GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester – I

Course Title: **Fundamentals of Fibre Science**
(Course Code: C4315903)

Diploma programme in which this course is offered	Semester in which offered
Textile Design	First

1. RATIONALE

Textile design engineers creating designs and structures for knitted, woven, non-woven or embroidery on fabrics. It involves producing patterns for various kinds of cloths as per their end use and market trend. The textile designer should be aware of different fibres verities and their behavior in different conditions, as these are helpful in designing/ engineering textile products as per needs of end user. This subject is essential to provide knowledge and practice to perceive variety of fibres. It also makes aware of properties of major useful fibres in the current market trends. This subject also deals with the various kinds of the Fibres, its origin, structure, properties and manufacturing process of manmade Fibres. This knowledge will be useful for students when they work on designing, producing or modifying various designs and structures for knitted, woven, non-woven or embroidery on fabrics.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Design different types of patterns using various cloths and fibres.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

a) Identify various textile Fibres based on their origin.
b) Identify properties of natural and manmade textile fibres for their specified end use.
c) Select manufacturing process for manmade fibres.
d) Examine the textile fibres for their identification.
e) Dispose fibrous & intermediate waste safely.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

Legends: ***L****-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *-Practical;* ***C*** *– Credit,* ***CA*** *- Continuous Assessment;* ***ESE*** *-End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the COs. *These PrOs need to be attained to achieve the COs.*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Prepare chart for classification of textile Fibres.	I	02
2	Prepare chart to describe the production process of Cotton Fibres.	II	02
3	Prepare chart to describe the production process of wool Fibres.	II	02
4	Prepare chart to describe the production process of Silk Fibres.	II	02
5	Prepare chart describe the production process of Jute Fibres.	II	02
6	Identify physical properties of given Natural textile fibres using microscope.	IV	02
7	Identify chemical properties of given Natural textile fibres using microscope.	IV	02
8	Draw neat sketch and Explain Melt spinning method.	III	01
9	Draw neat sketch and Explain Wet spinning method.	III	01
10	Draw sketch and Explain Dry spinning method.	III	01
11	Draw a line diagram and explain the manufacturing stages for viscose rayon Fibre.	III	01
12	Draw a line diagram and explain the manufacturing stages for Polyester Fibre.	III	01
13	Draw a line diagram and explain the manufacturing stages for Nylon Fibre.	III	01
14	Draw a line diagram and explain the manufacturing stages for Acrylic Fibre.	III	01
15	Identify physical properties of Manmade textile fibres using microscope.	IV	01
16	Identify chemical properties of Manmade textile fibres using microscope.	IV	01
17	Identification of textile fibres using microscope and draw their longitudinal & cross sectional views.	V	01
18	Perform burning test for identification of Textile Fibres.	V	01
19	Perform chemical dissolution tests for identification of Textile Fibres.	V	01
20	Perform stain tests for identification of Textile Fibres.	V	01
21	Perform the identification of unknown textile fibre.	V	01
	Total		**28**

Note

i. More ***Practical Exercises*** *can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list****. Use of actual samples should be encouraged in chart preparation***

*ii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course, which are embedded in the COs and ultimately the competency.*

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Preparation of experimental setup/setting of equipment (for exercises 15 to 21)	20
2	Perform the practical procedure uaing correct practices (for exercises 15 to 21)	20
3	Follow safe practices and measures(for all exercises 15)	10
4	Aesthetic neatness and information quality in illustration/chart (for exercises 1 to 14)	20
5	Interpret the result and reporting(for exercises 15 to 21)	30
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

These major equipments with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practicals in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Natural fibres spinning process setup	1,2,3,4,5
2	Strength tester	6,7,15,16
3	Weighing scale (Milligrams)	6,7,15,16
4	Melt spinning equipment	8,12,13
5	Wet & Dry spinning Equipment	9,10,11,14
6	Projection microscope	6,7,15,16,17, 21
7	Gas burner	18,21
8	Chemical lab equipments	19,20,21

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned COs and PrOs. More could be added to fulfil the development of this course competency.

a) Work as a leader/a team member.
b) Follow ethical practices.
c) Practice environmental friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of Revised Bloom's taxonomy that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit – I **Classification of Textile Fibres**	1a. Define Textile & fibre 1b. Understand basic requirements of fibres as a textile material 1c. Classify the Textile fibres	1.1 Definitions of Textile & Fibre 1.2 Types of textile fibres 1.3 Applications / Uses of textiles in various fields 1.4 Classification of textile fibres based on their origin.
Unit – II **Natural fibres**	2a. Distinguish the Natural fibres 2b. Identify resources of natural fibres 2c. Suggest processing of Natural textile fibres	2.1. Cotton fibre and their Processing 2.2. Wool fibre and their Processing 2.3. Jute fibre and their Processing 2.4. Silk fibre and their Processing
Unit– III **Man-made fibres**	3a. Distinguish the Man-made fibres 3b. Describe the salient features of Polymerization process 3c. Identify the different types of polymers 3d. Justify Spinning method for man-made fibresfibres 3e. Describe Manufacturing of various man-made fibres 3f. Identify the distinguishing features of recently developed fibres	3.1 Polymerization (a) Monomer & Polymer (b) Classification & Characteristics of polymer (c) Methods of polymerization 3.2 Spinning methods for Man-made fibres (a) Melt spinning (b) Wet spinning (c) Dry spinning 3.3 Manufacturing process of Rayon Fibre (Viscose/ Acetate/ Triacetate/ Cuprammonium) 3.4 Manufacturing process of Polyester Fibre 3.5 Manufacturing process of Nylon Fibre (Nylon-6/ Nylon-66/ nylon-11) 3.6 Manufacturing process of Acrylic

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
		Fibre 3.7 Manufacturing process of Polyolefin fibres (PP/PE) 3.8 Recently developed fibres (a) Performance based fibres (b) Speciality fibres (c) Sustainable fibres
Unit– IV **Properties of fibres**	4a. Identify essential properties of textile fibre 4b. Specify desirable properties of textile fibre 4c. Identify Physical properties of textile fibres 4d. Identify Chemical properties of textile fibres	4.1 Essential/Primary properties of textile fibre 4.2 Desirable/Secondary properties of textile fibre 4.3 Physical properties of Natural fibres 4.4 Physical properties of Man-Made fibres 4.5 Chemical properties of Natural fibres 4.6 Chemical properties of Man-Made fibres
Unit– V **Fibre Identi-fication**	5a. Identify textile fibres using microscopic views 5b. Suggest fibre identification by burning test 5c. Suggest chemical solubility test for fibre identification 5d. Suggest stain method for fibre identification	5.1 Microscopic test for fibre identification 5.2 Burning test for fibre identification 5.3 Chemical solubility test for fibre identification 5.4 Stain test for fibre identification
Unit– VI **Handling fibre Waste**	6a. Justify the need of understanding fibrous & intermediate waste. 6b. Establish the relationship of sustainability and fibre waste. 6c. Suggest methods of handling fibre waste with examples. 6d. Suggest methods to dispose fibrous & intermediate waste.	6.1 Concept of fibrous & intermediate waste 6.2 Sustainability and fibre waste 6.3 Methods to handle fibre waste 6.4 Disposal of fibrous & intermediate waste

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Classification of Textile Fibres	04	2	4	4	10
II	Natural fibres	10	3	6	6	15
III	Man-made fibres	14	2	8	10	20
IV	Properties of fibres	06	2	4	4	10
V	Fibre identification	06	2	4	4	10
VI	Handling fibre Waste	02	1	2	2	5
Total		**42**	**12**	**28**	**30**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary slightly from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should perform following activities in group and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

a) Prepare specification of different textile Fibres.
b) Explore library/internet for production technologies being used for production of different Fibres and make a report.
c) Visit to manmade Fibre industry and preparing report with sketches.
d) Prepare line diagram of manufacturing stages for different textile Fibres.
e) Undertake micro-projects in teams
f) Give seminar on any relevant topic.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4***means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessed using different assessment methods.

e) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environment and sustainability
g) Guide students for using data manuals.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should **not exceed three**.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the microproject should be about **14-16 (fourteen to sixteen) student engagement hours** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) **Natural Fibres**: Collect various samples of natural Fibres, study the Physical & chemical properties of Textile Fibres and prepare comparative report. (**Duration: 8-10 hours**)
b) **Manmade Fibre:** Collect various samples of manmade Fibres, prepare line diagram of manufacturing stages with relevant details of production of manmade Fibre.
c) **Melt, wet and Dry spinning:** Prepare a compiled report of Melt, Wet and Dry spinning technology with machine process parameters.
d) **Fibre identification:** Identify the unknown textile fibre using various methods and prepare a report of it.
e) **Fibre waste**: Compile a report of handling fibrous & intermediate waste with figures, tables and comparative charts and strategies used and suggested.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Manmade Fibres	R. W. Moncrieff	Publisher- Wiley ISBN: 0470613181,9780470613184
2	Handbook Of Textile Fibres	J. Cordon Cook	Merrow Publishing Co. Ltd, ISBN0 9040954 0 I
3	Textile Fibres	V.A. Shenai	Sevak Publications
4	Textile chemistry-I : The chemistry of fibres	R.H. Peters	Elsevier Publishing Company ISBN: 1114783838, 978-1114783836
5	Chemistry of Fibrous materials	F. Sadov	Publisher: Central Books Ltd ISBN : 0714712590,

S. No.	Title of Book	Author	Publication with place, year and ISBN
			9780714712598
6	Physical Properties of Textile Fibres	J. W. S. Hearle and William Ernest Morton	WoodheadPublishng ltd. ISBN:9781845694425, 1845694422
7	Handbook of Textile Fibre Structure: Volume 2: Natural, Regenerated, Inorganic and Specialist Fibres	J. W. S. Hearle, T. Kikutani, M Jaffe, Stephen J. Eichhorn	WoodheadPublishng ltd. ISBN:9781845697303
8	Identification of Textile Fibres	Max M Houck	WoodheadPublishng ltd. ISBN: 9781845695651, 1845695658
9	Introduction to Textile Fibres	H. V. Sreenivasa Murthy	WPI India ISBN:9781315359335, 1315359332
10	Handbook of Natural Fibres Volume 1: Types, Properties and Factors Affecting Breeding and Cultivation	Ryszard M. Kozlowski	WoodheadPublishng ltd. ISBN: 9780857095503, 0857095501
11	Handbook of Natural Fibres Volume 2: Processing and Applications	Ryszard M. Kozlowski	WoodheadPublishng ltd. ISBN: 9780128190708, 0128190701
12	Textiles and Fashion Materials, Design and Technology	Rose Sinclair	WoodheadPublishng ltd. ISBN: 9780857095619, 0857095617
13	Physical Testing of Textiles	B. P. Saville	WoodheadPublishng ltd. ISBN: 9781845690151
14	Sustainable Fibres and Textiles	Subramanian Senthilkannan Muthu	Elsevier Science ISBN: 9780081020425, 0081020422
15	Biodegradable and Sustainable Fibres	Richard Blackburn	WoodheadPublishng ltd. ISBN: 9781845690991, 1845690990

14. SOFTWARE/LEARNING WEBSITES

- https://nptel.ac.in/courses/
- http://www.textileworld.com/
- www.learningseed.com
- http://www.teonline.com/knowledge-centre/

- http://www.sitra.org.in
- http://www.btraindia.com
- www.nitratextile.org/
- https://www.britannica.com/technology/man-made-Fiber
- https://www.britannica.com/topic/natural-fiber
- https://textilestudycenter.com/textile-books-free-donwload/
- http://www.textileassociationindia.org/
- http://www.cottonsjourney.com/Storyofcotton/page5.asp
- http://textilelearner.blogspot.in/
- https://textilestudycenter.com/
- https://study.com/academy/topic/textile-fibers-fabrics.html
- www.fibersource.com
- https://www.fibre2fashion.com/

15. PO-COMPETENCY-CO MAPPING

Semester I	Fundamentals of Fibre Science (Course Code: C4315903)								
	POs and PSOs								
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning	* PSO 1	# PSO 2
Competency	**Design different types of patterns using various cloths and fibres.**								
Course Outcomes CO a) Identify various textile fibers based on their origin.	2	2	1	1	2	-	2	3	3
CO b) Identify properties of natural and manmade textile fibres for their specified end use.	2	2	2	2	2	2	2	3	2
CO c) Select manufacturing process for manmade fibres	2	-	-	3	2	-	2	-	-
CO d) Examine the textile fibres for their identification.	2	2	2	2	2	2	2	2	2
CO e) Dispose fibrous & intermediate waste safely.	3	3	3	2	3	2	3	3	3

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO/PSO.*

*** PSO 1** Ability to apply knowledge of textile design in identifying and providing appropriate solutions to the problems of Textiles & Fashion designing industry.

 # PSO 2 Ability to design and develop optimized textile process as per the need of global demand.

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

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NITTTR Resource Persons

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