

Program Name : Diploma in Textile Technology
Program Code : TC
Semester : Sixth
Course Title : Computer Aided Colour Science
Course Code : 22672

1. RATIONALE

In textile industry, various processes such as dyeing, printing, and finishing are used to manufacture quality textile. These major processes improve the aesthetic as well as the market value of the textile. Dyeing and printing are processes used for colouration of textile substrates such as cellulosic, polyester, nylon, acrylic and their blends. The knowledge and skills related to light theory, perception of colour, colour mixing using computer based colour matching system is essential for the diploma engineer to create quality textile with optimum cost. This course is developed in such a way that basic concepts and principles of light theory, colour mixing theories and application of computer colour matching system will help the diploma engineer to get quality fabrics with optimum cost. This will further help them to 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:

- **Prepare textile colour recipe in wet processing using principles of colour science and computer-based colour matching system.**

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:

- Use relevant spectrophotometer for colour measurement in textiles.
- Use relevant technique of colour specification in colour matching system.
- Use relevant colour standards in colour matching systems.
- Use relevant procedure to formulate quality recipe for colouration.
- Use relevant application to identify the given colour properties.

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	
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.

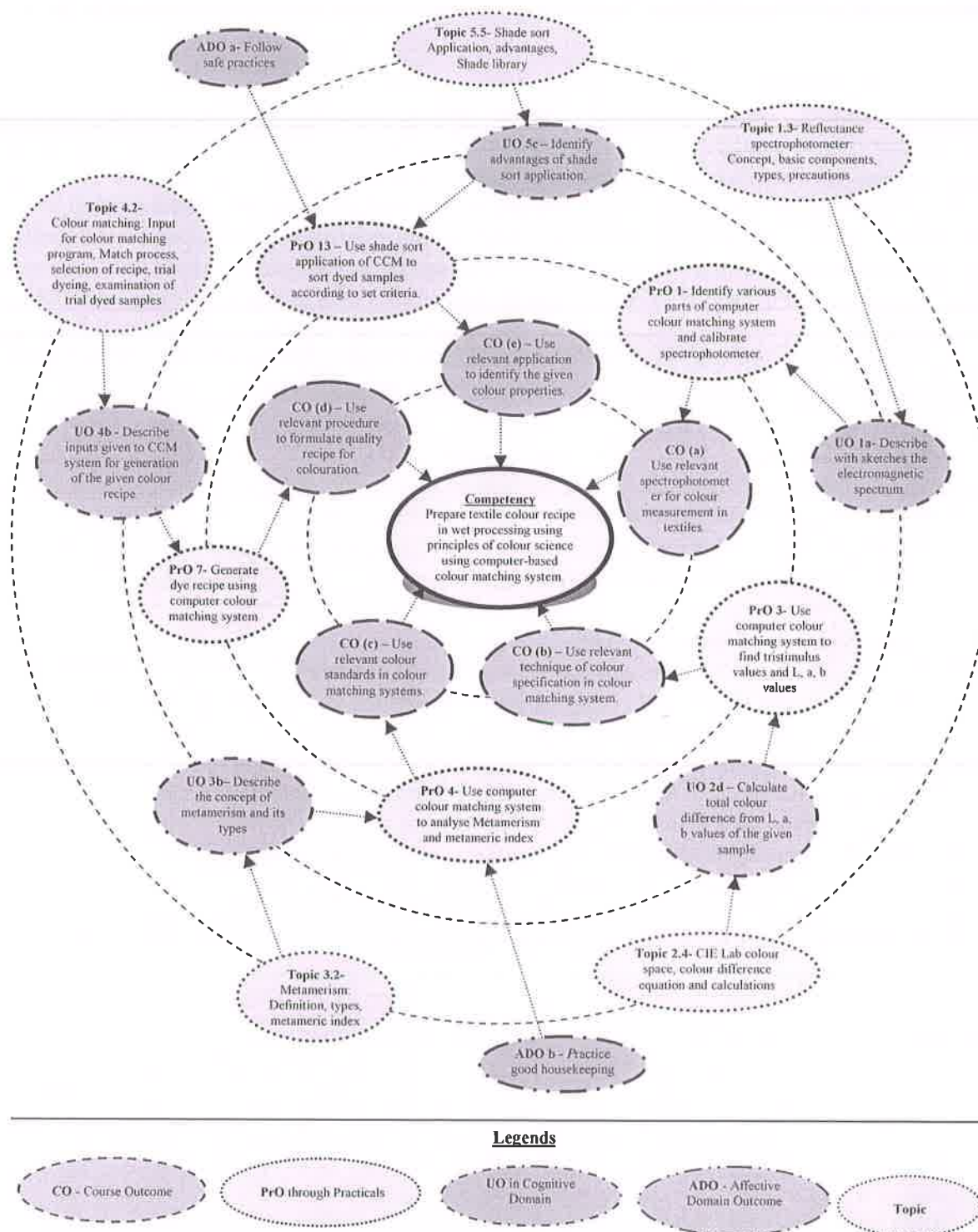


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The 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.	Identify various parts of computer colour matching system and calibrate spectrophotometer.	I	02*
2.	Use primary colours to produce secondary colours by subtractive colour mixing theory	I	02*
3.	Use computer colour matching system to find tristimulus values and L, a, b values	II	02*
4.	Use computer colour matching system to analyse Metamerism and metamerism index - Part I	III	02
5.	Use computer colour matching system to analyse Metamerism and metamerism index - Part II	III	02
6.	Use reactive dyes to produce database for exhaust dyeing. Part I	IV	02*
7.	Use reactive dyes to produce database for exhaust dyeing. Part II	IV	02*
8.	Use CCM to study effect of concentration of dye on fibre to K/S	IV	02
9.	Generate dye recipe using computer colour matching system for physical standard.	IV	02*
10.	Generate dye recipe using computer colour matching system for numerical standard	IV	02
11.	Use batch correction application of computer colour matching system to correct unmatched shade. Part I	IV	02
12.	Use batch correction application of computer colour matching system to correct unmatched shade. Part II	IV	02
13.	Use computer colour matching system to analyse colour difference	V	02*
14.	Evaluate washing fastness rating using computer colour matching system	V	02*
15.	Use computer colour matching system to evaluate whiteness index of bleached textile substrate	V	02*
16.	Use CCM to evaluate colour strength of dyes from different batches	V	02
17.	Use shade sort application of CCM to sort dyed samples according to set criteria.- Part I	V	02
18.	Use shade sort application of CCM to sort dyed samples according to set criteria.- Part II	V	02
19.	Use Pass / Fail application of CCM to approve batch sample against standard sample	V	02*
Total			38

Note

- 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.
- 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

S.No.	Performance Indicators	Weightage in %
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
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:

- Follow safety practices.
- Practice good housekeeping.
- Practice energy conservation.
- Work as a leader/a team member..
- 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	Computer colour matching system	1,3,5,6-14
2	High temperature high pressure beaker dyeing machine with micro-processor and dye-pot of 250ml capacity	2,6,8
3	Open bath beaker dyeing machine with micro-processor and dye-pot of 500 ml capacity	4,13
4	Volumetric flask, measuring cylinder, pipette, weighing balance, beakers, thermometer.	All
5	Grey Scale	10
6	Relative dyes, chemicals and auxiliaries	All
7	Electronic balance with 0.001gm accuracy, capacity 300 gm.	All

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 Light theory and	1a. Explain the specified colour mixing theory for the given situation.	1.1 Light theory: Electromagnetic spectrum, Visible light Colour mixing: Additive and

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Spectrophotometer	1b. Justify the selection of colours based on colour mixing theories for the given situation. 1c. Explain with sketch the construction and working of the given type of spectrophotometer. 1d. Explain functions of the specified parts of the given spectrophotometer. 1e. Describe calibration procedure of the given spectrophotometer	subtractive colour mixing 1.3 Reflectance spectrophotometer: Concept, basic components, types, precautions 1.4 Calibration procedure, Main features of modern spectrophotometer, reflectance curves.
Unit- II Colour specifications	2a. Describe elements of the given colour specifications. 2b. Explain the specified illuminants with its attributes. 2c. Describe features and limitations of the given CIE system. 2d. Calculate total colour difference from Lab values of the given sample	2.1 CIE colour specifications 2.2 Tristimulus values: Standard Illuminants, standard observer 2.3 Features and limitations of CIE system 2.4 CIE Lab colour space, colour difference equation and calculations
Unit-III Colour standards	3a. Justify the choice of the given sample preparation for colour standards 3b. Explain the concept of the specified feature of metamerism. 3c. Compare the given two standards based on the given criteria. 3d. Choose the colour standard for the given situation with justification.	3.1 Sample preparation: Types, Pretreatments, colouration, presentation, measurement 3.2 Metamerism: Definition, types, metamerism index 3.3 Physical standards, numerical standards
Unit –IV Recipe formulation	4a. Explain the specified points in K/S data generation. 4b. Describe the specified inputs given to CCM system for generation of the given colour recipe. 4c. Describe the specified correction application and its process. 4d. Describe the colour matching of the specified substrate	4.1 K/S data generation 4.2 Colour matching: Input for colour matching program, Match process, selection of recipe, trial dyeing, examination of trial dyed samples 4.3 Batch correction application, its process 4.4 Matching of blended fabrics
Unit-V Applications of computer colour matching system	5a. Describe the specified elements in colour difference. 5b. State advantages of the given type of assessment on CCM with respect to grey scale. 5c. Interpret the given colour strength values. 5d. Interpret the given Colour Inconstancy index.	5.1 Colour difference assessment- Elements in colour difference, Colour Inconstancy index (CII), Fastness rating, Pass / Fail 5.2 Shade sort Application, advantages, Shade library 5.3 Colour strength analysis 5.4 Whiteness index and

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		yellowness index 5.5 Limitations of computer colour matching system

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	Light theory and Spectrophotometer	12	04	06	06	16
II	Colour specifications	06	02	04	02	08
III	Colour standards	08	02	04	06	12
IV	Recipe formulation	10	04	04	06	14
V	Applications of computer colour matching system	12	04	06	10	20
Total		48	16	24	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:

- Visit any process house nearby and collect information from the processing in-charge about their routine practice of colour matching.
- Write report on visit to dye house and compile the existing problems in matching.
- Collect shade wise information of tolerance limits from different consumers.
- Prepare chart to produce secondary and tertiary colours by using primary colours.
- Library/Internet survey of developments in spectrophotometers.
- Prepare presentation incorporating visuals, photographs, animations, video on computer colour matching.
- Collect information from the process house about the faults in colour matching and relevant remedies.

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) **Importance of colour matching:** Collect various standard samples and batch samples of textile substrate and use colour difference application to analyse accuracy of matching.
- b) **Preparation of Database:** Prepare database of given dye on given substrate and evaluate K/S for its applicability on computer colour matching system.
- c) **Shade matching using CCM:** Collect different standard samples from different industries and reproduce any one on given substrate in laboratory using recipe formulation application of computer colour matching.
- d) **Study of Metamerism:** Collect different commercially dyed textile substrate and evaluate metameric index using computer colour matching system and find better recipe by using recipe formulation application.
- e) **CCM systems used in industries:** Collect information from different manufacturers of spectrophotometers used in CCM and compare their working, structure and techno commercial importance.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Computer Colour	Sule, A.D.	New Age International Publisher,

S. No.	Title of Book	Author	Publication
	Analysis		1997, ISBN: 9788122410846
2.	Color Matching: Using Color in Graphic Design	Wang, Shaoqiang	Sandu Publishing Co. Ltd.; Promopress, January 2015, ISBN: 978-8415967255
3.	Colour Measurement- Principles, Advances and Industrial Applications	Gulrajani, M.L.	Woodhead Publishing, August 2010, ISBN: 9781845695590
4.	Colour Technology Tools Techniques and Applications	Gupte, V.C.	Woodhead Publishing, January 2014, ISBN: 9788190259415
5.	Principles of Colour and Appearance Measurement: Object Appearance, Colour Perception and Instrumental Measurement	Choudhury, A. R.	Woodhead Publishing, January 2014, ISBN: 9780857092298

14. SOFTWARE/ LEARNING WEBSITES

- www.textilelearner.blogspot.com/2011/05/different-types-of-computer-color_9427.html
- www.youtube.com/watch?v=JNeFWS5Mr8Y
- www.textilefashionstudy.com/shade-checking-system-in-dyeing-floor-shade-matching/
- www.munsell.com/color-blog/color-matching-textile-apparel-industry/
- www.archive.org/details/colourmatchingon00pate

