

Revised Curriculum

For

Master of Technology



**Department of Textile
Technology**

Master of Technology
in
Textile Engineering

Master of Technology in Textile Engineering

- 1 TXL721 Theory of Yarn Structure**
- 2 TXL722 Mechanics of Spinning Processes**
- 3 TXL725 Mechanics of Spinning Machines**
- 4 TXP725 Mechanics of Textile Machines Laboratory**
- 5 TXL731 Theory of Fabric Structure**
- 6 TXL732 Advanced Fabric Manufacturing Systems**
- 7 TXP761 Evaluation of Textile Materials**
- 8 TXL775 Technical Textiles**
- 9 TXL783 Design of Experiments and Statistical Techniques**
- 10 TXD801 Major Project Part 1 (TXE)**
- 11 TXD803 Major Project Part 2 (TXE)**
- 12 TXL700 Modelling and Simulation in Fibrous Assemblies**
- 13 TXV702: Management of Textile Business**
- 14 TXV703 Special Module in Textile Technology**
- 15 TXV704 Special Module in Yarn Manufacture**
- 16 TXV705 Special Module in fabric Manufacture**
- 17 TXL734 Nonwoven Processes and Products**
- 18 TXL750 Science of Clothing Comfort**
- 19 TXL751 Apparel Engineering and Quality Control**
- 20 TXL752 Design of Functional Clothing**
- 21 TXL766 Design and Manuf. of Textile Structural Composites**
- 22 TXL771 Electronics and Controls for Textile Industry**
- 23 TXL772 Computational Methods for Textiles**
- 24 TXL774 Process Control in Yarn and Fabric Manufacturing**
- 25 TXL777 Product Design and Development**
- 26 TXL781 Project Appraisal and Finance**
- 27 TXL782 Production and Operations Management in Textile Industry**
- 28 TXL784 Supply Chain Management in Textile Industry**
- 29 TXS805 Independent Study (Textile Engineering)**
- 30 TXL807 Seminar (Textile Engineering)**
- 31 TXD809 Mini Project (Textile Engineering)**

Master of Technology in Textile Engineering
Department of Textile Technology

The overall credits structure

Category	PC	PE	OC	Total
Credits	42	12	00	54

Program Core (PC)

Programme Elective (PE)

TXL721	Theory of Yarn Structure	3-0-0	3	TXL700	Modelling and Simulation in Fibrous Assemblies	2-0-2	3
TXL722	Mechanics of Spinning Processes	3-0-0	3	TXV702:	Management of Textile Business	1-0-0	1
TXL725	Mechanics of Spinning Machines	3-0-0	3	TXV703	Special Module in Textile Technology	1-0-0	1
TXP725	Mechanics of Textile Machines Laboratory	0-0-2	1	TXV704	Special Module in Yarn Manufacture	1-0-0	1
TXL731	Theory of Fabric Structure	3-0-0	3	TXV705	Special Module in fabric Manufacture	1-0-0	1
TXL732	Advanced Fabric Manufacturing Systems	3-0-0	3	TXL710	High Performance & Specialty. Fibers	3-0-0	3
TXP761	Evaluation of Textile Materials	0-0-4	2	TXL719	Functional & Smart Textiles	3-0-0	3
TXL775	Technical Textiles	3-0-0	3	TXL724	Textured Yarn Technology	3-0-0	3
TXL783	Design of Experiments and Statistical Techniques	3-0-0	3	TXL734	Nonwoven Processes and Products	3-0-0	3
TXD801	Major Project Part 1 (TXE)	0-0-12	6	TXL740	Science and Applications of Nanotechnology in Textiles	3-0-0	3
TXD803	Major Project Part 2 (TXE)	0-0-24	12	TXL750	Science of Clothing Comfort	3-0-0	3
Total				TXL751	Apparel Engineering and Quality Control	2-0-2	3
				TXL752	Design of Functional Clothing	3-0-0	3
				TXL766	Design and Manuf. of Textile Structural Composites	3-0-0	3
				TXL771	Electronics and Controls for Textile Industry	3-0-2	4
				TXL772	Computational Methods for Textiles	2-0-2	3
				TXL773	Medical Textiles	3-0-0	3
				TXL774	Process Control in Yarn and Fabric Manufacturing	3-0-0	3
				TXL777	Product Design and Development	3-0-0	3
				TXL781	Project Appraisal and Finance	3-0-0	3
				TXL782	Production and Operations Management in Textile Industry	3-0-0	3
				TXL784	Supply Chain Management in Textile Industry	3-0-0	3
				TXS805	Independent Study (Textile Engineering)	0-3-0	3
				TXL807	Seminar (Textile Engineering)	0-2-0	2
				TXD809	Mini Project (Textile Engineering)	0-0-8	4
				TXL712	Polymer and Fibre Physics	3-0-0	3

M.Tech. in Textile Engineering

Sem.	Courses (Number, abbreviated title, L-T-P, credits)							Lecture Courses	Contact h/week				Credits
									L	T	P	Total	
I	TXL721 Theory of Yarn Structure (3-0-0) 3	TXL722 Mechanics of Spinning Processes (3-0-0) 3	TXL731 Theory of Fabric Structure (3-0-0) 3	TXL732 Advanced Fabric Manufacturing Systems (3-0-0) 3			PE-1 (3-0-0) 3	5	15	0	0	15	15
II	TXL775 Technical Textiles (3-0-0) 3	TXL725 Mechanics of Spinning Machines (3-0-0) 3	TXL783 Design of Expt. and Stat. Tech. (3-0-0) 3	TXP761 Evaluation of Textile Materials (0-0-4) 2	TXP725 Mechanics of Textile Machines Laboratory (0-0-2) 1		PE-2 (3-0-0) 3	4	12	0	6	18	15
Summer	TXD801 Major Project Part 1(TXE)							0					
III	TXD801 Major Project Part 1(TXE) (0-0-12) 6	PE-3 (3-0-0) 3	PE-4 (3-0-0) 3					2	6	0	12	18	12
IV	TXD803 Major Project Part 2(TXE) (0-0-24) 12							0	0	0	24	24	12

Total=54

COURSE TEMPLATE

1.	Department /Centre proposing the course	Department of Textile Technology		
2.	Course Title (<i>< 45 characters</i>)	Major Project Part 1 (TXE)		
3.	L-T-P structure	0-0-12		
4.	Credits	6		
5.	Course number	TXD801		
6.	Status (<i>category for program</i>)	PC for M.Tech. (Textile Engineering) students		

7.	Pre-requisites (course no./title)	None		
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)			
	8.1 Overlap with any UG/PG course of the Dept./Centre		No	
	8.2 Overlap with any UG/PG course of other Dept./Centre		No	
	8.3 Supersedes any existing course		TTD893	

9.	Not allowed for (indicate program names)	Allowed for only M. Tech. (Textile Engineering) students
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10.	Frequency of offering	Every sem 1st sem 2nd sem Either sem - 1st sem		
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11.	Faculty who will teach the course S. M. Ishtiaque, R. Chattopadhyay, B. K. Behera, R. Alagirusamy, R. S. Rengasamy, Apurba Das, Abhijit Majumdar, Amit Rawal, Dipayan Das			
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12.	Will the course require any visiting faculty? (yes/no)	No
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13.	Course objectives (<i>about 50 words</i>): To learn about preparation of research plan and systematically carry out research project.
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14.	Course contents (about 100 words) (Include laboratory/design activities): Preparation of research plan, Completion of targeted research work for the semester, Presentation of research work for award of grade.
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15. Lecture Outline (*with topics and number of lectures*) None

Module no.	Topic	No. of hours

16. Brief description of tutorial activities: None

Module no.	Description	No. of hours

17. Brief description of laboratory activities:

Module no.	Description	No. of hours
1	Experimental work	168
COURSE TOTAL (<i>14 times 'P'</i>)		168

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours

19. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Research articles published in literature.
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20. Resources required for the course (*itemized & student access requirements, if any*)

20.1	Software	Existing products from labs
20.2	Hardware	Existing products in labs or would be procured PPT
20.3	Teaching aides (videos, etc.)	
20.4	Laboratory	All textile labs
20.5	Equipment	All existing equipments
20.6	Classroom infrastructure	Lecture room with AV facility for regular interaction
20.7	Site visits	Not in particular
20.8	Others (please specify)	

21. Design content of the course (*Percent of student time with examples, if possible*)

21.1	Design-type problems	100 %
21.2	Open-ended problems	
21.3	Project-type activity	
21.4	Open-ended laboratory work	
21.5	Others (please specify)	

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Department of Textile Technology		
2.	Course Title (<i>< 45 characters</i>)	Major Project Part 2 (TXE)		
3.	L-T-P structure	0-0-24		
4.	Credits	12		
5.	Course number	TXD803		
6.	Status (<i>category for program</i>)	PC for M.Tech. (Textile Engineering) students		

7.	Pre-requisites (course no./title)	None		
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)			
	8.1 Overlap with any UG/PG course of the Dept./Centre		No	
	8.2 Overlap with any UG/PG course of other Dept./Centre		No	
	8.3 Supersedes any existing course		TTD894	

9.	Not allowed for (indicate program names)	Allowed for only M. Tech. (Textile Engineering) students		
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10.	Frequency of offering	Every sem 1st sem 2nd sem Either sem - 2 nd sem		
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11.	Faculty who will teach the course S. M. Ishtiaque, R. Chattopadhyay, B. K. Behera, R. Alagirusamy, R. S. Rengasamy, Apurba Das, Abhijit Majumdar, Amit Rawal, Dipayan Das			
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12.	Will the course require any visiting faculty? (yes/no)	No
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13.	Course objectives (<i>about 50 words</i>): To learn about preparation of research plan and systematically carry out research project
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14.	Course contents (about 100 words) (Include laboratory/design activities): Continuation of planned tasks started in TXD801: Major Project Part 1 (TXE), to completion, thesis writing and presentation of complete work for award of grade.
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15. Lecture Outline (*with topics and number of lectures*) None

Module no.	Topic	No. of hours

16. Brief description of tutorial activities: None

Module no.	Description	No. of hours

17. Brief description of laboratory activities:

Module no.	Description	No. of hours
1	Experimental work	336
	COURSE TOTAL (<i>14 times 'P'</i>)	336

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours

19. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Research articles published in literature.
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20. Resources required for the course (*itemized & student access requirements, if any*)

20.1	Software	Existing products from labs
20.2	Hardware	Existing products in labs or would be procured PPT
20.3	Teaching aides (videos, etc.)	
20.4	Laboratory	All textile labs
20.5	Equipment	All existing equipments
20.6	Classroom infrastructure	Lecture room with AV facility for regular interaction
20.7	Site visits	Not in particular
20.8	Others (please specify)	

21. Design content of the course (*Percent of student time with examples, if possible*)

21.1	Design-type problems	100 %
21.2	Open-ended problems	
21.3	Project-type activity	
21.4	Open-ended laboratory work	
21.5	Others (please specify)	

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Department of Textile Technology		
2.	Course Title (< 45 characters)	Mini Project (Textile Engineering)		
3.	L-T-P structure	0-0-8		
4.	Credits	4		
5.	Course number	TXD809		
6.	Status (category for program)	PE for M.Tech. (Textile Engineering) students		

7.	Pre-requisites (course no./title)	None		
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8.	Status vis-à-vis other courses (give course number/title)			
	8.1 Overlap with any UG/PG course of the Dept./Centre		No	
	8.2 Overlap with any UG/PG course of other Dept./Centre		No	
	8.3 Supersedes any existing course		None	

9.	Not allowed for (indicate program names)	Allowed for only M. Tech. (Textile Engineering) students
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10.	Frequency of offering	Every sem 1st sem 2nd sem Either sem - Either sem		
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11.	Faculty who will teach the course S. M. Ishtiaque, R. Chattopadhyay, B. K. Behera, R. Alagirusamy, R. S. Rengasamy, Apurba Das, Abhijit Majumdar, Amit Rawal, Dipayan Das			
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12.	Will the course require any visiting faculty? (yes/no)	No
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13.	Course objectives (about 50 words): The students are expected to design and develop a product or equipment or instrument in this project oriented course.
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14.	Course contents (about 100 words) (Include laboratory/design activities): This is an open ended course where the students are expected to design and develop a product or equipment or instrument relevant to the field of textile technology. In this process, the students are expected to demonstrate their ability to think on their own in design and development of hardware item. They are also expected to put down their thinking process in a report form with relevant literature background, methodology of design and development process and should have conducted some experiments with the developed hardware system. Finally, they need to present their work for the award of grade.
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15. Lecture Outline *(with topics and number of lectures)* None

Module no.	Topic	No. of hours

16. Brief description of tutorial activities: None

Module no.	Description	No. of hours

17. Brief description of laboratory activities:

Module no.	Description	No. of hours
1	Experimental work	112
COURSE TOTAL (14 times 'P')		112

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours

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19. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Research articles published in literature.
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20. Resources required for the course (*itemized & student access requirements, if any*)

20.1	Software	Existing soft wares in the department
20.2	Hardware	Existing products in labs or can be procured
20.3	Teaching aides (videos, etc.)	PPT
20.4	Laboratory	All textile labs
20.5	Equipment	All existing equipments
20.6	Classroom infrastructure	Lecture room with AV facility for regular interaction
20.7	Site visits	Not in particular
20.8	Others (please specify)	

21. Design content of the course (*Percent of student time with examples, if possible*)

21.1	Design-type problems	
21.2	Open-ended problems	
21.3	Project-type activity	
21.4	Open-ended laboratory work	100 %
21.5	Others (please specify)	

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department/Centre proposing the course	Department of Textile Technology
2.	Course Title (<i>< 45 characters</i>)	Modelling and Simulation in Fibrous Assemblies
3.	L-T-P structure	3-0-0
4.	Credits	3
5.	Course number	TXL700
6.	Status (<i>category for program</i>)	DE for B.Tech. (Textile Technology) students PE for M. Tech. (Textile Engineering) students PE for M. Tech. (Fibre Science & Technology) students

7.	Pre-requisites (course no./title)	TXL211/TXL221/TXL222/TXL231/TXL232 and EC 75 for UG students
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	No
8.2	Overlap with any UG/PG course of other Dept./Centre	No
8.3	Supersedes any existing course	TTL700

9.	Not allowed for (indicate program names)	No such restriction
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10.	Frequency of offering	☐ Every sem ☐ 1stsem ☒ 2ndsem ☐ Either sem
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11.	Faculty who will teach the course Amit Rawal, Abhijit Majumdar and Prabal Talukdar (Department of Mechanical Engineering, IIT Delhi)
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12.	Will the course require any visiting faculty? (yes/no)	No
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13.	Course objectives (<i>about 50 words</i>): The objective of the course is to familiarize the students with general understanding of various modelling and simulation techniques that are currently used for fibrous
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	assemblies. The students will be able to develop fundamental and empirical models based on the techniques covered in this course. They will also be able to optimize the structural and construction parameters of the fibrous assemblies for attaining the targeted properties.
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14.	Course contents (about 100 words) (Include laboratory/design activities): Introduction to textile modelling and simulation, Stochastic and Stereological Methods: Random fibrous assemblies, anisotropy characteristics in fibrous assemblies, two and three-dimensional fibrous assemblies; Neural Networks: Biological neural system, mathematical models of artificial neurons, Artificial Neural Network (ANN) architecture, Single and multi-layer perceptrons, Learning rules, Back propagation algorithm; Fuzzy Logic: Introduction to crisp and fuzzy sets, Operations of classical and fuzzy sets, Membership functions, Fuzzification, Fuzzy rule generation, Defuzzification; Genetic Algorithm (GA): Basics of GA, GA operators, Implementation of GA in fabric engineering; Curve Fitting Techniques: Prediction of mechanical properties of fibrous assemblies, process-structure-property relationship of fibrous structures. Computational modelling heat transfer in fibrous assemblies; Statistical Mechanics: Monte Carlo simulation of random fibrous assemblies, Multiscale Modelling: Geometrical modelling of textile structures.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Stochastic and Stereological Methods: Random fibrous assemblies, anisotropy characteristics in fibrous assemblies, two and three-dimensional fibrous assemblies.	4
2	Neural Networks: Biological neural system, mathematical models of artificial neurons, ANN architecture, single and multi-layer perceptrons, learning rules, back propagation algorithm, Applications of artificial neural networks in fibre, yarn and fabric modelling, sensitivity analysis.	5
3	Fuzzy Logic: Introduction to crisp and fuzzy sets, concepts of uncertainty and imprecision, operations of classical and fuzzy sets; Introduction to fuzzy logic, membership functions, fuzzification, fuzzy rule generation, defuzzification, different methods of defuzzification; Applications of fuzzy logic in yarn and fabric modelling.	4
4	Genetic Algorithm: Overview, GA vs traditional optimization, fitness function, GA operators, selection, crossover, mutation; Penalty function approach, bracket operator,	2
5	Curve Fitting Techniques: Linear and nonlinear curve fitting techniques, Prediction of mechanical properties of fibrous assemblies,	3

	process-structure-property relationship of fibrous structures.	
6	Computational Fluid Dynamics: Introduction to Finite Difference, Finite Element and Finite Volume Techniques, Newtonian and Non-Newtonian Fluids and their applications in extrusion processes, Computer simulation of fluid flows through porous materials, heat and mass transfer in fibrous assemblies.	5
7	Statistical Mechanics: Monte Carlo simulation of random fibrous assemblies	3
8	Multiscale Modelling: Geometrical modelling of textile structures, Prediction of properties of fibrous assemblies using Matlab®	2
COURSE TOTAL (14 times 'L')		28

16. Brief description of tutorial activities: Not applicable

Module no.	Description	No. of hours

17. Brief description of laboratory activities

Module no.	Description	No. of hours
1.	Developing ANN models for simple logic gates.	2
2.	Studying the effect of leaning parameters and network structure on the prediction accuracy of ANN using MATLAB.	2
3.	Developing a practical model for strength prediction of yarn/ woven fabric/ nonwoven fabric using MATLAB.	2
4.	Developing a simple fuzzy inference system and understanding the processes of fuzzification, fuzzy rules, aggregation and defuzzification using MATLAB.	2
5.	Developing a fuzzy inference system for fibrous assemblies.	2
6.	Optimization using Genetic algorithm	2
7.	To solve heat and mass transfer & revealing anisotropic characteristics of fibrous assemblies	2
8.	To simulate random fibrous assemblies using Monte Carlo simulation techniques	2
9.	To develop and simulate geometrical models of various textile structures using Matlab®	2
10.	To predict the mechanical properties of fibrous assemblies using curve fitting techniques	2

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours
1	Principles of Stereological methods	4
2	Levenberg-marquardt algorithm for ANN training	4
3	Hybrid soft computing systems, Adaptive network based fuzzy inference system and its application in yarn and fabric property modelling.	4
4	Multi-objective optimization; Application of genetic algorithm for multi-objective optimization, penalty function.	4
5	Basics of theory of fibre-to-fibre contacts and their relationship with the properties of fibrous assemblies	4
6	Principles of Conservation; Conservation of mass and momentum; fundamentals of discretization: Finite element and finite volume methods	4
7	Mesoscale modelling and other unit cell approaches	4
	Total	28

19. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1)	Bird, Byron, R. (1977), <u>Dynamics of Polymeric liquids</u> , John Wiley & Sons, New York, 214.
2)	Hirsch, C. (1988), <u>Numerical Computation of External and Internal Flows</u> , Vol.1, John Wiley & Sons, New York.
3)	Chung, T.J. (1978), <u>Finite Element Analysis in Fluid Dynamics</u> , McGraw-Hill, New York. L.Ames, Andrea (1997), <u>VRML 2.0 Sourcebook</u> , 2 nd edition, John Wiley & Sons, New York.
4)	Kendall, M.G. and Moran, P.A.P (1963), <u>Geometrical Probability</u> , Charles and Griffin Co. Ltd., London.
5)	Hilliard, J.E. (2003), <u>Stereology and Stochastic Geometry</u> , Kluwer Academic Publishers, Boston.
6)	Binder, K. and Heermenn, D.W. (1997), Monte Carlo Simulation in Statistical Physics: An Introduction, Springer Verlag, Berlin.
7)	Kartalopoulos, Understanding Neural Networks and Fuzzy Logic: Basic Concepts and Applications, Prentice-Hall of India Pvt. Ltd.
8)	Rajasekaran and Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications, Prentice-Hall of India Pvt. Ltd.

- 9) Zimmerman, Fuzzy Set Theory and its Applications, 2nd Edition, Allied Publishers Limited.
- 10) Berkan, and Trubatch, Fuzzy Systems Design Principles, Standard Publishers Distributors.
- 11) Bector, and Chandra, Fuzzy Mathematical Programming and Fuzzy Matrix Games, Springer publisher.

Resources required for the course (*itemized & student access requirements, if any*)

20.1	Software	Matlab 7, Statistica neural network, GAMBIT (Computer Aided Design software package), FLUENT (Computational Fluid Dynamics software)
20.2	Hardware	None
20.3	Teaching aides (videos, etc.)	PPT
20.4	Laboratory	Nil
20.5	Equipment	None
20.6	Classroom infrastructure	Lecture room with AV facility
20.7	Site visits	None
20.8	Others (please specify)	Nil

21. Design content of the course (*Percent of student time with examples, if possible*)

21.1	Design-type problems	20%
21.2	Open-ended problems	
21.3	Project-type activity	20%
21.4	Open-ended laboratory work	0%
21.5	Others (please specify)	0%

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Department of Textile Technology		
2.	Course Title (< 45 characters)	Theory of Yarn Structure		
3.	L-T-P structure	3-0-0		
4.	Credits	3		
5.	Course number	TXL721		
6.	Status (category for program)	PC for M.Tech. (Textile Engineering) students		

7.	Pre-requisites (course no./title)	None		
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8.	Status vis-à-vis other courses (give course number/title)			
	8.1 Overlap with any UG/PG course of the Dept./Centre		No	
	8.2 Overlap with any UG/PG course of other Dept./Centre		No	
	8.3 Supersedes any existing course		TTL721	

9.	Not allowed for (indicate program names)	Allowed for only M. Tech. (Textile Engineering) students
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10.	Frequency of offering	Every sem 1st sem 2nd sem Either sem - 1st sem		
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11.	Faculty who will teach the course S. M. Ishtiaque, R. Chattopadhyay, Dipayan Das
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12.	Will the course require any visiting faculty? (yes/no)	No
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13.	Course objectives (about 50 words): To provide students with in-depth understanding of the theoretical analysis of yarn structure and its response to mechanical deformations.
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14.	Course contents (about 100 words) (Include laboratory/design activities): General description of yarn structure, Fibre packing arrangement in yarns, Fibre directional arrangement in yarns, Geometry of pores in yarns, Relationship among yarn count, twist, and diameter, Helical model of fibers in yarns, Yarn retraction, Limits of twisting, Radial migration of fibers in yarns, Model of ideal fibre migration, Model of equidistant migration, Tensile mechanics of yarns, Yarn tensile behavior in light of helical model, Relationship between tensile behaviors of fiber and yarn, Yarn strength as a function of gauge length, Bending mechanics of yarns, Mass unevenness of yarns, Martindale's model of mass irregularity, Model of hierarchical structure of fibre aggregates, Hairiness of staple fiber yarns, Single- and double-exponential models of yarn hairiness, Structure and mechanics of plied yarns.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	General description of yarn structure Concept of fibre element, Position of fibre element, Directional angles and angles of projection, Directional characteristics of fibre elements, Description of fibre paths in yarn, Axial, radial, and angular arrangements of fibre path, Stochastic fibre path, or deterministic fibre path, Fibre path based classification of structural models of yarns	3
2	Fibre packing arrangement in yarns Concept of fibre packing density, Model of fibre packing arrangement in yarn, Method of evaluation of fibre packing density, Algorithm for determination of fibre packing density, Fiber packing in different yarns, Influence of yarn twist and count on packing density, Role of packing density on yarn properties.	3
3	Fibre directional arrangement in yarns Concept of fibre orientation, Model of fibre orientation in yarn, Method of evaluation of fibre orientation in yarn, Fiber orientation in different yarns, Influence of yarn twist and count on fibre orientation, Role of fibre orientation on yarn properties.	3
4	Geometry of pores in yarns Concept of pore, Characteristics of pores, Relationship between fibre characteristics and pore geometry, Generalized pore structure, Role of fibre geometry and yarn parameters on pore geometry, Influence of pore structure on fluid flow and wicking in yarns.	3
5	Yarn count, twist, and diameter Koechlin's model of yarn count, twist, and diameter, Application of results, Empirical corrections, Theoretical determination of yarn twist, and diameter, Role of twist on yarn characteristics,	3

	Snarling.	
6	Helical model of fibres in yarns Basic assumptions, Concept of differential layer, Determination of number of fibres in yarn cross-section, Yarn retraction, Limits of yarn twisting, Hypothesis of neutral radius, Hypothesis of constant fibre volume, Hypothesis of zero axial force, Comparison of hypotheses.	4
7	Radial fiber migration in yarns Idealized fibre path in yarn, Fundamental equation of ideal fibre migration, Approximated equation of ideal fibre migration, Modification to idealized fibre path in yarn, Characteristics of migration, Mechanisms of migration.	4
8	Tensile mechanics of yarns Failure mechanisms of different technological yarns, Yarn tensile behavior in light of helical model, Relationship between tensile behaviours of fibre and yarn, Yarn strength as a function of gauge length.	6
9	Bending mechanics of yarn Geometry of bent yarn, Relationship between bending behaviors of fiber and yarn, Contribution of fibre torque to bending moment of yarn, Bending rigidity of yarn.	3
10	Mass unevenness of yarns Martindale's model of mass irregularity, Index of irregularity, Idea of fibre bundles and clusters, Model of hierarchical structure of fibre aggregates, Mass unevenness of different yarns.	4
11	Hairiness of staple yarns Sphere of yarn hairiness, Exponential model of yarn hairiness, Structural interpretation of long and short hairs in yarns, Hairiness of different yarns.	4
12	Structure and mechanics of plied yarns Geometry of multi-ply yarns, Idea of doubly-would helix, Retraction of single and plied yarns, Relationship between twists in single and plied yarns, Stress-strain behaviour of plied yarns.	3
COURSE TOTAL (42 times 'L')		42

16. Brief description of tutorial activities: None

Module no.	Description	No. of hours

17. Brief description of laboratory activities: None

Module no.	Description	No. of hours

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours
1	General description of yarn structure Numerical problems, Reading research papers, Writing case studies.	3
2	Fibre packing arrangement in yarns Numerical problems, Reading research papers, Writing case studies.	3
3	Fibre directional arrangement in yarns Numerical problems, Reading research papers, Writing case studies.	3
4	Geometry of pores in yarns Numerical problems, Reading research papers, Writing case studies.	3
5	Yarn count, twist, and diameter Numerical problems, Reading research papers, Writing case studies.	3
6	Helical model of fibres in yarns Numerical problems, Reading research papers, Writing case studies.	4
7	Radial fiber migration in yarns Numerical problems, Reading research papers, Writing case studies.	4
8	Tensile mechanics of yarns Numerical problems, Reading research papers, Writing case studies.	6
9	Bending mechanics of yarn Numerical problems, Reading research papers, Writing case studies.	3
10	Mass unevenness of yarns	4

	Numerical problems, Reading research papers, Writing case studies.	
11	Hairiness of staple yarns Numerical problems, Reading research papers, Writing case studies.	4
12	Structure and mechanics of plied yarns Numerical problems, Reading research papers, Writing case studies.	3

19. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

J. W. S. Hearle, P. Grosberg, S. Backer, Structural mechanics of fibers, yarns, and Fabrics, Wiley-Interscience, New York – London – Sydney – Toronto, 1969.

W. Zurek, The structure of yarn, US Department of Agriculture and the National Science Foundation, Washinton, D. C., Warsaw, Poland, 1975.

P. Schwartz, Structure and Mechanics of textile fibrous assemblies, Woodhead Publishing Ltd., Ltd., UK, 2008.

B. Neckář and D. Das, Theory of structure and mechanics of fibrous assemblies, Woodhead Publishing India Pvt. Ltd., 2012.

20. Resources required for the course (*itemized & student access requirements, if any*)

20.1	Software	None
20.2	Hardware	None
20.3	Teaching aides (videos, etc.)	Chalkboard/Whiteboard, Tablet-PC, Laptop
20.4	Laboratory	None
20.5	Equipment	None
20.6	Classroom infrastructure	Lecture room with AV facility
20.7	Site visits	None
20.8	Others (please specify)	None

21. Design content of the course*(Percent of student time with examples, if possible)*

21.1	Design-type problems	15 %
21.2	Open-ended problems	15 %
21.3	Project-type activity	20 %
21.4	Open-ended laboratory work	
21.5	Others (please specify)	

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department/Centre proposing the course	Department of Textile Technology
2.	Course Title (<i>< 45 characters</i>)	Mechanics of Spinning Processes
3.	L-T-P structure	3-0-0
4.	Credits	3
5.	Course number	TXL722
6.	Status (<i>category for program</i>)	PC for M. Tech. (Textile Engineering) students

7.	Pre-requisites (course no./title)	None
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	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	Nil
8.2	Overlap with any UG/PG course of other Dept./Centre	Nil
8.3	Supersedes any existing course	TTL722

9.	Not allowed for (indicate program names)	Allowed for only M. Tech. (Textile Engineering) students
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10.	Frequency of offering	Every sem 1 st sem 2 nd sem Either sem - 1st sem
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11.	Faculty who will teach the course S. M. Ishtiaque, R. Chattopadhyay, R. Alagirusamy, R. Rengasamy, Apurba Das, Abhijit Majumdar, Dipayan Das	
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12.	Will the course require any visiting faculty?	No
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13.	Course objective (about 50 words): After attending the course the student will be able to - To analyse various processes involved in yarn manufacturing in greater depth. - To be able to diagnose the causes of various process related problems and faults.
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14.	Course contents (about 100 words) (Include laboratory/design activities): Principles of bale management. Forces acting on fibres during opening and cleaning, analysis of fibre compactness and blending in blowroom. Carding process, cylinder load and transfer efficiency, design of high production card, fibre shedding and card wire geometry, fibre configuration in card and drawn sliver. Fibre movement in drafting field, drafting wave, drafting force, roller slip, roller eccentricity and vibration, autolevelling. Fibre fractionation in comber, combing performance. Analysis of forces on yarn and traveler, spinning tension in ring and rotor spinning, spinning geometry, twist flow in ring and rotor spinning, end breaks. Mechanism of drafting and yarn formation in high speed spinning systems.
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15.	Lecture Outline (with topics and number of lectures)	
Module no.	Topic	No. of hours
1	Bale management and lot management, random picking and frequency relative picking, application of fibre quality index and spinning consistency index, Premium discount index in bale management	3
2	Opening and cleaning in blowroom, fibre compacting in chute feed system, concepts of modern openers, intensity of opening and relative amount of waste, Vario-set principle.	3
3	Blending delay time in multimixer, concept of stabilized blending delay time and its implication on quality, Dilute blending.	3
4	Theories of carding, transient state of carding machine, cylinder load, transfer coefficient and average number of revolution of fibre on cylinder, fibre mixing in carding; Design aspect of high performance card and it's significance	3
5	Fibre shedding from cylinder, effect of centrifugal force and air drag, role of wire geometry on fibre shedding, carding force between cylinder and flat and factors influencing it, hook formation in carding.	3
6	Drafting theory, analysis of fibre movement in drafting zone, normal shear and deviation from normal shear, drafting force and parameters influencing it, roller nip movement and its implication on quality	3

7	Autolevelling, over and under correction, early and late levelling, delay time of autoleveller, effect of break draft and roller setting on optimum delay time	3
8	Boundary length in forward and backward feed comber, probabilistic concepts for incorporation of fibre in noil or sliver, action of top comb, wavelength of piecing wave, differential combing, effect of batt weight in combing, probabilistic model for calculation of comber noil and effective noil removal.	3
9	Spinning geometry and its significance, spinning tension, Theory of formation of yarn balloon, balloon stability, ring spinning from sliver, limitation of ring-can system	3
10	Rotor spinning, fibre flux, fibre overlap and gap of fibre layer in rotor groove, change in fibre orientation in rotor spinning, generation of wrapper fibres	3
11	Air-jet and vortex technologies, role of edge fibres, high speed and high draft systems and its implication of yarn quality	3
12	Friction spinning, fibre arrangement in friction spun yarns, principles of yarn formation, torque on yarn, Composite yarn spinning in friction spinning, calculation for yarn count adjustments, possibilities and limitations,	3
13	Mechanism of end breaks in ring and rotor spinning, probability model of end breaks, roller lapping and its prevention, aprons and cots.	3
14	Basics of simulation, random number generation, application in spinning process	3
		42

16.	Brief description of tutorial activities: Not applicable
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17.	Brief description of laboratory activities: Not Applicable
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18.	Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)
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Module no.	Description	No. of hours
1	Blend parameters, Index of blend irregularity (IBI), Influence of blending technique on blend parameters and IBI.	3
2	Modern developments in blowroom machines, contamination removal in blowroom by imaging techniques	3
3	Use of AFIS for optimizing the blowroom process parameters	3

4	Processing of sticky cotton in blowroom and carding, processing of microdenier fibre in carding.	3
5	Marcov chain analysis for the fibre transfer between cylinder and flat	3
6-7	Fibre straightening and hook removal through drafting operation.	3
8	Analysis of mass profile of detached combed fringe	3
9	Air drag in ring spinning	3
10	Effect of opening roller and rotor speed on yarn properties	3
11-12	Compact spinning, migration in compact spun yarns	6
13	Apron slippage and process parameters influencing it.	3
14	Application of Crystal ball/ Matlab for solving simulation problem in spinning	6
	TOTAL	42

19.	Suggested texts and reference materials: - Fundamentals of spun yarn technology by C. Lawrence, CRC press. - Technology of carding by R. Chattopadhyay (NCUTE) - Advances in technology of yarn production by R. Chattopadhyay (NCUTE) - Open end spinning by R. Nield, Textile Institute monograph series, 1975 - Yarn Production, Theoretical aspects by P. Grosberg and C. Iype, The Textile Institute, 1999 - The principles and theory of ring spinning, A. E. De Barr, and H. Catling, Manual of cotton spinning Vol 5, The textile Institute, Manchester 1965	
20.	Resources required for the course (<i>itemized & student access requirements, if any</i>)	
20.1	Software	Crystal ball software for simulation
20.2	Hardware	None
20.3	Teaching aides (videos, etc.)	PPT
20.4	Laboratory	Nil
20.5	Equipment	None
20.6	Classroom infrastructure	Lecture room with AV facility
20.7	Site visits	None

21.	Design content of the course <i>(Percent of student time with examples, if possible)</i>	
21.1	Design-type problems	10%
21.2	Open-ended problems	15%
21.3	Project-type activity	15%
21.4	Open-ended laboratory work	0%
21.5	Others (please specify)	0%

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE(DRAFT)

1.	Department /Centre proposing the course	Department of Textile Technology
2.	Course Title (< 45 characters)	Mechanics of Spinning Machines
3.	L-T-P structure	3-0-0
4.	Credits	3
5.	Course number	TXL725
6.	Status (category for program)	PC for M.Tech. (Textile Engineering) students DE for B.Tech. (Textile Technology) students

7.	Pre-requisites (course no./title)	TXL221/TXL222 and EC75 for UG students
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8.	Status vis-à-vis other courses (give course number/title)	
8.1	Overlap with any UG/PG course of the Dept./Centre	No, 5% with TXL222
8.2	Overlap with any UG/PG course of other Dept./Centre	No, 20% with MEL311; 10% with MEL417
8.3	Supersedes any existing course	TTL725

9.	Not allowed for (indicate program names)	No such restriction
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☒ 2 nd sem ☐ Either sem
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11.	Faculty who will teach the course Apurba Das, R. S. Rengasamy, R. Alagirusamy, S. M. Ishtiaque, R. Chattopadhyaya, Abhijit Majumdar, Dipayan Das	
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12.	Will the course require any visiting faculty?	No
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13.	Course objective (about 50 words): Students will learn about spinning machine elements and their design aspects,	
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	drive and issues related to their selection
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14.	Course contents <i>(about 100 words) (Include laboratory/design activities):</i> Drive systems, belt drives, belt tensions, power transmission, variable, PIV and reversing drives. Polygonal effect in chain drives. Gear types, design aspects, interference and periodic faults, thrust loads and elimination, gear selection, planetary gear trains in spinning machines. Design of cone pulleys, design of transmission shafts and drafting rollers-materials, design against torsional & lateral rigidity. Clutches and brakes – design, torque transmission capacity, applications in textile machines, bush bearings-theory of lubrication, Rolling contact bearings in textile machines. Machine balancing – static, couple, dynamic unbalance, balancing of cylinder-plane transposition, practical aspects of balancing. Cams in roving and ring spinning machines.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction to drives and machine elements, Characteristics & selection of drives.	1
2	Flat belt- belt tensions, maximizing power transmission, V belt- force analysis, Round belt drive in friction spinning machine; Reversing, variable speed and special purpose drives in spinning machines- clutching action; PIV drive, cone and stepped pulleys; Methods of adjustment of belt tensions; Toothed belt drives- characteristics; Tapes, Comparison, selection and applications of belt drives in spinning machines.	4
3	Chain drives:- types, construction, lubrication, chain tension and bending force on shaft, polygonal effect, Selection and applications of chain drives in spinning machines.	2
4	Spur gears:- Design aspects, conjugate action; involute tooth; Interference & - periodic faults in fibre assemblies in roller drafting, Elimination of interference; Internal gears & rack and pinion gears; Force analysis- position of idler gears in headstock of spinning machines, torque and power transmission; Lubrication.	3
5	Parallel helical gears- geometry, hand notation, force analysis; thrust loads, Crossed helical gears- elimination of thrust loads for driving bobbins and flyers; Various bevel gears, Worm gears- terminology, single and double envelop worms; Characteristics, selection & applications of gears in textile	3

	machines.	
6	Planetary gear trains:- methods of speed calculation; Degrees of freedom; Planetary gear trains in roving machine- bobbin diameter and speeds of bobbin, roving stretch & slackness, relation between the speeds of bobbin and bottom cone pulley, Planetary gear train in combing machine- motion of detaching roller, control of web movement.	4
7	Cone pulleys in roving machine- design aspects, hyperbolic and straight cone pulleys, shifting of belt, belt slippage and corrections for belt position, belt shifting mechanism for straight cone pulleys, finer adjustment of belt shifting; Cone pulleys for piano-feed regulation in lap former.	2
8	Transmission shafts and drafting rollers: material properties; factor of safety and allowable stress; tensile, shear, bending and torsional stresses; Design of transmission shaft- against static load, maximum shear stress theory of failure,, design for torsional and lateral rigidity; Design of bottom drafting rollers- design and processing perspectives, design against torsional and lateral rigidity.	4
9	Clutches:- Mechanical lockup clutches- characteristics, applications in card, sliver doubling, roving and ring spinning machines; Friction clutches- single disk, torque transmitting capacity- theory of uniform pressure and wear, delayed start of drafting in ring spinning; Multi disk friction clutch- bale opener, Cone clutches- bobbin carriage; Centrifugal clutches- principle, applications.	3
10	Brakes:- Mechanical brakes- block brake with short shoe, analysis of forces acting on drum, Block brake in lap former; pivoted block brake with long shoe, spindle brake; differential band brake; disk brakes; Non-friction brakes; disc clutch and disc brakes, hysteresis clutch and brake, applications.	3
11	Bearings:- Sliding contact bearings-types, theory of lubrication, friction in bearings, Rolling contact bearings- ball, needle and roller bearings, Self-aligning, thrust bearings, bearing selection for various drives, static load and dynamic capacity, equivalent bearing load, load-life relationship, Applications of bearings in spinning machines.	4
12	Balancing of machines:- Unbalance, imaginary heavy spot and centrifugal force, relating unbalance to vibrations; static balancing; types of unbalance, dynamic unbalance- opening and cleaning roller, winding drum, balancing of card cylinder; trial weights; run out; unbalance due to eccentricity in	4

	mounting shaft and non-uniform mass distribution of rotor; dynamic balancing of single and multi-plane rotors; practical aspects of balancing during maintenance.	
13	Cams:- Design of cams for yarn winding in ring spinning and belt shifting in roving machines	2
14	Air drag forces-fibre opening & transportation, Curved path of fibres & roller offset in roller drafting, mechanism of nipper movement & intermittent motion to planetary gears in comber	3
	COURSE TOTAL (<i>42 times 'L'</i>)	42

16. Brief description of tutorial activities

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17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours
1.	Study different types of planetary gears and related calculations	10
2.	Power transmission through different types of gears and belts with related numerical	8
3.	Latest developments of clutches and brakes and power transmission calculations.	6
4.	Designing of cams for different types of motions.	10
5.	Geometry of spur gear, helical gear, worm & worm wheel etc. related calculations	8

19.	Suggested texts and reference materials: Mechanics of Spinning Machines, R. S. Rengasamy, NCUTE, New Delhi, 2002. Manual of Textile Technology: A Practical Guide to Combing and Drawing, Vol.
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	3, W. E. Klein, The Textile Institute, Manchester, 1987. Design of machine Elements, V. B. Bhandari, Tata McGraw-Hill, New Delhi, 1994. Machine Design, Mubeen, Khanna Publishers, Delhi, 1998. Machinery Vibration: Balancing, Victor Wowk, McGraw-Hill, Inc. New York, 1995. Machine Design: An Integrated Approach, Robert L. Norton, Prentice-Hall, New Jersey, 1996. NPTEL Course material.
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20. Resources required for the course *(itemized & student access requirements, if any)*

20.1	Software	NPTEL web site
20.2	Hardware	None
20.3	Teaching aides (videos, etc.)	Blackboard, PPT, Animation, videos
20.4	Laboratory	Yarn manufacture Laboratory
20.5	Equipment	None
20.6	Classroom infrastructure	Lecture room with AV facility
20.7	Site visits	None

20. Design content of the course *(Percent of student time with examples, if possible)*

21. 1	Design-type problems	50%
21. 2	Open-ended problems	10%
21. 3	Project-type activity	10%
21. 4	Open-ended laboratory work	10%
21. 5	Others (please specify)	-

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Department of Textile Technology
2.	Course Title (<i>< 45 characters</i>)	Theory of Fabric Structure
3.	L-T-P structure	3-0-0
4.	Credits	3
5.	Course number	TXL731
6.	Status (<i>category for program</i>)	PC for M. Tech. (Textile Engineering) students

7.	Pre-requisites (<i>course no./title</i>)	None
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	Nil
8.2	Overlap with any UG/PG course of other Dept./Centre	Nil
8.3	Supersedes any existing course	No

9.	Not allowed for (<i>indicate program names</i>)	Allowed for only M. Tech. (Textile Engineering) students
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10.	Frequency of offering	☐ Every sem ☒ 1st sem ☐ 2nd sem ☐ Either sem
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11.	Faculty who will teach the course B.K. Behera, Abhijit Majumdar, Amit Rawal, Dipayan Das
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12.	Will the course require any visiting faculty? (yes/no)	No
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13.	Course objectives (about 50 words): The objective of the course is to familiarise the students with general understanding of structure-property relationships of various types of fabrics. The students will be able to optimise various structural and construction parameters of fabrics in order to attain the targeted properties.
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14.	Course contents (about 100 words) (Include laboratory/design activities): Engineering approach to fabric formation. Fibre, yarn and fabric structure- property relationships. Crimp interchange in woven fabric. Elastica model for fabric parameters and crimp balance. Concept of fabric relaxation and set. Practical application of geometrical and elastica models, Uniaxial and biaxial tensile deformation of woven fabric. Bending deformation of woven fabric, bending behaviour of set and unset fabrics and bending in bias direction. Bending, Shear and drape properties of woven fabric. Buckling and compressional behaviour of woven fabrics. Mathematical models and their application in the study of tensile, bending, shear, compressional and buckling deformation of woven fabrics. Structure and properties of knitted fabrics, Structure-property relationship of nonwoven fabrics, Mechanical behavior of braided structures.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Geometry of woven fabrics, jamming conditions, calculation of constructional parameters for non-circular yarn cross-sections (elliptical, racetrack, lenticular)	4
2	Shrinkage and their mechanisms in woven fabrics, relaxed fabric and its calculations, crimp interchange, maximum fabric cover, weavability limit, calculation of tightness	4
3	Pierce Rigid model, equation of yarn path in woven fabrics, introduction to elastica, crimp balance equation	3
4	Geometrical changes during extension, biaxial tensile loading, saw-tooth model	4
5	Modelling of bending rigidity, clustering ratio, bending hysteresis, bending in the bias direction	3
6	Buckling deformation of woven fabric, Euler's buckling Column theory, fractional compression, shortening of gauge length	4
7	Pure shear, simple shear, calculation of shear parameters, shear hysteresis, initial shear behaviour of plain woven fabrics, drape of woven fabrics, drape parameters, factors influencing drape coefficients	5
8	Compression behaviour of woven fabrics, low stress compression characteristics, predicting compression behaviour	3

	of woven fabrics	
9	Theory of fibre-to-fibre contacts and its applications to various textiles structures, number of contacts and its relationship with mechanical behaviour	3
10	Overview of geometrical properties of nonwovens, tensile behaviour of thermally, spunbonded and needlepunched nonwovens, compression properties of nonwovens	3
11	Structure-property relationship of warp and weft knitted fabrics, energy and force methods for prediction of tensile properties of knitted fabrics	3
12	Introduction to braids, braid architecture, tensile properties of biaxial and triaxial braided structures, structural mechanics of multi-layered braided structures	3
COURSE TOTAL		42

16. Brief description of tutorial activities: Not applicable

Module no.	Description	No. of hours

17. Brief description of laboratory activities: Not Applicable

Module no.	Description	No. of hours

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours
1	Peirce flexible thread model, Geometry of Non-plain woven fabrics	4
2	Geometry of woven fabrics after physical/chemical modifications, mechanism of woven fabric shrinkage	4

3	Fundamentals of theory of elasticity and their applications	3
4	Load-extension behaviour of woven fabrics, Castigliano's theorem and their applications	4
5	Bending behaviour of plain woven fabrics, Beam-bending theory	3
6	Buckling of Elastic Materials	4
7	Fundamentals of shear deformations, nature of shear, two- and three-dimensional drape characteristics of woven fabrics	5
8	Fundamentals of compression deformations, General response of fabric to compression load	3
9	Structural arrangement of fibres in fibrous assemblies	3
10	Introduction to nonwovens, structure-property relationships	3
11	Basics of knitted fabrics, structural analysis, loop models	3
12	Process-structure-property of braided fabrics	3
Total		42

19. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

- i. Hearle JWS, Grosberg P and Backer S. Structural mechanics of fibers, yarns and fabrics. New York: Wiley- Interscience, 1969.
- ii. Peirce FT, Womersley JR. Cloth Geometry, Journal of the Textile Institute Transactions, 1937, pp. T45- T112.
- iii. Behera, BK., Hari, PK.: Woven textile structure, Theory and applications, Woodhead Publishing Limited, 2010.
- iv. Hearle JWS, Amirbayat J, Twaites JJ, Ed. Mechanics of flexible fibre assemblies. Alphen aan den Rijn: Sijthoff and Nordhof, 1980.
- v. Neckar B., and Ibrahim S, Structural Theory of Fibrous Assemblies and Yarns, Technical University of Liberec, 2003.
- vi. Van Wyk, C.M., Note on compressibility of wool, Journal of Textile Institute, 37, T285-T292 (1946).

20. Resources required for the course *(itemized & student access requirements, if any)*

20.1	Software	WiseTex®
20.2	Hardware	None
20.3	Teaching aides (videos, etc.)	PPT

20.4	Laboratory	Nil
20.5	Equipment	None
20.6	Classroom infrastructure	Lecture room with AV facility
20.7	Site visits	None
20.8	Others (please specify)	

21. Design content of the course *(Percent of student time with examples, if possible)*

21.1	Design-type problems	15%
21.2	Open-ended problems	10%
21.3	Project-type activity	15%
21.4	Open-ended laboratory work	0%
21.5	Others (please specify)	0%

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Department of Textile Technology
2.	Course Title (< 45 characters)	Advanced Fabric Manufacturing Systems
3.	L-T-P structure	3-0-0
4.	Credits	3
5.	Course number	TXL 732
6.	Status (category for program)	PC for M.Tech. (Textile Engineering) students

7.	Pre-requisites (course no./title)	None
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8.	Status vis-à-vis other courses (give course number/title)	
8.1	Overlap with any UG/PG course of the Dept./Centre	No
8.2	Overlap with any UG/PG course of other Dept./Centre	No
8.3	Supersedes any existing course	TTL 732

9.	Not allowed for (indicate program names)	Allowed for only M. Tech. (Textile Engineering) students
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10.	Frequency of offering	☐ Every sem ☐ 1stsem ☐ 2ndsem ☐ Either sem - 2 nd sem
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11.	Faculty who will teach the course B. K. Behera, Abhijit Majumdar, Amit Rawal
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12.	Will the course require any visiting faculty? (yes/no)	No
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13.	Course objectives (about 50 words): The objective of this course is to familiarize the students with manufacturing systems, recent developments and applications of various nonconventional fabrics mostly used for technical applications.
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14.	Course contents (about 100 words) (Include laboratory/design activities): Fabric manufacturing systems, Yarn quality and weavability, Yarn Preparation for High speed weaving, Preparation of high performance fibres/tows for weaving, Sizing of filament yarn, Shuttle less weaving systems: Advancements in each system with respect to productivity, yarn characteristics and fabric quality, energy requirement, design flexibility, applications and limitations, Specialty weaving: 3D weaving, Multilayer weaving, Spacer weaving, Profiled weaving, Polar and Spiral fabric, Circular Weaving, Honeycomb weaving, Denim manufacturing, Multiaxial weaving, Multiphase weaving, Terry weaving, Leno Weaving, Filament Weaving, Properties and applications of fabrics produced in these systems. Weft and warp knitted structures for technical applications, Braiding ; biaxial and triaxial braids, 3D braiding, Structure, properties and applications of braided fabrics, Developments in nonwoven technologies, Stitch bonding methods, Nonwoven composite fabrics, Electrospinning, 3D nonwovens
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15. Lecture Outline (with topics and number of lectures)

Module no.	Topic	No. of hours
1	Introduction to Fabric Manufacturing Systems	2
	Fabric Manufacturing Systems, Mechanism of fabric formation in weaving, knitting, nonwoven, braiding, lacing and netting, Comparative Analysis of technological potential and limitations of each system.	
2	Advancements in yarn preparation	5
	Yarn Quality and Weavability, Yarn Preparation for High speed weaving, Control systems in warping, Wet sizing, Control of squeeze pressure, concentration, add-on and drying temperature, Sizing-weaving curve, Size recipe formulation for various fibres, yarns and fabric constructions	
3	Preparation of High performance yarns/Tows	2
	Sizing of filament yarn, size recipe, application, tension control, weavability evaluation, Package formation and Preparation of filament yarn and tow for industrial fabrics	
4	Developments in Shuttleless weaving Technologies	6
	Shuttle less weaving systems; Advancements in each system with	

	respect to productivity, yarn characteristics and fabric quality, energy requirement, noise and waste, design flexibility, Automations and control systems in modern weaving machines, E-shedding, applications and limitations, Electronic Dobby and Jacquard, Shedding principle and advantages, Principle of design development by CAD	
5	Specialty weaving Specialty weaving; 3D weaving, Multilayer weaving, Noobing, Spacer weaving, Profiled weaving, Polar and Spiral fabric, Various 3D structures, properties and applications, Circular Weaving, classification, small and large diameter machine, mechanical and electromagnetic shuttle drive systems, design and technological problems, weave design and applications of circular fabrics	5
6	Pile fabrics Terry weaving, Phases of the pile formation on terry weaving machine ,classification of terry fabric, warp and filling pile, 3,4,5 pick terry, cut and loop piles, single and both sided pile, Properties and applications of terry fabric, Carpet weaving, Types of carpet; woven, needlefelt, knotted,cut pile, Saxony, velvet,frieze, loop pile, Flocking, Method of production, Applications	4
7	Denim manufacturing Denim manufacturing, Indigo dyeing and sizing, slasher and rope system,classification and construction of denim, Stretch denim, Denim finishing processes, Applications	2
8	Multiaxial and Multiphase weaving Multiaxial weaving, Multiweave concept , Multiweave machine, shed formation, bias yarn feeding and criss-crossing , weft insertion mechanism, Fabric properties and applications, Multiphase weaving, Phase number, warp and weft way shed formation, weft insertion and selvage formation, Limitations of multiphase weaving	2
9	Leno weaving Leno weaving, Harness requirement, single and double leno concept, structure properties of leno fabrics, Applications of leno structures	1
10	Narrow weaving Narrow weaving, Needle weaving machine, yarn preparation, selvage formation, finishing treatment, Safety belt , classification, Production method, finishing treatment, properties	2
11	Developments in Knitting Weft and warp knitted structures for technical applications, intelligent yarn delivery systems in weft knitting, weft knitted structures for moisture management and sound absorption,	4

	Sliver or high-pile knitting, Warp knitted structures, Warp knitted fabric with inlay thread, spacer fabric production on both weft and warp knitting	
12	Braiding Braiding ; Classification of braided structure, biaxial and triaxial braids, 2D and 3D braiding, flat and circular braided Structure, properties and applications of braided fabrics	3
13	Developments in Nonwoven Nonwoven: Stitch bonding methods , Malimo, Maliwatt, Malivlies, Kunit and Voltex system, Nonwoven composite fabrics, Coform Technology, SMS, SMMS and SSMMS, Electrospinning, 3D nonwovens	4
COURSE TOTAL (42 times 'L')		42

16. Brief description of tutorial activities: None

Module no.	Description	No. of hours

17. Brief description of laboratory activities : None

Module no.	Description	No. of hours

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours
1	Introduction to Fabric Manufacturing Systems	2
	Preparation of a term paper	
2	Advancements in yarn preparation	5
	Preparation and presentation of term paper	
3	Preparation of High performance yarns/Tows	2
	Preparation and presentation of term paper	
4	Developments in Shuttleless weaving Technologies	5
	Preparation and presentation of term paper	
5	Specialty weaving	5
	Preparation and presentation of term paper	
6	Pile weaving	4
	Preparation and presentation of term paper	
7	Denim manufacturing	2
	Preparation and presentation of term paper	
8	Multiaxial and Multiphase weaving	2
	Preparation and presentation of term paper	
9	Leno weaving	2
	Preparation and presentation of term paper	
10	Narrow weaving	2
	Preparation and presentation of term paper	
11	Developments in Knitting	4
	Preparation and presentation of term paper	
12	Braiding	3
	Preparation and presentation of term paper	
13	Developments in Nonwoven	4
	Preparation and presentation of term paper	
		42
COURSE TOTAL (42 times 'L')		

19. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. Advances in Modern Woven Fabrics Technology by Savvas Vassiliadis, InTech, 2011 2. Textile Technology, by Burkhard Wulforth, Thomas Gries and Dieter Veit, HANSER Publication, 2012 3. Handbook of weaving, by Sabit Adanur, Technomic publication, 2003 4. Handbook of Nonwoven, by S J Russel, WOODHEAD Publication, 2007

5.	Advances in Knitting Technology by K F Au, WOODHEAD Publication, 2009
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20. Resources required for the course (*itemized & student access requirements, if any*)

20.1	Software	10%
20.2	Hardware	30%
20.3	Teaching aides (videos, etc.)	20%
20.4	Laboratory	20%
20.5	Equipment	
20.6	Classroom infrastructure	20%
20.7	Site visits	
20.8	Others (please specify)	

21. Design content of the course (*Percent of student time with examples, if possible*)

21.1	Design-type problems	60%
21.2	Open-ended problems	10%
21.3	Project-type activity	20%
21.4	Open-ended laboratory work	10%
21.5	Others (please specify)	

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Department of Textile Technology		
2.	Course Title (< 45 characters)	Nonwoven Processes and Products		
3.	L-T-P structure	3-0-0		
4.	Credits	3		
5.	Course number	TXL734		
6.	Status (category for program)	PE for M.Tech. (Textile Engineering) students PE for M.Tech. (Fiber Science and Technology) students DE for B.Tech. (Textile Technology) students		

7.	Pre-requisites (course no./title)	TXL211/TXL221/TXL222/TXL231/TXL232 and EC75 for UG students		
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8.	Status vis-à-vis other courses (give course number/title)			
	8.1 Overlap with any UG/PG course of the Dept./Centre		No	
	8.2 Overlap with any UG/PG course of other Dept./Centre		No	
	8.3 Supersedes any existing course		TTL782	

9.	Not allowed for (indicate program names)	None
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10.	Frequency of offering	Every sem 1st sem 2nd sem Either sem - 2nd sem		
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11.	Faculty who will teach the course Dipayan Das, Amit Rawal, R. S. Rengasamy, Apurba Das			
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12.	Will the course require any visiting faculty? (yes/no)	No
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13.	Course objectives (about 50 words): To provide students with an in-depth understanding of nonwoven processes and products.			
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14.	Course contents (about 100 words) (Include laboratory/design activities): Definitions of nonwoven and their scopes and limitations. Staple fibre preparation processes. Staple fibre web formation processes: carding, air-laying, and wet-laying. Staple fibre web stacking processes: parallel-laying, cross-laying, and perpendicular-laying, Mechanical bonding processes: needle-punching and hydroentanglement. Thermal bonding processes: calendar, through-air, impingement, infra-red, and ultrasonic bonding. Chemical bonding process. Spunmelt processes: spunbonding and meltblowing. Medical nonwovens. Hygiene nonwovens. Nonwoven wipes. Nonwoven filters. Geononwovens. Automotive nonwovens. Case studies.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Definition of nonwovens Definitions of nonwoven as accepted by ASTM, ISO, EDANA, and INDA and their scopes and limitations, Structural definition of nonwoven and its advantages in relation to earlier definitions.	1
2	Staple fibre preparation processes Selection of raw materials, Opening of fibres, Types of opener, Intensity of opening, Weighing pan bale opener, Mixing of fibres, Multimixer, Fibre feeding to card, Longitudinal and tranverse feed uniformity controllers, Weighing pan system, Volumetric chute feed system, Roller weighing system, Scanfeed system.	3
3	Staple fibre web formation processes Carding process: Basic structure of roller carding machine, Machine elements and their functions, Principles of working, stripping, and brushing, Mathematical analysis of roller carding process, Carding power and mixing power, Recent developments in roller card, Quality control of carded fibreweb. Air-lay process: Basic structure of air-lay machine, Machine elements and their functions, Principles of air-laying, Dynamics of airflow, Motion of fibres in air-laying, Air-lay processes for non wood-pulp and wood-pulp fibres, Air cards, Quality control of air-laid fibreweb, Recent developments in air-laying. Wet-lay process: Evolution of wet-lay process, Basic structure of wet-lay machine, Machine elements and their functions, Theoretical basis of wet-laying, Models of fibre dispersion in water, Defects in wet-laid webs and their causes and remedies, Recent developments in wet-laying.	9

4	Staple fibre web stacking processes Parallel-lay process: Scheme of parallel-laying, Scopes and limitations. Cross-lay process: Basic structure of cross-lapper, Machine elements and their functions, Camel back lapper, Horizontal lapper, Kinematic analysis of cross-lapper, Profile cross-lapper, Web drafting, Quality control of cross-laid webs, Recent developments in cross-lapping. Perpendicular-lay process: Basic structure of perpendicular lappers, Machine elements and their functions, Reciprocating lapper, Rotary lapper.	3
5	Staple fibre web bonding processes Mechanical bonding processes: Needle-punching process: Basic structure of needle-punching machine, Machine elements and their functions, Design and selection of needles, Key process factors and their influences, Special purpose needle-punching machines, Defects in needle-punched fabrics and their causes and remedies, Recent developments in needle-punching machines. Hydroentanglement process: Basic structure of hydroentanglement machine, Machine elements and their functions, Design and selection of water jet nozzles, Disintegration of liquid jet, Stability curve, Liquid break-up regimes, Key process factors and their influences, Defects in hydroentangled fabrics and their causes and remedies, Recent developments in hydroentanglement machines. Thermal bonding processes: Calendar bonding process: Basic structure of calendar bonding machine, Machine elements and their functions, Principles of bond formation, Analysis of heat transfer in thermal calendar bonding process, Design of calendar rollers, Area bonding and point bonding, Geometry and arrangement of bond points, Key process factors and their influences, Recent developments in thermal calendars. Through-air bonding process: Basic structure of through-air	9

	bonding machine, Machine elements and their functions, Perforated drum through-air bonding, Perforated conveyor through-air bonding. Other thermal bonding processes: Impingement thermal bonding, Infra-red bonding, and Ultrasonic bonding. Chemical bonding process: Latex binder and its preparation, Working principle of binder, Methods of binder application, Saturation bonding, Spray bonding, Foam bonding, Print bonding, Drying/curing, Key process factors and their influences, Recent developments in chemical bonding.	
6	Spunmelt processes Spunbonding: Selection of polymers, Preparation of polymers, Basic variants of spunbonding process, Basic structure of spunbonding machine, Machine elements and their functions, Analysis of spunbonding process, Structure and property development in individual filaments during spun-bonding, Defects in spunbond fabrics and their causes and remedies, Recent developments in spunbonding. Meltblowing: Selection of polymers, Preparation of polymers, Basic structure of meltblowing machine, Machine elements and their functions, Analysis of fibre formation during meltblowing, Defects in meltblown fabrics and their causes and remedies, Difference between spunbonding and meltblowing, Recent developments in meltblowing.	6
7	Medical nonwoven products Medical nonwovens: Product requirements, Technological processes, Material-process-structure-property correlation, Barrier products, Surgical gowns, Face mask, Absorbents, Recent developments, Case studies.	2
8	Technical nonwoven products Nonwoven filters: Product requirements, Technological processes, Material-process-structure-property correlation, Nonwoven air filters, Nonwoven liquid filters, Recent developments. Case studies. Geononwovens: Functions and requirements, Technological processes, Material-process-structure-property correlation, Products made from geononwovens, Recent developments. Case studies.	5

9	Automotive nonwovens: Requirements, Technological processes, Material-process-structure-property correlation, Automotive components made from nonwovens, Recent developments. Case studies.	
	Consumer nonwoven products Nonwoven wipes: Product requirements, Technological processes, Material-process-structure-property correlation, Products for food services, Automotive products, Medical products, Cleanroom products, Personal care products, Recent developments. Case studies. Hygiene nonwovens: Product requirements, Technological processes, Material-process-structure-property correlation, Baby care products, Feminine hygiene products, Adult care products, Recent developments. Case studies.	4
COURSE TOTAL (42 times 'L')		42

16. Brief description of tutorial activities: None

Module no.	Description	No. of hours
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17. Brief description of laboratory activities: None

Module no.	Description	No. of hours
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18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours
1	Definition of nonwovens Preparation and presentation of term paper	1
2	Staple fibre preparation processes Solving numerical problems, Preparation and presentation of term	3

	paper	
3	Staple fibre web formation processes Solving numerical problems, Preparation and presentation of term paper	9
4	Staple fibre web stacking processes Solving numerical problems, Preparation and presentation of term paper	3
5	Staple fibre web bonding processes Solving numerical problems, Preparation and presentation of term paper	9
6	Spunmelt processes Solving numerical problems, Preparation and presentation of term paper	6
7	Medical nonwoven products Preparation and presentation of term paper	2
8	Technical nonwoven products Preparation and presentation of term paper	5
9	Consumer nonwoven products Preparation and presentation of term paper	4

19. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

S. Batra and B. Pourdeyhi, Introduction to Nonwovens Technology, DEStech Publications, Inc., 2012.

S. J. Russel, Handbook of Nonwovens, Woodhead Publishing Limited, UK, 2007.

W. Albrecht, H. Fuchs, and W. Kittelmann, Nonwoven Fabrics, Wiley-VCH, Germany, 2003.

V. R. Gowarikar, N. V. Viswanathan, and J. Sreedhar, Polymer Science, New Age International (P) limited, New Delhi, 2006.

W. E. Morton and J. W. S. Hearle, Physical Properties of Textile Fibres, Fourth Edition, Woodhead Publishing Ltd., UK, , 2008.

20. Resources required for the course *(itemized & student access requirements, if any)*

20.1	Software	None
20.2	Hardware	None
20.3	Teaching aides (videos, etc.)	Chalkboard/Whiteboard, Tablet-PC, Laptop
20.4	Laboratory	None
20.5	Equipment	None
20.6	Classroom infrastructure	Lecture room with AV facility
20.7	Site visits	None
20.8	Others (please specify)	None

21. Design content of the course *(Percent of student time with examples, if possible)*

21.1	Design-type problems	15 %
21.2	Open-ended problems	15 %
21.3	Project-type activity	20 %
21.4	Open-ended laboratory work	
21.5	Others (please specify)	

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the	Department of Textile Technology
2.	Course Title (<i>< 45 characters</i>)	Science of Clothing Comfort
3.	L-T-P structure	3-0-0
4.	Credits	3
5.	Course number	TXL 750
6.	Status (<i>category for program</i>)	DE for B.Tech. (Textile Technology) students PE for M.Tech. (Textile Technology) students PE for M. Tech. (Fibre Science and Technology) students

7.	Pre-requisites (course no./title)	TXL211/TXL221/TXL222/TXL231/TXL232 and EC75 for UG students
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	Nil
8.2	Overlap with any UG/PG course of other Dept./Centre	Nil
8.3	Supercedes any existing course	TTL750

9.	Not allowed for (indicate program names)	None
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem ☒ Either
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11.	Faculty who will teach the course Apurba Das and R. Alagirusamy	
12.	Will the course require any visiting faculty?	NIL

13.	Course objective (<i>about 50 words</i>): After attending the course the student will learn the followings: • Science of clothing comfort • various aspects (aesthetic, neuro-physiological , psychology, thermal,	
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	tactile etc.) related to clothing comfort • transmission behaviour of clothing

14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Clothing Comfort: Brief introduction to the various processes related to comfort, Application of science of clothing comfort. Psychology and comfort: basic concepts, Psychological research techniques, General aspects and measurement of aesthetic properties, changes in aesthetic behaviour. Neurophysiological Processes of Comfort: Neurophysiologic basis of sensory perceptions, Perceptions of sensations related to mechanical, thermal and moisture stimuli. Thermal transmission: Thermoregulatory mechanisms of human body, heat transfer theories, thermal conductivity of fibrous materials, steady state measurement techniques for heat transfer, transient heat transfer mechanism: warm-cool feeling. Moisture Transmission: transfer of liquid moisture and vapour transfer through fibrous materials. Dynamic Transmission of heat and moisture: Relationship of moisture and heat, multiphase flow through porous media, moisture exchange between fibre and air, temperature and moisture sensations: theories and objective measurement techniques, impact of microclimate. Tactile Aspects of Comfort: Fabric mechanical properties and tactile- pressure sensations like fabric prickliness, itchiness, stiffness, softness, smoothness, roughness and scratchiness, fabric hand value, clothing comfort aspects in relations with garment size and fit.

15. Lecture Outline (*with topics and number of lectures*)

Modul eno.	Lecture description	No. of hours
1	Definition of clothing comfort, importance of studying clothing comfort, Application of science of clothing comfort, basic consumer trends	1
2	Brief introduction to the various processes related to comfort: psychological, neurophysiological, physiological and physical: the human-clothing system	1
3	<i>Psychology and Comfort</i> : Perception of comfort, comfort sensory descriptors, psychophysics	1
4	<i>Psychological research techniques</i> : Psychological scaling, scales of measurement, wear trial technique	1
5	<i>Aesthetic Comfort</i> : General aspects, measurement of aesthetic	1

	properties, changes in aesthetic behaviour	
6	<i>Neurophysiological basis of sensory perceptions:</i> Skin structure, vascular system, skin stimuli and skin sensory system, transduction, sensory receptors, neural pathways and responses	2
7	<i>Perceptions of skin sensations related to mechanical stimuli:</i> Dynamics of wear sensation, touch and pressure, prickle, itch and inflammation, roughness and scratchiness	1
8	<i>Fabric mechanical properties and tactile- pressure sensations:</i> Fabric prickliness, fabric itchiness, fabric stiffness, fabric softness, fabric smoothness, fabric roughness and fabric scratchiness, fabric hand	2
9	<i>Perceptions of sensations related to thermal and moisture stimuli:</i> Thermoreceptors, sensible and insensible heat, thermoregulatory sweating mechanism, shivering, heat exchange at the skin surface, moisture exchange at the skin surface, typical skin temperatures, distribution of thermal sensitivity, thermal sensation and comfort, moisture effects on comfort, fabric thermal sensations, dampness sensations	3
10	<i>Revisiting the Thermoregulatory Mechanisms of human body:</i> The body core and skin temperature, hypothermia and hyperthermia, metabolic rate under different working conditions, thermoregulatory mechanism in humans: autonomic temperature regulation, two-node model of thermal regulation	2
11	<i>Heat Transfer Theories:</i> Basic modes of heat transfer, i.e. Conduction , Convection, Radiation and Evaporation; Steady state heat transfer, Fourier's law of thermal conduction, Newton's Law of cooling, Concept of a blackbody radiation, Stefan-Boltzmanns law of radiation, concept of transient state; Conductivity, resistance, emissivity, diffusivity, thermal absorptivity	3
12	<i>Thermal Conductivity of Fibrous Materials:</i> Various parameters and related factors that affect the thermal conduction through fibrous materials like fibre batts, nonwoven fabrics, woven and knitted fabrics, thickness, cover factor, fibre type, yarn structure, fibre morphology and shape, effect of fabric layers etc.	3
13	<i>Steady state measurement techniques for heat transfer:</i> Various techniques and methods	1
14	<i>Transient heat transfer mechanism (the warm-cool feeling):</i> Kawabata's theoretical proposition of thermal diffusivity as an	2

	objective parameter for evaluation of warm-cool feeling, Hess's proposition of thermal absorbtivity as a more suitable parameter for the same purpose, Kawabata's instrument, Alambeta	
15	<i>Liquid Moisture Transfer through Fibrous Materials (Wicking and Water absorption):</i> Theory of surface tension, theory of capillary action, wetting and wicking, interaction between liquid and fibrous materials, liquid spreading dynamics on a solid surface, Rayleigh instability, Lucas-Washburn theory, various theories and models on vertical and horizontal wicking through yarns, nonwoven fabrics and woven fabrics, absorption of water by a fibrous mass, objective measurement of wicking and absorption: angle of contact, droplet absorption test, vertical wicking, horizontal or transverse wicking tests	3
16	<i>Transfer of moisture vapour through Fibrous Materials:</i> Diffusion of vapour through a porous medium, various modeling approaches, moisture vapour permeability of fabrics, influence of various fabric parameters such as thickness, cover factor, etc. on the moisture vapour permeability, measurement of moisture vapour permeability, International standards	3
17	<i>Relationship of moisture and heat (basic concepts):</i> Evaporation as a process of mass and heat transfer, evaporation and condensation, latent heat, sorption and desorption	1
18	<i>Multiphase flow through porous media:</i> Mass and energy transport equations, thermodynamic relations, convective transport in liquid and gas phase, modified transport equations	2
19	<i>Moisture exchange between fibre and air:</i> Moisture diffusion into the fibres, behaviour of fabrics made from different fibres, drying of fabrics	1
20	<i>Temperature and moisture sensations (theories and objective measurement techniques):</i> Coolness to touch, warmth, dampness, clamminess and moisture buffering, environmental buffering, sweating skin and manikin, Hess's proposal of moisture absorbtivity as an objective measurement parameter, use of Permatext and Alambeta to measure dynamic interaction of heat and moisture in fabrics	3
21	<i>Clothing comfort aspects in relations with garment size and fit:</i> General aspects, construction, dimensional change, ergonomics, garment fit and pressure comfort, Effect of clothing design on performance: Impact of tight and loose fit, Impact of microclimate	2

22	<i>Concept of designing of clothing assemblies for specific applications:</i> It is very important to understand and analyze the requirements of specific applications to engineer a clothing system. The students will be given exposures on various clothing requirements for specific applications, like <i>Neonate, Infants, Work clothing, Extreme cold weather, Foul weather clothing, Surgical apparel, Sports wear, Special purpose clothing (e.g. Space suit, Fire fighter) etc.</i>	3
COURSE TOTAL (42 times 'L')		42

16. Brief description of tutorial activities: Not Applicable

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17. Brief description of laboratory activities: Not Applicable

Modul eno.	Experiment description	No. of hours

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours
1.	Fabric hand evaluation; total hand value; latest researches on objective measurements of fabric hand	8
2.	Latest researches on heat and mass transmission through textile materials (both single and multi-layered fabric ensembles)	10
3.	Effect of different parameters on heat and mass transmission of textile structure.	8
4.	Latest measurement technics of heat and mass transmission characteristics through clothing (like thermal manikin, sweating manikin, manikins for fire proof fabrics etc.)	10
5.	Clothing comfort for extreme weather- latest research trends	6

19. Suggested texts and reference materials:

Science in Clothing Comfort, Apurba Das & R. Alagirusamy, Woodhead Publishing India Pvt. Ltd., 2010

K. Slater, The Thermal Behaviour of Textiles, Textile Progress, Vol. 8, No. 3,

1976.

J. O. Ukponmwan, The Thermal Insulation Properties of Fabrics, Textile Progress, Vol. 24, No. 4, 1993

K. Slater, Comfort Properties of Textiles, Textile Progress, Vol. 9, No. 4, 1977

Y. Li, The Science of Clothing Comfort, Textile Progress, Vol. 31, No. 1 & 2, 2001

G. J. Morris, Thermal Properties of Textile Materials, J. Text. Inst., 44, 1953, T449

Patnaik et. al., Wetting and Wicking in Fibrous Materials, Textile Progress, Vol. 38, No. 1, 2006

Thermal and moisture transport in fibrous materials, edited by N. Pan and P. Gibson, The Textile Institute, Published by Woodhead Publishing Limited, Cambridge, England, 2006

20. Resources required for the course (*itemized & student access requirements, if any*)

20.1	Software	None
20.2	Hardware	None
20.3	Teaching aides (videos, etc.)	PPT & Blackboard
20.4	Laboratory	None
20.5	Equipment	None
20.6	Classroom infrastructure	Lecture room with AV facility
20.7	Site visits	None

21. Design content of the course (*Percent of student time with examples, if possible*)

21.1	Design-type problems	30%
21.2	Open-ended problems	15%
21.3	Project-type activity	15%

21. 4	Open-ended laboratory work	-
21. 5	Others (please specify)	-

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department/Centre proposing the course	Department of Textile Technology
2.	Course Title (<i>< 45 characters</i>)	Apparel Engineering and Quality Control
3.	L-T-P structure	2-0-2
4.	Credits	3
5.	Course number	TXL 751
6.	Status (<i>category for program</i>)	PE for M.Tech. (Textile Engineering) students PE for M.Tech. (Fiber Science and Technology) students DE for B. Tech. (Textile Technology) students

7.	Pre-requisites (course no./title)	TXL211/TXL221/TXL222/TXL231/TXL232 and EC75 for UG students
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	None
8.2	Overlap with any UG/PG course of other Dept./Centre	None
8.3	Supersedes any existing course	TTL 751

9.	Not allowed for (indicate program names)	None
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10.	Frequency of offering	☐ Every sem ☐ 1stsem ☐ 2ndsem ☐ Either sem - 2 nd semester
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11.	Faculty who will teach the course B. K. Behera and R.Rengasamy
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12.	Will the course require any visiting faculty? (yes/no)	No
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13.	Course objectives (<i>about 50 words</i>): This course is designed to provide an understanding of clothing manufacture process to produce high quality garment, Understanding critical machine and material parameters which influence product quality, To know important process parameters which determine product quality and ability to select fabric for different end use
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	applications. It will also provide knowledge of common defects both in fabric and garment.
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14.	Course contents (about 100 words) (Include laboratory/design activities): Introduction to clothing manufacture, Apparel Engineering Concept in Garment Industry , Need of Apparel engineering, Role and Methodology of Apparel Engineering, Industrial engineering concept in apparel engineering, Standardization and Production scheduling, Sewing Dynamics, Mechanics of sewing operation, Measurement and controls in sewing operation, Automation in sewing process, Modeling of sewing machine and operation, Fabric quality assessment for clothing industry, Evaluation and Application of low stress mechanical properties for making up process, Fabric mechanical properties and sewing operation interaction, Concept of Tailorability, Formability and Lindberg theory, Quality control in apparel manufacturing, Determination of sewability, Effect of sewing on fabric mechanical and aesthetic properties, Fabric defects and their impact on garment quality, Quality inspection and defects in apparels, Evaluation of sewing threads, Evaluation of clothing accessories, Material Functionality in clothing, Engineering of functional clothing.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
	Engineering aspects of clothing manufacturing process	
	Introduction to clothing manufacturing process, stitch and seam, classification and standard notations, trims, lining and interlining, fusing, pressing, Needle size and selection, Automatic sewing machine, Laser cutting, CNC sewing machine, Feeding systems, Automation	4
	Industrial engineering concept in apparel engineering	
	Industrial engineering concept in apparel engineering, Standardization and Production scheduling, Apparel Engineering Concept in Garment Industry, Management and Organization of clothing industry, Planning and control, Coordination, Performance evaluation	2
	Sewing Dynamics	
	Sewing Dynamics, Need and application of sewing dynamics study in apparel engineering, Mechanics of sewing operation, Measurement and controls in sewing operation, Automation in sewing process, Modeling of sewing machine and operation,	6

	Fabric feeding force, Force distribution on threads in a stitch, sewing thread tension, needle and bobbin thread dynamic tension plot, tightening tension, sewing machine setting for perfect seam, Needle penetration force, Mathematical model to determine penetration force, Friction force, Stab force, Needle heating, Thermal balance equation, Damage of fabric, thread and needle, Remedial measures	
	Fabric quality assessment for clothing industry	
	Fabric quality assessment for clothing industry, Performance of clothing materials, Utility performance, Comfort performance, Fabric performance during clothing manufacture, Evaluation and application of low stress mechanical properties for predicting making up process, Fabric mechanical properties and sewing operation interaction, Requirement of fabric properties for various end-use applications, Concept of Ideal and High quality fabric, Aesthetic evaluation of fabric, Fabric defects and their impact on garment quality, Garment defects, Quality inspection and defects in sewn garment, fabric, accessories, sewing thread and finished garment, In process inspection, Evaluation of clothing accessories, Evaluation of sewing threads and other trims,	8
	Tailorability, Formability, Sewability and Process control	
	Tailorability, Formability and Lindberg theory, Determination of sewability, Seam efficiency, Seam pucker, Seam slippage, Needle cutting index, Seam damage, Seam allowance, Relationship between fabric mechanical properties-garment design and tailorability, Effect of sewing on fabric mechanical and aesthetic properties, Prediction of garment appearance from fabric properties, Stitch quality monitoring during sewing	4
	Apparel Engineering –case studies	
	Material Functionality in clothing, Functional Fabrics in Clothing for Physiological Comfort, Engineering of functional clothing for drape, crease, texture, waterproofing, u-v protection and bagging effect, Application of artificial intelligence for apparel engineering, selected case studies.	4
COURSE TOTAL (28 times 'L')		28

16. Brief description of tutorial activities: None

Module no.	Description	No. of hours

17. Brief description of laboratory activities

Module no.	Description	No. of hours
1	Experiment on drive mechanism, feeding mechanism, control of tension and various settings	6
2	Production of various stitches, seams, and their evaluation	6
3	Determination of sewability for fabric and thread	6
4	Experiment on fusing, moulding, seam allowance	4
5	Damage analysis and Inspection	2
6	Experiment on Drape	4
	Total	28

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours
	Engineering aspects of clothing manufacturing process	
	Preparation and presentation of term paper	4
	Industrial engineering concept in apparel engineering	
	Preparation and presentation of term paper	4
	Sewing Dynamics	
	Preparation and presentation of term paper	10
	Fabric quality assessment for clothing industry	
	Preparation and presentation of term paper	8
	Tailorability, Formability and Sewability	
	Preparation and presentation of term paper	8
	Apparel Engineering –case studies	
	Preparation and presentation of term paper	8
	COURSE TOTAL (28 times 'L')	42

19. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. Quality Assurance for Textiles and Apparel ,2nd Edition by S J Kadolph, bloomsbury, 2007
2. Fashion Sewing: Advanced Techniques by Connie Amaden Crawford, Bloomsbury, 2015
3. Draping for Apparel Design, BY Helen Joseph Armstrong, bloomsbury, 2013
4. Technical Sourcebook for Designers, Jaeil Lee, Camille Steen, bloomsbury, 2013
5. A Guide to Evaluating Sewn Products By: Janace E. Bubonia, bloomsbury, 2007
6. Engineering apparel fabrics and garments by J. Fan and L.Hunter, WOODHEAD, 2009
7. Biomechanical engineering of textiles and clothing, by Y. Li and X-Q. Dai, WOODHEAD, 2006

20. Resources required for the course *(itemized & student access requirements, if any)*

20.1	Software	
20.2	Hardware	
20.3	Teaching aides (videos, etc.)	
20.4	Laboratory	Apparel Engineering lab
20.5	Equipment	Sewing machine, fusing machine, Pressing machine, Testing equipment
20.6	Classroom infrastructure	
20.7	Site visits	
20.8	Others (please specify)	

21. Design content of the course *(Percent of student time with examples, if possible)*

21.1	Design-type problems	40%
21.2	Open-ended problems	20%
21.3	Project-type activity	20%
21.4	Open-ended laboratory work	20%
21.5	Others (please specify)	

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department/Centre proposing the course	Textile Technology
2.	Course Title (<i>< 45 characters</i>)	Design of Functional Clothing
3.	L-T-P structure	3-0-0
4.	Credits	3
5.	Course number	TXL752
6.	Status (<i>category for program</i>)	PE for M. Tech. (Textile Engineering) students PE for M. Tech. (Fiber Science and Technology) students DE for B. Tech. (Textile Technology) students

7.	Pre-requisites (course no./title)	None
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8	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	Nil
8.2	Overlap with any UG/PG course of other Dept./Centre	Nil
8.3	Supersedes any existing course	No

9.	Not allowed for (<i>indicate program names</i>)	Nil
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem ☒ Either sem
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11.	Faculty who will teach the course Prof Deepti Gupta, Dr Abhijit Majumdar
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12.	Will the course require any visiting faculty?	No
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13.	Course objective (<i>about 50 words</i>): To familiarize students with the design and engineering of functional clothing; Principles of building specific functionalities into clothing while optimising body comfort and movement; ergonomics and its application to design of technical clothing. Application of optimal design approach to engineering of functional clothing. Performance testing and evaluation.
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Functional clothing - definition and classification. Techniques in design of functional clothing - 3D body scanning, human motion analysis, 2D/3D CAD and 3D
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	modelling. Design of patterns, garment assembling methods. Ergonomics in design of functional clothing. Principles and practice of Anthropometrics, Biomechanical considerations in design of clothing. Performance evaluation of performance clothing - subjective and objective methods, modelling and simulation; Human mechanics and operational performance. Modelling, optimisation and decision making techniques in design of functional clothing. Certification and standardization. Case studies - swimwear, sportswear, pressure garments, space suit, military clothing with a view to study specific design and manufacturing considerations.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction and classification of Functional clothing Protection, sports, medical, aesthetic and special needs. Requirements from functional clothing	3
2	Introduction to Ergonomics Introduction to Ergonomics and Human factors engineering. Human Motion analysis, quantitative kinematic analysis of body in action.	3
3	Ergonomics and design of functional clothing Environmental mapping, reducing heat stress, requirements of human mechanics, kinematic analysis. Design for insulation, ventilation, ease of motion and protection.	3
4	Techniques of body measurement and principles of fit Techniques of body measurement- manual, photographic and 3D body scanning; Body shapes, sizing and fit.	3
5	Clothing for functionality Principles of providing support and compression, reducing air/water drag, impact protection through garment design.	3
6	Garment design, assembly and making up 2D and 3D Pattern making for functional design; principle of zoning and layering, Selection of seams, stitches, seam finishes, accessories and closures. Lamination, moulding and seamless technology.	4
7	Testing and performance evaluation Subjective and objective testing, modeling and simulation; Testing human mechanics and operational performance	4
8	Anthropometrics Principles and practice of anthropometrics; Statistical description of human variability, Diversity in human bodies, design limits, design constraints and criteria. Static and dynamic measures. Application of anthropometry in design.	3
9	Biomechanics Biomechanical characteristics of human body; dynamic mechanical interactions between the body and clothing. Distribution of garment pressure and shear, stress distribution between clothing and body. Physiological effects resulting from clothing pressure, Direct and indirect pressure sensing systems, Range of tolerable pressure.	3
10	Engineering design of Functional envelopes	5

	Principles of optimal design engineering- tools and techniques, their application to design for humans. Modelling, optimization and decision making techniques in design of functional clothing, regression and ANN, linear programming and genetic algorithm techniques for process optimization. Multicriteria decision making techniques.	
11	Testing and certification Standards and certification for performance clothing.	2
12	Case studies Performance enhancing swimwear, sportswear, pressure garments, space suit, motorcyclists clothing, military clothing.	6
TOTAL		42

16.	Brief description of tutorial activities: Not applicable
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17.	Brief description of laboratory activities: Not Applicable
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18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours
1	Review papers on types and requirements of functional clothing. Identifying need for FC in their environment.	3
2	Planning an activity on human motion analysis	3
3	Inhibitory effect of clothing on movement.	3
4	Designing patterns in 2D and 3D Dart manipulation for a bullet proof vest for women.	2+2
5	Concept development for clothing with functionality.	3
6	Analysis of garments, layering and zoning principle	3
7	Clothing ergonomic design for thermal comfort	3
8	Analysis of anthropometric data: 1D, 2D, 3D and 4D data.	3
9	Principle of pressure generation on human body- fabric properties and garment design, measurement of pressure	3
10	Exercises and problems on optimisation of fabric parameters for specific end use.	4
11	Test batteries and methodologies for objective evaluation of clothing assemblies	3
12	Case Study preparation on a selected functional garment	10
	TOTAL	45h
19.	Suggested texts and reference materials: 1. C Fairhurst, Advances in apparel production, CRC Press, 2008. 2. D. Gupta and N. Zakaria, Anthropometry, Apparel sizing and design, Woodhead Publishing, 2014.	

	3. Y. Li and X-Q.Dai, Biomechanical Engineering of Textiles & Clothing, CRC Press, 2006. 4. J. Fan, W. Yu, and L. Hunter, Clothing appearance and fit: Science and technology, CRC Press, 2004 5. Y. Li and A.S.W. Wong, Clothing Biosensory Engineering, CRC Press, 2006. 6. W Fung, Coated and laminated textiles, CRC Press, 2002. 7. Functional clothing, Special issue, IJFTR, Dec.2011 8. K. H. E. Kroemer and E. Grandjean, Fitting the task to the human: a textbook of occupational ergonomics, CRC Press, 1997 9. W Yu, J Fan, S-P Ng, Innovation and technology of women's intimate apparel, Woodhead Publishing, 2006. 10. HR Mattila, Intelligent textiles and clothing, Woodhead Publishing, 2006 11. S C Anand, Medical textiles, Woodhead Publishing, 2001. 12. E Wilusz, Military Textiles, CRC Press, 2008. 13. Krister Forsberg, S. Z. Mansdorf Quick Selection Guide to Chemical Protective Clothing, , 2007 14. SP Ashdown, Sizing in Clothing, CRC Press, 2007. 15. Richard A Scott, Textiles for Protection, CRC Press, 2005. 16. R Shishoo, Textiles in Sport, by CRC Press, 2005 17. N Pan, Thermal and moisture transport in fibrous materials, CRC Press, 2006. 18. X M Tao, Wearable electronics and photonics, CRC Press, 2005.
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20. Resources required for the course (*itemized & student access requirements, if any*)

20.1	Software	
20.2	Hardware	
20.3	Teaching aides (videos, etc.)	
20.4	Laboratory	
20.5	Equipment	
20.6	Classroom infrastructure	yes
20.7	Site visits	yes

21. Design content of the course (*Percent of student time with examples, if possible*)

21.1	Design-type problems	20%
21.2	Open-ended problems	10%
21.3	Project-type activity	10%
21.4	Open-ended laboratory work	0%
21.5	Others (please specify)Term paper	10%

Date: 27.02.2015

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Department of Textile Technology
2.	Course Title (<i>< 45 characters</i>)	Design and Manufacturing of Textile Structural Composites
3.	L-T-P structure	3-0-0
4.	Credits	3
5.	Course number	TXL766
6.	Status (<i>category for program</i>)	PE for M.Tech. (Textile Engineering) students PE for M.Tech. (Fiber Science and Technology) students DE for B.Tech. (Textile Technology) students

7.	Pre-requisites (<i>course no./title</i>)	TXL211/TXL221/TXL222/TXL231/TXL232 and EC75 for UG students
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	None
8.2	Overlap with any UG/PG course of other Dept./Centre	None
8.3	Supersedes any existing course	TTL 766

9.	Not allowed for (<i>indicate program names</i>)	None
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10.	Frequency of offering	☐ Every sem ☐ 1stsem ☐ 2ndsem ☐ Either sem - 1 st semester
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11.	Faculty who will teach the course B. K. Behera, R. Alagirusamy, A. Rawal
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12.	Will the course require any visiting faculty? (yes/no)	No
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13.	Course objectives (about 50 words): The objective of this course is to familiarize the students with design, manufacturing, characterization and applications of textile reinforcement structures and their composites
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14.	Course contents (about 100 words) (Include laboratory/design activities): Definition of composites, textile composites and textile structural composites, Textile materials for composites, Matrix and Reinforcements, Classification of Textile Reinforced Structures based on axis and dimension; non-axial, mono-axial, biaxial, triaxial and multiaxial structures, UD, 2D,3D structures, Structural anisotropy, parallel arrangement and series arrangement of components, Chopped strand and Milled fibres, Hybrid fabrics, Non-crimp fabrics, Laminates, Stitched structure, Embroidery structures, Composite Rope, Design, manufacture and applications of reinforcements, Manufacture and characterization of extra-light 3D hollow textile structures for composites, Methods of composite processing, Manufacturing techniques of complex structural Composites, Characterization of structural Composites, Theory of composites, Composite concepts and theory, Rule of mixture, the synergy effect, Logarithmic mixing rule, Geometry of reinforcement, Particular, granular, fibrillar, lamellar, Properties of components, properties of interface, mechanism of adhesion, Mechanics of composite, Failure theory, Damage analysis, Modeling and simulation of various reinforcement structures and their composites, Applications of Textile structural composites, Textile Reinforced Concretes, Fibre concrete bonding, textile structure reinforcement concrete architecture, Characterization and applications of reinforced concretes
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
	Textile structural composites and basic materials used	
	Definition of composites, textile composites and textile structural composites, Textile materials for composites, Matrices and Reinforcements, classification, properties and selection of matrices, commingling, Advantages of textile structural composites.	4
	Textile structures for composites	
	Yarn structure, Fabric structure and behaviour, wovens, knits, braids and nonwovens, Classification of Textile Reinforced Structures based on axis and dimension; non-axial, mono-axial, biaxial, triaxial and multiaxial structures, UD, 2D,3D structures,	4

	Structural anisotropy, parallel arrangement and series arrangement of components, Chopped strand and Milled fibres, Hybrid fabrics, Non-crimp fabrics, Laminates, Stitched structure, Embroidery structures, Hybrid yarn for composites, Composite Ropes	
	Design and manufacturing of textile structures for composites	
	Design, manufacture , characterization and applications of various structural reinforcements, Production of 3D woven solid reinforcements, Extra-light 3D hollow textile structures for composites, single layer and multilayer spacers, Production of Profiled structures, advantage over conventional joints, Production of tubular, conical radome preforms, Design of Honeycomb structures, Hybrid Composite reinforcements, Polar and spiral fabrics,	6
	Manufacturing techniques of Textile structural Composites	
	Approaches to composite manufacturing, Hand and machine lay-up, Methods of composite processing, Manufacturing techniques of complex structural Composites, Moulding methods, design of customized moulds for profiled structures, spray-up moulding, vacuum-bag and pressure-bag moulding, autoclave, compression moulding, liquid resin molding, resin transfer moulding, Poltrusion, filament winding, injection moulding, thermoplastic processing, automated tape laying.	4
	Characterization, structure and properties of structural composites	
	Characterization of structural Composites, Mechanical Analysis, Tensile, bending, compression, impact, fatigue behavior, DMA, Thermal properties Internal Geometry of reinforcement structures, Fibre volume fraction and surface geometry, theoretical estimation of fibre volume fraction for various textile structures, Morphological characterization of composites reinforced by various textile structures, study of fibre-matrix behaviorat interface, Damage analysis,Failure mechanisms, matrix cracking, fibre fracture, debonding, delamination, fibre pullout, micro-buckling, kink bands, cone of fracture, Fractography, Failure criteria, Fracture mechanics, Non-Destructive Testing, electromagnetic, chemical spectroscopy and mechanical vibration.	6
	Theory of Textile structural composites	

	Theory of composites, Composite concepts and theory, Rule of mixture, the synergy effect, Logarithmic mixing rule, Geometry of reinforcement, Particular, granular, fibrillar, lamellar, Properties of components, properties of interface, mechanism of adhesion, Fibre volume fraction calculation for various complex textile structures, geometrical analysis of structural composites, unit cell concept, thickness, areal density Predicting properties of fibre reinforced composites,	6
	Modeling of Textile structures and their composites	
	Geometrical modeling of UD, 2D,3D woven structures, Finite Element Modeling of Tow Geometry in 3D Woven Fabrics , Modeling of the Geometry and Numerical Calculation of the Elasticity Parameters of 3D Braided Structures, Micro-structural Modeling of Three-Dimensional Woven Fabric Composites , Application of theoretical solid mechanics (two- and three-dimensional modeling as well as linear and non-linear analysis) to homogenous fibre-reinforced and laminated anisotropic composite structures and structural elements, FE modeling of textile reinforced composites and comparison with real testing, Contribution to multiscale modeling of textile reinforced composites , Meso-scale modeling of unbalanced woven composites, Effect of free edges on stresses in woven composites, Material damping simulation of textile composites by Finite Element Analysis, Simulating the Impact of Multi-Layer Fabric Targets using a Finite Element Method ,Simulation and Verification of Local and Global Forces on structural composites	6
	Applications of Textile structural composites	
	Applications of Textile structural composites, Structural composites for automotives, marine, aerospace, sports, protection systems, wind energy, machine components, construction engineering	4
	Textile Reinforced Concretes(TRC)	
	Textile Reinforced Concretes, Fibre concrete bonding, Fundamental concept of reinforcement mechanisms in TRC, Textile structures for TRC, Textile structure reinforced concrete architecture, Characterization and applications of reinforced concretes, Advantages of TRC, TRC as an alternative and sustainable building material, Seismic resistance structure using TRC	2
COURSE TOTAL (42 times 'L')		42

16. Brief description of tutorial activities: None

Module no.	Description	No. of hours

17. Brief description of laboratory activities : None

Module no.	Description	No. of hours

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours
	Textile structural composites and basic materials used	
	Preparation and presentation of term paper	4
	Textile structures for composites	
	Preparation and presentation of term paper	4
	Design and manufacturing of textile structures for composites	
	Preparation and presentation of term paper	6
	Manufacturing techniques of Textile structural Composites	
	Preparation and presentation of term paper	4
	Characterization, structure and properties of structural composites	
	Preparation and presentation of term paper	6
	Theory of Textile structural composites	
	Preparation and presentation of term paper	6
	Modeling of Textile structures and their composites	

	Preparation and presentation of term paper	6
	Applications of Textile structural composites	
	Preparation and presentation of term paper	4
	Textile Reinforced Concretes(TRC)	
	Preparation and presentation of term paper	2
COURSE TOTAL <i>(42 times 'L')</i>		42

19. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. Textile structural composites by Tsu Wei Chou and Frank K. Ko, ELSEVIER, 1989
2. 3D Fibrous assemblies, by Jinlian Hu, WOODHEAD, 2009
3. High performance fibre composites, by J G Morley, Harcourt Brace Jovanovinch, 1987
4. Textile structural composites, by S Advani, Conference proceedings, 2007
5. Design and Manufacturing of Textile structural composites by *A Long, WOODHEAD*

20. Resources required for the course *(itemized & student access requirements, if any)*

20.1	Software	
20.2	Hardware	
20.3	Teaching aides (videos, etc.)	
20.4	Laboratory	
20.5	Equipment	
20.6	Classroom infrastructure	
20.7	Site visits	
20.8	Others (please specify)	

21. Design content of the course *(Percent of student time with examples, if possible)*

21.1	Design-type problems	40%
21.2	Open-ended problems	20%
21.3	Project-type activity	40%

21.4	Open-ended laboratory work	
21.5	Others (please specify)	

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department/Centre proposing the course	Department of Textile Technology
2.	Course Title (<i>< 45 characters</i>)	Electronics and Control for Textile Industry
3.	L-T-P structure	3-0-2
4.	Credits	4
5.	Course number	TXL 771
6.	Status (<i>category for program</i>)	PE for M.Tech. (Textile Engineering) students

7.	Pre-requisites (course no./title)	None
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	None
8.2	Overlap with any UG/PG course of other Dept./Centre	None
8.3	Supersedes any existing course	TTL771

9.	Not allowed for (indicate program names)	B. Tech. Students
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10.	Frequency of offering	☐ Every sem ☒ 1 st sem ☐ 2 nd sem ☐ Either sem
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11.	Faculty who will teach the course	
	Anuj Dhawan (Department of Electrical Engineering, IIT Delhi)	

12.	Will the course require any visiting faculty?	No
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13.	Course objective <i>(about 50 words):</i> To introduce to the students the fundamentals of electronics and its application to textile industry for sensing process -parameters and keep them under control
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14.	Course contents <i>(about 100 words) (Include laboratory/design activities):</i> Overview of electronics and controls in modern textiles equipments and machines. Overview of basic analog electronics: Elements (R, L, C, V, I), circuit laws and theorems. Overview of basic digital electronics: Gates and ICs. Sensors and transducers (displacement, position, force, temperature, pressure, flow). Control elements, systems and examples. Data acquisition, analysis, control and automation by microprocessors and micro controllers. Motor and power drives. Power control devices. Some applications of data acquisitions and control systems in textiles and case studies.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Overview of electronics and controls in modern textiles equipments and machines	2
2	Overview of basic analog electronics: Elements (R, L, C, V, I), circuit laws and theorems, Operational amplifiers	4.5
3	Overview of basic digital electronics: Gates and ICs, Fundamentals of diodes, MOSFETs, and BJTs	5
4	Sensors and transducers (displacement, position, force, temperature, pressure, flow, humidity), Sensors employed in textile industry.	6

5	Signal conditioning	4.5
6	Control elements, systems and examples, some applications of control systems in textiles	5
7	Data acquisition, analysis, control and automation by microprocessors and micro controllers, some applications of data acquisitions in textiles and case studies	6
8	Motor and power drives	3
9	Power control devices	3
10	Electronic textiles	3
	COURSE TOTAL (<i>42 times 'L'</i>)	42

16. Brief description of tutorial activities

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17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Experiments on sensors and transducers (displacement, position, strain, temperature, rotational speed)	8
2	Basic analog circuits with diodes and transistors	5
3	Basic digital Gates	5
4	SCR and TRIAC control of motor speed	5
5	Data acquisition and control with micro processors/ micro controllers	5
	COURSE TOTAL (<i>14 time 'P'</i>)	28

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours
1.	Numerical problems on basic analog electronics	6
2.	Numerical problems on basic digital electronics	6
3.	Numerical problems on sensors and transducers	6
4.	Numerical problems on signals	6
5.	Numerical problems on controls	6
6.	Numerical problems on microprocessors	6
7.	Numerical problems on data acquisitions	6

19.	Suggested texts and reference materials: Automation and the Textile industry, Savas G Vassiliadis, Eurotex Haed office, University of Minho, Portugal , 1996
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20. Resources required for the course *(itemized & student access requirements, if any)*

20.1	Software	NPTEL web site
20.2	Hardware	None
20.3	Teaching aides (videos, etc.)	Blackboard, PPT, Animation, videos
20.4	Laboratory	Electronics laboratory
20.5	Equipment	None
20.6	Classroom infrastructure	Lecture room with AV facility
20.7	Site visits	None

21. Design content of the course *(Percent of student time with examples, if possible)*

21.1	Design-type problems	50%
21.2	Open-ended problems	10%
21.3	Project-type activity	10%
21.4	Open-ended laboratory work	10%
21.5	Others (please specify)	-

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Department of Textile Technology
2.	Course Title (<i>< 45 characters</i>)	Computational Methods for Textiles
3.	L-T-P structure	2-0-2
4.	Credits	3
5.	Course number	TXL772
6.	Status (<i>category for program</i>)	PE for M. Tech. (Textile Engineering) students PE for M. Tech. (Fibre Science & Technology) students

7.	Pre-requisites (course no./title)	EC75 for UG students
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	No
8.2	Overlap with any UG/PG course of other Dept./Centre	No
8.3	Supercedes any existing course	TTL772

9.	Not allowed for (indicate program names)	Not allowed for students who have taken CSL101 and CSL102
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem ☐ Either sem Once in a year, any semester
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11.	Faculty who will teach the course- Pragya Jain and Ram Lal (Computer Services Centre, IIT Delhi)	
12.	Will the course require any visiting faculty?	No

13.	Course objective (<i>about 50 words</i>): To familiarize students with various computation methods used in textiles.
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Numerical analysis, First-degree approximation methods, Linear algebraic equations, ordinary differential equations, interpolation, Fundamentals of
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	Computer Programming, Programming Methodology: Structured Programming and concepts of Object-Oriented Programming. Programming in C++ - Statements and Expressions, Control statements. Structure, Functions: Function Overloading etc. C++ as Object-Oriented Programming Language-Classes and Objects, Data Abstraction, Inheritance - Multilevel and Multiple inheritance etc., Polymorphism - operator overloading and virtual functions, file handling. Application development using C++.
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15. Lecture Outline *(with topics and number of lectures)*

Module no	Topics	No of lectures
1	<u>INTRODUCTION TO NUMERICAL ANALYSIS</u> : Analytic & Numerical solution, Sources of error (Inherent error, Truncation error, Round off error, Absolute error/ Relative error), Significant digits, Loss of significant digit.	1
2	<u>SOLUTION TO TRANSCENDENTAL EQUATIONS</u> : Initial Approximation (Bisection method), Methods based on first-degree approximation (Secant Method, Regula - Falsi Method, Newton - Raphson Method and its modifications), Rate of Convergence.	2
3	<u>SYSTEM OF LINEAR ALGEBRAIC EQUATIONS AND EIGENVALUE PROBLEMS</u> : Direct Methods (Cramer's rule, Gauss – Elimination method [Pivoting], Gauss – Jordan Elimination method, LU Decomposition, Cholesky factorisation), Iteration Methods (Jacobi Iteration method, Gauss – Seidel method), Eigenvalues and Eigenvectors (Jacobi & Given's method for symmetric matrices, Power method, Inverse power method, Shift of Origin)	6
4	<u>INTERPOLATION</u> : Arbitrary points (Lagrange Interpolation, Newton's Divided Difference), Equispaced points (Finite Differences, Newton Forward Difference, Newton Backward Difference).	3
5	<u>ORDINARY DIFFERENTIAL EQUATIONS</u> : Euler Method, Taylor Series Method, Explicit Runge-Kutta Method (second, fourth, higher order).	2
6	<u>FUNDAMENTALS OF COMPUTER PROGRAMMING</u> : Introduction, Flow charts, Pseudo Code	1
7	<u>CONCEPTS</u> : Structured Programming, Object Oriented Programming	1
8	<u>PROGRAMMING IN C++</u> : Classes and Objects, Constructors and Destructors, Operator Overloading, Inheritance, Pointers, Virtual Functions, Polymorphism.	12
	Total	28

16.	Brief description of tutorial activities -Not applicable
17.	Brief description of laboratory activities- Matlab programming, C++

	programming, TOTAL 28 hours
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18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours
1	INTRODUCTION TO NUMERICAL ANALYSIS Numerical problems	1
2	SOLUTION TO TRANSCENDENTAL EQUATIONS Numerical problems	2
3	SYSTEM OF LINEAR ALGEBRAIC EQUATIONS AND EIGENVALUE PROBLEMS Numerical problems	6
4	INTERPOLATION Numerical problems	3
5	ORDINARY DIFFERENTIAL EQUATIONS Numerical problems	2
6	FUNDAMENTALS OF COMPUTER PROGRAMMING Numerical problems	1
7	CONCEPTS Numerical problems	1
8	PROGRAMMING IN C++ Numerical problems	12

19.	Suggested texts and reference materials : Fundamentals of Engineering Numerical Analysis, Parvin Moin, Cambridge University Press. Object Oriented Programming in C++, Robert Lafore, 4 th Edition, SAMS Publication.
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20.	Resources required for the course (<i>itemized & student access requirements, if any</i>)	
20.1	Software	
20.2	Hardware	
20.3	Teaching aides (videos, etc.)	
20.4	Laboratory	Computer
20.5	Equipment	Computer
20.6	Classroom infrastructure	Classroom with AV facility
20.7	Site visits	-

21. Design content of the course *(Percent of student time with examples, if possible)*

21.1	Design-type problems	
21.2	Open-ended problems	
21.3	Project-type activity	-
21.4	Open-ended laboratory work	50 %
21.5	Others (please specify)	-

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department/Centre proposing the	Department of Textile Technology
2.	Course Title (<i>< 45 characters</i>)	Process control in yarn and fabric manufacturing
3.	L-T-P structure	3-0-0
4.	Credits	3
5.	Course number	TXL 774
6.	Status (<i>category for program</i>)	DE for B. Tech. (Textile Technology) students PE for M. Tech. (Textile Engineering) students PE for M. Tech. (Fibre Science & Technology) students

7.	Pre-requisites (course no./title)	TXL221, TXL222, TXL231, TXL232 and EC75 for UG students
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	Nil
8.2	Overlap with any UG/PG course of other Dept./Centre	Nil
8.3	Supersedes any existing course	TTL764

9.	Not allowed for (indicate program names)	Allowed only for TT, TTE and TTF students
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem X Either sem
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11.	Faculty who will teach the course S. M. Ishtiaque, R. Chattopadhyay, R. Alagirusamy, R Rengasamy, B. K. Behera, Apurba Das, Abhijit Majumdar, Amit Rawal, Dipayan Das.	
12.	Will the course require any visiting faculty?	NIL

13.	Course objective (<i>about 50 words</i>): This course is designed to provide the students with an understanding of the controlling of spinning and weaving processes. The students will learn about	
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	the principles of automatic control, types of controller action, controller mechanism, control strategies & techniques used for ensuring yarn and fabric quality, process efficiency, and minimizing process waste.
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14.	Course contents <i>(about 100 words)</i> <i>(Include laboratory/design activities):</i> Basics of automatic control, Statistical considerations in process control. Online and offline control measures in spinning. Control of yarn quality attributes. Spinning process performance. Post spinning problems. Control of winding, warping, sizing, weaving and knitting processes. Control of fabric defects and value loss. Yarn quality requirement and assessment for weaving

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Basics of automatic control Principles of automatic control , Open loop , closed loop, Types of controller action (On/off control, proportional control, proportional & integral control, proportional plus integral plus derivative control)	4
2	Statistical considerations in process control Different types of chart, Control charts, Cause effect diagram	3
3	On line & off line control measures in spinning Overview of process control activity in spinning, Control of mixing quality and cost , Bale management, Blendomat (Truetszschler), Autolevellers in card and draw frame	4
4	Control of yarn quality attributes Control of yarn unevenness, imperfections and periodic mass variation in yarn, Control of yarn count and count CV%, Control of strength(CSP and single yarn), elongation and their variation in cotton and blended yarn, Control of yarn hairiness	4
5	Spinning process performance Process capability, Static charge, it's effect (roller lapping, web breakage, soiling etc.) and control, Control of waste and cleaning in blow room, card, comber, On line monitoring of end breaks ring and rotor spinning and it's control	4
6	Post spinning problems Mixing and it's effect on shade variation and dyed specs, Barre: it's causes and control	2
7	Process control in winding and warping Controls for quality, machine stoppage and productivity in winding , warping, and pirn winding, process control program in winding and warping, Controls in the process of high twist yarns, blended yarns, filament yarns in warp and weft. Controls in the winding for processing yarns for dyeing & knitting, Controlling sloughing off during winding, warping , Control of yarn tension and clearer setting in winding, evaluation of knots	4

	and splice, control of hairiness, Calculations pertaining to production, efficiency and machine allocation in winding, warping, pirn winding, assessment of package and beam quality.	
8	Process control in sizing Selection of size material, control of size add on, sizing-weaving curve, Optimization of machine speed, squeeze pressure, drying temperature, size concentration and viscosity, size paste preparation, evaluation of size material and sized yarn, control of waste in sizing, Control of migration in sizing, size droppings, typical size mix for common fabric styles, preparation of filament yarns for weaving.	3
9	Process control in loom shed Control of machine stop and yarn breakage, Controls for yarn quality, machine and energy audit, housekeeping and material handling, Care, selection and consumption norms of accessories. formulation of maintenance schedule, Loom allocation, Temperature and humidity control, Statistical interpretation of data on waste and quality, troubleshooting in weaving room, weft loading in shuttleless weaving, control of air quality and water quality in jet weaving.	4
10	Process control in shuttle less weaving systems Automation of functions, weft entry angle, trouble shooting message analysis and suggestion of action, various machine adjustments, electronic weft insertion control, automatic pick finder, auto-setting and opening of valve in air-jet loom, settings of weave colour & colour pattern, electronic let-off & take-up, automatic stop-mark preventer, weft selection, automatic control of weft density and warp tension, material handling and QSC system, warp tension control, control of weft waste.	3
11	Fabric defects and value loss Fabric defects and their control, automatic fabric inspection, estimation of value loss, Control of value loss in fabrics through evaluation & grading of fabric defects, Fabric defect analysis based on minor, major and point system grading. remedial measures to control weaving defects, Control and norms for waste.	2
12	Process control in knitting and nonwoven Control of yarn tension, areal density, loop length in knitting. Spirality and its control. Process control in needle punching, hydroentanglement, melt blowing and spun bending operations.	2
13	Yarn quality requirement and assessment for weaving Warp breakage phenomena in weaving, warp breakage mechanism, factors affecting warp breakage rate, Estimation of warp breakage rate, empirical, statistical and instrumental approach, Concept of weavability, Yarn quality and weavability, CSP as a measure of weavability, Classimat analysis, role of	3

	classimat faults in assessing weaving performance of warp yarn.	
COURSE TOTAL (42 times 'L')		42

16. Brief description of tutorial activities: NOT APPLICABLE

17. Brief description of laboratory activities: NOT APPLICABLE

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours
1	Application of fuzzy control systems in textile machines (let-off in weaving etc.)	4
2	Process capability, six sigma, FMEA, Quality function deployment	3
3	Application of LPP and Goal programming for optimization of cotton mixing, sensitivity analysis for cost and cotton fibre quality.	4
4	Control of contamination problem; Removal of colored contamination in winding.	3
5	Process control for dyed fibre spinning, control of roller lapping and fly generation.	3
6	Conditioning of yarns after spinning and its impact on quality	3
7	Application of bivariate normal distribution for yarn quality evaluation for warping	4
8	Different grades of PVA and its application in sizing; High pressure sizing	3
9	Yarn quality requirements for high speed weaving	3
10	Effect of yarn parameters in air-jet weaving; Measurement of best up force in shuttle-less weaving and parameters influencing beat up force.	3
11	Image based system for automatic inspection of fabric quality; Uster fabriscan system	3
12	Yarn quality requirements for knitting; Optimization of process parameters in knitting	3
13	Twist loss in air-jet weaving; Predicting warp breakage rate from input yarn quality parameters	3
	TOTAL	42

19.	Suggested texts and reference materials: 1. Process control in textile manufacturing, edited by Majumdar, Das, Alagirusamy & Kothari, Woodhead 2. Seminar on Process Control in Spinning, Edited by R. Chattopadhyay, March 2001, IIT Delhi 3. Quality control in Spinning, 3 rd Edition, T. V. Ratnam and K.P. Chellamani, South India Textile Research Association, Coimbatore,1999 4. Process Control in Spinning , 2nd Edition,T A Subramaniam and AR Garde , ATIRA , Ahmedabad,1978 5. Process control in weaving, M C. Paliwal, P D. Kimothi, Ahmedabad Textile Industry's Research Association, 1983 6. Uster Sliver data for the process prior to spinning, Uster News Bulletin No.33/1986, Zellweger Uster 7. Product Quality and assurances at automatic rotor spinning machines, Uster News Bulletin No.34/1987, Zellweger Uster 9. The detection of end breaks in ring spinning, Uster News Bulletin No.27/1979, Zellweger Uster 10. The Uster system of yarn fault control, Uster News Bulletin No.29/1981, Zellweger Uster 11. Uster polyguard Q-pack,Uster News Bulletin No.37/1990, Zellweger Uster 12. Quality management in spinning mill, Uster News Bulletin No.39/1993, Zellweger Uster 13. On line quality control in spinning and weaving,Textile progress, Vol 17, No.1/2 14. Computer Integrated Manufacturing and Total Quality management, D.M. Sigmon, P.L. Grady and S.C. Winchester Textile Progress, Vol 27, No.4, The Textile Insitute,1998 15. Evenness testing in yarn production, Part –I and II, R. Fruter, Quality control and assessment series. The Textile Institute, Manchester 16. Engineering in Textile coloration, Edited by C. Duckworth, Dyers company publication trust, England , 1983
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20. Resources required for the course (*itemized & student access requirements, if any*)

20.1	Software	None
20.2	Hardware	None
20.3	Teaching aides (videos, etc.)	PPT
20.4	Laboratory	None
20.5	Equipment	None
20.6	Classroom infrastructure	Lecture room with AV facility
20.7	Site visits	None

21. Design content of the course (*Percent of student time with examples, if possible*)

21.1	Design-type problems	-
21.2	Open-ended problems	20 %
21.3	Project-type activity	-
21.4	Open-ended laboratory work	-
21.5	Others (please specify)	40% (case studies)

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Department of Textile Technology
2.	Course Title (< 45 characters)	Technical Textiles
3.	L-T-P structure	3-0-0
4.	Credits	3
5.	Course number	TXL775
6.	Status (category for program)	PC for M. Tech. (Textile Technology) students PE for M. Tech. (Fibre Science & Technology) students DE for B. Tech. (Textile Technology) students

7.	Pre-requisites (course no./title)	TXL211/TXL221/TXL222/TXL231/TXL232 and EC75 for UG students
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	Status vis-à-vis other courses (give course number/title)	
8.1	Overlap with any UG/PG course of the Dept./Centre	Nil
8.2	Overlap with any UG/PG course of other Dept./Centre	Nil
8.3	Supersedes any existing course	No

9.	Not allowed for (indicate program names)	Allowed for only B. Tech. (Textile Technology), M. Tech. (Textile Engineering) and M. Tech. (Fibre Science & Technology) students
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☒ 2 nd sem ☐ Either sem
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11.	Faculty who will teach the course	V. K. Kothari, R. Alagirusamy, Apurba Das, Abhijit Majumdar, Dipayan Das
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12.	Will the course require any visiting faculty?	No
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13.	Course objective <i>(about 50 words):</i> To introduce the selected aspects likes raw materials, design aspects, manufacturing details, and applications of technical textiles which involve mainly mechanical processing.
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14.	Course contents <i>(about 100 words) (Include laboratory/design activities):</i> Definition, classification, products, market overview and growth projections of technical textiles. Fibres, yarns and fabric structures in technical textiles and their relevant properties. Type and important characteristics of sewing threads. cords, ropes, braids and narrow fabrics. Textile and other filter media for dry and wet filtration. Fibre and fabric selection for filtration. Types and application of geosynthetics. Fibres and fabric selection criteria for geotextile applications. Application of textiles in automobiles. Requirement and design for pneumatic tyres, airbags and belts. Clothing requirements for thermal protection, ballistic protection. Materials used in bullet proof and cut resistant clothing. Material, method of production and areas of application of agrotexiles. Different types of fabrics used for packaging. Methods of production and properties of textiles used in these applications.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction, definition, classification, market and scope: Definition, classification, products, market overview and growth projections of technical textiles. Fibres, yarns and fabric structures in technical textiles and their relevant properties.	6
2	Sewing threads, cord, ropes, braids, narrow fabrics: Type and important characteristics of sewing threads. Definitions and major characteristics of cord, ropes, braids and narrow fabrics. Technical uses of these products.	6
3	Theory of filtration, types and concepts, filter fabrics: Textile and other filter media for dry and wet filtration. Mechanisms of separation. Requirements for good filter media and filtration. Fibre and fabric selection for filtration.	6
4	Geotextiles and other geosynthetics: Types and application of geosynthetics. Functions and application areas of geotextiles.	6

	Fibres and fabric selection criteria for geotextile applications. Mechanics of reinforcement, filtration and drainage by geotextiles. Soil characteristics. Methods of prediction of geotextile life and long term survivability in soil.	
5	Automotive Textiles: Application of textiles in automobiles. Requirement and design for pneumatic tyres, airbags and belts. Methods of production and properties of textiles used in these applications.	6
6	Protective Textiles – Protection against cold, bullets, cuts: Clothing requirements for thermal protection, ballistic protection. Extreme winter clothing with low heat transmission and comfort properties. Mechanism of high velocity impact absorption. Materials used in bullet proof and cut resistant clothing. Design for soft and hard armour. Design principles and evaluation of these protective clothing in these applications.	6
7	Agrotextiles, Architectural Fabrics, Textiles for Packaging etc.: Type and properties of fabrics used in these applications. Raw material, method of production and areas of application of agrotextiles. Different types of architectural fabrics and their property requirements. Design of temporary and permanent structures using fabrics. Different types of fabrics used for packaging. Their production techniques and properties.	6
		42

16.	Brief description of tutorial activities: Not applicable
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17.	Brief description of laboratory activities: Not Applicable
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18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours
1	Status and statistics on Indian technical textile industry. Government policies to promote technical textiles in India. Review on the fibre properties and statistics on the raw material availability for Indian technical textiles industry	6

2	Technology of manufacturing of different types of sewing threads, cord, ropes, braids, narrow fabrics. Commercial products available in these applications	6
3	Study of selected technical papers in the area of fabric filtration and preparation of term paper	6
4	Study on case studies of selected geotextile installations and preparing report	6
5	Issues related to recyclability and disposability of automotive components. Use of natural fibre based products in the automotive.	6
6	Status and statistics on the existing products in the area of thermal protection, ballistic protection, protection against knife attacks etc. Study of selected research papers in this area.	6
7	Government regulations for agrotextiles, architectural Fabrics and textiles for packaging. Textiles used in civil construction industry.	6
	TOTAL	42

19.	Suggested texts and reference materials: i. Handbook of Technical Textiles, Eds. A.R. Horrocks and S.C. Anand, Woodhead Publishing, U.K, 2000. ii. Wellington Sears Handbook of Industrial Textiles, Ed. S. Adanur, Alburn University, USA, Taylor & Francis, 1995. iii. Textiles in Automotive Engineering, Walter Fung and Mike Hardcastle, Woodhead Publishing, 2001. iv. Geotextiles, N.W.M. John, Chapman and Hall, New York, 1987. v. Technical Textile Yarns: Industrial and Medical Applications, Edited by R.Alagirusamy and A. Das, Woodhead Publishing Ltd, 2010 in association with Textile Institute.
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20. Resources required for the course (itemized & student access requirements, if any)

20.1	Software	Nil
20.2	Hardware	None
20.3	Teaching aides (videos, etc.)	PPT
20.4	Laboratory	Nil
20.5	Equipment	None
20.6	Classroom	Lecture room with AV facility

	infrastructure	
20.7	Site visits	None

21. Design content of the course *(Percent of student time with examples, if possible)*

21.1	Design-type problems	10%
21.2	Open-ended problems	10%
21.3	Project-type activity	10%
21.4	Open-ended laboratory work	0%
21.5	Others (please specify)	0%

Date:

(Signature of the Head of Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Department of Textile Technology		
2.	Course Title (<i>< 45 characters</i>)	Product Design & Development		
3.	L-T-P structure	3-0-0		
4.	Credits	3		
5.	Course number	TXL777		
6.	Status (<i>category for program</i>)	PE for M.Tech. (Textile Engineering) students PE for M.Tech. (Fiber Science and Technology) students DE for B.Tech. (Textile Technology) students		
7.	Pre-requisites (course no./title)	TXL211/TXL221/TXL222/TXL231/TXL232 and EC 75 for UG students		
8.	Status vis-à-vis other courses (<i>give course number/title</i>)			
	8.1 Overlap with any UG/PG course of the Dept./Centre	No		
	8.2 Overlap with any UG/PG course of other Dept./Centre	No		
	8.3 Supersedes any existing course	TTL765		
9.	Not allowed for (indicate program names)	Students from other departments		
10.	Frequency of offering	Every sem 1st sem 2nd sem Either sem - Either sem		
11.	Faculty who will teach the course R. Chattopadhyay, Apurba Das, Amit Rawal			
12.	Will the course require any visiting faculty? (yes/no)	No		
13.	Course objectives (<i>about 50 words</i>): To impart knowledge related to (i) structured method followed for designing and developing textile products (ii) developing design logic for apparel, home & technical textile products			

14.	Course contents (about 100 words) (Include laboratory/design activities): Introduction to product development, distinguishing features of textile products, and its classification. Generic product development process, identifying customer need and its analysis, development of specification, need to metric conversion; Concept generation methodology, concept selection. Material selection, performance characteristics of apparel, home textile and technical products, criterion for material selection. Role of fibre, yarn and fabric and finishing process on product performance. Industrial design, ergonomics and aesthetics, Product architecture, Anthropometric principles, fit. Principles of prototyping, 3 D computer modeling, free-form fabrication. Design options for improving properties and functional attributes of different products. Design logic for developing selected products, Analysis of few products ; Calculation of design parameters for a given end use, developing detail specification for each structural element.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction	2
	Introduction to product development , challenges in development process , distinguishing features in textile products, textile product classification	
2	Generic product development process	3
	Generic development process, process flow chart , identifying customer need and its analysis	
3	Specification development	3
	Specification for technical and apparel products, specification of fibre, yarn and fabrics, development of specification , need to metric conversion,	
4	Concept generation	2
	Concept generation methodology, concept selection	
5	Material selection	3
	Material data bank, comparative analysis, Criterion for material selection, types of fibres, yarns , fabrics and their characteristics	
6	Role of fibre, yarn and fabric parameters	4
	Role of fibre, yarn and fabric parameters on product performance, Various finishing treatments and its role on fabric performance, Qualitative and quantitative relationship between fibre, yarn and fabric properties	
7	Industrial design	5
	Industrial design, ergonomics and aesthetics, Product	

	architecture, Ergonomics in textile product design, Anthropometric principles, fit	
8	Prototyping Types of prototype, principles of prototyping, 3 D computer modeling, free form fabrication, planning for prototype	2
9	Incremental improvement in design Design options for improving wrinkling, pilling, bagging, durability, flammability, water proofing, UV protection of fabrics	5
10	Product analysis Analysis of few products (Jacket, medical gown, compression garment, etc.)	4
11	Design logic Design logic in developing selected products : sports wear, cold weather clothing, sleeping bags, fire fighters uniform, work wear, carpets, rope & braids, filter fabrics etc.	5
12	Design calculation Calculation of design parameters for a given end use, (industrial woven fabric, filter fabrics, towel, winter clothing , ropes , braid etc.) developing detail specification for each structural element	4
	COURSE TOTAL (42 times 'L')	42

16. Brief description of tutorial activities: None

Module no.	Description	No. of hours

17. Brief description of laboratory activities: None

Module no.	Description	No. of hours

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours
1	Identifying shortcomings in daily use products, listing them in order of importance	3
2	Customer need through survey questionnaire	6
3	Broad specification development based on survey	3
4	Few concept development exercises	10
5	Product analysis	6
6	Detail specification development of a chosen target product	10

19. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

- Karl T. Ulrich and Steven D. Eppinger, **Product design and development** Tata McGraw-Hill, 3rd edition 2003,
- Successful product design, Bill Hollins & Stuart Pugh, Butterworth & Co. 1990
- Y E Mogahzy, **Engineering textiles, Integrating the design and manufacture of textile products**, Wood Head publishing Ltd. Cambridge, England 2009
- T Matsuo & M. N. Suresh, **The design logic of textile products** Textile progress, Vol 27, No.3, Textile Institute
- Jacquie Wilson, **Handbook of textile design, principle, processes and practice**, The Textile institute, CRC Pres, Wood Head publishing Ltd, Cambridge, England, 2001

20. Resources required for the course (*itemized & student access requirements, if any*)

20.1	Software	Matlab®
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20.2	Hardware	None
20.3	Teaching aides (videos, etc.)	Chalkboard/Whiteboard, Tablet-PC, Laptop
20.4	Laboratory	None
20.5	Equipment	None
20.6	Classroom infrastructure	Lecture room with AV facility
20.7	Site visits	None
20.8	Others (please specify)	None

21. Design content of the course *(Percent of student time with examples, if possible)*

21.1	Design-type problems	40 %
21.2	Open-ended problems	
21.3	Project-type activity	
21.4	Open-ended laboratory work	
21.5	Others (please specify)	

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Department of Textile Technology
2.	Course Title (<i>< 45 characters</i>)	Project Appraisal & Finance
3.	L-T-P structure	3-0-0
4.	Credits	3
5.	Course number	TXL781
6.	Status (<i>category for program</i>)	PE for M.Tech. (Textile Engineering) students PE for M.Tech. (Fiber Science and Technology) students DE for B.Tech. (Textile Technology) students

7.	Pre-requisites (course no./title)	TXL211/TXL221/TXL222/TXL231/TXL232 and EC75 for UG students
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	None
8.2	Overlap with any UG/PG course of other Dept./Centre	None
8.3	Supersedes any existing course	TTL 761

9.	Not allowed for (indicate program names)	None
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10.	Frequency of offering	☐ Every sem ☐ 1stsem ☐ 2ndsem ☐ Either sem - 1 st semester
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11.	Faculty who will teach the course B. K. Behera, S. M. Ishtiaque, Abhijit Majumdar
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12.	Will the course require any visiting faculty? (yes/no)	No
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13.	Course objectives (about 50 words): This course is designed to help students to understand business environment with a view to take a decision to set up a project or to start a business specific to textile industry. The objective of this course is to familiarise the students with both, capital budgeting aspect and the contents of a bankable feasibility report. The course content will be supplemented by case studies of capital investments undertaken by corporate. The students will prepare a preliminary feasibility report covering all the elements of the course.
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14.	Course contents (about 100 words) (Include laboratory/design activities): Introduction to Project Finance - Description of Project Finance Transaction, difference between corporate finance and project finance, Indian Financial system, Structuring the Project, Limited Resource Structures, Capital Investments : Importance & Difficulties ,CPV analysis, Financial statements, Financial statement analysis, Working capital management, Inventory management, Project cycle, Project Formulation, Project Appraisal, Financial appraisal, Economic Appraisal, Social Cost Benefit Analysis-Shadow Prices and Economic rate of return, Financing Projects, Sources of funding, Valuing Projects , NPV, IRR, MIRR, Real Options, Decision Trees and Monte Carlo Simulations, Financial Estimates & projections, Technical Analysis, Market & Demand Analysis, Investment Criteria, Cost of capital, Project Risk analysis, Sensitivity Analysis, Leverage analysis, Environment Appraisal of the project and Detailed Project Report, Case studies on Textile projects
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
	Indian Financial system and Project finance	
	Indian Financial system, Financial Institutions, Introduction to Project Finance , Financing Projects, Understanding debt, Raising long-term finance, Raising Capital In international Markets, Project financing structures, Description of Project Finance Transaction, difference between corporate finance and project finance, Sources of Funding, Banking system, Structuring the Project, Limited Resource Structures, Capital Investments : Importance & Difficulties	2
	CPV Analysis	
	Profit calculation, Concept of depreciation, CPV analysis, Breakeven analysis, Algebraic Analysis of CVP relationship ,	2

	Nonlinear cost - volume – profit, Multiple product Analysis	
	Financial statements and analysis	
	Financial statements, Balance Sheet, Profit and Loss Account, Fund Flow Statement , Financial statement analysis, Financial Ratios, Comparative Analysis, Du Pont Analysis	6
	Inventory and working capital management	
	Inventory management, Order quantity, pricing of inventory, Monitoring and control of inventory, Working capital management, Working capital policy, Working capital financing	2
	Project Formulation	
	Project cycle, Functions in the project cycle, Project Formulation, Preparation of investment proposal, Market analysis, Technical analysis, Product analysis, Balancing of equipment, Determination of cost of project, Techno-commercial feasibility study	6
	Project Appraisal	
	Project Appraisal, Need for appraisal, Pre-Appraisal criteria, Management analysis, Financial appraisal, Cost of the project, Means of Finance, Market and selling arrangement, Profitability and cash flow, Balance sheet, Profit and Loss Account, Financial Estimates & projections, Analysis of working results, Investment decision, DCF and Non DCF criteria, Time value of money, Pay back period, ARR, NPV, IRR, BCR, DSCR, ROA, ROCE, Cost of capital, Economic Appraisal, Sustainability issue in project appraisal, Social and economic impact, Economic vs Financial Appraisal , Social Cost, Market imperfection, Shadow Prices, Economic Appraisal criteria, ERR, ERP, DRC,	6
	Environment and Misc. Analysis	
	Environment Appraisal of the project, Technical Analysis, Market & Demand Analysis, Project Risk analysis, Sensitivity Analysis, Leverage analysis,	2
	Case studies on Textile projects	2
	COURSE TOTAL (42 times 'L')	28

16. Brief description of tutorial activities:

Module no.	Topic	No. of hours
	Indian Financial system and Project finance	1

	CPV Analysis	2
	Financial statements and analysis	4
	Inventory and working capital management	1
	Project Formulation	1
	Project Appraisal	2
	Environment and Misc. Analysis	1
	Case studies on Textile projects	2
	COURSE TOTAL (14 times 'L')	14

17. Brief description of laboratory activities - None

Module no.	Description	No. of hours

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours
1	Indian Financial system and Project finance	
	Preparation and presentation of term paper	6
	CPV Analysis	
	Solving numerical problems, Preparation and presentation of term paper	4
	Financial statements and analysis	
	Solving numerical problems, Preparation and presentation of term	6

	paper	
	Inventory and working capital management	
	Solving numerical problems, Preparation and presentation of term paper	2
	Project Formulation	
	Solving numerical problems, Preparation and presentation of term paper	6
	Project Appraisal	
	Solving numerical problems, Preparation and presentation of term paper	10
	Environment and Misc. Analysis	
	Solving numerical problems, Preparation and presentation of term paper	6
	Case studies on Textile projects	2
	COURSE TOTAL (42 times 'L')	42

19. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. Financial Management by Prasanna Chandra, Tata McGraw-Hill publishing Ltd
2. Project Evaluation by Prasanna chandra, Tata McGraw-Hill publishing Ltd
3. Management Accounting by Khan and Jain, Tata McGraw-Hill publishing Ltd
4. Wheldon's Cost Accounting and costing methods, by L W J Owler and J L Brown,

20. Resources required for the course (*itemized & student access requirements, if any*)

20.1	Software	
20.2	Hardware	
20.3	Teaching aides (videos, etc.)	

20.4	Laboratory	No
20.5	Equipment	No
20.6	Classroom infrastructure	
20.7	Site visits	No
20.8	Others (please specify)	

21. Design content of the course *(Percent of student time with examples, if possible)*

21.1	Design-type problems	
21.2	Open-ended problems	60%
21.3	Project-type activity	40%
21.4	Open-ended laboratory work	
21.5	Others (please specify)	

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Department of Textile Technology
2.	Course Title (<i>< 45 characters</i>)	Production and Operations Management of Textile Industry
3.	L-T-P structure	3-0-0
4.	Credits	3
5.	Course number	TXL782
6.	Status (<i>category for program</i>)	DE for B.Tech. (Textile Technology) students and PE for M. Tech. (Textile Engineering) students PE for (Fibre Science & Technology) students

7.	Pre-requisites (course no./title)	TXL211/TXL221/TXL222/TXL231/TXL232 and EC75 for UG students
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	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	Nil
8.2	Overlap with any UG/PG course of other Dept./Centre	No SML 745 Operations management (15%)
8.3	Supersedes any existing course	TTL762

9.	Not allowed for (indicate program names)	No such restriction
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem ☒ Either sem
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11.	Faculty who will teach the course S. M. Ishtiaque, B K. Behera, R. Rengasamy, R, Alagirusamy, Abhijit Majumdar	
12.	Will the course require any visiting faculty?	No

13.	Course objective (<i>about 50 words</i>):	
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	After attending the course the student will learn – to study SOWT analysis of India textile industry, responsibility of function to make a required product of good quality with an acceptable price and delivery at time and place the customer desires with required efficiency and effectiveness and to understand the marketing and financial implications.
14.	Course contents <i>(about 100 words) (Include laboratory/design activities):</i> Indian textile industry scenario. Textile Policy. Production and operations management function. Operation strategy. Facility location and capacity planning. Production planning and control, aggregate planning, scheduling, PERT and CPM, product mix linear programming concepts. Inventory models, optimal order quantity, economic manufacturing batch size, classification of materials, materials requirement planning, Just in time concept. Supply chain Management. Maintenance management. Plant modernisation. Motion and time study. Job evaluation and incentive scheme. Productivity, partial and total productivity, machine, labour and energy productivity, efficiency and effectiveness, benchmarking, measure to increase productivity. Forecasting, methods of forecasting. Total quality management and Six Sigma. Product pricing. Financial and profit analysis, investment decisions. Management information system.

15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Indian textile industry scenario, production and export, yarn, fabric and apparel sectors.	2
2	Textile Policy, Sickness in textile industry, analysis and options.	2
3	Production and operations management function.	1
4	Operation strategy, facility location and capacity planning	3
5	Production planning and control; aggregate planning, scheduling, PERT and CPM, product mix using linear programming concepts.	4
6	Inventory models and safety stock; optimal order quantity, economic manufacturing batch size.	3
7	Classification of materials, materials requirement planning, material store management and distribution management, Just in time concept.	2
8	Supply chain Management in textile industry	2
9	Maintenance management in textile industry	2
10	Plant modernisation	2
11	Motion and time study	2
12	Job evaluation and incentive scheme.	1

13	Productivity; partial and total productivity, machine, labour and energy productivity, efficiency and effectiveness, benchmarking, measure to increase productivity.	3
14	Forecasting; methods of forecasting, moving average, regression and exponential smoothing techniques, forecasting accuracy.	2
15	Quality control, Total quality management and Six Sigma.	3
16	Product marketing and pricing for textile industry	2
17	Financial and profit analysis, investment decisions.	4
18	Management information system.	2
		42

16.	Brief description of tutorial activities: Not applicable
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17.	Brief description of laboratory activities: Not Applicable
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18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours
1-2	Product-process matrix for textile industries (synthetic fibre, yarn, fabric and apparel)	4
3-4	Techniques of facility layout, activity relationship chart and diagram, load-distance analysis, computerized facility layout planning	6
5-6	Project crashing method; Earned value analysis for project control; Managing project resources, resource levelling	6
7-8	Lean, agile and leagile supply chains and their metrics; Right supply chain for functional (predictable demand) and innovative products (unpredictable demand)	6
9-10	Techniques for the evaluation of alternative proposals for the modernization of plant; Decision tree model	4
11-12	NIL	-
13-14	Data envelopment analysis for efficiency measurement	6
15-16	Numerical problems related to six sigma and process capability; Product life-cycle analysis; Conflict of marketing and operation functions	6
17-18	Marginal analysis for investment decisions	4
TOTAL		48

19.	Suggested texts and reference materials: i. Production & Operations management by R. Panneerselvam ii. Operations and supply management by Chase, Ravi Shankar, Jacob & Aquilano iii. Operations management: Theory and Practice by B. Mahadevan iv. Operations management by Krajewski, Ritzman and Malhotra v. Operations research: An introduction by H. A. Taha vi. Management Accounting: M. Y. Khan & P. K. Jain, Tata McGraw-Hill
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20. Resources required for the course (*itemized & student access requirements, if any*)

20.1	Software	NPTEL web site, LINDO, MS PROJECT
20.2	Hardware	None
20.3	Teaching aides (videos, etc.)	PPT
20.4	Laboratory	Nil
20.5	Equipment	None
20.6	Classroom infrastructure	Lecture room with AV facility
20.7	Site visits	None

21. Design content of the course (*Percent of student time with examples, if possible*)

21.1	Design-type problems	10%
21.2	Open-ended problems	20%
21.3	Project-type activity	20%
21.4	Open-ended laboratory work	0%
21.5	Others (please specify)	0%

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Department of Textile Technology		
2.	Course Title (< 45 characters)	Design of Experiments and Statistical Techniques		
3.	L-T-P structure	3-0-0		
4.	Credits	3		
5.	Course number	TXL783		
6.	Status (category for program)	PC for M.Tech. (Textile Engineering) students PE for M.Tech. (Fiber Science and Technology) students DE for B.Tech. (Textile Technology) students		
7.	Pre-requisites (course no./title)	TXL211/TXL221/TXL222/TXL231/TXL232 and EC75 for UG students		
8.	Status vis-à-vis other courses (give course number/title)			
	8.1 Overlap with any UG/PG course of the Dept./Centre	No		
	8.2 Overlap with any UG/PG course of other Dept./Centre	No		
	8.3 Supersedes any existing course	TTL773		
9.	Not allowed for (indicate program names)	None		
10.	Frequency of offering	Every sem 1st sem 2nd sem Either sem - 2nd sem		
11.	Faculty who will teach the course R. Chattopadhyay and Dipayan Das			
12.	Will the course require any visiting faculty? (yes/no)	No		
13.	Course objectives (about 50 words): To provide students with a solid foundation about the fundamentals of experimental design, analysis of results and their interpretations.			

14.	Course contents (about 100 words) (Include laboratory/design activities): Objectives, principles, terminologies, guidelines, and applications of design of experiments. Completely randomized design. Randomized block design. Latin square design. Two level and three level full factorial designs. Fractional factorial designs. Robust design. Mixture experiments. Central composite and Box-Behnken designs. Response surface methodology. Multi-response optimization. Analysis of variance. Statistical test of hypothesis. Analysis of multiple linear regression. Use of statistical software packages.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction to design of experiments Objectives, principles, terminologies, guidelines, and applications of design of experiments.	1
2	Completely randomized design Principles and structure of completely randomized design, Statistical model, Statistical test of hypothesis, Analysis of variance, Multiple comparison among treatment means, Analysis of multiple linear regression, Practical examples, Use of software package.	6
3	Randomized block design Principles and structure of randomized block design, Statistical model, Statistical test of hypothesis, Analysis of variance, Multiple comparison among treatment means, Analysis of multiple linear regression, Practical examples, Use of software package.	4
4	Latin square design Principles and structure of Latin Square design, Statistical model, Statistical test of hypothesis, Analysis of variance, Multiple comparison among treatment means, Analysis of multiple linear regression, Practical examples, Use of software package.	4
5	Full Factorial designs Two-level and three-level full factorial designs, Analysis of main and interaction effects, Blocking, Confounding, Replication, Analysis of contrasts, Statistical model, Statistical test of hypothesis, Analysis of variance, Analysis of multiple linear regression, Practical examples, Use of software package.	8
6	Fractional factorial designs Two-level fractional factorial designs, Analysis of main and interaction effects, Statistical model, Statistical test of hypothesis, Analysis of variance, Analysis of multiple linear regression, Design resolution, Practical examples, Use of software package	4
7	Robust design	4

8	Orthogonal array, Signal-to-noise ratio, Quality characteristics, Analysis of multiple linear regression, Practical examples, Use of software package Mixture experiments	5
9	Simplex lattice designs, Augmented simplex designs, Standard mixture models, Statistical model, Statistical test of hypothesis, Analysis of variance, Analysis of multiple linear regression, Practical examples, Use of software package Response surface methodology	6
COURSE TOTAL (42 times 'L')		42

16. Brief description of tutorial activities: None

Module no.	Description	No. of hours

17. Brief description of laboratory activities: None

Module no.	Description	No. of hours

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours

1	Introduction to design of experiments Learning from published critical reviews on design of experiments	1
2	Completely randomized design Solving numerical problems using calculator, or by utilizing statistical software, Writing case studies on published research articles on applications of design of experiments.	6
3	Randomized block design Solving numerical problems using calculator, or by utilizing statistical software, Writing case studies on published research articles on applications of design of experiments.	4
4	Latin square design Solving numerical problems by hand using calculator, or by utilizing statistical software, Writing case studies on published research articles on applications of design of experiments.	4
5	Full Factorial designs Solving numerical problems using calculator, or by utilizing statistical software, Writing case studies on published research articles on applications of design of experiments.	8
6	Fractional factorial designs Solving numerical problems by hand using calculator, or by utilizing statistical software, Writing case studies on published research articles on applications of design of experiments.	4
7	Robust design Solving numerical problems using calculator, or by utilizing statistical software, Writing case studies on published research articles on applications of design of experiments.	4
8	Mixture experiments Solving numerical problems using calculator, or by utilizing statistical software, Writing case studies on published research articles on applications of design of experiments.	5
9	Response surface methodology Solving numerical problems using calculator, or by utilizing statistical software, Writing case studies on published research articles on applications of design of experiments.	6

19. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

G. A. V. Leaf, Practical Statistics for the Textile Industry, Part I & Part II, The Textile Institute, Manchester, 1984.

R. Panneerselvam, Design and Analysis of Experiments, PHL Learning Pvt. Ltd., New Delhi, 2012.

D. C. Montgomery, Design and Analysis of Experiments, Wiley-India, 2007.

C. R. Hicks, Fundamental Concepts in the Design of Experiments, CBS College Publishing, New York, 1982.

R. Panneerselvam, Research Methodology, Second Edition, PHL Learning Pvt. Ltd., Delhi, 2014.

S. C. Gupta and V. K. Kapoor, Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi, Fourth Edition, 2009.

D. C. Montgomery and G. C. Runger, Applied Statistics and Probability for Engineers, Wiley-India, 2008.

20. Resources required for the course (*itemized & student access requirements, if any*)

20.1	Software	Design Expert [®] , Matlab [®]
20.2	Hardware	None
20.3	Teaching aides (videos, etc.)	Chalkboard/Whiteboard, Tablet-PC, Laptop
20.4	Laboratory	None
20.5	Equipment	None
20.6	Classroom infrastructure	Lecture room with AV facility
20.7	Site visits	None
20.8	Others (please specify)	None

21. Design content of the course (*Percent of student time with examples, if possible*)

21.1	Design-type problems	40 %
21.2	Open-ended problems	5 %
21.3	Project-type activity	
21.4	Open-ended laboratory work	
21.5	Others (please specify)	

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department/Centre proposing the course	Department of Textile Technology
2.	Course Title (<i>< 45 characters</i>)	Supply Chain Management in Textile Industry
3.	L-T-P structure	3-0-0
4.	Credits	3
5.	Course number	TXL 784
6.	Status (<i>category for program</i>)	PE for M. Tech. (Textile Engineering) students PE for (Fibre Science & Technology) students

7.	Pre-requisites (course no./title)	None
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Status vis-à-vis other courses (<i>give course number/title</i>)		
8.1	Overlap with any UG/PG course of the Dept./Centre	No Operations and production management in textile industry (5 %)
8.2	Overlap with any UG/PG course of other Dept./Centre	No 1. Supply chain logistics management (SML 745): 10 % 2. Supply chain management (MEL 756): 10 %
8.3	Supersedes any existing course	No

9.	Not allowed for (indicate program names)	Students who have done SML 745/MEL 756
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10.	Frequency of offering	☐ Every sem ☒ 1 st sem ☐ 2 nd sem ☐ Either sem
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11.	Faculty who will teach the course Abhijit Majumdar, R. S. Rengasamy, S. M. Ishtiaque
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12.	Will the course require any visiting faculty?	No
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13.	Course objective (about 50 words): After attending the course the student will be able to – Design a supply chain network that is best suited for the textile (fibre, yarn, fabric and apparel) business – Devise strategies to handle uncertainty in textile supply chain – Understand the value of information and coordination in textile supply chain
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14.	Course contents (about 100 words) (Include laboratory/design activities): Definition, objectives, stages and metrics of textile supply chain; Life cycle of textile products, demand and fashion forecasting, forecasting techniques, bull-whip effect, aggregate forecasting in apparel industry; Designing of textile supply chain network, make vs buy and location decisions of textile SCM, reverse logistics in textile SCM; Risk mitigation in global textile supply chain, coordination among fabric, apparel and accessories manufacturers, role of dominant power; Transportation and distribution strategies; Supplier selection in textile SCM, quantitative models; Lean, agile and leagile textile supply chains and their enablers, designing resilient textile supply chain; Push-pull supply chain, decoupling point in textile SCM; Green and low carbon textile supply chain; Case studies related to textile and apparel supply chains.
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15. Lecture Outline (with topics and number of lectures)

Module no.	Topic	No. of hours
1	Introduction to textile and apparel supply chain, role of SCM in winning at market place and effective customer service, link of SCM with organizational strategy, flows in a decentralized textile and apparel supply network, issues related to cotton fibre and apparel supply chain, life cycle, seasonality and fashion trends, migration of textile supply chain, textile supply chain drivers and metrics.	3
2	Inventory management in textile industry, bale management, product mix issues in textile and apparel industry, EOQ with and without price breaks for fabrics and accessories, average inventory and safety stocks, ABC and VED analysis in spinning, weaving and apparel industry.	3
3	Value of information, bull-whip effect in textiles, aggregate demand forecasting in apparel industry by colour, size and blend, forecasting techniques, moving average, exponential smoothing, regression, forecasting errors, make or buy decisions, Postponement of product development, procurement,	3

	manufacturing and logistics postponement in textile supply chain, Aggregate planning in textile supply chain	
4	Designing and optimizing of textile supply chain network, facility location decisions for weaving and apparel units and warehouses, quantitative approaches, Brown-Gibson model, warehouse design, reverse logistics and recycling of textiles.	3
5	Transportation in textile supply chain with reference to cotton fibres, yarns, fabrics and apparels, selection of transportation modes, trade-offs, quantitative models of transportation, distribution strategies, benefits of centralized warehousing	3
6	Supplier selection in textile SCM, quantitative models for supplier selection, multi-criteria decision making techniques, applications of AHP, TOPSIS, handling uncertainty in supplier selection	3
7	Supply chain collaboration and coordination, obstacles, role of dominant power in textile supply chain, risk mitigation in global textile supply chain, strategic partnership and vendor development in supply chain, VMI, CPFR, supply chain disruptions and resilient supply chain.	3
8	Efficient and responsive supply chain; Lean, agile and leagile supply chains, order qualifiers and order winners, modelling enablers of agile and leagile supply chains.	3
9	Push, pull and push-pull supply chain, decoupling point for information and inventory, buy to order, make to order, assemble to order and ship to order, Just in time concepts, Interface of supply chain with marketing and finance	3
10	Emerging issues: green and low carbon textile supply chain, carbon footprints, eco-materials, sustainable manufacturing, green distribution and retailing, supply chain of organic cottons, Global organic textile standards (GOTS), ethical issues in textile supply chain, wages, sweatshop, labelling, health and environmental aspects, FTC guidelines.	3
11	Role of information technology in supply chain, RFID applications, decision support systems, smart pricing	3
12	Supply chain modelling, transportation problem, vendor quota allocation problem, vehicle routing model, beer game, applications of simulation, decision tree etc.	3
13	Case studies and discussion: Zara, Benetton, H & M, Sport Obermeyer etc., Apparel supply chains in USA, U. K. and Hong Kong.	6
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16.	Brief description of tutorial activities: Not applicable
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17.	Brief description of laboratory activities: Not Applicable
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18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours
1	Recent changes in apparel supply chain, Fast fashion supply chains.	3
2	Optimizing the product mix of apparel industry using LPP and goal programming; Impact of uncertainty on safety inventory in textile supply chain	4
3	Forecasting of apparel sales using soft computing techniques	4
4	Role of uncertainty in supply chain decisions and textile supply chain network design.	3
5	Role of information technology in logistics and transportation.	4
6	Fuzzy MCDM techniques for supplier selection in apparel industry	4
7	Quantifying risk in supply chain.	3
8	Modelling agile fashion supply chain.	4
9	Apparel supply chain and its variants for basic and fashion products.	3
10	Green vendor rating system; Green supplier selection	3
11	Case study on RFID application in European textile supply chain	3
12	OR techniques, LPP, Goal programming, Genetic algorithm, MODI and VAM methods of transportation	4
	TOTAL	42

19.	Suggested texts and reference materials: I. Fashion Supply Chain Management Using Radio Frequency Identification (RFID) Technologies by W. K. Wong and Z. X. Guo, Woodhead publisher. II. Design and managing the supply chain by Simchi Levi, Philip kaminsky, Edith Simchi Levi & Ravi Shankar, The Tata McGrawhill. III. Supply chain management: strategy, planning and operation by Chopra, Meindl and Kalra, Pearson Education IV. Supply Chain Management: Theories and practices by Mohanty and Deshmukh, Biztantra V. Quantitative models in Operations and supply chain management, G. Srinivasan, PHI Learning Pvt. Ltd. VI. Production & Operations management by R. Panneerselvam, PHI Learning Pvt. Ltd. VII. Operations research: An introduction by H. A. Taha, Pearson.
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20. Resources required for the course (*itemized & student access requirements, if any*)

20.1	Software	LINDO for optimization; Crystal ball software for simulation
20.2	Hardware	None
20.3	Teaching aides (videos, etc.)	PPT, Videos of supply chain best practices
20.4	Laboratory	Nil
20.5	Equipment	None
20.6	Classroom infrastructure	Lecture room with AV facility
20.7	Site visits	None

21. Design content of the course (*Percent of student time with examples, if possible*)

21.1	Design-type problems	20%
21.2	Open-ended problems	20%
21.3	Project-type activity	20%
21.4	Open-ended laboratory work	0%
21.5	Others (please specify)	0%

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Department of Textile Technology
2.	Course Title (<i>< 45 characters</i>)	Seminar (Textile Engineering)
3.	L-T-P structure	0-2-0
4.	Credits	2
5.	Course number	TXL807
6.	Status (<i>category for program</i>)	PE for M. Tech. (Textile Engineering) students

7.	Pre-requisites (course no./title)	N.A.
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	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	Nil
8.2	Overlap with any UG/PG course of other Dept./Centre	Nil
8.3	Supersedes any existing course	No

9.	Not allowed for (indicate program names)	Allowed for only M. Tech. (Textile Engineering) students
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem ☒ Either sem
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11.	Faculty who will teach the course S. M.Ishtiaque, R. Chattopadhyay, R.Alagirusamy, R. Rengasamy, Apurba Das, AbhijitMajumdar, Dipayan Das, Amit Rawal, B. K. Behera	
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12.	Will the course require any visiting faculty?	No
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13.	Course objective <i>(about 50 words):</i> Performing a comprehensive literature review on a research topic of current interest or futuristic, pertaining to a textile process or product or technology
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14.	Course contents <i>(about 100 words) (Include laboratory/design activities):</i> A comprehensive literature review on a research topic of current interest or futuristic, pertaining to a textile process or product or technology. Student should perform a comprehensive literature review on a research topic of current interest or futuristic, pertaining to a textile process or product or technology. The student should give an outline of the review and get approval from the program coordinator for registration of this course. The student registered for this course should give one mid-term presentation followed by a final presentation before a committee constituted by the program coordinator.
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15. Lecture Outline *(with topics and number of lectures)* **Not Applicable.**

Module no.	Topic	No. of hours
		28

16.	Brief description of tutorial activities: Not applicable
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17.	Brief description of laboratory activities: Not Applicable
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18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours
	TOTAL	28

19.	Suggested texts and reference materials: Not applicable.
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20. Resources required for the course (*itemized & student access requirements, if any*)

20.1	Software	None
20.2	Hardware	None
20.3	Teaching aides (videos, etc.)	None
20.4	Laboratory	None
20.5	Equipment	None
20.6	Classroom infrastructure	None
20.7	Site visits	None

21. Design content of the course *(Percent of student time with examples, if possible)*

21.1	Design-type problems	10%
21.2	Open-ended problems	15%
21.3	Project-type activity	15%
21.4	Open-ended laboratory work	0%
21.5	Others (please specify)	0%

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Department of Textile Technology
2.	Course Title (< 45 characters)	Mechanics of Textile Machines Laboratory
3.	L-T-P structure	0-0-2
4.	Credits	1
5.	Course number	TXP725
6.	Status (category for program)	PC for M.Tech. (Textile Engineering) students

7.	Pre-requisites (course no./title)	Nil
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8.	Status vis-à-vis other courses (give course number/title)	
8.1	Overlap with any UG/PG course of the Dept./Centre	Nil
8.2	Overlap with any UG/PG course of other Dept./Centre	Nil
8.3	Supersedes any existing course	No

9.	Not allowed for (indicate program names)	Allowed for only M. Tech. (Textile Engineering) students
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☒ 2 nd sem ☐ Either sem
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11.	Faculty who will teach the course Apurba Das, R. S. Rengasamy, R. Alagirusamy, S. M. Ishtiaque, R. Chattopadhyaya, Abhijit Majumdar, Dipayan Das	
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12.	Will the course require any visiting faculty?	No
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13.	Course objective (about 50 words): Students will do experimental analysis of various machine elements on textile	
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	machines.
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Study of clutch, brake, cam, belt, crossed helical gears, transmission shafts, drafting rollers, beaters, padding rollers and balancing of rotors in spinning, weaving, knitting and chemical processing machines.
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15. Lecture Outline (*with topics and number of lectures*): **Not applicable**

16. Brief description of tutorial activities: **Not applicable**

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17. Brief description of laboratory activities

Module no.	Topic	No. of hours
1.	Analysis of cams in weaving, knitting and spinning machines	6
2.	Analysis of profile of cone pulleys in textile machines	6
3.	Analysis of disc and cone clutches in textile machines	6
4.	Selection of multiple v-belts in textile machines	2
5.	Analysis of various brakes in textile machines	4
6.	Calculation of continuous and intermittent motions of planetary gears and delivery rate in comber	4
	COURSE TOTAL (14 times 'P')	28

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses): **Not applicable.**

19.	Suggested texts and reference materials: Basic reference books in spinning, weaving, knitting and chemical processing. NPTEL Course material.
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20. Resources required for the course (*itemized & student access requirements, if any*)

20.1	Software	NPTEL web site
20.2	Hardware	Machines in Textile Department
20.3	Teaching aides (videos, etc.)	Blackboard, PPT, Animation, videos
20.4	Laboratory	Laboratories of Textile Department
20.5	Equipment	Machines in Textile Department
20.6	Classroom infrastructure	Not required
20.7	Site visits	None

21. Design content of the course *(Percent of student time with examples, if possible)*

21.1	Design-type problems	-
21.2	Open-ended problems	-
21.3	Project-type activity	50%
21.4	Open-ended laboratory work	50%
21.5	Others (please specify)	-

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE TTP 761

1.	Department/Centre proposing the	Department of Textile Technology
2.	Course Title (<i>< 45 characters</i>)	Evaluation of Textile Materials
3.	L-T-P structure	0-0-4
4.	Credits	2
5.	Course number	TXP761
6.	Status (<i>category for program</i>)	PC for M. Tech. (Textile Engineering) students

7.	Pre-requisites (course no./title)	None
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	Nil
8.2	Overlap with any UG/PG course of other Dept./Centre	Nil
8.3	Supersedes any existing course	TTP761

9.	Not allowed for (indicate program names)	Allowed only for M. Tech (Textile Engineering) students
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem X 2 nd sem ☐ Either sem
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11.	Faculty who will teach the course S. M. Ishtiaque, R. Chattopadhyay, R. Alagirusamy, R. Rengasamy, B. K. Behera, Apurba Das, Abhijit Majumdar, Amit Rawal, Dipayan Das.	
12.	Will the course require any visiting faculty?	NIL

13.	Course objective (<i>about 50 words</i>): The introduce the advanced physical testing methods which are used to evaluate textile materials.	

14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Evaluation of clothing comfort, flammability, bursting strength, bandage pressure, UPF, impact resistance, pore size and filtration efficiency.

15. Lecture Outline (*with topics and number of lectures*): **NOT APPLICABLE**

16. Brief description of tutorial activities: NOT APPLICABLE

17. Brief description of laboratory activities:

Experiment no.	Description	No. of hours
1	Evaluation of heat and mass transmission through fabrics	4
2	Evaluation of fabric feel characteristics by extraction method	4
3	Evaluation of transverse and vertical wicking characteristics of fabrics	4
4	Evaluation of fabric handle characteristics by Kawabata Evaluation System	4
5	Evaluation of moisture vapour transmission by moisture management tester (MMT) and permitron	4
6	Evaluation of air permeability of woven fabrics and relating it with fabric cover.	4
7	Evaluation of fabric flame resistance	4
8	Evaluation of bursting strength and analysis of effect of repeated bursting cycle on bursting strength	4
9	Evaluation of internal pressure compression bandage (only bandage samples)	4
10	Evaluation of ultraviolet protection factor (UPF) of woven fabrics	4
11	Evaluation of impact energy absorption by high performance woven fabrics	4
12	Measurement of yarn pull-out force from high performance fabrics	4
13	Evaluation of pore characteristics of woven and nonwoven fabrics	4
14	Evaluation of filtration efficiency of nonwoven filters	4

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

19.	Suggested texts and reference materials: 1. Physical testing of textiles by B. P. Saville, Woodhead publisher. 2. Science in clothing comfort by Apurba Das and R. Alagirusamy, Woodhead publisher
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20.	Resources required for the course (<i>itemized & student access requirements, if any</i>)
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20.1	Software	None
20.2	Hardware	None
20.3	Teaching aides (videos, etc.)	None
20.4	Laboratory	Textile testing; Protective textile; Comfort; Fabric manufacture.
20.5	Equipment	Testing equipments: KES-F, MMT, MVTR cell, Alambeta, Permatext, Textest, UV transmittance analyzer, Instron tensile tester, True-burst, Porometer etc.
20.6	Classroom infrastructure	None
20.7	Site visits	None

21. Design content of the course (*Percent of student time with examples, if possible*)

21.1	Design-type problems	0%
21.2	Open-ended problems	0%
21.3	Project-type activity	80%
21.4	Open-ended laboratory work	20%
21.5	Others (please specify)	0%

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Department of Textile Technology
2.	Course Title (< 45 characters)	Independent Study (Textile Engineering)
3.	L-T-P structure	0-3-0
4.	Credits	3
5.	Course number	TXS805
6.	Status (category for program)	PE for M. Tech. (Textile Engineering) students

7.	Pre-requisites (course no./title)	N.A.
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	Status vis-à-vis other courses (give course number/title)	
8.1	Overlap with any UG/PG course of the Dept./Centre	Nil
8.2	Overlap with any UG/PG course of other Dept./Centre	Nil
8.3	Supersedes any existing course	TTS891

9.	Not allowed for (indicate program names)	Allowed for only M. Tech. (Textile Engineering) students
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem ☒ Either sem
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11.	Faculty who will teach the course S. M.Ishtiaque, R. Chattopadhyay, R. Alagirusamy, R. Rengasamy, Apurba Das, Abhijit Majumdar, Dipayan Das, Amit Rawal, B. K. Behera	
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12.	Will the course require any visiting faculty?	No
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13.	Course objective <i>(about 50 words):</i> To undertake research oriented activity on machine design, development of software, product, process and instrumentation or in-depth study of a subject that is outside the scope of regular courses offered in the program.
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14.	Course contents <i>(about 100 words) (Include laboratory/design activities):</i> Student should undertake a research oriented activity including software development, machine design & development, product & process development, instrumentation and in-depth study of a subject which is outside the regular courses offered in the program. This study should be carried out under the guidance of a faculty member. The subject area chosen by the student should be sufficiently different from the area of major project being pursued by the student. The student should submit a detailed plan of work to the program coordinator before approval of registration for the course. The student registered for this course should give one mid-term presentation followed by a final presentation before a committee constituted by the program coordinator.
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15. Lecture Outline *(with topics and number of lectures)*- **Not applicable**

Module no.	Topic	No. of hours
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16.	Brief description of tutorial activities: Not applicable
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17.	Brief description of laboratory activities: Not Applicable
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18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours
1	All the activities are of self-study nature under the supervision of a faculty	42
	TOTAL	42

19.	Suggested texts and reference materials: Not Applicable. i.
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20. Resources required for the course (*itemized & student access requirements, if any*)

20.1	Software	Crystal ball software for simulation, Matlab etc.
20.2	Hardware	Machines and equipment
20.3	Teaching aides (videos, etc.)	None
20.4	Laboratory	All the laboratories
20.5	Equipment	Necessary machines and instruments
20.6	Classroom infrastructure	None
20.7	Site visits	Industry, if the work is undertaken outside the department.

21. Design content of the course *(Percent of student time with examples, if possible)*

21.1	Design-type problems	100% (machine design and software development)
21.2	Open-ended problems	15%
21.3	Project-type activity	70%
21.4	Open-ended laboratory work	15%
21.5	Others (please specify)	0%

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department/Centre proposing the	Department of Textile Technology
2.	Course Title (<i>< 45 characters</i>)	Management of Textile Business
3.	L-T-P structure	1-0-0
4.	Credits	1
5.	Course number	TXV 702
6.	Status (<i>category for program</i>)	DE for B. Tech. (Textile Technology) students PE for M. Tech. (Textile engineering) students PE for M. Tech. (Fibre Science and Technology) students

7.	Pre-requisites (course no./title)	TXL211/TXL221/TXL222/TXL231/TXL232 and EC 75 for UG students
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	Nil
8.2	Overlap with any UG/PG course of other Dept./Centre	Nil
8.3	Supercedes any existing course	TTV702

9.	Not allowed for (indicate program names)	No such restriction
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem X ☒ Either sem
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11.	Faculty who will teach the course: Visiting Faculty	
12.	Will the course require any visiting faculty?	Yes

13.	Course objective (<i>about 50 words</i>): To introduce the aspects of textile industry and managing textile business in India.	
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): The textile industry of India : Past & its evolution to the present day. The	
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	structure of the Indian textile industry. Cotton textile sector, Jute textile sector. Silk textile sector. Manmade textile sector. Wool textile sector. Statistics of Indian textile business (domestic & export) and world textile trade. Textile policy 2000. Govt. of India. World trade practices. Norms, barriers etc. Various pertinent issues prevailing impacting textile industry and trade. Corporate social responsibility. Other compliances. ISO accreditation, etc. Retailing in textiles <i>vis-a-vis</i> consumer trend and behaviour. The challenging future of the Indian textile industry and trade.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	The Textile Industry of India : Past & its Evolution to the Present Day,	1
2	The Structure of the Indian Textile Industry	1
3	Cotton Textile sector	1
4	Jute Textile sector	1
5	Silk Textile sector	1
6	Man Made Textile sector,	1
7	Wool Textile sector	1
8	Statistics of Indian Textile Business (Domestic & Export) and World Textile Trade,	1
9	Various pertinent Issues prevailing impacting Textile Industry and Trade	1
10	Corporate Social Responsibility, other Compliances, ISO Accreditation etc	1
11	Retailing in Textiles <i>vis-a-vis</i> Consumer trend and behaviour and the challenging Future of the Indian Textile Industry and Trade	2
12	Seminar / presentation	1
13	Quiz/ Examination	1
COURSE TOTAL <i>(14 times 'L')</i>		14

16. Brief description of tutorial activities: NOT APPLICABLE

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17. Brief description of laboratory activities NOT APPLICABLE

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		

6		
7		
8		
9		
10		
COURSE TOTAL (14 times 'P')		

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours

19. Suggested texts and reference materials :

Course Based on Practical References and Data.

It is a special course- reading material needed would be referred to and intimated to the students in the class.

20. Resources required for the course (*itemized & student access requirements, if any*)

20.1	Software	None
20.2	Hardware	None
20.3	Teaching aides (videos, etc.)	PPT
20.4	Laboratory	None
20.5	Equipment	None
20.6	Classroom infrastructure	Lecture room with AV facility
20.7	Site visits	None

21. Design content of the course (*Percent of student time with examples, if possible*)

21.1	Design-type problems	-
21.2	Open-ended problems	-
21.3	Project-type activity	-
21.4	Open-ended laboratory	-

	work	
21.5	Others (please specify)	Group discussions (20 %)

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department/Centre proposing the	Department of Textile Technology
2.	Course Title (<i>< 45 characters</i>)	Special Module in Textile Technology
3.	L-T-P structure	1-0-0
4.	Credits	1
5.	Course number	TXV 703
6.	Status (<i>category for program</i>)	DE for B. Tech. (Textile Technology) students, PE for M. Tech. (Textile engineering/Fibre Science and Technology) students

7.	Pre-requisites (course no./title)	TXL211/TXL221/TXL222/TXL231/TXL232 and EC 75 for UG students
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	Nil
8.2	Overlap with any UG/PG course of other Dept./Centre	Nil
8.3	Supersedes any existing course	TTV703

9.	Not allowed for (indicate program names)	No such restriction
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem X ☒ Either sem
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11.	Faculty who will teach the course: Visiting Faculty	
12.	Will the course require any visiting faculty?	Yes

13.	Course objective (<i>about 50 words</i>): To introduce the special topics of textile technology.
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): The course aims at introducing special topics of textile technology. The course topics and content are likely to change with each offering depending upon the
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	current requirement and expertise available with the department including that of the visiting professionals.
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15. Lecture Outline (*with topics and number of lectures*)

Module no.	Topic	No. of hours
COURSE TOTAL (<i>14 times 'L'</i>)		14

16. Brief description of tutorial activities: NOT APPLICABLE

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17. Brief description of laboratory activities NOT APPLICABLE

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL (<i>14 times 'P'</i>)		

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module	Description	No. of hours
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no.		

19. Suggested texts and reference materials :

Course Based on Practical References and Data.

It is a special course- reading material needed would be referred to and intimated to the students in the class.

20. Resources required for the course (*itemized & student access requirements, if any*)

20.1	Software	None
20.2	Hardware	None
20.3	Teaching aides (videos, etc.)	PPT
20.4	Laboratory	None
20.5	Equipment	None
20.6	Classroom infrastructure	Lecture room with AV facility
20.7	Site visits	None

21. Design content of the course (*Percent of student time with examples, if possible*)

21.1	Design-type problems	-
21.2	Open-ended problems	-
21.3	Project-type activity	-
21.4	Open-ended laboratory work	-
21.5	Others (please specify)	Group discussions (20 %)

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department/Centre proposing the	Department of Textile Technology
2.	Course Title (<i>< 45 characters</i>)	Special Module in Yarn Manufacture
3.	L-T-P structure	1-0-0
4.	Credits	1
5.	Course number	TXV 704
6.	Status (<i>category for program</i>)	DE for B. Tech. (Textile Technology) students, PE for M. Tech. (Textile engineering/Fibre Science and Technology) students, OC for others

7.	Pre-requisites (course no./title)	TXL211/TXL221/TXL222/TXL231/TXL232 and EC 75 for UG students
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	Nil
8.2	Overlap with any UG/PG course of other Dept./Centre	Nil
8.3	Supercedes any existing course	TTV704

9.	Not allowed for (indicate program names)	No such restriction
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem X ☒ Either sem
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11.	Faculty who will teach the course: Visiting Faculty	
12.	Will the course require any visiting faculty?	Yes

13.	Course objective (<i>about 50 words</i>): To introduce the special topics of yarn manufacturing.
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): The course aims at introducing new or highly specialized technological aspects in yarn manufacture. The course topics and content is likely to change with each offering depending upon the current requirement and expertise available
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	with the department including that of the visiting professionals.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
COURSE TOTAL <i>(14 times 'L')</i>		14

16. Brief description of tutorial activities: NOT APPLICABLE

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17. Brief description of laboratory activities NOT APPLICABLE

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL <i>(14 times 'P')</i>		

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module no.	Description	No. of hours
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19. Suggested texts and reference materials :

Course Based on Practical References and Data.

It is a special course- reading material needed would be referred to and intimated to the students in the class.

20. Resources required for the course (*itemized & student access requirements, if any*)

20.1	Software	None
20.2	Hardware	None
20.3	Teaching aides (videos, etc.)	PPT
20.4	Laboratory	None
20.5	Equipment	None
20.6	Classroom infrastructure	Lecture room with AV facility
20.7	Site visits	None

21. Design content of the course (*Percent of student time with examples, if possible*)

21.1	Design-type problems	-
21.2	Open-ended problems	-
21.3	Project-type activity	-
21.4	Open-ended laboratory work	-
21.5	Others (please specify)	Group discussions (20 %)

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department/Centre proposing the	Department of Textile Technology
2.	Course Title (<i>< 45 characters</i>)	Special Module in Fabric Manufacture
3.	L-T-P structure	1-0-0
4.	Credits	1
5.	Course number	TXV 705
6.	Status (<i>category for program</i>)	DE for B. Tech. (Textile Technology) students, PE for M. Tech. (Textile engineering/Fibre Science and Technology) students

7.	Pre-requisites (course no./title)	TXL211/TXL221/TXL222/TXL231/TXL232 and EC 75 for UG students
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	Nil
8.2	Overlap with any UG/PG course of other Dept./Centre	Nil
8.3	Supersedes any existing course	TTV705

9.	Not allowed for (indicate program names)	No such restriction
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem X ☒ Either sem
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11.	Faculty who will teach the course: Visiting Faculty	
12.	Will the course require any visiting faculty?	Yes

13.	Course objective (<i>about 50 words</i>): To introduce the special topics of fabric manufacturing.
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): The course aims at introducing new or highly specialized technological aspects in fabric manufacture. The course topics and content is likely to change with each offering depending upon the current requirement and expertise available
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	with the department including that of the visiting professionals.
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15. Lecture Outline (*with topics and number of lectures*)

Module no.	Topic	No. of hours
COURSE TOTAL (<i>14 times 'L'</i>)		14

16. Brief description of tutorial activities: NOT APPLICABLE

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17. Brief description of laboratory activities NOT APPLICABLE

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL (<i>14 times 'P'</i>)		

18. Brief description of module-wise activities pertaining to self-study component (mandatory for 700 / 800 level courses)

Module	Description	No. of hours
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no.		

19. Suggested texts and reference materials :

Course Based on Practical References and Data.

It is a special course- reading material needed would be referred to and intimated to the students in the class.

20. Resources required for the course (*itemized & student access requirements, if any*)

20.1	Software	None
20.2	Hardware	None
20.3	Teaching aides (videos, etc.)	PPT
20.4	Laboratory	None
20.5	Equipment	None
20.6	Classroom infrastructure	Lecture room with AV facility
20.7	Site visits	None

21. Design content of the course (*Percent of student time with examples, if possible*)

21.1	Design-type problems	-
21.2	Open-ended problems	-
21.3	Project-type activity	-
21.4	Open-ended laboratory work	-
21.5	Others (please specify)	Group discussions (20 %)

Date:

(Signature of the Head of the Department)