GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)

Semester-II

Course Title: Natural Textile Fibre Science

(Course Code: C4322802)

Diploma programme in which this course is offered	Semester in which offered
Diploma in Textile Processing Technology	Second

1. RATIONALE

The knowledge of textile fibres is the basis of the textile manufacturing & processing. To achieve the best quality of textile materials, the diploma engineers must have adequate knowledge of the morphological structure, chemical composition, physical & chemical properties of the various Natural & Synthetic fibres. They need to adopt a relevant methodology for the chemical processing of different fibres. They must also posses' knowledge about the application areas of the fibres. This course is developed in such a way by which fundamental information will help the diploma engineers to apply the basic concepts of textile fibres to solve broad based problems in the textile industry.

2. COMPETENCY

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

- **Apply principles of fibre science to solve broadly-defined textile processing related problems.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:
Each CO should be concerning each Unit and should be observable and measurable, should reflect what students will be able to do after learning that unit. These COs will the ultimately responsible for achieving Competency.

1. Identify and classify the various textile fibres.
2. Relate the properties of cotton fibre for suitable chemical wet processes.
3. Relate the properties of Wool & Silk fibre for suitable chemical wet processes.
4. Relate the properties of Viscose Rayon fibre for suitable chemical wet processes.
5. Choose the sustainable textile fibre for suitable eco-friendly wet processes.

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	-	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 the 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. *Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.*

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1.	Identify the class of fibre by burning test. (Cellulosic Fibre)	1	02
2.	Identify the class of fibre by burning test. (Protein Fibre)	1	02
3.	Prepare a microscopical Views (Longitudinal & Cross sectional) of cotton fibre.	2	02
4.	Use chemical tests to identify cotton fibre.	2	02
5.	Determine moisture regain & moisture content of the given cotton fibre samples	2	02
6.	Prepare a microscopical Views (Longitudinal & Cross sectional) of Wool fibre.	3	02
7.	Use chemical tests to identify Wool fibre.	3	02
8.	Determine moisture regain & moisture content of the given Wool fibre samples	3	02
9.	Prepare a microscopical Views (Longitudinal & Cross sectional) of Silk fibre.	3	02
10.	Use chemical tests to identify Silk fibre.	3	02
11.	Determine moisture regain & moisture content of the given Silk fibre samples	3	02
12.	Prepare a microscopical Views (Longitudinal & Cross sectional) of Viscose Rayon fibre.	4	02
13.	Use chemical tests to identify Viscose Rayon fibre.	4	02
14.	Determine moisture regain & moisture content of the given Viscose Rayon fibre samples	4	02
15.	Prepare a microscopical Views (Longitudinal & Cross sectional) of Linen fibre.	5	02
16.	Prepare a microscopical Views (Longitudinal & Cross sectional) of Ramie fibre.	5	02
17.	Prepare a microscopical Views (Longitudinal & Cross sectional) of Jute fibre.	5	02

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.*

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 required which are embedded in the COs and ultimately the competency.*

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Preparation experimental set-up.	20
2	Setting & Operation	20
3	Follow safe practices.	10
4	Record observations correctly.	10
5	Interpret the result and conclude.	20
6	Answer to sample questions	10
7	Submission of report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

These major equipment 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	Electric Oven	5,8,11,14
2	Desiccator	5,8,11,14
3	Electronic Weighing Balance	5,8,11,14
4	Suitable Glassware	4,7,10,13

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 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 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

Only the major Underpinning Theory is formulated as higher-level UOs of *Revised Bloom's taxonomy* in order development of the COs and competency is not missed out by the students and teachers. If required, more such higher-level UOs could be included by the course teacher to focus on the attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
Unit – I Fibre Science	1a. Distinguish basic terminology of fibre forming polymer 1b. Explain basic terminology of textile fibre 1c. Classify the given fibres based on their chemical nature and origin. 1d. Differentiate between essential & Desirable properties of fibre	1.1 Fibre forming Polymer: Monomers, Polymers, Repeat unit and Degree of polymerization 1.2 Textile Basic Terminology: Definition of fibre, staple fibre, filament, Moisture Content, Moisture Regain, Hydrophobic & Hydrophilic fibres, orientation: Amorphous & crystallinity. 1.3 Classification of fibres: Chemical & origin 1.4 Properties of fibres: Essential & Desirable
Unit– II Plant based cellulosic Fibres - Cotton	2a. Describe varieties of cotton and Cotton morphological structure with diagram 2b. Describe the chemistry and composition of cellulose 2c. Choose the relevant chemicals and their concentrations based on physical and chemical properties of the given cotton 2d. Describe the chemical damage to cellulose 2e. Explain the microscopical of cotton fibre with sketch 2f. Enlist the end uses of cotton fibre	2.1 Cotton: varieties of cotton, Morphological structure 2.2 Cellulose: Chemistry of cellulose and chemical composition 2.3 Physical and chemical properties of cotton fibre 2.4 Chemistry of damage to cellulose: oxycellulose and hydrocellulose 2.5 Microscopical View (Longitudinal & Cross-sectional View) of cotton fibre 2.6 Application of cotton fibre
Unit– III Animal Protein Fibres – Wool & Silk	3a. Compare different type of wool 3b. Discuss the chemical structure and composition of wool fibre 3c. Compare different types of silk 3d. Describe the chemical structure and composition of silk fibre 3e. Choose the relevant chemicals & their concentration based on physical & chemical	3.1 Types and grading of wool 3.2 Chemical structure and composition of the wool fibre (Bonds present in wool and their effect on wet process) 3.3 Different types of silk 3.4 Chemical structure and composition of the silk fibre 3.5 Physical and chemical properties of Wool & Silk fibre 3.6 Microscopical View (Longitudinal & Cross-sectional View) of Wool & Silk fibre

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
	properties of Wool & Silk fibre. 3f. Explain the microscopical of Wool & Silk fibre with sketch 3g. Enlist various types of products produced using silk and wool fibres	3.7 Applications of wool & Silk fibre
UNIT-IV Regenerated & modified cellulosic fibres	4a. Compare different regenerated & Modified fibres 4b. Explain the manufacturing process for viscose rayon 4c. Choose the relevant chemicals & their concentration based on physical & chemical properties of Viscose rayon. 4d. Explain the microscopical of Viscose fibre with sketch 4e. List down end uses of viscose fibre	4.1 Introduction to regenerated & modified fibres (Viscose Rayon, polynosic fibre, Cuprammonium Rayon, Acetate rayon, Modal, Tencel, Lyocell) 4.2 Chemical technology & flow chart for viscose rayon manufacturing 4.3 Physical & Chemical Properties of viscose rayon 4.4 Microscopical view (Longitudinal & Cross sectional) of viscose rayon 4.5 Application of Viscose rayon
Unit– V Sustainable Natural Fibres	5a. Explain the concept of sustainability in Textile fibre 5b. Characterize different eco-friendly textile fibres 5c. Explain the microscopical of sustainable textile fibres with sketch 5d. Application of eco-friendly fibres	5.1 Concept of sustainability in textile fibre 5.2 Some sustainable textile fibre • Jute fibre • Bamboo fibre • Linen fibre • Ramie Fibre • Organic Cotton • Banana Fibre 5.3 Microscopical view (Longitudinal & Cross sectional) of above sustainable textile fibres 5.3 Application of above fibres

***Note**: The UOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
I	Fibre Science	08	6	4	2	12
II	Plant based cellulosic Fibres - Cotton	10	8	6	4	18
III	Animal Protein Fibres – Wool & Silk	10	8	6	4	18
IV	Regenerated & modified cellulosic fibres	08	6	4	2	12

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
V	Sustainable Natural Fibres	06	4	4	2	10
Total		**42**	**32**	**24**	**14**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*
Note*: This specification table provides general guidelines to assist students in their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to 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 the above table.*

10. SUGGESTED STUDENT ACTIVITIES

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

1) Cotton fibre staple length: Collect 5 different cotton samples & measure their lengths and present your results.
2) Wool fibre staple length: Collect 5 different wool samples & measure their lengths and present your results.
3) Silk filament length: Collect 5 different Silk samples & measure their lengths and present your results.
4) Viscose fibre staple length: Collect 5 different Viscose samples & measure their lengths and present your results.
5) Moisture regain & Moisture content: Collect 10 different natural fibres and measure its moisture content & moisture regain.

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/subtopics.
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 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.
h) Visual demonstration & Microscopic study of various fibres

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her at the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should preferably be ***individually*** undertaken to build up the skill and confidence in every student to become a problem solver so that s/he

contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, 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, an integration of PrOs, UOs and ADOs. Each student will have to maintain a dated work diary consisting of individual contributions in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit a 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:

1) Prepare a detailed classification of Natural Textile fibres on a full imperial sheet. Give example of each type of fibre with samples.
2) Prepare a Comparative table for physical properties of different natural fibres.
3) Prepare a Comparative table for Chemical properties of different natural fibres.
4) Study microscopic views of different Natural textile fibres.
5) Study on morphological structures of Natural textile fibres.
6) Applications of various natural textile fibres.
7) Study on important properties & terminologies of natural textile fibre forming polymer.
8) Draw life cycle of Silk warm and explain the same.
9) Explain reeling process of silk with the help of a diagram.
10) Prepare a chart showing different types of silk yarns produced during reeling, their method of numbering, number of constituent silk filaments, amount of twist, area of application.
11) Literature survey of sustainable natural textile fibres.
12) Study the concept of wool felting and its effects.
13) Prepare a report on silk degumming.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with the place, year and ISBN
1	A Text-Book of Fibre Science & Technology	S. P. Mishra	New Age International (P) Ltd.Publishers, New Delhi ,2000, ISBN: 81-224-1250-5
2	Fibre Science & Technology	R. Gopalakrishnan V. Kashinathan & K. Bagyan	SSM – ITT Staffs' & Students'; Co. Op. Stores Ltd, Tamilnadu, 1991.
3	Textile Fibres (Vol. – I)	V. A. Shenai	Sevak Publication, Mumbai,1984
4	Man-Made Fibres	R. W. Moncrieff	Heywod, Cambridge, London (UK),1970 ISBN: 9780470613184, 0470613181
5	Dyeing & Chemical Technology of Textile Fibres	E. R. Trotman	Charles Griffin & Company Limited, London,1975. ISBN: 0852641656

S. No.	Title of Book	Author	Publication with the place, year and ISBN
6	Hand Book of Textile Fibres (Vol. – I)	J. Gordon Cook	Wood Head Publishing Ltd.,ISBN: 1855734842 (ISBN13: 9781855734845)

14. SOFTWARE/LEARNING WEBSITES

- wikipedia.org/wiki/Fibre
- http://www.onlineclothingstudy.com/2012/01/microscopic-view-of-natural-and-man.html
- www.nptel.iitm.ac.in
- https://ndl.iitkgp.ac.in
- www.textileschool.com
- www.textileguide.chemsec.com
- www.textileassociationindia.org
- http://hperphysics.phy-astr.gsu.edu/hbase/hph.html
- www.physicsclassroom.com
- www.onlinelibrary.wiley.com
- www.rsc.org
- www.chemcollective.org

15. PO-COMPETENCY-CO MAPPING

Semester II	Natural Textile Fibre Science (Course Code: C4322802) 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
Competency	Apply principles of fibre science to solve broadly-defined textile processing related problems.						
Course Outcomes CO a) Identify and classify the various textile fibres.	3	1	-	2	-	1	1
CO b) Relate the properties of cotton fibre for	2	3	1	1	-	1	1

Legend: '**3**' for high, '**2**' for medium, '**1**' for low or '**-**' for the relevant correlation of each competency, CO, with PO

suitable chemical wet processes.							
CO c) Relate the properties of Wool & Silk fibre for suitable chemical wet processes.	2	3	1	1	-	1	1
CO d) Relate the properties of Viscose Rayon fibre for suitable chemical wet processes.	3	2	1	1	-	1	3
CO e) Choose the sustainable textile fibre for suitable eco-friendly wet processes.	2	-	-	-	3	1	2

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	Mrs P. A. Prajapati	RCTI, Ahmedabad	9920532970	parul10.iitd@gmail.com
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NITTTR Resource Persons

S. No.	Name and Designation	Department	Contact No.	Email
1				
2				