

Program Name : Diploma in Textile Technology
Program Code : TC
Semester : Sixth
Course Title : Advanced Textile Processing
Course Code : 22673

1. RATIONALE

Advancement taking place in chemical processing of textiles are in accordance with making use of minimum water for processing; legislation on health, safety and environment. To achieve the quality textiles, the diploma engineers must have adequate knowledge of new developments taking place in machineries and methods of textile chemical processing. This course deals with the eco-friendly pretreatment of textiles, processing of knitted fabrics, terry towels and developments in dyes. This course will facilitate the diploma engineer to apply the knowledge related to advancement in textile processing, in processing the textile and produce desired effects and finishes. It will also help the diploma engineers to analyze and rectify broad based problems in the textile chemical processing industry.

2. COMPETENCY

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

- **Produce different types of textiles using advanced textile processing.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

- Select bio-technology based auxiliaries in pretreatment processes.
- Use relevant methods and machines for processing of terry towels.
- Use relevant methods and machines for processing of knitted fabrics.
- Compile developments in new sustainable dyes.
- Compile developments in dyeing, printing and finishing machineries.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
Max	Min	Max	Min		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min		
3	--	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment 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, ESE -End Semester Examination; PA - Progressive Assessment

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)



This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

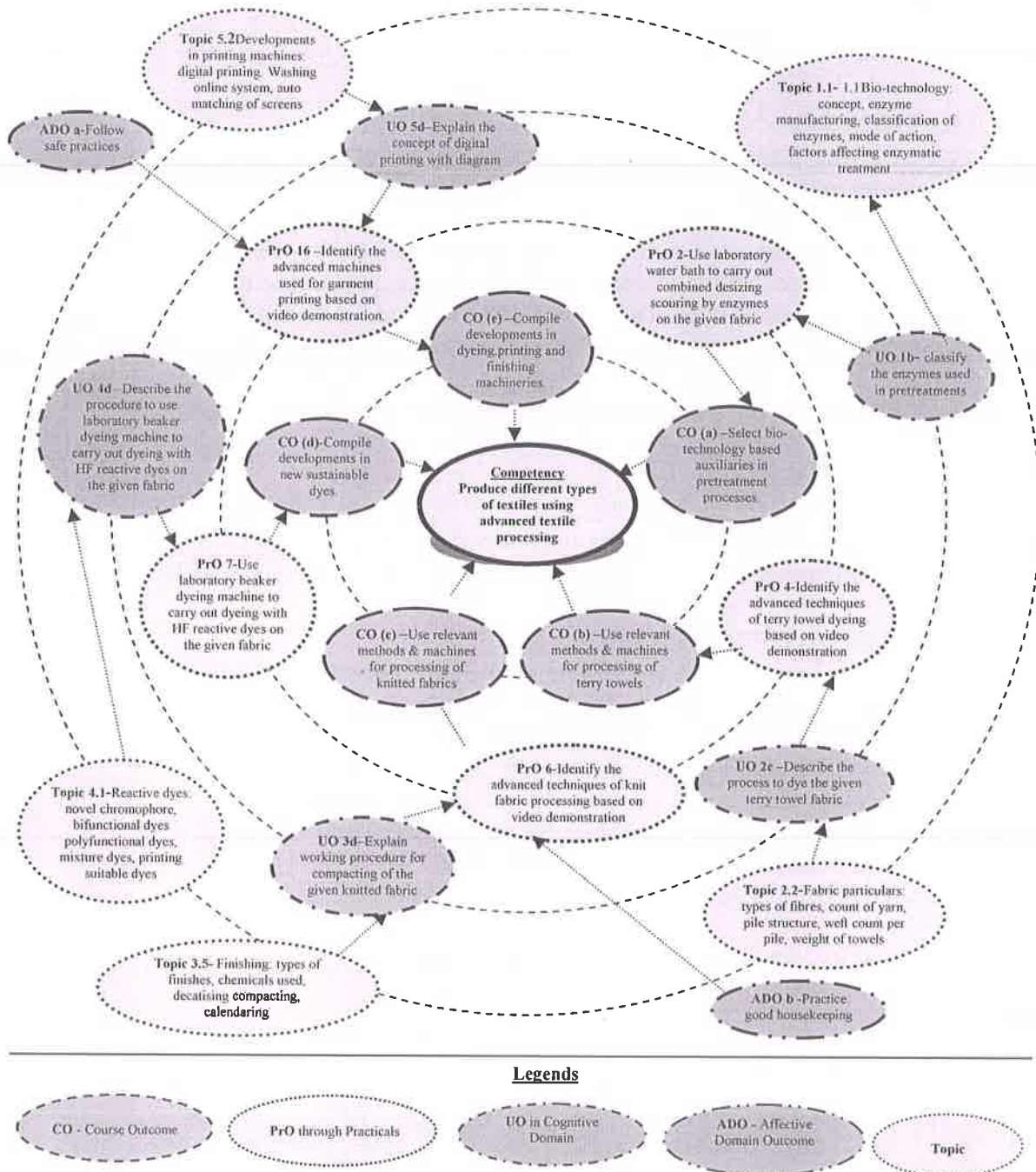
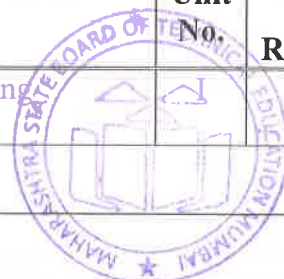


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practical's in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency:

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Use laboratory water bath to carry out combined scouring/bleaching by enzymes on the given fabric.		02*



S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
2.	Use laboratory water bath to carry out combined desizing scouring by enzymes on the given fabric.	I	02*
3.	Create a relevant production process sequence for processing of terry towels.	II	02*
4.	Identify the advanced techniques of terry towel dyeing based on video demonstration.	II	02
5.	Create a relevant production process sequence for processing of tubular knitted fabric.	III	02*
6.	Identify the advanced techniques of knit fabric processing based on video demonstration.	III	02*
7.	Use laboratory beaker dyeing machine to carry out dyeing with HF reactive dyes on the given fabric.	IV	02*
8.	Use laboratory laundrometer to compare wash fastness of HF reactive dyed fabric Vs conventional reactive dyed fabric.	IV	02*
9.	Identify the advanced methods used for fabric reactive based on PowerPoint demonstration	IV	02
10.	Identify the advancement in machines used for fabric dyeing based on video demonstration.	V	02*
11.	Identify the advancement in machines used for package dyeing based on video demonstration.	V	02*
12.	Identify the advancement in machines used for fabric printing based on video demonstration Part-I	V	02*
13.	Identify the advancement in machines used for fabric printing based on video demonstration Part-II	V	02*
14.	Identify the advancement in machines used for fabric finishing based on video demonstration Part-I	V	02*
15.	Identify the advancement in machines used for fabric finishing based on video demonstration Part-II	V	02
16.	Identify the advancement in machines used for garment printing based on video demonstration Part-III	V	02*
	Total		32

Note

- i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicious mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.
- ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S.No.	Performance Indicators	Weightage in %
1.	Preparation of experimental set up	20
2.	Setting and operation	20
3.	Safety measures	10
4.	Observations and Recording	10
5.	Interpretation of result and Conclusion	20
6.	Answer to sample questions	10



S.No.	Performance Indicators	Weightage in %
7.	Submission of report in time	10
Total		100

The above PrOs also comprise of the following social skills/ attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

- a) Follow safety practices.
- b) Practice good housekeeping.
- c) Practice energy conservation.
- d) Work as a leader/a team member..
- a) Follow ethical Practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organization Level' in 2nd year
- 'Characterisation Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1.	Dye Pots: 250 ml, 500 ml	1,2,7,8
2.	Glass rod: 15 cm, Diameter 0.5 cm	1,2,7,8
3.	Beaker: 50 ml, 100 ml, 150 ml, 200 ml, 500 ml, 1000 ml	1,2,7,8
4.	Measuring cylinder of capacity 10 ml, 25 ml, 100 ml and 1 lit	1,2,7,8
5.	Bunsen burner: 12x5x8 cm	1,2,7,8
6.	Pipette: 1 ml, 10 ml, 25 ml	1,2,7,8
7.	Electric drier: 230V, 200W	1,2,7,8
8.	Laboratory Drying, Curing and setting Chamber: temperature up to 220 ^o C, working width- 450 mm, length 1.7-meter, heater capacity- 8/16/24 kilo-watt.	1,2,7,8
9.	Laboratory Padding Mangle: Horizontal (60-80% Expression)	1,2,7,8
10.	Plastic Mug: 0.5, 1 and 2 lit capacity	1,2,7,8
11.	Digital Weighing balance: 0.02 gm accuracy (300 gm)	1,2,7,8
12.	Laboratory laundrometer: 5kg capacity	7, 8

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit- I Use of biotechnology in Pre- treatments	1a. Describe the mechanism of enzyme action on the given substrate 1b. Classify the specified enzymes used in pretreatments 1c. Formulate relevant processing method for desizing of the given substrate by enzymes 1d. Explain relevant ecological issues related to the processing of the given garment with justification. 1e. State the purposes of deactivation of the given enzymes with justification.	1.1 Bio-technology: concept, enzyme manufacturing, classification of enzymes, mode of action, factors affecting enzymatic treatment. 1.2 Use of enzymes in desizing: type, mechanism, chemical reaction, decomposition products, process parameters, batch wise and continuous process, deactivation 1.3 Use of enzymes in scouring: type, mechanism, chemical reaction, decomposition products, process parameters, batch wise and continuous process, deactivation 1.4 Use of enzymes in bleaching: type, mechanism, chemical reaction, decomposition products, process parameters, batch wise and continuous process, deactivation
Unit- II Processing of terry towels	2a. Describe the production process sequence of the given terry fabric 2b. State the particulars of fabric required for the given terry towel 2c. Describe the process to dye the given terry towel fabric 2d. Describe the process of providing soft finish to the given terry towel	2.1 Essential properties: softness, absorbency, sorption ability, water vapor permeability 2.2 Fabric particulars: types of fibres, count of yarn, pile structure, weft count per pile, weight of towels 2.3 Manufacturing sequence: warping, sizing, weaving, grey fabric inspection, wet processing, inspection, stitching 2.4 Wet processing: sequence, chemicals and dyes, process parameters, machinery set up, types of finishes
Unit-III Processing of knitted fabrics	3a. Differentiate between the specified two types of processing the given knitted fabric. 3b. Explain working principle for mercerization of the given type of knitted fabrics 3c. Name the machines used for finishing of the given knitted fabric with justification 3d. Explain working procedure for compacting of the given type of knitted fabric 3e. Describe the precautions needed while processing of the given type of knitted fabric.	3.1 Process sequence of knitted fabrics: tubular form of processing, open width form of processing, advantages and limitations of each 3.2 Pretreatments: desizing, scouring, bleaching mercerization 3.3 Dyeing: dyes used, dyeing parameters, machines used 3.4 Printing: dyes used, method of printing, machinery used 3.5 Finishing: types of finishes, chemicals used, decatizing compacting, calendaring.



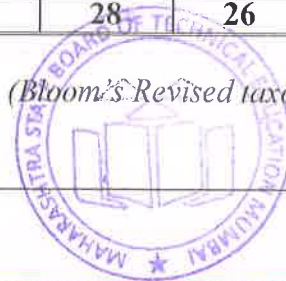
Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit –IV Developments in new sustainable dyes	4a. Identify the given types of low salt reactive dyes required for the given situation 4b. State advantages of the given non- sulphide reducing agents. 4c. Describe the procedure to use laboratory beaker dyeing machine to carry out dyeing with HF reactive dyes on the given type of fabric 4d. State the types of pigment dyes required for the given situation. 4e. State the types of new natural eco-friendly colorants for the given situation.	4.1 Reactive dyes: novel chromophore, bifunctional dyes polyfunctional dyes, mixture dyes, printingsuitable dyes 4.2 Vat and sulphur dyes: solublised dyes, use of non sulphide reducing agents, continuous processes of dyeing. 4.3 Pigments: types, application procedures, fastness properties. 4.4 Natural colorants: types, manufacturing process application procedures, fastness properties.
Unit-V Advancements in processing machineries	5a. Describe the working principle of the given air flow dyeing machine 5b. State the types of machines used for dyeing of the given delicate fabric 5c. Explain the concept of digital printing with diagram for the given situation. 5d. Explain with sketches the concept of laser engraving for the given situation.	5.1 Development in dyeing machines: air flow dyeing machines, multi nozzle soft flow dyeing machines, ultra-low liquor dyeing machines. E-control system, auto dosing system, padders in continuous dyeing system. 5.2 Developments in printing machines: digital printing. Washing online system, auto matching of screens 5.3 Finishing machines: 2 bowl padders, pinning system, selvedge locking system, unique nozzles for uniform temperature in stenter.

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'

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	Use of biotechnology in Pre-treatments	10	04	08	06	18
II	Processing of terry towels	08	02	04	04	10
III	Processing of knitted fabrics	10	06	04	04	14
IV	Developments in new sustainable dyes	08	02	04	04	10
V	Advancements in processing machineries	12	02	08	08	18
Total		48	16	28	26	70

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



Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary 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 conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- a) Visit any textile processing unit nearby and take the help of in-charge to know the activities going on.
- b) Write report of the visit; prepare lay out of the garment processing unit.
- c) Do internet survey to find out new developments in textile processing.
- d) Guide student(s) in undertaking micro-projects.
- e) Prepare power point presentation on different dyeing techniques.
- f) Analyze the colour fastness of various dyed garment samples.
- g) Prepare process flow charts for knitted fabrics.

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) '**L**' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
- c) About **15-20% of the topics/sub-topics** which is relatively simpler or descriptive in nature is to be given to the students for **self-directed learning** and assess the development of the COs through classroom presentations (see implementation guideline for details).
- d) With respect to item No.10, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
- e) Guide student(s) in undertaking micro-projects.
- f) Demonstrate students thoroughly before they start doing the practice.
- g) Encourage students to refer different websites to have deeper understanding of the subject.
- h) Observe continuously and monitor the performance of students in Lab

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. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become 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 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 total duration of the micro-project should not



be less than **16 (sixteen) student engagement hours** during the course. The student 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. Similar micro-projects could be added by the concerned faculty:

- a) **Scope and future of new generation dyes:** Collect information/ data from various sources for the last 15 years and analyse the trends in the textile Industry in domestic as well as international market. Present your observations, findings and thus project the future of the Industry.
- b) **Classification of natural colorants:** Collect atleast 50 samples of various types of natural dyed fabric, classify them according to types and present the results.
- c) **Comparison of conventional & digital printing of textiles:** Collect information from various sources to prepare a comparative chart related to type of machine, machine cost, operational cost, dyes & chemicals needed for garment printing. Present the results.
- d) **Short film on working of machine:** Visit different textile processing industries. Observe the working operations of machines at various stages and capture video clips. Edit the video clips as per specified process sequence and make a short film. Present the short film.
- e) **Collection of pretreated fabric sample:** Visit textile processing/ manufacturing units and collect at least 25 pretreated samples. Classify them according to types and present the results.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Biotechnology in Textile Processing	Ryszard Kozlowski, Georg M. Guebitz, Artur Cavaco-Paulo	CRC Press October 2006, ISBN:9781560221432
2	Woven Terry Fabrics	Jitendra Singh, Swadesh Verma	Elsevier Book publication, UK ISBN:9780081006863
3	Textile Printing	Miles L.W.C.	Society of Dyers and Colorists, UK, 1981 ISBN: 9780901956330
4	Introduction to Textile Finishing	Marsh J.T.	Chapman and Hall publications, U.K1966 ISBN: 9781114790087
5	Chemical Finishing of Textiles	Schindler W. D.; Hauser P. J.	Woodhead Publishing, 2004 ISBN: 9781855739055
6	Functional Finishes for Textiles-Improving Comfort, Performance and Protection	Paul Roshan	Woodhead Publishing,2014, ISBN: 9780857098399
7	Encyclopedia of Garment Printing	Fresener Scott	U.S. Screen Print Industries; 1985 ISBN: 9780933493001
8	Dyes and Pigments	Arnold R. Lang	Nova Science Publishers, Inc., 2013, ISBN:9781606920275

14. SOFTWARE/LEARNING WEBSITES

- a) www.megazyme.com/select-an-industry/textiles-industry
- b) www.textilelearner.blogspot.com/2013/03/enzyme-and-its-applications-in-textile.html
- c) www.onlinelibrary.wiley.com/doi/pdf/10.1111/j.1478-4408.2000.tb03779.x
- d) www.academia.edu/2966090/Production_and_Processing_of_Terry_Towels



- e) www.textileflowchart.com/2015/05/process-flow-chart-of-terry-towel.html
- f) www.textileflowchart.com/2015/06/flow-chart-of-textile-wet-processing.html
- g) www.extranet.nearchimica.it/admin/newspdf/Processing%20techniques%20for%20knitted%20fabrics.pdf
- h) www.w-program.nu/filer/exjobb/Erik_Moglia.pdf
- i) www.aidic.it/IBIC2008/webpapers/2Opwis.pdf
- j) www.theseus.fi/bitstream/handle/10024/60261/Xiao_Fang.pdf?sequence=1
- k) www.engineering-shirpur.nmims.edu/docs/terry-towel-industry-and-its-processing-ms.pdf
- l) www.ategroup.com/textile-engineering/terry-towels/product-family/wet-processing/
- m) www.mytextilenotes.blogspot.com/2009/03/terry-towel-manufacturing-process.html



