GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Synthetic Textile Fibre Science
(Course Code: 4332801)

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

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. Classify the various polymers.
2. Relate the properties of polyester fibre for suitable chemical wet processes.
3. Relate the properties of polyamides fibre for suitable chemical wet processes.
4. Relate the properties of acrylic fibre for suitable chemical wet processes.
5. Explain the behavior of different polymers

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. (Polyester)	2	02
2.	Identify the class of fibre by burning test. (Polyamide)	3	02
3.	Identify the class of fibre by burning test. (Acrylic)	4	
4.	Prepare a microscopical Views (Longitudinal & Cross sectional) of polyester fibre.	2	02
5.	Use chemical tests to identify polyester fibre.	2	02
6.	Determine moisture regain & moisture content of the given polyester fibre samples	2	02
7.	Prepare a microscopical Views (Longitudinal & Cross sectional) of polyamide fibers.	3	02
8.	Use chemical tests to identify polyamides fibre.	3	02
9.	Determine moisture regain & moisture content of the given polyamides fibre samples	3	02
10.	Prepare a microscopical Views (Longitudinal & Cross sectional) of acrylic fibre.	4	02
11.	Use chemical tests to identify acrylic fibre.	4	02
12.	Determine moisture regain & moisture content of the given acrylic fibre samples	4	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	6,9,12
2	Desiccator	6,9,12
3	Electronic Weighing Balance	6,9,12
4	Suitable Glassware	5,8,11

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 environmentally 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 Polymer Science	1a. Classify the polymers 1b. Distinguish basic terminology of fibre forming polymer 1c. Explain biopolymers	1.1 Man-Made fibers: Classification of polymers. 1.2 Terms of polymer science: - Monomers, Polymers, Functionality of monomers, Repeat unit and Degree of polymerization 1.3 Concept of Biopolymer
Unit– II Chemistry & manufacturing of polyester	2a. Describe the basic raw materials required for mfg. of polyester fiber 2b. Explain basic chemistry involved in Polyester fibre forming 2c. Describe spinning of polyester fibre 2d. Explain the properties of polyester fiber 2e. Explain the microscopical of polyester fibre with sketch 2f. Describe various applications of polyester fiber fibres	2.1 Raw material for polyester fibre 2.2 Polymerisation process for polyester fibre 2.3 Spinning process for polyester fibre 2.4 Physical & chemical properties of polyester fibre 2.5 Microscopical View (Longitudinal & Cross-sectional View) of polyester fibre 2.6 Chemical Modification of polyester (CD-PET) 2.7 Application of polyester fibre
Unit– III Chemistry & manufacturing of polyamides	3a. Describe the basic raw materials required for mfg. of polyamide fibers 3b. Explain basic chemistry involved in polyamide fibre forming 3c. Describe spinning of polyamide fibre 3d. Explain the properties of polyamide fibers 3e. Explain the microscopical of polyamide fibres with sketch	3.1 Raw material for Nylon 6 & Nylon 66 fibre 3.2 Polymerisation process for Nylon 6 & Nylon 66 fibre 3.3 Spinning process for Nylon 6 & Nylon 66 fibre 3.4 Physical & chemical properties of Nylon 6 & Nylon 66 fibre 3.5 Microscopical View (Longitudinal & Cross-sectional View) of Nylon 6 & Nylon 66 fibre

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
	3f. Describe various applications of polyamide fibres	3.6 Application of Nylon 6 & Nylon 66 fibre
Unit– III Chemistry & manufacturing of **Acrylic**	4.1 Describe the basic raw materials required for mfg. of synthetic polyamide fiber & Acrylic fiber 4.2 Explain the manufacturing methods and properties of synthetic polyamide fibers & Acrylic fiber with their sectional views 4.3 Describe various applications of synthetic polyamide fibres & Acrylic fiber	4.1 Introduction to copolymers 4.2 Chemistry of Acrylic fiber 4.3 Manufacturing process of acrylic fiber 4.4 Physical Properties, Chemical Properties of Acrylic fiber 4.5 Microscopical View (Longitudinal & Cross-sectional View) 4.6 Applications of Acrylic fiber
Unit– V Behavior of polymers	5a. Explain Amorphous & crystalline region in polymers 5b. Discuss glass transition temperature in polymer 5c. Differentiate between thermoplastic & thermoset 5d. Describe elastomers 5e. Define Adhesives 5f. Define Resins 5g. Define rheological aspects of polymers	5.1 Glass transition Temperature 5.2 Plastics Thermoplastic Thermoset 5.3 Elastomers Natural Rubber Vulcanized Rubber Synthetic Rubber 5.4 Adhesives 5.5 Resins 5.6 Rheological Aspects

***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	Polymer Science	06	4	4	2	12
II	Chemistry & manufacturing of polyester	08	8	6	4	18
III	Chemistry & manufacturing of polyamides	12	8	6	4	18
IV	Chemistry & manufacturing of Acrylic	08	6	4	2	12
V	Behavior of polymers	08	6	4	2	12

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
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) Moisture regain & Moisture content: Collect 5 different synthetic fibres and measure its moisture content & moisture regain.
2) Compare hygroscopic nature of synthetic fibres with natural fibres and reflect your views.
3) Measure the denier of synthetic fibres and summarise.
4) Collect different samples of synthetic and natural fabrics and measure their GSM and Weight per 1 meter.

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. Isomerism in polymer chains
2. History of polymers
3. Technique of polymerization
4. Polymer analysis and characterization
5. Prepare a detailed classification of Synthetic Textile fibres on a full imperial sheet. Give example of each type of fibre with samples.
6. Prepare a Comparative table for physical properties of different synthetic fibres.
7. Prepare a Comparative table for Chemical properties of different synthetic fibres.
8. Study microscopic views of different synthetic textile fibres.
9. Applications of various synthetic textile fibres.
10. Literature survey of elastomeric textile fibres.

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	Principles of polymer science	P Bahadur, N. V. Sastry	Narosa Publishing House, ISBN: 81-7319-655-9
3	Fibre Science & Technology	R. Gopalakrishnan V. Kashinathan & K. Bagyan	SSM – ITT Staffs' & Students'; Co. Op. Stores Ltd, Tamilnadu, 1991.
4	Textile Fibres (Vol. – I)	V. A. Shenai	Sevak Publication, Mumbai,1984
5	Man-Made Fibres	R. W. Moncrieff	Heywod, Cambridge, London (UK),1970 ISBN: 9780470613184, 0470613181
6	Dyeing & Chemical	E. R. Trotman	Charles Griffin & Company Limited, London,1975.

S. No.	Title of Book	Author	Publication with the place, year and ISBN
	Technology of Textile Fibres		ISBN: 0852641656
7	Hand Book of Textile Fibres (Vol. – II)	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: 4322802)						
	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.						
Classify the various polymers.	3	1	-	2	-	1	1

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

Relate the properties of polyester fibre for suitable chemical wet processes.	2	3	1	1	-	1	1
Relate the properties of polyamides fibre for suitable chemical wet processes	2	3	1	1	-	1	1
Relate the properties of acrylic fibre for suitable chemical wet processes.	3	2	1	1	-	1	3
Explain the behavior of different polymers	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
2	Mr R D Joshi	RCTI, Ahmedabad	9426387274	rdjrcti@gmail.com
3	Mr. P D Panwala	Dr. SSG, Surat	7228864435	pavan.panwala@hotmail.com