

Program Name : Diploma in Textile Technology
Program Code : TC
Semester : Fourth
Course Title : Dyeing of Natural Substrates
Course Code : 22458

1. RATIONALE

In textile industry, the quality textile is manufactured through many processes such as dyeing, printing, and finishing. These major processes improve the aesthetic as well as the market value of the textile. The knowledge and skills related to dyeing of natural fibres is essential for the diploma engineer to create quality textile. This course is developed in such a way that basic concepts and principles of dyeing of natural fibres and their application methods will help the diploma engineer to get quality dyed yarn and fabrics and solve broad based problems in the textile colouration processes.

2. COMPETENCY

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

- Use relevant dyes, chemicals, dyeing equipment for natural fibres and fabrics.

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 relevant pretreatment process and dyeing machines for dyeing of natural fibres.
- Use relevant method to dye cellulosic material with direct and reactive dyes.
- Use relevant method to dye cellulosic material with vat and sulphur dyes.
- Use relevant method to dye cellulosic material with azoics and pigments.
- Use relevant method to dye protein material with relevant dyes.

4. TEACHING AND EXAMINATION SCHEME

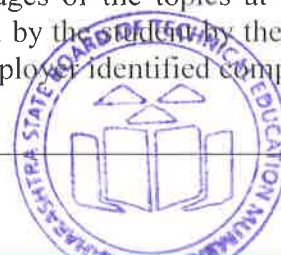
Teaching Scheme				Credit (L+T+P)	Examination Scheme											
L	T	P	Paper Hrs.		Theory						Practical					
					ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	4	7	3	70	28	30*	00	100	40	50#	20	50	20	100	40

(*): 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.



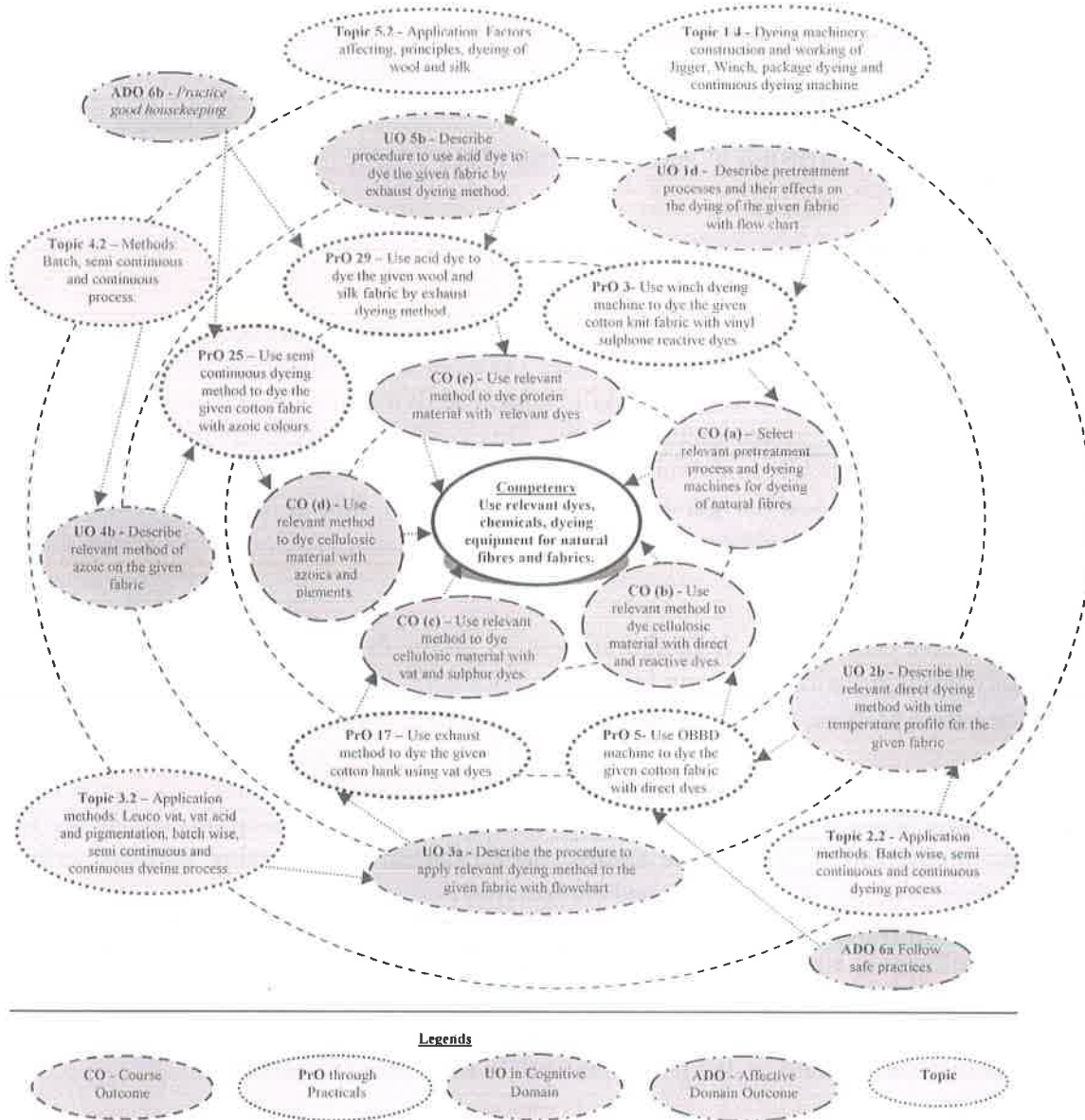


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals 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 pretreated samples from various stages to dye with direct dyes. Part - I	I	02*
2	Use pretreated samples from various stages to dye with direct dyes. Part - II	I	02
3	Use winch dyeing machine to dye the given cotton knit fabric with vinyl sulphone reactive dyes. Part - I	I	02*
4	Use winch dyeing machine to dye the given cotton knit fabric with vinyl sulphone reactive dyes. Part - II	I	02
5	Use OBBD machine to dye the given cotton fabric with direct dyes. Part - I	I	02*
6	Use OBBD machine to dye the given cotton fabric with direct	I	02



S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	dyes. Part - II		
7	Apply the given after-treatments on the given direct dyed fabric. Part - I	II	02*
8	Apply the given after-treatments on the given direct dyed fabric. Part - II	II	02
9	Use exhaust method to dye the given cotton yarn with HE brand reactive dyes. Part - I	II	02*
10	Use exhaust method to dye the given cotton yarn with HE brand reactive dyes. Part - II	II	02
11	Use OBBD machine to dye the given cotton fabric with cold brand reactive dyes. Part - I	II	02*
12	Use OBBD machine to dye the given cotton fabric with cold brand reactive dyes. Part - II	II	02
13	Use cold pad batch method to dye of cotton fabric with cold brand reactive dye. Part - I	II	02*
14	Use cold pad batch method to dye the given cotton fabric with cold brand reactive dye. Part - II	II	02
15	Use pad-dry-bake/steam method to dye the given cotton fabric with hot brand reactive dye. Part - I	II	02*
16	Use pad-dry-bake/steam method to dye of cotton fabric with hot brand reactive dye. Part - II	II	02
17	Use exhaust method to dye the given cotton hank using vat dyes. Part - I	III	02*
18	Use exhaust method to dye the given cotton hank using vat dyes. Part - II	III	02
19	Use padding mangle to dye the given cotton fabric with vat dye by pigmentation method. Part - I	III	02*
20	Use padding mangle to dye the given cotton fabric with vat dye by pigmentation method. Part - II	III	02
21	Use padding mangle to dye cotton fabric with vat dye by vat acid method. Part - I	III	02*
22	Use padding mangle to dye the given cotton fabric with vat dye by vat acid method. Part - II	III	02
23	Use exhaust method to dye the given cotton hank with azoic colours. Part - I	IV	02*
24	Use exhaust method to dye the given cotton hank with azoic colours. Part - II	IV	02
25	Use semi-continuous dyeing method to dye the given cotton fabric with azoic colours. Part - I	IV	02*
26	Use semi-continuous dyeing method to dye the given cotton fabric with azoic colours. Part - II	IV	02
27	Use basic dye to dye the given wool and silk fabric by exhaust dyeing method. Part - I	V	02*
28	Use basic dye to dye the given wool and silk fabric by exhaust dyeing method. Part - II	V	02
29	Use acid dye to dye the given wool and silk fabric by exhaust dyeing method. Part - I	V	02*
30	Use acid dye to dye the given wool and silk fabric by exhaust dyeing method. Part - II	V	02



S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
31	Use natural dye to dye the given fabric by pre mordanting dyeing method. Part - I	V	02*
32	Use natural dye to dye the given fabric by pre mordanting dyeing method. Part - II	V	02
Total			64

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 judicial mix of minimum 24 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	Selection of suitable component, apparatus/instrument	20
2	Preparation of experimental set up	10
3	Setting and operation	10
4	Safety measures	10
5	Observations and Recording	10
6	Interpretation of result and Conclusion	20
7	Answer to sample questions	10
8	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:

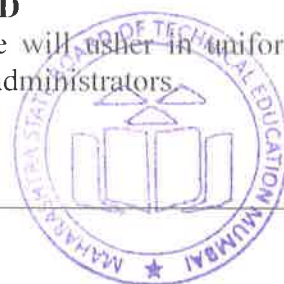
- a. Follow safety practices.
- b. Practice good housekeeping.
- c. Demonstrate working as a leader/a team member.
- d. Maintain tools and equipment.
- e. Follow ethical Practices.

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
- 'Organising Level' in 2nd year and
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will assist in uniformity in conduct of experiments, as well as aid to procure equipment by administrators

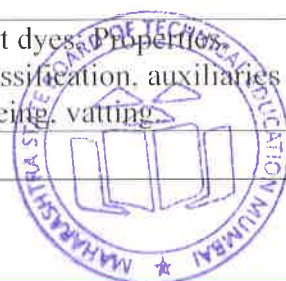


S. No.	Equipment Name with Broad Specifications	PrO. No.
1.	OBBD machine, 12 pots each with 300 ml. capacity.	1,4
2.	Water bath with china clay dye pots with 500 ml. capacity.	2,3,9,12,14,15
3.	Winch dyeing machine of 1kg. Fabric capacity.	5,13
4.	Two roller padding mangle.	6,7,8,10,11
5.	Hot air stenter frame. Temperature -200°C	7
6.	Electronic balance with 0.001gm accuracy.	All
7.	High temperature steamer. Temperature-150°C.	8,10,11

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 Preparation of natural fibres and dyeing machines	1a. Describe pretreatment processes and their effects on the dyeing of the given fabric with flow chart. 1b. Describe the process to analyse the quality parameters of the given textile material for dyeing. 1c. Calculate the given dyeing parameters for the specified fabric. 1d. Describe with sketches the procedure to operate the given dyeing machine with flow chart.	1.1 Pretreatment processes: Effect of Scouring, Mercerization, Bleaching, and Degumming on dyeing, quality parameters required for fabric to be dyed. 1.2 Dye properties: Substantivity, affinity, 1.3 Dyeing parameters- exhaustion, expression, percent shade, material to liquor ratio. 1.4 Dyeing machinery: construction and working of Jigger, Winch, package dyeing and continuous dyeing machine.
Unit-II Direct and Reactive Dyes	2a. Describe with sketches the application of direct dye with affecting parameters on the given fabric. 2b. Describe with sketches the relevant direct dyeing method with time temperature profile for the given fabric 2c. Explain with sketches the batch, semi-continuous and continuous methods for the given fabric 2d. Identify problems with remedies for the given direct dyed fabric. 2e. Describe with sketches the relevant method for reactive dye for the given fabric. 2f. Identify after-treatment(s) problems and their remedies on the given reactive dyed goods.	2.1 Direct Dyes: Properties, types, parameters affecting dyeing quality. 2.2 Application methods: Batch wise, semi continuous and continuous dyeing process. 2.3 After treatments: Procedure, effect on hue and fastness. 2.4 Problems and remedies 2.5 Reactive dyes: Properties, reactive systems, classification 2.6 Dyeing methods: Batch wise, semi continuous and continuous dyeing. 2.7 After treatments: Washing, soaping, stripping, fastness properties
Unit- III Water Insoluble	3a. Describe with sketches the the procedure to apply relevant dyeing method to the given	3.1 Vat dyes: Properties, classification, auxiliaries used in dyeing, vatting.



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Dyes	<p>fabric with flowchart.</p> <p>3b. Suggest the rectifications for the stated faults in the vat dyed material.</p> <p>3c. Describe with sketches the sulphur dyeing method for the given fabric with flowchart.</p> <p>3d. Identify faults and their remedies in the given sulphur dyed material.</p>	<p>3.2 Application methods: Leuco vat, vat acid and pigmentation, batch wise, semi continuous and continuous dyeing process.</p> <p>3.3 Faults and remedies.</p> <p>3.4 Sulphur dyes: Classification, auxiliaries</p> <p>3.5 Application methods: Batch and continuous dyeing methods.</p> <p>3.6 Problems and remedies in dyeing.</p>
Unit-IV Azoic and Pigments	<p>4a. Describe with sketches the relevant treatment for the given material.</p> <p>4b. Describe with sketches the relevant method of azoic on the given fabric.</p> <p>4c. Suggest the rectifications for the stated faults in the azoic dyed material.</p> <p>4d. Describe with sketches the relevant pigmentation process for the given fabric.</p>	<p>4.1 Treatments: Treatment with naphthols, intermediate treatments, development, after treatments.</p> <p>4.2 Methods: Batch, semi continuous and continuous processes.</p> <p>4.3 Stripping, faults and their remedies.</p> <p>4.4 Pigment: Application process, batch and continuous methods.</p>
Unit –V Acid, Basic and Natural Dyes	<p>5a. Describe with sketches the procedure to use basic dye to dye the given fabric.</p> <p>5b. Describe with sketches the procedure to use acid dye to dye the given fabric by exhaust dyeing method.</p> <p>5c. Select relevant dye to dye the given fabric with justification.</p> <p>5d. Suggest the rectifications for the stated faults in the given dyed goods.</p> <p>5e. Select relevant natural dye to dye the given fabric with justification.</p> <p>5f. Describe with sketches the application methods of dyeing the given fabric with natural dyes using the flow chart.</p>	<p>5.1 Acid dyes: Classification</p> <p>5.2 Application: Factors affecting, principles, dyeing of wool and silk.</p> <p>5.3 Exhaust dyeing method</p> <p>5.4 Basic dyes: Auxiliary, dyeing of wool and silk.</p> <p>5.5 Stripping, problems and their remedies.</p> <p>5.6 Natural Dyes: Classification, Sources.</p> <p>5.7 Application methods: Pre-mordanting, post mordanting and simultaneous mordanting.</p>

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' 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	Preparation of natural fibres and dyeing machines	09	04	04	06	14
II	Direct and Reactive Dyes	11	04	04	06	14
III	Water Insoluble Dyes	10	04	04	06	14
IV	Azoic and Pigments	06	02	04	04	10
V	Acid, Basic and Natural Dyes	12	04	06	08	18
Total		48	18	22	30	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

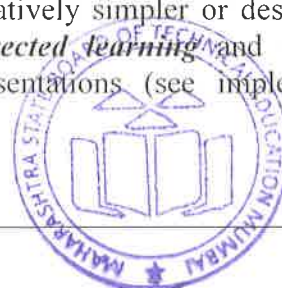
Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5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

- Survey market to collect information about different dyes, pigments available and compare them based on their properties, applications, and prices.
- Visit any natural fibre process house nearby and collect information from the processing in-charge about various processes conducted.
- Library/internet survey of developments in dyes, pigments and their applications.
- Prepare shade card using combination of primary colours.
- Prepare presentation incorporating visuals, photographs, animations, video on process sequence of dyeing natural fibres.
- Collect information from the natural fibre process house about the faults in dyeing and relevant remedies.
- Collect information on safety precautions of various chemicals and machinery used in the process house.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

- Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- '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.
- 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. Assign unit wise assignments to group of 4 to 5 students for solving unit wise questions.
- i. Use of video, animation films to explain concepts, facts and applications related to dyeing of natural 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 in the beginning of the semester. In the first four semesters, the micro-projects 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 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**.

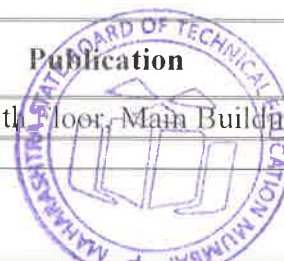
The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual 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 are given here. Similar micro-projects could be added by the concerned faculty:

- a. **Dyeing faults:** Visit industries and collect dyed samples of faulty dyeing and find remedies to rectify same. Present your report.
- b. **Lab to bulk dyeing:** Collect any two cotton dyed samples from industry with their recipe and produce same results in laboratory on OBBD machine by changing appropriate recipe. Correlate the results and present.
- c. **Dye and chemical cost:** Collection of recipe, price of dyes and chemicals of any two dyeing methods and prepare dyeing cost. Prepare report.
- d. **Water consumption:** Visit any textile dye house. Collect information of any two dyeing machines for their water consumption. Calculate the quantity of water consumption per kg of fabric. Present your report.
- e. **Shade matching:** Collect any one dyed sample from dye house. Using any class of dye match the shade in the laboratory. Present your matched samples with recipe.
- f. **Fastness properties:** Collect any one dyed sample from dye house and evaluate its fastness to washing, rubbing and perspiration. Present your ratings.
- g. **Effect of dyeing parameters:** select any one dye class and its one method and change the dyeing parameters like M:L, temperature, time, chemical concentration etc. Present the samples with your observations.
- h. **Effect of pretreatment:** collect pretreated samples at various stages and carry out the dyeing with same recipe and dyeing conditions. Present the samples with your observations.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Chemical Processing of	Koushik, C. V.;	NCUTE, 8th floor, Main Building.



S. No.	Title of Book	Author	Publication
	Textiles	Antao Irwin Josico	IIT, Hauz Khas, New Delhi, 2003
2.	Textile processing and Properties, Volume 11	Vigo, T. L.	Elsevier Science, B.V., Amsterdam, 1994, ISBN: 9780444882240
3.	The dyeing of cellulose fibres	Clifford Preston	Dyers co. Publication Trust, England, 1986, ISBN: 901956430
4.	Dyeing and chemical Technology of Textile Fibres	Trotman, E. R.	Hodder & Stoughton, 1991 ISBN: 9780852642672
5.	Silk dyeing printing and finishing	Gulrajani, M. L.	Dept. of Textile Technology, Indian Institute of Technology, Hauz Khas, New Delhi, 1988
6.	Technology of Dyeing	Shenai, V. A.	Sevak Publications Mumbai, 1984
7.	Handbook of Textile and Industrial Dyeing	Clark, M.	Woodhead Publishing, UK, 2011, ISBN: 9781845696955

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

- a. en.wikipedia.org/wiki/Dyeing
- b. www.teonline.com/knowledge-centre/dyeing-fiber-to-apparel.html
- c. www.teonline.com/knowledge-centre/dyeing.html
- d. textilelearner.blogspot.in/2011/12/methods-of-dyeing-different-dyeing.html
- e. study.com/academy/lesson/what-is-dyeing-in-textiles.html
- f. www.fibre2fashion.com/industry-article/3871/dyeing?page=1
- g. dyes-pigments.standardcon.com/batch-dyeing-process.html
- h. dyes-pigments.standardcon.com/continuous-dyeing-process.html
- i. dyes-pigments.standardcon.com/semi-continuous-process.html
- j. dyes-pigments.standardcon.com/pigment-dyeing.html



