Maharashtra State Board Of Technical Education, Mumbai
Teaching And Examination Scheme For Post S.S.C. Diploma Courses

Program Name : Diploma in Textile Manufacturers

Program Code : TX	**With Effect From Academic Year: 2017 - 18**
Duration of Program : 6 Semesters	**Duration : 16 Weeks**
Semester : Third	**Scheme - I**

S. N.	Course Title	Course Abbreviation	Course Code	Teaching Scheme			Credit (L+T+P)	Examination Scheme																Grand Total
									Theory								Practical							
				L	T	P		Exam Duration in Hrs.	ESE		PA		Total		ESE		PA		Total				
									Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks			
1	Carding and Combing	CAC	22365	4	-	2	6	3	70	28	30*	00	100	40	25#	10	25	10	50	20	150
2	Warp Yarn Preparation	WYP	22366	4	-	2	6	3	70	28	30*	00	100	40	25#	10	25	10	50	20	150
3	Elements of Wet Processing	EWP	22367	4	-	2	6	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
4	Basics of Fiber Science	BFS	22368	3	-	-	3	3	70	28	30*	00	100	40	--	--	--	--	--	--	100
5	Yarn Testing	YTE	22369	3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
7	Textronics	TEX	22031	2	-	2	4	--	--	--	--	--	--	--	25@	10	25~	10	50	20	50
	Total			20	-	10	30	--	350	--	150	--	500	--	125	--	125	--	250	--	750

Student Contact Hours Per Week: 35 Hrs.   Medium of Instruction: **English**

Theory and practical periods of 60 minutes each.   Total Marks : **750**

Abbreviations: ESE- End Semester Exam, PA- Progressive Assessment, L - Lectures, T - Tutorial, P - Practical

@ Internal Assessment, # External Assessment, *# On Line Examination, ^ Computer Based Assessment

* 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 LOs required for the attainment of the COs.

~ For the courses having ONLY Practical Examination, the PA marks Practical Part - with 60% weightage and Micro-Project Part with 40% weightage

 ➢ **If Candidate not securing minimum marks for passing in the "PA" part of practical of any course of any semester then the candidate shall be declared as "Detained" for that semester.**

Program Name : **Diploma in Textile Manufacturers**

Program Code : **TX**

Semester   : **Third**

Course Title   : **Carding and Combing**

Course Code   : **22365**

1. RATIONALE

In ginning and blow room, cotton seeds and heavy impurities are removed even though some impurities remain in the cotton material. Also the fibers are randomly arranged in blow room lap. This affects the quality of yarn, grey fabric and processed fabric. Through this course the diploma engineer will acquire knowledge and skills required to control spinning preparatory processes such as Carding, Combing and Drawing. Carding process improves fiber individualization and removes residual impurities from the cotton fibre. Combing is done for straightening, parallelization, upgrading the quality of cotton fibres and removing short fibres. In drawing process fiber parallelization and improvement in evenness is achieved. This course is designed to prepare the diploma engineer to apply the basic knowledge of carding, drawing and combing processes to solve broad based problems in textile 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:

- **Use carding machine to form uniform sliver product.**

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:

 a. Use carding machine to individualize the fibres, remove impurities and neps in cotton material.
 b. Use auto-levelers to produce even quality sliver.
 c. Use draw frame to produce even sliver.
 d. Use auto-levelers to control sliver quality of draw frame.
 e. Use comber lap preparatory to produce even lap sheet.
 f. Use comber to produce good quality sliver by removing short fibres and hooks.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Paper Hrs.	Theory						Practical					
L	T	P			ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4	-	2	6	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	Use carding machine to draw the passage of material.	I	02*
2	Trace gearing arrangement diagram of carding machine to calculate speed and production in Kg/shift.	I	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
3	Trace gearing arrangement diagram of carding machine to calculate draft and draft constant.	I	02
4	Set carding machine (front) zone using tools and gauges.	II	02*
5	Set carding machine (back) zone using tools and gauges.	II	02
6	Use draw frame machine to draw the passage of material.	III	02*
7	Trace gearing arrangement diagram of draw frame machine to calculate speed and production in Kg/shift.	IV	02*
8	Trace gearing arrangement diagram of draw frame machine to calculate draft and draft constant.	IV	02
9	Set draw frame machine using tools and gauges.	IV	02
10	Use sliver lap machine to draw the passage of material.	V	02*
11	Trace gearing arrangement diagram of sliver lap machine to calculate speed and production in Kg/shift.	V	02
12	Use ribbon lap machine to draw the passage of material.	V	02
13	Use comber machine to draw the passage of material.	VI	02*
14	Trace gearing arrangement diagram of comber machine to calculate production.	VI	02
15	Set comber machine using tools and gauges. Part - I	VI	02*
16	Set comber machine using tools and gauges. Part - I	VI	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 judicial 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
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. Demonstrate working as a leader/a team member.
e. Maintain tools and equipment.
f. 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
- 'Characterising Level' in 3rd year

7.   MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Carding machine (Doffer dia.-27 inch, Cylinder dia.-50 inch. Licker in-dia-9 inch. Feed roller dia.-2inch.) Digital Tachometer (100-5000 rpm), steel ruler, Vernier caliper	1,2,3
2	Leaf guages-5 thou (5"/1000), 7thou, 10thou,12thou.	4,5
3	Draw frame, Feeler gauges- 1/32" and 1/25"	6,7,8,9
4	Sliver lap machine, Shell roller dia-12inch.Calender roller dia-5inch.	10.11
5	Ribbon lap machine, Shell roller dia-12inch.Calender roller dia-5inch.	12
6	Comber machine, nips /min-350,feed /nip-1.1",Digital Tachometer (100-5000 rpm),steel ruler	13,14
7	Gauges- Step gauge, distance gauge, bowl gauge	15,16

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- 1 Carding Process	1a. Describe with sketches the construction and working of the specified parts of carding machine. 1b. Differentiate between feeding devices based on given parameters. 1c. Describe with sketches the relevant zones in carding machine based on given application. 1d. Describe with sketches the process of removing	1.1 Carding process: Purpose, Operating principle 1.2 Operating zones: material feed, feed device, feed device to licker-in(lap feed, chute feed),Licker-in zone, auxiliary carding devices, main cylinder, flats, doffing, detaching. 1.3 Coiling: types, condensing, trumpet, sliver coiling, can changer 1.4 Classification of fiber hooks at card

	impurities from given sample. 1e. Describe with sketches the process of fibre to fibre separation from given sample.	
Unit- II Carding quality and maintenance	2a. Interpret the specifications of given wire clothing. 2b. Explain with sketches the principle of given auto leveler 2c. Describe with sketches the relevant auto leveler measuring and monitoring devices. 2d. Describe with sketches the given method of card clothing maintenance. 2e. Explain importance of the specified carding related devices.	2.1 Card Clothing-classification, flexible clothing, semi-rigid clothing, metallic clothing, Choice of clothing 2.2 Maintenance– stripping, burnishing and grinding 2.3 Auto leveler - Basics, classification, principle of short, medium and long term auto leveling, Auto leveling Equipment-Function of Auto leveler at card, Auto level measuring and monitoring devices. 2.4 Card settings and their effect on sliver quality 2.5 Carding Machine Calculations - speeds, draft, production and hank of sliver. 2.6 Modern developments in carding- Comb bar, deflector blade, Stationary flats (Pre and post comb segments), Doffing devices – apron, roller doffing. 2.7 Features of high production card.
Unit –III Drafting process and draw frame machine	3a. Explain with sketches the construction and working of the specified parts of drawing machine. 3b. Describe with sketches the the given drafting arrangement 3c. Describe with sketches the maintenance procedure for the given type of rollers. 3d. Describe with sketches the the given draw frame.	3.1 Draw Frame: Purpose, operating principle, Attenuation (Draft), roller drafting, distribution of draft, Shirley drafting principle, principles of doubling, factor affecting the draft based on fibre material. Passage of material through draw frame. 3.2 Operating devices: Creel, Drafting arrangement, drafting rollers-top rollers, bottom rollers, cots buffing, roller setting, roller weighing systems, roller clearers, suction system. 3.3 Drafting systems used on draw frame 3/4, 3/3, 4/3, 5/4, pressure bar.
Unit –IV Monitoring and Auto leveling of Draw frame	4a. Describe with sketches the specified method of auto levelers. 4b. Describe application of the specified monitoring devices on draw frame. 4c. Explain the specified defects in drawn sliver with their causes and remedies.	4.1 Auto-leveler in draw frame. 4.2 Integrated monitoring system (sliver data) 4.3 Draw frame calculations: draft, production and waste, 4.4 Draw frame: Defects, causes and remedies, Features of high production draw frame.

	4d. Calculate the speed, draft and production of a draw frame for the given situation.	
Unit –V Comber lap preparation	5a. Describe with sketches the construction and working of the given machines. 5b. Explain influence of the given parameters of lap preparation on combing process. 5c. Explain the specified defects in comb sliver with their causes and remedies 5d. Calculate the production in Kg/shift of given combing preparatory machine with given data.	5.1 Comber: purpose. 5.2 Lap preparation: Effects on combing- effect of pre comb draft on comber performance, parallelization of fibre in the sheet, sheet thickness, evenness of lap sheet, disposition of the hooks. 5.3 Lap preparing machines- sliver lap, ribbon lap, lap former 5.4 Causes of defective production and their remedies. 5.5 Calculation related to production and draft of sliver lap and ribbon Lap
Unit –VI Combing Process	6a. Describe with sketches the sequence of operation of the given comber. 6b. Explain importance of index wheel for the given combing machine 6c. Calculate the production in Kg/shift and draft of the given combing machine with given data. 6d. Compare the features of the given types of feed.	6.1 Comber- Elements, working, Types, 6.2 Technology of combing- parameters influencing the combing operation, influence of the combing on quality, Sequence of operation of rectilinear comber; Defects, causes and remedies of comber machine, features of modern comber. Types of feed- forward feed, backward feed. 6.3 Index wheel timing and setting of comber. Influence of machine component and setting on combing performance. 6.4 Calculations related to draft, noil and production.

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	Carding Process	12	02	04	06	12
II	Carding quality and maintenance.	12	04	02	06	12
III	Drafting process and draw frame machine	10	02	02	04	08
IV	Monitoring and auto- levelers of draw frame machine	06	02	02	06	10
V	Comber lap preparation.	08	02	02	06	10
VI	Combing Process		04	04	10	18

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
Total		64	16	16	38	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.   Prepare journals based on practical's performed in laboratory.
b.   Measure sliver evenness specification.
c.   Give seminar on any relevant topic.
d.   Library survey regarding modern features of carding, drawing, comber preparatory and comber machine use in different industries.
e.   Prepare power point presentation for showing principles of Carding, Drawing and combing.

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.   Use Flash/Animations to explain the principle of Carding Drawing and combing
g.   Give micro projects to students

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 are given here. Similar micro-projects could be added by the concerned faculty:

a. **Carding Process:**
   i. Collect different card wires and draw diagrams of the same.
   ii. Prepare chart for wire point specification of licker-in, cylinder, doffer and flat tops of different manufacturers with trade name.
   iii. Collect wastes at different parts and enlist type of waste and calculate its percentage
   iv. Refer monograph published by different research association and prepare chart for specification of waste extracted at different for different quality of cotton.

b. **Carding quality and maintenance.**
   Draw line diagram of various autoleveler measuring devices and Enlist merits and demerits of each system.

c. **Drafting process and draw frame machine:**
   Draw line diagram of various drafting systems and Enlist merits and demerits of each system.

d. **Monitoring and Auto-levelers of Draw frame process.**
   Collect photographs and specification of various auto leveler and Prepare booklet..

e. **Comber lap preparation:**
   Collect photographs and specification of various combing preparatory machines and Prepare booklet.

f. **Combing Process:**
   Prepare index wheel timing in tabular form and draw a line diagram of combing cycle.

13.   SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	A Practical guide to Opening and Carding, Vol.-	Klein, W.	The Textile Institute,Manchenstar,1987 ISBN: 0900739924
2	A Practical guide to Combing and Drawing,	Klein, W.	The Textile Institute,Manchenstar,1987 ISBN: 0900739932
3	Spinning	Lord, P.R	Wood head publications, India,1970, ISBN: 185573 9771
4	Spinning of Manmade and Blends on cotton spinning	Salhotra, K.R	The Textile Association of India, Ahmedabad, 2016 , ISBN:18932800X
5	Spun Yarn Technology	Eric,Oxtoby	Butterworth's (Publishers) Limited, 1983, ISBN:0408014644

14.   SUGGESTED SOFTWARE/LEARNING WEBSITES
   a.   www.nptl.comhttp://www.textileschool.com/articles/109/blow-room-functions
   b.   www.textilelearner.blogspot.in/2011/07/basic-operations-in-blowroom_485.html
   c.   www.textilelearner.blogspot.in/2011/03/blowroom-objects-of-blow-room-basic_2485.html

d. www.rieter.com/cz/rikipedia/articles/combingand drawing-spinning/applications-engineering/preparation-of-raw-material/the-processing-stages/blowroom/

e. www.youtube.com/watch?v=IDGmXssFa6s

f. www.en.wikipedia.org/wiki/Cotton_gin

g. www.s-media-cache-ak0.pinimg.com/564x/b8/76/b6/b876b60703a1b40138e5b800dd7212e2.jpg

h. www.gluedideas.com/Encyclopedia-Britannica-Volume-6-Part-2-Colebrooke-Damascius/Cotton-Ginning-Machinery.html

i. www.textilelearner.blogspot.in/2011/08/what-is-ginning-cotton-ginning-types-of_8829.html

j. www.textilefashionstudy.com/what-is-textile-fiber-classifications-of-textile-fiber/

k. www.cms.gcg11.ac.in/attachments/article/87/CLASSIFICATION%20OF%20YARN.pdf

l. www.nptel.ac.in/corses/116102034/1

Program Name	: **Diploma in Textile Manufacturers**
Program Code	: **TX**
Semester	: **Third**
Course Title	: **Warp Yarn Preparation**
Course Code	: **22366**

1.   RATIONALE

Weaving for textile is an important activity for any textile engineer. The knowledge of basic process such as warping and sizing are essential process of any weaving technique. This course will help the diploma engineer to develop woven fabric using principle of warping and sizing. Fundamental information of warp preparation will help him/ her to apply the basic concepts of preparatory process to deliver relevant package for sizing. Sizing process will help weaving process by developing relevant package with known length parameters. This course is developed in the way by which fundamental information will help the diploma engineers to apply the basic concepts of warping and sizing in various fabric producing methods in solving broad based textile weaving problems.

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 principles of warping and sizing process to prepare raw material for weaving process.**

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:

- a.   Select relevant warping machine for manufacturing weavers beam.
- b.   Use beam warping machine to convert single end package into multi end package.
- c.   Use sectional warping machine to produce stripped color pattern weaver's beams.
- d.   Use sizing process to capsulate the yarn surface.
- e.   Select relevant sizing process parameters for types of yarn.
- f.   Use quality control parameters to produce quality sized yarn.

4.   TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Paper Hrs.	Theory						Practical					
L	T	P			ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4	-	2	6	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.

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.
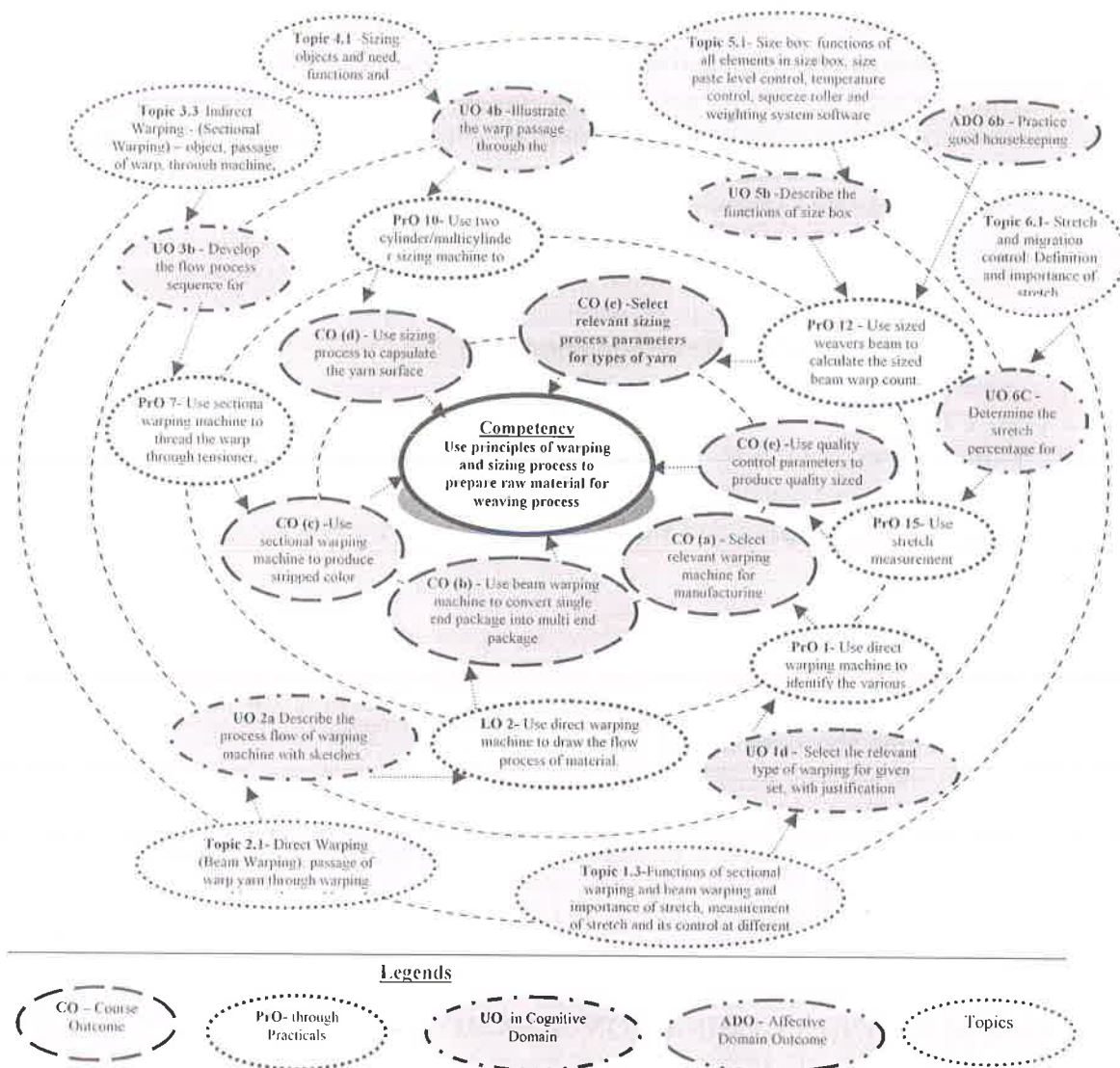

Figure 1 - Course Map

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 direct warping machine to identify the various elements of warping machine.	I	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
2	Use direct warping machine to draw the flow process of material.	II, III	02
3	Use direct warping machine to: a. Estimate creel capacity for given warping set. b. Creel and decreel as per estimated creel capacity.	II	02*
4	Use fabric five samples , a. Select relevant warping process. b. Calculate number of beams/sections required for further process.	III,II	02
5	Use five stripe pattern fabrics to: a. Calculate the number of ends on weavers beam. b. Estimate number of sections on sectional drum. c. Calculate the sectional and beam width.	III,II	02*
6	Use five check pattern fabrics to: a. Calculate warp color pattern/repeat and total number of warp repeats. b. Estimate rearrangement of color warp patterns in a section. b. Arrange color cones in the creel.	III	02
7	Use sectional warping machine to thread the warp through tensioner, thread guide, comber board and sectional reed.	III	02
8	Use given fabric length parameter of warping machine to: a. Estimate warp length for each beam/section. b. Estimate the number of beam/section required.	II, III	02
9	Use section warping machine to insert lease band while preparing sections for weavers beam.	III	02
10	Use section/beam warping machine to estimate the production of warp in kg/shift or meters/shift for given data.	II, III	02
11	Use two cylinder/multicylinder sizing machine to draw the process flow of material for given quality.	IV,V	02
12	Use size box to sketch outline of various elements and write their functions.	IV,V	02
13	Use sized weavers beam to calculate the sized beam warp count.	IV	02*
14	Use tensile strength instrument to measure increased yarn strength of given sized yarn.	V	02*
15	Use stretch measurement instrument to measure stretch percentage of given sized yarn.	VI	02*
16	Use sizing machine to measure migration of warp for given warp.	VI	02
17	Observe and record the formulation of size paste.	VI	02
	Total		**34**

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 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
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. Demonstrate working as a leader/a team member.
e. Maintain tools and equipment.
f. 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
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Beam warping machine with working width of 1800-2400 mm	1 to 10
2	Section warping machine with speed of 1000meters/min	1 to 10
3	Check and striped Fabric with EPI less than 60 and PPI less than 40	1 to 10
4	Sizing machine with Two/multicylinder drying system	11 to 16
5	Tensile strength tester with CRE principle	11 to 16

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 Basics of Warping	1a. Classify the given types of warping processes. 1b. Describe the functions of given warping process. 1c. Select the relevant type of warping for given set, with justification. 1d. Describe the specified winding package used for working.	1.1 Necessity and function of warping. 1.2 Types of warping: beam warping, section warping, single end warping. 1.3 Functions of sectional warping and beam warping. 1.4 Types of different winding packages used for warping.
Unit– II Beam warping	2a. Select relevant creel for given quality with justification. 2b. Select suitable tensioner for given type of yarn with justification. 2c. Select relevant tension range for given yarn with justification. 2d. Calculate the number of ends on warpers beam for given set. 2e. Determine the production in kg/shift for given data and situation. 2f. Calculate the number of warping beams for sizing for the given situation.	2.1 Direct Warping (Beam Warping): passage of warp yarn through warping machine , working of spindle driven/ Drum warping machines. 2.2 Creel: Types, Merits and demerits ,modern creel. Study of automations in creels and creeling 2.3 Tensioner: Necessity, Types, pre-tensioner, pneumatic tensioner, central control of tension, Range of tension. Merits and demerits of tensioner. 2.4 Head Stock details: spindle and drum drive, braking arrangements, expanding comb, manual and automatic doffing, system to give pressure on beam, 2.5 Stop motions: working, types, significance and effect on beam quality. 2.6 Calculation: production, number of beams in set, efficiency by time loss method, beam quality factors.
Unit– III Sectional warping	3a. Describe the given process sequence for producing stripe pattern. 3b. Describe the leasing principle to introduce leases during the given operation. 3c. Determine the creel capacity for given quality of fabric for the given situation 3d. Determine the section width and number of sections for the fabric quality for the given number of ends and creel capacity. 3e. Calculate number of weavers beam in stipulated time period	3.1 Indirect Warping:- (Sectional Warping) – object, passage of warp, through machine, preparation of sections, construction of warping drum, lease rod, section reed, traverse motion. 3.2 Section warping, leasing, beaming and creeling for colour patterns, Introduction to colour master used for creeling. 3.3 Automations in creels and creeling. Salient features of Modern Warping machines. 3.4 Production and efficiency of indirect Warping machine. Number of sections and section width for Sectional Warping.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit-IV Basics of sizing	4a. Describe with sketches the warp passage through the given sizing machine. 4b. Differentiate the salient features between the given two types of sizing machines. 4c. Select suitable sizing ingredient for preparation of size paste for given yarn type with justification.	4.1 Sizing: objects, functions and importance, passage of warp through two cylinder and multicylinder sizing machine. 4.2 Size paste preparation: functions of Sizing ingredients, cooking of size paste, pressure cooker and storage. 4.3 Size paste properties: congealing and keeping properties and their importance. Viscosity and concentration of size paste. Testing of adhesives.
Unit –V Sizing machine components	5a. Select the suitable creel for given set of beams with justification. 5b. Describe with sketches the functions of the given size box. 5c. Choose the suitable parameters of saw box for the given yarn with justification. 5d. Describe with sketches the functions of given zone. 5e. Choose the sequence of sizing process for given yarn with justification.	5.1 Creel: types, merits and demerits of various types of creel. 5.2 Size box: functions of all elements in size box, size paste level control, temperature control, squeeze roller and weighting system, immersion roller. Wet splitting & its importance. 5.3 Automatic size box, construction and working. 5.4 Drying zone: multi-cylinder drying, removal of condensed water, Teflon coating, temperatures and its control. 5.5 Splitting zone: leasing, splitting, moisture control device. 5.6 Details of headstock, marking and measuring device, comb, sheeting rollers, drag roller. drive to the weavers beam. PIV gears, differential cone drive, multi-motor drive.
Unit-VI Quality aspects of sizing	6a. Describe the given ingredients of paints and their function. 6b. Determine the stretch percentage for given type of yarn. 6c. Determine the migration for given set of yarns. 6d. Calculate the size pickup for given yarn type. 6e. Determine the sized warp yarn count for the given weavers beam.	6.1 Stretch and migration control: Definition and importance of stretch, measurement of stretch and its control at different zones (stretch meter), definition of lappers and migration, measurement of Migration. 6.2 Size pick up: requirement of size pick up, size add-on, factors effecting size pickup. Testing of sized yarn 6.3 Calculations of efficiency, dead loss, count of sized beam warp.

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	R Level	U Level	A Level	Total Marks
I	Basics of warping	08	04	04		08
II	Beam warping	12	04	04	04	12
III	Sectional warping	12	04	04	06	14
IV	Basic of sizing	08	02	04	06	12
V	Sizing machine components	12	02	04	06	12
VI	Quality aspects of sizing	12	02	04	06	12
	Total	**64**	**18**	**24**	**28**	**70**

Note: Distribution of Theory Marks spans R Level, U Level, A Level, Total Marks columns.

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. Use of video, animation films to explain principle of direct/sectional warping, basics of sizing process.
  b. Visit to modern warping unit to know the working principle of various elements.
  c. Visit to modern sizing unit to know the working of sizing machine.
  d. Prepare catalogue showing features of modern sizing and warping machine.
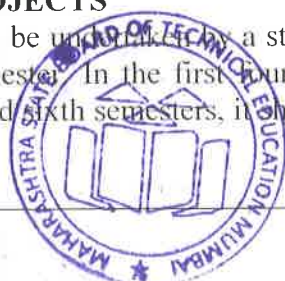
11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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. Use Flash/Animations to explain various Principles of sizing.

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. **Basics of warping:** Collect the photographs of sectional/beam warping machine and stick on card sheet by listing the features of both machine.
b. **Beam warping:** Collect the photographs of various creels, tensioning devices and prepare booklet by writing their features.
c. **Beam warping:** Collect the photographs of various tensioning devices and stick on card sheet by writing features of each tensioning device.
d. **Beam warping:** Prepare chart of various tension ranges for various types of yarns.
e. **Sectional Warping:** Collect photographs of sequence of leasing operation and stick over black card sheet.
f. **Sectional Warping:** Prepare comparative table of salient features of various sectional/direct warping machine manufacturer.
g. **Basics of Sizing:** Prepare card sheet showing passage of warp trough sizing machine and collect the photographs of various types of creel used for sizing and label the features of the each creel.
h. **Size machine components:** Draw labeled sketch of modern size box. Collect the photographs of various size boxes components and prepare booklet by writing features of each components and sticking on card sheet.
i. **Quality aspects of Sizing:** Conduct the study of migration on sizing machine and find the consequence of the same on further quality of material.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Weaving Conversion of Yarns to Fabric	Lord P.R	Woodhead Publication ISBN:1 855734834
2	Textile Sizing	Bhuvenesh C. Goswami, Rajesh D. Anandjiwala, David M. Hall	Marcel Dekker, New York ISBN: 0-8247-5053-5
3	Weaving: Machines, Mechanisms, Management	Talukdar M.K, Ajgaonkar D.B, Sriramulu P.K	Mahajan Publisher Private Ltd, ISBN:81-85401-16-0
4	Modern Preparation and Weaving Technology	Ormerod A.	Butterworth, (Publishers), 1983, ISBN: 9780408012126
5	Winding and Warping	Talukdar M.K.	Mahajan Publisher Private Ltd.
6	Industrial Practices in	M K Singh, G	Woodhead Publishing

S. No	Title of Book	Author	Publication
	Weaving Preparation	Kanpur, India	India title, ISBN: 978 0 85709 825 2

14. SUGGESTED SOFTWARE/ LEARNING WEBSITES

a. www.nptel.ac.in/courses/116102005/16
b. www.nptel.ac.in/courses/116102005/19
c. www.karlmayer.com/en/products/warp-preparation/creels/yarn-tensioners-yarn-stop-motions/
d. www.karlmayer.com/en/products/warp-preparation/sectional-warpers/automatic-sectional-warpers/
e. www.youtube.com/watch?v=fAvLgG8R100
f. en.wikipedia.org/wiki/Textile_sizing_machine
g. textilecalculation.blogspot.com/2014/12/mathematical-problems-of-sizing-in-weaving.html
h. textilecalculation.blogspot.com/2015/06/production-calculation-of-slasher.html
i. www.fibre2fashion.com/industry-article/5717/sizing-impact-of-process-parameter-on-beam-quality
j. nopr.niscair.res.in/bitstream/123456789/32473/1/IJFTR%2018%284%29%20165-169.pdf

Program Name	: **Diploma in Textile Manufacturers**
Program Code	: **TX**
Semester	: **Third**
Course Title	: **Elements of Wet Processing**
Course Code	: **22367**

1.   RATIONALE

Diploma engineers have to work at various levels in textile industry as shift supervisor to marketing head. To solve the textile manufacturing related problems, they should have a basic knowledge of each stage of textile production starting from fibre production up to garment manufacturing. This course develops necessary skills in using the chemicals which are used during pretreatment process for improving absorbency and whiteness of fabrics .This course also gives the basic knowledge about dyeing, printing and finishing processes of textile which improves the aesthetic value of textile substrate.

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 principles of chemical wet processing in textile manufacturing.**

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:
  a.   Use principles of pretreatment of fabrics in textile manufacturing
  b.   Use relevant method for desizing, scouring and bleaching of fabrics.
  c.   Use relevant dyes and dyeing methods for given cellulosic and protein fabrics.
  d.   Use relevant dyes and dyeing methods for given synthetic fabrics.
  e.   Select relevant ingredients for formulation of print paste for printing cellulosic and synthetic textiles.
  f.   Choose relevant finishing process according to the end uses.

4.   TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
					Theory						Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4	-	2	6	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.
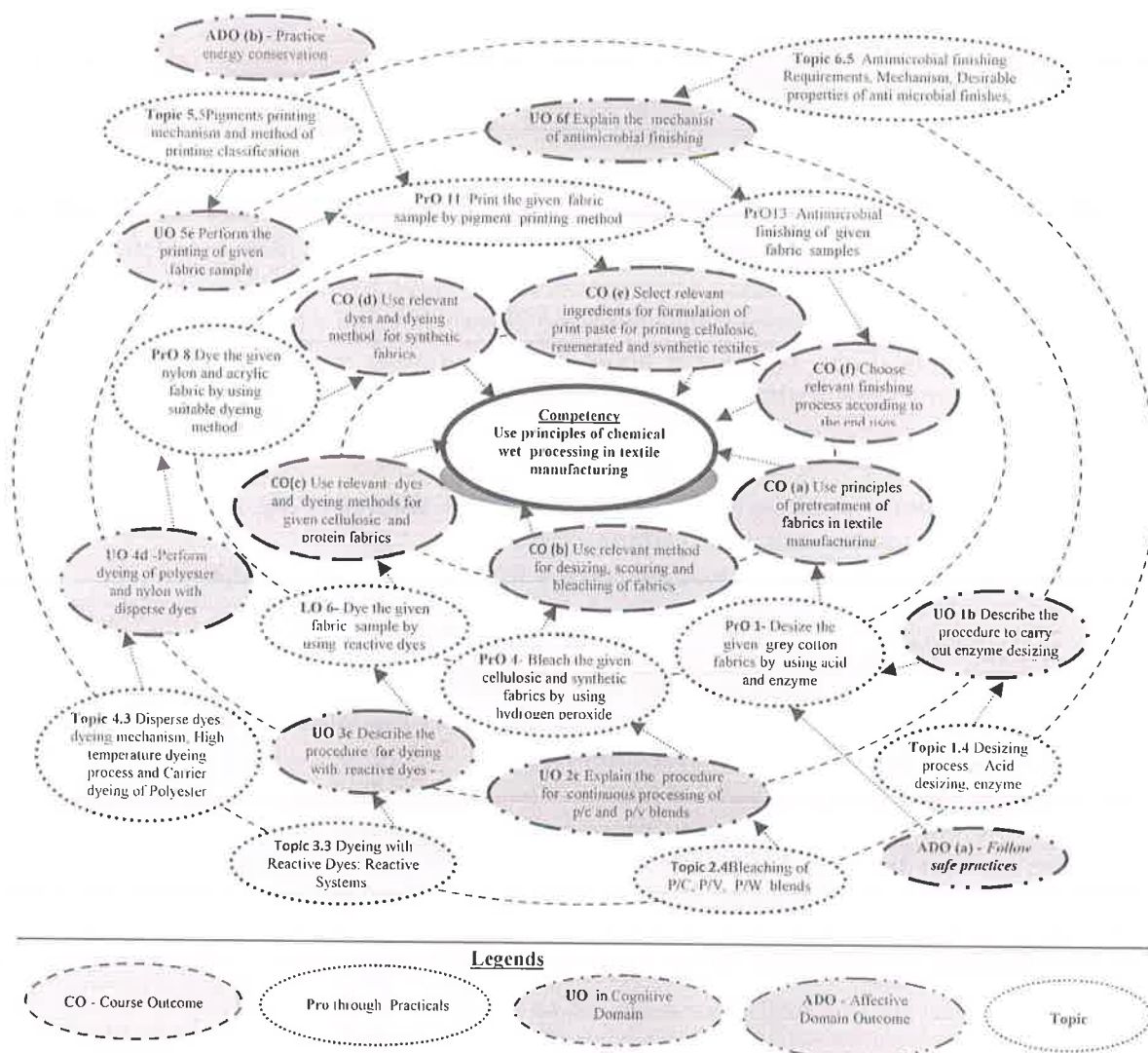

Figure 1 - Course Map

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	Desize the given grey cotton fabrics by using acid /enzyme.	I	02*
2	Scour the given cellulosic and synthetic fabrics.	I	02
3	Bleach the given cotton fabric by using sodium hypochlorite.	I	02
4	Bleach the given cellulosic and synthetic fabrics by using hydrogen peroxide. Part - I	II	02*
5	Bleach the given cellulosic and synthetic fabrics by using hydrogen peroxide. Part - II	II	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
6	Dye the given fabric sample by using direct dyes.	III	02*
7	Dye the given fabric sample by using reactive dyes.	III	02
8	Dye the given polyester/nylon fabric with disperse dyes by using H.T.H.P./ Carrier dyeing method.	IV	02*
9	Dye the given acrylic fabric by using cationic dyes.	IV	02
10	Print the given fabric sample by direct style of printing by using direct dyes.	V	02*
11	Print the given fabric sample by discharge styles of printing by using reactive dyes. Part - I	V	02
12	Print the given fabric sample by discharge styles of printing by using reactive dyes. Part - II	V	02
13	Print the given fabric sample by pigment printing method.	V	02
14	Resin finish the given fabric samples.	VI	02*
15	Perform finishing of Antimicrobial fabric samples.	VI	02
16	Carry out softening treatment of fabrics.	VI	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 judicial 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 %
a.	Correctness of Practical	40
b.	Reasoning ability	20
c.	Quality of presentation	10
d.	Answer to sample questions	20
e.	Submit 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
- 'Characterising Level' in 3rd year.

7.   MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	PrO. S. No.
1	Laboratory Glass Ware (beaker, measuring cylinder)	1to14
2	Laboratory steamer (50 psi)	2,8,9
3	Dye pot(capacity 500 ml)	5,6,7,8
4	Dye bath (6 or 12 pots)	5,6,7,8
5	Laboratory Rota dyer(250ml 12 or24 pots)	5,6,7,8
6	Laboratory HTHP beaker dyeing machine(250ml 12 or24 pots)	7,8
7	Printing screen(12 x12 inch),rubber squeeze	9,10,11
8	Stiffness tester	12
9	Curing chamber	11to 14
10	Padding mangle	11to 14

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 Basics of pretreatments	1a. Describe with sketches the features of the given system 1b. Describe with sketches the procedure to carry out the given type of desizing. 1c. Determine the scouring loss% in the given situation. 1d. Describe with sketches the procedure to carry out given type of bleaching.	1.1 Grey inspection process: objective, Four point checking system. 1.2 Shearing and cropping process: Shearing cropping machine, Two cutter and four cutter system 1.3 Singeing process and gas singeing machine. 1.4 Desizing process: Acid desizing, enzyme desizing, Batch wise and continuous process of desizing. 1.5 Scouring process: vertical pressure kier and J-box system 1.6 Bleaching process. sodium hypochlorite and hydrogen peroxide bleaching. 1.7 Mercerization: factors affecting the process of mercerization. Machine used for mercerization

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit– II Bleaching of regenerated and synthetic fibres	2a. Explain with sketches the procedure for processing of the given type of fibre. 2b. Explain with sketches the procedure for continuous processing of the given type of blend 2c. Explain with sketches the pretreatment of given type of synthetic fibres. 2d. Describe with sketches the heat setting for setting up process sequence of the given type of synthetic fibres	2.1 Batch wise and continuous method of bleaching 2.2 Wet Process sequence for P/C, P/V, P/W and synthetic goods 2.3 Machines used for bleaching: Jiggers, winch, soft flow, continuous bleaching range. 2.4 Bleaching of P/C, P/V, P/W blend 2.5 Heat setting process 2.6 Details of preparatory processes for PET, Nylon, Acrylic and its blends
Unit– III Dyeing of cellulosic fibres	3a. Describe with sketches for processing of given type of cellulose fibre. 3b. Describe with sketches the procedure for using the given type of dye. 3c. Describe the features of the given type of vatting systems 3d. Describe with sketches the given type of dyeing method	3.1 Colouring matter: classification of dyes. 3.2 Direct dyes: method of application, after treatments on direct dyed goods. 3.3 Reactive Dyes: classification , method of dyeing 3.4 Dyeing with vat Dyes: Use wise classification, dyeing method. 3.5 Dyeing methods: dyeing of yarn and fabric with batch-wise and continuous processes
Unit-IV Dyeing of protein and synthetic fibres	4a. Describe with sketches the procedure for dyeing with the given type of dyes on wool 4b. Describe with sketches the procedure for dyeing with basic dye on the given synthetic fibre. 4c. Describe with sketches the given dyeing method.	4.1 Acid dyes: Classification of acid dyes application of acid dyes on wool and silk. 4.2 Basic dyes: Application of Basic dyes on wool and silk 4.3 Disperse dyes: dyeing mechanism, High temperature dyeing process and Carrier dyeing of Polyester 4.4 Nylon dyeing: Dyeing mechanism, dyeing with acid and metal complex dyes, dyeing with disperse and reactive dyes. 4.5 Acrylic Dyeing: Preparation of acrylic for dyeing. Dyeing of acrylic fibre with disperse dyes. 4.6 Dyeing methods: Batch and continuous dyeing process of poly / cellulose blends

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit –V **Basic** **concepts** **of printing**	5a. Describe with sketches the procedure for of the given method of printing. 5b. Describe the features of the given style of printing. 5c. Describe with sketches the construction of given type of printing machine 5d. Describe with sketches the procedure for printing of the given type of fabric sample	5.1 Printing: objective. Methods and Styles of Printing Fixation of printed textiles 5.2 Screen printing: table screen printing, Flat bed screen printing m/c. and its various parts. Technical features of printing with flat bed printing m/c. . Rotary screen printing m/c. and its various parts. Squeeze system. Technical features of rotary printing machine. 5.3 Printing with direct dye :Print paste ingredients for direct and discharge style of printing 5.4 Printing with reactive dyes: Print paste ingredients for direct, discharge and resist style of printing. 5.5 Pigments printing: mechanism and method of printing
Unit–VI **Basic** **concepts** **of** **finishing**	6a. Describe the features of the given type of finishing machinery. 6b. Describe with sketches the mechanism of the given type of finishing 6c. Describe with sketches the given type of softening treatment 6d. Describe with sketches the mechanism of antimicrobial finishing for the given type of fabrics.	6.1 Finishing: objective of textile finishing, classification of finishing 6.2 Finishing machinery : Calendaring, Decatising , Raising, Sueding, felting, Sanforising, Stenter, 6.3 Resin finishing :Mechanism of creasing and resin finishing, Types of resin finishing, concept of Anticrease, wash-n-wear and Durable Press, 6.4 Flame retardant finishing: Concept of flame proof and flame retardancy. Limiting oxygen Index and its importance, Thermal behaviour of textile fibres. 6.4 Softening treatments: classification of softeners. Properties, mode of action and application of softeners 6.5 Antimicrobial finishing Requirements, Mechanism, Desirable properties of anti microbial finishes, and various antimicrobial finishes for cotton, wool, silk, polyester, nylon and acrylic.

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	Basics of pretreatment processes	08	04	04	-	08
II	Bleaching of regenerated and synthetic fibres	08	-	03	04	07
III	Dyeing of cellulosic fibres	10	02	03	04	09
IV	Dyeing of protein and synthetic fibres	10	02	05	07	14
V	Basic concepts of printing	14	02	06	09	17
VI	Basic concepts of finishing	14	02	06	07	15
	Total	64	12	27	31	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. collection of fabric swatches (dyed/printed/finished)
  b. preparation of charts of various dye classes
  c. Visit textile process house and observe various activities.
  d. Collection of videos on chemical processing.

11.   SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES
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. Encourage students to refer different websites to have deeper understanding of the subject.
  g. 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 are given here. Similar micro-projects could be added by the concerned faculty:

a. **Collection of samples:** Collect samples at each stages of pretreatment and check the absorbency
b. **Effect on depth of shade:** Collect various fabric qualities carry out dyeing with direct dyes and check the depth of shade
c. **Colour fastness:** Carry out dyeing with three selected dyes and check the washing fastness, rubbing fastness.
d. **Preparation of charts**: Collect printed samples made by various printing methods and prepare chart of it.
e. **Shade card preparation**: Select three reactive dyes carry out dyeing activity and prepare shade cards.
f. **Collection of processing information**: Visit different chemical processing units and collect their process sequence.
g. **Power point presentations:** Prepare presentation on relevant machineries used in chemical processing.

13.   SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Dyeing and chemical Technology of Textile Fibres	Trotman, E. R. T.	John willey and Sons Inc,1985 ISBN: 978-0471809104
2	Silk Dyeing printing and finishing by	Gulrajani, M. L.	BPB Publications, New Delhi 2016, ISBN:978-8183331630
3	Fundamental Principles of Textile Processing	Shenai, V.A.	Sevak Publications, Bombay, 1984 ISBN 13: 9783659686047.
4	Textile Printing	Miles, L.W.C.	Published by Society of Dyers and Colourists (1981) ISBN: 9780901956330
5	An Introduction to Textile Printing	Clarke, W.	CBS Publishers and Distributors Pvt. Ltd., New Delhi 2004; ISBN: 9781855739949
6	Technology of Printing	Shenai, V.A.	Sevak Publications, Bombay,1984 ISBN 13: 9783659686047

14.   SUGGESTED SOFTWARE/LEARNING WEBSITES

a.   www.textilelearner.blogspot.in/2011/07/dyeing-process-different-types-of-dye

b.   www.teonline.com/knowledge-centre/dyeing-fiber-

c.   www.en.wikipedia.org/wiki/ dyeing

d.   www.en.wikipedia.org/wiki/Textile_printing

e.   textilelearner.blogspot.com/printing-method-method-of-printing

f.   www.tikp.co.uk/knowledge/technology/finishing/textile-finishing/

g.   textilefashionstudy.com/finishing-of-textiles-definitions-objectives

h.   www.sciencedirect.com/science/book/9781855739055

Program Name	: Diploma in Textile Manufacturers
Program Code	: TX
Semester	: Third
Course Title	: Basics of Fibre Science
Course Code	: 22368

1. RATIONALE

Manufacturing of textiles is an art of producing a fabric from yarn which are made from fibrous materials. These textile fibres are from natural, modified natural as well as man- made origin. A textile manufacturing technologist must have the adequate knowledge of these fibers, their origin, manufacturing processes, and their physical and chemical properties. This will help him to select methods to convert them into yarn and fabrics. It will also help him in wet processing of the fabric made from these fibres. This subject intends to equip students with the concepts, principles and methods of production of man-made fibres and filaments which are helpful in processing during subsequent processes, process control and quality assurance.

2. COMPETENCY

The aim 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 select methods of manufacturing natural and synthetic fibres/filaments.**

3. COURSE OUTCOMES (COs)

The theory 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:

a. Identify fibre forming polymers.
b. Use the relevant method for manufacturing fibres.
c. Select the natural fibres for processing them.
d. Analyse the properties of regenerated fibres/filaments.
e. Analyse the properties of synthetic fibres/filaments.
f. Select method of manufacturing textured yarn for required end use.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Paper Hrs.	Theory						Practical					
L	T	P			ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	-	3	3	70	28	30*	00	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 ~~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

Not applicable

7.   MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

Not applicable

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 Fibre forming polymers	1a. Differentiate the properties of the given types of fibres. 1b. Differentiate the properties of the given types of filaments. 1c. Describe importance of the given fibre structure useful for specified textile application. 1d. Describe characteristics of given fibre forming polymer.	1.1 Substrate: Fibre, Filament, Essential and desirable properties of fibres 1.2 Fibre structure: crystalline, mesomorphous and amorphous regions and their importance. 1.3 Polymer: monomer, polymer, degree of polymerization. polymerisation techniques, addition and condensation polymerization, Characteristics of fibre forming polymers . 1.4
Unit II- Methods of fibres Manufacturing	2a. Explain the given terms. 2b. Describe with sketches the function of the specified part of melt spinning machine. 2c. Describe with sketches the function of the specified part of dry spinning machine. 2d. Describe with sketches the function of the specified part of wet spinning machine. 2e. Explain with sketches the process flow of material through given type of spinning line for given requirement of filaments.	2.1 Definition- LOY MOY, POY, FOY yarns 2.2 Melt spinning-Melt spinning method and equipment 2.3 Dry spinning- Preparation of dope, dry spinning unit, solidification process in dry spinning. 2.4 Wet spinning – Wet spinning line, solidification process in wet spinning.
Unit –III Natural Fibres	3a. Describe with sketches the morphological structure of given natural fibre. 3b. Describe end uses of the given type of fibre 3c. Describe with sketches the morphological structure of given animal fibre 3d. Describe the physical and chemical properties of the given type of fiber for producing yarn, for the specified application	3.1 Morphological structure of cotton. Physical and chemical properties and uses of cotton. 3.2 Unconventional Natural Fibres: Morphological structure and chemical constitution of Jute, Coir, and Flax. physical and chemical properties and uses of Jute , Coir and Flax. 3.3 Animal Protein fibres: Source and grading of wool, Morphological structure of wool, physical and chemical properties of wool, varieties of silk, production of raw silk, morphological structure, physical and chemical properties and uses of wool and silk.
Unit-IV Regenerated Fibre	4a. Identify essential requirements of the given type of spinning with justification. 4b. Describe with sketches the	4.1 Essential requirements of wet spinning with reference to polymer properties 4.2 Regenerated cellulosic fibres: Raw

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	manufacturing process of given regenerated fibre. 4c. Describe the physical and chemical properties of regenerated fibre for production of fabric of specified characteristics. 4d. Identify various end uses of given type of fibre.	material, manufacturing process Physical and chemical properties of End uses of viscose rayon, and Tencel.
Unit –V Synthetic Fibres	5a. Describe with sketches the manufacturing of the given type of synthetic fibre using the flow chart. 5b. Describe the physical and chemical properties of the given type of fibre for production of the fabric of specified characteristics. 5c. Identify various end uses of given type of fibre.	5.1 Polyester - Flow chart for manufacturing, raw materials used, process parameters, chemical reactions, physical and chemical properties and end use. 5.2 Nylon 66 - Flow chart for manufacturing, raw materials used, process parameters, chemical reactions, physical and chemical properties and end use. 5.3 Polypropylene - Flow chart for manufacturing, raw materials used, process parameters, chemical reactions, physical and chemical properties and end use 5.4 Polyacrylonitrile - Flow chart for manufacturing, raw materials used, process parameters, chemical reactions, physical and chemical properties and end use.
Unit VI- Texturising	6a. Compare the salient properties of the given types of yarn. 6b. Describe the properties of relevant textured yarn for specified end use application. 6c. Select the method of texturising for production of textured yarn of specified properties with justification. 6d. Explain with sketches the functions of given parts of friction disc texturising machine. 6e. Describe the importance of the specified process parameters on texturising machine.	6.1 Texturising : purpose ,classification stretch and bulk yarn, advantages of textured yarn. Properties of textured yarn, concept of false twist. 6.2 Friction disc texturising- Passage of yarn, construction and working and process parameters. 6.3 Air texturising - Passage of yarn, construction and working and process parameters. 6.4 Factors influencing texturising time, temperature, twist and tension and their significance.

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	Basic concepts of fibre Manufacturing	4	2	2	4	8
II	Methods of Synthetic fibres Manufacturing	6	2	2	6	10
III	Natural Fibres	10	2	2	8	12
IV	Regenerated fibres	6	3	3	6	12
V	Synthetic fibres	12	2	4	8	14
VI	Texturising	10	2	4	8	14
	Total	**48**	**13**	**17**	**40**	**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.   Collect different fibres/filaments used in industry. Collect data on the name of the company, price of the same.
   b.   Collect data on the names of fibres/filaments and the technique of production of the same.
   c.   Collect data on various types of silk yarn produced in India and their prices.
   d.   Collect data of various end uses of Viscose Rayon, and Tencel.
   e.   Collect data of various Polyester filament yarn used in industry, their specifications, and end use.
   f.   Collect data on various types of texturising machines used in various texturising units, make of texturising machines, name of the units, speeds used for texturising of polyester

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. Assign Mini projects to students.

g. Apply the concepts learnt in this course to address specific problems.

h. Use different instructional strategies in classroom teaching.

i. Use video programs available on the internet also to teach some topics.

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 are given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare a drawing showing a sketch of crystalline region, amorphous region and mesomorphous region and state their importance.

b. Draw a detailed classification chart of fibre used in textile industry with examples of each variety.

c. Prepare a chart showing the schematic diagrams of different techniques used for man-made fibre production.

d. Prepare a chart for morphological structure of cotton and wool and label the parts.

e. Prepare a chart showing comparison of various physical and chemical properties of cotton, wool and silk.

f. Prepare a chart showing photograph of various end uses of unconventional fibres – Jute, Coir, and Flax.

g. Prepare a chart showing photographs of different varieties of silk produced in India and write characteristics of each variety. In the same chart show life cycle of silkworm and manufacturing process of silk yarn.

h. Draw a chart for manufacturing of Viscose Rayon giving all the details of the process.

i. Draw a schematic diagram of manufacturing of Polyester filament yarn starting from raw material on a board.

j. Prepare a chart depicting each method of texturising schematically.

k. Collect various textured yarns available in the industry, write the particulars of the same and write end uses.

13.   SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Artificial Fibres	Moncrieff, R.W.	National Trade Press Limited, London
2	A Textbook on Fibre Science and Technology	Mishra, S.P.	New Age International, New Delhi ISBN-13: 978-8122412505
3	Textile Fibres	Shenai, V.A.	Sevak Publications, New Delhi
4	Handbook of Fibre Science and Technology	Lewin, Menachem and Piearce, Eli M.	Marvel Dekkar Inc. ISBN 0-8247-7010-2 (volume I) ISBN 0-8247-7335-7 (Volume IV)
5	Synthetic Fibre Production	Vaidya, A.A.	PHI Learning. New Delhi, 2016 ISBN 0 87692-578-6
6	Handbook of Textile Fibres – Animal Fibres	Cook, J. Gordon	Merrow Publishing Co. Limited. ISBN 0904095 39 8
7	Handbook of Textile Fibres- Man-made Fibres	Cook, J. Gordon	Merrow Publishing Co. Limited. ISBN 0904095 40 1
8	Yarn Texturising Technology	Hearle,J W; Hillock ,S L. and Wilson, D.K.	Woodhead Publications Limited. ISBN 1 85573 575 X
9	Manufactured Fibre Technology	Gupta, V.B. and Kothari, V.K.	Springer (India) Private Limited. ISBN 978-81-3220789-4

14.   SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.nptel.ac.in/courses/116102026/3
b. www.textileapex.blogspot.in/2014/08/polymer.html
c. www.nptel.ac.in/courses/116102026/36
d. www.tikp.co.uk/knowledge/technology/fibre-and-filament-production/melt-spinning/
e. www.textilecentre.blogspot.com/2016/09/morphological-structure-of-cotton-fibre.html
f. www.nopr.niscair.res.in/bitstream/123456789/32483/1/IJFTR%2017%281%29%201-8.pdf
g. www.namateco.com/attachments/086_Natural%20Fibers%20and%20the%20Environment.pdf
h. www.textilebd-yarn.blogspot.in/search?updated-max=2012-02-20T09%3A53%3A00-08%3A00&max-results=4
i. www.ied.ineris.fr/sites/default/interactive/bref_text/breftext/anglais/bref/BREF_tex_gb4.html
j. www.costfp1205.com/en/events/Documents/sixtatroedsson3dec.pdf
k. www.madehow.com/Volume-2/Polyester.html
l. www.tikp.co.uk/knowledge/technology/texturing/
m. www.teonline.com/knowledge-centre/polyester-manufacturing.html
n. www.indiantextilejournal.com/News.aspx?nId=iPGy2X/alahEuCFZSBjPTA.

Program Name	: **Diploma in Textile Manufacturers**
Program Code	: **TX**
Semester	: **Third**
Course Title	: **Yarn Testing**
Course Code	: **22369**

1.   RATIONALE

In textile industry, yarn is used as raw material to produce fabric. Quality of fabric depends on the yarn properties, yarn parameters and their quality control testing. The diploma engineer needs to have relevant knowledge and skills related to yarn testing. This subject intends to equip students with the concepts, principles and methods of testing of yarns, which are helpful in selection of raw materials for further processing of yarn, process control and quality assurance. The process improvement is also an important aspect, which requires lot of experimentation. Yarn testing requires recording of number of observations, which are to be analyzed, interpreted and used for best results. Therefore, knowledge of yarn testing is essential for controlling yarn manufacturing process. This course is developed in the way by which fundamental information will help the diploma engineers to apply the basic concepts of yarn testing to solve broad problems in textile manufacturing.

2.   COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:
  - **Apply principles of yarn testing in selection of raw materials and process control.**

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:
  a. Apply yarn numbering system to determine its linear density.
  b. Test the yarn to determine its twist parameters by different methods.
  c. Measure yarn unevenness by different methods.
  d. Test yarn for its hairiness parameter by relevant method.
  e. Apply principle of tensile testing to determine yarn strengths.
  f. Evaluate physical properties of textured yarns.

4.   TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
					Theory						Practical					
L	T	P		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.
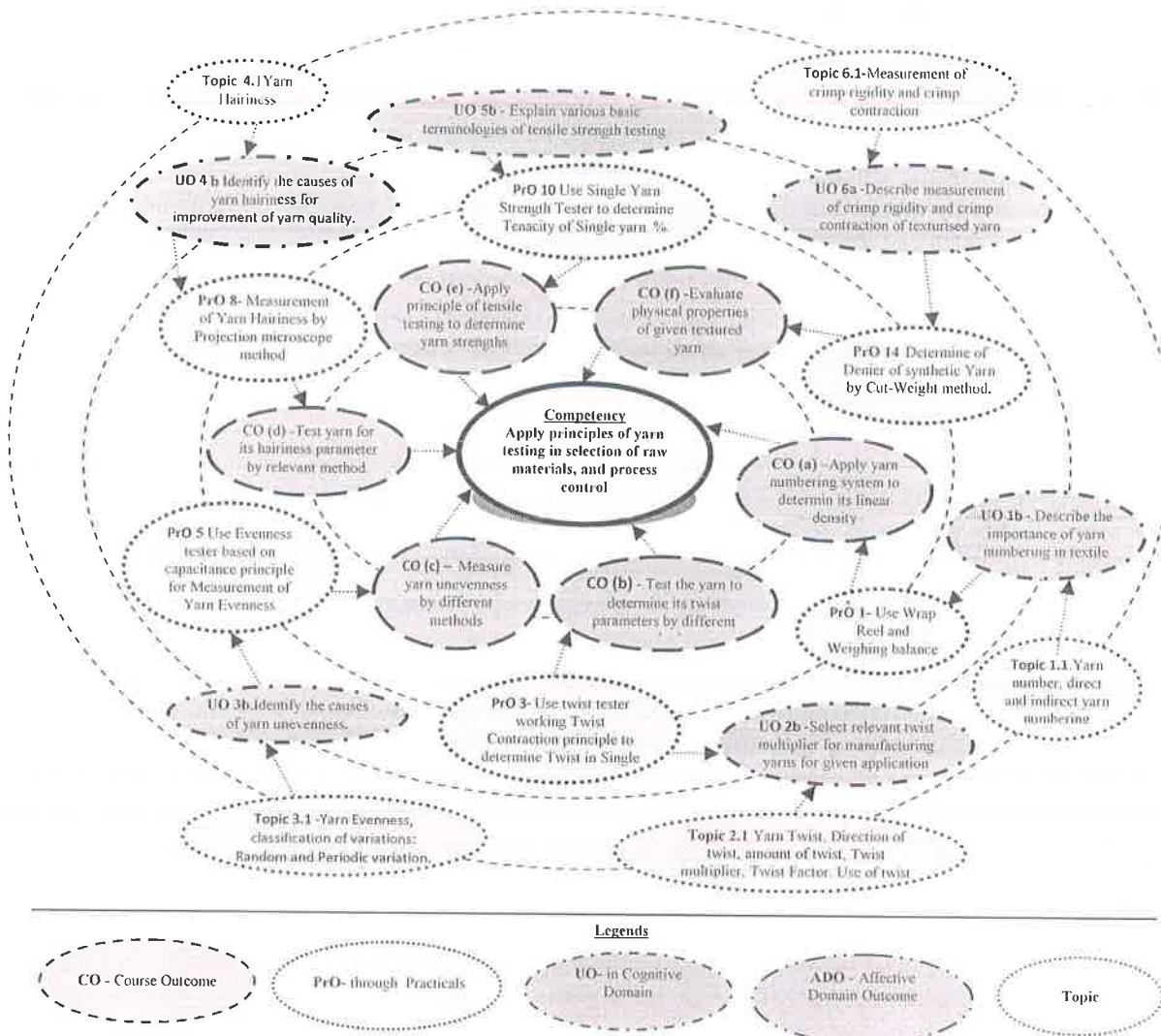

Figure 1 - Course Map

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	Use Wrap Reel and Weighing balance to determine Yarn number	I	02*
2	Determine Yarn number of yarn removed from fabric	I	02
3	Use twist tester working Twist Contraction principle to determine	II	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	Twist in Single yarn.		
4	Use twist tester working on Untwisting principle to determine twist in Double yarn by Untwisting method.	II	02
5	Use Evenness tester based on capacitance principle for Measurement of Yarn Evenness.	III	02*
6	Grading of yarn by ASTM Yarn appearance method.	III	02
7	Estimation of Hank and Hank C.V. % of sliver and roving sample using wrap reel.	III	02
8	Measure Yarn Hairiness by Projection Microscope Method.	IV	02*
9	Measure Yarn Hairiness by optical Method	IV	02
10	Use Single Yarn Strength Tester to determine Tenacity of Single yarn and calculate C.V. %.	V	02*
11	Determine lea strength and CSP of given yarn sample using Lea Strength tester and calculate C.V. %.	V	02
12	Determine work of rupture by Ballistic strength tester	V	02
13	Determine bundle strength of Yarns using Stelometer.	V	02
14	Determine of Denier of synthetic Yarn by Cut-Weight method.	VI	02*
15	Determine Shrinkage% of Synthetic yarn for hot water and hot air.	VI	02
16	Determine crimp rigidity and crimp contraction of texturised yarn.	VI	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 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	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
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. 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 usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	Pro. S. No.
1	Electronic balance, with the scale range of 0.001g to 500g. Pan size 100 mm; response time 3-5 sec.; power requirement 90-250 V, 10 watt.	1,2,7,1 114,
2	Microscope, with magnification ranges 5x to 100 x.	8
3	Electric oven inner size 18''x18''x18''; temperature range 100 to 250^0 C. with the capacity of 40lt, moisture tester.	15
4	English Wrap reel with 1.5 yard circumference.	1
5	British Wrap reel with 1 meter circumference.	1
6	Single yarn twist tester based on twist contraction principle	3
7	Double yarn twist tester based on untwist principle	4
8	Yarn Evenness tester based on capacitance principle.	5
9	Black board wrapping machine.	6
10	Yarn Hairiness tester based on optical principle	9
11	Single yarn strength tester based on CRE principle (capacity 0-1000gmf).	10
12	Lea strength tester based on CRE or Pendulum lever principle (capacity 200lbs).	11
13	Bursting strength tester (capacity 0-50kg/cm^2).	12
14	Stelometer	13
15	Crimp rigidity tester.	16

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 **Yarn Linear** **density**	1a. Describe the features of the given yarn numbering systems. 1b. Calculate weight, length and count of the given type of yarn using relevant yarn numbering system for the given situation. 1c. Calculate production rate of	1.1 Yarn number, direct and indirect yarn numbering systems 1.2 Direct yarn numbering: Tex, Denier Indirect yarn numbering: British, Metric, Worsted, Woolen, Linen. 1.3 Resultant count calculation. Weight, length and count of yarn

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics

	yarn with given parameters in spinning process.
	1d. Select relevant method for testing of yarn number of the given sample with justification.
	1e. Calculate yarn diameter based on the given data.
		numerical on Yarn numbering, production rate of yarn in spinning process.
		1.5 Testing of yarn count:
		  i) Yarn in package form (ASTM D-1907-89)
		  ii) Yarn removed from fabric (IS-3442-98)
		1.6 Relation between yarn count and yarn diameter.

Unit-II **Yarn Twist**	2a. Select relevant twist multiplier for manufacturing yarns for given situation with justification. 2b. Explain the effects of twist on properties of given yarn/fabric. 2c. Select relevant twist measurement method for given yarn sample with justification. 2d. Describe with sketches the procedure to determine the yarn twist by relevant method.	2.1 Yarn Twist, Direction of twist, amount of twist, Twist multiplier, Twist Factor. Use of twist multiplier. 2.2 Twist and yarn strength relationship: spun and filament yarn. Effect of twist on fabric properties. 2.3 Measurement of twist in single Yarn: Straightened yarn method (ASTM D-1422-92), Twist contraction method (ASTM D-1422-92), Twist to break method 2.4 Measurement of twist in Double Yarn: Take up Twister (untwisting principle)

Unit– III
Yarn Evenness
	3a. Classify the types of variation of the given yarns.
	3b. Describe with sketches the measurement of yarn unevenness by given method.
	3c. Apply results of analysis of spectrogram for identifying the faults of the specified machinery.
	3d. Describe the effect of irregularity on the given yarn/ fabric property.
		3.1 Yarn Evenness, classification of variations: Random and Periodic variation.
		3.2 Causes of unevenness
		3.3 Terms and Definitions: U%, C.V. %, Limit irregularity, Index of Irregularity, addition of irregularity, reduction in irregularity.
		3.4 Measurement of yarn unevenness:
		  i) Cutting and weighting method
		  ii) Visual examination(ASTM)
		  iii) Capacitance principle
		3.5 Analysis of Spectrogram.
		3.6 Effects of Irregularity.

Unit-IV
Yarn Hairiness
	4a. Describe causes of Hairiness of the given yarn.
	4b. Describe effects of Hairiness of the given yarn and fabric properties.
		4.1 Yarn Hairiness: Causes and effects
		4.2 Yarn hairiness testing:
		  i) Microscopic method
		  ii) Photoelectric method

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	4c. Identify the causes of yarn hairiness for improvement of the given yarn quality. 4d. Describe with sketches the procedure to Measure yarn hairiness by given method.	
Unit –V Tensile Strength testing of yarn	5a. Explain the specified terminologies related to tensile strength testing. 5b. Identify the relevant factor affecting Yarn Strength of the given yarn with justification 5c. Describe with sketches the measurement method of yarn strength of the given yarn sample. 5d. Determine the count strength product of a given yarn sample for the given situation. 5e. Summarize various parameters of given advance strength testing machine.	5.1 Tensile strength, Load, Tenacity, Breaking Length, Elongation, Breaking extension, Breaking Strength 5.2 Load elongation curve, stress strain curve, Initial Young's modulus, Work of rupture, Work Factor, Elastic recovery, Instantaneous and time dependant effects. 5.3 Factors affecting tensile properties of textiles 5.4 Constant Rate of Extension (CRE), Constant Rate of Loading (CRL), Constant Rate of Traverse (CRT), Pendulum Lever principle and Strain Gauge Principle. 5.5 Yarn strength tester: Stelometer, Instron. 5.6 Yarn strength tester: Single yarn strength tester, Lea strength tester, Count strength product (CSP). Ballistic/Impact strength tester. 5.7 Features of advanced strength testing like Tensojet and Tensorapid.
Unit-VI Testing of Textured Yarn	6a. Describe with sketches the measurement procedure of crimp rigidity of given yarn by the given method 6b. Describe with sketches the measurement of crimp contraction of the given yarn by given method. 6c. Determine the dimensional stability of the given yarn for the given situation.	6.1 Measurement of crimp rigidity and crimp contraction of textured filament yarn by crimp rigidity tester. 6.2 Yarn bulk 6.3 Dimensional stability of synthetic yarn: Hot Air and Hot water

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 PER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Yarn Numbering	08	02	03	06	11
II	Yarn Twist	08	02	02	05	09
III	Yarn Evenness	12	02	04	10	16
IV	Yarn Hairiness	04	02	02	04	08
V	Tensile Strength Testing of Yarn	14	03	07	10	20
VI	Testing of Synthetic Yarn	02	02	02	02	06
	Total	**48**	**13**	**20**	**37**	**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. Market survey of different yarns of natural and man-made origin of different yarn numbers based on application and price.
   b. Library survey of different yarns used in the industry with respect to name of manufacturer, current price, counts of yarn and blend proportion.
   c. Prepare table for norms published by different research organizations for different yarn properties for various types of yarns.
   d. Prepare question bank referring old MSBTE question papers for yarn testing.

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. Assign unit wise tutorials to group of 4 to 5 students for solving problems unit wise.
   g. Assign micro projects to group of 4 to 5 students and let them prepare and present the project through PPT. Group shall submit a report which is limited to 5 pages.
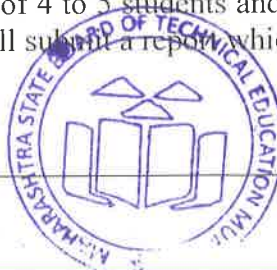
  h. Use of video, animation films to explain concepts, facts and applications related to yarn testing.

  i. In respect of item 10 above, teachers need to ensure to create opportunities and provisions for such co-curricular activities.

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 are given here. Similar micro-projects could be added by the concerned faculty:

  a. **Yarn Numbering:** Collect yarns of different yarn number and prepare a chart from higher number to lower number in each system. Also prepare a chart for conversion of yarn number from one system to another.

  b. **Yarn Numbering:** Each batch will solve 50 numerical on yarn numbering.

  c. **Yarn Twist:** Collect different yarn samples used for different applications like hosiery, warp, weft, voile, fancy yarn, crepe yarn. Identify direction of twist and calculate amount of twist and twist multiplier. Prepare chart for the same.

  d. **Yarn Evenness:** Collect and prepare chart of yarn samples for different faults like thick, thin, neps and also collect norms for imperfections of at least 10 counts.

  e. **Yarn Hairiness:** Collect 10 yarn samples from course to fine, measure yarn hairiness by optical method. Plot a graph of hairiness parameter against count and interpret the result.

  f. **Tensile Strength:** Draw schematic diagrams of different principles and instruments based on them for tensile strength testing. Test two yarn samples of different counts on these instruments and prepare a chart for test results.

  g. **Testing of Synthetic yarn:** Collect 5 samples of texturised yarn and calculate crimp rigidity and crimp contraction.

  h. **Testing of Synthetic yarn:** Collect 5 samples of synthetic yarn, heat set the same at different temperatures varying from 180^0 to210^0C. Test dimensional stability by hot boiling water test method.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Physical Properties of Textile Yarns'	Morton. W.E; Hearle. J.W	Wood head publishing 2008. ISBN 9781845692209.
2	Hand book of Textile Testing-part-1: Testing and		SP 15-1:Published 1989 Bureau of Indian Standards(BIS)

S. No.	Title of Book	Author	Publication
	grading of textile yarns.		
3	Textile Testing Physical, Chemical and Microscopical	Skinkle, John H.	Chemical Publishing Co Inc (1940) ASIN: B001OMN6VS
4	Principles of Textile Testing	Booth, J. E.	CBS publishers and distributors private ltd. 1996.New Delhi India. ISBN:9788123905150
5	Testing and Quality Management	Kothari, V.K.	IAFL, New Delhi 1999 ISBN 819010330X, 9788190103305
6	Hand book of Textile Testing and Quality Control	Grover,E.B; Hamby, D.C.	Textile Book Publishers, 1960 - Technology and Engineering the University of Michigan.
7	Physical Testing of Textiles	Saville, B.P.	Wood head publishing limited -2002 Cambridge England.CRC press ISBN: 0849305683.
8	Methods of Tests, Yarn, Yarn and Fabric	--	CIRCOT, Mumbai
9	A Practical Guide to Textile Testing	Amutha,K.	Wood head Publishing New Delhi India.2016; ISBN:9789385059070 .

14.   SUGGESTED SOFTWARE/LEARNING WEBSITES

a. Textilelearner.blogspot.in/2012/05/yarn-numbering-system-yarn-count-direct.html
b. Textilestudycenter.com/yarn-numbering-system/
c. textilelearner.blogspot.in/2013/03/yarn-twist-relationship-between-yarn.html
d. nptel.ac.in/courses/116102029/64
e. www.slideshare.net/fahim55/yarn-twist
f. textilelearner.blogspot.in/2013/03/yarn-twist-relationship-between-yarn.html
g. nptel.ac.in/courses/116102029/37
h. textilelearner.blogspot.com/2012/05/yarn-evenness-unevenness-irregularity.html
i. textilestudycenter.com/yarn-evenness-ii-classification/
j. nptel.ac.in/courses/116102029/29
k. nptel.ac.in/courses/116102029/38
l. www.scribd.com/doc/201648794/SITRA-NORMS-SPINNING-MILLS-2010
m. www.uster.com/fileadmin/customer/Services/USTER_Statistics/Application_handbook_USTER_Statistics_2013.pdf

Program Name	: Diploma in Textile Manufacturers
Program Code	: TX
Semester	: Third
Course Title	: Textronics
Course Code	: 22031

1.   RATIONALE

In present day scenario using advanced electronic machinery, textile industry can produce the best quality fabric with very high production rates. It has been possible to monitor process by use of microprocessors, microcontroller and PLC. Along with this, electronic industries have introduced many electronic devices in textile sector to indicate measure and control various units of textile processes. This course is developed in the way to apply practical based knowledge of electronics devices in textile manufacturing.

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 different sensors, transducers, electronics and digital devices deployed in textile machines and process control.**

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:

- a.   Check the functioning of the sensors and actuators in textile machines.
- b.   Check the functioning of optoelectronic devices in textile machines.
- c.   Check the functioning of op-amp, power semiconductor devices and control systems in textile electronic circuits.
- d.   Check the functioning of electromagnetic devices and switches in textile industry.
- e.   Check the functioning of microcontroller, microprocessor and PLC in atomization in textile industry.

4.   TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Paper Hrs.	Theory						Practical					
					ESE		PA		Total		ESE		PA		Total	
L	T	P			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
2	-	2	4	-	--	--	--	--	--	--	25#	10	25~	10	50	20

*(#):No theory Exam; (~¹): For the **practical only courses,** the PA has two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e.30 marks) and micro-project assessment (seen in section 12) has a weightage of 40% (i.e.20 marks). This is designed to facilitate attainment of COs holistically, as there is no theory ESE.*
Legends: L-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment, #: No theory paper.

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.
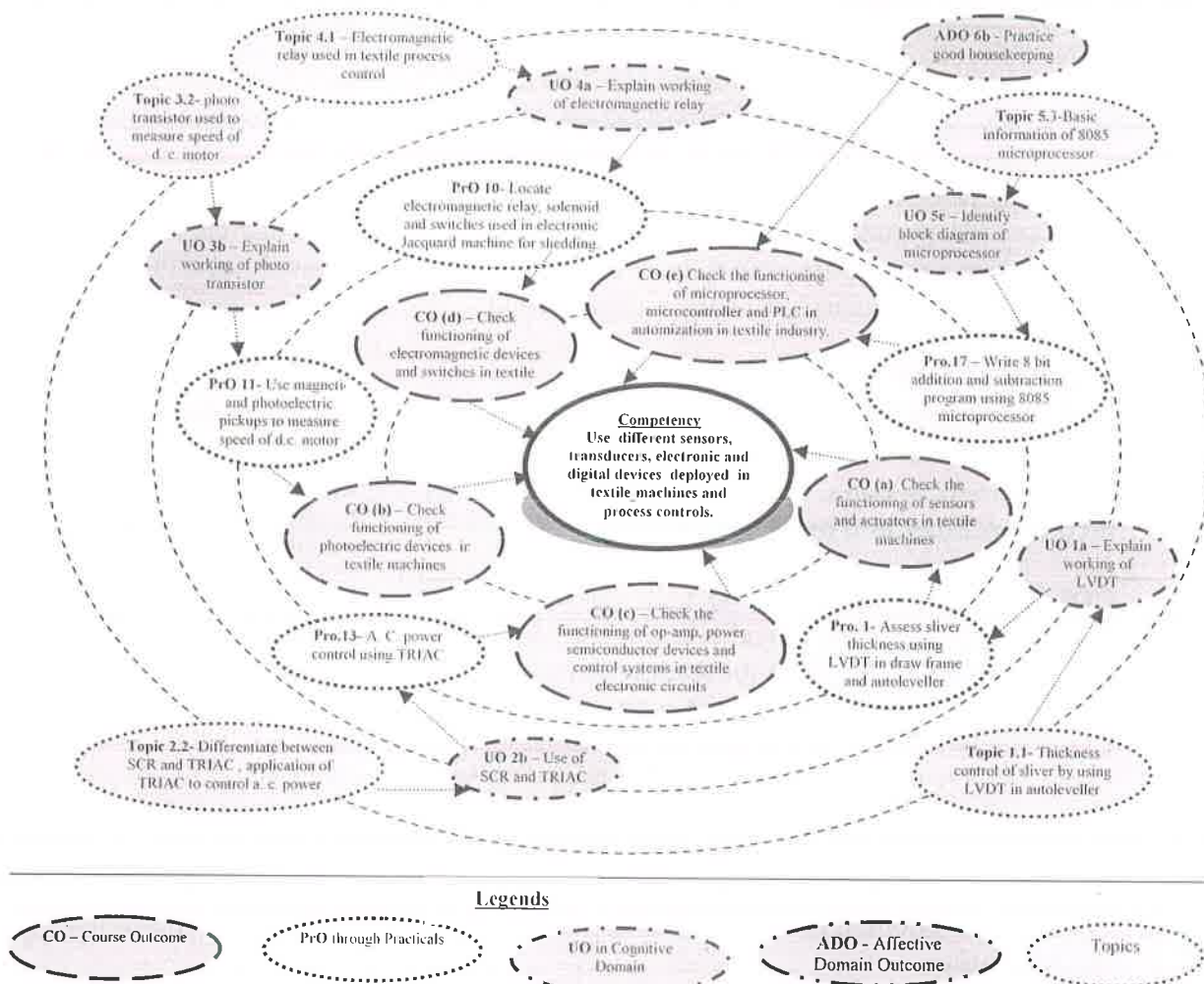

Figure 1 - Course Map

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	Assess sliver thickness using LVDT in draw frame and autoleveller.	I	02*
2	Measure the temperature using RTD (Resistance Temperature Detector) in size box.	I	02
3	Measure the temperature using thermister /thermocouple in dryer	I	02
4	Measure moisture content in fiber and yarn using moisture meter.	I	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
5	Interpret the feedback circuit (open loop and close loop) in carding and draw frame.	II	02*
6	Adjust the speed of stepper motor and inverter in ring frame.	II	02
7	Set the pressure in air jet loom using transducer.	I	02
8	Measure tensile strength of fiber and yarn using strain gauge.	I	02
9	Determine voltage gain of inverting and non-inverting amplifier using op-amp.	II	02
10	Locate electromagnetic relay, solenoid and switches used in electronic Jacquard machine for shedding and draw their functional diagram.	IV	02*
11	Use magnetic pickup and photoelectric pickup to measure speed of given dc motor.	I, III	02
12	Test sliver breaks stop motion in speed frame using optoelectronic sensor.	III	02*
13	Use TRIAC to control A.C. power.	II	02
14	Use smoke detector circuit in blow room to prevent from fire.	III	02
15	Test the output of given basic gates (NOT, OR, AND) and their combinations.	V	02*
16	Test the output of given RS, D, JK flip-flops and write their applications in textile industry.	V	02
17	Write 8 bit addition and subtraction program using 8085 microprocessor.	V	02
	Total		**34**

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 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.

i. 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 design assignment	20
2	Planning and visualization of design	20
3	Safety measures	10
4	Accuracy and neatness	10
5	Final design output	20
6	Answer to sample questions	10
7	Submission of design 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. Practice good housekeeping.

b. Demonstrate working as a leader/a team member.
c. Maintain tools and equipment.
d. 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
- 'Characterising Level' in 3rd year..

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specifications mentioned here will usher 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	LVDT transducer kit used draw frame and autoleveller	1
2	RTD temperature measurement kit used in size box.	2
3	Thermistor/thermocouple temperature measurement kit used in dying	3
4	Moisture meter, connecting cords	4
5	Feedback circuit diagram layout in carding and draw frame	5
6	Stepper motor and inverter setup used in ring frame and textile loom	6
7	Pressure transducer setup used in air jet loom.	7
8	Smoke detector circuit kit in blow room.	14
9	Strain gauge setup, sample of yarns, fibers.	8
10	741op-amp inverting and non-inverting amplifier kit, connecting cords.	9
11	A.C. power control using TRIAC kit, CRO, 100 watt bulb, connecting wires	13
12	D. C. motor 0-1500 rpm, magnetic and photoelectric pickup, tachometer 0-3000 rpm, variable transformer 0-300v.	11
13	LEDs and optocoupler	11
14	Electromagnetic relay, solenoids and different type of switches in electronic Jacquard machine	10
15	Optoelectronic sensor setup in speed frame	12
16	IC 7404, 7408, 7432(basic gates), 7402(RS flip-flop), 7474(D-flip-flop), 7476(JK-flip-flop), bread board, connecting wires, d. c. power supply	15,16
17	8085 microprocessor kit	17

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	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I **Transducers and sensors**	1a. Explain with sketches the working of the specified displacement measurement sensor. 1b. Explain with sketches the working of the specified temperature transducer. 1c. Explain with sketches the working of the specified pressure transducer. 1d. Explain with sketches the working of the specified magnetic pickup.	1.1 Thickness control of sliver by using LVDT in autoleveller. 1.2 To measure temperature using RTD in size box and thermistor/ thermocouple in dying. 1.3 Humidity measurement in fiber and yarn. 1.4 To measure tensile strength of fiber and yarn using strain gauge. 1.5 Speed measurement of d. c. motor using magnetic pickup.
Unit– II **Power semiconductor, op-amp and control system**	2a. Explain with sketches the working of the specified op-amp. 2b. Explain with sketches the working of the specified power semi-conductor. 2c. Classify the given types of control systems. 2d. Explain with sketches the working of the given type of stepper motor.	2.1 Operational amplifier 741used in inverting and non-inverting mode. 2.2 Differentiate between SCR and TRIAC, application of TRIAC to control A. C. Power. 2.3 Block diagram of control system, open loop and close loop control system. 2.4 Operating principle of stepper motor and inverter, their application in textile machines.
Unit– III **Optoelectronic devices**	3a. Explain with sketches the working of the specified type of LDR. 3b. Explain with sketches the working of the specified type of phototransistor. 3c. Explain with sketches the working of the given type of optoelectronic sensor used in stepper motor.	3.1 Operation of smoke detector circuit using LDR in blow room. 3.2 Phototransistor used to measure speed of D.C. motor. 3.3 Optoelectronic sensor used in speed frame.
Unit-IV **Electromagnetic devices and switches**	4a. Explain with sketches the working of the given type of electromagnetic relay. 4b. Explain with sketches the working of the given type of solenoid. 4c. Explain with sketches the working of the given type of switch.	4.1 Electromagnetic relay used in textile processes control. 4.2 Solenoid valves used in textile plants, applications of solenoids. 4.3 Push button switches, magnetic switches.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit-V Digital electronics	5a. Explain with sketches the working of the given type of gates. 5b. Explain with sketches the working of the given type of flip-flop in digital circuits. 5c. Explain with sketches the working of the given type of microprocessor. 5d. Explain with sketches the working of the given type of PLC.	5.1 Working of NOT gate, AND gate, OR gate. 5.2 Working of RS, D, JK flip-flop. 5.3 Working of 8085 microprocessor. 5.4 Working of 8051 microprocessor. 5.5 Working of PLC.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN
- Not Applicable -

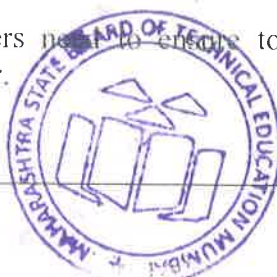## 10. SUGGESTED STUDENT ACTIVITIES
Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group 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. Prepare a table of different types of sensors used in spinning, weaving, dying and garment processes of textile.
   b. Prepare presentation showing different types of power semiconductors devices and operational amplifiers used in textile industries.
   c. Collect leaflets and specific information of different types of electromagnetic relays, solenoids and different switches used in textile process control.
   d. Collect leaflets and specific information of optoelectronic devices used different textile machines.
   e. Identify microprocessor, microcontroller and PLC used in automatic textile process control and write down the operation.
   f. Collect leaflets and specification of stepper motor and inverters used to control speed of motors in textile industries.
   g. Observe different textile process control systems, prepare layout of open loop and close loop control system, differentiate between them.

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. Use of video, animation films to explain concepts, facts and applications related to electrical and electronics engineering.
g. In respect of item 10 above, teachers need to ensure to create opportunities and provisions for such co-curricular activities.

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 are given here. Similar micro-projects could be added by the concerned facultymicro-projects could be added by the concerned faculty:

a. **Transducers and sensors:** Visit textile industry/department collect information and prepare presentation incorporating animation displaying transducers and sensors used in blow room, sizing, ring frame, draw frame, speed frame, carding, dying and testing.
b. **Power semiconductors and op-amp:** Visit textile industry/department collect information of power semiconductor devices used to control high power. Also Op-amp used in control system. Prepare presentation incorporating animation.
c. **Optoelectronic devices:** Prepare presentation incorporating animation to display detailed specifications and information of optoelectronic devices used in different processing machines.
d. **Electromagnetic devices and switches:** Visit textile industry/department prepare presentation incorporating detailed information of actuators – relays, contactors, solenoids, electric and pneumatic valves, switches used in different textile processing units.
e. **Automatic textile process control system:** Visit textile industry/department, collect information about automatic textile process control system and digital devices prepare presentation incorporating animation.

13.   SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Basic Electronics (solid state)	Theraja, B. L.	S. Chand New Delhi, 2006 ISBN: 9788121925556
2	Electronics and Electrical Measurements and Instrumentation	Sawhaney, A. K.	Dhanpat Rai and Co. New Delhi, 2014 ISBN: 9788177001006
3	A Course in Electronics and	Gupta, J. B.	K Kataria and Sons, India, 2013

S. No.	Title of Book	Author	Publication
	Electrical Measurements and Instrumentation		ISBN: 9788188458936
4	Sensors and Actuators: Control System Instrumentation	De Silva, Clarence W.	CRC Press; Taylor and Francis, Boco Roton, 2007 ISBN: 9781420044836
5	Electronic controls in Textile Machines	Joshi, Hiren; Joshi, Gauri.	NCUTE training program, New Delhi, 2003
6	Op-Amps and Linear Integrated Circuits	Gayakwad R. A.	Prentice Hall, India, 2000 ISBN: 9780136303282
7	A Textbook of Applied Electronics	Sedha R. S.	S. Chand , India, 1990 ISBN: 9788121927833
8	Fundamentals of Digital Circuits	Anand Kumar A.	PHI, Delhi, 2014 ISBN:9788120350526

14.   SUGGESTED SOFTWARE/ LEARNING WEBSITES

a.   https://www.circuitspecialists.com/blog/differences-between-analog-and-digital-panel-meters/

b.   http://www.electronicsandyou.com/blog/active-and-passive-electronic-components.html

c.   https://www.ethz.ch/flexible-electronics

d.   https://learn.sparkfun.com/tutorials/transistors

e.   www.ee.buffalo.edu/faculty/paololiu/566/sensors.ppt

f.   http://www.zapmeta.com.my/src?q=electronic+sensorsandsc=s

g.   www.zapmeta.co.in/Electronic+sensors

h.   http://www.electronics-tutorials.ws/io/io_3.html

i.   http://www.engineersgarage.com/articles/pressure-sensors-types-working

j.   https://ielm.ust.hk/dfaculty/ajay/courses/alp/ieem110/lecs/actuators/actuators.html