module Coordinator-Spinning Department of Textile Technology, Kumaraguru College of Technology.

Recommended by BoS on	07.05.2025		
Academic Council Approval	No 28	**Date**	26.06.2025

24TTI203	WEAVING TECHNOLOGY - I	L	T	P	J	C
		3	0	2	0	4
PC		SDG	4, 9, 12, 13			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Understand the basic process involved in woven fabric production.
2	Impart knowledge of various processes involved in weaving preparatory.
3	Know the basics of weaving motions in woven fabric formation.
4	Acquire practical skills in pattern preparation for small to large motifs.
5	Familiarize students with various mechanisms in fabric formation.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Explain winding and warping mechanisms and perform related calculations.	U
CO 2	Analyze sizing systems and optimize size pick-up and production parameters.	U
CO 3	Distinguish between different shedding systems and their working principles.	Ap
CO 4	Evaluate picking, beat-up, and take-up motions and suggest system improvements.	E
CO 5	Justify use of auxiliary motions and automation for sustainable weaving.	E

CO 6	Perform hands-on analysis of weave mechanisms using CAD and lab equipment.	An

Course Outcomes (CO)	**Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)**											**Program Specific Outcomes (PSO)**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	3	3			3						3	3	3
2	3	3	3		3						3	3	3
3	3	3			3						3	3	3
4	3	3	3		2						3	3	3
5			3			2	2			3	3	3	
6				3	3			3		3	3	3	

Course Content

WINDING TECHNOLOGY	**9 Hours**
Objectives of winding, types of packages, yarn withdrawal, definition of wind, wind per double traverse and angle of wind. Package density. Types of winders, drum driven winders, precision winders. Yarn tensioner, objectives, additive and multiplicative tensioners. Yarn clearer, principles of mechanical and electronic clearers, classimat faults, splicing and knotting. Pirn winding, bunch building. Calculation related to production cone winding and pirn winding.	
Practical Component:	**6 Hours**
1. Analysis of geometry of the packages given. 2. Analysis of yarn fault, winding cuts and SLT channels.	

WARPING AND SIZING Passage of warp, Types of creels. Beam warping machines, Sectional warping. Calculations related to beam and sectional warping. Sizing-Objective, weaving curve, size ingredients, preparation of the size paste. Sizing machine -Multi cylinder sizing machine and single end sizing machine. Calculations related to production, size add on, size pick up and water evaporation.	**9 Hours**
Practical Component: 1. Prepare the warp design pattern and perform the drawing-in process. 2. Size the given yarn and analyze the size pick-up and tensile properties.	**6 Hours**

SHEDDING MECHANISMS Introduction of shedding mechanisms, types of shed, tappet shedding, shedding with negative cams, positive shedding using grooved cams, limitations of tappet shedding. Dobby shedding- cam and rotary dobby, jacquard shedding- single lift single cylinder jacquard, double lift single cylinder jacquard, double lift double cylinder jacquard, Verdol jacquard, Reversing mechanisms.	**9 Hours**
Practical Component: 1. Analyze the geometry of the shed, depth of the shed and calculate the strain in the warp from shed height. 2. Prepare the pattern card for custom design and simulate the fabric using CAD for dobby shedding. 3. Prepare the pattern card for custom design and simulate the fabric using CAD for Jacquard shedding.	**9 Hours**
PICKING AND BEAT-UP Picking methods, shuttle picking, shuttle timing. Loom timing diagram, relation between shuttle velocity and loom speed, loom width and rate of weft insertion, conventional picking mechanisms, classification, cone over pick, cone under pick, advantages and limitations. Shuttle checking devices. Beat up mechanism, sley eccentricity.	**9 Hours**
Practical Component: 4. Analyze the Motion of shuttle during acceleration, catapult effect, nominal and actual, displacement. 5. Analyze the Movement of sley, beat up, sley eccentricity and the factors influencing it.	**6 Hours**
SECONDARY & AUXILIARY MOTIONS Let off motions, negative and positive let off motions. Take up motions, objectives, five-wheel, seven wheel take up motions, Auxiliary motions- weft stop motions, side fork and center fork motions, warp protector motions, loose reed and fast reed, warp stop motions. Automatic looms, weft feelers, bobbin change systems, weft mixing, drop box motions.	**9 Hours**
Practical Component: 1. Prepare the pattern card with custom design for weft in drop box mechanism.	**3 Hours**

Theory Hours:	45	**Tutorial Hours:**	**0**	**Practical Hours:**	**30**	**Project Hours:**	**0**	**Total Hours:**	**75**

Learning Resources
Textbooks:
1. Lord, P.R., and Mohamed, M.H. Weaving: Conversion of Yarn to Fabric. Merrow Publishing, UK, 2021. 2. Talukdar, M.K., Sriramulu, P., and Ajgaonkar, D.B. Winding and Warping. Textile Trade Press, India, 2020. 3. Marks, R, and Robinson, A.T.C. Principles of Weaving. Textile Institute, 1976.

4. Majumdar, A. Principles of Woven Fabric Manufacturing. CRC Press, 2016.
References:
1. Ajgaonkar, D.B. Textile Manufacturing Processes. Woven Fabric Tech Publications, India, 2022. 2. Banerjee, P.K. Principles of Fabric Formation. CRC Press, 2015. 3. Goswami,B.C., Anandjiwala, R., and Hall. Textile Sizing. Woodhead Publishing. 2004 4. Booth, J.E. Textile Mathematics (Volume III). Textile Institute 1977.

Assessment (Embedded course)
SA, Activity and Learning Task(s)*, Mini project, MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert(s)**
Mr. V. Sembian, Vignesh Super Fabrics, 6/320, Peedampalli Road, Pattanam, Coimbatore-641016.	Dr. N. K. Palaniswamy, Associate Professor, Textile Technology, National Institute of Technology (NIT), Jalandhar, Punjab 144008.		Dr. S. Ariharasudhan Assistant Professor III, Department of Textile Technology, Kumaraguru College of Technology, Coimbatore – 641049.
Recommended by BoS on	07.05.2025		
Academic Council Approval	No 28	**Date**	26.06.2025

24MAI232	APPLIED STATISTICS FOR ENGINEERS (Common to BT, FT, TT)	L	T	P	J	C
		3	0	2	0	4
BS		SDG	3, 8			

Pre-requisite courses	Frequency distribution, Sample and Population	Data Book / Codes / Standards (If any)	Statistical Tables

Course Objectives:	The purpose of taking this course is to:
1	Introduce the concept of random variables and their probability distributions.
2	Explore two-dimensional random variables, correlation, and regression analysis
3	Provide knowledge of hypothesis testing using small and large sample tests.
4	Explain the principles of experimental design and analysis of variance
5	Familiarize students with statistical quality control techniques

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Describe different types of random variables and their probability distributions.	Ap
CO 2	Analyse joint distributions and measure relationships using correlation and regression techniques	An
CO 3	Conduct hypothesis tests using Z-tests and Chi-square for large samples	Ap
CO 4	Perform small sample hypothesis tests using t-tests and F-tests.	Ap
CO 5	Apply ANOVA and experimental design methods for data analysis.	An

CO 6	**Construct and interpret control charts for process monitoring.**	**Ap**

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	3	2			2								
2	3	3			2								
3	3	3		2	1				2				
4	3	3		2	1				2				
5	3	3		1	3				2				
6	3	3		1	3				2				

Course Content

RANDOM VARIABLES **Axioms of probability - Conditional probability – Total probability – Baye's theorem** **- Random variable – Properties – Probability mass function – Probability density function – Distribution function - Binomial, Poisson and Normal distributions.** **Practical Component** • **Generate a Binomial distribution, plot its PMF and CDF, find the probability of a given range, and compute its mean and variance.** • **Simulate Poisson and Normal distributions, visualize them using PMF and histograms, and calculate probabilities for given ranges.**	**9 Hours** **6 Hours**

TWO DIMENSIONAL RANDOM VARIABLES AND CORRELATION AND REGRESSION **Two dimensional random variables – Joint Density and Distribution Functions – Marginal distributions- Correlation – Karl Pearson's Correlation coefficient ((Discrete Data) – Regression lines. (Discrete Data). central limit theorem-Simple problems.** **Practical Component**	**9 Hours** **6 Hours**

• **Generate a two-dimensional discrete random variable, compute its joint probability distribution, and plot the joint probability mass function (PMF).** • **Compute Karl Pearson's and Spearman's Rank Correlation coefficients for a given discrete dataset, fit regression lines, and interpret the results.**	
TESTING OF HYPOTHESIS **Testing of hypothesis for large samples: single mean, difference of means- Small samples tests based on t and F distributions: single mean, difference of means, paired *t*- test and variance ratio test – Chi-square test for independence of attributes and goodness of fit.** **Practical Component** • **Perform hypothesis testing for large samples by conducting Z-tests for a single mean and difference of means and interpret the results.** • **Conduct t-tests (single mean, difference of means, and paired t-test), F-test for variance ratio, and Chi-square tests for independence of attributes and goodness of fit using given datasets.**	**9 Hours** **6 Hours**
DESIGN OF EXPERIMENTS **Analysis of Variance (ANOVA) – Completely Randomized Design (CRD) –** **Randomized Block Design (RBD) -Latin Square Design** **Practical Component** • **Conduct an ANOVA using a Completely Randomized Design (CRD) and a Randomized Block Design (RBD) on a given dataset and compare the treatment effects.** • **Perform a Latin Square Design ANOVA on provided data, analyze the treatment differences, and interpret the outcomes.**	**9 Hours** **6 Hours**

STATISTICAL QUALITY CONTROL **Concept of process control - Control charts for variables: Mean and Range charts –** **Control charts for attributes: p, np, c – charts.** **Practical Component** • **Construct and analyze Mean and Range ($\bar{X}$ and R) control charts for a given dataset to monitor process stability.** • **Develop p, np, and c control charts for attribute data, interpret the control limits, and determine if the process is in control.**	**9 Hours** **6 Hours**

Theory Hours:	**45**	**Tutorial Hours:**	**Practical Hours:**	**30**	**Project Hours:**	**Total Hours:**	**75**

Learning Resources
Textbooks
1. Walpole R. E., Myers S.L. & Keying Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education Inc, 10th edition, 2020. 2. Charles Henry Brase and Corrinne Pellillo Brase "Understandable Statistics", Cengage Learning Company, Toronto, 12th edition, 2016. 3. Andy Field, Jeremy Miles, and Zoë Field, "Discovering Statistics Using R", Sage Publications, 1st edition, 2012.
Reference books
4. Johnson R. A., Miller & Freund's "Probability and Statistics for Engineers", 9th Edition, Pearson Education, Delhi, 2017. 5. Gupta S.C, and KapurV.K "Fundamentals of Applied Statistics", Sultan Chand, New Delhi, 4th Edition, 2014. 6. Michael J. Crawley, "The R Book", Wiley, 3rd Edition,2020.
Online Resources/Web Links
Introduction to Probability and Statistics Using R: https://www.atmos.albany.edu/facstaff/timm/ATM315spring14/R/IPSUR.pdf

Assessment	
Formative	**Summative**
Assignments / PBA, SBA, Worksheet, Quiz, Lab	SA- I, SA – II and End Semester Examination (ESE)

<table>
<tr><td colspan="4">Course Curated By</td></tr>
<tr><td>Expert(s) from Industry</td><td colspan="2">Expert(s) from Higher Education Institutions</td><td>Internal Expert(s)</td></tr>
<tr><td>1. Dr. R VASU
Business Excellence and Management Systems Consultant Specialisation in Process Excellence, Six Sigma Quality, Health Safety & Environment Systems
Vice President (Retired) Brakes India.</td><td colspan="2">1. Dr. M. Sivakumar
Assistant Professor Sr. Grade
Vellore Institute of Technology, Vellore
2. Dr. Ramesh Babu
Assistant Professor (SG)
Amrita University Coimbatore, Tamil Nadu.</td><td>1. Dr. R. Marudhachalam
Associate Professor, Department of Mathematics, KCT</td></tr>
<tr><td>Recommended by BoS on</td><td colspan="3">25.4.2025</td></tr>
<tr><td>Academic Council Approval</td><td>No 28</td><td>Date</td><td>26.06.2025</td></tr>
</table>

24HSP005	MASTERING CONVERSATIONS	**L**	**T**	**P**	**J**	**C**
		0	**0**	**2**	**0**	**1**
Course Category: HS		**SDG**	**4 & 8**			

Pre-requisite courses - Nil	NIL	**Data Book / Codes / Standards (If any)**	Nil

Course Objectives:	**The purpose of taking this course is to:**
1	Demonstrate understanding of different perspectives by analyzing complex personal and professional situations.
2	Engage in thoughtful dialogue and discussions about complex, real-world issues, utilizing critical thinking to assess different viewpoints.
3	Apply role-playing as a tool to enhance understanding of workplace dynamics, conflict resolution, and team collaboration.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Bloom's Taxonomy Level (BTL)**
CO 1	Empathize with and understand people in both professional and personal contexts, reflecting on situations from multiple perspectives and participating in activities that mirror career-related scenarios	Ap
CO 2	Analyze and converse critically on complex subjects, demonstrating the ability to approach and deal with various social contexts effectively	An
CO 3	Exhibit skills in role-playing and enacting given situations to navigate diverse social interactions and career-related contexts.	C

Course Outcomes should be clear, measurable, aligned with broader educational objectives, and focused on developing essential engineering skills while preparing students for future challenges in the field

COs: Embedded (3 to 4 credits): –6,, Theory only- 5, Micro-credentials - 3, lab only – 3, project – 4

BTL: R, U, Ap, An, E, C (Remember, Understand, Apply, Analysis, Evaluate, Create)

	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11		
Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1						3			3	2	3		
2									1	2			
3									3	2			

Course Content	
Practical Component / Roleplays Dynamics Introduction to Role play - Benefits of role plays - Importance of gesture, tone and modulation-Skill development through role play activities - Types of role plays -Conversation Building through communicative functions-Initiating a dialogue- Framing questions- Receiving feedback	**6 Hours**
Practical Component /Roleplays on Social Skill Social Interactions: - (Ordering food at a restaurant- Making a reservation at a hotel-- Shopping at a store-- Attending a party or social gathering) Travel and Tourism:(Asking for directions- Booking a flight or hotel-- Exploring a new city- Interacting with local people) Community and Volunteering:(Participating in a charity event- Volunteering at a local organization- Discussing community issues- Organizing a community project)	**6 Hours**

Practical Component / Roleplays on Education and Technology Education and Personal Growth:(Setting goals-(Short term & Long term)-Creating a study plan- Participating in a workshop- Reflecting on personal growth) Technology and Online Interactions:(Participating in an online meeting-Creating a social media post- Writing an email or text message- Making an online purchase) Technology and Science:(Explaining a scientific concept- Discussing emerging technologies- participating in Hackathons- Presenting a research paper)	**6 Hours**
Practical Component / Roleplays on Strategic Insights Critical Thinking :(Evaluating a news article-solving a moral dilemma-Decision with incomplete information-Assessing a historical event)	**6 Hours**

Problem-Solving:(Resolving a conflict- Negotiating a deal - Making a complaint- Apologizing for a mistake) Business and Entrepreneurship:(Pitching an idea- Negotiating a contract- Conducting a market Research- Presenting a product launch)	
Practical Component / Roleplays on Cultural Exchange Cultural Exchange:(Sharing customs and traditions- Discussing cultural differences- Exploring historical events- Participating in a cultural festival) Media and Entertainment:(Event planning- Creating an advertisement-Digital Marketing-Conducting interviews- Creating news broadcast- Writing and Performing a script- Enacting one act plays) Arts and Culture:(Visiting an art gallery - Attending/ organizing a concert or play - Discussing literature- Creating a piece of art)	**6 Hours**

Theory Hours:	**Tutorial Hours:**	**Practical Hours:**	**30**	**Project Hours:**	**Total Hours:** 30

Learning Resources*
Textbooks
Reference books/ Web Links
1.Bonwell, C. C., & Eison, J. A. (1991). Active learning: Creating excitement in the classroom. Washington, DC: The George Washington University. 2. Harbour, E., & Connick, J. (2005). Role playing games and activities rules and tips. Retrieved from https://www.businessballs.com/roleplayinggames.htm 3. Lebaron, J., & Miller, D. (2005). The potential of jigsaw role playing to promote the social construction of knowledge in an online graduate education course. Retrieved from http://paws.wcu.edu/jlebaron/Jigsaw-FnlTCRpdf_050812.pdf 4. Davies, A. (2018). Teaching and learning through role-play: A practical guide. Maidenhead, UK: McGraw-Hill Education. 5. Young, K. C. (2016). The art of role play: Developing realistic scenarios for skill development. Boston, MA: Pearson. 6. Yardley-Matwiejczuk, K. M. (1997). Role play: Theory and practice. London, UK: SAGE Publications Ltd.
Online Resources

https://www.niu.edu/citl/resources/guides/instructional-guide **https://positivepsychology.com/role-playing-scripts/**

Assessment	
Formative	Summative
Assignments / Mini project), Quiz, Lab	Quizzes and written assignments, Participation in group activities

Course Curated By		
Expert(s) from Industry	**Expert(s) from Higher Education Institutions**	**Internal Expert(s)**
Mr.Vijayan Ramanathan , Project manager, Toppan Merrill. Technologies, Coimbatore	Dr. Aninditha Sahoo, IIT, Madras Dr.P.R.Sujatha Priyadharshini, Anna University Chennai Dr. E. Justin Ruben, CIT, Coimbatore	Dr. Arokia Lawrence Vijay Dr. Tissaa Tony

Reccomended by BoS on	**16.08.2024**		
Academic Council Approval	**No 28**	**Date**	**26.06.2025**

24INM201	UNIVERSAL HUMAN VALUES II: Understanding Harmony (Common to All Branches)	L	T	P	J	C
		1	0	0	0	1
HS		SDG	5,10,16			

Pre-requisite courses		Data Book / Code book (If any)	

Course Objectives:	
The purpose of taking this course is to:	
1	Introduce the concept and significance of value education in shaping a meaningful and fulfilling life.
2	Enable students to understand the human being as a co-existence of self and body and the harmony within.
3	Develop an understanding of harmony in relationships, family, and society.
4	Help students appreciate the interconnectedness and harmony in nature and existence.
5	Instill the importance of ethical behavior in personal, professional, and social contexts.

Course Outcomes		
After successful completion of this course, the students shall be able to		**Revised Bloom's Taxonomy Levels(RBT)**
CO1	Understand the foundational concepts of value education and human aspirations.	U
CO2	Analyse the human being as a holistic entity comprising self and body.	An
CO3	Evaluate and cultivate harmonious relationships within the family and society.	E
CO4	Interpret the interconnectedness in nature and recognize harmony in existence.	U
CO5	Apply holistic understanding to professional ethics and sustainable living.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO	
	1	2	3	4	5	6	7	8	9	10	11		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems		The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO 1	
1						3	3	3	3		3		
2						3	3	3	3		3		
3						3	3	3	3		3		
4						3	3	3	3		3		
5						3	3	3	3		3		

Course Content	
Introduction to Value Education Value Education- Self-exploration as the Process for Value Education- Basic Human Aspirations and their Fulfilment- Right Understanding, Relationship and Physical Facility- Happiness and Prosperity – Current Scenario- Method to Fulfil the Basic Human Aspirations.	**3 Hours**
Harmony in the Human Being Human Being as Co-existence of the Self and the Body- Distinguishing between the Needs of the Self and the Body- The Body as an Instrument of the Self- Understanding Harmony in the Self- Harmony of the Self with the Body- Programs to Ensure Self-regulation and Health.	**3 Hours**
Harmony in the Family and Society Harmony in the Family –The Basic Unit of Human Interaction-'Trust' – The Foundational Value in Relationship-Respect – As the Right Evaluation- Other Values in Human-to-Human Relationship- Understanding Harmony in the SocietyLecture Vision for the Universal Human Order.	**3 Hours**

Harmony in the Nature (Existence) Understanding Harmony in Nature- Interconnectedness, Self-regulation and Mutual Fulfilment among the Four Orders of Nature- Realizing Existence as Co-existence at All Levels- The Holistic Perception of Harmony in Existence.	**3 Hours**

Implications of the Holistic Understanding- A Look at Professional Ethics Basis for Universal Human Values-Definitiveness of (Ethical) Human Conduct - professional Ethics in the Light of Right Understanding-A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order-Holistic Technologies, Production Systems-and Management Models-Typical Case Studies Strategies for Transition towards Value-based Life and Profession	**3 Hours**

Theory Hours:	Tutorial Hours:	Practical Hours:	Project Hours:	Total Hours:
15				15

Learning Resources
Textbooks:
Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
References:
Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, Jeevan Vidya:Publishers, 1999.
Online Resources (Weblinks)
https://www.uhv.org.in/uhv-ii
Assessment (Theory course)
Presentation, MCQ, Assignment, Case Study and E Chart.

Course Curated by		
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**

	Sh. Umesh Jadhav, NCCIP (National Co-oridnation Committee)-AICTE		Dr. S. Sivakumar, Associate Professor, SFS Dr.R.Prakasam, Assistant Professor, Department of Physics Mr.J.Sivaguru, Assistant Professor, Department of Mechatronics	
Recommended by BoS on	03-05-2025			
Academic Council Approval	No 28	**Date**	26-06-2025	

24EII225	MEASUREMENT AND INSTRUMENTATION FOR TEXTILE INDUSTRIES	L	T	P	J	C
		3	0	2	0	4
Professional Core		SDG	8, 9, 12			

Pre-requisite courses		**Data Book / Code book (If any)**	Nil

Course Objectives:	
The purpose of taking this course is to:	
1	Learn the fundamentals of measurement systems, calibration, sensors, and textile-specific parameter measurement.
2	Calibrate instruments, apply appropriate sensors, operate textile instrumentation, and program basic PLC systems for data acquisition and automation.
3	Build the ability to apply measurement and instrumentation knowledge for data-driven quality control, process monitoring, and automation in textile production.

Course Outcomes		
After successful completion of this course, the students shall be able to		**Revised Bloom's Taxonomy Levels (RBT)**
CO 1	Understand the principles of measurement systems, calibration standards, and sources of error in engineering measurements.	U
CO 2	Apply appropriate transducers and sensors for measuring physical and process parameters in textile applications.	Ap
CO 3	Analyze performance characteristics of sensors and instrumentation systems for accurate data acquisition and control.	An

CO 4	Perform calibration and validation of measurement instruments using standard procedures and interpret results.	Ap
CO 5	Operate and troubleshoot textile-specific instrumentation systems for monitoring yarn, fabric, and dyeing parameters.	Ap
CO 6	Develop basic PLC-based automation programs for process monitoring and control in textile production environments.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO 1	PSO 2
1	3	2									2	1	
2	3	3	2	2	3						2	3	
3	3	3	2	3	2						2	3	
4	3	2		3	3						2	3	
5	3	2	2	2	3			2	2		2	1	
6	3	2	3	2	3			2	2		2		2

Course Content

Fundamentals of Measurement	4 Hours
Introduction to measurement systems, Types of measurements: Direct & Indirect, Standards and calibration, Accuracy, precision, sensitivity, repeatability, linearity, Types and sources of errors in measurement	
Practical Component: o Calibration of Measurement Instruments- pressure gauge / thermometer using standard methods.	4 Hours

Transducers and Sensors Classification of transducers, Electrical, mechanical, thermal, optical transducers, Working principles: RTD, thermocouples, LVDT, strain gauges, capacitive, piezoelectric, Fiber-optic sensors, Signal conditioning basics **Practical Component:** ○ Measurement of Displacement using LVDT ○ Strain Gauge Based Load/Pressure Measurement ○ Study of Capacitive and Inductive Proximity Sensor.	**6 Hours** **6 Hours**
Measurement of Physical Parameters Displacement, velocity, acceleration (textile machinery vibration), Temperature measurement (dyeing, heat setting), Pressure and vacuum measurement (printing, vacuum drying), Flow measurement: orifice, venturi,	**8 Hours**

rotameter, electromagnetic, ultrasonic, Level measurement techniques (chemical tanks, dye baths) **Practical Component:** • Temperature Measurement using RTD and Thermocouple • Measurement of Flow Rate using venturimeter- Flow control in dyeing and chemical dosing systems	**8 Hours**
Textile-Specific Instrumentation Measurement in spinning: yarn count, twist, tension, evenness, hairiness, Weaving instrumentation: warp tension control, fabric width, Knitting : loop length, yarn input monitoring, Dyeing and finishing: pH, conductivity, temperature, Colour monitoring, Non-contact sensors (infrared, laser-based) in textile inspection **Practical Component:** • pH Monitoring • Speed Measurement and Control of a DC Motor	**9 Hours** **4 Hours**
Data Acquisition and Instrumentation Systems Basics of data acquisition systems (DAQ),Analog-to-digital and digital-to-analog conversion, Interfaces: RS232, USB, GPIB, Ethernet, PLCs and SCADA systems in textiles, Introduction to smart sensors and IoT in textile monitoring **Practical Component:** • Ladder logic programming. -PLC	**9 Hours** **4 Hours**

Quality Control and Automation	9 Hours
Online vs offline measurements, Feedback and feedforward control, Statistical process control using instrumentation data, Case studies of automation in modern textile mills, Safety and maintenance of instruments **Practical Component:** • PLC-based Control Simulation (e.g., Tank Level Control)	4 Hours

Theory Hours:	45	Tutorial Hours:		Practical Hours:	30	Project Hours:		Total Hours:	75

Learning Resources

Textbooks:

1. Bunsell, Anthony R., ed. *Handbook of properties of textile and technical fibres*. Woodhead Publishing, 2018.
2. Mather, R. R., Wardman, R. H., & Rana, S. Chemistry of textile fibres. Royal Society of Chemistry, Royal society of Chemistry, 2023

References:

1. Eichhorn, Stephen, John WS Hearle, Michael Jaffe, and Takeshi Kikutani, eds. "Handbook of textile fibre structure: volume 2: natural, regenerated, inorganic and specialist fibres." (2009).
2. Gupta V. B. and Kothari V. K. (Editors), "Manufactured Fibre Technology", Kluwer Academic Publishers, 1997.
3. Kozłowski, Ryszard M., and Maria Mackiewicz-Talarczyk. "Introduction to natural textile fibres." In *Handbook of natural fibres*, pp. 1-13. Woodhead Publishing, 2020.

.Online Educational Resources:

1. **NPTEL Courses**: Measurement and Instrumentation, Textile Testing
2. **MIT OpenCourseWare**: Instrumentation tutorials

Assessment (Embedded course)
SA, Activity and Learning Task(s)* , Mini project, MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce,

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
Dr Prem Kumar R & D Head LMW Coimbatore	Dr J C Sakthivel Associate Professor Textile Technology PSG College of Technology, Coimbatore	E. Muthuramalingam Department of Electronics and Instrumentation Engineering	
Recommended by BoS on	07.05.2025		
Academic Council Approval	No. 28	**Date**	26.06.2025

SEMESTER IV

24TTT205	CHARACTERISTICS OF TEXTILE FIBRES	L	T	P	J	C
		3	0	0	0	3
PC		SDG	7, 8, 10			

Pre-requisite courses	24TTI201	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Study the fine structure of polymeric system and phenomenon of absorption nature of fibres
2	Analyze the mechanical behaviour and optical properties of fibres.
3	Explore the frictional, electrical and thermal properties of fibres.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Analyze the influence of molecular structure on and differentiate between natural and man-made fibres.	An
CO 2	Evaluate the effect of fibre structure on moisture absorption and recommend conditioning techniques for fibres.	E
CO 3	Analyze stress-strain curves of various textile fibres and prioritize mechanical properties based on typical values.	An
CO 4	Evaluate the factors influencing optical properties of fibres and justify techniques for measuring fibre friction.	E
CO 5	Analyze problems encountered during processing due to static electricity and design elimination techniques.	An

	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)	Program Specific

	1	2	3	4	5	6	7	8	9	10	11	Outcomes (PSO)	
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	2	2											
2	2	2										2	
3	2	2						2	2				
4	2		3										
5	2	2											

Course Content	
STRUCTURE OF FIBRES Basic requirements for fiber formation, Intra- and inter-molecular forces, degree of order, degree of orientation of molecular chains, crystalline and amorphous regions –Models of fibre structure. Similarities and differences amongst the structural features of natural and man-made fibres. Analysis of charts from X-ray diffraction methods.	**9 Hours**
MOISTURE ABSORPTION PROPERTIES OF FIBRES Absolute humidity and relative humidity- moisture content and regain of different fibres- Moisture regains curves, Hygroscopic nature of fibres. Hysteresis in moisture absorption. Equilibrium absorption - Effect of fibre structure – hydrophilic groups and non-crystalline regions on Moisture absorption. Conditioning of fibers –Conditioning process, factors influencing rate of conditioning, effect of conditioning on fibre properties	**9 Hours**
MECHANICAL PROPERTIES OF FIBRES Definitions –Load elongation, breaking strength, breaking extension, tensile Stress, tensile strain, mass specific stress, yield point, initial modulus, work of rupture and work factor. Stress-strain curves for various textile fibres and their significance. Elastic properties – elasticity, elastic recovery and its relation to stress and strain, work recovery, typical values of elastic recovery and work recovery for various textile fibres. Mechanical conditioning of fibres – advantages. Time effects – stress relaxation and creep phenomena. Torsional rigidity – its relation to other fibre properties. Flexural rigidity – its relation to other fibre properties.	**9 Hours**
OPTICAL AND FRICTIONAL PROPERTIES Refractive index and Birefringence of fibres –effect of factors like fibre orientation, density and regain. Optical orientation factor, its relation with refractive index and birefringence. Reflection of light – specular and diffused reflection, lustre, lustre index, factors influencing lustre. Absorption of light – dichroism, dichroic ratio. Theories of fibre friction- Amonton’s law; Lindberg’s inter fibre friction Yarn to yarn abrasion and friction; friction of wool.	**9 Hours**

ELECTRICAL AND THERMAL PROPERTIES Static electricity – generation of static charge, problems encountered during Processing, elimination techniques. Electrical resistance of fibres, factors influencing electrical resistance. Dielectric properties, factors influencing di-electricity. Thermal properties – specific heat, thermal conductivity, thermal expansion and contraction, structural changes in fibres on heating, heat setting of various synthetic fibres.	**9 Hours**

Theory Hours:	45	Tutorial Hours:	0	Practical Hours:	0	Project Hours:	0	Total Hours:	45

Learning Resources
Textbooks:
1. Morton W.E and Hearle, J.W.S., “Physical Properties of Textile Fibres”, The Textile Institute, Manchester, U.K., 4th Edition,2008. 2. Gohl E.P.G. and Vilensky L.D., “Textile Science”, second edition, CBS Publisher and Distributor, 1983.
References:
1. Meredith. R and Hearle, J.W.S., “Physical Methods of Investigation of Textiles”, Wiley Publication, New York, 1989. 2. Gupta V.B., “Textile Fibres: Developments and Innovations”, Vol. 2, “Progress in Textiles: Science & Technology”. Edited by V.K. Kothari, IAFL Publications, 2000. 3. Meredith R.., “Mechanical Properties of Textile Fibres”, North Holland, Amsterdam 1986. 4. Mishra, S.P., Fibre Science & Technology, New Age International Publishers, 2000. 5. Gupta V.B. and Kothari V.K., “Manufactured Fibre Technology”, Chapman and Hall, 1997.

Assessment (Theory course)
CAT, Activity and Learning Task: Socratic seminar, Case study, MCQ, End Semester Examination (ESE)

Course Curated by				
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert(s)**	
Mr. Senthilkumar R Regional Product Head-PSF-South India, Reliance Industries Limited,	Dr. N. Gobi Professor Department of Technology AC Tech Campus, Guindy, Anna University, Chennai - 600025		Dr. Sivakumar.P Mrs. R.Sukanyadevi Department of Textile	
Recommended by BoS on	07.05.2025			
Academic Council Approval	No 28	**Date**	26.06.2025	

24TTI206	YARN MANUFACTURING TECHNOLOGY-II	L	T	P	J	C
		3	0	2	0-	4
PC		SDG	7, 8, 10			

Pre-requisite courses	24TTI202	Data Book / Code book (If any)	-

Course Objectives:

The purpose of taking this course is to:

1	Study the principles of ring spinning and compact spinning of cotton fibres.
2	Analyze the operation of rotor, air jet spinning, and other spinning systems of cotton fibres.
3	Explore the importance and mechanism of winding, doubling, yarn conditioning and packing process.

Course Outcomes

After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Analyze the basic principles of ring spinning system.	An
CO 2	Evaluate the principle and mechanism of compact spinning and comparison with other systems including ring spinning.	E
CO 3	Analyse the principle and yarn formation in rotor spinning.	An
CO 4	Discuss the concept & mechanism in other spinning systems like friction, air jet, twist, adhesive, cover processes.	E
CO 5	Justify the processes of winding, doubling including TFO, yarn conditioning and packing.	An
CO 6	Demonstrate and evaluate the various parameters in ring, rotor & other spinning systems and in winding & doubling.	E

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	3							2			3		
2		3			2							2	2
3	2		1					2			2		
4		3					2					2	
5				1		2	2						2
6						1		3		2	2		

Course Content

RING FRAME **Theory** Yarn Classifications and yarn count. Objective of Ring Spinning. Principle and operation of a modern ring frame. Drafting- Creel and feed, Rollers, Cots, Spacers and Condensers- Types of Top roller pressure application-shore hardness- waste suction-impact on yarn quality. Ideal Yarn geometry, spinning triangle. Twisting- principles of ring twisting- types of twist- twisted yarn structure- twist and strength relationship-twist multiplier. Twisting elements- spindle, its structure and type, spindle drive, rings, travellers, separators, ballon control ring Cop building- structure of cop, formation and mechanism.	**12 Hours**

Manual doffing-end breaks- temperature and humidity requirements Auto Doffing- Concept of Link coners-Modern development in ring frames-Long frames-Individual Spindle monitoring for production Drafts, Speeds, Settings and Production Calculation.	
Practical 1. Evaluation of draft distribution & production calculation in ring frame 2. Demonstrate calculated twist and actual yarn twist of yarn production.	**6 Hours**

COMPACT SPINNING **Theory** Objectives of Compact Spinning. Principle and Introduction - spinning triangle. Working principles of different types of compact spinning systems- Suction, Mechanical, Magnetic-Suessen EliTe- Rieter Comfor Spin-Zinser- RoCos-LMW Spinpact. Structure and yarn properties of compact yarns. Compact spinning and Twisting: EliTwist yarn, Com4 Yarn, Core Spun Yarn, Process Improvements with Compact Yarn, Applications of compact yarn - Techno economics of compact spinning.	**6 Hours**
Practical 1. Analysis of working mechanism and principle of compact spinning system. 2.Justify the structural and few properties enhancement in compact yarn in comparison with ring spun yarn through analysis. 3. Comparison of Elitwist yarn and equivalent double yarns.	**6 Hours**
ROTOR SPINNING **Theory** Rotor Spinning - Operating principle, Advantages and limitations of Rotor Spinning. Raw material requirements. Machine design features- opening roller, rotor diameter, rotor speed, groove design, profile of doffing tube. Yarn characteristics, Comparison of characteristics of yarn from different spinning systems. Fully automatic and semi-automatic.	**12 Hours**
Practical 4. Evaluation of the calculated production capacity & yarn twist in rotor spinning machine. 5. Justify the structural and property differences of produced yarns between rotor spun and ring spun.	**6 Hours**

OTHER SPINNING SYSTEMS **Theory** Friction Spinning – Dref 2 to Dref 3000-Operating principle, Classification, Advantages and limitations of friction spinning. The Platt Saco Lowell Masterspinner. Disc Spinning. Air-jet spinning – double-nozzle airjet spinning, air vortex - operating principle, Raw material requirements-Automation in air jet spinning (Murata and Rieter)-Yarn Structure-Advantages and limitations. Twist Spinning-SIRO Spinning- Yarn properties and applications. Self-twist spinning: Yarn properties and applications- Repco Spinner. Adhesive Process:	**9 Hours**

Bob Tex spinning. Compound Yarn: Covered spun yarn & core spun. Wrap Spinning: Operating Principle and ParafiL System.	
Practical 1. Compare the properties and structural differences of yarn from the following machines air jet spinning and SIRO spinning. 2. Conduct a detailed study of Ring spun and air jet spun Yarns.	**6 Hours**
WINDING, DOUBLING AND PACKING **Theory** Winding-Purpose, manual and auto winders, packages-cone/cheese, effect of winding on yarn quality, and yarn clearers. Rewinding. Doubling: Need for doubling, twisting -S and Z twists, conventional ring doubling processes and machines-up twister and down twister. Working of Two for One Twister. Yarn Conditioning- Need and basic operating principle of operating yarn conditioning machine. Packing: Various types of packing, automatic packing process, packing material, packing cost, storage.	**6 Hours**
Practical 1. Production and twist calculation in ring doubler and calculation of resultant count. 2. Production and twist calculation of fancy doubler and calculation of resultant count of fancy yarn. 3. Production & twist calculation in TFO and its effect on yarn strength.	**6 Hours**

Theory Hours: 45	**Tutorial Hours: 0**	**Practical Hours: 30**	**Project Hours: 0**	**Total Hours: 75**

Learning Resources
Textbooks:

1. Oxtoby E “Spun Yarn Technology” butter worth’s, London, New Edition 2002.
2. Carl A KLawrence, Fundamentals of Spun Yarn Technology, CRC Press, 2023.

References:

3. Klein. W, Manual of Textile Technology, Short Staple Spinning Series, Vol 4-5, The Textile Institute
4. Handbook of Yarn Production: Technology, Science and Economics, Woodhead Publishing, 2003.
5. Textile and Fashion-Materials, Design and Technology, , Woodhead Publishing, 2015.

4. Chattopadhyay R., Technology of Carding, NCUTE, IIT Delhi, 2003.
5. Chattopadhyay R. (Ed), Advances in Technology of Yarn Production, NCUTE, IIT Delhi, 2002
6. Salhotra K. R. &Chattopadhyay R., Book of papers on “Blow room and Carding” ,IIT Delhi 1998.
7. Duraiswamy I, Chellamani P &Pavendhan A., “Cotton Ginning” Textile Progress, The Textile Institute, Manchester, U.K., 1993.

Assessment (Theory course)
CAT, Activity and Learning Task:Quiz, Case study, MCQ, End Semester Examination (ESE)

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert(s)**
Mr. Gopalakrishnan P Chief General Manager-Quality Control Sri Shanmugavel Group of Mills, Thadicombu-624 709 Dindigul	Dr. J. C. Sakthivel Associate Professor Department of Textile Technology PSG College of Technology Peelamedu Coimbatore - 641004		Prof. A. Pavendhan, Associate Dean-Textile Cluster & Dr. Sivakumar. P, Module Coordinator-Spinning Department of Textile Technology, Kumaraguru College of Technology.
Recommended by BoS on	07.05.2025		
Academic Council Approval	No 28	**Date**	26.06.2025

24TTI207	WEAVING TECHNOLOGY - II	L	T	P	J	C
		3	0	2	0	4
PC		SDG	4, 9, 12, 13			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	To provide foundational knowledge on the classification and working principles of shuttle and shuttleless looms.
2	To enable students to understand the mechanism and salient features of projectile and rapier looms.
3	To impart knowledge on fluid jet weaving machines and analyze their suitability for various fabrics.
4	To provide insights into the operational parameters and engineering considerations for loom shed management.
5	To develop practical skills in analyzing loom components, layout planning, and productivity assessment.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Apply the knowledge of shuttle and shuttleless loom types to illustrate their classification and performance.	Ap
CO 2	Analyze the working cycle and mechanisms of projectile loom to distinguish their functional features.	An
CO 3	Evaluate the rapier loom classifications and mechanisms to recommend suitable applications for fabric types.	E
CO 4	Analyze the air and water jet weaving mechanisms to interpret their	An

	efficiency and fabric suitability.	
CO 5	Evaluate loom shed parameters and layout strategies to assess productivity and cost-effectiveness.	E
CO 6	Demonstrate the selection and analysis of loom components to develop solutions for practical weaving issues.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	3				3						3	3	
2		3		3	3						3		3
3		3	3		2						3	3	
4		3		3	3								3
5			3							3	3	3	
6		3		3	3						3		

Course Content

FUNDAMENTALS OF SHUTTLELESS LOOM Limitation of shuttle looms-parameters affecting productivity-Classification of shuttleless looms. Comparison of shuttle and shuttleless looms - warp and weft yarn requirement for shuttleless weaving. Weft accumulators – types- Unconventional selvedge formation. Multiphase weaving machine- Types, warp shed wave and weft shed wave principle. circular weaving machines.	**9 Hours**
Practical Component: 1. Analyze the warp and weft yarn selection for shuttleless loom. 2.. Study of weft accumulator and selvedge formation in shuttleless loom.	**6 Hours**
PROJECTILE LOOM Gripper projectile machines: Working elements and weft insertion cycle in projectile loom. Torsion bar picking mechanism-Weft selection device-Salient features of projectile machine, Loom timing diagram. Matched cam Shedding mechanism- Cam	**9 Hours**

beat-up mechanism.	
Practical Component: 1. Study of weft insertion system and sequence of operations in a projectile Loom. 2. Study of torsion bar picking mechanism.	**6 Hours**

RAPIER LOOM Rapier Machines: - Classification of rapier weaving machines: Flexible, Rigid rapiers-Principles of tip and loop transfer-Weft insertion cycle-Rapier drives-movement pattern of weft in rapier picking system -Salient features.	**9 Hours**
Practical Component: 1. Study of weft insertion system and sequence of operations in a rapier loom 2. Study of rapier drive- single and double rapier system.	**6 Hours**
FLUID JET LOOMS Jet weaving Machines-Principle of air jet weaving, air nozzles, auxiliary nozzles, profile reed. Air requirements. Suitability of air jet weaving for different fabrics. Principle of water jet weaving – Weft insertion cycle for water jet –Salient features-Water requirements - Suitability of water jet weaving for different fabrics.	**9 Hours**
Practical Component: 3. Study of weft insertion system and sequence of operations in air jet loom. 4. Analyze the quality requirements for fluid jet looms (air / water jet).	**6 Hours**
LOOM SHED MANAGEMENT Fabric engineering-calculation of heald, reed, loom, weft insertion rate and production, Fabric costing. Weaving plant layout, ventilation and humidification, lighting, Material handling, quick style change, loom productivity, fabric inspection system. Loom monitoring and control.	**9 Hours**
Practical Component: 1. Prepare the layout for 200 loom shed. **2.** Calculate the fabric cost and productivity of loom shed.	**6 Hours**

Theory Hours: 45	**Tutorial Hours:** **0**	**Practical Hours:** **30**	**Project Hours:** **0**	**Total Hours:** **75**

Learning Resources
Textbooks:

1. Adanur, S. Handbook of Weaving. CRC Press, 2001.
2. Ormerod, A., and Sondhelm, W.S. Weaving Technology and Operations.CRC Press. 1988.
3. Majumdar, A. Principles of Woven Fabric Manufacturing. CRC Press, 2016.

References:

4. Ajgaonkar, D.B. Textile Manufacturing Processes. Woven Fabric Tech Publications, India, 2022.
5. Talukdar, M.K., Sriramulu, P., and Ajgaonkar, D.B. Winding and Warping. Textile Trade Press, India, 2020.
6. Banerjee, P.K. Principles of Fabric Formation. CRC Press, 2015.
7. Booth, J.E. Textile Mathematics (Volume III). Textile Institute.

Assessment (Embedded course)
CAT, Activity and Learning Task(s)*, Mini project, MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert(s)**
Mr. V. Sembian, Vignesh Super Fabrics, 6/320, Peedampalli Road, Pattanam, Coimbatore-641016.	Dr. N. K. Palaniswamy, Associate Professor, Textile Technology, National Institute of Technology (NIT), Jalandhar, Punjab 144008.		Dr. S. Ariharasudhan Assistant Professor III, Department of Textile Technology, Kumaraguru College of Technology, Coimbatore – 641049.
Recommended by BoS on	07.05.2025		
Academic Council Approval	No 28	**Date**	26.06.2025

24TTI208	TEXTILE DESIGN STRUCTURES	L	T	P	J	C
		2	0	2	0	3
PC		SDG	4, 9, 12, 13			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	To introduce the fundamental concepts of woven fabric structures and design principles.
2	To develop the ability to design and analyze elementary to advanced weave patterns.
3	To explore functional, decorative, and sustainable woven fabric structures relevant to the textile industry.
4	To enhance knowledge of modern techniques in color-and-weave, pile, and double cloth fabric design.
5	To integrate practical skills in fabric analysis and weave structure interpretation using contemporary tools

Course Outcomes		
After successful completion of this course, the students shall be able to		**Revised Bloom's Taxonomy Levels (RBT)**
CO 1	Understand the concepts of cloth geometry, elementary weaves, and basic drafting methods.	R
CO 2	Analyze towel and cord effect fabrics for structural variation and performance.	An
CO 3	Evaluate colour and weave effects for design aesthetics and structural outcomes	E
CO 4	Integrate knowledge of double for advanced textile innovations.	C
CO 5	Design pile fabrics for specific end-uses.	E
CO 6	Perform systematic fabric analysis and reconstruct design, draft, and peg plan for various structures.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	3		3		3						2	2	
2	3	3	3		2						1	2	
3		3	3		3				2			1	
4		2	2	2	2						2		2
5		3	3		3		2					1	1
6		2		3	2								2

Course Content

BASIC WEAVES :	**6 Hours**
Geometry – Cover Factor – Use of Point Paper –Basics details of cloth – Back /Face of the cloth, warp count, weft count, warp crimp, weft crimp, warp cover factor, weft cover factor, Relative cover factor- Calculations-Design-Draft- Peg plan- Types of draft- Straight draft-Pointed draft- Mixed draft- Divided draft- Uses of design-draft and pegplan-Elementary weaves – plain and its derivatives- Design, draft and peg plan for Regular/Irregular -Warp rib- Regular/Irregular weft rib- Regular/Irregular Matt-Ornamentation of plain weave-End uses of plain weave . Definition of Twill-Classification twill- Design, draft and peg plan for Twill derivatives: Pointed twill, Herring bone twill, Broken twill, curved twill, Cork screw Twill, Drill, Denim, transposed twill, Diamond twill- Twill angle and calculation- End uses of twill structures- Satin – Sateen, Difference, Rule forming satin/Sateen, Design, draft and peg plan for regular and irregular sateen/Satin, and Satin stripes and Checks.	

Practical Component: Analysis with respect to -EPI,PPI, GSM, Warp cover factor, Weft cover factor, Warp count, weft count, warp crimp, weft crimp, Design, draft and peg plan 1. Analysis of plain weave structures. 2. Analysis of twill weave structures. 3. Analysis of satin/sateen weave structures.	**4 Hours**
TOWEL FABRIC AND CORD EFFECTS FABRICS: Basic requirement of towel cloth-Classification of towel cloth structures, Design, draft and peg plan for Ordinary Honey comb- Warp way ordinary honey comb, Weft way ordinary honey comb- Special type of ordinary honey comb- Design with even end and even picks with double diagonal base(example 10 ends and 10 picks), design with end or pick with multiple of 4 and with even pick /even end (Example 6 end and 8 picks or 8 end and 6 picks),Ordinary honey comb designed for having straight draft, and Brighten Honey Comb, Comparison of ordinary honey comb with Brighton honey comb- Huck-a-Back and modification. Mock Leno – Distorted Mock leno – Crepe weaves. Definition	**6 Hours**

of crepe, Methods forming crepe, Chemical treatment method, Design, draft and peg plan for Crepe weave by woven design: On sateen base, Floating weave with plain threads, reversing a Motif, imposing of one weave over the other, End used of crepe weave, Cloth Particulars, Bedford cords: Definition-Classification- Design ,draft, peg plan and cross sectional diagram for -Plain Faced bedford cord with pair of pick principle- Plain faced bedford cord with alternate pick principle- Twill faced bedford card with alternate pick principle- plain faced bedford cord with pair of pick /Alternate pick principle- End use applications of bedford cord- welts and piques-Definition- Classification- Design , cross sectional diagram for ordinary welts and piques- Wadded piques – Loose and fast back welts and piques- End use applications of welts and piques- comparison of bedford cord and welts & piques	
Practical Component: Analysis with respect to -EPI,PPI, GSM, Warp cover factor, Weft cover factor, Warp count, weft count, warp crimp, weft crimp, Design, draft and peg plan 1. Analysis of honey comb weave structures. 2. Analysis of Huck a back-weave structures. 3. Analysis of crepe weave structures. 4. Analysis of Bedford cord weave structures.	**4 Hours**
COLOUR AND WEAVE EFFECTS: Spot figuring – Arrangement of figures – Drop Designs Half drop bases – Sateen system of distribution. Colour theory – Light and Pigment Theory – Modification of colour – Colour Schemes-Application of colours – colour and weave effects-Design of: Hair Lines or Pin Stripe effect, Crows Foot Pattern effect, Dog’s Tooth Or Hound’s Tooth Pattern , Shepherd’s Check Pattern, Birds Eye Effect, Stepped Twill Pattern- Designing of Extra warp and Extra weft figuring with two colours- comparison of extra warp and extra weft figured structures ,Design ,draft and peg plan for Backed fabrics: Reversible Warp and Weft backed cloth, Non-reversible Warp and Weft backed cloth.	**6 Hours**
Practical Component: Analysis with respect to -EPI,PPI, GSM, Warp cover factor, Weft cover factor, Warp count, weft count, warp crimp, weft crimp, Design, draft and peg plan 5. Analysis of extra warp figured weave structures. 6. Analysis of extra weft figured weave structures.	**2 Hours**

DOUBLE CLOTH: Double cloth: Classification – Types of stitches-Design, notation, stitch diagram for -Face to back self-stitched double cloth- Back to face self-stitched – Combined stitch (Face to back-Back to face) stitch) double cloth- centre stitched double cloth- warp centre stitched double cloth- weft centre stitched double cloth, wadded double cloth -Purpose of wadding- Design, notation, stitch diagram for warp wadded double cloth -weft wadded double cloth –Ply Fabrics- End uses of double cloth and ply fabrics.	**6 Hours**
Practical Component: Analysis with respect to -EPI,PPI, GSM, Warp cover factor, Weft cover factor, Warp count, weft count, warp crimp, weft crimp, Design, draft and peg plan 1. Analysis of double cloth structures	**2 Hours**

PILE FABRICS:	
Pile fabrics – Factors governing pile height and pile density-Classification of weft pile structures-Design, Uncut and cut cross section for - Plain back velveteen - Twill back velveteen- Weft plush/ Lashed pile- corduroy- Classification of corduroy- Design, Uncut and cut cross section for V shape, W shape, Combined W and V shape corduroy-calculation of tuft per unit area-End uses of corduroy- Post operations of velveteen fabric- Warp pile, Fast wire pile – Design, draft and peg plan for Terry weaves – Terry stripe and checks. Comparison of warp and weft pile- Applications of warp and weft pile fabric	**6 Hours**
Practical Component: Analysis with respect to -EPI,PPI, GSM, Warp cover factor, Weft cover factor, Warp count, weft count, warp crimp, weft crimp, Design, draft and peg plan 1. Analysis of Velvet velveteen structures 2. Analysis of velveteen structures	**3 Hours**

Theory Hours:	30	Tutorial Hours:	0	Practical Hours:	15	Project Hours:	0	Total Hours:	45

Learning Resources

Textbooks:

1. Grosicki Z.J., “Watson’s Textile Design and Colour”-Volume 1 – Butterworths London, 1988.
2. Grosicki Z J, “Advanced Textile Design and Color” Volume 2– Butterworths London, 2004.

References:

3. Goerner D, “Woven Structure and Design”, Part – I – WIRA, 1986
4. Jacquire Wilson, “ Hand Book of Textile Design, Woodhead Publishing Ltd, 2001.
5. Robert Beameront, “Colour in Woven Design” Whittaker & Co, 1972.
6. B.K.Behra and P.K.Hari, “Woven Textile Structure (Theory and Application), Woodhead Publishing Limited, 2010.
5. J Herbert Cooke, “Velvet and Corduroy”, Sir issac pitman & Sons Ltd, London

Assessment (Embedded course)
CAT, Activity and Learning Task(s)*, Mini project, MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by		
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**
Mr. V. Sembian, Vignesh Super Fabrics, 6/320, Peedampalli Road, Pattanam, Coimbatore-641016.	Dr. P. Ganesan Assistant Professor, Textile Technology, PSG College of Technology, Peelamedu, Coimbatore-641049	Dr. S. Sundaresan Associate Professor Department of Textile Technology, Kumaraguru College of Technology, Coimbatore – 641049.

Recommended by BoS on	07.05.2025		
Academic Council Approval	No 28	**Date**	26.06.2025

24TTI209	KNITTING TECHNOLOGY	L	T	P	J	C
		3	0	2	0	4
PC		SDG	4, 9, 12, 13			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	To understand the basic concepts and comparisons of weft and warp knitting with woven fabrics.
2	To study the mechanisms and operations of various weft and warp knitting machines.
3	To analyze weft and warp knitted structures, including technical and symbolic representations.
4	To examine dimensional and production parameters of knitted fabrics.
5	To introduce sustainable and emerging knitting technologies for technical textiles and apparel.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Compare knitting with woven fabrics and differentiate between warp and weft knitting	U
CO 2	Explain and demonstrate the working of weft knitting machines and their components	An
CO 3	Identify and represent basic and derivative weft knitted structures and analyze their behavior	Ap
CO 4	Explain the fundamentals of warp knitting and compare different warp knitting machines	

		U
CO 5	Analyze and represent warp knitted structures using chain link notation and their applications	An
CO 6	Operate circular and socks knitting machines to produce and analyze knitted samples	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	2	2									2	2	2
2	2		1		2						2	2	2
3	2	2	2	2							2	2	2
4	2	2									2	2	2
5	2			2	2						2	2	
6					2			2			2	2	

Course Content	
INTRODUCTION Concept of knitting – Weft knitting, warp knitting - Comparison between woven and knitted fabric. Comparison of warp and weft knitting -Knitting needles: spring beard, latch, compound needles, Knitting cycle of latch, spring bearded and compound needle Classification of knitting machines. General definitions and elements of knitted loop structure- Yarn quality requirements for weft knitting.	**9 Hours**
Practical Component: 1. Analyze 2 woven and 2 knitted fabric samples; record observations (stretch, structure, hand feel) 2. Collection of knitted samples, visualization, analysis and their commercial names.	**6 Hours**

WEFT KNITTING Knitting Elements: Cylinder, knitting cam, sinker, feeder, stop motions. Working of plain, rib and interlock knitting machine. Pattern wheel, punched steel tape jacquard - Electronic Jacquard knitting machines- Fundamentals of formation of knit, tuck and float stitches- Basic principles and elements of flat knitting machines- Different types of flat knitting machines; mechanical and computerized knitting machines.	**9 Hours**
Practical Component: 3. Operate Circular Knitting Machine to Produce Single Jersey Fabric. 4. Knit basic Socks Sample and Record Process Parameters	**6 Hours**

WEFT KNITTED STRUCTURES Weft knit structures-Technical terms and symbolic representation of weft knit structures Characteristics of plain, rib, Interlock, purl knit structures- Derivatives of weft knit structures: lacoste, accordion and check effect -Faults in knitted fabrics and their causes and remedies - dimensional parameters such as stitch length, WPI, CPI, stitch density, GSM- Effect of Stitch Lengths and Yarn Counts on GSM, WPI and CPI- Selection of suitable machine gauge by considering GSM, shrinkage, and spirality of knit fabric-Tightness factor-spirality-Production calculations of weft knitting.	**9 Hours**
Practical Component: 1. Analyze Physical Characteristics of the given Weft Knit Structures 2. Analyze Fabric Faults in Circular Knitted Fabric and Recommend Remedies 3. Calculate Production per Shift of Circular Knitting Machine.	**8 Hours**
WARP KNITTING Warp knitting machines: needle bar, sinker bar, guide bar –pattern wheel –chain link-Warp knitting fundamentals- Knitting cycle for warp knitting- closed lap and open lap stitches – Raschel, compound needle and Tricot knitting machines- Comparison of raschel and tricot knitting machines. Materials for warp knitting-direct warping and indirect warping for warp knitting. Rack, run-in, quality, production calculations of warp knitting.	**9 Hours**
Practical Component: 4. Analyze Physical Characteristics of the given single bar warp Knit Structures 5. Analyze Physical Characteristics of the given double bar warp Knit Structures	**6 Hours**
WARP KNITTED STRUCTURES Representation of warp knit structures – chain link notation – basic warp knitted structures single for fabrics; Chain or pillar stitch and atlas lap - Two bar structures; Full tricot-Lock knit-Reverse lock knit-Satin. Application of weft and warp knit fabric in Technical Textiles. Introduction to seamless knitting, principles and machine working, garment shaping techniques, applications, advantages and limitations, sustainability benefits	**9 Hours**
Practical Component: 1. Comparison of given Two-Bar Warp Knit Structures Based on Chain Link Notation	**4 Hours**

Theory Hours:	Tutorial Hours:	Practical Hours:	Project Hours:	Total Hours:
45	0	30	0	75

Learning Resources
Textbooks:
1. David J. Spencer, *“Knitting Technology”*, Woodhead Publishing, 4th Edition, 2001. 2. Sadhan Chandra Ray, *“Fundamentals and Advances in Knitting Technology”*, CRC Press, 2012. 3. Dr. S. Raz, *“Warp Knitting Production”*, Melliand Textilberichte (via Karl Mayer), 1987. 4. Dr. N. Anbumani, *“Knitting Fundamentals, Machines, Structures and Developments”*, New Age International, 2006.

References:
1. **Ajgaonkar D. B.,** *"Knitting Technology"*, Universal Publishing Corporation, 1998. 2. **K. F. Au,** *"Advances in Knitting Technology"*, CRC Press, 2011.

Assessment (Embedded course)
CAT, Activity and Learning Task(s)*, Mini project, MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by		
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**
Mr. Manikandan, Shahi Exports Private Limited, Sarjapur - Marathahalli Rd, Bellandur, Bengaluru, Karnataka 560103	Dr. N. K. Palaniswamy, Associate Professor, Textile Technology, National Institute of Technology (NIT), Jalandhar, Punjab 144008.	Dr. S.Natarajan Assistant Professor III, Department of Textile Technology, Kumaraguru College of Technology, Coimbatore – 641049.

Recommended by BoS on	07.05.2025		
Academic Council Approval	No 28	**Date**	26.06.2025

24INM202	ENVIRONMENTAL SCIENCE AND SUSTAINABILITY (Common to All Branches)	L	T	P	J	C
		1	0	2	0	2
HS		SDG	6, 13, 15			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	To introduce the importance, types, and conservation strategies of natural resources, with a focus on sustainable practices in water and food management.
2	To understand the structure and function of ecosystems and biodiversity, and explore the need for conservation through the study of hotspots and global environmental concerns.
3	To examine the causes and effects of environmental degradation, including pollution and waste management, and to promote mitigation strategies for sustainable development.
4	To provide knowledge of the legal and institutional frameworks for environmental protection in India and globally, including critical environmental acts and enforcement challenges.
5	To explore conventional and alternative energy resources, and to assess methods for energy conservation and carbon footprint reduction through audits and sustainability measures.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO1	Apply the concept of natural resource conservation to demonstrate sustainable practices	Ap
CO2	Analyse the structure, function, and adaptive capacity of ecosystems to categorize threats and conservation strategies for biodiversity.	An
CO3	Analyse various forms of environmental degradation and propose management and preventive solutions.	An
CO4	Apply national environmental laws and frameworks in the personal and professional contexts	Ap

CO5	Design strategies using renewable energy principles to develop sustainable energy utilization plans through audits and footprint analysis to transfer a healthy environment for future generations.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	2	–	–	–	–	2	3	–	1	–	–	2	–
2	2	2	–	–	–	2	3	1	–	–	–	2	2
3	2	3	–	2	–	3	3	1	–	–	–	2	3
4	–	2	–	–	–	3	3	3	1	2	2	–	2
5	2	2	3	2	2	3	3	–	1	2	2	2	2

Course Content

NATURAL RESOURCES	**3 Hours**

Introduction to Natural resources : Types, significance, and conservation strategies
Water resources: Utilization, management practices, and conservation strategies - rainwater harvesting methods.– Water distribution system audit

Food resources: Challenges of food security in India - impact of modern agriculture, and environmental concerns related to fertilizers and pesticides.

Practical Component:

- Parameter Testing : Water / Effluent / Soil/Fertiliser
- Simulation Experiments
- Online Course

10 Hours

ECOSYSTEM AND BIODIVERSITY **Ecosystem:** Structure and function of an ecosystem - ecosystem resilience and adaptive capacity **Biodiversity:** Values of biodiversity - Hot Spot of biodiversity (in the Himalayas, the Western Ghats, the Indo-Burma region, and the Gulf of Mannar) - Threats to biodiversity. **Conservation Strategies:** Emerging Issues in Biodiversity Conservation - Citizen science - In-situ and Ex-situ conservation of biodiversity. **Practical Component:** • Documentation of biodiversity in the campus	**3 Hours** **6 Hours**
ENVIRONMENTAL DEGRADATION AND MANAGEMENT **Pollution**: Causes, effects and control measures of Air pollution, Water pollution - Role of an individual in prevention of pollution **Waste management**: Circular Economy vs. Linear Economy - Disposal of solid wastes - Treatment of Liquid wastes **Disaster Management**: Mitigation strategies and Readiness **Practical Component:**	**3 Hours**

• Waste Management and Resource recovery in Campus • Documentation of Environmental Data Resources and Monitoring Tools.	**6 Hours**
LEGAL FRAMEWORK FOR ENVIRONMENTAL PROTECTION IN INDIA **Global and National Initiatives**: United Nations Sustainable Development Goals - Coastal Regulation Zone - Environmental impact assessment **Environmental Legislation in India**: Key Legal and Regulatory Terminology in India – Valuation of Ecosystem Services and integration of Acts in the workplace - Plastic Waste Management Rules - E-Waste Management Rules - Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act **Implementation Challenges**: Issues involved in enforcement of environmental legislation **Practical Component:** • Online Course	**3 Hours** **2 Hours**
ENERGY MANAGEMENT **Energy Resources:** Energy Demand and Urban energy Challenges - Necessity of alternate energy methods - Renewable and Non- renewable energy resources - Carbon footprint and carbon credit – Sustainable energy utilization – Case study **Energy Audits** – Purpose, methodology, and common instruments used **Practical Component**: • Documentation of Energy usage through Carbon foot print calculation - Personal aswell as Institutional	**3 Hours** **6 Hours**

Theory		Tutorial		Practical		Project		Total	
Hours:	**15**	**Hours:**	**0**	**Hours:**	**30**	**Hours:**	**0**	**Hours:**	**45**

Learning Resources
References:

1. Bharucha, E. (2021). Textbook of environmental studies for undergraduate courses (3rd ed.). Orient BlackSwan / Universities Press - Hyderabad, India.
2. Miller, G. T., & Spoolman, S. E. (2014). Environmental science (14th ed.). Cengage India
3. Anubha Kaushik & C.P. Kaushik (2024). Perspectives in Environmental Studies (8th ed.). New Age International Publishers, New Delhi.
4. Masters, G. M., & Ela, W. P. (2013). Introduction to environmental engineering and science (3rd ed.). Pearson Education, New Delhi.
5. Leelakrishnan, P. (2018). Environmental law in India (3rd ed.). LexisNexis Butterworths, New Delhi.
6. Botkin, D. B., & Keller, E. A. (2014). Environmental science: Earth as a living planet (9th ed.). Wiley, Hoboken, NJ.
7. Armstrong, J. (2023). The future of energy: The 2023 guide to the energy transition. Independently published.
8. Easton, T. (Ed.). (2017). Taking sides: Clashing views on environmental issues (17th ed.). McGraw-Hill Education, New York, NY.
9. Ishwaran, N. (2022). Ecosystem services and economic valuation. New Delhi: TERI Press.

Online Resources (Weblinks)
https://www.youtube.com/watch?v=j4Z6WmTnhRQ How to Conduct a Water Audit in Institutions • https://www.youtube.com/watch?v=_OKYio2Yk9U India's Food Security Challenge • https://www.youtube.com/watch?v=IjNT9Z2OLf4 India's Biodiversity Hotspots • https://www.youtube.com/watch?v=_c_sJIEJY4M What is Citizen Science? • https://www.youtube.com/watch?v=1HZR3GyzFZc What is a Circular Economy • https://www.youtube.com/watch?v=6_tLYyR_3Vo Environmental Law and Acts in India

Assessment (Embedded course)
CAT, Activity and Learning Task(s), MCQ, End Semester Examination (ESE) Lab Workbook, Report Submission

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert(s)**
Dr. Muthuraja Perumal General Manager - Research & Development Rohith Industries, APIIC Industrial Park, Andhra Pradesh	Dr. Mathivanan Packiarajan University of Michigan Ann Arbor, MI USA Dr. Venkatakrishnan Professor, School of Chemical Sciences Indian Institute of Technology (Mandi) Himachal Pradesh India		Faculty Of Chemistry Department of Chemistry
Recommended by BoS on	07.05.2025		
Academic Council	No. 28	**Date**	26.06.2025

Approval			

24HSP006	MASTERING GROUP DISCUSSION AND PRESENTATION SKILLS	L	T	P	J	C
		0	0	2	0	1
Practical		SDG	4 & 8			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	

Course Objectives:	The purpose of taking this course is to:
1	To equip learners with techniques for organizing and presenting ideas effectively, ensuring logical flow and engaging delivery through appropriate visual and verbal strategies.
2	To enhance students' ability to evaluate diverse viewpoints and articulate reasoned arguments, fostering meaningful participation in collaborative discussions.
3	To strengthen students' ability to adapt their speaking style and content to different audiences and contexts, utilizing digital tools for enhanced presentation effectiveness.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Create and deliver structured presentations with a clear introduction, body, and conclusion, utilizing effective visual tools and appropriate pacing to enhance clarity and impact.	C
CO 2	Analyse issues from multiple perspectives, articulate ideas effectively within group discussions	An
CO 3	Deliver confident presentations and speeches in professional and social settings, leveraging digital tools and technologies to enhance quality and effectiveness.	Ap

Cou rse	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)										Program Specific Outcomes (PSO)
	1	2	3	4	5	6	7	8	9	10	11	

	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1		2			1	2		3	3		3		
2		2			1	2		3	3		3		
3		2			1	2		3	3		3		

Course Content

MODULE 1 **Introduction to Group** Discussions - Key skills for effective participation - Phases in a GD - Conversational Phrases in GD. **Group Dynamics** - Understanding group roles and dynamics - Conflict resolution and management in groups - Techniques for fostering collaboration.	**6 Hours**

Presentations - Introduction to Visual Aids and Technology in Presentations. **Delivery Techniques** - Voice modulation and speech clarity - Body language and gestures – audience analysis. **Handling Q&A Sessions** - Preparing for audience questions - Techniques for handling difficult questions - Mock Presentation with Q&A sessions.	
MODULE 2 **Factual Group Discussions**: Focus on sharing and verifying accurate information on a given topic. Participants base their contributions on verifiable data and concrete evidence. **Opinion-based / Argumentative Group Discussion**: Encourages participants to express and defend their point of view on a topic. Evaluate different perspectives and build critical thinking skills.	**6 Hours**
MODULE 3 **Case Study Group Discussion**: Involves analyzing the complexities, identifying key issues, and developing insights or solutions based on the group's collective knowledge. **Abstract Discussion**: Deals with intangible concepts, ideas, or themes without concrete reference points. Encourages creative thinking and theoretical exploration.	**6 Hours**
MODULE 4 **Impromptu Presentations**: Participants speak on a given topic with little to no preparation. Helps develop quick thinking and effective communication skills. **Informative Presentation**: Aims to educate the audience on a specific topic by providing clear, factual information. The focus is on clarity, accuracy, and comprehensiveness. **Demonstrative Presentation**: Interactive sessions where participants engage in hands-on activities to learn practical skills. Often includes exercises, demonstrations, and collaborative tasks.	**6 Hours**

MODULE 5 **Training and Technical Presentation**: Designed to teach specific technical skills or procedures. Includes detailed instructions, demonstrations, and may involve technical jargon. **Academic Presentation**: Involves presenting research findings or theoretical concepts in an academic setting. Emphasizes clarity, evidence-based arguments, and adherence to scholarly standards. **Pitch Presentation:** A concise, persuasive presentation aimed at securing support, investment, or approval. Focuses on the value proposition, potential benefits, and unique selling points. **Persuasive Presentation**: Seeks to convince the audience to adopt a particular viewpoint or take a specific action. Utilizes logical arguments, emotional appeals, and credible evidence. **Multimedia Presentations**: Uses visual and auditory media to convey information and present arguments. Enhances engagement and aids in illustrating complex concepts.	**6 Hours**

Theory Hours:	**-**	**Tutorial Hours:**	**-**	**Practical Hours:**	**2**	**Project Hours:**	**-**	**Total Hours:**	**30**

Learning Resources*
Reference books/ Web Links
1. Powell, M. (2010). Dynamic presentations student’s book with audio CDs (2). Cambridge University Press. 2. Reynolds, G. (2011). Presentation Zen: Simple ideas on presentation design and delivery. New Riders. 3. Galanes, G. J., Adams, K., & Brilhart, J. K. (2020). Effective group discussion: Theory and practice (15th ed.). McGraw-Hill Education. 4. Adams, K., & Galanes, G. (2018). Communicating in groups: Applications and skills, a practical guide (18th ed.). McGraw-Hill Education. 5. Ivy, D. K., & Backlund, P. (2018). Speak with confidence: A practical guide. Pearson. 6. Reynolds, G. (2019). Presentation Zen: Simple ideas on presentation design and delivery. New Riders.
Online Resources
7. https://www.coursera.org/learn/verbal-communications-and-presentation-skills 8. https://www.coursera.org/learn/present-with-purpose 9. https://www.coursera.org/learn/teamwork-skills-effective-communication

Assessment	
Formative	Summative
-----	1. Participation in group discussions (40%) 2. Individual presentations (40%) 3. Quizzes and written assignments (20%)

Course Curated By		
Expert(s) from Industry	**Expert(s) from Higher Education Institutions**	**Internal Expert(s)**
Mr. Bhuvana Sundar Soorappaiah Program Manager Bosch, Coimbatore	Dr Kishore Selva Babu Head and Associate Professor Department of English and Cultural Studies Christ University Bangalore-560029	Dr. J Srikala- AP III Dr. C Tissaa Tony - AP III Dr. S G Mohanraj – AP III Dr. S Sreejan – AP III Dr. R Hema – AP II Dr. A S Mythili - AP II

Reccomended by BoS on	25.04.2025		
Academic Council Approved	**No 28**	**Date**	**26.06.2025**

			L	T	P	J	C
24INP202	**Innovation Practicum - 4**		**0**	**0**	**2**	**0**	**1**
ES			**SDG**	**4, 9**			

Pre-requisite courses	**24INP201**	**Data Book / Code book (If any)**	**-**

Course Objectives:	
The purpose of taking this course is to:	
1	Learn and apply the Forge Innovation Handbook (FIH) to problem-solving.
2	Develop a minimum usable prototype (MUP) through iterative design, development, and testing.
3	Effectively demonstrate the developed MUP.

Course Outcomes		
After successful completion of this course, the students shall be able to		**Revised Bloom's Taxonomy Levels (RBT)**
CO1	Apply the FIH to identify and solve problems.	Ap
CO2	Create, design, build, and demonstrate a MUP.	C
CO3	Communicate and present project outcomes effectively.	E

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)	
	1 Engineering Knowledge	2 Problem Analysis	3 Design/Development of Solutions	4 Conduct Investigations of Complex Problems	5 Engineering Tool Usage	6 The Engineer and The World	7 Ethics	8 Individual and Collaborative Team work	9 Communication	10 Project Management and Finance	11 Life-Long Learning	PSO-1	PSO-2
1	3	2	2	2	2								
2			3	2			2		2			2	
3									2	3	2		2

Course Content	
Innovation fundamentals **Master Class #1:** Explore the core concepts of product design and development. **ster Class 2:** Introduction to the Forge Innovation Handbook (FIH) and its applications. **rkshop 1:** Utilize the FIH Canvas to identify challenges, validate problems, understand user needs, and define pain points, gains, and value propositions. **#**	**3 Hours**
Advanced prototyping techniques **Master Class #3:** Rapid Prototyping Techniques - 1. **Master Class #4:** Rapid Prototyping Techniques - 2. **#** **k Time 1:** Engage in hands-on experimentation to test core assumptions, refine the Proof of Concept (PoC). Incorporate rapid prototyping techniques and iterate on the design to enhance functionality.	**6 Hours**

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llectual property and Proof of concept **Master Class 5:** Gain insights into intellectual property (IP) and prior art search. **k Time 2:** Develop and refine a working prototype. Build a Minimum Usable Prototype (MUP) based on feedback and iteration.	**6 Hours**
Build Minimum Usable Prototype (MUP) **k Time 3:** Enhance the prototype through iterative improvements. Utilise feedback from mentoring sessions to make targeted adjustments and refinements, optimising the prototype's functionality and design based on practical insights. **k Time 4:** Develop the Minimum Usable Prototype (MUP). Build the final version of the	**7 Hours**

MUP incorporating all iterative refinements. Ensure that it meets the defined criteria and is ready for comprehensive testing and presentation.	
Perfect pitch and Product showcase **#** **k Time 5:** Conduct a final demonstration and technical testing of the prototype. Create a compelling pitch to articulate the value proposition and potential impact of the innovation, aimed at securing support or funding. **Pitch Presentation and MUP Demonstration:** Students showcase their completed prototype through a comprehensive demonstration, highlighting its key features and functionalities to Industry experts, incubators and investors. They deliver a compelling pitch that clearly communicates the innovation's impact, market potential, and benefits. This presentation aims to effectively convey the value of the prototype, engage potential stakeholders, and secure support or funding opportunities	**8 Hours**

Theory Hours:	**0**	**Tutorial Hours:**	**0**	**Practical Hours:**	**30**	**Project Hours:**	**0**	**Total Hours:**	**30**

Learning Resources

References:

Text Books

1. Rapid Prototyping And Engineering Applications: A Toolbox For Prototype Development - Frank W.Liou, 2007
2. Rapid Prototyping Technology: Selection And Application - COOPER K. G, 2001

References

3. Jazz Factory - All about Presentations and http://blog.jazzfactory.in/
4. Pretotyping Methodology - https://www.pretotyping.org/methodology.html
5. How to give a killer presentation - https://hbr.org/2013/06/how-to-give-a-killer-presentation
6. Evaluating Product Innovations — proof, potential, & progress:https://blog.forgeforward.in/evaluating-product-innovations-e8178e58b86e

Assessment (Practical course)
Lab Workbook, Experimental Cycle tests, viva-voce

<table>
<tr><th colspan="4">Course Curated by</th></tr>
<tr><th>Expert(s) from Industry</th><th colspan="2">Expert(s) from Higher Education Institution</th><th>Internal Expert(s)</th></tr>
<tr><td>Dr. Mahesh Veezhinathan
Director Forge. Academy</td><td colspan="2">-</td><td>Dr. Samuel Ratna Kumar P S Assistant Professor – III Department Mechanical Engineering</td></tr>
<tr><td>Recommended by BoS on</td><td colspan="3">07/05/2025</td></tr>
<tr><td>Academic Council Approval</td><td>No: 28</td><td>Date</td><td>26/06/2025</td></tr>
</table>

SEMESTER V

24TTI301	GARMENT MANUFACTURING TECHNOLOGY	L	T	P	J	C
		3	0	2	0	4
PC		SDG	4, 9, 12, 13			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:

The purpose of taking this course is to:

1	To establish foundational knowledge of garment construction processes, from pattern development and pre-production to final finishing and packing.
2	To impart knowledge on marker planning, fabric spreading, and cutting technologies used in garment manufacturing.
3	To analyze the relationship between machine parameters, material properties, and the quality of stitches and seams in various sewing operations.
4	To evaluate various garment joining, finishing, and pressing techniques, emphasizing efficient, **sustainable**, and quality-driven industrial practices.
5	To develop practical skills in garment prototyping, quality control auditing, and productivity assessment relevant to modern apparel industry needs.

Course Outcomes

After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Apply the principles of manual pattern drafting, grading, and sizing systems to develop patterns for different categories of apparel	K3
CO 2	Analyze fabric spreading and cutting operations, and compare cutting technologies.	K4
CO 3	Analyze the mechanism of different industrial sewing machines, stitch formations, and feed systems to diagnose and resolve common stitch and seam defects.	K4
CO 4	Evaluate the selection criteria for both traditional and sustainable apparel accessories (threads, interlinings, closures) and their impact on garment performance and environmental footprint.	K5
CO 5	Evaluate advanced fusing, pressing (including 3D pressing), and garment finishing technologies to ensure high-quality, defect-free, and dimensionally stable final garments.	K5
CO 6 **(Practical)**	Create a complete garment prototype, from pattern development and digital marker planning to finishing and quality audit, demonstrating proficiency in all manufacturing stages (K6).	K6

Co urs	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)
	1	2	3	4	5	6	7	8	9	10	11	

	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	2	2	2		2				1			2	2
2		2		1	3					1			3
3	2	2		2	1							1	
4			1			1	2		1			1	
5			1	2	1					1			1
6	1	1	1	2	1			1	1	1	1	1	2

Course Content	
PATTERN MAKING & DESIGN Introduction to Garment Manufacturing: Pattern making: Definition - Head theory - Measuring of sizes and Size chart - Seam allowances - 3D body scanning for sizing and virtual try-on - Manual Drafting, Grading, and Draping - Grain lines - Dart manipulation. Development of Patterns: Kids wear (Baby's Frock) - Men's wear (Shirt and Trouser) - Women's wear (Plain Skirt). Introduction to digital pattern concepts (Lectra/Gerber/CLO/Style2D/REACH CAD,TukaTech etc – awareness).	**9 Hours**
Practical Component: 1. Developing patterns for Kids wear: Baby frock. 2. Developing patterns for Men's wear: Shirt and Trouser.	**6 Hours**
CUTTING TECHNOLOGY Material Handling and Automated Spreading Systems. Spreading: Requirements and Methods - Types of spreading and lay - Lay limit. Marker planning: Requirements and Methods - Marker efficiency - Advantages of Computer Aided Marker Planning. Cutting: Objectives - Methods - Cutting machines - Straight knife - Round knife - Band knife - Die cutting - Computer Controlled Cutting (CNC, Laser Cutting, Plasma) - Automated systems (Lectra, Gerber, Tuka, Reach CAD) - Integration of 3D Body Scan data with CAD/CAM.	**9 Hours**
Practical Component: 1. Developing patterns for Women's wear: Plain Skirt. 2. Prepare manual marker plan for plain /check/stripe fabric. Optimization of marker efficiency by trial-and-error method and simulation in CAD system.	**6 Hours**

SEWING TECHNOLOGY Definition of Stitch and Seam - Stitch and Seam classifications (ISO 4915 & 4916). Classification of Sewing Machines - based on application, based on bed type. Basic stitching machine - parts and their functions. Mechanism of stitch formation (Lock Stitch, Chain Stitch, Overlock, Flatlock). Feed system: Drop feed - Unison feed - Differential feed - Compound feed - Puller feed - Automated Sewing and Robotics in Assembly. Stitch and seam defects - causes and remedial measures-SAM/SMV awarness.	**9 Hours**
Practical Component: 1. Demonstrate sewing operation in Single Needle Lock Stitch Machine. Machine adjustments: Threading, SPI, and Tension. 2. Demonstrate Sewing operations in Overlock and Flat lock machines. Machine adjustments: Threading, SPI, and Tension setting.	**6 Hours**
APPAREL ACCESSORIES & TECH PACK Needle – types and selection. Sewing thread – types and applications - Ticket number. Supporting materials & Closures: Buttons - Zippers - Velcro - Hook and eye - Hook and Bar - Fasteners - Closures - Lining - Interlining (Fusible vs. Non-Fusible, Sustainable Interlining)- Wadding - Tapes - Elastic - Popular brands. Trims and Accessories-Tech Pack.	**9 Hours**
Practical Component: 1. Prepare a Trim Card and a full Technical Specification Sheet (Tech Pack) for one chosen garment. **2.** Construction and labelling of standard seam types (plain, lapped, bound, flat) as per ISO 4916	**6 Hours**
FUSING, PRESSING, PACKING & QUALITY Fusing: Means - Equipment (Flat Bed, Rotary Press) and Methods - Requirements (Temp, Pressure, Time) - Fusing defects and remedies. Pressing: Purpose - Categories - Means - Equipment and methods (Steam Iron, Vacuum Table, Buck Press, Form Press, 3D Pressing) - Pleating - Permanent press/Finishing. Sustainable Finishing Processes (e.g., Ozone, Laser). Packing: Method - Types - Components of packing - Sustainable Packaging Materials. Quality Control: Final Garment Audit (AQL), Measurement Check.	**9 Hours**
Practical Component: **1.** Study and demonstration on fusing and pressing machines (Rotary Press, Vacuum Table). Identification and analysis of fusing defects. **2.** Conduct final garment quality audit (AQL standard, Measurement Check, and Care Labeling Compliance).	**6 Hours**

Theory Hours:	45	**Tutorial Hours:**	0	**Practical Hours:**	30	**Project Hours:**	0	**Total Hours:**	75

Learning Resources
Textbooks:
1. Nayak, Rajkishore, and Rajiv Padhye, editors. Garment Manufacturing Technology. Woodhead Publishing (Elsevier), United Kingdom, 2015. 2. Tyler, David. Carr and Latham's Technology of Clothing Manufacture. 5th ed., Wiley-Blackwell, United Kingdom, 2021.

3. Aldrich, Winifred. Metric Pattern Cutting for Women's Wear. 6th ed., Wiley-Blackwell, United Kingdom, 2015.

References:

1. Cooklin, Gerry, Steven George Hayes, and John McLoughlin. Introduction to Clothing Manufacture. 4th ed., Wiley-Blackwell, United Kingdom, 2016.
2. Solinger, Jacob. Apparel Manufacturing Handbook: Analysis, Principles and Practice. Van Nostrand Reinhold Company, United States, 1988.
3. Laing, R.M., and J. Webster. Fundamentals of Stitches and Seams. The Textile Institute, United Kingdom, 1998.
4. **Ramesh Babu, V.** Industrial Engineering in Apparel Production. 1st ed., Woodhead Publishing Ltd., Cambridge, United Kingdom, 2012. ISBN: 9780857091079
5. Ramesh Babu, V., and S. Sundaresan. Home Furnishing. Woodhead Publishing India in Textiles Series, CRC Press/Woodhead Publishing India, Boca Raton, FL, USA, 2018. ISBN: 9789385059285.
6. Ramesh Babu, V., and A. Arunraj. Fashion Marketing Management. Woodhead Publishing India Pvt. Ltd., New Delhi, India, 2019. ISBN: 9789385059490.
7. **Ramesh Babu, V.** Smart Solutions in Textile and Apparel: Real-World Challenges and Problem-Based Learning. CRC Press, Boca Raton, FL, USA, 2026. ISBN: 9781041349198
8. **Ramesh Babu, V., and A. Arunraj.** Apparel Quality Management. 1st ed., Woodhead Publishing India Pvt. Ltd., New Delhi, India, 2023. ISBN: 9788196148980

Recommended online Courses

Platform	**Course Name**	**Relevance**
NPTEL (Swayam)	**Apparel Designing** (CEC)	Covers Pattern Making, Garment Construction, CAD, and Accessories (CO1, CO3, CO4).
Coursera	**Sustainable Textile Manufacturing** (Politecnico di Milano)	Focuses on sustainable supply chain, production, and environmental impact (CO4, CO5, SDG 12).
Coursera	**Digital Technologies and the Future of Manufacturing** (University of Michigan)	Addresses Industry 4.0, IoT, and digital transformation in manufacturing (CO2, CO3, SDG 9).
MOOCs (Generic)	**Pattern Making Technology for Fashion**	Deep dive into technical skills of pattern development and grading (CO1, CO6).

Assessment (Embedded course)
CAT, Activity and Learning Task(s)*, Mini project, MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce

<table>
<tr><th colspan="5">Course Curated by</th></tr>
<tr><th>Expert(s) from Industry</th><th colspan="2">Expert(s) from Higher Education Institution</th><th colspan="2">Internal Expert(s)</th></tr>
<tr><td>G.Manigandan, Senior manager
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Bengaluru- 560076</td><td colspan="2">Dr. N. K. Palaniswamy,
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National Institute of Technology (NIT), Jalandhar, Punjab 144008.</td><td colspan="2">Dr. V Ramesh Babu Professor, Department of Textile Technology, Kumaraguru College of Technology, Coimbatore – 641049.</td></tr>
<tr><td>Recommended by BoS on</td><td colspan="4">17.11.2026</td></tr>
<tr><td>Academic Council Approval</td><td></td><td>Date</td><td colspan="2"></td></tr>
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24TTI302	TEXTILE CHEMICAL PROCESSING – I	L	T	P	J	C
		3	0	2	0	4
		SDG	4, 9, 12, 13			

Pre-requisite courses	Weaving Technology - II	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Familiarise objectives and process sequences for textile chemical processing of cotton, silk, wool, polyester and sustainable fibres, reinforce through lab desizing and grey fabric preparation experiments.
2	Impart knowledge on pretreatment aligned with AATCC and BIS standards; develop practical skills through hands-on scouring, bleaching, and mercerisation lab experiments.
3	Develop skills in dye recipe preparation and dyeing process selection with emphasis on GOTS-approved and ZDHC-compliant auxiliaries; practise through dyeing experiments on cotton, wool, and silk.
4	Examine colour fastness evaluation referencing AATCC test methods with grey scale assessment; conduct fastness testing in the lab on all dyed specimens.
5	Expose students to dyeing machinery selection for low-liquor processing, introduce effluent management principles and reinforce through lab effluent colour/pH audit exercise.

Course Outcomes		
After successful completion of this course, the students shall be able to		**Revised Bloom's Taxonomy Levels (RBT)**
CO 1	Deliberate the principle, mechanism and evaluation of singeing and desizing processes in the integrated lab with the understanding of process sequence for the sustainable fibres.	K2
CO 2	Explain scouring, bleaching and mercerisation, evaluation of scouring materials by loss%, WI and BAN value in the lab, bio-scouring, CPB bleaching, and ZDHC-compliant chemical selection for sustainable fibres.	K3
CO 3	Prepare dye recipes for colouring cotton with direct, reactive, vat, and naphthol dyes, wool/silk with acid dyes, dye exhaustion % measurements, GOTS, ZDHC MRSL-compliant auxiliaries, REACH-banned azo dyes.	K4
CO 4	Perform the dyeing of polyester with disperse dye, cotton/polyester blend with reactive/disperse combination, acrylic with cationic dyes; colour fastness assessment using AATCC standards, demonstrate low-liquor ratio dyeing for environmental compliance.	K5

CO 5	Explain dyeing machinery selection principles for low-liquor sustainable processing; relate effluent treatment (ZLD, ZDHC Wastewater Framework) to laboratory chemical handling and disposal procedures.	K5

Course Outcomes (CO)	**Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)**											**Program Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**			
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2	PSO-3
1	3	2		2								1		
2	2	1										3		
3	2	1										3		
4	2	1										3		
5	2	1										3		
6	3	1	3	1	3						1	3	3	

Course Content	
INTRODUCTION TO TEXTILE PROCESSING Objectives of textile chemical processing; significance in the textile value chain. Process sequence of cotton, silk, wool, polyester, and polyester/cotton blend. Singeing: objectives, gas-flame method, Desizing: objectives, methods — hydrolytic (enzyme, acid, alkali); oxidative; mechanism and kinetics - desizing efficiency (Tegewa violet scale / Tagawa method). Process sequence for Tencel/Lyocell, enzyme finishing and controlled fibrillation management, gentle alkaline pretreatment, GOTS-compliant chemical selection for organic Tencel, Process sequence for recycled polyester (rPET).	**9 Hours**
Practical Component: 1. Enzymatic Desizing of Grey Cotton Fabric Using Amylase. 2. Quantification of Desizing Efficiency by Tagawa Iodine Colour-Score Method and Drop Absorbency Assessment.	**6 Hours**
CHEMICAL PRETREATMENT Scouring: objectives, alkaline mechanism, scouring - scouring loss%, drop absorbency test. Bio-scouring: pectinase enzymes: mechanism of pectin removal, comparison with conventional NaOH scouring, COD reduction, GOTS compliance benefit. Bleaching: objectives, mechanisms of oxidative bleaching (hypochlorite, hydrogen peroxide) and reductive bleaching (sodium hydrosulphite) - Copper Number, Methylene Blue Absorption, Cuprammonium Fluidity.	**9 Hours**

Hydrogen peroxide: optimisation, stabilisers, combined scouring and bleaching; ozone pre-treatment as a sustainable alternative. Mercerisation: objectives, mechanism, methods — chainless, tension, mercerisation of knitted fabric and blends, liquid ammonia treatment - Barium Activity Number, changes in mechanical properties.	
Practical Component: 1. Alkaline Scouring of Desized Cotton Fabric: Determination of Scouring Loss (%) and Wettability by Drop Absorbency Test (AATCC 39 reference). 2. Oxidative Bleaching of Cotton Fabric with Sodium Hypochlorite: Measurement of CIE Whiteness Index and Assessment of Fibre Tenacity Retention. 3. Stabilised Hydrogen Peroxide Bleaching of Cotton Fabric: CIE Whiteness Index Measurement and Comparative Evaluation against Hypochlorite-Bleached Samples (Exp 3 vs Exp 4). 4. Mercerisation of Cotton Yarn with Cold NaOH Solution: Assessment of Mercerisation Efficiency by Drop Absorbency Test and Visual Lustre Comparison Before and After Treatment. 5. Pectinase-Based Bio-Scouring of Cotton Fabric: Comparative Evaluation of Scouring Loss (%) and Drop Absorbency versus Conventional NaOH Scouring — GOTS v7.0 Compliance Awareness.	**6 Hours**
DYEING OF CELLULOSE AND PROTEIN FIBRES Colorants: classification, theory of dyeing (free volume, receptor, Donnan membrane equilibrium), Dye uptake kinetics, Properties and principle of dye-fibre interaction, applications and mechanisms; Direct dyes - exhaustion, salt effect; Reactive dyes - hot-brand, cold-brand; Vat dyes - reduction-oxidation cycle, leuco form; Sulphur dyes - oxidation-reduction mechanism; Azoic dyes - diazotisation and coupling in-situ on cellulose fibres. Acid dyes on wool and silk; Basic/Cationic dyes on silk; Reactive dyes on wool - dye-fibre bond types; ZDHC and MRSL: banned azo dyes, restricted metal-complex dyes (Cr, Co).	**9 Hours**
Practical Component: 1. Exhaust Dyeing of Cotton with Direct Dye: Determination of Colour Yield (K/S) and Effect of Electrolyte (NaCl) on Dye Exhaustion (%). 2. Vat Dyeing of Cotton Fabric: Reduction-Oxidation Cycle and Grey Scale Assessment of Wash Fastness (AATCC 61) and Crocking Fastness (AATCC 8). 3. Exhaust Dyeing of Cotton with Hot-Brand Reactive Dye: Determination of Dye Exhaustion (%) from Pre- and Post-Dyebath Absorbance by Spectrophotometry.	**6 Hours**

4. Acid Dyeing of Silk Fabric by Exhaustion Method: Grey Scale Assessment of Wash Fastness (AATCC 61) and Crocking Fastness (AATCC 8) with Pass/Fail Evaluation against Minimum Export Buyer Specifications.	
DYEING OF SYNTHETIC FIBRES AND BLENDS Mass coloration/dope dyeing (polyester, nylon, polypropylene) Disperse dyeing of polyester: Carrier method, HTHP method, Thermosol method — mechanism, process parameters, advantages and limitations. Cationic dyeing of acrylic: retarder, pH, uptake rate, Saturation factor. Dyeing of elastomeric fibres (Spandex/Lycra blends) and bi-component fibres. Dyeing of recycled polyester (rPET) and bio-based polyester (PLA/PTT). Fastness Assessment: wash, crocking, light, perspiration, rubbing (AATCC/ISO test methods) — grey scale principle.	**9 Hours**
Practical Component: 1. Exhaust Dyeing of Cotton with Direct Dye: Determination of Colour Yield (K/S) and Effect of Electrolyte (NaCl) on Dye Exhaustion (%) 2. Vat Dyeing of Cotton Fabric: Reduction-Oxidation Cycle and Grey Scale Assessment of Wash Fastness (AATCC 61) and Crocking Fastness (AATCC 8) 3. Exhaust Dyeing of Cotton with Hot-Brand Reactive Dye: Determination of Dye Exhaustion (%) from Pre- and Post-Dyebath Absorbance by Spectrophotometry 4. Acid Dyeing of Silk Fabric by Exhaustion Method: Grey Scale Assessment of Wash Fastness (AATCC 61) and Crocking Fastness (AATCC 8) with Pass/Fail Evaluation against Minimum Export Buyer Specifications	**6 Hours**
DYEING MACHINERY AND EFFLUENT MANAGEMENT **Fibre and Yarn dyeing machines:** Loose stock autoclave, tow dyeing, sliver dyeing; hank, cone/package (ultra-low LR 1:4.5), beam, knit-de-knit space dyeing. **Fabric dyeing machines:** Jigger and winch, HTHP jet dyeing, soft-flow/overflow low-tension machines, padding mangle — Cold Pad-Batch (CPB) for reactive on woven cotton, Thermosol for disperse/polyester and Pad-Steam for vat and reactive on woven fabrics. **Garment dyeing machines:** Rotary drum, paddle, waterless dyeing: Supercritical CO_2 dyeing for polyester, foam dyeing, electrochemical dyeing. **Drying and finishing after dyeing:** Squeeze mangle, centrifuge, cylinder/can dryer, stenter. **Effluent treatment:** ETP stages - primary, secondary, tertiary.	**9 Hours**
Practical Component:	**6 Hours**

1. Comparison of Dyeing at Low Liquor Ratio (LR 1:6, Soft-Flow Simulation) vs High Liquor Ratio (LR 1:20, Winch Simulation) 2. Measurement of Water Consumption (L/kg), Dye Exhaustion (%), and Colour Yield (K/S) for Sustainable Dyeing Evaluation	

Theory Hours:	**45**	**Tutorial Hours:**	**0**	**Practical Hours:**	**30**	**Project Hours:**	**0**	**Total Hours:**	**75**

Learning Resources

Textbooks:

1. Broadbent, A. D., Basic Principles of Textile Coloration, Society of Dyers and Colourists (SDC), Bradford, UK, 2001.
2. Shore, J. (Ed.), Cellulosics Dyeing, Society of Dyers and Colourists (SDC), Bradford, 1995.
3. Shore, J. (Ed.), Blends Dyeing, Society of Dyers and Colourists (SDC), Bradford, 1998.
4. Trotman, E. R., Dyeing and Chemical Technology of Textile Fibres, Griffin Publishers, 6th edition, 1984.
5. Shenai, V. A., Technology of Textile Processing, Vol. II — Technology of Bleaching, Dhiraj Publishers, Mumbai.

Standards for Reference:

1. AATCC Technical Manual — Current Edition (AATCC 61, AATCC 8, AATCC 16 test methods). American Association of Textile Chemists and Colorists.
2. GOTS Version 7.0 — Global Organic Textile Standard. Global Standard gGmbH, Frankfurt, 2023.
3. ZDHC MRSL Version 3.1 — Manufacturing Restricted Substances List. ZDHC Foundation, Amsterdam, 2023.
4. REACH Regulation (EC) No. 1907/2006 — Annex XVII: Restricted Azo Colourants. European Chemicals Agency.
5. Bluesign® System Standard — Chemical Management, Water and Energy Requirements. bluesign Technologies AG.
6. GRS (Global Recycled Standard) Version 4.0. Textile Exchange, 2023.
7. BIS IS 1964 — Colour Fastness of Textiles (Indian Standard).

Online Resources:

1. NPTEL — Textile Chemical Processing: https://archive.nptel.ac.in/courses/116/106/116106104/
2. AATCC Test Method Resources: https://www.aatcc.org/testing/
3. GOTS Certified Products Database: https://global-standard.org/

4. ZDHC Gateway (Chemical compliance): https://gateway.roadmaptozero.com
Reference Books:
1. Montgomery, D. C., & Runger, G. C. (2023). *Applied statistics and probability for engineers* (8th ed.). Wiley. **2.** Grover, G., & Hamby, D. S. (2022). *Statistical process control* (8th ed.). McGraw-Hill Education. **Online Resources** 1. **American Association of Textile Chemists and Colorists (AATCC).** *AATCC test methods*. Retrieved from https://www.aatcc.org 2. Bureau of Indian Standards. (2025). *Indian standards for textile testing*. BIS. 3. Uster Technologies AG. (2024). *USTER tester application handbook*. Uster Technologies AG. 4. Uster Technologies AG. (2024). *USTER AFIS application handbook*. Uster Technologies AG. 5. Premier Evolvics Pvt. Ltd. (2024). *OFDA user manual and fibre testing guide*. Premier Evolvics Pvt. Ltd. 6. Zellweger Uster AG. (2024). *USTER classimat and evenness testing manual*. Uster Technologies AG.

Assessment (Embedded course)
CAT, Activity and Learning Task(s)*, Mini project, MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert(s)**
			R.Sukanya Devi Assistant Professor III, Department of Textile Technology, Kumaraguru College of Technology, Coimbatore – 641049.
Recommended by BoS on			
Academic Council Approval		**Date**	

24TTI303	**TEXTILE TESTING**	**L**	**T**	**P**	**J**	**C**
		3	**0**	**2**	**0**	**4**
PC		**SDG**	**4, 9, 12, 13**			

Pre-requisite courses		**Data Book / Code book (If any)**	-

Course Objectives:	
The purpose of taking this course is to:	
1	To impart fundamental and advanced knowledge on fibre, yarn, fabric, and garment testing along with emerging test technologies.
2	To provide hands-on experience in operating modern textile testing instruments and interpreting test data accurately.
3	To enable students to apply statistical tools for data analysis, quality control, and process optimization in textile industries.

Course Outcomes		
After successful completion of this course, the students shall be able to		**Revised Bloom's Taxonomy Levels (RBT)**
CO 1	Explain the principles of textile testing, sampling, and statistical quality control tools.	K2
CO 2	Apply suitable methods and instruments for fibre testing including advanced technologies.	K3
CO 3	Analyze yarn properties using conventional and automated testing equipment.	K4
CO 4	Evaluate fabric properties using structural, mechanical, comfort, and functional tests.	K5
CO 5	Select and recommend appropriate testing protocols and standards for end-use performance of garments and quality assurance.	K5
CO 6	Perform and interpret fibre, yarn, fabric and garment tests using modern laboratory equipment and statistical tools for quality evaluation.	K4

C ou	**Program Outcomes (PO)** **(Strong-3, Medium – 2, Weak-1)**	

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Program Specific Outcomes (PSO)**		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2	PSO-3
1	3	2		2								1		
2	2	1										3		
3	2	1										3		
4	2	1										3		
5	2	1										3		
6	3	1	3	1	3						1	3	3	

Course Content

INTRODUCTION TO TEXTILE TESTING & STATISTICS Objectives of testing: quality control, assurance, certification. Sampling techniques: fibre, yarn, and fabric. Measurement systems, errors, calibration, uncertainty. Descriptive Statistics**:** Mean, SD, CV%, confidence limits, Tools: Control charts (X-bar, R-chart, p-chart), regression & correlation, Computer-aided statistical analysis using Minitab Overview of test standards: ISO, ASTM, AATCC, BIS,EN standards	**9 Hours**
Practical Component: 1. Sampling methods for fibre, yarn, and fabric 2.. Calculation of mean, SD, CV% of sliver hank and roving using wrap block 3. Preparation and interpretation of Control Charts	**6 Hours**
FIBRE TESTING Fibre length characteristics – staple length, effective length, span length, Upper Half Mean Length (UHML) and length uniformity, measurement techniques using Baer Sorter, Fibre fineness, maturity, micronaire value and fibre maturity ratio.Fibre strength, elongation, fibre friction, cohesion and crimp characteristics. Moisture relations, moisture regain and moisture content of textile fibres. Assessment of trash content, neps, seed coat fragments and fibre cleanliness.	**9 Hours**

Advanced instruments: HVI (High Volume Instrument), AFIS (Advanced Fibre Information System),OFDA (Optical Fibre Diameter Analyzer),, Fibre friction & cohesion testing. HVI Data interpretation	
Practical Component: **1.** Determination of the fibre length using Baer Sorter and BISFA method. 2. Determination of Fibre fineness by airflow principle and Fibre maturity coefficient 3. Determination of bundle fibre strength and elongation using Stelometer **4.** Determination of the percentage of Trash, Lint, Micro dust, Invisible loss using Trash analyzer	**6 Hours**
YARN TESTING Yarn count systems, Twist & twist factor, Yarn strength (bundle and single yarn), elongation – CRE/CRT/CRL testers, Evenness & imperfections – U% & CV% USTER Statistics and Classimat system. Hairiness measurement, Yarn friction, abrasion, rigidity, packing factor, Online yarn quality monitoring systems. Advanced yarn characterization techniques, interpretation of yarn quality indices.	**9 Hours**
Practical Component: 1. Determination of Yarn count and CSP measurement, 2. Determination of Single yarn strength and yarn appearance **3.** Determination of Single yarn and Ply yarn twist of the given yarn	**6 Hours**
FABRIC AND TECHNICAL TEXTILE TESTING Fabric cover factor, Tensile, tear, bursting strength, Abrasion & pilling resistance, Crease recovery & drape, Low-stress mechanical properties – Kawabata Evaluation System (KES)**,** FAST**.** Functional finishing evaluation: wicking, repellency, UV protection, anti-microbial assessment Testing of technical textiles: flammability, thermal protective performance, biocompatibility, absorbency tests in medical textiles, puncture and cut resistance, porosity, and impact resistance	**9 Hours**
Practical Component: 1. Determination of fabric GSM & thickness, stiffness, crease recovery and drape testing 2. Determination of Fabric tensile strength (strip & grab methods) 3. Determination of Tearing & bursting strength **4.** Determination of Abrasion & pilling resistance	**6 Hours**
COMFORT PROPERTIES AND GARMENT TESTING Air permeability, water vapour permeability, Thermal resistance & conductivity, Seam strength, seam slippage, stitch density, Needle damage, garment dimensional stability.	**9 Hours**

Inspection: Fabric and Garment Inspection, AQL. Test report interpretation and decision-making. Emerging approaches in garment quality evaluation, including digital inspection systems, image-based defect detection, and sustainability performance assessment.	
Practical Component: 1. Determination of fabric dimensional stability, Fabric stretch and recovery 2. Determination of air permeability and water vapour permeability of fabric 3. Determination of Seam strength & seam slippage of garments **4.** Determination of button pull strength and peel bond strength	**6 Hours**

Theory Hours:	**45**	**Tutorial Hours:**	**0**	**Practical Hours:**	**30**	**Project Hours:**	**0**	**Total Hours:**	**75**

Learning Resources
Textbooks:
1. Saville, B. P. (2019). *Physical testing of textiles* (4th ed.). Woodhead Publishing. ISBN: 978-0-08-102992-6 2. Kothari, V. K. (Ed.). (2016). *Testing and quality management in textiles*. Woodhead Publishing. ISBN: 978-0-08-100573-9 3. Amutha, K. (2016). *A practical guide to textile testing*. CRC Press.ISBN: 781498763748, doi.org/10.1201/9781498763755 4. ASTM International. (2025). *Annual book of ASTM standards: Textiles*. ASTM International. 5. International Organization for Standardization. (2025). *ISO standards for textiles*. ISO.
References:

1. Montgomery, D. C., & Runger, G. C. (2023). *Applied statistics and probability for engineers* (8th ed.). Wiley.
2. Grover, G., & Hamby, D. S. (2022). *Statistical process control* (8th ed.). McGraw-Hill Education.

Online Resources

1. American Association of Textile Chemists and Colorists (AATCC). *AATCC test methods*. Retrieved from https://www.aatcc.org
2. Bureau of Indian Standards. (2025). *Indian standards for textile testing*. BIS.
3. Uster Technologies AG. (2024). *USTER tester application handbook*. Uster Technologies AG.
4. Uster Technologies AG. (2024). *USTER AFIS application handbook*. Uster Technologies AG.
5. Premier Evolvics Pvt. Ltd. (2024). *OFDA user manual and fibre testing guide*. Premier Evolvics Pvt. Ltd.
6. Zellweger Uster AG. (2024). *USTER classimat and evenness testing manual*. Uster Technologies AG.

Assessment (Embedded course)
CAT, Activity and Learning Task(s)*, Mini project, MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert(s)**
			R.Sukanya Devi Assistant Professor III, Department of Textile Technology, Kumaraguru College of Technology, Coimbatore – 641049.
Recommended by BoS on			
Academic Council Approval		**Date**	

24TTE011	MANUFACTURED FIBRE TECHNOLOGY	L	T	P	J	C
		3	0	0	0	3
PE		SDG 10, 12				

Pre-requisite courses		**Data Book / Code book (If any)**	-

Course Objectives:

The purpose of taking this course is to:

1	Understand the fundamentals of fibre forming polymers, Newtonian fluid flow and different spinning techniques.
2	Apply knowledge of polymers and spinning techniques to the manufacture of regenerated and synthetic textile fibres.
3	Analyze the characteristization techniques of man-made fibres and the effect of post spinning operations.

Course Outcomes (COs)

After successful completion of this course, the students should be able to

CO1	Analyze the manufacturing processes of regenerated fibres such as viscose rayon, cellulose derivative, soya bean, and bicomponent fibres.
CO2	Evaluate the manufacturing techniques of synthetic fibres including polyester, nylon, polyethylene, polypropylene, acrylic, and elastomeric fibres.
CO3	Apply the principles of post-spinning processes including spin finish application, drawing, heat setting, and texturizing in fibre manufacturing.
CO4	Demonstrate the characterization methods of fibres at both molecular and thermal levels using techniques such as molecular weight analysis and thermal analysis.
CO5	Understand innovative approaches for optimizing fibre manufacturing processes to enhance fibre properties and performance.

Course Outcomes (CO)	**Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)**											**Program Specific Outcomes (PSO)**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	2	2			2				2			2	2
2	3	2				2						2	2
3	3	2				2						3	2
4	2	3	1	1	2	2	2					2	
5	2	3	2				2	3	2	2		2	3

Course Content	
INTRODUCTION Thermal transitions. Polymerization techniques. Basic principles of fluid flow during fibre spinning: viscous flow, Newtonian fluids. Components of spinning of process: extruder gear pump, filters, manifold, spinning head, quenching chamber and winder. Introduction to staple and filament yarn manufacturing.	**9 Hours**
REGENERATED FIBRE Differences between manufacturing process of Viscose rayon fibre - Lyocell and bamboo fibrese and their sustainability features. Bicomponent fibre with different cross section and super absorbent fibre. Encapsulation technique in fibre formation.	**9 Hours**
SYNTHETIC FIBRES Manufacturing process of polyester, Nylon 6 and Nylon 66 focus on Recycled and bio-based fibres. Specialty polyamide and polyester fibres. Manufacturing process of Polyethylene and Polypropylene fibre. Manufacturing process of Acrylic fibre. Manufacturing process of Elastomeric fibres.	**9 Hours**
POST SPINNING PROCESS Additives used in fibre manufacturing. Introduction to delusturing. Recap of spin finish and drawing and Heat setting. Tow to top conversion. Texturising: False Twist, Air Texturising, stuffer-box, edge crimped and Draw texturising process.	**9 Hours**
CHARACTERIZATION OF FIBRES Characterization at molecular level: molecular weight averages, end group analysis, membrane osmometry, and viscometry–thermal characterization: differential thermal calorimetry analysis, thermogravimetry and thermomechanical analysis.	**9 Hours**

Theory Hours:	Tutorial Hours:	Practical Hours:	Project Hours:	Total Hours:
45	**0**	**0**	**0**	**45**

Learning resources

Textbooks

1. V.B. Gupta and V. K. Kothari, "Manufactured Fibre Technology", Chapman and hall, First edition 1997.
2. R.W.Moncrief, "Man Made fibres", 6th edition, London Newnes-Butterworths, 1975
3. **"The Chemistry of Textile Fibres" (3rd Edition) Robert R. Mather, Roger H. Wardman, and Sohel Rana 2023**
4. **Regenerated Cellulose Fibres Calvin Woodings (Ed.) — Woodhead Publishing, 2001 (Elsevier reprint 2021)**

References

1. A Vaidya, "Production of synthetic fibres", Prentice Hall of India Pvt. Ltd., New Delhi, 1988.
2. "GATE Textile Engineering & Fibre Science Theory Books" (Updated Syllabus Edition)Publisher: Diwakar Education Hub / Comprehensive Academic Sets Publication Year: 2025/2026
3. Sustainable Fibres and Textiles Subramanian Senthilkannan Muthu (Ed.) — Woodhead Publishing (Elsevier), 2017
4. H.G Mark, S. M Atlas and D. Certia. E. (Editors), "Man made fibres-science and Technology", Vol. I-III, Inter science publishers, New York, 1987.
5. Usenko, V., "Processing of Man-Made fibres", MIR publishers, Moscow, 1985.
6. Menachem Lewin and Eli M. Pearce (editors), "Handbook of fibre science and Technology: Vol. IV Fibre chemistry", Marcel Decker Inc., New York, 1985.
7. J. Gordon Cook, "Hand book of Textile fibres (Volume 2 – Manmade fibres)", CBS Publishers and Distributors, 2005

Assessment (Theory course)

CAT, Activity and Learning Task: Socratic seminar, Case study, MCQ, End Semester Examination (ESE)

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert(s)**
Mr. SenthilKumar R R&D head Sharadha Terry Ltd Mettupalayam Coimbatore	Dr. R. Vijaya Sekar Assistant Professor Department of Textile Technology PSG College of Technology Coimbatore.		Dr. Saminathan R. Department of Textile Technology
Recommended by BoS on			
Academic Council Approval		Date	

24TTE012	HIGH PERFORMANCE FIBERS	L	T	P	J	C
		3	0	0	0	3
PE		SDG	3, 9, 12			

Pre-requisite courses	24TTI201 Textile Fibres	Data Book / Code book (If any)	-

Course Objectives:

The purpose of taking this course is to:

1	Understand the classification, formation, structure, and properties of high-performance fibers.
2	aluate manufacturing processes and emerging technologies used in producing advanced fibers.
3	Develop knowledge of the applications of high-performance fibers in composites, textiles, rospace, defense, and medical industries.

Course Outcomes

After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Evaluate the formation, structure, properties, and applications of aramid, PEEK, and sulphur-based fibers.	E
CO 2	Apply carbon and glass fibers based on properties, manufacturing processes, and applications.	Ap
CO 3	Evaluate the ceramic, elastomeric, HDPE, and PBI fibers and assess their suitability for specialized applications.	E
CO 4	Analyze metallic fibers (steel, aluminium oxide, lead) and their use in composites and shielding applications.	An
CO 5	Analyze the emerging fibers (polystyrene-based, microfibers, bio-absorbable, nanofibers, hollow fibers) for industrial and biomedical applications.	An

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	2	2	2		1		2					3	2
2	2	3	2		2		2					3	3
3	2	2	2		2		1					3	3
4	2	2	2		2		1					3	3
5	2	2	2		2		1					3	3

Course Content	
ARAMID, PEEK AND SULPHER BASED FIBRES Requirements of high-performance fibres. Aramid fibre – Kevlar fiber - Formation – Structure- Nomex fiber – formation – structure – properties and application. PEEK- Formation – Structure– Properties and application. Polyphenyl sulphide fibres - Fibre formation - Properties – Applications.	**9 Hours**
CARBON AND GLASS FIBRES Classification of Carbon fibres - Manufacturing processes from Polyacrylonitrile (PAN), Rayon and Pitch based fibres- Properties and Applications. Recycled Carbon fiber- Recycling methods- Properties- advantages and limitations- applications. Glass fibres- Types and composition -manufacturing processes - Fibre structure - Properties - Applications.	**9 Hours**
CERAMIC, ELASTOMERIC AND OTHER FIBRES Ceramic fibres – classification, fibre formation, composition, structure, properties and applications. Elastomeric (Polyurethane) fibres - manufacturing processes - Properties - Applications. HDPE fibres- manufacturing processes - Properties - Applications. Polybenzimidazole (PBI) - Fibre formation, structure, properties and applications.	**9 Hours**
METALLIC FIBRES Metallic fibres -Steel fibre - Formation – Structure – Properties and application. Aluminium Oxide fibres - Preparation and manufacturing process - Properties - Applications – Composites of Aluminium Oxide fibres. Lead fibres – Fibre Preparation - Properties - Applications–Sound Control and Radiation Shielding Materials.	**9 Hours**
NEW FIBRES Polystyrene based fibres - Preparation - Properties – Applications. Micro fibres- Preparation –Properties; Bio-absorbable fibres from Cotton, Rayon, Poly Lactic Acid (PLA); Nano-fibre- Production Process- Properties- Applications. Ultra-fine fibres, Hollow fibres and its uses.	**9 Hours**

Theory Hours:	45	**Tutorial Hours:**	0	**Practical Hours:**	0	**Project Hours:**	0	**Total Hours:**	45

Learning Resources

Textbooks:

1. Hearle, John W. S., et al. High-Performance Fibres. Woodhead Publishing, UK, 2021.
2. Paul, Roshan. Functional Textiles and High-Performance Fibers. Springer, Germany, 2020.
3.Mukhopadyay S.K., “High Performance Fibres”, Textile Progress, Textile Institute, Manchester, Vol. 25, 1993.

References:

1. Menachem Lewin and Jack Preston., “High Technology fibres - part B”, Marcel Dekker, New York, 1989.
2.Savage, George. Glass Fibre Reinforced Plastics. Woodhead Publishing, UK, 2019.
3.Akel, M. Nanofibers: Advances and Applications. Elsevier, Netherlands, 2021.

Assessment (Theory course)
CAT, Activity and Learning Task: Socratic seminar, Case study, MCQ, End Semester Examination (ESE)

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert(s)**
Mr. R. SenthilKumar R&D head Sharadha Terry Ltd Mettupalayam Coimbatore.	Dr. R. Vijaya Sekar Assistant Professor Department of Textile Technology PSG College of Technology Coimbatore.		Dr. P.Chandrasekaran Department of Textile Technology Coimbatore
Recommended by BoS on			
Academic Council Approval		Date	

24TXE042	MARKET RESEARCH	L	T	P	J	C
		3	0	0	0	3
PE		SDG	9, 12, 13			

Pre-requisite courses		Data Book / Code book (If any)	-

Course Objectives:

The purpose of taking this course is to:

1	To provide students with fundamental knowledge of market research concepts, processes, and market intelligence sources relevant to the textile and apparel industry.
2	To develop the ability to collect, analyze, and interpret consumer and market data using appropriate research methods, forecasting techniques, and digital tools.
3	To equip students with the skills required to support strategic marketing decisions related to market positioning, brand development, and new product innovation in the textile sector.

Course Outcomes

After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Explain the concepts, processes, and significance of market research in textile and apparel industries	Ap
CO 2	Design and implement appropriate research methodologies, sampling plans, and survey instruments for textile market studies.	Ap
CO 3	Analyze consumer behavior and apply segmentation, targeting, and positioning strategies for textile and apparel products	An
CO 4	Apply demand forecasting techniques and digital market research tools to identify market trends and evaluate business opportunities	Ap
CO 5	Evaluate market research findings to support brand equity assessment, new product development, and strategic decision-making in textile enterprises.	An

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	3	2	-	-	1	-	2	-	-	3	2	3	2
2	2	3	2	3	3	-	-	1	-	2	3	3	2
3	2	3	3	2	1	1	-	2	-	2	3	2	2
4	2	3	2	2	3	-	-	-	2	2	3	2	2
5	2	3	3	2	2	2	1	1	3	2	3	2	3

Course Content

FOUNDATIONS OF MARKET RESEARCH IN THE TEXTILE INDUSTRY Introduction to market research — nature, scope, and significance in the textile and apparel sector; the marketing research process; problem identification and formulation; primary and secondary data sources; ethics in marketing research; role of market research in textile branding, exports, and fashion forecasting; India textile and apparel export intelligence: DGCI&S export statistics, AEPC market intelligence portal, and FIEO trade data.	**9 Hours**
RESEARCH DESIGN, SAMPLING, AND DATA COLLECTION Qualitative techniques — focus groups and in-depth interviews; quantitative techniques — surveys; questionnaire design and scaling methods (Likert, semantic differential); sampling concepts; digital data collection through online and mobile surveys: Google Forms (free, basic), Qualtrics (enterprise, analytics), SurveyMonkey (mid-market); applications in fabric preference and garment fit studies.	**9 Hours**
CONSUMER BEHAVIOR, AND MARKET POSITIONING Consumer behavior in apparel and home textiles: psychological factors, sociocultural influences; decision-making process for apparel purchase; textile-specific considerations. Market segmentation, targeting, and positioning (STP): demographic, psychographic, behavioral, and geographic segmentation; identifying target segments for textile products; positioning strategies for premium vs. commodity textiles; case study — FabIndia positioning strategy	**9 Hours**
DEMAND FORECASTING AND EMERGING TOOLS Textile-specific demand forecasting methods: Exponential Smoothing for seasonal garment cycles, and Qualitative Delphi Technique: expert forecasting for new technical textile product categories; Emerging tools in market research: Google Trends analysis for identifying fabric and apparel trend cycles; AI trend forecasting overview and textile applications.	**9 Hours**
STRATEGIC MARKET RESEARCH APPLICATIONS IN TEXTILES Brand equity research in textile industry: brand awareness, perception, and loyalty studies; competitive brand positioning analysis; consumer preference for textile brands. New product development research: concept testing for technical textiles, smart textiles, and sustainable fabrics; prototype evaluation; market readiness assessment; consumer acceptance of innovation.	**9 Hours**

Theory Hours:	45	**Tutorial Hours:**	**0**	**Practical Hours:**	**0**	**Project Hours:**	**0**	**Total Hours:**	**45**

Learning Resources
Textbooks:
1. V. Kumar, Robert P. Leone, David A. Aaker & George S. Day. Marketing Research. 13th ed. Wiley India, India, 2023. 2. Richard A. Brealey, Stewart C. Myers & Franklin Allen (eds.). Principles of Corporate Finance. 14th ed. McGraw-Hill/Irwin, USA, 2022.
References:

1. Thierry Roncalli. Introduction to Risk Parity and Budgeting. Chapman & Hall/CRC, UK, 2013
2. Zvi Bodie, Alex Kane & Alan J. Marcus. Investments. McGraw-Hill Education, USA, 13th ed., 2022.

Assessment (Theory course)
CAT, Activity and Learning Task: Socratic seminar, Case study, MCQ, End Semester Examination (ESE)

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert(s)**
Mr. Senthilkumar R R&D head Sharadha Terry ltd Mettupalayam Coimbatore	Dr. N. Gobi Professor Department of Technology AC Tech Campus, Guindy, Anna University, Chennai - 600025		Dr. S Sundaresan Department of Textile
Recommended by BoS on			
Academic Council Approval		**Date**	

24TTE046	PRINCIPLES OF MANAGEMENT	L	T	P	J	C
		3	0	0	0	3
PE		SDG 8, 9, 12				

Pre-requisite courses	-	**Data Book / Code book (If any)**	-

Course Objectives:

The purpose of taking this course is to:

1	Understand the key functions, principles, and theories of management and how they apply in engineering and textile contexts.
2	Apply planning, organizing, leading, and controlling techniques to textile-industry case studies, including sustainable textile operations.
3	Communicate managerial decisions effectively and ethically, considering stakeholder impact and alignment with global development goals.

Course Outcomes

After successful completion of this course, the students shall be able to		**Revised Bloom's Taxonomy Levels (RBT)**
CO 1	Apply the functions, evolution, and principles of management in modern organizations.	Ap
CO 2	Analyze different managerial roles, decision-making processes, and management styles in an organizational context.	An
CO 3	Apply planning, organizing, leading, and controlling techniques to real-world scenarios, especially in textile operations.	Ap
CO 4	Evaluate the impact of emerging technologies and sustainability on management practices in textile firms.	E
CO 5	Create an ethically sound managerial strategy for a textile company that integrates sustainability and aligns with relevant Sustainable Development Goals.	C

Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) / **Program Specific Outcomes (PSO)**

Course Outcomes (CO)	1 Engineering Knowledge	2 Problem Analysis	3 Design/Development of Solutions	4 Conduct Investigations of Complex Problems	5 Engineering Tool Usage	6 The Engineer and The World	7 Ethics	8 Individual and Collaborative Team work	9 Communication	10 Project Management and Finance	11 Life-Long Learning	PSO-1	PSO-2
1	2	2	2							3			
2	2	2	2				2			3			
3	2	2	2							3			
4	2	2	2							3			
5	2	2	2							3			

Course Content	
MANAGEMENT AND EVOLUTION OF MANAGEMENT THOUGHT Definition, nature, purpose, and scope of management, Managerial skills and roles (interpersonal, informational, decisional), Principles of management, Classical approaches: Scientific management (Taylor), Administrative management (Fayol), Bureaucracy (Weber) with few examples in Textile Industry. Behavioral & human relations approach (Mayo, Maslow), Modern approaches: Systems theory, Contingency theory.	**9 Hours**
MANAGERIAL ETHICS, CSR, AND SUSTAINABILITY Business ethics and corporate social responsibility, Sustainable management in the textile industry, green management, CSR models, Ethical leadership and stakeholder theory.Case Studies in Textile and Apparel industry on the above Topics.	**9 Hours**
MANAGEMENT FUNCTION: PLANNING AND ORGANIZING Planning Process, Types of Plans: strategic, tactical, operational, contingency, - SWOT–PESTEL–Porter's Five Forces, - Management by Objectives (MBO), Organizing: Organizational Structures Organizational structure types (functional, divisional, matrix, network), Authority & Decentralization, and Organizing for Textile Operations: supply chain, production units, R&D, sustainability teams.	**9 Hours**
MANAGEMENT FUNCTION: STAFFING, LEADING, AND CONTROLLING Staffing: Human resource planning, Recruitment, selection, and placement, Performance appraisal, training & development. Leading: Leadership theories: trait, behavioral, contingency, transformational, servant leadership, Motivation: Maslow, Herzberg, McGregor's Theory X & Y. Communication: process, barriers, effective communication in teams, Controlling: Control process: setting standards, measuring, correcting, Types of control: feed-forward, concurrent, feedback, Control techniques: budgets, KPIs, Quality management & total quality management (TQM) in textiles.	**9 Hours**
CHANGE MANAGEMENT & INNOVATION: Sources and types of organizational change, Change models (Lewin's, Kotter's 8-step), Innovation management in textile industry (smart textiles, sustainable processes), Disruptive innovation and organizational agility, Industry 4.0 in textiles: IoT, AI, robotics, digital twin, Digital business models in textiles and Sustainability Decision Models and Green IT.	**9 Hours**

Theory Hours:	45	**Tutorial Hours:**	0	**Practical Hours:**	0	**Project Hours:**	0	**Total Hours:**	45

Learning Resources
Textbooks:
1. Robbins, Stephen P., and Mary A. Coulter. Management. 16th ed., Pearson, USA, 2024. 2. Tripathi, P. C., and P. N. Reddy. Principles of Management. 7th ed., McGraw-Hill Education India, India, 2021.
References:
1. Bauer, Talya, Berrin Erdogan, and Jeremy Short. Principles of Management. 4.0 ed., FlatWorld Knowledge, USA, 2018. 2. Gill, Pushpinder Singh, and Paramjeet Kaur. Principles of Management. Atlantic Publishers & Distributors, India, 2019.

Assessment (Theory course)
CAT, Activity and Learning Task: Socratic seminar, Case study, MCQ, End Semester Examination (ESE)

Course Curated by				
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert(s)**	
Mr. R. SenthilKumar R&D head Sharadha Terry Ltd Mettupalayam Coimbatore.	Dr. Sakthivel JC Associate Professor Department of Textile Technology PSG College of Technology Coimbatore.		Dr.Sivakumar P Department of Textile Technology Coimbatore	
Recommended by BoS on				
Academic Council Approval		Date		

SEMESTER VI

24TTT304	TECHNICAL TEXTILE	L T P J C	3 0 0 0 3
Category	PC	**SDG**	SDG 3, 9, 11, 12

Pre-requisite courses	24TTI201 Textile Fibres	Data Book / Code book: -

Course Objectives: The purpose of taking this course is to:
1. Introduce the classification, global market, and end-use categories of technical textiles including Agrotech, Buildtech, Clothtech, Geotech, Hometech, Indutech, Meditech, Mobiltech, Oekotech, Packtech, Protech and Sporttech.
2. Impart knowledge on raw materials, engineering fibres, structures, and manufacturing routes used in technical textiles.
3. Enable students to evaluate performance testing standards (ISO, ASTM, EN, BIS) and product certifications relevant to technical textiles.
4. Expose students to the Indian technical textile ecosystem — National Technical Textile Mission (NTTM), PLI scheme, and Indian manufacturers (SRF, Garware, Kusumgar, Supreme Nonwovens).
5. Develop competence in selecting technical textile solutions for functional requirements aligned with SDG 9 and SDG 12.

Course Outcomes: After successful completion of this course, the students shall be able to	**RBT Level**
CO 1: Explain the classification, global and Indian market structure, and functional end-uses of technical textiles.	**K2 — Understand**
CO 2: Identify appropriate engineering fibres and fabric structures for specific technical textile applications.	**K3 — Apply**
CO 3: Analyse the manufacturing routes (weaving, knitting, nonwoven, braiding, coating, lamination) for technical textile products.	**K4 — Analyse**
CO 4: Evaluate the performance and certification requirements of technical textiles using ISO, ASTM, EN, and BIS standards.	**K5 — Evaluate**
CO 5: Recommend technical textile solutions for industrial applications aligned with the National Technical Textile Mission and PLI scheme.	**K5 — Evaluate**

CO - PO / PSO Mapping (Strong-3, Medium-2, Weak-1)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	-	-	-	1	-	-	-	-	-	1	2
CO2	3	2	2	-	1	1	-	-	-	-	-	-	3

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO3	3	3	2	2	2	1	-	-	-	-	-	1	3
CO4	2	3	2	2	2	2	1	-	-	-	-	1	2
CO5	2	2	3	1	2	3	2	-	-	-	2	2	2

Course Content

INTRODUCTION AND CLASSIFICATION OF TECHNICAL TEXTILES 9 Hours

Definition, characteristics and scope of technical textiles. Classification: twelve application sectors — Agrotech, Buildtech, Clothtech, Geotech, Hometech, Indutech, Meditech, Mobiltech, Oekotech, Packtech, Protech, Sporttech. Global market — Techtextil Frankfurt, IndexNonwovens Geneva. Indian market: National Technical Textile Mission (NTTM), PLI scheme for MMF & Technical Textiles, HSN codes 207. Major Indian manufacturers — SRF, Garware Technical Fibres, Kusumgar, Supreme Nonwovens, Arvind Advanced Materials. Global majors — Freudenberg, Berry Global, Ahlstrom, DuPont, Toray. Structure-property relationship. Roadmap for Indian technical textile industry to USD 40 billion (2030 target).

ENGINEERING FIBRES AND STRUCTURES 9 Hours

High-performance fibres in technical textiles — aramids (Kevlar, Nomex, Twaron), UHMWPE (Dyneema, Spectra), PBO (Zylon), PBI, PPS, carbon, glass, ceramic, basalt, high-tenacity polyester and nylon, bicomponent fibres. Nano-fibres and micro-fibres. Fabric structures — 2D and 3D woven fabrics, warp and weft knit structures, spacer fabrics, nonwovens (spunlaid, meltblown, SMS, needle-punched, hydroentangled), braided structures, unidirectional and multi-axial fabrics. Composite reinforcements — pre-pregs, tow-preg, textile reinforced concrete.

AGROTECH, BUILDTECH, CLOTHTECH AND HOMETECH 9 Hours

Agrotech: shade nets, mulch mats, crop protection nets, anti-hail nets, aquaculture nets (Garware); properties and durability under UV. Buildtech: architectural membranes (PTFE, ETFE — Serge Ferrari, Sefar), scaffolding nets, concrete curing textiles, geotextiles for civil engineering (woven, nonwoven, geogrids, geomembranes — Terram, Naue). Clothtech: interlinings (Freudenberg), sewing threads, labels, zip fasteners, elastomeric tapes. Hometech: mattress ticking, blinds, upholstery, HEPA filter media, carpet backing (Amcol).

MEDITECH, PROTECH, MOBILTECH AND SPORTTECH 9 Hours

Meditech: surgical gowns and drapes (SMS, tri-laminate), face masks (N95, surgical), wound dressings (alginate, hydrocolloid, silver-coated), sutures (Vicryl, PDS), vascular grafts (Dacron, ePTFE — Gore-Tex), scaffolds for tissue engineering. Protech: bullet-proof vests (Kevlar/Twaron, UHMWPE — DSM Dyneema), stab-resistant, cut-resistant gloves (EN 388), heat and flame-resistant workwear (Nomex, PBI), chemical protective suits (Tychem), high-visibility clothing (EN ISO 20471). Mobiltech: airbags (PA 6.6 silicone-coated), seat belts, tyre cord (rayon, nylon, aramid — SRF, Kordsa), automotive carpets, headliners, EV battery separators. Sporttech: sports shoes uppers (Flyknit, Primeknit), swimwear (Speedo LZR Racer, Fastskin), parachutes, sails (Dimension-Polyant), climbing ropes.

OEKOTECH, PACKTECH, INDUTECH AND TESTING 9 Hours

Oekotech: erosion-control geotextiles, oil-spill sorbent booms, wastewater filtration bags, biodegradable nonwovens. Packtech: FIBC (Flexible Intermediate Bulk Containers — Emmbi, Kanpur Plastipack), tea bags, coffee filters, container liners, wrapping fabrics. Indutech: conveyor belts (Habasit, Ammeraal), filter fabrics (bag filters — GKD, Sefar), abrasive belts, papermakers' fabrics (Voith, Andritz), drive belts. Testing and standards: tensile (ISO 13934, ASTM D5034), tear (ISO 13937), bursting (ISO 13938), abrasion (ISO 12947 Martindale), flame resistance (ISO 15025, NFPA 701), UV protection (AATCC 183), water penetration (ISO 811 hydrostatic head), air permeability (ISO 9237), biocompatibility (ISO 10993). Certifications — CE marking, OEKO-TEX, GRS, ZDHC.

Theory Hours	Tutorial Hours	Practical Hours	Project Hours	Total Hours
45	0	0	0	**45**

Learning Resources

Textbooks:

1. Horrocks, A. R., and S. C. Anand (eds). Handbook of Technical Textiles: Vol. 1 Technical Textile Processes; Vol. 2 Technical Applications. 2nd ed., Woodhead Publishing, UK, 2016.
2. Adanur, Sabit. Wellington Sears Handbook of Industrial Textiles. Technomic Publishing, USA, 1995.
3. Chapman, R. A. (ed). Applications of Nonwovens in Technical Textiles. Woodhead Publishing, UK, 2010.

References:

1. Kaswell, E. R. Handbook of Industrial Textiles. Wellington-Sears, USA, 2018.
2. Rajesh Mishra and Jiri Militky. Nanotechnology in Textiles: Theory and Application. Woodhead Publishing, UK, 2019.
3. Ministry of Textiles, Government of India. National Technical Textile Mission — Operational Guidelines, 2020.
4. SRF, Garware, Kusumgar — Annual Reports and Product Catalogues.

Recommended Online Courses:

1. NPTEL: Technical Textiles by Prof. B. K. Behera, IIT Delhi — covers all twelve application sectors.
2. Coursera: Materials in Modern Manufacturing (Georgia Tech) — includes advanced fibres and composites.
3. Techtextil Frankfurt Virtual — Technical Textile Symposium proceedings.

Assessment
CAT-1, CAT-2, Activity and Learning Task (Case study on Indian technical textile manufacturer — SRF/Garware/Supreme), MCQ, Model Exam, End Semester Examination (ESE).

Course Curated by		
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**
Mr. Vasanth Kumar Head — Technical Textiles Garware Technical Fibres Ltd Pune	Prof. B. K. Behera Department of Textile Technology Indian Institute of Technology Delhi	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile

		Technology Kumaraguru College of Technology

24TTI305	**TEXTILE WET PROCESSING – II**	**L T P J C**	**3 0 2 0 4**
Category	PC	**SDG**	SDG 6, 9, 12, 13

Pre-requisite courses	24TTI302 Textile Wet Processing – I	Data Book / Code book: **-**

Course Objectives: The purpose of taking this course is to:
1. Impart knowledge of textile printing methods — block, roller, screen, transfer, and digital inkjet printing.
2. Develop understanding of style, class, and technique of printing on cellulosic, protein, and synthetic fibres.
3. Provide expertise on functional and aesthetic finishing of textiles including durable-press, water-repellent, flame-retardant, antimicrobial, and softening finishes.
4. Introduce sustainable and low-impact finishing chemistries aligned with ZDHC MRSL and REACH regulations.
5. Enable students to evaluate finish performance, fastness, and hand-value using instrumental techniques (KES-F, FAST, CCM).

Course Outcomes: After successful completion of this course, the students shall be able to	**RBT Level**
CO 1: Explain the principles, styles, classes and techniques of textile printing including digital inkjet printing.	**K2 — Understand**
CO 2: Apply appropriate printing methods and dye-thickener systems for cellulosic, protein and synthetic fibres.	**K3 — Apply**
CO 3: Analyse the mechanism and process parameters of chemical, mechanical, and functional finishing operations.	**K4 — Analyse**
CO 4: Evaluate the performance, durability, and fastness of finished textiles using standard test methods.	**K5 — Evaluate**
CO 5: Select sustainable printing and finishing chemistries and processes compliant with ZDHC, GOTS, REACH.	**K5 — Evaluate**
CO 6: Perform printing and finishing operations in the laboratory and interpret the fastness, hand and functional test results.	**K4 — Analyse (Practical)**

CO - PO / PSO Mapping (Strong-3, Medium-2, Weak-1)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	-	-	-	1	-	-	-	-	-	1	2
CO2	3	2	2	-	2	1	-	-	-	-	-	1	3
CO3	3	3	2	2	2	2	1	-	-	-	-	1	3

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO4	2	3	2	2	3	1	-	-	-	-	-	1	2
CO5	2	2	3	1	2	3	3	-	-	-	-	2	2
CO6	2	2	2	3	3	1	-	2	1	-	-	2	3

Course Content

STYLES AND METHODS OF PRINTING 9 Hours

Difference between dyeing and printing. Styles of printing: direct, discharge, resist, raised, flock, blotch, tie & dye, batik. Machinery — Block printing, Roller printing, Flat-bed and Rotary Screen printing (Stork, Reggiani), Transfer printing. Print paste ingredients — dyes/pigments, thickeners (natural — sodium alginate, guar gum; synthetic — sodium polyacrylate), hygroscopic agents, defoamers, oxidising/reducing agents. After-treatments — steaming (age, HT, HP), thermofixation, washing-off.

Practical Component: 6 Hours

1. Preparation of print paste for reactive, disperse, and pigment printing.
2. Screen printing of cotton fabric using reactive dyes — direct style.

PRINTING OF COTTON, WOOL, SILK AND SYNTHETIC FIBRES 9 Hours

Printing of cotton with reactive, vat, azoic, pigment dyes. Printing of wool and silk with acid, metal-complex, reactive dyes. Printing of polyester with disperse dyes — direct, transfer, high-temperature steam methods. Printing of polyester/cotton blends. Printing of nylon and acrylic. Faults in printing and their remedies. Colour matching in printing.

Practical Component: 6 Hours

1. Pigment printing of polyester/cotton blend fabric.
2. Disperse dye transfer printing of polyester and evaluation.

DIGITAL INKJET AND SUSTAINABLE PRINTING 9 Hours

Digital textile printing — piezo drop-on-demand inkjet technology. Machines: Kornit Presto and Atlas, MS-JPK (Italy), Reggiani ReNOIR, Mimaki Tx-series, Epson SureColor. Ink chemistries — reactive, disperse (sublimation and direct), acid, pigment inks. Pre-treatment and post-treatment for digital printing. Colour management (RIP software — ErgoSoft, ColorGATE). Advantages — short run, mass customisation, low water usage. Sustainability in printing — waterless printing (ColorZen, DyeCoo pigment), plasma pre-treatment, digital pigment printing. Global adoption — Surat digital printing cluster, Kornit installations in India.

Practical Component: 6 Hours

1. Digital inkjet printing of pre-treated cotton fabric — process demonstration.
2. Colour management workflow using RIP software (demo).

MECHANICAL AND CHEMICAL FINISHING 9 Hours

Mechanical finishes — calendering (friction, chasing, Schreiner, embossing), sanforising (compressive shrinkage — Cluett Peabody, Monforts), raising, cropping/shearing, decatising, sueding, emerising, glazing. Chemical finishes — softening (cationic, non-ionic, silicone), hydrophilic softeners, optical brightening agents (OBA), stiffening (starch, PVA), weighting (silk with tin salts). Durable press / easy-care finishing — DMDHEU, glyoxal-based low-formaldehyde, formaldehyde-free (BTCA, polycarboxylic acid). Resin curing conditions and evaluation of crease recovery.

Practical Component: **6 Hours**

1. Application of softener finish on knitted cotton fabric — evaluation of hand.
2. Durable-press finishing of cotton fabric and crease recovery angle measurement.

FUNCTIONAL, SPECIALITY AND SUSTAINABLE FINISHING 9 Hours

Water-repellent and waterproof finishes — silicones, fluorocarbons (C6, C0 alternatives — Rudolf Bionic-Finish), hydrostatic pressure test. Flame-retardant finishes on cotton (Proban, Pyrovatex), polyester, wool; test methods (ISO 15025, LOI). Antimicrobial finishes — silver nanoparticles, triclosan (banned), chitosan, tea-tree, PHMB; AATCC 100. UV protective finishes (UPF). Insect-repellent, mothproofing. Soil-release finishes. Nanofinishes — self-cleaning (TiO_2), lotus effect. Plasma finishing, enzymatic finishing (bio-polishing). Sustainable finishing — ZDHC MRSL, GOTS, bluesign; foam finishing (Gaston Systems); ionic-liquid finishing. Evaluation using KES-FB, FAST, and Instron for hand and function.

Practical Component: **6 Hours**

1. Water-repellent finishing of woven fabric and hydrostatic head test.
2. Antimicrobial finishing with silver nano/chitosan — AATCC 100 evaluation.
3. UV protection factor determination for finished fabric.

Theory Hours	Tutorial Hours	Practical Hours	Project Hours	Total Hours
45	0	30	0	**75**

Learning Resources

Textbooks:

1. Miles, L. W. C. (ed). Textile Printing. 2nd ed., Society of Dyers and Colourists, UK, 2003.
2. Schindler, W. D., and P. J. Hauser. Chemical Finishing of Textiles. Woodhead Publishing, UK, 2020.
3. Ujiie, Hitoshi (ed). Digital Printing of Textiles. Woodhead Publishing, UK, 2015.

References:

1. Broadbent, A. D. Basic Principles of Textile Coloration. Society of Dyers and Colourists, UK, 2001.
2. Heywood, D. (ed). Textile Finishing. Society of Dyers and Colourists, UK, 2003.
3. Roy Choudhury, A. K. Principles of Textile Finishing. Woodhead Publishing, UK, 2017.
4. Paul, Roshan (ed). Functional Finishes for Textiles. Woodhead Publishing, UK, 2015.

Recommended Online Courses:

1. NPTEL: Textile Chemical Processing by Prof. M. L. Gulrajani and Prof. Kushal Sen, IIT Delhi.
2. Coursera: Sustainable Textile Manufacturing (Politecnico di Milano) — covers ZDHC and low-impact finishing.
3. Kornit Digital Academy — online modules on digital textile printing workflows.
4. SDC Colour Index Online — reference database for dyes and pigments.

Assessment
CAT-1, CAT-2, Activity and Learning Task (industry visit report to a printing/finishing unit — Best Corporation/KPR/Arvind), Mini Project, MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, Viva-voce.

Course Curated by		
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**
Mr. C. Muthukumar General Manager — Processing Arvind Ltd Ahmedabad	Prof. M. Parthiban Department of Fashion Technology PSG College of Technology Coimbatore	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile Technology Kumaraguru College of Technology

24TTT306	NONWOVEN TECHNOLOGY	L T P J C	3 0 0 0 3
Category	PC	**SDG**	SDG 3, 9, 12

Pre-requisite courses	24TTI201 Textile Fibres	Data Book / Code book: **-**

Course Objectives: The purpose of taking this course is to:
1. Introduce the classification, definition, and global market of nonwoven fabrics.
2. Impart knowledge on web-forming techniques — dry-laid, wet-laid, and polymer-laid processes.
3. Provide detailed understanding of web-bonding techniques — mechanical, thermal, and chemical bonding.
4. Enable analysis of nonwoven fabric properties, testing (INDA/EDANA WSP standards), and application-specific engineering.
5. Expose students to disposable, medical, hygiene, geotextile, and automotive nonwoven applications with focus on Indian manufacturers.

Course Outcomes: After successful completion of this course, the students shall be able to	**RBT Level**
CO 1: Explain the classification, definitions, and market segmentation of nonwoven fabrics globally and in India.	**K2 — Understand**
CO 2: Apply appropriate web-forming techniques for a given end-use in nonwoven manufacturing.	**K3 — Apply**
CO 3: Analyse the mechanism and process parameters of web-bonding routes and finishing operations.	**K4 — Analyse**
CO 4: Evaluate nonwoven fabric properties using INDA/EDANA WSP and ISO test standards.	**K5 — Evaluate**
CO 5: Recommend suitable nonwoven products for hygiene, medical, geotextile, and automotive applications.	**K5 — Evaluate**

CO - PO / PSO Mapping (Strong-3, Medium-2, Weak-1)

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

Course Content

INTRODUCTION AND CLASSIFICATION OF NONWOVENS 9 Hours

Definition of nonwoven (ISO 9092, INDA, EDANA). Difference between wovens, knits and nonwovens. Global market — INDEX Geneva, IDEA Miami, ANEX Tokyo. Indian market — Supreme Nonwovens, Ginni Filaments, Fibroline, Freudenberg India. Classification: web-forming route (dry-laid, wet-laid, polymer-laid — spunbond, meltblown), bonding route (mechanical, thermal, chemical), end-use (durable vs disposable). Raw materials — natural fibres (cotton, jute, viscose, lyocell), synthetics (polypropylene, polyester, polyamide, bicomponent). SMS and SMMS composite structures. Bio-based nonwovens — PLA, cellulose nonwovens (Ahlstrom, Suominen).

DRY-LAID AND WET-LAID WEB FORMATION 9 Hours

Dry-laid process — fibre opening, blending, carding (carded web — parallel-laid, cross-laid, random web using aerodynamic condenser). Cross-lapping (Asselin, Autefa). Air-laid process (Dan-Web, M&J Fibretech). Wet-laid process — modified paper-making route, inclined-wire former, tilted-wire, drum former (Voith HydroFormer). Furnish preparation, fibre length limitations, drainage. Comparison of dry-laid vs wet-laid. Applications — teabags, wipes, medical drapes, filtration media.

POLYMER-LAID (SPUNBOND AND MELTBLOWN) WEB FORMATION 9 Hours

Spunbond process — extrusion, filament drawing (aerodynamic vs mechanical), web-laying. Machines — Reifenhäuser Reicofil (RF-5 / RF-Ultra), Oerlikon Neumag, Rieter Perfojet. Meltblown process — die-tip design, hot-air attenuation, sub-micron fibre formation. Machines — Reifenhäuser, Biax-Fiberfilm, Kasen. SMS (spunbond-meltblown-spunbond) and SMMS composite lines. Nanofibre production — electrospinning (Elmarco Nanospider, Inovenso), centrifugal spinning, forcespinning. Applications — surgical masks, N95, filter media, hygiene topsheets.

WEB BONDING TECHNIQUES 9 Hours

Mechanical bonding: needle-punching (Dilo, Autefa, Asselin — needle boards, penetration, advance per stroke); hydroentanglement / spunlace (Andritz Perfojet, Truetzschler Fleissner — waterjet manifolds, energy consumption); stitch-bonding (Malimo, Kunit, Multiknit). Thermal bonding — calender bonding (point bond, area bond), through-air bonding (TAB), impingement, ultrasonic bonding. Chemical bonding — saturation, spray, print bonding, foam bonding; binder chemistry (acrylic, vinyl acetate, styrene-butadiene). Finishing of nonwovens — antistatic, hydrophilic/hydrophobic, antimicrobial, flame retardant, softening.

APPLICATIONS AND TESTING OF NONWOVENS 9 Hours

Disposable nonwovens — hygiene (diapers — Pampers, MamyPoko; feminine care — Whisper, Stayfree; adult incontinence), wipes (baby, industrial, cosmetic — Suominen, Sandler), medical (surgical gowns, drapes, face masks, wound dressings, sterile packaging). Durable nonwovens — geotextiles (Terram, Naue — separation, filtration, drainage, reinforcement), automotive (Autoneum — carpets, headliners, trunk liners, insulation), filtration (bag filters, HEPA, HVAC), furniture, apparel interlinings. Testing — INDA/EDANA WSP standards — basis weight (WSP 130), thickness (WSP 120), tensile (WSP 110), tear (WSP 100), absorbency (WSP 010), air permeability (WSP 070), MVTR, bacterial filtration efficiency (BFE — EN 14683). PPE nonwovens — post-pandemic Indian capacity expansion.

Theory Hours	Tutorial Hours	Practical Hours	Project Hours	Total Hours

45	0	0	0	**45**

Learning Resources

Textbooks:

1. Russell, S. J. (ed). Handbook of Nonwovens. 2nd ed., Woodhead Publishing, UK, 2022.
2. Albrecht, W., H. Fuchs, and W. Kittelmann (eds). Nonwoven Fabrics: Raw Materials, Manufacture, Applications, Characteristics, Testing Processes. Wiley-VCH, Germany, 2003.
3. Kellie, George (ed). Advances in Technical Nonwovens. Woodhead Publishing, UK, 2016.

References:

1. Batra, S. K., and B. Pourdeyhimi. Introduction to Nonwovens Technology. DEStech Publications, USA, 2012.
2. Wilson, A. Development of the Nonwovens Industry. Textile Institute, UK, 2010.
3. INDA and EDANA. Worldwide Strategic Partners Standard Procedures (WSP) — annual edition.
4. Chapman, R. A. (ed). Applications of Nonwovens in Technical Textiles. Woodhead Publishing, UK, 2010.

Recommended Online Courses:

1. NPTEL: Nonwoven Technology by Prof. R. Chattopadhyay, IIT Delhi.
2. INDA Nonwovens Institute online courses — Raleigh, NC State University.
3. EDANA e-Learning — Nonwoven Training Courses.

Assessment
CAT-1, CAT-2, Activity and Learning Task (Case study on Indian nonwoven manufacturer — Supreme Nonwovens/Ginni Filaments), MCQ, Model Exam, End Semester Examination (ESE).

Course Curated by		
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**
Mr. Rajesh Kumar Head — Nonwoven Division Supreme Nonwovens Pvt Ltd Mumbai	Prof. R. Chattopadhyay Department of Textile Technology Indian Institute of Technology Delhi	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile Technology Kumaraguru College of Technology

24TTT307	PROTECTIVE TEXTILE	L T P J C	3 0 0 0 3
Category	PC	**SDG**	SDG 3, 8, 9

Pre-requisite courses	24TTE012 High Performance Fibres (concurrent) or 24TTI201 Textile Fibres	Data Book / Code book: **-**

Course Objectives: The purpose of taking this course is to:
1. Impart knowledge on the requirements, classification, and standards of protective textiles for various hazards.
2. Introduce ballistic, stab, cut, and impact protective textiles with focus on Kevlar, Twaron, Dyneema, Spectra.
3. Develop understanding of thermal, flame, arc-flash, and chemical/biological protective textiles.
4. Provide expertise on protective clothing standards — EN, NFPA, NIJ, ANSI, IS.
5. Enable evaluation and selection of protective textile solutions for defence, industrial, medical, and firefighting applications.

Course Outcomes: After successful completion of this course, the students shall be able to	**RBT Level**
CO 1: Explain the classification, standards, and requirements of protective textiles for various hazard categories.	**K2 — Understand**
CO 2: Apply appropriate materials and constructions for ballistic, stab, cut, and impact protection.	**K3 — Apply**
CO 3: Analyse the mechanism of thermal, flame, arc-flash, and radiation protective textiles.	**K4 — Analyse**
CO 4: Evaluate protective clothing performance against EN, NFPA, NIJ, and BIS standards.	**K5 — Evaluate**
CO 5: Recommend protective textile solutions for defence, firefighter, industrial, and medical applications.	**K5 — Evaluate**

CO - PO / PSO Mapping (Strong-3, Medium-2, Weak-1)

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

Course Content

INTRODUCTION TO PROTECTIVE TEXTILES 9 Hours

Definition, classification, and scope. Types of hazards — mechanical (ballistic, stab, cut, impact), thermal (heat, flame, arc-flash, molten metal), chemical, biological, radiation, electrical, environmental (cold, rain, UV). Standards overview — CE PPE Regulation 2016/425 (EU), NFPA 1971/2112 (USA), NIJ 0101.06 (ballistic), EN 388 (mechanical), EN ISO 11612 (heat & flame), EN 13034 (chemical), IS 17334, ISO 20471 (high visibility). PPE categorisation — Category I, II, III. Comfort vs protection trade-off. Indian defence procurement — DRDO, Ordnance Factory Board, MKU Ltd, Anjani Technoplast.

BALLISTIC AND MECHANICAL PROTECTION 9 Hours

Ballistic protection — soft body armour (Kevlar KM-2, Twaron, Dyneema HB80/SB301, Spectra Shield), hard armour plates (ceramic — B4C, SiC, Al2O3 with UHMWPE backing). NIJ 0101.06 threat levels (IIA, II, IIIA, III, IV). Impact energy absorption mechanism — fibre extension, delamination, pyramid deformation. Testing — NIJ ballistic test, back-face signature. Stab and spike protection (NIJ 0115). Cut protection — EN 388 (Coup Test A–F), TDM-100. Puncture protection. Layered constructions — hybrid armour, shear-thickening fluid (STF) impregnated fabrics. Manufacturers — Point Blank, MKU Ltd (Kanpur), TATA Advanced Materials.

THERMAL AND FLAME PROTECTION 9 Hours

Flame retardancy mechanism — heat sink, char formation, gas phase interference. Inherently FR fibres — Nomex, Kevlar, PBI, Basofil, Kermel, Modacrylic, wool, FR viscose (Lenzing FR), Twaron. Treated FR fabrics — Proban, Pyrovatex, N-methylol cotton. Firefighter suits — three-layer construction (outer shell / moisture barrier / thermal liner). NFPA 1971 (structural firefighting), NFPA 1977 (wildland), EN 469. TPP (Thermal Protective Performance) test, RPP (Radiant), TP (Total Heat Flux — TP-index). Arc-flash protection — NFPA 70E, ATPV rating. Molten metal splash, welding protection (EN ISO 11611). Aluminised proximity suits.

CHEMICAL, BIOLOGICAL AND RADIATION PROTECTION 9 Hours

Chemical protective clothing (CPC) — EN 14126 (biological), EN 943 (gas-tight suits), EN 13034 (Type 6 limited splash). Materials — Tychem (DuPont — QC, C, F, BR, TK), butyl rubber, Viton, PVC, neoprene. Permeation, penetration, and breakthrough time (ASTM F739). Chemical warfare agent protection — activated carbon (Saratoga suit), Nano-fibre membranes. Biological protection — surgical gowns (AAMI PB70 levels 1-4), coveralls (EN 14126), N95/FFP3 masks (NIOSH 42 CFR 84). Radiation — X-ray shielding aprons (lead vs bismuth composites), NBC (Nuclear-Biological-Chemical) suits. HIV/Ebola protective clothing lessons. COVID-19 PPE Indian ramp-up (SITRA test certification).

OTHER SPECIALITY PROTECTIVE APPLICATIONS AND EVALUATION 9 Hours

High-visibility clothing — ISO 20471, retroreflective materials (3M Scotchlite, Reflexite). Cold weather protection — Gore-Tex, eVent, primaloft insulation, mountaineering (Everest, Antarctic use). UV protective clothing — UPF (AATCC 183, EN 13758). Electrostatic dissipative clothing — EN 1149. Motorcycle protection — EN 17092, D3O, SAS-TEC impact absorbers. Sports impact — cricket helmets, hockey gear. Space suits — layered ITMG (Integrated Thermal Micrometeoroid Garment) — ISRO Gaganyaan. Comfort assessment — thermal manikin (Newton, Coppelius), sweating manikin, wear-trial protocols. Life cycle assessment of protective clothing.

Theory Hours	Tutorial Hours	Practical Hours	Project Hours	Total Hours
45	0	0	0	**45**

Learning Resources

Textbooks:

1. Scott, R. A. (ed). Textiles for Protection. Woodhead Publishing, UK, 2005.
2. Chapman, R. A. (ed). Smart Textiles for Protection. Woodhead Publishing, UK, 2013.
3. Wang, Faming, and Chuansi Gao (eds). Protective Clothing: Managing Thermal Stress. Woodhead Publishing, UK, 2014.

References:

1. Bajaj, P., and A. K. Sengupta. Protective Clothing. Textile Progress, Textile Institute, UK, 1992.
2. Haase, J. High-Visibility Clothing. Textile Institute, UK, 2009.
3. NIJ Standard 0101.06. Ballistic Resistance of Body Armor. US National Institute of Justice, 2008.
4. NFPA 1971. Standard on Protective Ensembles for Structural Fire Fighting. NFPA, 2018.

Recommended Online Courses:

1. NPTEL: Textiles for Non-clothing Applications by Prof. B. K. Behera, IIT Delhi — includes protective textiles.
2. Cornell University edX: Protective Clothing and Materials.
3. DuPont Personal Protection e-learning modules.

Assessment
CAT-1, CAT-2, Activity and Learning Task (design of protective ensemble for a specific hazard — case study), Seminar, MCQ, End Semester Examination (ESE).

Course Curated by		
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**
Mr. Neeraj Gupta Senior Vice President MKU Ltd (Ballistic Division) Kanpur	Dr. Manjeet Jassal Professor, Department of Textile & Fibre Engineering Indian Institute of Technology Delhi	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile Technology Kumaraguru College of Technology

24TTT308	TEXTILE COSTING	L T P J C	3 0 0 0 3
Category	PC	**SDG**	SDG 8, 9, 12

Pre-requisite courses	-	Data Book / Code book: -

Course Objectives: The purpose of taking this course is to:
1. Impart fundamental knowledge of cost concepts, elements of cost, and costing methods relevant to the textile industry.
2. Develop competence in calculating spinning, weaving, knitting, wet processing, and garment manufacturing costs.
3. Enable students to prepare cost sheets, break-even analysis, and pricing decisions for textile products.
4. Introduce activity-based costing, target costing, and life-cycle costing for sustainable textile operations.
5. Provide exposure to Indian textile cost benchmarks (SIMA, CITI, TEA), export costing, and duty drawback.

Course Outcomes: After successful completion of this course, the students shall be able to	**RBT Level**
CO 1: Explain the fundamental cost concepts, cost elements, and cost classification in the textile industry.	**K2 — Understand**
CO 2: Apply costing methods to calculate spinning, weaving, knitting, and wet processing costs.	**K3 — Apply**
CO 3: Analyse garment costing including CMT, FOB, CIF, and export duty drawback calculations.	**K4 — Analyse**
CO 4: Evaluate break-even, contribution, marginal costing, and pricing decisions for textile products.	**K5 — Evaluate**
CO 5: Design activity-based, target-costing, and life-cycle-costing frameworks for sustainable textile production.	**K6 — Create**

CO - PO / PSO Mapping (Strong-3, Medium-2, Weak-1)

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

Course Content

INTRODUCTION TO COST ACCOUNTING 9 Hours

Cost, costing, and cost accounting — definitions and objectives. Difference between cost accounting, management accounting, and financial accounting. Elements of cost — materials, labour, expenses (direct and indirect). Classification of costs — fixed, variable, semi-variable; product vs period; controllable vs uncontrollable; sunk vs opportunity. Cost centres and cost units in textile industry. Cost sheet preparation. Overhead classification and absorption — machine hour rate, labour hour rate. Indian Costing Standards issued by ICAI (Institute of Cost Accountants of India).

COSTING OF SPINNING, WEAVING AND KNITTING 9 Hours

Spinning cost — cotton mixing cost, waste calculation (blow-room, carding, comber noil, dropping, sweep), conversion cost per kg (Rs./kg) — SITRA and SIMA benchmarks. Direct and indirect labour, power (units per kg), maintenance, depreciation. Yarn cost per bag/count. Weaving cost — warp and weft cost per metre, sizing cost, loom running cost (Rs./pick or Rs./metre), fabric cost calculation for shirting, suiting, denim. Knitting cost — yarn cost per kg of fabric, machine cost per hour on circular knitting machines (Rs./kg). Case: calculation for Tirupur T-shirt fabric.

COSTING OF WET PROCESSING AND GARMENT MANUFACTURING 9 Hours

Wet processing costs — pre-treatment (desizing, scouring, bleaching, mercerising), dyeing (dye cost, chemical cost, water/steam/power), printing, finishing. Cost per kg or per metre. ETP/ZLD operating cost. Garment costing — fabric consumption (marker efficiency, wastage %), CMT (Cost of Making with Trims), overheads, profit margin. FOB (Free On Board), CIF (Cost, Insurance, Freight), LDP (Landed Duty Paid) calculations. Duty drawback, RoDTEP rates. Case: costing for a 100% cotton knit T-shirt for US market.

MARGINAL COSTING, BREAK-EVEN AND PRICING DECISIONS 9 Hours

Marginal costing — contribution, PV ratio, margin of safety. Break-even analysis — BEP in units and value, graphical and algebraic. Cost-Volume-Profit (CVP) analysis. Make vs buy decisions. Pricing methods — cost plus, target return, competitive, penetration, skimming. Bulk order pricing. Sensitivity analysis for cotton price fluctuations. Budgeting — flexible budget, cash budget. Standard costing — variance analysis (material, labour, overhead). Textile industry margin structure — spinning (10-14%), weaving (12-18%), garmenting (20-30%).

MODERN COSTING TECHNIQUES AND SUSTAINABILITY 9 Hours

Activity-Based Costing (ABC) — cost drivers, activity pools, application to textile mills. Target costing — cost planning during product design. Life-Cycle Costing (LCC) — from cradle to grave. Environmental costing — carbon accounting (Scope 1, 2, 3 emissions), water footprint, chemical costing. Total Cost of Ownership (TCO) for textile machinery — Rieter Ring vs Compact vs Rotor spinning economics. Higg Materials Sustainability Index (Higg MSI) as a costing tool. Cost of quality — prevention, appraisal, internal failure, external failure. Cost benchmarking by SIMA (Southern India Mills' Association), CITI (Confederation of Indian Textile Industry), TEA (Tirupur Exporters Association).

Theory Hours	Tutorial Hours	Practical Hours	Project Hours	Total Hours

45	0	0	0	**45**

Learning Resources

Textbooks:

1. Vasant, D. Cost Accounting: Principles and Practice. 13th ed., Prentice Hall of India, 2019.
2. Nayak, R., and R. Padhye. Garment Manufacturing Technology (Chapter on Costing). Woodhead Publishing, UK, 2015.
3. Chuter, A. J. Introduction to Clothing Production Management. Blackwell Scientific, UK, 1988.

References:

1. Horngren, C. T., et al. Cost Accounting: A Managerial Emphasis. 16th ed., Pearson, USA, 2018.
2. Jain, S. P., and K. L. Narang. Cost Accounting: Principles and Practice. Kalyani Publishers, India, 2020.
3. SITRA. Norms for Spinning Mills — Annual Publication.
4. Rathinamoorthy, R., and R. Surjit. Apparel Merchandising. CRC Press, USA, 2017.

Recommended Online Courses:

1. NPTEL: Cost Accounting by Prof. A. K. Singh, IIT Kharagpur.
2. Coursera: Managerial Accounting Fundamentals (University of Virginia).
3. SIMA Cost Estimation Portal (member access).

Assessment
CAT-1, CAT-2, Activity and Learning Task (cost sheet preparation for a real textile product), Case study, MCQ, End Semester Examination (ESE).

Course Curated by		
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**
Mr. K. Selvaraju Secretary General Southern India Mills' Association (SIMA) Coimbatore	Dr. V. R. Sampath Associate Professor, Department of Textile Technology Anna University Chennai	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile Technology Kumaraguru College of Technology

SEMESTER VII

24TTT401	TEXTILE BUSINESS MANAGEMENT	L T P J C	3 0 0 0 3
Category	Mgmt / Fin	**SDG**	SDG 8, 9, 12, 17

Pre-requisite courses	-	Data Book / Code book: -

Course Objectives: The purpose of taking this course is to:
1. Impart knowledge on the structure, segments, and value chain of the global and Indian textile & apparel industry.
2. Develop understanding of textile marketing, retail, and consumer behaviour in domestic and export markets.
3. Enable students to apply principles of supply chain management, sourcing, and merchandising in textile business.
4. Introduce international trade, WTO framework, FTAs, sustainability compliance, and digital transformation in textile business.
5. Provide exposure to entrepreneurship, MSME schemes, and start-up ecosystem in the Indian textile sector.

Course Outcomes: After successful completion of this course, the students shall be able to	**RBT Level**
CO 1: Explain the structure, segments, and value chain of the global and Indian textile & apparel industry.	**K2 — Understand**
CO 2: Apply marketing, retail, and consumer behaviour principles for textile products in domestic and export markets.	**K3 — Apply**
CO 3: Analyse supply chain, sourcing, and merchandising decisions in textile and apparel business.	**K4 — Analyse**
CO 4: Evaluate international trade regulations, sustainability compliance frameworks, and digital transformation initiatives.	**K5 — Evaluate**
CO 5: Create a business plan for a textile start-up, MSME, or new business unit aligned with government schemes.	**K6 — Create**

CO - PO / PSO Mapping (Strong-3, Medium-2, Weak-1)

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

Course Content

GLOBAL AND INDIAN TEXTILE INDUSTRY STRUCTURE 9 Hours

Global textile & apparel industry — size (USD 1.7 trillion), major producers (China, India, Bangladesh, Vietnam, Turkey), major consumers (USA, EU, Japan). Indian textile industry — 4.6% GDP, 12% exports, 45 million employed. Segments — cotton, MMF, technical textiles, silk, wool, jute, handloom, handicrafts. Value chain — farm to fashion. Government schemes — PLI, PM-MITRA (7 mega parks), NTTM (National Technical Textile Mission), Amended Technology Upgradation Fund Scheme (ATUFS), SAMARTH skill scheme, Silk Samagra. Key industry bodies — Textile Ministry, Textile Commissioner, CITI, SIMA, TEA, AEPC, TEXPROCIL, SRTEPC, CMAI. Textile clusters — Coimbatore, Tirupur, Surat, Bhiwandi, Ludhiana, Panipat.

TEXTILE MARKETING, RETAIL AND CONSUMER BEHAVIOUR 9 Hours

Marketing concepts — 4Ps (Product, Price, Place, Promotion) and 4Cs (Consumer, Cost, Convenience, Communication). Textile market segmentation — demographic, psychographic, behavioural. B2B vs B2C marketing. Retail formats — MBO, EBO, department stores, hypermarkets, e-commerce (Myntra, Amazon Fashion, Nykaa Fashion, Ajio), quick commerce, D2C brands. Fast fashion (Zara, H&M, Shein), slow fashion, sustainable fashion. Brand management — private labels vs national brands. Consumer behaviour — purchase decision process, digital consumer journey. Textile advertising and PR. Fashion cycles — trend forecasting (WGSN, Fashion Snoops). Season planning — SS, AW, resort, cruise.

SUPPLY CHAIN, SOURCING AND MERCHANDISING 9 Hours

Textile supply chain — fibre → yarn → fabric → garment → retailer → consumer. Sourcing strategies — vertical integration, contract manufacturing, private label. Global sourcing hubs — China, India, Bangladesh, Vietnam, Turkey, Ethiopia. Merchandising — types (retail, export, product), functions (line planning, sampling, costing, quality, shipment). Vendor evaluation, PO management. Tech pack, T&A (time and action) calendar. Compliance audits — SEDEX SMETA, WRAP, BSCI, SA8000, GOTS, OCS, GRS. Lean supply chain, just-in-time. Digital supply chain — ERP (SAP AFS, WFX), PLM (Centric, Gerber YuniquePLM), blockchain (TextileGenesis, Circular ID).

INTERNATIONAL TRADE AND SUSTAINABILITY COMPLIANCE 9 Hours

WTO framework, MFA phase-out (2005). Free Trade Agreements — India-UAE CEPA (2022), India-Australia ECTA (2022), India-UK FTA (ongoing), India-EU FTA (negotiation). Rules of Origin. Tariff and non-tariff barriers. Export procedures and documentation — commercial invoice, packing list, BL/AWB, certificate of origin, LC, GSP. Duty drawback, RoDTEP, RoSCTL, Advance Authorisation, EPCG. Sustainability compliance — ZDHC MRSL, Higg Index (BRM, FEM, FSLM), CDP (Carbon Disclosure), Science Based Targets initiative (SBTi), EU Green Deal, CSDDD (Corporate Sustainability Due Diligence Directive), EPR (Extended Producer Responsibility) for textiles. Digital Product Passport (DPP) — EU 2027 mandate.

ENTREPRENEURSHIP, MSME AND DIGITAL TRANSFORMATION 9 Hours

Textile entrepreneurship — business plan, feasibility study, financial projections. MSME classification (revised 2020). MSME schemes — CGTMSE, PMEGP, ZED (Zero Defect Zero Effect), MUDRA. Start-up India — DPIIT recognition, tax benefits, funding sources (venture capital, angel investors, crowdfunding). Textile start-up examples — Zilingo, FabAlley, Bombay Shirt Company, Grameen

Suvidha, TextileGenesis. Digital transformation — Industry 4.0 in textile business (IoT, AI, big data, digital twin, cloud). E-commerce and D2C playbook. Fashion-tech — virtual try-on (Metaverse fashion, Roblox), NFTs in fashion. Post-COVID reshoring and near-shoring. Family business succession in Indian textiles.

Theory Hours	Tutorial Hours	Practical Hours	Project Hours	Total Hours
45	0	0	0	**45**

Learning Resources

Textbooks:

1. Dickerson, K. G. Inside the Fashion Business. 7th ed., Prentice Hall, USA, 2003.
2. Jackson, T., and D. Shaw. The Fashion Handbook. Routledge, UK, 2020.
3. Rathinamoorthy, R., and R. Surjit. Apparel Merchandising. CRC Press, USA, 2017.

References:

1. Kunz, G. I., and M. B. Garner. Going Global: The Textile and Apparel Industry. 3rd ed., Fairchild Books, USA, 2016.
2. Sen, A. Global Textile and Apparel Industry: Regional Overview and Perspectives. Woodhead Publishing, UK, 2017.
3. Ministry of Textiles, Government of India. Annual Report — latest edition.
4. Wazir Advisors. Indian Apparel Market Report — annual publication.

Recommended Online Courses:

1. NPTEL: Marketing Management by Prof. Zillur Rahman, IIT Roorkee.
2. Coursera: Fashion as Design (MoMA); Fashion & Luxury Compliance in the New Digital Era (Bocconi).
3. IIM Bangalore edX: Digital Transformation of Business.
4. AEPC and TEXPROCIL knowledge portals.

Assessment
CAT-1, CAT-2, Activity and Learning Task (business plan for a textile start-up), Socratic seminar on trade agreements, Case study on sustainability compliance, MCQ, End Semester Examination (ESE).

Course Curated by		
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**
Dr. A. Sakthivel Chairman Apparel Export Promotion Council (AEPC) Gurugram	Prof. Prabir Jana Professor, Department of Fashion Technology National Institute of Fashion Technology (NIFT) New Delhi	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile Technology Kumaraguru College of Technology

24TTJ401	PROJECT PHASE I	L T P J C	0 0 0 3 3
Category	PR (Project)	**SDG**	SDG 4, 9, 17

Pre-requisite courses	Completion of Semester VI	Data Book / Code book: **-**

Course Objectives: The purpose of taking this course is to:
1. Enable students to identify a real-world engineering, research, or industry problem in textile technology.
2. Develop skills in literature review, problem formulation, and research methodology.
3. Introduce experimental design, data collection, and preliminary analysis for textile projects.
4. Foster team collaboration, project planning, and time management using industry-standard tools (Gantt chart, MS Project).
5. Prepare students to communicate research findings through interim reports, presentations, and technical documentation.

Course Outcomes: After successful completion of this course, the students shall be able to	**RBT Level**
CO 1: Identify and formulate a significant problem in textile technology aligned with industry or societal need.	**K3 — Apply**
CO 2: Conduct a systematic literature review using databases (Scopus, WoS, Textile Institute, ScienceDirect).	**K4 — Analyse**
CO 3: Design an experimental methodology or engineering solution framework with justified selection of materials and methods.	**K5 — Evaluate**
CO 4: Execute preliminary experiments / prototype development / feasibility study and analyse initial results.	**K5 — Evaluate**
CO 5: Communicate progress through structured interim reports, technical presentations, and reviews.	**K5 — Evaluate**

CO - PO / PSO Mapping

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

Project Structure and Guidelines

Project Phase I is the first stage of a two-semester capstone project (Phase I in VII semester and Phase II in VIII semester). Students work in teams of 2-3 members under the guidance of a faculty supervisor and, where applicable, an industry / research co-supervisor.

Timeline	Activity
Weeks 1-2	Problem identification, team formation, supervisor allocation, and topic finalisation.
Weeks 3-5	Systematic literature review (30-50 papers, focus on last 5 years), gap analysis, formulation of problem statement and objectives.
Weeks 6-7	First Review — Zero Review: Problem statement, literature synthesis, objectives, methodology (40 marks).
Weeks 8-11	Design of experiments / prototype planning, procurement of materials, laboratory / industry / field access arrangements.
Weeks 12-13	Second Review — Progress Review: Methodology finalisation, preliminary experiments, characterisation plan (30 marks).
Weeks 14-15	Preliminary experimental / prototype execution, initial data collection, and analysis.
Week 16	Final Review — Phase I Completion Review: Interim report (30-50 pages) submission, PPT presentation, viva-voce (30 marks).

Project Domains — Illustrative (aligned to R24 curriculum):

Sustainable spinning, weaving, knitting, wet processing; technical textiles (medical, protective, geotech, mobiltech, sporttech); nonwoven product design; nanofinishing and functional coatings; digital textile printing; industrial IoT and Industry 4.0 in textile mills; artificial intelligence for shade matching, defect detection, quality prediction; textile robotics and automation; circular economy and textile recycling; smart / e-textile wearables; product development for MSME clusters; industry consultancy problems (from Arvind, KPR, Vardhman, Shahi, Best Corp, etc.).

Deliverables at End of Phase I

1. Interim Project Report (30-50 pages) — literature review, methodology, preliminary results. 2. Three Review Presentations — Zero Review, Progress Review, Phase I Completion Review. 3. Individual work-log book validated by supervisor (bi-weekly). 4. Draft manuscript / patent application / prototype design document (recommended for high-performing teams).

Assessment

Component	Reviewer	Marks
Zero Review (Problem statement, literature, objectives)	Review Committee	20
Progress Review (Methodology, preliminary results)	Review Committee	20
Phase I Completion Review (Interim Report + Viva)	Review Committee + External	30

Component	Reviewer	Marks
Supervisor's Continuous Assessment (Log book, teamwork, initiative)	Faculty Supervisor	30
Total		**100**

SEMESTER VIII

24TTJ402	**PROJECT PHASE II**	**L T P J C**	**0 0 0 12 12**
Category	PR (Project)	**SDG**	SDG 4, 8, 9, 12, 17

Pre-requisite courses	24TTJ401 Project Phase I	Data Book / Code book: -

Course Objectives: The purpose of taking this course is to:
1. Execute the complete experimental / design / development plan set up in Phase I.
2. Analyse results using statistical, computational, and instrumental techniques with rigour.
3. Develop working prototypes, publication-quality manuscripts, patent applications, or industry deployment plans.
4. Demonstrate professional communication through comprehensive reports, presentations, and defence of thesis.
5. Contribute to sustainable and industry-aligned outcomes with measurable impact (energy, water, carbon, cost, quality).

Course Outcomes: After successful completion of this course, the students shall be able to	**RBT Level**
CO 1: Execute the planned methodology / prototype development to completion with appropriate modifications as required.	**K5 — Evaluate**
CO 2: Analyse and interpret experimental / performance data using statistical and computational tools.	**K5 — Evaluate**
CO 3: Create novel textile products, processes, or engineering solutions with demonstrable innovation.	**K6 — Create**
CO 4: Communicate research outcomes via publications (journals / conferences), patents, or industry reports.	**K6 — Create**
CO 5: Defend the project outcome to academic and industry examiners demonstrating depth of understanding.	**K6 — Create**

CO - PO / PSO Mapping

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

Project Execution Structure

Project Phase II is a full-time, 12-credit capstone project spanning the entire VIII semester. Students continue with the team, topic, and supervisor from Phase I. The dedicated project mode allows deep engagement with the problem, either on-campus, in an industrial R&D environment, or in a research institute (in-plant or on-site with MoU).

Timeline	Activity
Weeks 1-3	Refinement of methodology based on Phase I outcomes, procurement of any additional materials / equipment, calibration and standardisation of instruments.
Weeks 4-6	First Review — Progress Review 1: Detailed methodology, initial results, adherence to plan (20 marks).
Weeks 7-10	Main experimental / development phase — design of experiments (DoE), sample fabrication, characterisation, iterative improvement.
Weeks 11-12	Second Review — Progress Review 2: Complete results, statistical analysis, discussion (20 marks).
Weeks 13-14	Manuscript writing (journal paper), patent drafting (if applicable), report preparation.
Weeks 15-16	Final Review — Project Defence: Comprehensive report submission, PPT presentation, viva-voce with external examiner (40 marks).

Expected Deliverables at End of Phase II

1. Comprehensive Project Thesis / Report (80-120 pages) following IEEE / Elsevier / IIT format. 2. Working prototype, functional sample, or industry deployment (as applicable). 3. Journal / conference manuscript prepared for submission (Scopus / WoS indexed). 4. Provisional patent application (recommended for novel technology). 5. Final PPT presentation to internal and external examiners. 6. Individual work-log book validated throughout the semester.

Types of Project Recognised

(a) Research Project — investigation of scientific / engineering problem with publication as target. (b) Product Development Project — new textile product / process / prototype for industry / MSME. (c) Industry Consultancy Project — problem-solving assignment from industry partner (Arvind, KPR, Vardhman, Best Corp, Shahi, Raymond, Welspun, etc.) with signed MoU. (d) Start-up / Entrepreneurship Project — feasibility study, MVP development, business validation aligned with Startup India / KCT iHub. (e) Interdisciplinary Project — with allied departments (CSE for AI/ML, Mechanical for automation, Fashion for design, Biotech for biomaterials).

Assessment

Component	Reviewer	Marks
Progress Review 1 (Methodology & initial results)	Review Committee	15
Progress Review 2 (Complete results & analysis)	Review Committee	15
Final Project Defence (Thesis + Presentation + Viva)	Review Committee + External Examiner	40

Component	Reviewer	Marks
Supervisor's Continuous Assessment (Log book, initiative, rigour)	Faculty Supervisor	20
Publication / Patent / Prototype Deliverable	Departmental Committee	10
Total		**100**

SYLLABUS – PROFESSIONAL ELECTIVES

TRACK-I : TECHNICAL

Courses : 24TTE011 – 24TTE015

S. No	Course Code	Course Title	L-T-P-J-C
1	24TTE011	Manufactured Fibre Technology	3-0-0-0-3
2	24TTE012	High-Performance Fibres	3-0-0-0-3
3	24TTE013	Process Control In Spinning And Weaving	3-0-0-0-3
4	24TTE014	Sustainability In Textile Manufacturing And Material	3-0-0-0-3
5	24TTE015	Garment Processing	3-0-0-0-3

24TTE011	MANUFACTURED FIBRE TECHNOLOGY					CATEGORY
	L 3	T 0	P 0	J 0	C 3	PE

Pre-requisite Courses	Data Book / Codes / Standards	SDG Mapping
24TTI201 – Textile Fibres	Nil	SDG 9, 12

COURSE OBJECTIVES

1	To impart knowledge on the classification, raw materials and polymer chemistry of manufactured fibres.
2	To develop understanding of the melt, dry, wet, gel and electro-spinning technologies used for manufactured fibre production.
3	To familiarise the students with post-spinning operations such as drawing, texturising, heat setting and crimping.
4	To provide expertise on the structure–property relationships of PET, PA, PP, PAN, viscose and lyocell fibres.
5	To enable the selection of manufactured fibres for apparel, home, industrial and technical textile applications.

COURSE OUTCOMES

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

CO	Course Outcome	RBT Level
CO1	Explain the classification, raw materials and polymer chemistry of manufactured fibres.	K2 – Understand
CO2	Compare the melt, dry, wet, gel and electro-spinning routes for various polymer systems.	K2 – Understand
CO3	Apply the principles of drawing, texturising and heat setting to modify fibre properties.	K3 – Apply
CO4	Analyse the structure–property relationships of PET, PA, PP, PAN, viscose and lyocell fibres.	K4 – Analyse
CO5	Recommend suitable manufactured fibres for apparel, home, industrial and technical textile end-uses.	K5 – Evaluate

MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES / PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong; 2 – Medium; 1 – Weak

COURSE CONTENT

UNIT	CONTENT
UNIT I : INTRODUCTION TO MANUFACTURED FIBRES (9 Hours)	
Global fibre landscape and share of manufactured fibres. Classification – regenerated cellulosic, regenerated protein, synthetic, inorganic and specialty fibres. Generic and trade names – Terylene, Dacron, Nylon, Tencel, Modal, Lyocell, Kevlar, Nomex, Spandex. Requirements of a fibre-forming polymer – molecular weight, chain regularity, crystallinity, glass transition temperature (Tg), melting temperature (Tm). Polymerisation techniques – addition, condensation, ring-opening. Indian and global manufactured fibre industry – Reliance Industries, Grasim, Indorama, Toray, Teijin, Lenzing, Kelheim. Statistics from Fibre Year, ICAC, Textile Exchange.	
UNIT II : MELT SPINNING TECHNOLOGY (9 Hours)	

Principle of melt spinning – polymer chip preparation, drying, extrusion, filtration, spinneret design, quench air, take-up, winding. Melt spinning of Polyester (PET) – DMT and TPA routes, esterification, polycondensation, chip crystallisation. Melt spinning of Nylon 6 and Nylon 6,6 – caprolactam and hexamethylene diamine routes. Polypropylene (PP) fibre – Ziegler-Natta catalyst, isotactic PP, spinning parameters. Bicomponent spinning – side-by-side, sheath-core, islands-in-the-sea, segmented pie configurations. Machinery – Barmag, Oerlikon, TMT.	
UNIT III : WET, DRY, GEL AND ELECTRO-SPINNING (9 Hours)	
Wet spinning of Viscose rayon – steeping, pressing, shredding, ageing, xanthation, dissolving, ripening, spinning, regeneration. Modal and Lyocell – NMMO solvent process. Dry spinning of acetate and triacetate. Wet spinning of Acrylic (PAN) fibre – DMF and DMAc solvents, modacrylic co-polymer systems. Gel spinning of UHMWPE (Dyneema, Spectra) and high-tenacity fibres. Electrospinning – set-up, parameters (voltage, flow rate, distance, humidity), Taylor cone, nanofibre production, needle-less electrospinning (Nanospider). Centrifugal spinning.	
UNIT IV : POST-SPINNING OPERATIONS AND FIBRE PROPERTIES (9 Hours)	
Drawing – hot and cold drawing, draw ratio, orientation, effect on tenacity and elongation. Heat setting – free and constrained, effect on crystallinity, boiling water shrinkage. Texturising methods – false-twist, air-jet, BCF, stuffer box, edge crimping, gear crimping. Crimping and cutting – tow-to-top and tow-to-staple conversion. Fibre characterisation – denier, tenacity, elongation, modulus, moisture regain, DSC, TGA, WAXD, SAXS, FTIR, SEM. Structure–property relationships in PET, PA, PP and PAN staple and filament yarns.	
UNIT V : SPECIALITY AND SUSTAINABLE MANUFACTURED FIBRES (9 Hours)	
Microfibres and split microfibres. Profiled cross-section fibres – trilobal, hollow, star. Bio-based synthetic fibres – PLA (NatureWorks), Bio-PET, PHA, PTT (Sorona). Recycled fibres – rPET (Reliance R|Elan, Unifi Repreve), chemical recycling. Solution-dyed and dope-dyed fibres. High-performance fibres – aramid (Kevlar, Twaron, Nomex), UHMWPE, PBO, carbon, glass, basalt, ceramic fibres. Applications in apparel, home textile, sportswear, automotive, protective, medical and geo-textile sectors. Sustainability certifications – GRS, RCS, OEKO-TEX, Bluesign.	
TOTAL HOURS	**45 Hours**

LEARNING RESOURCES

Text Books

1. Gupta, V. B. and Kothari, V. K., "Manufactured Fibre Technology", Springer, New Delhi, 2019.
2. Mishra, S. P., "A Text Book of Fibre Science and Technology", New Age International Publishers, New Delhi, 2018.

Reference Books

1. McIntyre, J. E., "Synthetic Fibres – Nylon, Polyester, Acrylic, Polyolefin", Woodhead Publishing, Cambridge, 2020.
2. Sinclair, R., "Textiles and Fashion – Materials, Design and Technology", Woodhead Publishing, Cambridge, 2021.
3. Salem, D. R., "Structure Formation in Polymeric Fibres", Hanser Publishers, Munich, 2019.
4. Nakajima, T., "Advanced Fibre Spinning Technology", Woodhead Publishing, Cambridge, 2018.

Online Educational Resources

1. NPTEL Course – "Manufactured Fibre Technology", IIT Delhi. https://nptel.ac.in
2. SWAYAM Course – "Textile Fibre Science", IIT Delhi. https://swayam.gov.in
3. The Fibre Year – Global Report on Fibres and Nonwovens. https://www.thefiberyear.com

MODE OF ASSESSMENT

CAT-1, CAT-2, Assignment / Activity based Learning Task, MCQ, Model Examination, and End Semester Examination (ESE) as per KCT R24 assessment framework.

COURSE CURATED BY

Industry Expert	Higher Educational Institution Expert	Internal Expert

Mr. R. Rajkumar Head – R&D Reliance Industries Limited Mumbai	Prof. B. K. Behera Department of Textile & Fibre Engineering Indian Institute of Technology Delhi New Delhi	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile Technology Kumaraguru College of Technology

BOARD OF STUDIES / ACADEMIC COUNCIL APPROVAL

Approved in BoS Meeting held on	26th BoS – June 2026
Approved in Academic Council Meeting held on	31st ACM – 19 June 2026

24TTE012	HIGH-PERFORMANCE FIBRES					CATEGORY
	L 3	T 0	P 0	J 0	C 3	PE
Pre-requisite Courses		Data Book / Codes / Standards			SDG Mapping	
24TTI201 – Textile Fibres		Nil			SDG 9, 12	

COURSE OBJECTIVES

1	To introduce the classification and property requirements of high-performance fibres for advanced technical applications.
2	To impart knowledge on the production, structure and properties of aramid, UHMWPE, PBO and PIPD fibres.
3	To develop understanding of carbon, glass, basalt and ceramic fibres and their manufacturing routes.
4	To familiarise the students with heat and flame resistant fibres and their end-uses.
5	To provide expertise on the applications of high-performance fibres in ballistic, aerospace, composite and industrial sectors.

COURSE OUTCOMES

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

CO	Course Outcome	RBT Level
CO1	Classify high-performance fibres based on their chemical structure and property profile.	K2 – Understand
CO2	Explain the manufacturing process, structure and properties of para-aramid, meta-aramid, UHMWPE and PBO fibres.	K2 – Understand
CO3	Compare the production routes, morphology and properties of carbon, glass, basalt and ceramic fibres.	K4 – Analyse
CO4	Analyse the thermal, mechanical and chemical performance of heat and flame resistant fibres.	K4 – Analyse
CO5	Recommend suitable high-performance fibres for ballistic protection, aerospace composites and industrial applications.	K5 – Evaluate

MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES / PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong; 2 – Medium; 1 – Weak

COURSE CONTENT

UNIT	CONTENT
UNIT I : INTRODUCTION TO HIGH-PERFORMANCE FIBRES (9 Hours)	
Definition and requirements of high-performance fibres. Classification – organic (aramid, UHMWPE, PBO, PIPD, LCP), inorganic (carbon, glass, basalt, silicon carbide, alumina) and natural high-performance fibres. Property benchmarks – tenacity (>20 g/den), modulus (>500 g/den), thermal resistance (>250 °C), chemical resistance. Global market – DuPont, Teijin, Toray, Honeywell, Toyobo, DSM. Selection criteria for aerospace, defence, protective, industrial and composite applications. Overview of Indian scenario – NAL, HAL, DRDO, Kevlar-K29, K49, K129.	
UNIT II : ARAMID AND POLYMERIC HIGH-MODULUS FIBRES (9 Hours)	
Para-aramid fibres – Kevlar (DuPont), Twaron (Teijin), Technora – synthesis of PPTA (poly-p-phenylene terephthalamide), sulphuric acid dope, liquid crystalline spinning, dry-jet wet spinning. Meta-aramid – Nomex,	

Conex – synthesis of PMPI (poly-m-phenylene isophthalamide), wet spinning. Ultra-High Molecular Weight Polyethylene (UHMWPE) – Dyneema (DSM), Spectra (Honeywell) – gel spinning. PBO – Zylon (Toyobo), PIPD – M5. Liquid Crystal Polymer (LCP) fibres – Vectran (Kuraray). Properties – tenacity, modulus, creep, UV stability, cost.	
UNIT III : CARBON AND GRAPHITE FIBRES (9 Hours)	
Carbon fibre – classification based on precursor (PAN, pitch, rayon, mesophase pitch). PAN-based carbon fibre – stabilisation (200–300 °C, oxidation), carbonisation (1000–1700 °C), graphitisation (>2000 °C). Pitch-based carbon fibre – isotropic and mesophase pitch, spinning and heat treatment. Structure – turbostratic, graphitic. Grades – standard modulus (T300), intermediate modulus (T800), high modulus (M60J), ultra-high modulus. Manufacturers – Toray, Teijin, Hexcel, Mitsubishi Rayon, SGL. Surface treatment and sizing. Applications in aerospace, wind energy, sports and automotive composites.	
UNIT IV : GLASS, CERAMIC AND INORGANIC FIBRES (9 Hours)	
Glass fibre – E-glass, S-glass, R-glass, ECR-glass, AR-glass – composition, direct melt process, marble melt process, sizing. Continuous filament, chopped strand, roving, mat. Basalt fibre – single-melt process, properties, applications. Silicon carbide (SiC) fibre – Nicalon, Sylramic, Tyranno. Alumina fibre – Nextel, Saphikon. Boron fibre – CVD process on tungsten substrate. Metal fibres – stainless steel, copper, aluminium. Applications in composites, insulation, reinforcement and high-temperature environments (turbines, brake pads, exhaust filters).	
UNIT V : HEAT/FLAME RESISTANT FIBRES AND APPLICATIONS (9 Hours)	
Heat and flame resistant fibres – PBI (polybenzimidazole), PEEK, PTFE, PPS, oxidised PAN (Panox, Pyron), melamine (Basofil), FR viscose, FR polyester, FR modacrylic. LOI, thermal degradation, TGA analysis. Ballistic textiles – soft body armour, hard armour, helmets – ballistic testing (NIJ standards). Aerospace composites – CFRP for A350, B787, LEAP engine. Wind turbine blades. Fire fighter suits, structural fire suits, industrial gloves, cut-resistant gloves (EN 388). Rope, cable, sailcloth, industrial webbing. Case studies – NASA, ISRO, Indian defence.	
TOTAL HOURS	**45 Hours**

LEARNING RESOURCES

Text Books

1. Hearle, J. W. S., "High-performance Fibres", Woodhead Publishing, Cambridge, 2019.
2. Bhat, G., "Structure and Properties of High-Performance Fibres", Woodhead Publishing, Cambridge, 2020.

Reference Books

1. Chawla, K. K., "Fibrous Materials", Cambridge University Press, Cambridge, 2018.
2. Peebles, L. H., "Carbon Fibres – Formation, Structure and Properties", CRC Press, Boca Raton, 2019.
3. Bunsell, A. R., "Handbook of Properties of Textile and Technical Fibres", Woodhead Publishing, 2018.
4. Mukhopadhyay, S. K., "Advances in Fibre Science", The Textile Institute, Manchester, 2020.

Online Educational Resources

1. NPTEL Course – "High Performance Fibres and Composites", IIT Delhi. https://nptel.ac.in
2. Composites World – Technical Articles on Advanced Fibres. https://www.compositesworld.com
3. The Fibre Society – Publications on High-performance Fibres. https://www.thefibersociety.org

MODE OF ASSESSMENT

CAT-1, CAT-2, Assignment / Activity based Learning Task, MCQ, Model Examination, and End Semester Examination (ESE) as per KCT R24 assessment framework.

COURSE CURATED BY

Industry Expert	Higher Educational Institution Expert	Internal Expert
Mr. R. Rajkumar Head – R&D Reliance Industries Limited Mumbai	Prof. B. K. Behera Department of Textile & Fibre Engineering Indian Institute of Technology Delhi New Delhi	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile Technology Kumaraguru College of Technology

BOARD OF STUDIES / ACADEMIC COUNCIL APPROVAL

Approved in BoS Meeting held on	26th BoS – June 2026
Approved in Academic Council Meeting held on	31st ACM – 19 June 2026

24TTE013	PROCESS CONTROL IN SPINNING AND WEAVING					CATEGORY
	L 3	T 0	P 0	J 0	C 3	PE
Pre-requisite Courses			Data Book / Codes / Standards		SDG Mapping	
24TTI202 – Yarn Manufacture; 24TTI301 – Fabric Manufacture			Nil		SDG 9, 12	

COURSE OBJECTIVES

1	To impart knowledge on the principles of process control and quality management in spinning and weaving mills.
2	To familiarise the students with process control tools, SQC techniques and industry norms for yarn production.
3	To develop understanding of process control in blowroom, carding, drawing, combing, speed frame and ring frame.
4	To provide expertise on process control in warping, sizing, drawing-in and weaving operations.
5	To enable the interpretation of Uster Statistics and setting of KPIs for continuous improvement.

COURSE OUTCOMES

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

CO	Course Outcome	RBT Level
CO1	Explain the fundamentals of process control, quality management systems and Uster Statistics in textile mills.	K2 – Understand
CO2	Apply SQC tools (X-bar/R chart, p-chart, c-chart, histogram, Pareto, cause-and-effect) to spinning and weaving operations.	K3 – Apply
CO3	Analyse process parameters, waste levels and quality indices in blowroom, carding, drawing, combing and ring frame.	K4 – Analyse
CO4	Analyse the process control parameters in warping, sizing and weaving to minimise defects and downtime.	K4 – Analyse
CO5	Evaluate mill performance using KPIs (efficiency, RKM, U%, CV%, warp/weft breakage) and recommend corrective actions.	K5 – Evaluate

MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES / PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong; 2 – Medium; 1 – Weak

COURSE CONTENT

UNIT	CONTENT
UNIT I : PRINCIPLES OF PROCESS CONTROL AND QUALITY MANAGEMENT (9 Hours)	
Concept of quality – Deming, Juran, Crosby philosophies. TQM, ISO 9001:2015, Six Sigma, Lean, Kaizen. Process control vs product control. Statistical Quality Control (SQC) – control charts for variables (X-bar, R, s), attributes (p, np, c, u). Process capability – Cp, Cpk, Pp, Ppk. Uster Statistics 2018 – yarn count CV%, U%, thin/thick/nep levels, IPI, hairiness. Uster Tester 6, Uster Classimat 5, Uster HVI 1000. Norms for 5%, 25%, 50%, 75%, 95% USTER benchmarks. Role of quality circles, poka-yoke, 5S and TPM in textile mills.	
UNIT II : PROCESS CONTROL IN BLOWROOM, CARDING AND DRAW FRAME (9 Hours)	
Blowroom – bale management, mixing, opening, cleaning efficiency, lint/trash separation, waste percentage. Modern lines – Truetzschler BO-P, Rieter Unifloc A12, VarioClean. Carding – wire specification, licker-in and	

cylinder speed, flat setting, autoleveller, sliver hank, CV%, nep removal efficiency, waste extraction. Rieter C 81, Truetzschler TC 19i. Drawframe – autoleveller (short-term/long-term), draft distribution, doubling, sliver evenness, spectrogram analysis. Rieter RSB-D 26, Truetzschler TD 10. Waste norms, work practices and SOPs.	
UNIT III : PROCESS CONTROL IN COMBING, SPEED FRAME AND RING FRAME (9 Hours)	
Combing – lap preparation (Unilap E 36), noil %, top comb setting, cylinder needling, comber efficiency. Rieter E 90 comber. Speed frame – draft, twist, roving CV%, tension, package build-up. Rieter F 40, Toyota FL 200. Ring frame – spindle speed, ring-traveller selection, yarn tension, end breaks per 1000 spindle hours, roving-to-yarn conversion, U%, CV%, RKM, hairiness (H-value, S3), thin/thick/nep, IPI norms. Rieter G 38, Toyota RX 300, Lakshmi LR 6/S. Compact spinning – Compact-K, Suessen EliTe, Rieter K 47. TFO doubling and Assembly winding.	
UNIT IV : PROCESS CONTROL IN WEAVING PREPARATION AND WEAVING (9 Hours)	
Warping – direct and sectional, warp tension, package density, breakage rate, machine efficiency. Karl Mayer, Benninger, Prashant Westpoint. Sizing – add-on %, size pick-up, stretch, moisture, abrasion resistance, hairiness reduction. Sizing formulations – starch, PVA, CMC, acrylics. Karl Mayer Prosize, Suker Muller. Drawing-in and knotting – automatic drawing-in machines. Weaving – warp/weft break rate per 100 000 picks, machine efficiency, snap-study analysis, shed geometry, tension variation. Air-jet (Picanol Omni Plus, Toyota JAT 810), rapier (Picanol Optimax, Itema R9500), water-jet, projectile. Defects – broken pick, warp streak, missing end.	
UNIT V : YARN AND FABRIC QUALITY EVALUATION AND KPIs (9 Hours)	
Yarn quality parameters – count, CV%, twist, U%, thin/thick/nep, hairiness, tenacity, RKM, elongation. Fabric inspection systems – 4-point, 10-point, Graniteville systems. Common woven fabric defects – reed marks, broken picks, starting marks, streakiness, oil stains. Loom shed efficiency, machine utilisation, downtime analysis. KPIs – OEE (Overall Equipment Effectiveness), MTBF, MTTR, OTIF. Cost of quality – prevention, appraisal, internal failure, external failure. Case studies from Vardhman, Nahar, Arvind, Trident, Welspun, KPR, Loyal, Sri Karpagam. Digital tools – MillMaster from Uster, Rieter SPIDERweb, Truetzschler MyWires.	
TOTAL HOURS	**45 Hours**

LEARNING RESOURCES

Text Books

1. Ratnam, T. V. and Chellamani, K. P., "Quality Control in Spinning", SITRA, Coimbatore, 2020.
2. Sengupta, A. K. and Chattopadhyay, R., "Process Control in Textile Manufacturing", Woodhead Publishing, Cambridge, 2019.

Reference Books

1. Klein, W., "The Rieter Manual of Spinning – Volumes 1 to 7", Rieter Machine Works Ltd., Winterthur, 2020.
2. Adanur, S., "Handbook of Weaving", CRC Press, Boca Raton, 2018.
3. Uster Statistics 2018 – The Industry's Quality Benchmarks, Uster Technologies AG, Uster, 2018.
4. Ormerod, A. and Sondhelm, W. S., "Weaving – Technology and Operations", The Textile Institute, Manchester, 2019.

Online Educational Resources

1. NPTEL Course – "Process Control in Yarn Manufacture", IIT Delhi. https://nptel.ac.in
2. Uster Technologies – Technical Bulletins. https://www.uster.com
3. SITRA Coimbatore – Norms and Publications. https://www.sitra.org.in

MODE OF ASSESSMENT

CAT-1, CAT-2, Assignment / Activity based Learning Task, MCQ, Model Examination, and End Semester Examination (ESE) as per KCT R24 assessment framework.

COURSE CURATED BY

Industry Expert	Higher Educational Institution Expert	Internal Expert
Mr. R. Rajkumar Head – R&D	Prof. B. K. Behera Department of Textile & Fibre	Dr. Bhaarathi Dhurai Professor & BoS Coordinator

Reliance Industries Limited Mumbai	Engineering Indian Institute of Technology Delhi New Delhi	Department of Textile Technology Kumaraguru College of Technology

BOARD OF STUDIES / ACADEMIC COUNCIL APPROVAL

Approved in BoS Meeting held on	26th BoS – June 2026
Approved in Academic Council Meeting held on	31st ACM – 19 June 2026

24TTE014	SUSTAINABILITY IN TEXTILE MANUFACTURING AND MATERIAL					CATEGORY
	L 3	T 0	P 0	J 0	C 3	PE
Pre-requisite Courses			Data Book / Codes / Standards		SDG Mapping	
Nil			Nil		SDG 6, 12, 13	

COURSE OBJECTIVES

1	To impart knowledge on sustainability principles, UN SDGs and circular economy concepts in the textile value chain.
2	To familiarise the students with sustainable fibres, yarns and fabrics from natural, recycled and bio-based sources.
3	To develop understanding of cleaner production, water/energy conservation and effluent management in wet processing.
4	To provide expertise on sustainability standards, certifications and Life Cycle Assessment (LCA) methodologies.
5	To enable the design and evaluation of sustainable textile products and circular business models.

COURSE OUTCOMES

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

CO	Course Outcome	RBT Level
CO1	Explain the principles of sustainability, UN SDGs and circular economy in the textile industry.	K2 – Understand
CO2	Identify sustainable fibres, yarns and fabrics from natural, recycled and bio-based sources.	K3 – Apply
CO3	Apply cleaner production, water and energy conservation techniques to textile wet processing.	K3 – Apply
CO4	Analyse the sustainability standards, certifications and Life Cycle Assessment methodologies applicable to textiles.	K4 – Analyse
CO5	Evaluate sustainable textile products and design circular business models for the fashion industry.	K5 – Evaluate

MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES / PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong; 2 – Medium; 1 – Weak

COURSE CONTENT

UNIT	CONTENT
UNIT I : PRINCIPLES OF SUSTAINABILITY IN TEXTILES (9 Hours)	
Definition of sustainability – triple bottom line (people, planet, profit). UN Sustainable Development Goals (SDG 6, 8, 9, 12, 13, 14, 15) relevance to textiles. Environmental impact of the textile industry – water consumption (2700 L/t-shirt), CO_2 emissions (1.2 billion tonnes/year), microplastic shedding, chemical pollution. Linear vs circular economy – Ellen MacArthur Foundation model. Cradle-to-cradle, cradle-to-grave, cradle-to-gate approaches. R-strategies – Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle, Recover. Global initiatives – UN Fashion Charter for Climate Action, Fashion Pact, Textile Exchange, ZDHC, SAC (Higg Index). Indian initiatives – Sustainable Apparel Coalition.	

UNIT II : SUSTAINABLE FIBRES AND MATERIALS (9 Hours)	
Organic cotton – GOTS, OCS standards. Better Cotton Initiative (BCI), Fairtrade cotton. Bast fibres – hemp, flax, jute, ramie. Regenerated cellulose – Lyocell (Tencel), Modal, Refibra (Lenzing), Livaeco (Birla). Bio-based synthetics – PLA (NatureWorks Ingeo), Bio-PET, PHA, Sorona. Recycled fibres – rPET from bottles (Reliance R|Elan, Unifi Repreve), pre- and post-consumer recycled cotton (Recover, Renewcell Circulose). Chemical recycling – Ioncell, Infinited Fiber, Worn Again. Alternative materials – banana, pineapple (Piñatex), Mylo (mushroom leather), orange fibre. Vegan and cruelty-free materials.	
UNIT III : CLEANER PRODUCTION IN WET PROCESSING (9 Hours)	
Cleaner production hierarchy – prevention, reduction, recycle, treat, dispose. Water conservation in dyeing – low material-to-liquor ratio, cold pad batch, ultrasonic dyeing, supercritical CO_2 dyeing (DyeCoo). Waterless technologies – digital printing, plasma, foam finishing. Energy conservation – heat recovery, LED lighting, VFDs, solar thermal. Chemical management – ZDHC MRSL, RSL. Enzymatic processing – bio-scouring, bio-polishing, bio-desizing. Natural dyes and pigments – indigo, madder, turmeric, neem, marigold. Effluent treatment – primary, secondary, tertiary treatment, MBR, RO, ZLD systems. Case studies – Arvind, Welspun, Shahi, Loyal, Best Corp. Higg FEM – Facility Environmental Module.	
UNIT IV : SUSTAINABILITY STANDARDS AND CERTIFICATIONS (9 Hours)	
Fibre and material standards – GOTS, OCS, GRS, RCS, RWS, RDS, Content Claim Standard (CCS). Chemical management – OEKO-TEX Standard 100, STeP by OEKO-TEX, Bluesign, ZDHC Gateway. Environmental standards – ISO 14001 (EMS), ISO 14040/44 (LCA), ISO 14067 (carbon footprint), ISO 14046 (water footprint), EU Ecolabel, Nordic Swan. Social standards – SA 8000, WRAP, BSCI, Fair Trade, Sedex SMETA. Higg Index – FEM, FSLM, MSI, PM, BRM. Digital Product Passport (DPP) under EU Textile Strategy. Extended Producer Responsibility (EPR). Life Cycle Assessment (LCA) methodology – goal, scope, inventory, impact, interpretation. Software – SimaPro, GaBi, OpenLCA.	
UNIT V : CIRCULAR ECONOMY AND SUSTAINABLE PRODUCT DESIGN (9 Hours)	
Circular design principles – design for disassembly, mono-material, recyclability, biodegradability. Product-as-a-Service (PaaS) models – rental, leasing, subscription (Rent the Runway, Nuuly). Take-back schemes – H&M, Patagonia Worn Wear, Uniqlo Re.Uniqlo. Resale and second-hand – ThredUp, Vestiaire, Depop. Upcycling and downcycling. Textile recycling – mechanical, chemical, thermal. Automated sorting (Fibersort, TrinamiX NIR). Post-consumer textile waste management. Microplastic mitigation – Guppyfriend bag, Cora Ball, PlanetCare filters. Consumer behaviour and sustainable fashion. Slow fashion movement. Corporate sustainability reporting – GRI, SASB, BRSR (India), CSRD (EU). PM MITRA and NTTM sustainability focus. Case studies – Patagonia, Eileen Fisher, Stella McCartney, Arvind.	
TOTAL HOURS	**45 Hours**

LEARNING RESOURCES

Text Books

1. Muthu, S. S., "Sustainability in the Textile Industry", Springer, Singapore, 2020.
2. Blackburn, R. S., "Sustainable Textiles – Life Cycle and Environmental Impact", Woodhead Publishing, Cambridge, 2019.

Reference Books

1. Muthu, S. S., "Handbook of Sustainable Apparel Production", CRC Press, Boca Raton, 2020.
2. Fletcher, K., "Sustainable Fashion and Textiles – Design Journeys", Routledge, London, 2018.
3. Gardetti, M. A. and Muthu, S. S., "The UN Sustainable Development Goals for the Textile and Fashion Industry", Springer, Singapore, 2020.
4. Niinimäki, K., "Sustainable Fashion in a Circular Economy", Aalto University Publications, Helsinki, 2018.

Online Educational Resources

1. Textile Exchange – Preferred Fibre and Materials Market Report. https://textileexchange.org
2. Higg Index by Sustainable Apparel Coalition. https://apparelcoalition.org
3. Ellen MacArthur Foundation – Circular Economy for Fashion. https://ellenmacarthurfoundation.org
4. NPTEL Course – "Sustainability in Textile Wet Processing". https://nptel.ac.in

MODE OF ASSESSMENT

CAT-1, CAT-2, Assignment / Activity based Learning Task, MCQ, Model Examination, and End Semester Examination (ESE) as per KCT R24 assessment framework.

COURSE CURATED BY

Industry Expert	Higher Educational Institution Expert	Internal Expert
Mr. R. Rajkumar Head – R&D Reliance Industries Limited Mumbai	Prof. B. K. Behera Department of Textile & Fibre Engineering Indian Institute of Technology Delhi New Delhi	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile Technology Kumaraguru College of Technology

BOARD OF STUDIES / ACADEMIC COUNCIL APPROVAL

Approved in BoS Meeting held on	26th BoS – June 2026
Approved in Academic Council Meeting held on	31st ACM – 19 June 2026

24TTE015	GARMENT PROCESSING					CATEGORY
	L 3	T 0	P 0	J 0	C 3	PE

Pre-requisite Courses	Data Book / Codes / Standards	SDG Mapping
24TTI302 – Textile Chemical Processing	Nil	SDG 9, 12

COURSE OBJECTIVES

1	To impart knowledge on garment preparation, garment dyeing techniques and machinery.
2	To develop understanding of garment washing processes for denim and other apparel.
3	To familiarise the students with garment finishing techniques for value addition.
4	To provide expertise on garment printing methods and their compatibility with different substrates.
5	To enable the selection of appropriate garment processing routes for various fabric types and product categories.

COURSE OUTCOMES

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

CO	Course Outcome	RBT Level
CO1	Explain the principles and machinery involved in garment preparation and dyeing.	K2 – Understand
CO2	Apply appropriate garment washing techniques for denim and non-denim garments.	K3 – Apply
CO3	Analyse garment finishing techniques for functional and aesthetic value addition.	K4 – Analyse
CO4	Compare various garment printing methods for different apparel substrates.	K4 – Analyse
CO5	Recommend suitable garment processing routes based on fabric type, product category and end-use.	K5 – Evaluate

MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES / PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong; 2 – Medium; 1 – Weak

COURSE CONTENT

UNIT	CONTENT
UNIT I : GARMENT PREPARATION AND MACHINERY (9 Hours)	
Introduction to garment processing – scope, advantages over piece-goods processing, need for value addition at garment stage. Types of garments – knit (T-shirt, polo, hoodie), woven (shirt, trouser, denim), sportswear, innerwear, sleepwear. Fabric preparation for garment wet processing – singeing, desizing, scouring, bleaching. Garment loading and unloading systems – rotary drum, paddle, side-loading. Machinery – Tolkar Genghis, Tonello G1, Ramsons R-Clean, Yamuna washer-extractor. Batch capacity, MLR (Material-to-Liquor Ratio) selection. Pre-treatment auxiliaries – wetting agents, sequestering agents, anti-creasing agents, lubricants. Automation and Industry 4.0 in garment processing plants.	
UNIT II : GARMENT DYEING (9 Hours)	
Principle of garment dyeing – advantages, quick response, small batch flexibility, colour matching. Suitable garment types and fabrics. Dye classes for garment dyeing – reactive (cotton, viscose), disperse (polyester	

blends), acid (nylon, wool), direct, sulphur. Machinery – Tonello G2, Then Airflow, Tolkar, ATYC. Process sequence for cotton knit garments – pretreatment, dyeing, soaping, fixing, softening. Garment dyeing of polyester and blends – high temperature (130 °C) or carrier dyeing. Reactive dyeing recipes for cotton T-shirts. Common defects – patchy dyeing, listing, tailing, streakiness. Right-first-time dyeing. Ecological dyestuffs. Dope-dyed and solution-dyed alternatives.	
UNIT III : GARMENT WASHING AND DENIM PROCESSING (9 Hours)	
Objectives of garment washing – size removal, softness, faded look, comfort. Types of washing – rinse wash, garment wash, stone wash, bleach wash, enzyme wash, acid wash, silicon wash, sand blasting, laser wash, ozone wash. Denim washing sequence – desizing, stone wash (pumice stone), enzyme wash (cellulase), bleaching (potassium permanganate, hypochlorite), tinting, softening. Machinery – Tonello EcoFree, Jeanologia laser (G2, e-Flow, e-Soft), ozone systems. Chemicals – amylase, cellulase, laccase, sodium metabisulphite. Sustainable denim finishing – waterless (Jeanologia H2Zero), ozone bleaching, laser distressing. Environmental impact and effluent management in denim washing. Case studies – Arvind, Raymond UCO.	
UNIT IV : GARMENT FINISHING (9 Hours)	
Objectives of garment finishing – softness, dimensional stability, functional properties, aesthetics. Softening finishes – silicone, macro-silicone, cationic softeners. Wrinkle-free finish – DMDHEU, non-formaldehyde resins, VLC (vapour phase). Water/oil repellent finish – C6 fluorocarbon, C0 non-fluorinated (Rudolf Bionic-Finish Eco), silicone. Antimicrobial finish – silver nanoparticle, chitosan, triclosan (restricted). Flame retardant – Proban, Pyrovatex. UV protection, moisture management, mosquito repellent, aroma finish. Application methods – pad-dry-cure, spray, exhaust, foam. Machinery – tumble dryer, calender, stenter (Bruckner, Monforts). 3D moulding and heat setting. Case studies from athleisure and technical apparel.	
UNIT V : GARMENT PRINTING AND EMBELLISHMENT (9 Hours)	
Screen printing on garments – flat-bed, rotary. Pigment printing – binder, thickener, fixation. Plastisol printing on cotton and blends. Discharge printing on dyed fabrics. Reactive printing on cotton knits. Digital garment printing – Direct-to-Garment (DTG) – Kornit, Brother, Epson. Direct-to-Film (DTF), Direct-to-Substrate (DTS). Sublimation printing on polyester. Heat transfer printing – vinyl (HTV), sublimation transfer. 3D embossing, high-density printing, foil printing, flock printing, glitter printing. Embroidery – computerised, 3D puff, appliqué. Rhinestones, sequins, beadwork. Placement, matching, quality checks. Print defects – ghosting, cracking, bleeding, migration. Fastness testing. Case studies from Shahi Exports, Gokaldas, Raymond, KPR Mill and Loyal Textiles.	
TOTAL HOURS	**45 Hours**

LEARNING RESOURCES

Text Books

1. Kan, C. W. and Wong, W. Y., "Denim – Manufacture, Finishing and Applications", Woodhead Publishing, Cambridge, 2019.
2. Mishra, R., "Garment Processing and Finishing", Woodhead Publishing India, New Delhi, 2020.

Reference Books

1. Chinta, S. K. and Landage, S. M., "Garment Wet Processing", CRC Press, Boca Raton, 2019.
2. Paul, R., "Denim – Manufacture, Finishing and Applications", Woodhead Publishing, Cambridge, 2018.
3. Choudhury, A. K. R., "Principles of Textile Finishing", Woodhead Publishing, Cambridge, 2019.
4. Ujiie, H., "Digital Printing of Textiles", Woodhead Publishing, Cambridge, 2020.

Online Educational Resources

1. NPTEL Course – "Chemical Processing of Textiles", IIT Delhi. https://nptel.ac.in
2. Jeanologia Technology Portal. https://www.jeanologia.com
3. Kornit Digital – DTG Printing Resources. https://www.kornit.com
4. Textile Today – Garment Processing Articles. https://www.textiletoday.com.bd

MODE OF ASSESSMENT

CAT-1, CAT-2, Assignment / Activity based Learning Task, MCQ, Model Examination, and End Semester Examination (ESE) as per KCT R24 assessment framework.

COURSE CURATED BY

Industry Expert	Higher Educational Institution Expert	Internal Expert
Mr. R. Rajkumar Head – R&D Reliance Industries Limited Mumbai	Prof. B. K. Behera Department of Textile & Fibre Engineering Indian Institute of Technology Delhi New Delhi	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile Technology Kumaraguru College of Technology

BOARD OF STUDIES / ACADEMIC COUNCIL APPROVAL

Approved in BoS Meeting held on	26th BoS – June 2026
Approved in Academic Council Meeting held on	31st ACM – 19 June 2026

Professional Electives — TRACK II: Entrepreneurship and Business

(Course Codes: 24TTE041 to 24TTE052)

S.No	Course Code	Course Title	Mode	L-T-P-J-C
1	24TTE041	New Product Development and Strategy	Theory	3-0-0-0-3
2	24TTE042	Market Research and Portfolio Management	Theory	3-0-0-0-3
3	24TTE043	Supply Chain Management	Theory	3-0-0-0-3
4	24TTE044	Textile Project Management and Finance	Theory	3-0-0-0-3
5	24TTE045	Export Documentation and Business Strategy	Theory	3-0-0-0-3
6	24TTE046	Principles of Management	Theory	3-0-0-0-3
7	24TTE047	Apparel Quality Management	Theory	3-0-0-0-3
8	24TTE048	Apparel Production Planning and Control	Theory	3-0-0-0-3
9	24TTE049	Fashion Marketing Management	Theory	3-0-0-0-3
10	24TTE050	Industrial Engineering	Theory	3-0-0-0-3
11	24TTE051	Sustainable Textile Manufacturing and Strategy	Embedded	2-0-2-0-3
12	24TTE052	Textile Robotics and Automation	Embedded	2-0-2-0-3

24TTE041	**NEW PRODUCT DEVELOPMENT AND STRATEGY**		**L**	**T**	**P**	**J**	**C**
Category	PE	**SDG**	3	0	0	0	**3**
SDG				SDG 8, 9, 12			
Pre-requisite courses		-		**Data Book / Code book (If any)**		-	

Course Objectives: The purpose of taking this course is to:

1.	Impart knowledge on the fundamentals of new product development (NPD), innovation strategy, and the product life cycle for textile and apparel products.
2.	Develop competence in applying stage-gate, agile, and design-thinking frameworks for NPD in the textile industry.
3.	Enable students to conduct opportunity identification, concept generation, and concept screening for new textile products.
4.	Introduce product architecture, industrial design, prototyping, and go-to-market strategies for textile innovations.
5.	Provide exposure to intellectual property protection, launch planning, and post-launch performance evaluation of new textile products.

Course Outcomes: After successful completion of this course, the students shall be able to

Course Outcomes	RBT Level
CO 1: Explain the fundamentals of new product development, innovation types, and product life cycle in the textile and apparel industry.	**K2 — Understand**
CO 2: Apply stage-gate, agile, and design-thinking frameworks for developing new textile product concepts.	**K3 — Apply**
CO 3: Analyse market opportunities, consumer insights, and competitive positioning for new textile product ideas.	**K4 — Analyse**
CO 4: Evaluate product architecture, prototyping techniques, and go-to-market strategies for textile innovations.	**K5 — Evaluate**
CO 5: Design a complete new product development plan for a textile or apparel product, integrating IP, launch, and post-launch strategy.	**K6 — Create**

CO - PO / PSO Mapping (Strong-3, Medium-2, Weak-1)

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

Course Content

UNIT I: FUNDAMENTALS OF NEW PRODUCT DEVELOPMENT	9 Hours

New product — definitions, classification (new-to-world, new-to-firm, line extensions, repositioning, cost reductions). Innovation types — incremental, radical, disruptive, sustaining. Product life cycle (PLC) — introduction, growth, maturity, decline; PLC strategies for textile products. Sources of new product ideas — technology push vs market pull. NPD success and failure factors — data from PDMA (Product Development and Management Association) benchmarking studies. Role of NPD in Indian textile industry — Arvind, Raymond, Welspun, Trident, Vardhman case snapshots. Sustainable Development Goals alignment — SDG 9 and SDG 12 in textile NPD.

UNIT II: NPD PROCESS AND FRAMEWORKS	9 Hours

Traditional stage-gate model (Cooper) — discovery, scoping, business case, development, testing, launch. Agile NPD — sprints, scrum, minimum viable product (MVP). Design thinking — empathise, define, ideate, prototype, test. Lean start-up — build-measure-learn cycle. Fuzzy front-end management. Portfolio management — Boston Consulting Group (BCG) matrix, GE-McKinsey matrix, product-market grid. Concurrent engineering. Voice of Customer (VoC), Quality Function Deployment (QFD), House of Quality for textile products. Kansei engineering for aesthetic textiles.

UNIT III: MARKET OPPORTUNITY AND CONCEPT GENERATION	9 Hours

Opportunity identification — trend analysis, gap analysis, jobs-to-be-done framework. Trend forecasting sources — WGSN, Fashion Snoops, Trendstop, Première Vision, Heimtextil, Techtextil. Consumer insights — ethnographic research, netnography, social listening. Segmentation, Targeting, Positioning (STP) for new textile products. Concept generation — brainstorming, SCAMPER, TRIZ, morphological analysis, biomimicry (lotus effect, shark-skin inspired fabrics). Concept screening — Pugh matrix, weighted scoring. Concept testing — conjoint analysis, A/B testing. Business case development — NPV, IRR, payback period for NPD projects.

UNIT IV: PRODUCT ARCHITECTURE, DESIGN AND PROTOTYPING	9 Hours

Product architecture — modular vs integral; platform-based product development (Toyota, Zara model). Industrial design principles — form, function, ergonomics, aesthetics. Design for X (DfX) — Design for Manufacturing (DFM), Design for Assembly (DFA), Design for Environment (DfE), Design for Disassembly (DfD). Textile prototyping — sample development, lab-dip approval, pilot production, wear trials. Rapid prototyping in textiles — 3D knitting (Shima Seiki, Stoll), 3D weaving, digital printing. Virtual prototyping — CLO 3D, Browzwear VStitcher, Optitex. Colour management — Pantone TCX, Datacolor. Product testing — durability, colourfastness, comfort, safety per BIS, ASTM, ISO, OEKO-TEX standards.

UNIT V: LAUNCH, IP AND POST-LAUNCH STRATEGY	9 Hours

Go-to-market strategy — pricing (skimming, penetration, value-based), channel selection (retail, e-commerce, D2C, marketplace), promotion mix. Pre-launch — teaser campaigns, influencer seeding, PR. Launch — soft launch, full-scale launch, phased rollout. Intellectual property in textiles — patents (utility, design), trademarks (brand, logo), copyrights (prints, artwork), Geographical Indications (Kancheepuram Silk, Coimbatore Wet Grinder, Bhagalpur Silk, Chanderi, Pochampally Ikat). Trade secrets — dye recipes, finishing formulations. Post-launch review — sales tracking, consumer feedback, warranty claims, product recall management. Continuous improvement — Kaizen loop. Case: Fabindia, W for Woman, and Arvind Denim Lab NPD stories.

Theory Hours	Tutorial Hours	Practical Hours	Project Hours	Total Hours
45	0	0	0	**45**

Learning Resources

Textbooks:

1. Ulrich, K. T., and S. D. Eppinger. Product Design and Development. 7th ed., McGraw-Hill, New York, 2020.
2. Cooper, R. G. Winning at New Products: Creating Value Through Innovation. 5th ed., Basic Books, USA, 2017.
3. Rathinamoorthy, R., and R. Surjit. Apparel Merchandising. CRC Press, USA, 2017.

References:

1. Trott, P. Innovation Management and New Product Development. 7th ed., Pearson, UK, 2021.
2. Sinha, P., et al. New Product Development for Fashion. Bloomsbury, London, 2019.
3. Kotler, P., and K. L. Keller. Marketing Management. 15th ed., Pearson, India, 2018.
4. Osterwalder, A., and Y. Pigneur. Business Model Generation. Wiley, USA, 2010.

Recommended Online Courses:

1. NPTEL: New Product Development by Prof. Nikhilesh Dholakia, IIT Kharagpur.
2. Coursera: Design Thinking for Innovation, University of Virginia.
3. edX: Product Management with Lean, Agile and System Design Thinking, Boston University.
4. PDMA (Product Development and Management Association) knowledge portal.

Assessment
CAT-1, CAT-2, Activity and Learning Task (NPD project — concept to prototype for a new textile product), Case study analysis (Zara, Fabindia, Arvind), MCQ, End Semester Examination (ESE).

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
Mr. J. Suresh CEO — Retail Brands Arvind Fashions Ltd., Bengaluru	Prof. Prabir Jana Professor, Department of Fashion Technology National Institute of Fashion Technology (NIFT) New Delhi	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile Technology Kumaraguru College of Technology, Coimbatore

24TTE042	**MARKET RESEARCH AND PORTFOLIO MANAGEMENT**		**L**	**T**	**P**	**J**	**C**
Category	PE	**SDG**	3	0	0	0	**3**
SDG				SDG 8, 9, 12			
Pre-requisite courses		-		**Data Book / Code book (If any)**		-	

Course Objectives: The purpose of taking this course is to:

1.	Impart knowledge on the fundamentals, process, and design of market research applied to textile and apparel businesses.
2.	Develop competence in quantitative and qualitative data collection, sampling, and analysis techniques for textile markets.
3.	Enable students to apply statistical tools and consumer analytics for demand estimation and market segmentation.
4.	Introduce product portfolio management concepts, tools, and strategies for optimising the textile product mix.
5.	Provide exposure to digital market research tools, social analytics, and brand portfolio management in the Indian textile ecosystem.

Course Outcomes: After successful completion of this course, the students shall be able to

Course Outcomes	RBT Level
CO 1: Explain the fundamentals, objectives, and process of market research in the textile and apparel industry.	**K2 — Understand**
CO 2: Apply appropriate research designs, sampling, and data collection methods for textile market studies.	**K3 — Apply**
CO 3: Analyse consumer data using statistical, qualitative, and digital analytics tools to derive market insights.	**K4 — Analyse**
CO 4: Evaluate product portfolio management frameworks and strategic decisions for textile brands and product lines.	**K5 — Evaluate**
CO 5: Design a market research and portfolio management plan for a textile firm using contemporary tools and best practices.	**K6 — Create**

CO - PO / PSO Mapping (Strong-3, Medium-2, Weak-1)

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

Course Content

UNIT I: INTRODUCTION TO MARKET RESEARCH	9 Hours

Market research — definition, scope, and importance in textile and apparel decisions. Types — exploratory, descriptive, causal. Marketing Research vs Market Research vs Market Intelligence. Marketing Information System (MkIS). Marketing research process — problem definition, research design, data collection, analysis, reporting. Ethics in market research — ESOMAR code, MRSI (Market Research Society of India) guidelines. Structure of the Indian market research industry — Nielsen, Kantar, Ipsos, GfK, IMRB. Applications in textile industry — trend research, brand tracking, retail audit, price research.

UNIT II: RESEARCH DESIGN AND DATA COLLECTION	9 Hours

Research designs — cross-sectional vs longitudinal, exploratory vs conclusive. Secondary data sources — Ministry of Textiles reports, Wazir Advisors, Technopak, Euromonitor, Statista, Kantar Worldpanel. Primary data collection — surveys (online, mail, telephone, personal), observation, experimentation, focus groups, in-depth interviews, projective techniques. Questionnaire design — types of questions, scaling techniques (Likert, semantic differential, Stapel, constant sum). Sampling — probability and non-probability methods; sample-size determination for textile consumer surveys. Retail audit and consumer panel — Nielsen Retail Index, Kantar Worldpanel.

UNIT III: DATA ANALYSIS AND CONSUMER INSIGHTS	9 Hours

Data preparation — coding, editing, transcription. Descriptive statistics — measures of central tendency and dispersion, cross-tabulation. Hypothesis testing — chi-square, t-test, ANOVA, F-test. Multivariate techniques — multiple regression, factor analysis, cluster analysis, discriminant analysis, conjoint analysis, multidimensional scaling (MDS). Qualitative analysis — content analysis, thematic analysis. Digital analytics — Google Analytics, social listening (Sprinklr, Brandwatch, Meltwater), sentiment analysis, netnography. Textile-industry KPIs — sell-through rate, gross margin return on inventory (GMROI), weeks of supply (WOS). Tools — SPSS, R, Python, Power BI, Tableau.

UNIT IV: PORTFOLIO MANAGEMENT — CONCEPTS AND FRAMEWORKS	9 Hours

Portfolio management — definition, need, objectives. Product portfolio analysis — Boston Consulting Group (BCG) growth-share matrix (Stars, Cash Cows, Question Marks, Dogs). GE-McKinsey nine-cell matrix. Ansoff growth matrix (market penetration, market development, product development, diversification). Product-line analysis — length, width, depth, consistency. Product-mix decisions — line extension, brand extension, rationalisation, pruning. Category management in textile retail — role of category captain (Big Bazaar, Reliance Trends, Shoppers Stop). Textile brand portfolio — masterbrand, endorsed, house-of-brands (ITC Lifestyle, Aditya Birla Fashion — Van Heusen, Louis Philippe, Allen Solly, Peter England).

UNIT V: STRATEGIC PORTFOLIO DECISIONS AND EMERGING TRENDS	9 Hours

Portfolio review process — periodic and event-triggered reviews. Portfolio balancing — risk vs return, short-term vs long-term. Resource-allocation frameworks — Pareto analysis, ROI ranking. Scenario planning for cotton price volatility and demand shocks. Digital transformation of market research — AI-enabled consumer analytics, virtual focus groups, eye-tracking studies, neuromarketing. Big-data analytics for fashion — predictive demand sensing (Stitch Fix, Amazon fashion). Portfolio management in sustainability era — eco-fabric portfolios (BCI cotton, organic cotton, recycled polyester, Tencel, hemp). Case studies — Raymond, Vardhman, Welspun, Trident brand portfolio evolution.

Theory Hours	Tutorial Hours	Practical Hours	Project Hours	Total Hours
45	0	0	0	**45**

Learning Resources

Textbooks:

1. Malhotra, N. K., and S. Dash. Marketing Research: An Applied Orientation. 7th ed., Pearson, India, 2020.
2. Kotler, P., and K. L. Keller. Marketing Management. 15th ed., Pearson, India, 2018.
3. Rathinamoorthy, R., and R. Surjit. Apparel Merchandising. CRC Press, USA, 2017.

References:

1. Aaker, D. A., V. Kumar, and G. S. Day. Marketing Research. 12th ed., Wiley, USA, 2019.
2. Churchill, G. A., and D. Iacobucci. Marketing Research: Methodological Foundations. 12th ed., Cengage, USA, 2019.
3. Sinha, P. K., and D. P. Uniyal. Managing Retailing. 3rd ed., Oxford University Press, India, 2018.
4. Wazir Advisors. Indian Apparel Market Report — Annual Publication.

Recommended Online Courses:

1. NPTEL: Marketing Research and Analysis by Prof. Jogendra Kumar Nayak, IIT Roorkee.
2. Coursera: Market Research and Consumer Behaviour, IE Business School.
3. edX: Data Analysis for Decision Making, Wharton School.
4. ESOMAR and MRSI knowledge portals.

Assessment
CAT-1, CAT-2, Activity and Learning Task (mini market research project on a selected textile product category), Portfolio analysis case study, MCQ, End Semester Examination (ESE).

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
Mr. Ashok Rajagopal Managing Director Kantar (South Asia) — Textiles & Apparel Practice, Mumbai	Dr. Rajesh S. Upadhyayula Professor of Strategic Marketing Indian Institute of Management (IIM) Kozhikode	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile Technology

		Kumaraguru College of Technology, Coimbatore

24TTE043	SUPPLY CHAIN MANAGEMENT		L	T	P	J	C
Category	PE	**SDG**	3	0	0	0	**3**
SDG				SDG 8, 9, 12, 17			
Pre-requisite courses		-		**Data Book / Code book (If any)**		-	

Course Objectives: The purpose of taking this course is to:

1.	Impart fundamental knowledge on supply chain management concepts and architecture for the textile and apparel industry.
2.	Develop competence in demand planning, inventory management, and network design for textile supply chains.
3.	Enable students to analyse sourcing, procurement, and logistics decisions across global textile value chains.
4.	Introduce digital supply chain technologies, Industry 4.0 tools, and sustainable and circular supply chain practices.
5.	Provide exposure to Indian textile sourcing hubs, PLI-linked ecosystems, and global compliance frameworks.

Course Outcomes: After successful completion of this course, the students shall be able to

Course Outcomes	RBT Level
CO 1: Explain the concepts, objectives, drivers, and structure of supply chain management in the textile and apparel industry.	**K2 — Understand**
CO 2: Apply demand-planning, inventory-management, and warehouse-management techniques for textile supply chains.	**K3 — Apply**
CO 3: Analyse sourcing, procurement, transportation, and network-design decisions for textile firms.	**K4 — Analyse**
CO 4: Evaluate digital, agile, and sustainable supply chain strategies including risk management and resilience.	**K5 — Evaluate**
CO 5: Design an integrated supply chain solution for a textile or apparel firm incorporating Industry 4.0 and circular economy principles.	**K6 — Create**

CO - PO / PSO Mapping (Strong-3, Medium-2, Weak-1)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2

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

Course Content

UNIT I: FUNDAMENTALS OF SUPPLY CHAIN MANAGEMENT	9 Hours

Supply chain — definition, structure, and objectives. Textile supply chain: fibre → yarn → fabric → garment → retail → consumer → end of life. Global textile trade flows and Harmonized System (HS) codes. Supply chain drivers — facilities, inventory, transportation, information, sourcing, pricing. Push vs pull, and push-pull boundary in textile supply chains. Bullwhip effect — causes and countermeasures. Supply chain performance — SCOR (Supply Chain Operations Reference) model, KPIs (Perfect Order Fulfilment, Cash-to-Cash cycle, Inventory Days, OTIF). Value chain of Indian textile industry — PLI Scheme, PM MITRA parks, National Technical Textile Mission.

UNIT II: DEMAND PLANNING, INVENTORY AND WAREHOUSING	9 Hours

Demand planning — qualitative and quantitative forecasting; moving average, exponential smoothing, ARIMA, CPFR (Collaborative Planning, Forecasting and Replenishment). Fast-fashion demand sensing — Zara model. Inventory management — ABC, VED, HML, FSN classifications. EOQ, safety stock, reorder point, Vendor Managed Inventory (VMI), Just-in-Time (JIT). Warehouse management systems (WMS) — SAP EWM, Manhattan Associates, Blue Yonder. Warehouse layout — U-shape, I-shape, cross-docking. Automated storage and retrieval systems (AS/RS), pick-to-light, voice picking, mobile robots (Grey Orange, GreyMatter.AI). Barcoding, RFID and IoT sensors in textile warehouses.

UNIT III: SOURCING, PROCUREMENT AND LOGISTICS	9 Hours

Strategic sourcing — Kraljic matrix, make vs buy, single vs multiple sourcing, near-shoring vs off-shoring. Global textile sourcing hubs — China, India, Bangladesh, Vietnam, Turkey, Ethiopia. Indian textile clusters — Coimbatore, Tirupur, Ludhiana, Surat, Bhiwandi, Panipat. Vendor evaluation and development, e-procurement. Transportation — modes (road, rail, sea, air), Incoterms 2020, LCL vs FCL. Ocean freight — bill of lading, container types. Air freight for time-critical fashion. Reverse logistics — returns management for e-commerce fashion. 3PL and 4PL logistics providers — DHL Supply Chain, TVS SCS, Delhivery, DTDC, Blue Dart.

UNIT IV: DIGITAL, AGILE AND SUSTAINABLE SUPPLY CHAINS	9 Hours

Digital supply chain — ERP (SAP AFS, Oracle Fusion, Microsoft Dynamics), PLM (Centric, Gerber Yunique, PTC FlexPLM), advanced planning (Kinaxis, o9). Blockchain in textiles — TextileGenesis, IBM Fabric Trust, FibreTrace. IoT, digital twin, and control tower concepts. Agile and responsive supply chain — Zara case. Lean supply chain — Toyota production system principles applied to garment manufacturing. Sustainable and circular supply chains — closed-loop textile-to-textile recycling, take-back schemes (H&M Conscious, Uniqlo). Compliance frameworks — SEDEX SMETA, WRAP, BSCI, SA8000, Higg Index (FEM, FSLM), ZDHC MRSL, GOTS, OCS, GRS. Extended Producer Responsibility (EPR) and Digital Product Passport (DPP) — EU 2027 mandate.

UNIT V: SUPPLY CHAIN RISK, RESILIENCE AND STRATEGY	9 Hours

Supply chain risk — sources (demand, supply, operational, financial, geopolitical). COVID-19 and Red Sea crisis — lessons for textile supply chains. Risk mitigation — dual sourcing, safety stock buffers, nearshoring, regionalisation. Resilience frameworks — TSCM (Textile Supply Chain Management) resilience index. Design of a resilient network — capacity planning, plant location decisions (centre-of-gravity method, transportation LP). Sustainability strategy — Science Based Targets initiative (SBTi), CDP, Fashion Industry Charter for Climate Action (UNFCCC). Case studies — Arvind, Welspun, Shahi Exports, and PDS Multinational supply chain transformation journeys.

Theory Hours	Tutorial Hours	Practical Hours	Project Hours	Total Hours
45	0	0	0	**45**

Learning Resources

Textbooks:

1. Chopra, S., and P. Meindl. Supply Chain Management: Strategy, Planning, and Operation. 7th ed., Pearson, India, 2019.
2. Simchi-Levi, D., et al. Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies. 4th ed., McGraw-Hill, USA, 2021.
3. Bruce, M., L. Daly, and N. Towers. Lean or Agile: A Solution for Supply Chain Management in the Textiles and Clothing Industry. Woodhead, UK, 2015.

References:

1. Christopher, M. Logistics and Supply Chain Management. 5th ed., Pearson, UK, 2017.
2. Fernie, J., and L. Sparks. Logistics and Retail Management. 5th ed., Kogan Page, UK, 2019.
3. Wazir Advisors. Indian Apparel Sourcing Report — Annual Publication.
4. Ministry of Textiles. PLI Scheme and PM MITRA — Guidelines and Progress Reports.

Recommended Online Courses:

1. NPTEL: Supply Chain Management by Prof. Rajat Agrawal, IIT Roorkee.
2. Coursera: Supply Chain Management Specialisation, Rutgers University.
3. edX: Supply Chain Analytics by MITx (MicroMasters).
4. AIMA and CII knowledge portals on supply chain and logistics.

Assessment
CAT-1, CAT-2, Activity and Learning Task (SCM redesign project for a textile/apparel firm), Case study (Zara, Arvind, Shahi Exports), MCQ, End Semester Examination (ESE).

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
Mr. K. E. Raghunathan Former President All India Manufacturers Organisation (AIMO) & CMD, Solar Group, Chennai	Dr. Janat Shah Professor of Operations Management & Director Indian Institute of Management (IIM) Udaipur	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile Technology Kumaraguru College of Technology, Coimbatore

24TTE044	TEXTILE PROJECT MANAGEMENT AND FINANCE		L	T	P	J	C
Category	PE	**SDG**	3	0	0	0	**3**
SDG				SDG 8, 9, 12, 17			
Pre-requisite courses		-		**Data Book / Code book (If any)**		-	

Course Objectives: The purpose of taking this course is to:

1.	Impart knowledge on project management concepts, life cycle, and processes as applied to textile industry projects.
2.	Develop competence in project scheduling, resource planning, and risk management using standard project management tools.
3.	Enable students to prepare techno-economic feasibility studies and detailed project reports (DPR) for textile ventures.
4.	Introduce project finance sources, capital structure decisions, and financial appraisal techniques for textile projects.
5.	Provide exposure to Indian government schemes, banking norms, and international financing mechanisms for textile expansions.

Course Outcomes: After successful completion of this course, the students shall be able to

Course Outcomes	RBT Level
CO 1: Explain project management concepts, life cycle, and processes applicable to textile industry projects.	**K2 — Understand**
CO 2: Apply project scheduling, resource-allocation, and monitoring tools such as CPM, PERT, and Gantt charts.	**K3 — Apply**
CO 3: Analyse project cost estimation, working-capital needs, and financial statements of textile projects.	**K4 — Analyse**
CO 4: Evaluate project feasibility using techniques such as NPV, IRR, payback, sensitivity analysis, and risk assessment.	**K5 — Evaluate**
CO 5: Design a comprehensive Detailed Project Report (DPR) for a textile venture including financing plan and compliance.	**K6 — Create**

CO - PO / PSO Mapping (Strong-3, Medium-2, Weak-1)

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

Course Content

UNIT I: PROJECT MANAGEMENT FUNDAMENTALS	9 Hours

Project — definition and characteristics. Project vs operations. Project management — PMBOK Guide 7th edition process groups (Initiating, Planning, Executing, Monitoring & Controlling, Closing) and ten knowledge areas. Project life cycle — predictive, iterative, adaptive (Agile). Textile industry project types — greenfield spinning mill, brownfield expansion, technology upgradation (ATUFS), captive garment unit, PM MITRA park anchor unit. Role of project manager. Stakeholder analysis and power-interest grid. Project charter and Work Breakdown Structure (WBS). Introduction to PMI-PMP, PRINCE2, and Six Sigma Green Belt frameworks.

UNIT II: PROJECT SCHEDULING AND CONTROL	9 Hours

Network techniques — Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT). Activity time estimation — three-point estimation, PERT beta distribution. Float — total, free, independent. Resource smoothing and levelling. Crashing — cost-time trade-off analysis. Gantt charts, S-curve, milestone charts. Earned Value Management (EVM) — Planned Value, Earned Value, Actual Cost; CPI, SPI, ETC, EAC. Project management software — MS Project, Primavera P6, Zoho Projects, Asana. Change control and configuration management. Progress reporting for textile mill erection projects (civil, machinery installation, utilities, trial runs).

UNIT III: PROJECT COST ESTIMATION AND WORKING CAPITAL	9 Hours

Capital cost estimation — order-of-magnitude, budget authorisation, definitive estimates. Cost of land, building, plant and machinery, utilities, pre-operative expenses, contingency, working capital margin. Textile mill cost benchmarks (per spindle for spinning, per loom for weaving, per SMV for garment) — SITRA (South India Textile Research Association) and SIMA data. Working capital — gross vs net; operating cycle; Tandon and Chore committee norms. Sources of working-capital finance — cash credit, packing credit, bill discounting, factoring. Ratio analysis — liquidity, solvency, profitability, activity ratios. Fund flow and cash-flow statements. Understanding a textile-mill balance sheet.

UNIT IV: PROJECT APPRAISAL AND RISK MANAGEMENT	9 Hours

Financial appraisal — Payback Period, Discounted Payback, ARR, NPV, IRR, MIRR, Profitability Index. Cost of capital — WACC. Sensitivity analysis, scenario analysis, Monte Carlo simulation for textile projects. Break-even and margin of safety. Techno-economic feasibility for a compact spinning unit and a garment factory. Project risks — technical, financial, market, environmental, geopolitical. Risk register, risk-response strategies (avoid, transfer, mitigate, accept). Insurance for textile projects — fire, machinery breakdown, marine, business interruption. Environmental and social risk assessment — Equator Principles.

UNIT V: PROJECT FINANCING AND GOVERNMENT SCHEMES	9 Hours

Sources of project finance — internal accruals, promoters equity, term loans, external commercial borrowing (ECB), corporate bonds, IPO, private equity. Textile-specific financial institutions — IFCI, SIDBI, EXIM Bank, TUFCORP. Central government schemes — Amended Technology Upgradation Fund Scheme (ATUFS), Production Linked Incentive (PLI) for MMF and technical textiles, PM MITRA parks, National Technical Textile Mission (NTTM), SITP (Scheme for Integrated Textile Parks), SAMARTH — Skill India for Textiles. State schemes — Tamil Nadu Textile & Apparel Policy 2019, Comprehensive Powerloom Cluster Development Scheme. MSME schemes — CGTMSE, PMEGP, ZED, MUDRA. International green finance — IFC textile fund, EU Just Transition. Case: financing plan and DPR of a 25,000-spindle compact spinning unit and a 500-machine garment factory.

Theory Hours	Tutorial Hours	Practical Hours	Project Hours	Total Hours
45	0	0	0	**45**

Learning Resources

Textbooks:

1. Chandra, P. Projects: Planning, Analysis, Selection, Financing, Implementation and Review. 9th ed., McGraw-Hill, India, 2019.
2. Nagarajan, K. Project Management. 8th ed., New Age International, India, 2019.
3. Project Management Institute. PMBOK Guide. 7th ed., PMI, USA, 2021.

References:

1. Meredith, J. R., S. J. Mantel, and S. M. Shafer. Project Management: A Managerial Approach. 11th ed., Wiley, USA, 2021.
2. Khan, M. Y., and P. K. Jain. Financial Management. 8th ed., McGraw-Hill, India, 2018.
3. SITRA. Norms for Spinning Mills — Annual Publication.
4. Ministry of Textiles, Government of India. ATUFS, PLI and PM MITRA Guidelines — latest edition.

Recommended Online Courses:

1. NPTEL: Project Management by Prof. Raghunandan Sengupta, IIT Kanpur.
2. Coursera: Google Project Management Professional Certificate.
3. edX: Financial Management by IIMBx (IIM Bangalore).
4. SIDBI and TUFCORP knowledge portals for textile financing.

Assessment
CAT-1, CAT-2, Activity and Learning Task (DPR preparation for a chosen textile venture), CPM/PERT problem set, Financial appraisal case study, MCQ, End Semester Examination (ESE).

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
Mr. Prashant Agarwal Joint Managing Director	Dr. P. K. Jain Professor of Finance & Modi Chair Professor	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile Technology

Wazir Advisors Pvt. Ltd., Gurugram	Department of Management Studies, IIT Delhi	Kumaraguru College of Technology, Coimbatore

24TTE045	EXPORT DOCUMENTATION AND BUSINESS STRATEGY		L	T	P	J	C
Category	PE	**SDG**	3	0	0	0	**3**
SDG				SDG 8, 9, 17			
Pre-requisite courses		-		**Data Book / Code book (If any)**		-	

Course Objectives: The purpose of taking this course is to:

1.	Impart knowledge on the framework, procedures, and documentation of international trade with focus on textile and apparel exports.
2.	Develop competence in preparing commercial, banking, statutory, and logistics documents for export shipments.
3.	Enable students to apply Incoterms 2020, payment mechanisms, and trade-finance instruments for textile exports.
4.	Introduce Free Trade Agreements (FTAs), Rules of Origin, WTO framework, and non-tariff barriers affecting textile trade.
5.	Provide exposure to export marketing strategies, market-entry modes, and Indian government incentive schemes for textile exports.

Course Outcomes: After successful completion of this course, the students shall be able to

Course Outcomes	RBT Level
CO 1: Explain the framework, agencies, and procedures involved in Indian textile exports.	**K2 — Understand**
CO 2: Apply the correct documents, Incoterms, and payment mechanisms for a textile export transaction.	**K3 — Apply**
CO 3: Analyse export incentive schemes, FTAs, and non-tariff barriers relevant to textile products.	**K4 — Analyse**
CO 4: Evaluate market-entry strategies, pricing, and channel decisions for export of textile and apparel products.	**K5 — Evaluate**
CO 5: Design an export business strategy and documentation kit for a chosen textile product and target market.	**K6 — Create**

CO - PO / PSO Mapping (Strong-3, Medium-2, Weak-1)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2

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

Course Content

UNIT I: FRAMEWORK OF INDIAN TEXTILE EXPORTS	**9 Hours**

International trade — importance and gains. Indian textile exports — size (USD 44 billion FY 2023-24), share in world trade. Major products — cotton, MMF, apparel, made-ups, carpets, silk, jute, technical textiles. Major destinations — USA, EU, UK, Bangladesh, UAE. Foreign Trade Policy (FTP) 2023 — objectives and structure. Directorate General of Foreign Trade (DGFT) — IEC (Import Export Code), RCMC (Registration cum Membership Certificate). Export Promotion Councils — AEPC, TEXPROCIL, SRTEPC, Cotton Textiles Export Promotion Council, Wool & Woollens Export Promotion Council, Handloom Export Promotion Council, Carpet Export Promotion Council. FIEO, EEPC. Customs Act 1962, GST law on exports (zero-rated supply, LUT, refund of ITC). ICEGATE and Common Customs Portal.

UNIT II: EXPORT DOCUMENTATION	**9 Hours**

Documents required — commercial (proforma invoice, commercial invoice, packing list, bill of lading / airway bill / multimodal transport document, insurance policy). Banking documents — bill of exchange, letter of credit (LC), bank certificate. Regulatory documents — shipping bill (electronic through ICEGATE), GR / SDF form, ARE-1 / ARE-2 (post-GST equivalents), RBI EDPMS (Export Data Processing and Monitoring System). Auxiliary documents — certificate of origin (preferential and non-preferential), GSP form-A, inspection certificate (Textiles Committee, EIA), quality certificate (GOTS, OEKO-TEX, OCS, GRS), health / phytosanitary certificate. Digital initiatives — e-BRC, e-Sanchit, single-window clearance. Practical documentation workflow for a Tirupur knitwear consignment to the US.

UNIT III: INCOTERMS, PAYMENTS AND TRADE FINANCE	**9 Hours**

Incoterms 2020 — EXW, FCA, CPT, CIP, DAP, DPU, DDP, FAS, FOB, CFR, CIF. Choice of Incoterm for cotton yarn (FOB) vs technical textile (DDP). Payment methods — advance payment, open account, documentary collection (DP / DA), letter of credit (Sight, Usance, Confirmed, Transferable, Standby, Back-to-back). UCP 600, ISBP 745, URC 522. Bank guarantee and Standby LC. Trade-finance instruments — pre-shipment credit (packing credit in rupees and foreign currency), post-shipment credit (bill discounting, negotiation, factoring, forfaiting). Export credit insurance — ECGC policies (Standard, Turnover, Multi-Buyer). Foreign-exchange risk management — forward, futures, options; RBI-approved hedging instruments; SWIFT and TReDS platforms.

UNIT IV: EXPORT INCENTIVES, FTAs AND COMPLIANCE	**9 Hours**

Duty drawback scheme — All Industry Rate and Brand Rate. RoDTEP (Remission of Duties and Taxes on Exported Products) — Chapter 50–63 rates. RoSCTL (Rebate of State and Central Taxes and Levies) — apparel and made-ups. Advance Authorisation, EPCG (Export Promotion Capital Goods) — 6% zero-duty and 3% duty schemes. Deemed exports. SEZs, EOUs, FTWZs. Interest Equalisation Scheme (IES) for MSMEs and textiles. Free Trade Agreements — India-UAE CEPA (2022), India-Australia ECTA (2022), India-EFTA (2024), India-UK FTA, India-EU FTA (negotiation). Rules of Origin — wholly obtained, substantial transformation, value-added, tariff-heading change. Non-tariff barriers — REACH, CPSIA, EU Green Deal, CBAM (Carbon Border Adjustment Mechanism), Digital Product Passport (DPP), Uyghur Forced Labour Prevention Act (US).

UNIT V: EXPORT MARKETING AND BUSINESS STRATEGY	9 Hours

Export marketing — differences from domestic marketing. Market selection frameworks — Ansoff, GE-McKinsey, PESTEL analysis. Market-entry modes — direct exporting, indirect exporting, licensing, joint venture, wholly owned subsidiary, contract manufacturing, e-commerce (Amazon Global, Alibaba, Etsy, Shein marketplace). Buyer identification — trade fairs (Heimtextil, Techtextil, Première Vision, Magic Las Vegas, Bharat Tex, India ITME), B2B portals (Alibaba, Global Sources, IndiaMART Export), embassy commercial wings. Buying houses — Li & Fung, Impulse International, Triburg. Export pricing strategies — cost-plus, market-based, competition-based; marginal-cost pricing for bulk orders. Digital marketing for exports — LinkedIn outreach, SEO, WhatsApp Business API. Case: Tirupur cluster export journey and Welspun home-textiles global expansion.

Theory Hours	Tutorial Hours	Practical Hours	Project Hours	Total Hours
45	0	0	0	**45**

Learning Resources

Textbooks:

1. Ram, P. Export: What, Where and How. 19th ed., Anupam Publishers, India, 2020.
2. Cherunilam, F. International Business. 6th ed., PHI Learning, India, 2020.
3. Rathinamoorthy, R., and R. Surjit. Apparel Merchandising. CRC Press, USA, 2017.

References:

1. Paul, J., and R. Aserkar. Export Import Management. 3rd ed., Oxford University Press, India, 2020.
2. Directorate General of Foreign Trade. Foreign Trade Policy 2023 and Handbook of Procedures — latest edition.
3. FIEO. Handbook on Export Documentation and Procedures — latest edition.
4. International Chamber of Commerce. Incoterms 2020 Rules. ICC Publications, Paris, 2019.

Recommended Online Courses:

1. NPTEL: International Business by Prof. J. K. Nayak, IIT Roorkee.
2. IIFT Certificate Course on Export-Import Management.
3. Coursera: International Business Essentials, University of London.
4. DGFT, AEPC, TEXPROCIL, and RBI online knowledge portals.

Assessment
CAT-1, CAT-2, Activity and Learning Task (complete export documentation kit for a chosen textile product), Case study on FTA utilisation, MCQ, End Semester Examination (ESE).

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)

Dr. A. Sakthivel Chairman Apparel Export Promotion Council (AEPC), Gurugram	Dr. K. Rangarajan Professor & Head, Kolkata Campus Indian Institute of Foreign Trade (IIFT)	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile Technology Kumaraguru College of Technology, Coimbatore

24TTE046	PRINCIPLES OF MANAGEMENT		L	T	P	J	C
Category	PE	**SDG**	3	0	0	0	**3**
SDG				SDG 4, 8, 9			
Pre-requisite courses		-		**Data Book / Code book (If any)**		-	

Course Objectives: The purpose of taking this course is to:

1.	Impart foundational knowledge on the nature, evolution, and functions of management with reference to the textile industry.
2.	Develop competence in planning, decision-making, and strategy formulation for textile organisations.
3.	Enable students to apply organising, staffing, and human-resource principles in a manufacturing context.
4.	Introduce directing, leadership, motivation, and communication practices essential for effective supervision.
5.	Provide exposure to controlling, performance measurement, and contemporary management issues including digital transformation and ESG.

Course Outcomes: After successful completion of this course, the students shall be able to

Course Outcomes	RBT Level
CO 1: Explain the nature, evolution, and functions of management, and their relevance to the textile industry.	**K2 — Understand**
CO 2: Apply the principles of planning, organising, and decision-making for typical textile mill and apparel factory settings.	**K3 — Apply**
CO 3: Analyse staffing, leadership, motivation, and communication issues in textile organisations.	**K4 — Analyse**
CO 4: Evaluate controlling techniques, performance-measurement systems, and change-management strategies for textile firms.	**K5 — Evaluate**
CO 5: Design a management-improvement plan for a chosen textile organisation integrating contemporary practices.	**K6 — Create**

CO - PO / PSO Mapping (Strong-3, Medium-2, Weak-1)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	1	-	-	2	1	1	2	2	2	1	2

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

Course Content

UNIT I: NATURE AND EVOLUTION OF MANAGEMENT	9 Hours

Management — definitions, characteristics, and importance. Management as science, art and profession. Levels of management — top, middle, supervisory. Managerial roles (Mintzberg) and skills (Katz). Evolution of management thought — scientific management (F. W. Taylor), administrative management (Henri Fayol), human relations (Elton Mayo — Hawthorne studies), behavioural (Maslow, Herzberg, McGregor), systems and contingency approaches. Modern approaches — TQM, Six Sigma, business excellence (EFQM, Baldrige, CII-EXIM Bank Business Excellence). Applicability to Indian textile mills — from Mumbai mill culture of the 1900s to modern integrated units. Ethics and CSR — Companies Act 2013 Section 135.

UNIT II: PLANNING, DECISION MAKING AND STRATEGY	9 Hours

Planning — nature, types (strategic, tactical, operational), planning process. Objectives and MBO (Management by Objectives). Forecasting techniques — qualitative and quantitative. Strategy — vision, mission, corporate, business and functional levels. Strategic tools — SWOT, PESTEL, Porter's Five Forces, Value Chain, BCG matrix, Ansoff matrix, Blue Ocean Strategy. Decision-making — programmed vs non-programmed; individual vs group. Techniques — decision tree, payoff matrix, break-even. Rational, bounded-rationality (Simon), intuitive, and evidence-based decision models. Textile industry case: strategic response of Vardhman, Trident, and Welspun to global sourcing shifts.

UNIT III: ORGANISING, STAFFING AND HUMAN RESOURCE	9 Hours

Organising — process, principles (unity of command, span of control, scalar chain). Organisation structures — line, functional, line-and-staff, matrix, project, network, virtual. Departmentation bases. Authority, responsibility and delegation. Centralisation vs decentralisation. Coordination mechanisms (Mintzberg). Staffing — human resource planning, job analysis, recruitment, selection, induction, training and development, performance appraisal, compensation, career planning. Talent management in textile mills — technician-worker mix; skill development through NIFT, NIT-Jalandhar, Textile Institute, and SAMARTH. Industrial relations — Trade Unions Act, Industrial Disputes Act, Factories Act 1948, and the Labour Codes 2020.

UNIT IV: DIRECTING, LEADERSHIP AND MOTIVATION	9 Hours

Directing — meaning, principles and importance. Motivation — content theories (Maslow, ERG, Herzberg, McClelland) and process theories (Vroom, Adams equity, Locke goal-setting). Financial and non-financial incentives. Leadership — trait, behavioural (Ohio State, Michigan), situational (Hersey-Blanchard, Fiedler), transformational vs transactional, servant leadership. Emotional intelligence (Goleman). Communication — process, formal and informal channels, barriers, digital communication tools (Microsoft Teams, Slack, WhatsApp Business). Team building and conflict resolution. Case: leadership lessons from Kasturi Rangan Iyer of Vardhman and Rakesh Bhardwaj of Ginni Filaments.

UNIT V: CONTROLLING AND CONTEMPORARY ISSUES	9 Hours

Controlling — process, types (feedforward, concurrent, feedback), techniques (budgetary control, variance analysis, MIS, dashboards, KPIs, Balanced Scorecard). Total Quality Management — Deming, Juran, Crosby philosophies. Six Sigma — DMAIC, DMADV. Benchmarking. Change management — Lewin, Kotter's eight-step model. Learning organisation (Senge). Contemporary issues — digital transformation (Industry 4.0), remote and hybrid workforce, diversity and inclusion, ESG (Environmental, Social, Governance) and sustainability reporting (BRSR — Business Responsibility and Sustainability Report — SEBI mandate for top 1000 listed firms), circular economy, AI and generative AI in management decisions. Case: digital transformation of Arvind Ltd. and Raymond Ltd.

Theory Hours	Tutorial Hours	Practical Hours	Project Hours	Total Hours
45	0	0	0	**45**

Learning Resources

Textbooks:

1. Robbins, S. P., M. Coulter, and N. Vohra. Management. 14th ed., Pearson, India, 2019.
2. Koontz, H., and H. Weihrich. Essentials of Management: An International, Innovation and Leadership Perspective. 10th ed., McGraw-Hill, India, 2015.
3. Tripathi, P. C., and P. N. Reddy. Principles of Management. 6th ed., McGraw-Hill, India, 2017.

References:

1. Stoner, J. A. F., R. E. Freeman, and D. R. Gilbert. Management. 6th ed., Pearson, India, 2018.
2. Drucker, P. F. The Practice of Management. HarperBusiness, USA, 2006 (reissue).
3. Robbins, S. P., and T. A. Judge. Organizational Behavior. 18th ed., Pearson, India, 2020.
4. CII. Business Excellence Model — CII-EXIM Bank Award Framework, latest edition.

Recommended Online Courses:

1. NPTEL: Principles of Management by Prof. Susmita Mukhopadhyay, IIT Kharagpur.
2. Coursera: Principles of Management, Johns Hopkins University.
3. edX: Leadership and Management by IIMBx (IIM Bangalore).
4. AIMA and Harvard Business Review knowledge portals.

Assessment
CAT-1, CAT-2, Activity and Learning Task (management-improvement project for a chosen textile company), Group discussion on leadership case, MCQ, End Semester Examination (ESE).

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
Mr. Sanjay Jayavarthanavelu Chairman & Managing Director LMW Group (Lakshmi Machine Works), Coimbatore	Prof. Prashant Kale Professor of Strategic Management Jones Graduate School of Business, Rice University (Visiting: IIM Bangalore)	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile Technology Kumaraguru College of Technology, Coimbatore

24TTE047	APPAREL QUALITY MANAGEMENT		L	T	P	J	C
Category	PE	**SDG**	3	0	0	0	**3**
SDG				SDG 8, 9, 12			
Pre-requisite courses		-		**Data Book / Code book (If any)**		-	

Course Objectives: The purpose of taking this course is to:

1.	Impart knowledge on quality concepts, quality standards, and quality-management systems relevant to the apparel industry.
2.	Develop competence in raw material and in-process inspection systems for garment manufacturing.
3.	Enable students to apply statistical quality control tools and sampling plans for apparel production.
4.	Introduce Total Quality Management, Six Sigma, and Lean quality tools in apparel operations.
5.	Provide exposure to buyer compliance, product-safety regulations, and quality laboratory testing standards.

Course Outcomes: After successful completion of this course, the students shall be able to

Course Outcomes	RBT Level
CO 1: Explain the concepts, dimensions, and evolution of quality with focus on the apparel industry.	**K2 — Understand**
CO 2: Apply raw-material, in-process, and final-inspection systems in a garment factory environment.	**K3 — Apply**
CO 3: Analyse defects, root causes, and process capability using statistical quality control tools.	**K4 — Analyse**
CO 4: Evaluate quality-management systems (ISO 9001), Six Sigma projects, and Lean quality initiatives for apparel firms.	**K5 — Evaluate**
CO 5: Design a comprehensive quality-management plan for an apparel factory in line with major global buyer requirements.	**K6 — Create**

CO - PO / PSO Mapping (Strong-3, Medium-2, Weak-1)

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

CO5	3	3	3	2	3	3	2	2	2	2	3	3	3

Course Content

UNIT I: QUALITY CONCEPTS AND STANDARDS	9 Hours

Quality — definitions (Crosby, Juran, Deming, Taguchi, ISO 9000). Dimensions of quality (Garvin). Cost of quality — prevention, appraisal, internal failure, external failure. Evolution of quality — inspection, quality control, quality assurance, TQM, Six Sigma, business excellence. Quality standards in apparel — ISO 9001:2015 (QMS), ISO 14001 (EMS), ISO 45001 (OH&S), ISO 17025 (labs), ISO 3758 (care labels), ISO 8402. Textile-specific standards — AATCC, ASTM, BIS, EN, JIS, GB. Sustainability standards — GOTS, OEKO-TEX Standard 100 & STeP, OCS, GRS, RCS, BCI, Fairtrade. Buyer-specific standards — Walmart, Marks & Spencer, H&M, Target, C&A, Primark. Structure of quality department in a large export house.

UNIT II: INSPECTION SYSTEMS IN APPAREL	9 Hours

Raw-material inspection — fabric inspection (4-point system, 10-point system, Graniteville system), shade banding, shrinkage testing, GSM, colourfastness, thread and trim inspection. In-process inspection — cutting inspection (fabric laying, marker efficiency, cut-panel audit), sewing inspection (traffic-light, end-of-line, roving, offline), finishing inspection (pressing, packing). Final inspection — AQL 2.5 for major and AQL 4.0 for minor defects. Statistical sampling — MIL-STD-105E, ISO 2859, ANSI/ASQ Z1.4. Single, double and multiple sampling plans. Defect classification — critical, major, minor. Common garment defects and remedies — broken stitches, skip stitches, needle marks, puckering, shade variation, measurement deviation.

UNIT III: STATISTICAL QUALITY CONTROL	9 Hours

Statistical Process Control (SPC) — 7 QC tools (check sheet, Pareto, cause-and-effect / Ishikawa, histogram, scatter, flow chart, control chart). New 7 management tools (affinity, interrelationship, tree, matrix, arrow, PDPC, matrix data analysis). Control charts — variable (X-bar, R, s) and attribute (p, np, c, u). Process capability indices — Cp, Cpk, Pp, Ppk. Sigma level and DPMO calculation. Sample application to sewing line CTQs (Critical to Quality) — SPI (stitches per inch), seam allowance, and seam strength. Measurement System Analysis (MSA) — Gauge R&R for garment measurement tools. Reliability — seam strength, colourfastness, dimensional stability.

UNIT IV: TQM, SIX SIGMA AND LEAN QUALITY	9 Hours

TQM — philosophy of Deming (14 points, PDCA), Juran (trilogy, breakthrough), Crosby (zero defects, 4 absolutes), Ishikawa (company-wide quality control), Taguchi (loss function, robust design). Kaizen and 5S. Quality Circles. Six Sigma — DMAIC (Define, Measure, Analyse, Improve, Control) and DMADV. Belt hierarchy — Yellow, Green, Black, Master Black Belt, Champion. Six Sigma projects in apparel — reducing DHU (Defects Per Hundred Units), reducing rework, improving RFT (Right First Time). Lean quality tools — Value Stream Mapping, Poka-Yoke (mistake-proofing) in sewing operations, Jidoka, Andon system, TPM. Case: Six Sigma Green Belt project on skipped-stitch defect reduction in a Tirupur knitwear unit.

UNIT V: BUYER COMPLIANCE AND PRODUCT SAFETY	9 Hours

Buyer compliance audits — SEDEX SMETA (4-Pillar), WRAP, BSCI (amfori BSCI), SA8000, Higg FEM, FSLM, and BRM. Technical audit protocols — Walmart Ethical Sourcing, M&S Global Sourcing Principles, H&M Sustainability Commitment. Product-safety regulations — CPSIA (US), Prop 65 (California), REACH (EU), AZO dye ban (EU), formaldehyde limits (Japan Law 112), phthalates in kidswear, lead limits, nickel release. Care labelling — ISO 3758, GINETEX symbols, FTC US, TCPA India. Quality laboratory testing — Bureau Veritas, SGS, Intertek, TUV, MTS, TEC, SITRA, BTRA, NITRA, NIFT and Textiles Committee India. Recall management, RCA (Root Cause Analysis) and 8D report. Emerging — Digital Product Passport (DPP EU 2027) and Chemical Fingerprinting.

Theory Hours	Tutorial Hours	Practical Hours	Project Hours	Total Hours
45	0	0	0	**45**

Learning Resources

Textbooks:

1. Mehta, P. V., and S. K. Bhardwaj. Managing Quality in the Apparel Industry. New Age International, India, 2018.
2. Kadolph, S. J. Quality Assurance for Textiles and Apparel. 3rd ed., Fairchild Books, USA, 2019.
3. Rathinamoorthy, R., and R. Surjit. Apparel Merchandising. CRC Press, USA, 2017.

References:

1. Montgomery, D. C. Introduction to Statistical Quality Control. 8th ed., Wiley, USA, 2019.
2. Besterfield, D. H. Total Quality Management. 5th ed., Pearson, India, 2018.
3. Carr, H., and B. Latham. Carr and Latham's Technology of Clothing Manufacture. 4th ed., Wiley-Blackwell, UK, 2020.
4. Bureau of Indian Standards. Indian Standards on Textile and Apparel Testing — latest edition.

Recommended Online Courses:

1. NPTEL: Quality Design and Control by Prof. Pradip Kumar Ray, IIT Kharagpur.
2. Coursera: Six Sigma Yellow Belt Specialisation, University System of Georgia.
3. ASQ Learning Institute — Certified Quality Engineer preparation.
4. AATCC and ASTM online technical libraries.

Assessment
CAT-1, CAT-2, Activity and Learning Task (Six Sigma Green Belt style project — reduce a chosen apparel defect), Mock buyer compliance audit, MCQ, End Semester Examination (ESE).

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
Mr. Muthurathinam Sabaratnam Executive Director Eastman Exports Global Clothing Pvt. Ltd., Tirupur	Dr. R. Rathinamoorthy Associate Professor, Department of Fashion Technology PSG College of Technology, Coimbatore	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile Technology Kumaraguru College of Technology, Coimbatore

24TTE048	APPAREL PRODUCTION PLANNING AND CONTROL		L	T	P	J	C
Category	PE	**SDG**	3	0	0	0	**3**
SDG				SDG 8, 9, 12			
Pre-requisite courses		-		**Data Book / Code book (If any)**		-	

Course Objectives: The purpose of taking this course is to:

1.	Impart knowledge on the concepts, objectives, and structure of production planning and control (PPC) in the apparel industry.
2.	Develop competence in demand forecasting, capacity planning, and master production scheduling for garment factories.
3.	Enable students to apply line-balancing, sequencing, and dispatching techniques on the sewing floor.
4.	Introduce lean manufacturing, quick response, and modular production systems in apparel operations.
5.	Provide exposure to digital PPC tools, ERP-PLM integration, and Industry 4.0 in a modern garment factory.

Course Outcomes: After successful completion of this course, the students shall be able to

Course Outcomes	RBT Level
CO 1: Explain the concepts, functions, and structure of PPC as applied to the apparel manufacturing environment.	**K2 — Understand**
CO 2: Apply forecasting, capacity planning, and master scheduling techniques to garment factory operations.	**K3 — Apply**
CO 3: Analyse line-balancing, sequencing, and dispatching problems and propose improvements for the sewing floor.	**K4 — Analyse**
CO 4: Evaluate lean manufacturing, modular, and quick-response systems used in progressive apparel companies.	**K5 — Evaluate**
CO 5: Design a digital PPC framework integrating ERP, PLM, and Industry 4.0 tools for a garment factory.	**K6 — Create**

CO - PO / PSO Mapping (Strong-3, Medium-2, Weak-1)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2

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

Course Content

UNIT I: INTRODUCTION TO PPC IN APPAREL	**9 Hours**

Production Planning and Control (PPC) — definitions, objectives and functions. Types of production systems — job, batch, mass, continuous, project. Apparel-specific systems — Progressive Bundle System (PBS), Unit Production System (UPS), Modular Production System (MPS). Structure of the PPC department. Order flow in an export house — order receipt → tech pack → pattern → sampling → PP meeting → bulk planning → cutting → sewing → finishing → packing → shipment. Time and Action (T&A) calendar. Interface of PPC with Merchandising, Sourcing, Cutting, Sewing, Finishing, Warehouse, Quality and Logistics. Terminology — SMV, SAM, DHU, RFT, OTIF, Line Efficiency, WIP.

UNIT II: FORECASTING, CAPACITY PLANNING AND SCHEDULING	**9 Hours**

Demand forecasting for apparel — moving average, weighted moving average, exponential smoothing, Holt-Winters, causal models, judgemental forecasts. Fashion demand sensing — POS data, EDI. Aggregate production planning — level, chase, mixed strategies. Capacity planning — installed vs available vs effective capacity. Machine mix and layout planning for the sewing floor. Master Production Schedule (MPS), Material Requirement Planning (MRP), Manufacturing Resource Planning (MRP II). Detailed scheduling — order sequencing (SPT, EDD, LPT, CR), Johnson's rule for two/three-machine problems. Bottleneck management using Theory of Constraints (TOC) — Drum-Buffer-Rope in a knitting-to-garment value stream.

UNIT III: LINE BALANCING AND SEWING FLOOR OPERATIONS	**9 Hours**

Sewing operations — line balancing terminology (SMV/SAM, cycle time, takt time, station time, target output, line efficiency). Precedence diagrams. Heuristic methods — Largest Candidate Rule, RPW (Ranked Positional Weight), Kilbridge and Wester, Moodie-Young. Computerised line balancing — GSD (General Sewing Data), MODAPTS, GMT (General Manufacturing Time). Work study — method study (five steps), work measurement (time study, PMTS, activity sampling). Allowances (relaxation, contingency). Ergonomics of the sewing workstation. Skill matrix and multi-skilled operator planning. Line balancing a basic T-shirt line — case study with performance metrics.

UNIT IV: LEAN, MODULAR AND QUICK RESPONSE	**9 Hours**

Lean manufacturing — origin (Toyota Production System), principles (value, value stream, flow, pull, perfection). Value Stream Mapping (VSM) — current and future state for garment factory. 8 wastes (TIMWOODS). 5S, visual management, Andon, Poka-Yoke, SMED, TPM. Kanban and pull production. Modular Production System — Toyota Sewing System (TSS), U-cell, group technology; case: Coats Viyella and Shahi Exports modular lines. Quick Response (QR) manufacturing — Sam-Walton-era origin, and modern expressions in Zara, H&M, Uniqlo, and Shein. Agile manufacturing. Small-batch production. Nearshoring and reshoring implications for Indian PPC. Case: Zara's 15-day design-to-shelf model.

UNIT V: DIGITAL PPC AND INDUSTRY 4.0	9 Hours

Digital PPC ecosystem — ERP (SAP Fashion Management Solution FMS, Oracle Fusion, Microsoft Dynamics 365 F&O, WFX ERP, Ramco), PLM (Centric, Gerber Yunique, PTC FlexPLM, Coats Digital), MES (Manufacturing Execution System — CGS BlueCherry Shop Floor Control, DataS, Datatex NOW). RFID and IoT on the sewing floor. Real-time line balancing and dashboards (SEWMAN, ThreadSol). AI-based demand prediction, digital twin for garment factory. Industry 4.0 pillars — CPS, IoT, big data, cloud, robotics, additive manufacturing. Automation of specific operations — automated cutting (Gerber, Bullmer, Lectra), automatic pocket setter, robotic loading (Sewbo, Softwear Automation). Sustainability-linked PPC KPIs — CO2 per garment, water per garment. Case: digital transformation of Shahi Exports and Arvind Ltd. garment divisions.

Theory Hours	Tutorial Hours	Practical Hours	Project Hours	Total Hours
45	0	0	0	**45**

Learning Resources

Textbooks:

1. Chuter, A. J. Introduction to Clothing Production Management. Blackwell Scientific, UK, 1988 (reprint 2015).
2. Glock, R. E., and G. I. Kunz. Apparel Manufacturing: Sewn Product Analysis. 4th ed., Pearson, USA, 2005.
3. Rathinamoorthy, R., and R. Surjit. Apparel Merchandising. CRC Press, USA, 2017.

References:

1. Carr, H., and B. Latham. Carr and Latham's Technology of Clothing Manufacture. 4th ed., Wiley-Blackwell, UK, 2020.
2. Chary, S. N. Production and Operations Management. 6th ed., McGraw-Hill, India, 2019.
3. Vollmann, T. E., W. L. Berry, and D. C. Whybark. Manufacturing Planning and Control for Supply Chain Management. 6th ed., McGraw-Hill, USA, 2018.
4. Coats Digital / GSD. General Sewing Data Reference Manual — latest edition.

Recommended Online Courses:

1. NPTEL: Production Planning and Control by Prof. Ravi Shankar, IIT Delhi.
2. Coursera: Operations Management, University of Illinois.
3. edX: Lean Production, TU Munich.
4. Coats Digital and Werner International webinars on digital PPC.

Assessment
CAT-1, CAT-2, Activity and Learning Task (line-balancing project on a chosen basic garment), Lean VSM case study, MCQ, End Semester Examination (ESE).

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
Mr. Vasanth Kumar Managing Director	Prof. Prabir Jana Professor, Department of Fashion Technology	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile Technology

Shahi Exports Pvt. Ltd. (South Region), Bengaluru	National Institute of Fashion Technology (NIFT) New Delhi	Kumaraguru College of Technology, Coimbatore

24TTE049	FASHION MARKETING MANAGEMENT		L	T	P	J	C
Category	PE	**SDG**	3	0	0	0	**3**
SDG				SDG 8, 9, 12			
Pre-requisite courses		-		**Data Book / Code book (If any)**		-	

Course Objectives: The purpose of taking this course is to:

1.	Impart knowledge on the fundamentals of fashion marketing, the fashion cycle, and consumer behaviour in fashion.
2.	Develop competence in fashion market segmentation, targeting, positioning, and brand development.
3.	Enable students to design integrated fashion marketing mix strategies for domestic and international markets.
4.	Introduce fashion retail formats, visual merchandising, and omnichannel strategies for apparel and textile brands.
5.	Provide exposure to digital fashion marketing, influencer marketing, sustainability marketing, and fashion-tech innovations.

Course Outcomes: After successful completion of this course, the students shall be able to

Course Outcomes	RBT Level
CO 1: Explain the fundamentals of fashion marketing, fashion cycle, and consumer behaviour in the apparel industry.	**K2 — Understand**
CO 2: Apply STP (Segmentation, Targeting, Positioning) and brand-building principles for fashion products.	**K3 — Apply**
CO 3: Analyse fashion marketing mix decisions (product, price, place, promotion, people, process, physical evidence) for a chosen brand.	**K4 — Analyse**
CO 4: Evaluate retail formats, visual merchandising, and omnichannel strategies used by leading fashion brands.	**K5 — Evaluate**
CO 5: Design a digital and sustainable fashion marketing plan integrating contemporary tools and platforms.	**K6 — Create**

CO - PO / PSO Mapping (Strong-3, Medium-2, Weak-1)

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

Course Content

UNIT I: INTRODUCTION TO FASHION MARKETING	9 Hours

Fashion — definition, key terminology (style, fashion, fad, classic, avant-garde, haute couture, prêt-à-porter, mass fashion). Fashion cycle — introduction, rise, culmination, decline, obsolescence. Adoption theories — trickle-down (Simmel), trickle-up, trickle-across. Fashion levels — haute couture, designer, bridge, better, moderate, budget, mass. Fashion marketing — definition, scope, and unique features (short life cycle, aesthetic content, seasonality, emotional value). Structure of the Indian fashion industry — designer segment (FDCI, LFW, ICW), branded segment (Aditya Birla Fashion, Arvind Fashions, Raymond, Trent), mass segment (Reliance Trends, Max, Style Bazaar). Global fashion capitals — Paris, Milan, New York, London, Tokyo.

UNIT II: FASHION CONSUMER BEHAVIOUR AND STP	9 Hours

Consumer behaviour in fashion — Maslow needs, symbolic consumption, self-concept, VALS framework. Cultural, social (reference groups, family, opinion leaders, celebrities, influencers), personal, and psychological determinants. Buying decision process for fashion (need recognition → information search → evaluation → purchase → post-purchase). High-involvement vs low-involvement fashion purchases. Generation cohorts — Gen X, Millennials, Gen Z, Gen Alpha buying patterns. Fashion segmentation — demographic, geographic, psychographic, behavioural, benefit-based. Targeting strategies — mass, differentiated, concentrated, micro-targeting. Positioning — perceptual mapping, positioning statement. Trend forecasting — WGSN, Fashion Snoops, Trendstop, Peclers Paris, and Indian sources (Blink Fashion, FDCI reports).

UNIT III: FASHION MARKETING MIX	9 Hours

Product decisions — line and range planning, collections (SS, AW, resort, cruise, festive, wedding), core vs seasonal SKUs, private label vs national brand. Fashion pricing — cost-plus, competitor-based, value-based, price skimming (luxury), penetration (fast fashion), psychological pricing (₹999, ₹1,499). Discount and markdown strategy — end-of-season sale (EOSS). Distribution channels — MBO, EBO, department stores, hypermarkets, luxury malls (Palladium, Emporio, UB City), rural (Fabindia, Anokhi), e-commerce (Myntra, Amazon Fashion, Ajio, Nykaa Fashion), D2C. Fashion promotion — advertising, PR, fashion shows (LFW, FDCI, Wills India Fashion Week), sales promotion, direct marketing, personal selling. Extended 7Ps for fashion services — people (store staff, stylists), process (personal shopping), physical evidence (store ambience, packaging).

UNIT IV: FASHION RETAIL AND VISUAL MERCHANDISING	9 Hours

Fashion retail formats — specialty stores, chain stores, department stores, off-price outlets (Brand Factory), pop-ups, quick commerce (Blinkit, Zepto for accessories). Store atmospherics — layout (grid, free-flow, boutique, racetrack), lighting, colour, music, scent. Visual merchandising (VM) — window display, mannequin styling, in-store displays, focal points, planogram, colour blocking, thematic displays, seasonal decor, VM calendar. Store operations — sell-through, GMROI, footfall, conversion rate, average bill value (ABV), items per bill (IPB). Omnichannel retail — click and collect, endless aisle, showrooming and webrooming, virtual try-on (Lenskart, Nykaa, Adidas Try On), Metaverse fashion stores. Case: Zara, Uniqlo, Nykaa Fashion, and Fabindia store experience.

UNIT V: DIGITAL, SUSTAINABLE AND FASHION-TECH MARKETING	9 Hours

Digital fashion marketing — SEO, SEM (Google Ads), display, social media (Instagram, Facebook, YouTube, TikTok, Pinterest), content marketing, video marketing, email marketing. Influencer marketing — mega, macro, micro, nano influencers; deliverables, disclosure norms (ASCI guidelines). Social commerce — Instagram Shop, Meesho, live-shopping. Marketing analytics — GA4, Meta Business Suite, marketing attribution, customer lifetime value (CLV). Sustainable fashion marketing — greenwashing risks, transparency (Fashion Transparency Index), certified narratives (GOTS, GRS, Fair Trade). Fashion 2.0 tech — NFTs, virtual apparel (DressX, RTFKT), Metaverse events (Decentraland Fashion Week), AI-generated designs, AR filters. Ethical marketing and inclusive representation. Case: Sabyasachi x H&M, Anokhi digital revival, and Doodlage recycled fashion campaign.

Theory Hours	Tutorial Hours	Practical Hours	Project Hours	Total Hours
45	0	0	0	**45**

Learning Resources

Textbooks:

1. Easey, M. Fashion Marketing. 3rd ed., Wiley-Blackwell, UK, 2018.
2. Posner, H. Marketing Fashion: Strategy, Branding and Promotion. 3rd ed., Laurence King, UK, 2020.
3. Rathinamoorthy, R., and R. Surjit. Apparel Merchandising. CRC Press, USA, 2017.

References:

1. Kotler, P., and K. L. Keller. Marketing Management. 15th ed., Pearson, India, 2018.
2. Jackson, T., and D. Shaw. The Fashion Handbook. Routledge, UK, 2020.
3. Sinha, P. K., and D. P. Uniyal. Managing Retailing. 3rd ed., Oxford University Press, India, 2018.
4. FDCI. India Fashion Forum Reports — annual publication.

Recommended Online Courses:

1. NPTEL: Consumer Behaviour by Prof. Sangeeta Sahney, IIT Kharagpur.
2. Coursera: Fashion as Design, Museum of Modern Art (MoMA).
3. edX: Fashion and Luxury Compliance in the New Digital Era, Bocconi University.
4. BoF (Business of Fashion) Education and WGSN insights platform.

Assessment
CAT-1, CAT-2, Activity and Learning Task (integrated fashion marketing plan for a chosen Indian brand), Social media campaign design, MCQ, End Semester Examination (ESE).

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
Ms. Sunita Kaur Suri Chief Executive Officer Anokhi (Mumbai) — Sustainable Handblock Fashion Brand	Dr. Vandana Bhandari Professor & Former Director National Institute of Fashion Technology (NIFT) New Delhi	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile Technology Kumaraguru College of Technology, Coimbatore

24TTE050	INDUSTRIAL ENGINEERING		L	T	P	J	C
Category	PE	**SDG**	3	0	0	0	**3**
SDG				SDG 8, 9, 12			
Pre-requisite courses		-		**Data Book / Code book (If any)**		-	

Course Objectives: The purpose of taking this course is to:

1.	Impart knowledge on the concepts, scope, and evolution of industrial engineering with reference to the textile and garment industry.
2.	Develop competence in work-study, method-study, and work-measurement techniques on the sewing floor.
3.	Enable students to apply ergonomics, workplace design, and productivity-improvement techniques in textile factories.
4.	Introduce facility layout, plant location, and materials-handling systems for textile and apparel plants.
5.	Provide exposure to Lean, Six Sigma, incentive schemes, and Industry 4.0-enabled productivity management.

Course Outcomes: After successful completion of this course, the students shall be able to

Course Outcomes	RBT Level
CO 1: Explain the scope, history, and role of industrial engineering in the textile and apparel industry.	**K2 — Understand**
CO 2: Apply method-study and work-measurement techniques to a chosen textile or garment operation.	**K3 — Apply**
CO 3: Analyse ergonomic and workplace design issues on the sewing floor and propose improvements.	**K4 — Analyse**
CO 4: Evaluate facility layout, plant location, and materials-handling systems for a textile / apparel plant.	**K5 — Evaluate**
CO 5: Design a productivity-improvement programme integrating Lean, Six Sigma, and Industry 4.0 tools.	**K6 — Create**

CO - PO / PSO Mapping (Strong-3, Medium-2, Weak-1)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2

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

Course Content

UNIT I: INTRODUCTION TO INDUSTRIAL ENGINEERING	**9 Hours**

Industrial Engineering (IE) — definitions (AIIE, ASME). History — F. W. Taylor scientific management, Frank and Lillian Gilbreth motion study, Henry Ford assembly line, Toyota Production System, digital IE. Scope of IE — productivity, quality, cost, safety, ergonomics, sustainability. IE functions in a textile mill and garment factory. Productivity — definitions, single-factor and total-factor productivity. Productivity measurement — labour productivity (SMV / minute achieved), machine productivity (OEE — Availability × Performance × Quality), material productivity (fabric utilisation). Textile industry benchmarks — SITRA and ITMF productivity reports. Case: comparative productivity of Indian, Chinese, Bangladeshi, and Vietnamese apparel factories.

UNIT II: METHOD STUDY AND WORK MEASUREMENT	**9 Hours**

Method study — objectives, procedure (SREDIM: Select, Record, Examine, Develop, Install, Maintain). Recording techniques — process chart symbols, outline process chart, flow process chart, two-handed process chart, multiple activity chart, string diagram, flow diagram. Micromotion study, therbligs. Critical examination — 5W1H, ECRS (Eliminate, Combine, Rearrange, Simplify). Work measurement — objectives, techniques (time study, work sampling, predetermined motion time systems). Time study — stopwatch method, standard time computation, rating, allowances. PMTS — MTM (Methods Time Measurement), MOST (Maynard Operation Sequence Technique), Work-Factor. Textile-specific — General Sewing Data (GSD), Sewing Performance Data (SPD), MODAPTS. Standard Allowed Minutes (SAM) calculation for a basic T-shirt.

UNIT III: ERGONOMICS AND WORKPLACE DESIGN	**9 Hours**

Ergonomics — definition, objectives, and importance. Anthropometry — Indian population data. Physical ergonomics — workstation design (chair, table, needle, sewing machine, cutting table). Cognitive ergonomics — display, control, decision aids. Organisational ergonomics — job design, work-rest schedules. Musculoskeletal disorders (MSDs) in sewing operators — neck, shoulder, lower back. RULA (Rapid Upper Limb Assessment), REBA (Rapid Entire Body Assessment), OWAS (Ovako Working Postures Analysis System). Environmental ergonomics — heat, humidity, noise, illumination, dust, fibre exposure. Indian standards on illumination — IS 3646 for textile floors. Safety in a garment factory — factories act 1948, fire safety (NFPA, TN Fire Prevention Rules), personal protective equipment (PPE).

UNIT IV: FACILITY LAYOUT AND MATERIALS HANDLING	**9 Hours**

Plant location — factors (raw material, labour, market, utilities, transport, government policy, clusters). Location analysis — factor-rating, centre-of-gravity, break-even, transportation LP. Locational advantages of Coimbatore, Tirupur, Surat, Ludhiana, Panipat, and PM MITRA parks. Facility layout — product, process, fixed-position, cellular, and hybrid. Layout for spinning mill, weaving shed, dyehouse, and garment factory. Systematic Layout Planning (SLP) — Muther's SLP procedure. CRAFT, ALDEP, CORELAP. Materials handling — principles, systems, equipment (conveyors, AGVs, stackers, overhead cranes, monorails, bundling systems). Storage — bulk yarn, fabric roll, greige, trims, finished-goods warehouses. Bar code and RFID enabled tracking.

UNIT V: PRODUCTIVITY, INCENTIVES AND INDUSTRY 4.0	9 Hours

Productivity-improvement programmes — Lean manufacturing (Toyota Production System applied to garments), Six Sigma, TPM, 5S, Kaizen, Quick Changeover (SMED). Value engineering. Overall Equipment Effectiveness (OEE) improvement. Wage and incentive schemes — Halsey, Rowan, Taylor differential piece rate, Merrick, Gantt, Emerson efficiency, and modern individual and group incentives in garment factories. ILO and PMKVY (Pradhan Mantri Kaushal Vikas Yojana) frameworks. Industry 4.0 productivity levers — real-time production monitoring (Coats Digital GSD Cloud, Datatex NOW, ThreadSol, CGS BlueCherry, Fashinza), IoT sensors on sewing machines, RFID hangers, AI vision-based quality inspection (Datacolor, Uster, Loepfe), digital twin. Sustainability-linked productivity — CO_2 / garment and litres of water / garment as new KPIs. Case: Shahi Exports and Arvind Ltd. productivity journey.

Theory Hours	Tutorial Hours	Practical Hours	Project Hours	Total Hours
45	0	0	0	**45**

Learning Resources

Textbooks:

1. International Labour Office. Introduction to Work Study. 4th revised ed., ILO Geneva, 2015 (Indian reprint).
2. Khanna, O. P. Industrial Engineering and Management. Dhanpat Rai Publications, India, 2019.
3. Rathinamoorthy, R., and R. Surjit. Apparel Merchandising. CRC Press, USA, 2017.

References:

1. Barnes, R. M. Motion and Time Study: Design and Measurement of Work. 7th ed., Wiley, USA, 2019.
2. Sundaresan, S. Textile Machinery Erection Handbook. NCUTE, India, 2019.
3. Kroemer, K. H. E., et al. Ergonomics: How to Design for Ease and Efficiency. 3rd ed., CRC Press, USA, 2018.
4. Coats Digital. GSD Reference Manual — latest edition.

Recommended Online Courses:

1. NPTEL: Industrial Engineering by Prof. Pradip Kumar Ray, IIT Kharagpur.
2. Coursera: Six Sigma Yellow Belt Specialization, University System of Georgia.
3. edX: Human Factors and Ergonomics, University of Michigan.
4. ILO and SITRA online reference libraries.

Assessment
CAT-1, CAT-2, Activity and Learning Task (method study & SAM computation project for a chosen garment operation), Ergonomic RULA/REBA analysis of a sewing workstation, MCQ, End Semester Examination (ESE).

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
Mr. S. Uthirapathi Senior Vice President — Operations KPR Mill Ltd., Coimbatore	Dr. G. Nagarajan Professor & Head Department of Industrial Engineering, Anna University, Chennai	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile Technology Kumaraguru College of Technology, Coimbatore

24TTE051	SUSTAINABLE TEXTILE MANUFACTURING AND STRATEGY		L	T	P	J	C
Category	PE	**SDG**	2	0	2	0	**3**
SDG				SDG 6, 7, 9, 12, 13, 17			
Pre-requisite courses		-		**Data Book / Code book (If any)**		-	

Course Objectives: The purpose of taking this course is to:

1.	Impart knowledge on the principles, drivers, and frameworks of sustainable textile manufacturing.
2.	Develop competence in evaluating environmental impact using life cycle assessment (LCA) and Higg Index tools.
3.	Enable students to apply cleaner-production, water, energy, and chemical management practices in textile mills.
4.	Introduce circular economy, textile-to-textile recycling, and closed-loop business models.
5.	Provide exposure to sustainability strategy, ESG reporting, certifications, and green-finance mechanisms.

Course Outcomes: After successful completion of this course, the students shall be able to

Course Outcomes	RBT Level
CO 1: Explain the drivers, frameworks, and principles of sustainability applied to textile manufacturing.	**K2 — Understand**
CO 2: Apply Life Cycle Assessment (LCA) and Higg Index tools to evaluate the environmental footprint of a textile product.	**K3 — Apply**
CO 3: Analyse water, energy, chemical, and waste-management options for textile wet processing and finishing operations.	**K4 — Analyse**
CO 4: Evaluate circular economy business models, recycling technologies, and sustainability certifications relevant to textiles.	**K5 — Evaluate**
CO 5: Design a sustainability strategy and BRSR-aligned action plan for a textile firm covering ESG, carbon, water, and social dimensions.	**K6 — Create**

CO - PO / PSO Mapping (Strong-3, Medium-2, Weak-1)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2

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

Course Content

UNIT I: FUNDAMENTALS OF SUSTAINABILITY IN TEXTILES	**6 Hours**

Sustainability — Brundtland definition (1987), triple bottom line (people, planet, profit). United Nations Sustainable Development Goals (SDGs) — mapping to textile sector (SDG 6, 7, 9, 12, 13, 17). Environmental footprint of textiles — 2 to 8% of global carbon emissions (UNEP, Ellen MacArthur), 20% of global industrial wastewater, 35% of ocean microplastics. Fashion Industry Charter for Climate Action (UNFCCC). Sustainability drivers — regulatory (EU Green Deal, CBAM, CSDDD, DPP 2027), buyer (H&M, Inditex, Nike commitments), investor (SBTi, CDP), consumer (Gen Z conscious consumption). Indian regulatory context — Environment Protection Act 1986, Water Act 1974, Air Act 1981, Hazardous Waste Rules 2016, Plastic Waste Management Rules and EPR notifications.

UNIT II: LIFE CYCLE ASSESSMENT AND HIGG INDEX	**6 Hours**

Life Cycle Assessment (LCA) — ISO 14040 / 14044 framework. Goal and scope, life-cycle inventory (LCI), life-cycle impact assessment (LCIA), interpretation. Impact categories — GWP (Global Warming Potential), water scarcity footprint, eutrophication, acidification, toxicity. LCA of cotton, polyester, viscose, lyocell (Tencel), recycled polyester. LCA tools — SimaPro, GaBi, OpenLCA, Ecoinvent database. Higg Materials Sustainability Index (Higg MSI), Product Module (Higg PM), Facility Environmental Module (Higg FEM), Social & Labour Module (Higg FSLM), Brand & Retail Module (Higg BRM). Cradle-to-Cradle certification. Environmental Product Declaration (EPD). Carbon labelling.

UNIT III: WATER, ENERGY AND CHEMICAL MANAGEMENT	**6 Hours**

Water management — water footprint of textile products (cotton T-shirt ≈ 2,700 L, denim jeans ≈ 7,500 L). Waterless / low-liquor dyeing — DryDye (Colorep), airflow dyeing (Then), CO_2 dyeing (DyeCoo). Effluent Treatment Plant (ETP), Zero Liquid Discharge (ZLD) and Reverse Osmosis in Tirupur cluster. Rainwater harvesting. Energy management — solar rooftop, wind, biomass boilers, heat recovery, VFDs, LEDs, waste-heat recovery from stenter exhaust. Energy KPIs — kWh/kg fabric, thermal energy MJ/kg. Chemical management — ZDHC (Zero Discharge of Hazardous Chemicals) MRSL, RSL, InCheck reports, ChemCheck. GOTS-permitted chemistry. Sustainable auxiliaries — enzymes, bio-mordants, natural dyes (Colouricious, Indigo). Green chemistry principles.

UNIT IV: CIRCULAR ECONOMY AND RECYCLING	**6 Hours**

Circular economy — Ellen MacArthur principles (design out waste, keep products in use, regenerate natural systems). Butterfly diagram — biological and technical cycles. Textile recycling — mechanical, chemical, thermal. Mechanical cotton recycling (Recover, Shreyans Industries). Chemical recycling of polyester (Loop Industries, Eastman, Reliance Recron GreenGold), viscose (Renewcell Circulose, Infinited Fiber Company, Aditya Birla Liva Reviva). Regenerated cellulose from waste cotton. Down-cycling vs up-cycling. Take-back schemes — H&M Conscious, Uniqlo Re.Uniqlo, Levi's Second Hand, Doodlage.

Business models — repair, resale (Thredup, Poshmark), rental (Rent the Runway, Flyrobe), refurbishment. Extended Producer Responsibility (EPR) for textiles — India Draft 2024 and EU 2025 framework. Digital Product Passport for textiles — EU 2027 mandate.

UNIT V: SUSTAINABILITY STRATEGY, ESG AND CERTIFICATIONS	6 Hours

Sustainability strategy — materiality assessment, science-based targets (SBTi), roadmap. ESG (Environmental, Social, Governance) frameworks — GRI, SASB, TCFD (climate risk disclosure), CDP. India-specific — SEBI Business Responsibility and Sustainability Report (BRSR) for top 1000 listed entities, BRSR Core assurance. Sustainability certifications — GOTS (Global Organic Textile Standard), OEKO-TEX Standard 100 & STeP, OCS (Organic Content Standard), GRS (Global Recycled Standard), RCS (Recycled Claim Standard), Bluesign, Cradle-to-Cradle Certified, Fairtrade Cotton, BCI (Better Cotton Initiative), REEL Cotton, Regenerative Organic Certified. Green finance — Green Bonds, Sustainability-Linked Loans, IFC Green Buildings program, SBTi Financial Sector. Case: Arvind Ltd., Grasim (Liva Reviva), Welspun (Wel-Trak) and Trident sustainability strategies.

Theory Hours	Tutorial Hours	Practical Hours	Project Hours	Total Hours
30	0	29	0	**59**

List of Experiments / Practical Component

S. No.	Experiment / Activity	Hours
1	LCA of a T-shirt — use OpenLCA / Higg MSI to compute cradle-to-gate impact of a 180 GSM cotton (BCI vs organic vs conventional) knit T-shirt.	4
2	Higg FEM self-assessment — group activity: fill Higg FEM module for a hypothetical dyehouse and interpret verified score.	3
3	Water footprint calculation — compute litres/kg for a woven dyeing process using thermosol vs exhaust; propose water-saving alternatives.	3
4	Chemical management audit — screen a sample dyehouse recipe against ZDHC MRSL v3.1 and identify substitutions.	3
5	Energy audit walk-through — measure kWh/kg for a stenter drying operation and identify heat-recovery opportunities using stack loss estimation.	3

6	Textile recycling demo — mechanical recycling of pre-consumer cotton waste to shoddy yarn, and evaluate resulting yarn quality (CV%, tenacity).	3
7	Circular business model canvas — design a take-back and resale programme for a chosen Indian apparel brand.	3
8	BRSR draft preparation — group task: draft Principle 6 (Environment) section of a BRSR for a chosen listed textile firm.	3
9	Certification comparison — map GOTS, OEKO-TEX STeP, and Bluesign requirements against a garment unit and prepare gap-closure plan.	2
10	Sustainability strategy pitch — capstone: 10-minute pitch of a 3-year sustainability roadmap for a chosen textile firm to a mock investor panel.	2

Learning Resources

Textbooks:

1. Muthu, S. S. (Editor). Sustainability in the Textile and Apparel Industries. Springer, Singapore, 2022.
2. Blackburn, R. S. Sustainable Textiles: Life Cycle and Environmental Impact. 2nd ed., Woodhead Publishing, UK, 2020.
3. Fletcher, K. Sustainable Fashion and Textiles: Design Journeys. 3rd ed., Routledge, UK, 2020.

References:

1. Ellen MacArthur Foundation. A New Textiles Economy: Redesigning Fashion's Future. 2017.
2. Muthu, S. S. Handbook of Life Cycle Assessment (LCA) of Textiles and Clothing. Woodhead Publishing, UK, 2015.
3. ZDHC. Manufacturing Restricted Substances List (MRSL) v3.1 and Wastewater Guidelines — latest edition.
4. SEBI BRSR Framework and BRSR Core — latest edition.

Recommended Online Courses:

1. NPTEL: Industrial Wastewater Treatment by Prof. Manoj Kumar Tiwari, IIT Kharagpur.
2. Coursera: Circular Economy — Sustainable Materials Management, EIT RawMaterials and Lund University.
3. edX: Sustainability in the Fashion Industry, Copenhagen Business School.
4. Higg Index (Cascale) and Ellen MacArthur Foundation learning portals.

Assessment
CAT-1, CAT-2, Continuous evaluation of laboratory / activity practicals, Sustainability strategy pitch (capstone), MCQ, End Semester Examination (ESE) — theory and practical viva.

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
Mr. Abhishek Bansal Head of Sustainability Arvind Ltd., Ahmedabad	Dr. S. S. Muthu Chief Sustainability Officer — SgT & API Group; Editor, Textiles & Clothing Sustainability (Springer), Hong Kong	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile Technology Kumaraguru College of Technology, Coimbatore

24TTE052	TEXTILE ROBOTICS AND AUTOMATION		L	T	P	J	C
Category	PE	**SDG**	2	0	2	0	**3**
SDG				SDG 8, 9, 12			
Pre-requisite courses		-		**Data Book / Code book (If any)**		-	

Course Objectives: The purpose of taking this course is to:

1.	Impart knowledge on the fundamentals of automation, robotics, and control systems in textile manufacturing.
2.	Develop competence in identifying sensors, actuators, and PLC-based automation for spinning, weaving, and wet processing.
3.	Enable students to apply robotic solutions in materials handling, cutting, sewing, and packaging operations.
4.	Introduce vision systems, artificial intelligence, and machine-learning applications in textile quality and process control.
5.	Provide exposure to Industry 4.0 architecture, digital twin, and smart factory implementation in the textile sector.

Course Outcomes: After successful completion of this course, the students shall be able to

Course Outcomes	RBT Level
CO 1: Explain the fundamentals of automation, robotics, and control systems as applied to textile manufacturing.	**K2 — Understand**
CO 2: Apply sensor, actuator, and PLC-based solutions for spinning, weaving, and wet-processing automation.	**K3 — Apply**
CO 3: Analyse robotic applications in material handling, cutting, sewing, and packaging for textile and apparel plants.	**K4 — Analyse**
CO 4: Evaluate vision-based inspection, AI/ML models, and cyber-physical systems used in modern textile factories.	**K5 — Evaluate**
CO 5: Design a smart-factory framework integrating Industry 4.0, IoT, and digital-twin concepts for a textile facility.	**K6 — Create**

CO - PO / PSO Mapping (Strong-3, Medium-2, Weak-1)

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

Course Content

UNIT I: FUNDAMENTALS OF AUTOMATION IN TEXTILES	6 Hours

Automation — definitions, need, benefits, and levels (fixed, programmable, flexible, integrated). Historical evolution in textile machinery — from Northrop automatic loom (1894) to autoconer and compact spinning. Control systems — open-loop, closed-loop, feedback. Sensors used in textile mills — photoelectric (Uster Quantum, Loepfe Zenit), capacitive, inductive, temperature (RTD, thermocouple), pressure, load cell, encoder, humidity, gas sensors. Actuators — pneumatic cylinders, solenoids, AC / DC / servo / stepper motors, VFDs. Programmable Logic Controllers (PLC) — Siemens S7, Allen Bradley, Mitsubishi, Delta. HMI and SCADA — Siemens WinCC, Wonderware, Rockwell FactoryTalk. Industrial communication protocols — RS-485, Modbus, Profibus, Profinet, EtherCAT, OPC UA. Fieldbus in modern spinning mills.

UNIT II: AUTOMATION IN YARN AND FABRIC MANUFACTURING	6 Hours

Blowroom and carding automation — chute feed, autolevellers (RSB series, Trützschler TC), can changer, sliver monitoring. Draw-frame autoleveller feedback loop. Combing — Rieter E-Series and Trützschler TCO with servo-driven detaching. Ring frame — Automatic Doffer, Robolink Rieter, Toyota, Lakshmi RXi 240. Rotor spinning — Rieter R70, Saurer Autocoro 10 with automated piecing. Autoconer — Muratec Process Coner II, Saurer Autoconer X6, with Uster Quantum 4 and Loepfe YarnMaster Prisma clearer. Weaving preparation — automatic drawing-in (Stäubli SAFIR S60, Delta 110). Automatic warp tying — Stäubli TOPMATIC. Weaving — Picanol OMNIplus-i air-jet, Itema R95002denim, Toyota JAT910 with e-Shed, Sultex M8300 rapier — servo shed, servo weft insertion, quick style change. Knitting — Santoni Mecmor SM8 seamless, Shima Seiki MACH2XS whole-garment. Digital jacquard.

UNIT III: ROBOTICS IN MATERIAL HANDLING AND GARMENT MAKING	6 Hours

Industrial robot fundamentals — classification (SCARA, articulated, delta, Cartesian, collaborative / cobots). Robot anatomy — end effectors, degrees of freedom, work envelope. Robot programming — teach-pendant, offline (RoboDK), Universal Robots URScript, ROS. Robotic material handling in textile mills — bale opening, roving bobbin transport, package doffing, fabric roll transport, yarn cone palletising (KUKA KR Quantec, ABB IRB 660, Yaskawa MPL). AGVs and AMRs — Grey Orange Butler, Locus Robotics, MiR, and their use in garment factories. Automated cutting — Gerber ZSeries, Lectra Vector iQ, Bullmer Premium Cut, Kuris Sharp Cut. Automated bundling — Softwear Automation Sewbots, Sewbo. Robotic sewing — Elrod Robotics for pockets, ZSK for embroidery, Juki AMS/AP series. Automated pressing (Veit, Macpi). Automated packing and cartoning.

UNIT IV: VISION SYSTEMS, AI AND QUALITY CONTROL	6 Hours

Machine vision — imaging systems, camera (CCD, CMOS, line-scan), lens, lighting, frame grabber. Image processing — thresholding, edge detection, morphology, feature extraction. Machine vision in textiles —

Uster Fabriq Vision and Q-Bar for online fabric defect detection. Loepfe LabMaster for fabric inspection. Datacolor Match Textile and X-Rite Ci7860 for colour matching. AI and Machine Learning — CNN (Convolutional Neural Networks) for fabric defect classification (holes, oil stains, broken ends, weft bar, shade variation). Deep-learning frameworks (TensorFlow, PyTorch). Predictive maintenance using vibration and current signature analysis. Digital colour management and closed-loop shade correction. Generative AI in textile design (Runway, Midjourney, Stable Diffusion). Ethics and cybersecurity of AI in manufacturing.

UNIT V: INDUSTRY 4.0 AND SMART TEXTILE FACTORY	6 Hours

Industry 4.0 pillars — Cyber-Physical Systems (CPS), Industrial Internet of Things (IIoT), Big Data, Cloud computing, Edge computing, Additive Manufacturing, AR/VR, Cyber Security. Reference architecture — RAMI 4.0, IIC IIRA. Digital thread and digital twin for textile machinery — from Rieter SPIDERweb to Trützschler T-Data and Uster Quality Expert 4. Smart mill dashboards — TMT Machinery Vision, Loepfe MillMaster, Uster Sentinel. Predictive maintenance and condition monitoring. Smart Apparel factory 4.0 — Coats Digital GSD Cloud, Datatex NOW, ThreadSol IntelloCut, CGS BlueCherry Shop Floor Control, Fashinza real-time analytics. Cyber-security in factories (IEC 62443). Sustainability-linked digital KPIs — CO_2 / kg, litres of water / kg. Case: Trützschler T-Data enabled spinning mill in Coimbatore and Arvind Ltd. denim smart factory.

Theory Hours	Tutorial Hours	Practical Hours	Project Hours	Total Hours
30	0	30	0	**60**

List of Experiments / Practical Component

S. No.	Experiment / Activity	Hours
1	Sensor identification and characterisation — study of photoelectric yarn clearer, capacitive evenness sensor and load cell on a laboratory ring frame.	4
2	PLC programming — write ladder logic on Siemens LOGO! for start / stop / auto-doff sequencing of a mini spinning simulation.	3
3	Autoleveller simulation — study a drawframe autoleveller feedback loop using MATLAB / Simulink; analyse response to step input in sliver linear density.	3
4	Robot programming — pick and place demonstration using a 6-DoF cobot (e.g. Universal Robots UR5) or educational robotic arm for yarn-cone stacking.	3

5	Vision-based fabric defect detection — capture fabric images and run OpenCV-based defect detection for holes, oil stains, and weft bar.	3
6	CNN-based fabric classification — train a small convolutional neural network in TensorFlow / Keras to classify plain vs twill vs satin from images.	3
7	Machine-vision inspection of sewing seams — inspect seam images for skip stitch and needle marks using image processing.	2
8	Digital twin lab — build a simple digital twin of a stenter drying process using open-source tools and study impact of speed change.	3
9	IIoT dashboard — set up a Raspberry Pi with sensors (temperature, current) to stream data to a ThingSpeak / Node-RED dashboard for a textile machine model.	3
10	Capstone project — students propose and prototype an automation / robotics solution for one unit operation in a textile / apparel factory; presentation and mini-report.	3

Learning Resources

Textbooks:

1. Groover, M. P. Automation, Production Systems, and Computer-Integrated Manufacturing. 5th ed., Pearson, USA, 2019.
2. Ognjanovic, M., and D. Milovanovic (Editors). Digital Textile Manufacturing and Industry 4.0. Springer, 2022.
3. Nayak, R., and R. Padhye. Automation in Garment Manufacturing. Woodhead Publishing, UK, 2018.

References:

1. Siciliano, B., and O. Khatib (Editors). Springer Handbook of Robotics. 2nd ed., Springer, 2016.
2. Rieter. The Rieter Manual of Spinning — Volumes 1 to 7. Rieter Machine Works, Switzerland — latest edition.
3. Uster Technologies. Uster Statistics and Uster Sentinel Technical Manuals — latest edition.
4. Coats Digital. GSD Cloud and Fast React Reference Documents — latest edition.

Recommended Online Courses:

1. NPTEL: Industrial Automation and Control by Prof. S. Mukhopadhyay, IIT Kharagpur.
2. NPTEL: Introduction to Machine Learning by Prof. Balaraman Ravindran, IIT Madras.
3. Coursera: Robotics Specialization, University of Pennsylvania.
4. Siemens, Rockwell Automation, and Universal Robots online learning academies.

Assessment
CAT-1, CAT-2, Continuous evaluation of laboratory practicals, Automation / robotics capstone project, MCQ, End Semester Examination (ESE) — theory and practical viva.

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
Mr. R. Vijaykumar Vice President — Technology & Automation Rieter India Pvt. Ltd., Coimbatore	Dr. Prabir Kumar Banerjee Professor & Head Department of Textile Technology, IIT Delhi	Dr. Bhaarathi Dhurai Professor & BoS Coordinator Department of Textile Technology Kumaraguru College of Technology, Coimbatore

PROFESSIONAL ELECTIVES

TRACK III – ADVANCED RESEARCH IN TEXTILE ENGINEERING

SYLLABUS

LIST OF COURSES

Sl. No.	Course Code	Course Title	Type	Credits
1	**24TTE071**	DIGITAL PRINTING IN TEXTILES	Theory	**3**
2	**24TTE072**	3-D PRINTING IN TEXTILES	Theory	**3**
3	**24TTE073**	SMART TEXTILES AND WEARABLE TECHNOLOGY	Theory	**3**
4	**24TTE074**	BIOMIMETIC AND BIO-INSPIRED TEXTILES	Theory	**3**
5	**24TTE075**	TEXTILE ROBOTICS AND AUTOMATION	Theory	**3**
6	**24TTE076**	COMPUTATIONAL TEXTILES	Theory	**3**
7	**24TTE077**	MANUFACTURE OF SPECIALTY YARNS AND FABRICS	Theory	**3**
8	**24TTE078**	SPECIALTY KNITS	Theory	**3**
9	**24TTE079**	MECHANICS OF TEXTILE MACHINERY	Theory	**3**
10	**24TTE080**	NANO AND SMART MATERIALS IN TEXTILES	Theory	**3**
11	**24TTE081**	SMART TEXTILE MANUFACTURING	Embedded	**3**
12	**24TTE082**	APPLIED ARTIFICIAL INTELLIGENCE IN TEXTILES	Embedded	**3**
13	**24TTE083**	DIGITAL TWINS & INDUSTRY 5.0 IN TEXTILES	Embedded	**3**

urse Code	Course Title	L	T	P	J	C	Category
TTE071	**DIGITAL PRINTING IN TEXTILES**	**3**	**0**	**0**	**0**	**3**	**PE**
G Mapping		SDG 9: Industry, Innovation and Infrastructure | SDG 12: Responsible Consumption and Production					
-requisite Course/Knowledge			24TTI302 Textile Chemical Processing I				
ta Book / Codes / Standards			Nil				

COURSE OBJECTIVES

1	To familiarize students with the fundamentals of digital printing systems used in textiles and the associated print heads, drop generation and colour management technologies.
2	To provide knowledge on the chemistry and rheology of digital inks with respect to different fibre substrates and print head technologies.
3	To impart knowledge on pre-treatment, printing, fixation and post-treatment processes involved in digital textile printing.
4	To develop skills in workflow design, RIP software, colour profiling and quality evaluation of digitally printed textiles.
5	To create awareness on the sustainability, industry 4.0 integration and emerging trends in digital textile printing.

COURSE OUTCOMES

At the end of the course, the students will be able to:

CO No.	Course Outcome	RBT Level
CO1	Explain the working principles, classification and components of digital textile printing machines.	**U**
CO2	Interpret the properties of digital inks and their compatibility with fibre substrates and print heads.	**U**
CO3	Apply appropriate pre-treatment, fixation and post-treatment processes for direct-to-fabric and transfer digital printing.	**Ap**

CO4	Analyse colour management, RIP workflow and quality parameters of digitally printed textiles.	**An**
CO5	Evaluate the sustainability, productivity and economic aspects of digital printing in comparison with conventional printing.	**E**

RBT Levels: R – Remember, U – Understand, Ap – Apply, An – Analyse, E – Evaluate, C – Create

CO – PO / PSO MAPPING

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

Strength of Correlation: 3 – Strong, 2 – Medium, 1 – Weak, "-" – No Correlation

COURSE CONTENT

UNIT I FUNDAMENTALS OF DIGITAL TEXTILE PRINTING	9 Hours
Evolution of textile printing – conventional versus digital printing – classification of digital printing systems – Continuous Ink Jet (CIJ), Drop on Demand (DoD) – Thermal, Piezoelectric and Electrostatic print heads – drop generation, drop-size control and resolution (dpi) – single pass and multi pass printers – printer architecture: paper feed, belt drive, sticky belt, curing units – colour models: RGB, CMYK, spot colours – ICC profile and gamut mapping – Direct-to-Fabric (DTF), Direct-to-Garment (DTG) and dye sublimation transfer printing.	

UNIT II DIGITAL INKS AND SUBSTRATE COMPATIBILITY	9 Hours
Classification of digital inks: reactive, acid, disperse, pigment and sublimation inks – chemistry, colourant loading, viscosity, surface tension and particle size requirements – ink rheology and jetting behaviour – fibre-ink compatibility: cotton, silk, wool, polyester, nylon and blends – pre-treatment chemistry: alkali, urea, thickener, cationisation of cotton – coating and padding techniques for pre-treatment – shelf life, storage and handling of inks – eco-labels and OEKO-TEX / GOTS / ZDHC compliance for digital inks.	

UNIT III PRINTING, FIXATION AND POST-TREATMENT	9 Hours

Print head maintenance, purging, capping and nozzle-check – roll-to-roll and cut-piece printing – steamer fixation: atmospheric, high-temperature and pressure steamers – dry heat fixation for pigment and disperse inks – washing off, soaping and after-treatment – transfer printing: sublimation transfer, cold-peel and hot-peel films – DTF powder adhesive process – curing conditions and press parameters – troubleshooting: banding, mottling, colour bleeding, poor rub and wash fastness.

UNIT IV COLOUR MANAGEMENT AND WORKFLOW	**9 Hours**
Design workflow: file preparation, vector versus raster – RIP (Raster Image Processor) software: RGB to CMYK conversion, linearisation, ink limit and colour separation – colour profiling using spectrophotometer – Delta E measurement and colour tolerance – dot gain, halftoning and screening methods (AM, FM, hybrid) – colour matching under D65, TL84, CWF illuminants – metamerism – print quality evaluation: sharpness, colour depth, rub, wash, light and perspiration fastness – standards: AATCC, ISO and BIS test methods for digitally printed textiles.	

UNIT V SUSTAINABILITY AND INDUSTRY 4.0 IN DIGITAL PRINTING	**9 Hours**
Water, energy and effluent savings in digital printing versus conventional rotary/flat-bed printing – carbon and water footprint comparison – on-demand and short-run production – mass customisation – integration of digital printing in Industry 4.0: MES, ERP, IoT-enabled printers, cloud-based colour libraries – AI-assisted colour matching and defect detection – 3D and functional printing on textiles – digital printing in home textiles, apparel, technical textiles and signage – market trends, leading OEMs (Kornit, Epson, Mimaki, EFI Reggiani, MS Printing, Konica Minolta) – case studies.	

Contact Hours (Theory)	**Total: 45 Hours**

LEARNING RESOURCES

Text Books

1. Ujiie H., "Digital Printing of Textiles", Woodhead Publishing, Cambridge, 2nd Edition, 2020.
2. Cie C., "Ink Jet Textile Printing", Woodhead Publishing, Cambridge, 1st Edition, 2015.

Reference Books

1. Yang Y., Naarani V., "Advances in Digital Printing of Textiles", CRC Press, Boca Raton, 2020.
2. Kiatkamjornwong S., "Digital Textile Printing: Science, Technology and Markets", Springer, Singapore, 2019.
3. Miles L.W.C., "Textile Printing", Society of Dyers and Colourists, Bradford, Revised Edition, 2018.

Online Educational Resources

1. https://onlinecourses.nptel.ac.in/noc21_te04 – NPTEL: Textile Chemical Processing
2. https://www.aatcc.org – American Association of Textile Chemists and Colorists
3. https://www.oeko-tex.com – OEKO-TEX standards for digital inks
4. https://www.epson.com/textile – Epson Digital Textile Printing resources

ASSESSMENT PATTERN

Assessment Component	Continuous Assessment	End Semester Examination	Total
Marks	50	50	**100**

COURSE CURATED BY

Industry Expert	Higher Education Institution Expert	Internal Expert

Approved in BoS Meeting on: __________	**Approved in Academic Council on: __________**

urse Code	Course Title	L	T	P	J	C	Category
TTE072	**3-D PRINTING IN TEXTILES**	**3**	**0**	**0**	**0**	**3**	**PE**

G Mapping	SDG 9: Industry, Innovation and Infrastructure | SDG 12: Responsible Consumption and Production
-requisite Course/Knowledge	24TTI201 Fibre Science; 24TTI302 Textile Chemical Processing I
a Book / Codes / Standards	Nil

COURSE OBJECTIVES

1	To introduce the fundamentals of additive manufacturing and its integration with textile substrates.
2	To familiarize students with 3D printing technologies suitable for direct and hybrid printing on textiles.
3	To impart knowledge on the polymers and biopolymers used as filaments and resins for textile applications.
4	To develop skills in CAD modelling, slicing and process parameter optimization for 3D printed textiles.
5	To create awareness on the applications, sustainability and industrial adoption of 3D printing in fashion and technical textiles.

COURSE OUTCOMES

At the end of the course, the students will be able to:

CO No.	Course Outcome	RBT Level
CO1	Describe the principles, classification and process chain of additive manufacturing technologies used for textiles.	**U**
CO2	Compare different 3D printing techniques with respect to textile substrates and end applications.	**An**
CO3	Select suitable polymers, biopolymers and composite feedstocks for 3D printing on textiles.	**Ap**
CO4	Apply CAD, slicing and parameter optimization for the production of 3D printed textile structures.	**Ap**
CO5	Evaluate the mechanical, functional and sustainability aspects of 3D printed textiles for fashion and technical applications.	**E**

RBT Levels: R – Remember, U – Understand, Ap – Apply, An – Analyse, E – Evaluate, C – Create

CO – PO / PSO MAPPING

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

Strength of Correlation: 3 – Strong, 2 – Medium, 1 – Weak, "-" – No Correlation

COURSE CONTENT

UNIT I FUNDAMENTALS OF ADDITIVE MANUFACTURING	**9 Hours**

Introduction to additive manufacturing – ASTM/ISO 52900 classification – Vat Photopolymerisation (SLA, DLP), Material Extrusion (FDM/FFF), Material Jetting (MJ), Binder Jetting (BJ), Powder Bed Fusion (SLS, MJF), Directed Energy Deposition (DED) and Sheet Lamination – process chain: CAD → STL/3MF → slicing → printing → post-processing – layer resolution, build orientation, support structures – advantages and limitations of AM – relevance of AM to textiles: on-fabric printing, seamless garments, functional components.

UNIT II 3D PRINTING TECHNIQUES FOR TEXTILES	**9 Hours**

Direct printing on textile substrates using FDM: interface bonding, textile pre-heating, first-layer settings – SLA and DLP for flexible textile-like structures – SLS for chainmail-like flexible parts – hybrid processes: embroidery + 3D print, knitted mesh + 3D lattice – 4D printing with shape memory polymers – auxetic and origami-inspired structures – printing on woven, knitted and nonwoven substrates – process-substrate compatibility – peel strength and washing durability of print-fabric interface.

UNIT III MATERIALS FOR 3D PRINTING ON TEXTILES	**9 Hours**

Thermoplastic filaments: PLA, ABS, PETG, TPU, Nylon, PP – flexible elastomers for textile compatibility – photopolymer resins: standard, flexible, tough, biocompatible – bio-based and biodegradable feedstocks: PLA blends, PHA, PBS – conductive and functional filaments: carbon-black PLA, graphene, magnetic and thermochromic filaments – fibre-reinforced filaments (carbon, glass, aramid) – food-grade and skin-contact grades – material selection matrix for wearables, orthotics and technical textiles – safety data sheets and processing windows.

UNIT IV DESIGN AND PROCESS PARAMETERS	9 Hours
CAD tools: Rhino + Grasshopper, Fusion 360, Blender, Clo3D – parametric design, topology optimisation, generative design – slicing software: Cura, PrusaSlicer, Simplify3D – process parameters: nozzle temperature, bed temperature, layer height, infill %, print speed, cooling – adhesion strategies for textile beds: PVA glue, hair spray, hot air pre-conditioning – Design of Experiments (DoE) for optimisation – dimensional accuracy, surface finish and mechanical testing – hand feel, drape and bending rigidity of 3D printed textile assemblies.	

UNIT V APPLICATIONS AND SUSTAINABILITY	9 Hours
Fashion applications: haute couture (Iris van Herpen, Danit Peleg), footwear midsoles (Adidas 4D, New Balance), customised accessories – performance sportswear – protective equipment: helmets, guards, prosthetics and orthotics – medical textiles: patient-specific splints, ostomy supports – smart wearables with embedded 3D printed circuits – space, defence and automotive interior applications – circular economy: closed-loop filament recycling – carbon footprint of AM versus conventional manufacture – IPR, standards (ASTM F42, ISO/TC 261) – case studies of industrial adoption in India and abroad.	

Contact Hours (Theory)	Total: 45 Hours

LEARNING RESOURCES

Text Books

1. Gibson I., Rosen D., Stucker B., Khorasani M., "Additive Manufacturing Technologies", Springer, 3rd Edition, 2021.
2. Eichenhofer M., Wong J.C.H., Ermanni P., "3D Printing of Fibre-Reinforced Composites", Springer, 1st Edition, 2020.

Reference Books

1. Chua C.K., Leong K.F., "3D Printing and Additive Manufacturing: Principles and Applications", World Scientific, 5th Edition, 2017.
2. Gao W. et al., "3D Printing in Textiles: Materials, Design and Manufacture", Woodhead Publishing, 2022.
3. Redwood B., Schöffer F., Garret B., "The 3D Printing Handbook", 3D Hubs, 2018.

Online Educational Resources

1. https://onlinecourses.nptel.ac.in – NPTEL: Rapid Manufacturing (Additive Manufacturing)
2. https://www.asme.org/topics-resources/content/3d-printing – ASME 3D Printing resources
3. https://www.astm.org/COMMITTEE/F42.htm – ASTM Committee F42 on Additive Manufacturing
4. https://all3dp.com – Learn/Compare 3D printing technologies

ASSESSMENT PATTERN

Assessment Component	Continuous Assessment	End Semester Examination	Total
Marks	50	50	**100**

COURSE CURATED BY

Industry Expert	Higher Education Institution Expert	Internal Expert

Approved in BoS Meeting on: __________	Approved in Academic Council on: __________

urse Code	Course Title	L	T	P	J	C	Category
TTE073	**SMART TEXTILES AND WEARABLE TECHNOLOGY**	**3**	**0**	**0**	**0**	**3**	**PE**
G Mapping		SDG 3: Good Health and Well-being | SDG 9: Industry, Innovation and Infrastructure					
-requisite Course/Knowledge			24TTI201 Fibre Science; Fundamentals of Electronics				
ta Book / Codes / Standards			Nil				

COURSE OBJECTIVES

1	To introduce the concept, classification and generations of smart and interactive textiles.
2	To familiarize students with conductive fibres, yarns and fabrics used in wearable electronic systems.
3	To impart knowledge on sensors, actuators and energy harvesting elements integrated into textiles.
4	To develop understanding of signal processing, connectivity and data analytics in wearable systems.
5	To create awareness on applications, standards and challenges in commercialising smart textiles.

COURSE OUTCOMES

At the end of the course, the students will be able to:

CO No.	Course Outcome	RBT Level
CO1	Classify smart and wearable textiles based on functionality, materials and integration level.	**U**
CO2	Explain the properties of conductive fibres, yarns and fabrics and their integration methods.	**U**
CO3	Analyse the working principles of textile-based sensors, actuators and energy harvesting devices.	**An**
CO4	Design smart textile systems using appropriate materials, sensors and communication modules for a given application.	**C**
CO5	Evaluate the reliability, safety, standards and commercialisation aspects of smart textile products.	**E**

RBT Levels: R – Remember, U – Understand, Ap – Apply, An – Analyse, E – Evaluate, C – Create

CO – PO / PSO MAPPING

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

Strength of Correlation: 3 – Strong, 2 – Medium, 1 – Weak, "-" – No Correlation

COURSE CONTENT

UNIT I INTRODUCTION TO SMART AND INTERACTIVE TEXTILES	9 Hours
Definitions – passive, active and very smart textiles – generations of e-textiles – wearable technology ecosystem – historical evolution – performance requirements: comfort, washability, drape, durability – human factors: skin biomechanics, ergonomics, biocompatibility – market segments: healthcare, sports, defence, fashion, industrial – key industry players and research consortia.	

UNIT II CONDUCTIVE FIBRES, YARNS AND FABRICS	9 Hours
Metallic fibres (stainless steel, silver-coated), inherently conductive polymers (PEDOT:PSS, PANI, PPY), carbon-based materials (CNT, graphene, carbon fibre) – conductive coatings and printing (silver, copper) – conductive hybrid yarns: core-spun, wrapped, plied – measurement of electrical resistivity and durability – integration methods: weaving, knitting, embroidery, printing, lamination – flexible circuits and stretchable interconnects – washing and abrasion durability testing.	

UNIT III TEXTILE SENSORS AND ACTUATORS	9 Hours
Physical sensors: strain, pressure, temperature, humidity, ECG, EMG, EEG, respiration – chemical and biosensors: sweat pH, lactate, glucose, cortisol – piezoresistive, capacitive, piezoelectric, triboelectric transduction – textile-based electrodes for biopotential monitoring – actuators: shape memory alloys and polymers, dielectric elastomers, thermoresponsive fibres, McKibben muscles – heating textiles – electrochromic and phase-change based thermal management.	

UNIT IV ENERGY, ELECTRONICS AND CONNECTIVITY	9 Hours

Textile-based energy harvesting: solar (organic PV), piezoelectric (PVDF), triboelectric nanogenerators – flexible batteries and supercapacitors – wireless power transfer – microcontrollers for wearables (Arduino Lilypad, Adafruit Flora, ESP32) – BLE, NFC, Wi-Fi, LoRa, 5G for wearable connectivity – on-body and body-area networks – signal conditioning, sampling and filtering – edge AI and machine learning for gesture, activity and health monitoring – data privacy and cybersecurity.

UNIT V APPLICATIONS, STANDARDS AND CHALLENGES	**9 Hours**
Healthcare: remote monitoring, rehabilitation, wound sensing, smart bandages – sports and fitness: performance analytics, motion capture – defence: soldier of the future, exoskeletons – fashion and lifestyle: light emitting garments, adaptive apparel – automotive and interior smart textiles – standards: IEC 63203 series, ISO/IEEE 11073, IPC-8921 for e-textiles – safety: EMF, thermal, skin sensitisation – washability standards (AATCC 135, ISO 6330) – sustainability, end-of-life recovery, WEEE compliance – business models and startups in India.	

Contact Hours (Theory)	**Total: 45 Hours**

LEARNING RESOURCES

Text Books

1. Tao X., "Handbook of Smart Textiles", Springer, Singapore, 2nd Edition, 2020.
2. Koncar V., "Smart Textiles and Their Applications", Woodhead Publishing, 2nd Edition, 2022.

Reference Books

1. McCann J., Bryson D., "Smart Clothes and Wearable Technology", Woodhead Publishing, 2nd Edition, 2022.
2. Cho G., "Smart Clothing: Technology and Applications", CRC Press, 2019.
3. Van Langenhove L., "Advances in Smart Medical Textiles", Woodhead Publishing, 2018.

Online Educational Resources

1. https://onlinecourses.nptel.ac.in – NPTEL: Smart Materials and Structures
2. https://www.wtin.com/technology/smart-textiles – WTiN Smart Textiles resources
3. https://ieeexplore.ieee.org – IEEE journals on wearable technology
4. https://cordis.europa.eu – EU research projects on smart textiles

ASSESSMENT PATTERN

Assessment Component	Continuous Assessment	End Semester Examination	Total
Marks	50	50	**100**

COURSE CURATED BY

Industry Expert	Higher Education Institution Expert	Internal Expert

Approved in BoS Meeting on: ___________	**Approved in Academic Council on: ___________**

urse Code	Course Title	L	T	P	J	C	Category
TTE074	BIOMIMETIC AND BIO-INSPIRED TEXTILES	3	0	0	0	3	PE
G Mapping		SDG 9: Industry, Innovation and Infrastructure | SDG 15: Life on Land					
-requisite Course/Knowledge			24TTI201 Fibre Science; Fundamentals of Biology				
a Book / Codes / Standards			Nil				

COURSE OBJECTIVES

1	To introduce the science of biomimicry and its relevance to textile engineering.
2	To familiarize students with structural and functional principles observed in nature for translation into textile products.
3	To impart knowledge on bio-inspired fibres, surfaces, structures and colouration.
4	To develop skills to analyse and design bio-inspired textile solutions for engineering problems.
5	To create awareness on sustainability, ethics and case studies of biomimetic innovation in textiles.

COURSE OUTCOMES

At the end of the course, the students will be able to:

CO No.	Course Outcome	RBT Level
CO1	Explain the principles, levels and design methodology of biomimicry as applied to textiles.	**U**
CO2	Analyse structure-function relationships in natural systems relevant to fibres, fabrics and finishes.	**An**
CO3	Describe bio-inspired functionalities such as super-hydrophobicity, thermoregulation, and structural colouration.	**U**
CO4	Design bio-inspired textile structures and finishes for defined performance requirements.	**C**
CO5	Evaluate the sustainability, feasibility and ethical dimensions of bio-inspired textile innovations.	**E**

RBT Levels: R – Remember, U – Understand, Ap – Apply, An – Analyse, E – Evaluate, C – Create

CO – PO / PSO MAPPING

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

Strength of Correlation: 3 – Strong, 2 – Medium, 1 – Weak, "-" – No Correlation

COURSE CONTENT

UNIT I PRINCIPLES OF BIOMIMICRY IN TEXTILES	9 Hours
Definitions of biomimicry, bionics, bio-inspiration, bio-utilisation – levels of biomimicry: form, process, ecosystem – Biomimicry 3.8 design spiral – Life's Principles – natural systems as source of textile innovation – hierarchical structuring in biological materials – from micro to nano to macro scale – biomimetic tool: AskNature database – successful case studies (Velcro, Speedo Fastskin, Lotus effect finish, Morphotex).	

UNIT II BIO-INSPIRED FIBRES AND YARNS	9 Hours
Spider silk: molecular structure of spidroins, dragline versus flagelliform silks – recombinant spider silk (Spiber, Bolt Threads) – wool and keratin biomimicry – gecko-inspired fibres for adhesion – cactus spine-inspired water harvesting fibres – hair-like fibres from polar bears for insulation – muscle-fibre-inspired actuator yarns (coiled polymer, CNT) – cotton fibre convolutions and moisture management – processing challenges of biomimetic fibres – LCA of bio-inspired versus synthetic fibres.	

UNIT III BIO-INSPIRED SURFACES AND STRUCTURES	9 Hours
Lotus leaf: super-hydrophobicity, self-cleaning – rose petal effect – Nepenthes pitcher plant: slippery surfaces (SLIPS) – shark skin riblets for drag reduction: Speedo Fastskin, wind turbines – Namib desert beetle water collection – moth eye anti-reflective structures – gecko foot adhesion – pinecone hygroscopic actuation – burr-inspired hook-and-loop fasteners – bio-inspired surface texturing methods: laser, plasma, self-assembly – durability and washability of biomimetic finishes.	

UNIT IV BIO-INSPIRED FUNCTIONALITY	9 Hours

Structural colouration: morpho butterfly, peacock feathers, opal, beetle iridescence – photonic crystal fabrics – chameleon-inspired colour changing textiles – thermoregulation: camel fur, penguin feathers, elephant skin – phase change and radiative cooling textiles – biomineralisation-inspired flame retardancy (nacre-like coatings) – sound absorption inspired by moth wings – hedgehog-inspired impact protection – biofouling resistance from shark skin, mussel byssus adhesion for medical textiles.

UNIT V APPLICATIONS AND SUSTAINABILITY	**9 Hours**
Sports and performance textiles: swimsuits, running shoes, cycling suits – medical textiles: mussel-inspired wound closure, gecko-inspired dressings – protective gear: bone-inspired composites – military and defence textiles – architectural textiles and adaptive facades – smart windows – circular design inspired by ecosystems – biomimicry as a tool for cradle-to-cradle textiles – ethical, IP and biopiracy concerns – design tools, standards and future outlook.	

Contact Hours (Theory)	**Total: 45 Hours**

LEARNING RESOURCES

Text Books

1. Benyus J.M., "Biomimicry: Innovation Inspired by Nature", Harper Perennial, Revised Edition, 2019.
2. Eadie L., Ghosh T.K., "Biomimicry in Textiles: Past, Present and Potential", Journal of the Royal Society Interface Reader, Woodhead, 2021.

Reference Books

1. Rossbach V., Patanaik A., Anandjiwala R.D., "Bioinspiration in Textiles", Springer, 2020.
2. Bar-Cohen Y., "Biomimetics: Nature-Based Innovation", CRC Press, 2018.
3. Vincent J.F.V., "Structural Biomaterials", Princeton University Press, 3rd Edition, 2019.

Online Educational Resources

1. https://asknature.org – The Biomimicry Institute's AskNature portal
2. https://biomimicry.net – Biomimicry 3.8 methodology
3. https://onlinecourses.nptel.ac.in – NPTEL: Bio-inspired Materials
4. https://www.nature.com – Journal Nature: bio-inspired materials collection

ASSESSMENT PATTERN

Assessment Component	Continuous Assessment	End Semester Examination	Total
Marks	50	50	**100**

COURSE CURATED BY

Industry Expert	Higher Education Institution Expert	Internal Expert

Approved in BoS Meeting on: ___________	**Approved in Academic Council on: ___________**

urse Code	Course Title	L	T	P	J	C	Category
TTE075	**TEXTILE ROBOTICS AND AUTOMATION**	**3**	**0**	**0**	**0**	**3**	**PE**
G Mapping		SDG 8: Decent Work and Economic Growth | SDG 9: Industry, Innovation and Infrastructure					
-requisite Course/Knowledge			Basics of Mechatronics and Manufacturing				
a Book / Codes / Standards			Nil				

COURSE OBJECTIVES

1	To introduce the fundamentals of automation, robotics and their relevance to textile and apparel manufacturing.
2	To familiarize students with sensors, actuators, controllers and vision systems used in textile automation.
3	To impart knowledge on robotic handling of limp fabric and garment components.
4	To develop understanding of automated systems in spinning, weaving, knitting, finishing and garmenting.
5	To create awareness on collaborative robotics, safety and productivity assessment in textile plants.

COURSE OUTCOMES

At the end of the course, the students will be able to:

CO No.	Course Outcome	RBT Level
CO1	Explain the classification, components and configurations of robotic and automated systems used in textiles.	**U**
CO2	Interpret the working of sensors, actuators, controllers and machine-vision modules used in textile automation.	**U**
CO3	Analyse strategies for robotic handling of limp textile materials and garment components.	**An**
CO4	Apply automation solutions for specific processes in spinning, weaving, knitting, finishing and garmenting.	**Ap**
CO5	Evaluate the productivity, safety, ROI and human-robot collaboration aspects of textile automation projects.	**E**

RBT Levels: R – Remember, U – Understand, Ap – Apply, An – Analyse, E – Evaluate, C – Create

CO – PO / PSO MAPPING

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

Strength of Correlation: 3 – Strong, 2 – Medium, 1 – Weak, "-" – No Correlation

COURSE CONTENT

UNIT I AUTOMATION AND ROBOTICS FUNDAMENTALS	9 Hours
Automation: fixed, programmable, flexible – hierarchy of automation in a textile plant – definition and classification of robots – configurations: SCARA, articulated, delta, Cartesian, cylindrical – DOF, work envelope, payload, repeatability, accuracy – end effectors: grippers, needle grippers, suction, Bernoulli grippers – collaborative robots (cobots) – AGV, AMR, gantry systems – introduction to PLC, HMI, SCADA.	

UNIT II SENSORS, ACTUATORS AND VISION SYSTEMS	9 Hours
Encoders, tachometers, load cells, tension sensors, moisture, colour, RFID, ultrasonic and laser sensors used in textile machines – servo, stepper and BLDC actuators – variable frequency drives – machine vision: cameras, illumination, image acquisition, pre-processing, feature extraction – deep-learning based fabric defect detection – colour and shade sorting – 3D vision for pile inspection – integration of sensors with PLC/SCADA and IIoT platforms.	

UNIT III ROBOTIC HANDLING OF LIMP MATERIALS	9 Hours
Challenges in handling limp, deformable textile materials – picking single ply from a stack – gripper technologies: pin, needle, suction, coanda, electrostatic, freezing, Bernoulli – cloth spreading, alignment and buffering – seam tracking – dual-arm robotic sewing – fabric feeding using vision guidance – Sewbo, Softwear Automation Sewbot – kitting and pick-and-place in cutting rooms – case studies of automated apparel lines.	

UNIT IV AUTOMATION IN TEXTILE PROCESSES	9 Hours

Spinning: auto doffing, robotic can transportation, robotic package handling, autoconers with Muratec/Savio robotic linkage – weaving: automatic pirn changer, weft feeler, automatic drawing-in and warp tying, ATC/APCS systems – knitting: fully-fashioned WholeGarment, Shima Seiki Mach2X, Santoni seamless with automation – chemical processing: auto colour kitchen, robotic bale opening, dyehouse automation, RFT dyeing systems – garment finishing: automatic pressing, folding, packing – warehouse automation and RFID-based inventory.

UNIT V HUMAN-ROBOT COLLABORATION AND PRODUCTIVITY	**9 Hours**
Safety standards: ISO 10218, ISO/TS 15066, IEC 60204 – risk assessment and mitigation – human factors and ergonomics – reskilling and workforce transition – productivity metrics: OEE, MTTR, MTBF, SAM, throughput – ROI and payback analysis for automation projects – impact on employment and social sustainability in Indian textile sector – case studies of automation in Tirupur, Coimbatore, Surat and Bhiwandi clusters – emerging trends: soft robotics, swarm robotics, digital twin-enabled robotics.	

Contact Hours (Theory)	**Total: 45 Hours**

LEARNING RESOURCES

Text Books

1. Groover M.P., "Automation, Production Systems and Computer-Integrated Manufacturing", Pearson, 5th Edition, 2019.
2. Nayak R., Padhye R., "Automation in Garment Manufacturing", Woodhead Publishing, 2nd Edition, 2022.

Reference Books

1. Craig J.J., "Introduction to Robotics: Mechanics and Control", Pearson, 4th Edition, 2018.
2. Gong R.H., "Specialist Yarn and Fabric Structures", Woodhead Publishing, 2020.
3. Meixell M.J., "Industry 4.0 for the Textile and Apparel Sector", Springer, 2021.

Online Educational Resources

1. https://onlinecourses.nptel.ac.in – NPTEL: Robotics and Industrial Automation
2. https://www.iso.org/committee/54138.html – ISO/TC 299 Robotics
3. https://www.universal-robots.com/academy – Universal Robots Academy
4. https://www.sewbo.com – Sewbo automated sewing resources

ASSESSMENT PATTERN

Assessment Component	Continuous Assessment	End Semester Examination	Total
Marks	50	50	**100**

COURSE CURATED BY

Industry Expert	Higher Education Institution Expert	Internal Expert

Approved in BoS Meeting on: ___________	**Approved in Academic Council on: ___________**

urse Code	Course Title	L	T	P	J	C	Category
TTE076	**COMPUTATIONAL TEXTILES**	**3**	**0**	**0**	**0**	**3**	**PE**
G Mapping		SDG 9: Industry, Innovation and Infrastructure | SDG 4: Quality Education					
-requisite Course/Knowledge			Basic Programming; Textile Materials and Structures				
ta Book / Codes / Standards			Nil				

COURSE OBJECTIVES

1	To introduce the fundamentals of computational modelling and simulation for textile materials and processes.
2	To familiarize students with geometric and mechanical modelling of yarns, fabrics and garment structures.
3	To impart knowledge on finite element and multi-scale modelling of textile assemblies.
4	To develop skills in the use of computational tools for textile design and analysis.
5	To create awareness on data-driven modelling, machine learning and virtual prototyping in textiles.

COURSE OUTCOMES

At the end of the course, the students will be able to:

CO No.	Course Outcome	RBT Level
CO1	Explain the role of computational modelling in the analysis and design of textile materials and processes.	**U**
CO2	Develop geometric models of yarns, woven, knitted and nonwoven fabrics using computational tools.	**Ap**
CO3	Apply finite element and multi-scale techniques to analyse the mechanical behaviour of textile assemblies.	**Ap**
CO4	Analyse fabric drape, hand and comfort through computational simulation platforms.	**An**
CO5	Evaluate data-driven and virtual prototyping approaches for textile product development.	**E**

RBT Levels: R – Remember, U – Understand, Ap – Apply, An – Analyse, E – Evaluate, C – Create

CO – PO / PSO MAPPING

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

Strength of Correlation: 3 – Strong, 2 – Medium, 1 – Weak, "-" – No Correlation

COURSE CONTENT

UNIT I FUNDAMENTALS OF COMPUTATIONAL MODELLING	9 Hours
Need for computational modelling in textiles – deterministic and stochastic models – continuum, discrete and hybrid approaches – multi-scale nature of textile structures – solid mechanics preliminaries: stress, strain, constitutive equations – programming basics for textile modelling using Python/MATLAB – overview of software: TexGen, WiseTex, DYNAFAB, LS-DYNA, ABAQUS, COMSOL, Clo3D, Optitex.	

UNIT II GEOMETRIC MODELLING OF YARNS AND FABRICS	9 Hours
Yarn geometry: idealised, migration, hairiness – Peirce, Kemp and modified geometric models of plain weave – 3D geometric modelling of woven, knitted and braided structures using TexGen and WiseTex – geometry of weft and warp knits, spacer fabrics, multi-axial fabrics – voxel-based and NURBS-based modelling of nonwovens – computer-aided design of jacquards – input parameters and validation with microscopic images.	

UNIT III MECHANICAL MODELLING OF FABRICS	9 Hours
Force-elongation behaviour of yarns and fabrics – tensile, shear, bending and compression models – Kawabata and FAST parameter modelling – finite element modelling of woven and knitted fabrics – multi-scale approach: fibre → yarn → fabric → composite – modelling of technical textiles: airbag deployment, ballistic impact, geotextile pull-out – case studies using ABAQUS and LS-DYNA.	

UNIT IV DRAPE, HAND AND COMFORT SIMULATION	9 Hours
Cusick drape simulation and prediction – cloth simulation methods: particle-based, mass-spring, finite element – garment simulation platforms: Clo3D, Browzwear V-Stitcher, Optitex – virtual fit and grading – digital human avatars and pose libraries – thermal, moisture and air permeability simulation for comfort assessment – coupled hygro-thermal-mechanical modelling – validation with wearer trials.	

UNIT V DATA-DRIVEN AND VIRTUAL TEXTILE ENGINEERING	9 Hours
Introduction to machine learning: regression, classification, clustering, neural networks – surrogate modelling for fabric properties – convolutional networks for defect detection – generative models for pattern design – digital twin of a textile plant – virtual prototyping and virtual sampling – integration with PLM and ERP – case studies on data-driven optimisation of spinning and dyeing – future outlook.	

Contact Hours (Theory)	Total: 45 Hours

LEARNING RESOURCES

Text Books

1. Chen X., "Modelling and Predicting Textile Behaviour", Woodhead Publishing, 2nd Edition, 2020.
2. Boisse P., "Composite Reinforcements for Optimum Performance", Woodhead Publishing, 2nd Edition, 2021.

Reference Books

1. Long A.C., "Design and Manufacture of Textile Composites", Woodhead Publishing, 2018.
2. Miao M., Xin J.H., "Engineering of High-Performance Textiles", Woodhead Publishing, 2018.
3. Zoltan K., "Simulation in Textile Technology: Theory and Applications", Woodhead Publishing, 2019.

Online Educational Resources

1. https://onlinecourses.nptel.ac.in – NPTEL: Introduction to Finite Element Method
2. https://texgen.sourceforge.io – TexGen open-source geometric modelling software
3. https://www.clo3d.com – Clo3D virtual fashion simulation
4. https://simulia.com – Abaqus tutorials for textile composites

ASSESSMENT PATTERN

Assessment Component	Continuous Assessment	End Semester Examination	Total
Marks	50	50	**100**

COURSE CURATED BY

Industry Expert	Higher Education Institution Expert	Internal Expert

Approved in BoS Meeting on: __________	Approved in Academic Council on: __________

urse Code	Course Title	L	T	P	J	C	Category
TTE077	**MANUFACTURE OF SPECIALTY YARNS AND FABRICS**	**3**	**0**	**0**	**0**	**3**	**PE**
G Mapping		SDG 9: Industry, Innovation and Infrastructure | SDG 12: Responsible Consumption and Production					
-requisite Course/Knowledge			24TTI202 Yarn Manufacture I; Fabric Manufacture I				
a Book / Codes / Standards			Nil				

COURSE OBJECTIVES

1	To introduce specialty yarn and fabric structures beyond conventional constructions.
2	To familiarize students with fancy, novelty and hybrid yarn manufacturing systems.
3	To impart knowledge on manufacture of specialty woven and knitted fabrics for functional applications.
4	To develop understanding of quality assurance and end-use suitability of specialty products.
5	To create awareness on innovation, IPR and sustainability aspects of specialty yarns and fabrics.

COURSE OUTCOMES

At the end of the course, the students will be able to:

CO No.	Course Outcome	RBT Level
CO1	Classify specialty yarns and fabrics based on structure, function and end-use.	**U**
CO2	Explain the manufacturing techniques for fancy, novelty, core, wrapped and elastic yarns.	**U**
CO3	Analyse the manufacture of specialty woven fabrics such as pile, terry, jacquard and 3D structures.	**An**
CO4	Apply appropriate processes for the production of specialty knitted, braided and nonwoven fabrics.	**Ap**
CO5	Evaluate quality parameters, cost implications and sustainability of specialty textile products.	**E**

RBT Levels: R – Remember, U – Understand, Ap – Apply, An – Analyse, E – Evaluate, C – Create

CO – PO / PSO MAPPING

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

Strength of Correlation: 3 – Strong, 2 – Medium, 1 – Weak, "-" – No Correlation

COURSE CONTENT

UNIT I CLASSIFICATION OF SPECIALTY YARNS AND FABRICS	**9 Hours**
Specialty vs commodity textiles – classification of specialty yarns: fancy, novelty, core-spun, wrapped, compact, siro, air-vortex, plied and cabled, textured, high-twist – specialty fabrics: pile, terry, velvet, corduroy, jacquard, 3D, spacer, warp-knit lace, seamless, braided, coated, laminated, nonwoven composites – end-uses: fashion, home, technical, defence, sportswear.	

UNIT II MANUFACTURE OF SPECIALTY YARNS	**9 Hours**
Fancy yarns: slub, snarl, boucle, chenille, loop – production on OE, hollow spindle and DREF systems – core-spun yarns: elastane, aramid, polyester core – wrapping techniques – air-vortex spinning: MVS 870/870EX, LTF 3060 – compact spinning: EliTe, K44, ComforSpin – siro and solospun – Suessen PLYfil – multi-count and multi-colour yarns – high-twist voile and crepe yarns – texturised POY and DTY – auto-doffing and package winding.	

UNIT III SPECIALTY WOVEN FABRICS	**9 Hours**
Pile fabrics: cut, uncut, warp and weft pile mechanisms – terry towel weaving on Sulzer Rueti, Picanol, Toyota JAT 810/910 – velvet and velveteen – corduroy manufacture and finishing – jacquard weaving: electronic jacquards (Stäubli LX/CX 3200), high-density head, damask – 3D woven fabrics: orthogonal, angle-interlock, layer-to-layer – spacer, multi-axial and Y-shaped preforms – airbag and parachute fabrics – seamless woven structures.	

UNIT IV SPECIALTY KNITTED, BRAIDED AND NONWOVEN FABRICS	**9 Hours**
Warp-knit lace on Rachel and jacquardtronic – warp-knit spacer fabrics for automotive and medical – seamless knitting: Santoni SM8-TOP2V, Shima Seiki WholeGarment – integral knit sensors and heaters – biaxial and triaxial braiding – overbraiding of composite preforms – specialty nonwovens: bicomponent spunlaid, meltblown, spunlace	

lace, wet-laid mineral, needle-punched geotextiles – SMS composites for medical drapes – 3D printed hybrid textiles.

UNIT V QUALITY, COST AND INNOVATION IN SPECIALTY TEXTILES	9 Hours
Quality parameters: unevenness (U%, CV%), imperfections, hairiness, twist, count strength – fabric quality: GSM, cover factor, air permeability, drape, hand – process economics: raw material cost, machine hire, productivity, downtime – value addition and pricing – patenting of yarn structures and fabric constructions – sustainability: recycled and bio-based fibres in specialty yarns – trends: hybrid yarns for smart textiles, phase-change and antimicrobial specialty yarns – case studies of Indian specialty yarn/fabric mills.	

Contact Hours (Theory)	Total: 45 Hours

LEARNING RESOURCES

Text Books

1. Gong R.H., Wright R.M., "Fancy Yarns: Their Manufacture and Application", Woodhead Publishing, 2nd Edition, 2018.
2. Gandhi K.L., "Woven Textiles: Principles, Technologies and Applications", Woodhead Publishing, 2nd Edition, 2020.

Reference Books

1. Klein W., "A Practical Guide to Compact, Air-Jet and Rotor Spinning", Textile Institute Manchester, 2019.
2. Spencer D.J., "Knitting Technology", Woodhead Publishing, 3rd Edition, 2018.
3. Chen X., "Advances in 3D Textiles", Woodhead Publishing, 2020.

Online Educational Resources

1. https://onlinecourses.nptel.ac.in – NPTEL: Yarn Manufacture / Fabric Manufacture
2. https://www.itmach.com – ITMACH India specialty fabrics resources
3. https://www.shimaseiki.com – WholeGarment technology
4. https://www.stäubli.com – Stäubli Jacquard and weaving preparation systems

ASSESSMENT PATTERN

Assessment Component	Continuous Assessment	End Semester Examination	Total
Marks	50	50	**100**

COURSE CURATED BY

Industry Expert	Higher Education Institution Expert	Internal Expert

Approved in BoS Meeting on: __________	**Approved in Academic Council on: __________**

urse Code	Course Title	L	T	P	J	C	Category
TTE078	**SPECIALTY KNITS**	**3**	**0**	**0**	**0**	**3**	**PE**
G Mapping		SDG 9: Industry, Innovation and Infrastructure | SDG 12: Responsible Consumption and Production					
-requisite Course/Knowledge			Fabric Manufacture II - Knitting				
ta Book / Codes / Standards			Nil				

COURSE OBJECTIVES

1	To introduce advanced weft and warp knitted structures beyond conventional constructions.
2	To familiarize students with seamless, fully fashioned and shape-knit garment technologies.
3	To impart knowledge on specialty warp knits used in fashion, medical and technical applications.
4	To develop understanding of quality parameters and defects in specialty knitted fabrics.
5	To create awareness on innovation and sustainability in the specialty knitting sector.

COURSE OUTCOMES

At the end of the course, the students will be able to:

CO No.	Course Outcome	RBT Level
CO1	Explain the classification, structure and end-uses of specialty knitted fabrics.	**U**
CO2	Interpret the manufacturing principles of seamless, fully fashioned and shape-knit garments.	**U**
CO3	Analyse specialty warp knits including raschel, tricot, spacer and lace fabrics.	**An**
CO4	Apply appropriate machinery and process settings for manufacture of specialty knits.	**Ap**
CO5	Evaluate quality, productivity and sustainability aspects of specialty knitting operations.	**E**

RBT Levels: R – Remember, U – Understand, Ap – Apply, An – Analyse, E – Evaluate, C – Create

CO – PO / PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2

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

Strength of Correlation: 3 – Strong, 2 – Medium, 1 – Weak, "-" – No Correlation

COURSE CONTENT

UNIT I OVERVIEW OF SPECIALTY KNITS	**9 Hours**
Definition and classification of specialty knits – performance, aesthetic and structural specialty – specialty weft knits: interlock derivatives, ottoman, milano, punto-di-roma, blister, jacquards – specialty warp knits: tricot, raschel, simplex, powernet, marquisette, mesh, lace – three dimensional knits: spacer, seamless, shape-knit – application matrix across apparel, home, medical, industrial and sports textiles.	

UNIT II SEAMLESS AND FULLY FASHIONED KNITTING	**9 Hours**
Seamless knitting concept – Santoni SM8-TOP2V, SM4-TL2, X-Machine – yarn feed, needle actuation and pattern selection – production of seamless bodywear, sportswear and shapewear – fully fashioned knitting: Shima Seiki SES and SIG series – widening, narrowing, transfer and hold – WholeGarment technology: Mach2X, SWG091N2, SVR093 – integral knit accessories and neckband – productivity comparison and economics of seamless versus cut-and-sew.	

UNIT III SPECIALTY WARP KNIT STRUCTURES	**9 Hours**
Karl Mayer HKS, HKS-4M-EL, RSJ, RJPC series – tricot fabrics: locknit, satin, sharkskin – raschel fabrics: lace, curtain, sports mesh, powernet – jacquardtronic and lacetronic mechanisms – double needle bar raschel for spacer fabrics – auto-teller mesh for cricket nets and shade nets – warp knit for medical: hernia mesh, vascular graft, wound dressing – geotextile warp knits – auxetic and negative-Poisson's-ratio structures.	

UNIT IV SPECIALTY WEFT KNITS AND SHAPE KNITTING	**9 Hours**
Double-jersey derivatives: interlock, punto di Roma, ottoman, blister, French terry – electronic jacquard weft knits: single and double jersey – intarsia and vanisade – computerised flat knitting: pattern preparation software (SDS-ONE APEX, M1plus) – shape knitting for footwear uppers: adidas Primeknit, Nike Flyknit, Under Armour Threadborne – auxetic knits, thermoregulating knits, sensor-integrated knits – 3D fashioning of body-conforming garments.	

UNIT V QUALITY, PRODUCTIVITY AND SUSTAINABILITY	9 Hours
Structural parameters: stitch length, tightness factor, GSM, wale/course density – defects in specialty knits: press-off, needle line, drop stitch, cloud, barré, streak – process control: yarn tension, positive feed, LFA laser stop motion, camera-based inspection – productivity: RPM, machine utilisation, gauge selection – sustainability: near-zero waste seamless production, recycled yarns, on-demand knit-to-shape – case studies from Tirupur and Ludhiana knitting hubs – Industry 4.0 and digital knitting.	

Contact Hours (Theory)	Total: 45 Hours

LEARNING RESOURCES

Text Books

1. Spencer D.J., "Knitting Technology: A Comprehensive Handbook and Practical Guide", Woodhead Publishing, 3rd Edition, 2018.
2. Ray S.C., "Fundamentals and Advances in Knitting Technology", Woodhead Publishing, 2nd Edition, 2020.

Reference Books

1. Au K.F., "Advances in Knitting Technology", Woodhead Publishing, 2019.
2. Ajgaonkar D.B., "Knitting Technology", Universal Publishing Corporation, Mumbai, Revised Edition, 2019.
3. Gong H., Ozgen B., "3D Fibrous Assemblies", Woodhead Publishing, 2018.

Online Educational Resources

1. https://onlinecourses.nptel.ac.in – NPTEL: Fabric Manufacture II **-** Knitting
2. https://www.shimaseiki.com – Shima Seiki Knitting Technology
3. https://www.karlmayer.com – Karl Mayer warp knitting
4. https://www.santoni.com – Santoni seamless technology

ASSESSMENT PATTERN

Assessment Component	Continuous Assessment	End Semester Examination	Total
Marks	50	50	**100**

COURSE CURATED BY

Industry Expert	Higher Education Institution Expert	Internal Expert

Approved in BoS Meeting on: __________	Approved in Academic Council on: __________

urse Code	Course Title	L	T	P	J	C	Category
TTE079	**MECHANICS OF TEXTILE MACHINERY**	**3**	**0**	**0**	**0**	**3**	**PE**
G Mapping		SDG 9: Industry, Innovation and Infrastructure					
-requisite Course/Knowledge			Engineering Mechanics; Kinematics of Machines				
ta Book / Codes / Standards			PSG Design Data Book (Optional)				

COURSE OBJECTIVES

1	To introduce the principles of mechanics, kinematics and dynamics as applied to textile machinery.
2	To familiarize students with drive systems, cams, gears and linkages in textile machines.
3	To impart knowledge on vibration, balancing and noise in high-speed textile machinery.
4	To develop skills to analyse mechanical elements of spinning, weaving, knitting and processing machines.
5	To create awareness on condition monitoring, maintenance and reliability engineering in textile plants.

COURSE OUTCOMES

At the end of the course, the students will be able to:

CO No.	Course Outcome	RBT Level
CO1	Explain the basic mechanical principles governing textile machinery operation.	**U**
CO2	Interpret the working of cams, gears, linkages and drives in various textile machines.	**U**
CO3	Analyse vibration, balancing and noise problems in high-speed textile machines.	**An**
CO4	Apply mechanical analysis techniques to selected textile machine elements.	**Ap**
CO5	Evaluate the reliability, condition monitoring and maintenance requirements of textile machinery.	**E**

RBT Levels: R – Remember, U – Understand, Ap – Apply, An – Analyse, E – Evaluate, C – Create

CO – PO / PSO MAPPING

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

Strength of Correlation: 3 – Strong, 2 – Medium, 1 – Weak, "-" – No Correlation

COURSE CONTENT

UNIT I PRINCIPLES OF MECHANICS FOR TEXTILE MACHINERY	9 Hours
Recap of statics, dynamics and kinematics – degrees of freedom – force, torque, power and efficiency calculations for textile machines – friction and belt drives: flat, V, timing and toothed belts – chain drives, rope drives – power transmission losses – energy consumption in spinning, weaving, knitting and processing – energy audit basics.	

UNIT II CAMS, GEARS AND LINKAGES	9 Hours
Cams in weaving: tappet, dobby and jacquard shedding cams – displacement, velocity and acceleration diagrams – cams for knitting: raising, clearing, tuck, miss – cam curves and dwell periods – gear trains in ring frames, autoconers, warping and sizing – planetary and epicyclic gears – four-bar linkages in sley motion and needle bar traverse – slider-crank in shuttleless picking mechanisms – worked examples for pick timing and shedding synchronisation.	

UNIT III DRIVE SYSTEMS AND CONTROL	9 Hours
Single motor and sectional drive concepts – variable frequency drives, servo drives, direct-drive motors – spindle drives on ring frames (tape, four-motor, individual) – direct drive weaving machines: Toyota JAT 910, Picanol OmniPlus-i Connect, Itema R9500 – electronic let-off and take-up – electronic dobbies and jacquards – programmable positive yarn feed on knitting – dyeing machine circulation pump drives – energy-efficient motor selection: IE3/IE4 standards, BEE guidelines.	

UNIT IV VIBRATION, BALANCING AND NOISE	9 Hours
Sources of vibration in textile machines – free and forced vibration – single degree of freedom systems – critical speeds of spindles, ring rails and warping beams – rotor balancing in OE and air-jet spinning – vibration isolation, dampers, resilient mounts – noise generation and propagation in weaving sheds – OSHA and BIS noise exposure	

limits – design and use of silencers and acoustic enclosures – measurement using accelerometers, FFT analysers, sound level meters.

UNIT V CONDITION MONITORING AND MAINTENANCE	9 Hours
Maintenance policies: breakdown, preventive, predictive, TPM, RCM – condition monitoring techniques: vibration signature, thermography, oil analysis, ultrasonic, motor current signature – reliability engineering basics: MTBF, MTTR, failure rate, availability – IIoT-based real-time machine monitoring in textile plants – lubrication management – spare parts and inventory optimisation – case studies of predictive maintenance in Indian spinning and weaving mills.	

Contact Hours (Theory)	Total: 45 Hours

LEARNING RESOURCES

Text Books

1. Talavasek O., Svaty V., "Shuttleless Weaving Machines", Elsevier, Reprint 2019.
2. Marks R., Robinson A.T.C., "Principles of Weaving", The Textile Institute Manchester, Reprinted 2018.

Reference Books

1. Bhattacharya S.K., "Principles of Machine Design", Wheeler Publications, Revised Edition, 2019.
2. Klein W., "The Rieter Manual of Spinning – Vols. 1-7", Rieter, Revised 2018.
3. Ormerod A., Sondhelm W.S., "Weaving: Technology and Operations", Woodhead Publishing, Reprint 2020.

Online Educational Resources

1. https://onlinecourses.nptel.ac.in – NPTEL: Kinematics and Dynamics of Machines
2. https://www.bee-india.gov.in – Bureau of Energy Efficiency motor guidelines
3. https://www.rieter.com – Rieter Manual of Spinning resources
4. https://www.textileworld.com – Textile Industry technical articles

ASSESSMENT PATTERN

Assessment Component	Continuous Assessment	End Semester Examination	Total
Marks	50	50	**100**

COURSE CURATED BY

Industry Expert	Higher Education Institution Expert	Internal Expert

Approved in BoS Meeting on: __________	**Approved in Academic Council on: __________**

urse Code	Course Title	L	T	P	J	C	Category
TTE080	**NANO AND SMART MATERIALS IN TEXTILES**	**3**	**0**	**0**	**0**	**3**	**PE**
G Mapping		SDG 3: Good Health and Well-being | SDG 9: Industry, Innovation and Infrastructure					
-requisite Course/Knowledge			24TTI201 Fibre Science; Fundamentals of Chemistry				
ta Book / Codes / Standards			Nil				

COURSE OBJECTIVES

1	To introduce nanomaterials and smart materials relevant to textile applications.
2	To familiarize students with synthesis, characterisation and application methods of nano and smart materials in textiles.
3	To impart knowledge on functionalisation of textiles using nanocoatings, nanofibres and stimuli-responsive materials.
4	To develop understanding of performance evaluation of nano and smart-finished textiles.
5	To create awareness on safety, regulation and sustainability of nano and smart materials in textiles.

COURSE OUTCOMES

At the end of the course, the students will be able to:

CO No.	Course Outcome	RBT Level
CO1	Explain the fundamentals, classification and unique properties of nano and smart materials for textiles.	**U**
CO2	Describe synthesis techniques and characterisation tools used for nano and smart materials.	**U**
CO3	Apply nano-finishing and smart material integration techniques to functionalise textile substrates.	**Ap**
CO4	Analyse the performance, durability and functional attributes of nano and smart-treated textiles.	**An**
CO5	Evaluate the safety, regulatory and sustainability aspects of nano and smart materials in textiles.	**E**

RBT Levels: R – Remember, U – Understand, Ap – Apply, An – Analyse, E – Evaluate, C – Create

CO – PO / PSO MAPPING

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

Strength of Correlation: 3 – Strong, 2 – Medium, 1 – Weak, "-" – No Correlation

COURSE CONTENT

UNIT I FUNDAMENTALS OF NANO AND SMART MATERIALS	9 Hours
Definition of nanomaterials – 0D, 1D, 2D and 3D nanostructures – quantum size effect, surface-to-volume ratio – classification of smart materials: piezoelectric, shape memory, electroactive polymers, magnetorheological, photochromic, thermochromic, phase change – size-property relationships – relevance to textile industry – historical development and market outlook.	

UNIT II SYNTHESIS AND CHARACTERISATION	9 Hours
Top-down and bottom-up approaches – sol-gel, hydrothermal, chemical reduction, electrospinning, chemical vapour deposition, atomic layer deposition – production of silver, TiO_2, ZnO, SiO_2, carbon nanotube, graphene and MXene nanoparticles – characterisation techniques: SEM, TEM, AFM, XRD, FTIR, DLS, BET, TGA, XPS, UV-Vis – electrospinning process parameters – needleless electrospinning (Nanospider) – melt-blown nanofibres – bicomponent fibre splitting.	

UNIT III NANOFINISHES ON TEXTILES	9 Hours
Antimicrobial finishes: Ag, Cu, ZnO nanoparticles – UV-protective finishes: TiO_2, ZnO – self-cleaning: photocatalytic TiO_2, lotus-effect SiO_2 – flame retardant nanofinishes: LDH, POSS, MXene – hydrophobic and oleophobic finishes: fluorine-free per- and polyfluoroalkyl alternatives, silica – conductive finishes: PEDOT:PSS, CNT, graphene – application techniques: pad-dry-cure, exhaust, layer-by-layer, plasma-assisted deposition – washing durability.	

UNIT IV SMART MATERIALS AND STIMULI-RESPONSIVE TEXTILES	9 Hours
Phase change materials: paraffin, salt hydrates, encapsulation and application methods – Outlast, ComfortTemp – shape memory polymers and alloys – nitinol and PU-based fibres – chromic materials: photo, thermo, electro, mechanochromic – hydrogel-based responsive fibres – bioactive smart materials: drug-releasing, growth-factor-loaded – electroactive polymers and dielectric elastomers – application in adaptive apparel, wound care, temperature-regulating bedding and sportswear.	

UNIT V PERFORMANCE, SAFETY AND SUSTAINABILITY	9 Hours
Evaluation of functional performance: antimicrobial (AATCC 100, ISO 20743), UV (AS/NZS 4399), self-cleaning, flame retardancy, hydrophobicity, conductivity – wash-durability testing – release of nanoparticles: risk assessment, ecotoxicity, LCA – nano-safety regulations: REACH, OSHA, BIS guidelines, EU Nanoregulation – labelling and consumer information – green synthesis using plant extracts – circular design and end-of-life challenges – future outlook: 4D textiles, MXene wearables, bio-hybrid smart materials.	

Contact Hours (Theory)	Total: 45 Hours

LEARNING RESOURCES

Text Books

1. Wei Q., "Functional Nanofibres and Their Applications", Woodhead Publishing, 2nd Edition, 2020.
2. Brown P., Stevens K., "Nanofibres and Nanotechnology in Textiles", Woodhead Publishing, Reprinted 2019.

Reference Books

1. Mondal S., "Nano-finishing of Textile Materials", Woodhead Publishing, 2018.
2. Schwarz-Pfeiffer A., "Smart Materials in Textile Design", Springer, 2020.
3. Yilmaz N.D., "Smart Textiles: Wearable Nanotechnology", Wiley-Scrivener, 2019.

Online Educational Resources

1. https://onlinecourses.nptel.ac.in – NPTEL: Nanotechnology in Textiles
2. https://www.iso.org/committee/381983.html – ISO/TC 229 Nanotechnologies
3. https://echa.europa.eu – European Chemicals Agency (REACH & Nanomaterials)
4. https://www.nanowerk.com – Nanowerk resources on functional nanofinishes

ASSESSMENT PATTERN

Assessment Component	Continuous Assessment	End Semester Examination	Total
Marks	50	50	**100**

COURSE CURATED BY

Industry Expert	Higher Education Institution Expert	Internal Expert

Approved in BoS Meeting on: __________	**Approved in Academic Council on: __________**

urse Code	Course Title	L	T	P	J	C	Category
TTE081	SMART TEXTILE MANUFACTURING	2	0	2	0	3	PE

G Mapping	SDG 9: Industry, Innovation and Infrastructure | SDG 12: Responsible Consumption and Production
-requisite Course/Knowledge	24TTI201 Fibre Science; Basics of Electronics
a Book / Codes / Standards	Nil

COURSE OBJECTIVES

1	To introduce the concept of smart manufacturing in the textile industry.
2	To familiarize students with sensors, actuators and communication technologies in modern textile plants.
3	To impart knowledge on integration of IoT, data analytics and cloud platforms with textile machinery.
4	To develop hands-on skills in prototyping smart textile manufacturing modules.
5	To create awareness on Industry 4.0 use cases, ROI and workforce implications for textile plants.

COURSE OUTCOMES

At the end of the course, the students will be able to:

CO No.	Course Outcome	RBT Level
CO1	Explain the pillars, architecture and enablers of smart manufacturing in the textile sector.	**U**
CO2	Interpret sensor, actuator and communication technologies used in textile machinery.	**U**
CO3	Apply IoT and data analytics platforms to selected textile manufacturing processes.	**Ap**
CO4	Develop simple smart manufacturing modules using microcontrollers and cloud dashboards.	**C**
CO5	Evaluate productivity, quality and sustainability benefits of smart textile manufacturing solutions.	**E**

RBT Levels: R – Remember, U – Understand, Ap – Apply, An – Analyse, E – Evaluate, C – Create

CO – PO / PSO MAPPING

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

Strength of Correlation: 3 – Strong, 2 – Medium, 1 – Weak, "-" – No Correlation

COURSE CONTENT

UNIT I SMART MANUFACTURING AND INDUSTRY 4.0	**6 Hours**
Pillars of Industry 4.0 – nine technologies enabling smart manufacturing – Reference Architecture Model (RAMI 4.0) – vertical, horizontal and end-to-end integration – MES, ERP, PLM, SCADA in textile plants – digital thread and digital twin overview – Industry 4.0 maturity models – Indian textile sector readiness.	

UNIT II SENSORS, ACTUATORS AND COMMUNICATION	**6 Hours**
Machine sensors: RPM, temperature, humidity, tension, moisture, load, vibration, current – product sensors: colour, defect vision, RFID – actuators: servo, stepper, VFD, solenoid – field bus and industrial communication: RS-485, Modbus, PROFINET, OPC-UA, MTConnect – wireless: Wi-Fi, BLE, LoRa, NB-IoT, 5G – OEM smart connectivity: Rieter SPIDERweb, Loepfe MillMASTER TOP, Truetzschler T-DATA, Picanol PicConnect.	

UNIT III IoT AND DATA ANALYTICS PLATFORMS	**6 Hours**
Edge, fog and cloud computing – IoT platforms: AWS IoT Core, Azure IoT Hub, Google Cloud IoT, ThingSpeak, Node-RED, Blynk – data acquisition and storage – time-series databases – descriptive, diagnostic, predictive and prescriptive analytics – dashboards using Power BI, Grafana, Tableau – OEE, throughput, quality first pass yield, downtime dashboards – cybersecurity for OT/IT convergence.	

UNIT IV SMART TEXTILE MACHINERY AND PROCESSES	**6 Hours**
Smart spinning: Rieter ESSENTIAL, Muratec Vortex 870, Toyota RX-300 with SmartFactory – smart weaving: automatic pick finding, live production monitoring, remote diagnostics – smart knitting: real-time defect detection using AI vision – smart processing: recipe management, RFT dyeing systems (Then, Thies), colour kitchen automation – AGV/AMR for material handling – warehouse automation with barcode/RFID – smart maintenance: predictive analytics for spindles, weaving cams and gearboxes.	

UNIT V IMPLEMENTATION AND EVALUATION	6 Hours
Smart factory roadmap: pilot to scale – cost-benefit analysis and ROI computation – workforce implications: reskilling operators, data-savvy supervisors – sustainability benefits: energy monitoring, water metering, carbon accounting – standards and frameworks: ISA-95, IEC 62443 (OT security), ISO 22400 (KPIs) – government schemes: PLI for MMF and technical textiles, ATUFS, SITP – case studies of digital transformation in Indian textile mills.	

Theory: 30 Hours | Practical: 30 Hours	Total: 60 Hours

LIST OF PRACTICAL EXERCISES

Sl. No.	Practical Exercise	Hours
1	Study of sensors and actuators used in a modern textile machine and preparation of a data-sheet.	3
2	Interfacing a temperature and humidity sensor with Arduino/ESP32 for a spinning cabin environment monitor.	3
3	Design and implementation of a machine RPM and running/stopped status monitor using a hall-effect sensor and microcontroller.	3
4	Development of an IoT dashboard using ThingSpeak/Node-RED for real-time monitoring of a small textile process parameter.	3
5	Implementation of an OEE calculation module for a simulated weaving machine dataset using Python/Excel.	3
6	Development of a fabric defect image dataset and training of a simple CNN classifier using Google Colab.	3
7	Study of Modbus/OPC-UA communication between a textile PLC and a SCADA screen (simulated environment).	3
8	Preparation of a Power BI dashboard for spinning production KPIs using a provided dataset.	3
9	Design of a barcode / QR code-based work-in-progress tracking module for a small garment unit.	3
10	Preparation of a smart manufacturing roadmap and ROI worksheet for a chosen textile plant (mini-project).	3

LEARNING RESOURCES

Text Books

1. Nayak R., "Digital Manufacturing Technology for Sustainable Anthropometric Apparel", Woodhead Publishing, 2022.
2. Ustundag A., Cevikcan E., "Industry 4.0: Managing The Digital Transformation", Springer, 2nd Edition, 2019.

Reference Books

1. Behera B.K., "Industry 4.0 for the Textile Industry", Woodhead Publishing, 2022.
2. Gilchrist A., "Industry 4.0: The Industrial Internet of Things", Apress, 2018.
3. Prasad R., "Wireless Communications and Networks for the Internet of Things", Wiley, 2019.

Online Educational Resources

1. https://onlinecourses.nptel.ac.in – NPTEL: Introduction to Industry 4.0 and Industrial IoT
2. https://www.plattform-i40.de – Platform Industrie 4.0 – reference architectures
3. https://aws.amazon.com/iot/ – AWS IoT resources and tutorials
4. https://www.trai.gov.in – Indian standards on 5G and IoT

ASSESSMENT PATTERN

Assessment Component	Continuous Assessment	End Semester Examination	Total
Marks	50	50	**100**

COURSE CURATED BY

Industry Expert	Higher Education Institution Expert	Internal Expert

Approved in BoS Meeting on: __________	**Approved in Academic Council on: __________**

urse Code	Course Title	L	T	P	J	C	Category
TTE082	**APPLIED ARTIFICIAL INTELLIGENCE IN TEXTILES**	**2**	**0**	**2**	**0**	**3**	**PE**
G Mapping		SDG 4: Quality Education | SDG 9: Industry, Innovation and Infrastructure					
-requisite Course/Knowledge			Basic Programming; Statistics				
a Book / Codes / Standards			Nil				

COURSE OBJECTIVES

1	To introduce the fundamentals of Artificial Intelligence and Machine Learning with a textile perspective.
2	To familiarize students with supervised, unsupervised and deep learning techniques applied to textile problems.
3	To impart knowledge on computer vision, natural language processing and generative AI for textiles.
4	To develop hands-on skills in building AI models for textile classification, prediction and design.
5	To create awareness on responsible AI, ethics and regulations relevant to textile applications.

COURSE OUTCOMES

At the end of the course, the students will be able to:

CO No.	Course Outcome	RBT Level
CO1	Explain the fundamentals, life cycle and taxonomy of AI/ML applicable to textile problems.	**U**
CO2	Apply supervised and unsupervised learning techniques to textile datasets.	**Ap**
CO3	Develop computer vision-based solutions for textile defect detection and quality assessment.	**C**
CO4	Analyse the use of NLP and generative AI in textile design, retail and supply chain.	**An**
CO5	Evaluate ethical, legal and sustainability aspects of AI adoption in the textile sector.	**E**

RBT Levels: R – Remember, U – Understand, Ap – Apply, An – Analyse, E – Evaluate, C – Create

CO – PO / PSO MAPPING

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

Strength of Correlation: 3 – Strong, 2 – Medium, 1 – Weak, "-" – No Correlation

COURSE CONTENT

UNIT I FUNDAMENTALS OF AI AND MACHINE LEARNING	6 Hours
Definitions of AI, ML, DL – narrow, general and super intelligence – AI project life cycle: problem framing, data collection, feature engineering, model selection, training, evaluation, deployment, monitoring – categories of ML: supervised, unsupervised, semi-supervised, reinforcement – textile problem catalogue: quality inspection, demand forecasting, colour matching, virtual sampling, supply chain optimisation – overview of Python, scikit-learn, PyTorch, TensorFlow ecosystems.	

UNIT II SUPERVISED AND UNSUPERVISED LEARNING	6 Hours
Regression: linear, polynomial, ridge, lasso – classification: logistic regression, decision trees, random forest, SVM, XGBoost, naïve Bayes – k-fold cross-validation, confusion matrix, ROC, F1 score – unsupervised: k-means, DBSCAN, hierarchical clustering, PCA, t-SNE – applications in textiles: yarn count prediction, fabric hand classification, market segmentation, colour palette clustering, spinning mill benchmarking.	

UNIT III DEEP LEARNING AND COMPUTER VISION	6 Hours
Neural network fundamentals: perceptron, MLP, activation, back-propagation, optimisers, regularisation – convolutional neural networks: LeNet, VGG, ResNet, MobileNet, EfficientNet, YOLO, U-Net – transfer learning – image data augmentation – computer vision applications: fabric defect detection, colour and shade sorting, weave-pattern recognition, measurement of drape and fibre orientation, sewing seam quality, garment fit evaluation – edge deployment on Jetson Nano, Raspberry Pi and cloud APIs.	

UNIT IV NLP AND GENERATIVE AI FOR TEXTILES	6 Hours
Text processing basics – word embeddings – transformers, BERT, GPT family – applications in textiles: e-commerce product tagging, review sentiment mining, chat-based customer support, sustainability reporting, tender document analysis – generative AI: diffusion models (Stable Diffusion, DALL·E) for print/pattern design –	

generative jacquard design – AI-driven trend forecasting from social media – responsible use, IP concerns and originality in AI-generated designs.

UNIT V RESPONSIBLE AI, ADOPTION AND FUTURE OUTLOOK	**6 Hours**
Bias, fairness, transparency, explainability (LIME, SHAP) – privacy and data protection: DPDP Act 2023, GDPR – environmental impact of large models – cost of training/inference – AI deployment strategies for MSME textile clusters – build-vs-buy decisions – governance frameworks: NITI Aayog AI strategy, ISO/IEC 42001, EU AI Act – future trends: foundation models for materials, autonomous mill operations, human-AI teaming.	

Theory: 30 Hours | Practical: 30 Hours	**Total: 60 Hours**

LIST OF PRACTICAL EXERCISES

Sl. No.	Practical Exercise	Hours
1	Exploratory Data Analysis of a spinning/weaving production dataset using pandas and matplotlib.	3
2	Prediction of yarn strength from fibre and process parameters using linear/polynomial regression in Python.	3
3	Classification of woven fabric weave patterns (plain/twill/satin) using SVM and Random Forest with a curated dataset.	3
4	Clustering of yarn samples by hairiness/CV% using k-means and PCA visualisation.	3
5	Training a CNN model to classify defective vs non-defective fabric images using transfer learning.	3
6	Real-time fabric defect detection using YOLO/OpenCV on a laptop webcam feed.	3
7	Development of a colour matching / shade sorting tool using k-nearest neighbours on Lab colour values.	3
8	Text mining of e-commerce reviews of a chosen apparel category using an NLP pipeline (topic modelling, sentiment).	3
9	Generation of print motif variants for saree/kurta using an open-source diffusion model (Stable Diffusion).	3
10	Mini-project: End-to-end AI use-case selection, data collection, model building and dashboard demo for a chosen textile process.	3

LEARNING RESOURCES

Text Books

1. Géron A., "Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow", O'Reilly, 3rd Edition, 2023.
2. Nayak R., Padhye R., "Artificial Intelligence for Textile and Apparel Industry", Woodhead Publishing, 2022.

Reference Books

1. Goodfellow I., Bengio Y., Courville A., "Deep Learning", MIT Press, Reprinted 2020.
2. Chollet F., "Deep Learning with Python", Manning Publications, 2nd Edition, 2021.
3. Russell S., Norvig P., "Artificial Intelligence: A Modern Approach", Pearson, 4th Edition, 2020.

Online Educational Resources

1. https://onlinecourses.nptel.ac.in – NPTEL: Deep Learning; Machine Learning
2. https://www.deeplearning.ai – deeplearning.ai specialisations
3. https://www.kaggle.com – Kaggle textile/defect datasets and notebooks
4. https://huggingface.co – Hugging Face models and tutorials

ASSESSMENT PATTERN

Assessment Component	Continuous Assessment	End Semester Examination	Total
Marks	50	50	**100**

COURSE CURATED BY

Industry Expert	Higher Education Institution Expert	Internal Expert

Approved in BoS Meeting on: __________	**Approved in Academic Council on: __________**

urse Code	Course Title	L	T	P	J	C	Category
TTE083	**DIGITAL TWINS & INDUSTRY 5.0 IN TEXTILES**	**2**	**0**	**2**	**0**	**3**	**PE**
G Mapping		SDG 9: Industry, Innovation and Infrastructure | SDG 12: Responsible Consumption and Production					
-requisite Course/Knowledge			24TTE081 Smart Textile Manufacturing (Preferred)				
a Book / Codes / Standards			Nil				

COURSE OBJECTIVES

1	To introduce the concept, architecture and value proposition of digital twins in the textile industry.
2	To familiarize students with modelling, simulation and visualisation platforms used to build textile digital twins.
3	To impart knowledge on the transition from Industry 4.0 to Industry 5.0 and the role of human-centric technologies.
4	To develop hands-on skills in building simple digital twin prototypes for textile products and processes.
5	To create awareness on the sustainability, circularity and workforce implications of Industry 5.0 in textiles.

COURSE OUTCOMES

At the end of the course, the students will be able to:

CO No.	Course Outcome	RBT Level
CO1	Explain the concept, types and architecture of digital twins as applied to textile products and processes.	**U**
CO2	Interpret modelling, simulation and visualisation approaches used to construct textile digital twins.	**U**
CO3	Distinguish the transition from Industry 4.0 to Industry 5.0 and its implications for textile manufacturing.	**An**
CO4	Develop simple digital twin prototypes for a textile product or process using open-source tools.	**C**

CO5	Evaluate sustainability, circularity, human-centricity and resilience aspects of Industry 5.0 textile solutions.	**E**

RBT Levels: R – Remember, U – Understand, Ap – Apply, An – Analyse, E – Evaluate, C – Create

CO – PO / PSO MAPPING

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

Strength of Correlation: 3 – Strong, 2 – Medium, 1 – Weak, "-" – No Correlation

COURSE CONTENT

UNIT I DIGITAL TWIN FUNDAMENTALS	**6 Hours**
Definition of digital twin (DT) – digital model, digital shadow, digital twin – classification: product, process, system twin – DT reference architecture (5D and 8D models) – enabling technologies: IoT, cloud, edge, simulation, XR, AI – value proposition: design optimisation, predictive maintenance, energy and quality management – market overview and vendor landscape (Siemens Xcelerator, PTC ThingWorx, Dassault 3DEXPERIENCE, Bentley iTwin).	

UNIT II MODELLING, SIMULATION AND VISUALISATION	**6 Hours**
Data-driven, physics-based and hybrid twin modelling – reduced order models – simulation tools for textile products: TexGen, WiseTex, Abaqus, ANSYS, LS-DYNA, COMSOL – process simulation: spinning triangle, weaving beat-up, dyeing hydrodynamics using CFD/FEM – visualisation: Unity, Unreal, Omniverse, web-based dashboards – XR interfaces: AR/VR/MR for training and remote assistance – data pipelines: sensors → gateway → cloud → visualisation.	

UNIT III INDUSTRY 5.0 AND HUMAN-CENTRIC TECHNOLOGIES	**6 Hours**
Definition of Industry 5.0 – European Commission's vision – three pillars: human-centric, sustainable, resilient – differences between Industry 4.0 and Industry 5.0 – collaborative robots (cobots) and exoskeletons in textiles – operator 5.0 – ergonomics and safety – digital literacy and lifelong learning – generative design with humans-in-the-loop – ethical AI in the shop floor.	

UNIT IV APPLICATIONS OF DIGITAL TWINS IN TEXTILES	6 Hours
Product twins: virtual fabric library, virtual sampling in Clo3D/Browzwear – process twins: spinning mill twin, weaving twin, dyehouse twin, garment line twin – asset twins: motors, compressors, boilers – supply chain twins: raw material, logistics, retail store – sustainability twins: energy, water and carbon accounting – case studies: Adidas Speedfactory legacy, Levi Strauss FLX, Uniqlo Ariake supply chain twin, Indian pilots at Trident, Vardhman and Arvind.	

UNIT V SUSTAINABILITY, CIRCULARITY AND WORKFORCE	6 Hours
Digital Product Passport (DPP) and EU ESPR – material tracking and traceability using digital twins – circular economy: reuse, repair, recycle enabled by DT – carbon footprint modelling using LCA linked to DT – workforce reskilling and reimagining jobs – gender inclusion, MSME participation, cluster-level DT initiatives – policy and standards: NASSCOM CoE for Industry 4.0, National Textile Technology Mission – future outlook: cognitive twins, autonomous mills and Society 5.0.	

Theory: 30 Hours | Practical: 30 Hours	Total: 60 Hours

LIST OF PRACTICAL EXERCISES

Sl. No.	Practical Exercise	Hours
1	Preparation of a digital-twin architecture diagram for a chosen textile process (spinning/weaving/dyeing/garmenting).	3
2	Development of a virtual 3D model of a woven fabric structure using TexGen and analysis of its geometric parameters.	3
3	Virtual sampling of a T-shirt design in Clo3D/Browzwear demo version and evaluation of virtual fit on avatars.	3
4	Building a simple product digital twin for a garment: parametric CAD model + material properties + energy footprint.	3
5	Real-time process twin: streaming sensor data from a lab process (temperature/motor RPM) to a cloud dashboard (ThingSpeak/AWS).	3
6	Development of an AR-based operator instruction module for a textile machine using open tools (Vuforia/8th Wall/Unity).	3
7	CFD-based simulation of dye bath circulation in a jet dyeing machine using ANSYS/COMSOL student edition.	3

8	Predictive maintenance twin: training a simple LSTM/ARIMA model on machine vibration data.	3
9	Sustainability twin: computing energy, water and CO_2 per kg fabric using a Sankey diagram tool.	3
10	Mini-project: end-to-end digital twin prototype for a chosen textile use-case with presentation and technical brief.	3

LEARNING RESOURCES

Text Books

1. Grieves M., Vickers J., "Digital Twin: Mitigating Unpredictable Events for Complex Systems", Springer, Revised Edition, 2020.
2. Nahavandi S., "Industry 5.0: A Human-Centric Solution", Springer, 2022.

Reference Books

1. Tao F., Zhang M., Nee A.Y.C., "Digital Twin Driven Smart Manufacturing", Academic Press, 2019.
2. Xu X., Lu Y., Vogel-Heuser B., Wang L., "Industry 4.0 and Industry 5.0—Inception, conception and perception", Journal of Manufacturing Systems, 2021.
3. Behera B.K., "Industry 4.0 for Textile Industry", Woodhead Publishing, 2022.

Online Educational Resources

1. https://onlinecourses.nptel.ac.in – NPTEL: Digital Twin and Cyber Physical Systems
2. https://research.ec.europa.eu/industry-5-0 – European Commission Industry 5.0 portal
3. https://developer.nvidia.com/omniverse – NVIDIA Omniverse digital twin platform
4. https://www.digitaltwinconsortium.org – Digital Twin Consortium resources

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